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CALIFORNIA ENERGY COMMISSION
CALIFORNIA PUBLIC UTILITIES COMMISSION
CALIFORNIA INDEPENDENT SYSTEM OPERATOR

In the Matter of:	)	Docket No. 17-IEPR-12
	)	
	)	JOINT AGENCY WORKSHOP
	)	
2017 Integrated Energy Policy Report (2017 IEPR)	)	Re: Review of the Actions and Status of State-level Energy Roadmaps

JOINT AGENCY STAFF WORKSHOP ON THE REVIEW OF
THE ACTIONS AND STATUS OF STATE-LEVEL ENERGY ROADMAPS

CALIFORNIA PUBLIC UTILITIES COMMISSION

AUDITORIUM

505 VAN NESS AVENUE

SAN FRANCISCO, CALIFORNIA 94102

TUESDAY, JUNE 13, 2017

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Reported By:
Julie Link

APPEARANCES

JOINT AGENCY PARTICIPANTS

Gabe Petlin, California Public Utilities Commission, CPUC

Peter Klauer, California Independent Systems Operator, CAISO

Mike Gravely, California Energy Commission, CEC

Rachel McMahon, California Public Utilities Commission

Delphine Hou, CAISO

Noel Crisostomo, California Energy Commission

Kiel Pratt, California Energy Commission

David Hungerford, California Energy Commission

Martha Brook, California Energy Commission

Melicia Charles, California Public Utilities Commission

STAFF:

Arthur O'Donnell, California Public Utilities Commission

Bruce Kaneshiro, California Public Utilities Commission

PUBLIC SPEAKERS (* Via telephone and/or WebEx)

Steven Kelly, Independent Energy Producers Association

Bud Beebe, California Hydrogen Business Council

Phil Toth, Southern California Edison

Polly Shaw, Stem Incorporated

APPEARANCES

PUBLIC SPEAKERS (* Via telephone and/or WebEx)

Will Rostov, Sierra Club

Larry McLaughlin, Southern California Regional Transit Training Consortium, SCRTTC

*George Nesbitt, HERS Rater

Niki de Leon, Kitu Systems

Liang Min, Lawrence Livermore National Laboratory

Dean Taylor, Southern California Edison

David Schlosberg, eMotorWerks

Jamie Hall, General Motors (GM)

I N D E X

I N D E X (Cont.)

P R O C E E D I N G S

June 13, 2017 10:01 a.m.

MR. PETLIN: Good morning. Welcome to the Joint Agency Staff Workshop on the Review of the Actions and Status of State Level Energy Roadmaps. My name is Gabe Petlin. I work in the Energy Division as a Supervisor in Grid Planning and Reliability. And my team works on the Energy Storage Proceeding as well as the Interconnection and Distributed Planning.

So we do have this as a Webinar, so we'll have a number of people on the phone. And the presentations have been posted. We are going to periodically open the phone lines for comments at set intervals, but we'll leave them muted just to avoid any kind of background noise and disturbances.

And so I just want to make a brief safety announcement. So in the event of a need to evacuate the building we have a meeting point, which is on Van Ness Avenue just half a block south of McAllister. Between the War Memorial Opera House and the other building there's an open plaza, so in the event of evacuation just walk down Van Ness Avenue to that park.

So I'm just going to give a very brief overview of what the workshop is today and then turn to our partner agencies for some brief opening remarks before we get into

it. So we're going to be discussing three state agency roadmaps. One is the Energy Storage Roadmap, which was developed jointly, collaboratively by all three agencies: the California Energy Commission, CAISO and the CPUC.

Then the Demand Response/Energy Efficiency Roadmap. This one was also developed collaboratively, though I don't think it was ever approved by the CPUC, but it is something that was a collaborative product and we some input into.

And third, the Vehicle-Grid Integration Roadmap, which was also collaborative of the three agencies.

And the main goal here is to give you some overview of what has been accomplished in the roadmaps, since they were adopted as well as hear some comment from you about how you think we're doing in terms of implementing milestones. We'll be sharing a lot of information about sort of the status of a number of items. But there's so much content today that we can't cover everything in every roadmap. So we'll rely on you to pinpoint specific questions and issues you have and we can go into further detail if we have time.

Because of the amount of content we have, I think we're going to limit speaking to about three minutes.

UNIDENTIFIED SPEAKER: It's normally three.

MR. PETLIN: Yeah, okay.

And so here's just a quick overview of the agenda. We're going to do some opening remarks from the three agencies. And then we'll start with the storage roadmap and have a public comment period and then break for lunch. Actually, we're going to start the next roadmap before lunch, so we'll start DR/Energy Efficiency before lunch. Then take a break, continue with some more Q&A. And then our third afternoon roadmap, we'll look at the Vehicle-Grid Integration Roadmap, with some Q&A. And then we'll come back together for some closing comments and next steps.

So I'd like to turn it over to Mike Gravely from the California Energy Commission, who's going to tell you more about the IEPR process how this workshop relates to that.

MR. GRAVELY: So for those who aren't familiar, the state has a report we put out every two years called the Integrated Energy Policy Repot. Its lead agency is the Energy Commission, but it's a statewide report including all the agencies, certainly the three that are here. And so this workshop is a part of that development process. This one will be done by the end of this fiscal year, so 2017 is a year for a full report. The way they do it is they do a full report every two years and a brief report in between those. So this year is a complete report.

And so the topic that I'm working with the Commission is Distributed Energy Resources (DER) so we have a couple of workshops. This one is considered a DER. All three of these roadmaps are considered DER under the definition. There will be a primary workshop at the end of the month, on the 30th (correction: 29th), with Commissioners at the CEC to review the results of this workshop and all the other activities that are happening in DER.

So we do have a court reporter here that's going be recording this information. The text will be available online when it's completed. All the presentations are available online and the information from here, as I said again, will be rolling into that. So that at the end of the workshop or during the day if you want to submit comments, depending on how many people want to comment, we have about 45 minutes to an hour after each presentation to take public comment. And if there's only a few comments, then we can take a little longer. If there's a lot of people that want to speak, then we'll have to limit people to three minutes. We'll obviously get all the public comment in that we have to that people want to make.

And then also there is a formal process for you to provide written comments. It's here on the slides. There are copies of all the presentations in the back of the room. And also for those online, all the presentations

have been posted on the website where this announcement was posted, in addition to you'll be able to see it on the WebEx. So there's written procedures to follow to file these. We ask you to file them by the 27th, so we can continue to integrate the information into it. And then this information, as I said is also on the public announcement, where to send it to, whether you do it electronically or by paper from that perspective.

And the only thing is closing comments. As we go through the different roadmaps today, one of the areas that we do at the Energy Commission -- I do specifically in the Research and Development Division -- is we do some research projects that are pretty relevant. So we're just going to give a couple of examples today during different workshops.

And in the Energy Storage Roadmap we've done some research where we've developed a model that's available to the public, so we'll talk about that briefly. And in the Energy Efficiency DR one we recently awarded a large number of contracts for Transactive Energy. And Transactive Energy becomes one of the action items for all three roadmaps, so we'll be discussing those. If there are questions on the other areas we'll cover those. But I just wanted to cover those two, because they were so relevant to today's discussions.

And with that, I'll turn it over to Peter from

the ISO just to give us some opening comments.

MR. KLAUER: Good morning, everybody. My name is Peter Klauer. I work for the California ISO. And I'll be part of this roadmap review to talk about where we have been progressing.

I think just a few opening remarks, before we get into the presentation. The ISO has been fortunate enough to work with the California Energy Commission and the California Public Utilities Commission to embark on these roadmaps. And I think these roadmaps have been an important tool in terms of defining and articulating the goals as well as the challenges that each of the state agencies has, in terms of their role in solving some of these things.

What you'll notice is that as the presentations go on, that the ISO is involved in a number of different public stakeholder processes that span changes to the ISO, markets, to the operations, to our tariff. And all these changes are designed to help facilitate these new technologies, these emerging technologies across storage, electric vehicles and demand response. So you may see, in some of these presentations, the same stakeholder initiative. But that's because these stakeholder initiatives are actually a broader sort of set of goals that actually touch upon each of these roadmaps.

I think as we move forward, I think it's important to see and hopefully to realize that we have made progress in terms of meeting some of these goals that have been identified, and challenges in the roadmaps. But I think you'll also recognize that there's still further work to be done.

As we advance the topic in these areas, we're actually embarking on sort of a new domain of distributed energy resources, which is a bit more complex, because it's basically merging the domains of the transmission system and the distribution system. And creating new policy and new rules, new operational processes that allow, for example the transmission operations to unlock and actually utilize some of these new technologies that are for a large part being embedded in the distribution system. So those are continuing challenges that we're going to continue to work on as a joint agency team.

But I guess the point is that we've made a lot of progress, but there's more work to be done. So hopefully you'll see that in these presentations and you'll help us identify the continued challenge that we have to work on, moving forward. Thanks.

MR. PETLIN: Thank you, Peter.

So I'm just going to make very brief overview remarks before we get into the specific roadmaps. So while

these three roadmaps are resource-specific and very, very important, the CPUC has also recently taken an approach of creating what we're calling the Distributed Energy Resources Action Plan. And this was created at the initiative of President Picker, last year. And it was endorsed by the Commission in a fall meeting. And you can find it on the CPUC website under President Picker's personal page. And this document serves to help create an overall coordinated pathway for distributed energy resource proceedings and policy initiatives at the Commission, while we continue to collaborate with other agencies.

So it is sometimes a very specific document that gets into specific proceedings and objectives and helps make sure that when we scope a new proceeding or we renew the scope of a proceeding that we are thinking about the linkages between how does storage fit in with distributed energy resource planning? And how does an integrated distributed energy resource procurement process incorporate the role of grid services? And so that's really something I want to just encourage people to take a look at and help us stay on path for.

We've been noticing, increasingly parties are making reference to the DER Action Plan in their filed comments and testimony. It's showing up in scoping memos, in proceedings, so it's definitely being used. And I

encourage you to try to take advantage of it as well. If you see that a proceeding is not addressing an issue that you think is in there, you have the grounds to bring it up. And the same thing applies to the roadmaps. People are citing them in their comments, referring to them in scoping memos, so there's always an opportunity to try to shape the agenda. And I think these roadmaps help remind us all what are some of the core goals.

So I think with that, we're ready to get started on the main presentations. Do you want to just stop here and ask if anyone has questions about sort of the overall goal of the day and purpose before we get into the specific roadmaps?

UNIDENTIFIED SPEAKER: (Indiscernible)

MR. PETLIN: Okay. Well, I'd like to invite Rachel McMahon to join me up here, because she's the Lead Energy Analyst on Storage, for the Energy Division, and did the lion's share of work to prepare this presentation. And we're going to tag team a little bit as we go through it. And so, Rachel, would you please join us? And I think we could probably -- yeah, why don't we just sit down there together and we'll go over it.

Yeah, all right. So the idea is here the way it's structured is we're going to do about a 20-minute overview of the roadmap and some of the highlights and main

goals and highlight some of the areas of progress. But we're really leaving about an hour for audience discussion and Q&A, so this is really intended to be participatory. I really encourage everyone to ask questions and think about which areas of the roadmaps you think we have made the most progress on or need to go further.

So the Energy Storage Roadmap was built around a set of guiding principles. So the guiding principles were expanding revenue opportunities for storage, reducing the cost of integrating and connecting storage to the Grid, and streamlining and clarifying policies and processes to increase market certainty. And out of those principles, we formed five priority tracks including planning, procurement, rate treatment, interconnection and market participation.

And in terms of the CPUC's role in the Storage Roadmap activity, it's natural that we would be approaching this from a variety of different proceedings. Storage is the type of resource that really touches many different resource areas, because it can be both a load and a source of generation. It can provide grid services. And it is an integral technology to many different proceedings. So the areas that we focus on, in terms of achieving the roadmap vision, is through the Distributed Resource Planning Proceeding. While storage isn't explicitly the goal there,

it is that proceeding focuses on developing new tools and planning processes to increase the role of all distributed energy resources in Distributed Resource Planning, including storage. And so it's led to a number of processes that will result in procurement of DER that could displace capital investments that would traditionally be done through say a substation.

And so we're looking at how DERs can play a role in displacing the need for capital investments on the Distribution Grid. And a sister proceeding to the DRP proceeding, is the Integrated Distributed Energy Resources (IDER) Proceeding. And so while DRP is identifying the optimal locations for distributed energy resources and the planning tools to incorporate the role of DER into planning, IDER is the sourcing proceeding to identify the sourcing mechanisms to procure these resources.

And so they are focused on currently a pilot phase where they are testing out a competitive solicitation process and an investor owned utility shareholder incentive to procure DER resources to displace capital investments such as a substation. And they will be looking at additional sourcing mechanisms beyond RFOs in the near future.

And then the Energy Storage Proceeding, which Rachel leads, is focused on procurement policy issues for

energy storage. And Rachel will be going into much more detail about that.

Do you want to say a few more words about that?

MS. MCMAHON: Sure, just specifically -- and we'll get into this on the slides after each agency gives their update -- but there are three issues that are specific to the roadmap that are in the scope in the Energy Storage Proceeding.

The first two are Multi-Use Applications and Station Power, so I'll make specific reference as we go through the slides. Those of you who are engaged in the Energy Storage Proceeding we're very much in the thick of those issues now, so thank you for your participation. And then the third one is an evaluation RFP. So AB 2514 required the Commission to evaluate the program every three years. So that is one that is pending issuance.

MR. PETLIN: Okay. And then another focus area for achieving the Action Plan is interconnection. Finding ways to streamline the interconnection of storage has been a major focus. And so it just shows how storage can really be a very active part of many proceedings. We had an entire track in the Rule 21 Proceeding focused on streamlining methods for interconnecting non-exporting storage. And we've had a lot of success in that area in terms of reducing some of the interconnection barriers and

making it easier and faster for storage to connect to the Grid.

We've also been advancing our plans to use smart inverters. And we are about to see the first mandatory phase of smart inverters in September. It will become the default requirement for any interconnecting distributed resource under Rule 21 to have a Phase 1 capable smart inverter. And we have a working group that's continuing to develop Phase 2 and 3 standards for advanced communication. And those will have their own mandatory dates as well. As we move towards 2020, being the outside goal for having full functionality of all smart inverter functionality. And then I mentioned in my intro the DER Action Plan is also a big part of implementing the roadmap.

MS. MCMAHON: And finally the two issues on the roadmap have been dealt with in this proceeding. One is the developing the qualifying capacity valuation for storage. And then the second was considering unbundling flexible capacity from Resource Adequacy Proceeding, which is Rulemaking 14-10-010 and the two issues on the roadmap have been dealt with in this proceeding. One is the developing the qualifying capacity evaluation for storage and then the second was considering unbundling flexible capacity from generic capacity.

MR. PETLIN: Great. So I think we're going to

pass it to the CAISO and CEC for their overview perspective on implementing the Storage Roadmap.

MR. KLAUER: Thanks Gabe and Rachel.

So as I mentioned in the sort of opening remarks, the ISO has been involved in a number of different stakeholder initiatives and so some of those are listed here. I'd actually go back a little bit further in time before the roadmap was created at the end of 2014. We actually had a storage model for participation, as early as 2012. And part of the roadmap process and desired outcome of the roadmap was to kind of further those initiatives.

And one of the first things we did, back in April of 2015, was the ISO held an educational forum. We had two days basically, where we invited the public and stakeholders to the ISO and we basically gave an overview, an all-day overview on two different dates of how storage and how aggregation worked. And tried to understand kind of how we could encourage the communication of how we could accommodate storage into our market.

At the same time, we had a Storage Interconnection Stakeholder Initiative. We knew we had a lot of pent-up projects in terms of storage, and understanding how they would go through our interconnection process was very important. We also had an initiative called Expanding Metering and Advanced Telemetry

Stakeholder Initiative.

This is important for a couple of things. This is really around understanding how DER, Distributed Energy Resources, could be aggregated and represented as a wholesale resource and so many of you have heard the term DERP, which stands for Distributed Energy Resource Provider. This is the initiative where that came from. And what that did was it had identified a new entity in the ISO Tariff that could represent many of these small resources.

At this point in time, we still don't see, although they're getting larger, the storage resources that we're seeing on the market are still relatively small compared to traditional transmission assets. I mean we're now in the 10s and 15s and we actually have a 30 megawatt resource. But up until this year, we were working with 2, 3, 5 megawatts and things like that. And we understand that storage, because of its cost and because of its nature, won't be deployed necessarily on the transmission system. It's going to be deployed at the utility distribution system or even behind-the-meter.

So this DERP concept is real important, because it's going to allow those smaller resources to be aggregated and then represented in a way that they could participate, using that resource model, like I spoke about.

The Metering Rules Enhancement Stakeholder Initiative is important, because up until fairly recently any resource that was participating with the ISO -- if it was acting as a generator, which storage does -- required an ISO meter. And that was cost prohibitive in terms of especially these smaller resources. So that initiative actually allows for what we call a Scheduling Coordinator Metered Entity as opposed to an ISO Metered Entity. The difference is a big one. It's that scheduling coordinator how has the power to go out and collect the revenue quality meter data and submit that to the ISO, using local regulatory authority-approved meters, not necessarily an ISO meter.

So we're really trying to use that initiative to further the ability to adopt small resources, allow for aggregation, simplify telemetry, simplify metering to really kind of push the envelope there.

The last one, actually the first bullet on the list, is probably the most comprehensive in terms of what the ISO is doing: ESDER, Energy Storage and Distributed Energy Resource. So this stakeholder initiative actually started back in two thousand - I think early '15 if not late '14. And it was really kind of an add-on to the educational forum. What have we learned? What do we need to do to our models? What do we need to do to facilitate

the removal of challenges and barriers?

So the ESDER Initiative is actually just about ready to move from its second to third phase. But we've completed Phase 1 and we're about to complete Phase 2. And in that initiative we actually have brought forward improvements to the resource modeling. Namely around for storage, it's around the treatment of state of charge. State of charge is a very important parameter when we are working with batteries. And so we need to know much energy is actually in that resource, in order to optimize it against other resources in order to feasibly dispatch it in the market. So we've made improvements there.

We actually have also made improvements on that model where we recognize that as we move to aggregations, the concept around state of charge might not be as important. Because when you have resources, like the electric vehicles, that are coming and going into this aggregation, the state of charge is dynamically changing. So we're actually -- we tightened the ability to use state of charge. And we also sort of unleashed the ability to use a storage model without the state of charge, which allows for greater flexibility for aggregations of virtual power plants and microgrids and things like that. So we're really trying to set this vision that has the new technologies and these new resources coming to the ISO.

We're trying to make it more flexible for those resources to participate. So I'll end it there.

MR. GRAVELY: Well thank you, Peter.

So again, folks online, this is Mike Gravely, from the California Energy Commission. And where in a particular roadmap there's no specific actions that are for the CEC to participate, one of the areas that we are very active in energy storage is the research and development area. We are giving opportunities, grant funding opportunities to commercial companies who want to demonstrate their product. We are working to do grants where we integrate products for solar and storage together, microgrids, net zero energy, community homes and other areas where storage is an integral part, but not the only part of a solution.

So for those that aren't familiar, in the first EPIC Plan we did award grants specifically for storage development, what we call applied research. In fact two of those companies that received awards back then, Eos and Amber Kinetics, actually were able to leverage what they were doing under our project to be selected, in the 2016 round of the [AB] 2514 procurement procedure that the PUC had with PG&E. So both of them received follow-on projects that will be installed by 2020 in those areas, so there was some success from the perspective of where they able to

leverage the grants here.

As we go forward, most of our focus is on integrating storage into a system. For example, we have a large microgrid solicitation coming out in probably about 30 to 60 days. We'll be doing microgrid demonstrations and we envision all those microgrids, including storage. Two years ago, we did a large microgrid solicitation and we awarded seven grants. And all seven grants had storage as part of the microgrid.

We also are active participants in all of the PUC and ISO proceedings and working groups and provide information there. As part of our role, we also take what we can and integrate it into the Integrated Energy Policy Report.

We also, from a technical perspective, are connected very actively with the Department of Energy and NYSERDA. NYSERDA currently right now has a very active effort in energy storage. They're very much interested in lowering the costs of energy storage and they're working very actively in that area. Many of the technologies that are participating with NYSERDA are also participating out here in California.

And of course the Department of Energy, we always try and get as many of those grant opportunities to be demonstrated in California. And we provide co-funding for

people that apply for those Department of Energy grants to allow them to hopefully bring their technology forward and demonstrate that in California.

I will just provide one brief demonstration of a technology that's available, that's currently commercially available for people to do or publicly available. When 2514 hearings were developed, the PUC in the hearing process looked at the different models that were available to assess the value of storage. There were two main models looked at and the basic decision was neither of those models was adequate enough to be selected for the process of making people use that or as a primary source.

So we took the information from that proceeding and the things that needed to be approved. And we went and did a competitive solicitation and made an award about three years ago to EPRI. And they developed a model, which is called StorageVET. Next chart, please?

So this chart here just gives you the process of how to get to it. So it is a model that allows you to pick a location, pick storage, and then assess the different values. It has all of the approved use cases that PUC uses under their 2514 process, and the ones the IOUs are authorized to use for those processes, so we have selected and modeled all those different use cases. It does allow you to answer some general questions, but it provides you

information on the value of that storage in a particular location. We've shared this with the California Energy Storage Alliance. About 50 of their members were online. We have shared it with the Department of Energy, with NYSERDA, with other states.

So the general perception is the tool is very useful and we're very interested in learning what it can do and what it can't do, so we can modify if we need, but ultimately we're trying to develop a tool that will give the utilities the opportunity to assess the value. And then also for the vendors to know how they're being assessed at the same time, so this is what we're trying to do with this.

If this is successfully accepted, then PUC would use it in the future rulemaking to have it reassessed publicly. But right now, it's going through an evaluation phase. This is how you access it. It just basically requires for you to have Excel. If you have Excel capability, then you can run the model. And with that I'll turn it back over to Gabe.

MR. PETLIN: All right. Thank you both.

So we have about six or so minutes left and we have a sort of reference presentation on many of the action items in the roadmap, organized by the tracks. And we don't have time to go through the 50 or 60 of each action

item, but what we're going to do is we're just going to briefly hit a few of them just to highlight a handful. And so we'll just tag team a little bit and feel free to jump in, Peter or Mike, if you want to highlight one from your agencies. So starting with planning and we're not going to go through all of them. And so that way if you have questions or you want to hear more about them, we have a whole hour almost, set aside for that.

So starting with the Planning Track, I think you could say the CPUC is making some good progress on some of the priority action items. So I'm going to look at the first three here. In terms of describing the Distribution Grid operational needs, maybe this was written before the DRP was created or maybe it was written afterwards, but I think this speaks to the DRP proceeding and what it's trying to do. And although it's doing that for all distributed energy resources it's going to benefit storage.

And so that proceeding is developing new analytic tools and investment frameworks, integrate the role of DERs into distribution system planning. And so what we mean by that is forecasting projected load and DER growth, measuring available grid hosting capacities for further integration of DERs without significant upgrade costs. And then we call that integration capacity analysis. And then we determine optimal locations for DERs to avoid planned

grid upgrades through the use of locational net benefit analysis. And then that leads to a procurement process in the IDER Proceeding.

The second item has to do with the ability to interconnect distributed energy resources in a more streamlined way to the Grid. And we do have a whole track on interconnection but this, what it has to do with is when the DRP develops integrated capacity analysis, which we are in midstream of doing, that will essentially be like a heat map on the Grid of where it is less expensive and more expensive and even no impact integrate more DER. And this will be very helpful for developers that want to identify sites that might be less costly to interconnect. It also will be helpful to utilities and their distribution planning.

But more specifically, we plan to take that data and port it over to a new interconnection OIR, which we hope will launch later this year, to actually look at how would this information help streamline the interconnection process. Can we make that process run differently to the way it is now, which is more or less each and every applicant interconnection goes through some form of study. And that could be a quick study or a long study. But it is a study. And if we know where it's going to be easy to connect, we can reduce study time and then possibly

eliminate the really labor intensive part of that. So that's one example of what we're doing for all resources, not just storage.

And a third one is looking for opportunities for storage to defer or displace distribution upgrades. So distribution deferral is one of the 19, I believe, 22 use cases in the storage proceeding. It's also now a part of ongoing procurement in the storage procurement. But it's now also part of DRP demonstration projects, particularly Demo C, which is focused on opportunities to defer distribution upgrades through open, competitive DER sourcing. And it's also part of the IDER competitive solicitation framework, which is also doing a pilot to test how DERs can defer distribution upgrades.

So we do think in those three areas we're making some good progress and look forward to further progress. So any other points you guys want to make about planning?

MR. KLAUER: The whole page, right? So just to point out maybe -- this is Peter Klauer from California ISO -- just to point out, I think everyone in the audience and on the line probably has heard the ISO talk about some of the operational challenges and needs that are coming forward with the increased amount of renewables. So as we move to 50 percent and beyond, you've got the challenge of the ramping when the sun comes up, and when the sun goes

down, those operational challenges. And so I think just to point out that's really what we're really trying to accommodate is look across the board in terms of how do we meet state goals and the challenges of those moving forward? And so our stakeholder initiatives are really kind of designed to do that.

Our coordination process with the other agencies is nothing new. We've had to overcome challenges at Aliso Canyon, San Onofre, planned retirement of the Diablo Canyon nuclear facilities. I think the ISO has a good track record of working closely with the other agencies in the state and outside the state to look at the pending changes, both in policy and in the state vision and make those changes happen.

MR. PETLIN: All right. So we're going to move on briefly to the next procurement track and Rachel would you like to offer some of your observations about progress?

MS. MCMAHON: Sure. I'll answer this quickly. So with the first, I mentioned this in the opening, so consider refinements to the evaluation methodologies used by IOUs to support CPUC decisions on storage procurement. As I mentioned earlier we have a consultant RFP that is pending release from our contracts office. That deals with the considered refinements to evaluation methodologies in terms of making models publicly available. The CEP, the

Consistent Evaluation Protocol, is publicly available and each utility discusses its own evaluation process within its application for approval of contracts. So the models are certainly available. We've been talking informally about how to incorporate StorageVET into the proceeding.

So then moving on, I mentioned earlier the Resource Adequacy Proceeding. The two issues that are in the roadmap for the RA Proceeding, you'll see the decision numbers on the right, so that's where the issues were considered. In the first D-1406050, that's where the QC methodology for storage was adopted, Appendix A to that decision. And then the second decision is actually 2017 RA decision wherein it continued to defer unbundling flexible capacity from generic capacity.

MR. GRAVELY: I will add something in this area, and that is one of the key focuses in our research that we're doing now, we've got about a dozen different storage technologies and projects that we're evaluating in the field. And that is coming up with the business case, so understanding the total cost and the value streams that the storage can bring. So one of the areas we're trying to do is come up with some consistent way to measure the value streams and account for those, so that we can come up with a good way to develop business cases going forward. So that's an area that we are hoping to provide more and more

information again from actual field demonstrations and from actual data collected. And so each of our storage projects comes up when we award them with a proposal and then they demonstrate that and measure it.

But we are focusing all our attention in the storage area on trying to quantify these and come up with a business case that helps the PUC, the utilities, and the industry determine the tradeoff on a cost versus benefit basis.

MR. PETLIN: Great. And maybe, Rachel, do you want to talk about the Multi-Use Application Initiative? That seems like a really important one under the rate treatment track.

MS. MCMAHON: So it looks like we're skipping down to the middle items. So, "Clarify rate treatment for customer sites with a mix of resources that help meet local consumption needs and do not result in an export of energy and want to provide wholesale good services." That was a mouthful. So that actually gets specifically to station power.

And I didn't mention this at the beginning and I apologize, but the CAISO and the PUC have actually jointly been developing the policy proposals on Station Power and Multiple-Use Applications, so it's been a great collaborative relationship. So in any case, this is an

issue that has been deferred from our original proposal and station power to our current consideration of multiple use applications. So I'm talking very fast, because I'm trying to make up time.

But we had a workshop on this on June 2nd and comments are due this Friday. So we're not only looking at that issue, but we are also what we have done jointly is develop a framework for combining value streams, using the same capacity. So we've thus far defined 20 services in five domains, three grid domains, two service domains, and rules around -- a list of 20 or 25 rules around the combinations of those services. So we will take comments, as I mentioned this Friday.

And of course for the IOU station powered by Sutters (phonetic) the protests are due this Thursday.

MR. PETLIN: Great. Well, I mean we could cover many areas, but I think what we really want to do is open it up to audience comments and discussions. But as you can see, a lot of progress is being made across the three agencies to implement the vision of the storage roadmap. And certainly more work is yet to be done, but it's been a really helpful document, I have to say, in terms of helping us structure our work and proceedings and also reminding us of where we need to go. So thank you all for contributing to it.

And I'd like to open it up now for audience questions and comments. Let us know if you have a question about a specific action item you'd like to hear more about the status or if you have a comment on your view of progress made. And if there's an area you think we need to further make progress or even that's not included in the roadmap, we're open to hearing about all of those.

Let's get those mics on.

MR. KELLY: I'm Steven Kelly, with Independent Energy Producers Association and many of my members are interested in developing storage facilities.

As we move to a model, which is aggregating essentially behind-the-meter resources to play in what appears to be both the retail space and the wholesale space, one of the things that would be very helpful would be a roadmap in writing about where the jurisdictional issues fall out in this matter. Because as you start to develop resources you need to know who's going to have responsibility for what activity, when and where. And I haven't seen that in writing yet. I've heard talk about it and I've raised it at some different forums. But is there an initiative within your planning process to develop in writing some assessment of the jurisdictional questions regarding who's got responsibility for what and when?

MS. MCMAHON: So can I ask clarifying question?

So when you say a roadmap, in terms of who has responsibility, would it be a roadmap for the perspective of the developer? Or essentially saying how you get your project from here to there, in terms of approvals or --

MR. KELLY: Well, it's not so much the interconnection rules. It's just if I have a resource that has the capability of moving between two domains, like retail and wholesale, who's got jurisdiction over that activity? Knowing that in advance is going to be essential to knowing how you're going to develop your resource.

Now, I know it comes up in some of the metering things that we've had, in discussions about that. It's coming up a little bit in the multi-use applications thing. I've been commenting on it and I will comment on it a little bit about this, the need for clarity in this regard. But I think it would be very helpful for you all to consider how you might approach this from a legal perspective. How do the jurisdictional responsibilities fall between the Public Utilities Commission and the Federal Energy Regulatory Commission?

If you are aggregating disaggregated units behind-the-meter, are all those disaggregated units, for example if they're on households, subject to FERC jurisdiction or not? That's a fundamental question. It really needs to be addressed up front, in my view, as

opposed to waiting till later, when we've got this model developed and we're planning for the resources to develop in a timely fashion.

So I would just urge you to maybe think about that, where that fits into your planning process and the pathways, and roadmaps, and so forth. Thank you.

MR. PETLIN: I'm wondering, Peter, if you could maybe comment on the status of for example, the DERP filing that was approved by FERC. My understanding is it defers to the local jurisdiction to determine the type of interconnection. In that case, it's Rule 21 for behind-the-meter, sub-resources that can aggregate into a wholesale virtual aggregation. How do you think that's going to work in practice?

MR. KLAUER: Certainly, so the distributed energy resource provider concept has been approved by FERC and is in the ISO tariff. One of the provisions of that though, is recognizing that these resources are not interconnected to the transmission system, right? They're connected to the distribution system. So there is a deferral for the interconnection process within the distribution system.

Once that interconnection agreement or application has been approved and completed, then that aggregation resource, which could be one or many, would come back to the ISO and enter the necessary contractual

agreements as a wholesale participant. So this is some of the complexity area I kind of alluded to where there's sort of this joint concern once that resource is then providing service to the ISO. There is a participating generator agreement. There's all the same sort of agreements that are in place for sort of a transmission connected resource as well.

Now, so we at the ISO have made some significant steps to recognize this capability, but there are still some challenges in terms of how would the distribution system study this resource. So even though, within the ISO tariff, this DERP concept exists the first step of that process is to notify the ISO. "I'm an entity. I want to create a DERP." So we say, "Fine." You fill out a form. And they go back and work with the distribution system to figure out what the aggregation looks like. And understanding of that has to be studied, just like any other interconnection. So we're kind of waiting now for them to come back to the ISO with their approved aggregation.

And as of today, unfortunately, we have not had anyone come back to the ISO with an approved aggregation. We've got several people who are interested and who are looking, but they're still working to figure out how they want that aggregation to look and how to operate and get

the necessary approvals.

MR. KELLY: Just to follow up, so those aggregations, let's assume that they're moving across the reach on wholesale space within the hour, within the day, depending on whatever the use applications are. How is that going to be treated or monitored?

MR. KLAUER: That's an excellent question. I must say we're still in the very early stages of this. So for example, one of the challenges is the multi-use. Right now, we still have a provision with the ISO tariff. If you're participating at a wholesale service of 24/7, we're going to read that meter 24/7.

So one of the things that we're working on now as part of the ESDER Initiative is this concept of multi-use. How can we break down intervals of the day, at what point are they participating with one customer, and then what interval with another and then how do you collect and measure that performance over time?

So right now we have the basics sort of framework in place. It's still a little strict, I would say, but part of the efforts of this ongoing effort is to try to open that up.

MR. KELLY: So is this going to be addressed in more detail, in the multiple use application step of this?

MS. MCMAHON: I think it will have to be. It

will have to be, in order to operationalize anyway it has to be. We didn't get into that, because we were trying to figure out the framework. But no, your point is a good one. It's a very good one.

MR. KELLY: I look forward to it. Thanks.

MR. GRAVELY: So just one quick comment I was going to make, from the R&D side. So we do have some projects that are pretty relevant here. One L.A. Air Force Base is actually using in their electric vehicles, about 43 of them, to participate in the frequency [regulation] market. And we've gone through a very large learning curve with that in answering some of those questions you're talking about. To actually they have successfully done that for that particular one. It is a research project, but it does involve the Department of Defense and us and so there are other unique challenges in addition to the standard ones. But we have learned a lot, and they are up and running in the whole process. So we are doing some research there.

The second one on the whole concept of transactive energy, in the second [presentation] later, when we talk about DR, David Hungerford will talk about some of the projects and some of the examples that we have, where we're doing more research in the area. Where we're looking at how do you do these transactions, how do you use

signals and everything else? And we're working out some demonstration projects to hopefully help provide information to allow the PUC and ISO to make their decision. So we do have some very active projects right now in this field, gathering data to help us down that road.

MR. KLAUER: This is Peter again, just to kind follow up as well. So Gabe, your comment about the interconnection agreement, so you're right, today there are sort of two basic interconnection agreements. Rule 21 and then what's called a WDAT, Wholesale Distribution Access Tariff. And I don't think I know. When we talked about DERP the idea at the ISO is we weren't going to prescribe what kind of interconnection agreement had to be in place at the distribution level with the hope and thought that we are kind of in a new territory.

You know, is there a new type of interconnection agreement that might be a better fit, or a modified Rule 21 or a modified WDAT? Especially when you start talking about maybe distributed resources that are only acting as a load. Could that simplify the study process? Could that simplify the interconnection process? So those are things that are going on.

And then to Mike's point, there's actually some more discussion, quite a bit of discussion going on between

the ISO and the utilities in terms of understanding this concept of multi-use. And not just multi-use, but if I had resource that's comprised of smaller resources within a distribution system to the ISO that looks like one resource. And our network model of this resource is done sort of at a higher level, it's done at the transmission, distribution sort of demarcation.

So we don't have the situational awareness. The ISO does not have, from an operational perspective, the understanding of what those distribution circuits are doing at the time of dispatch, which presents a significant challenge, right? Because our primary goal is to maintain reliability and so, we need to work on some sort of communication process or system-level approval process. So that before the ISO dispatches a distributed resource, there's got to be some checks and balances in place to make sure that we're not disrupting or harming the Grid.

We need to have some checks in place by the utility. We need to have some insight in terms of what that resource is capable of doing. It may be certified to provide, let's say an aggregated five megawatts, but maybe some circuits are down, so maybe it can only provide two. So that whole communication process to preserve reliability must remain intact. And so those are the types of things that we're trying to work out.

MR. BEEBE: Good morning. My name is Bud Beebe. And I'm with the California Hydrogen Business Council. California Hydrogen Business Council is an aggregate of members who have great technology capabilities, great programmatic capabilities, and other good characteristics to be able to play not only in the storage piece here. But also in other issues that we'll be talking about later this afternoon.

Specific to the storage issue, I was looking through the existing roadmap document on storage. And I did a search on hydrogen and I didn't come up with anything. I did a search on power-to-gas. I didn't get anything. I did a search, you know all that stuff, right? Nothing, right? Batteries hit four times, which for a four-or-five-year old document is actually probably pretty good. So we're moving fast in this space.

But certainly our members are disappointed in the amount of attention that's been given to what will become a very critical part of our ability to store energy, particularly store energy that's valuable across different sectors and is valuables across different seasons.

We, in the hydrogen space in sometimes it's called power-to-gas, sometimes it's called hydrogen, sometimes it's called renewable gas. These are a suite of technologies available to us that we need to include in our

roadmaps. Certainly, there's capability there. And I think when we talk about it like this everybody can say, "Yeah, it's kind of good," right? But we haven't been able to break across a couple of barriers that are important.

There's a need for regulatory change to overcome historic paradigms that built the natural gas and electric utilities to what they are today, which are great. They're great entities. They have a great capability. But we have historic boundaries between them that I think prevent us from going further. This is complicated by the fact that the transportation sector is such a valuable part of this also, okay?

So as you know, in the storage space, you're already starting to figure out how to go from electricity to transportation, as an important aspect of storage. And hydrogen is that same kind of capability, but so far we've not really made much progress in being able to go from, say the use of electricity, renewable electricity, to hydrogen and then that renewable electricity to say the transportation sector and maybe even back again. Even though you're talking about those concepts in electricity, through batteries, you need to know, or certainly you do know, but it's not in our documentation yet that hydrogen can transform from electricity to renewable gas. It can go to a methane substance that's a renewable resource. It can

go into the transportation sector. And it can come back out of the transportation sector, either as electricity or as other valuable functions, so all of these things just need to begin to make their way into these roadmaps.

For instance, these are broad topics obviously, and we're going to follow this up with a written piece for you, okay? But the fact that we have important members who have been unable to get, for instance, the PUC to be able to handle the hydrogen in a practical way in the storage space has been very frustrating. So we're here and we're ready.

Clearly the people who have been looking at these storage technology capacities in Europe have planned for hydrogen as a part of that future. And they have existing facilities there that are proving that capability. We just don't see any movement yet in California, where we're going to need this.

So thank you very much for your attention. We certainly appreciate that, questions?

MS. MCMAHON: I was just going to say thank you for your comments.

MR. TOTH: As I limp up here to the mic, sorry the back's hurting today. Am I on? Yes, I'm on.

I'm Phil Toth with Southern California Edison. I've been struggling or at least doing mental gymnastics to

get my arms around this, because it's huge. It's monstrous. And valuing and optimizing and getting a way to optimize the introduction in the market as well as introduction to where it's needed and how it's needed. And all of it is critical and I'm not demeaning anything that's going on. Without all this work, nothing can move forward and so please don't get what I'm about to say wrong.

In my mental gymnastics, I was trying to take this down to a circuit level. And each circuit has a different peak, has a different customer mix. And a lot of differences go on. And we have what, 4,500 different circuits. We have a load shape for the circuit. We have a load shape for each resource. We have -- and all of a sudden it explodes.

In the data is where it gets foggy in my mind. And how do you apply and optimize the different resources with the 4,500 different circuit peaks in and all the different resources that go in, whether it be EE or DR or storage or solar and all this kind of stuff? And I've been struggling with how to optimize it in two instances. How to optimize to what is needed on that particular circuit, which is difficult. Is it the peak? Is it the ramp? Is it this? Each one's going to be different.

And so this is the optimizing part. We have the EE and DR, programs that are TRC-based (phonetic) costs.

We have solar that is an installed cost, which is different. And so EE and DR optimize on solar resource cost tests and that kind of thing, which has a different portfolio makeup as what is needed at the distribution level. And see all of these things I'm just struggling to get my arms around. And how do we actually optimize it in terms of cost and location and need and when it's available and when it's not available?

So this the part where I'm not demeaning anything that's being done, because without all this foundational effort we cannot get to the next phase, which is the mind boggling mental gymnastics phase that I'm trying to get my arms around. To say, "Okay, here we go. Here's how we apply everything that all this foundational is going to," so I just wanted to say I don't have an answer and I don't think anyone else does. But it is, for a geek like me, it gets quite interesting in how do we move forward.

And then the interrelationships between the CEC, the CPUC, the ISO and all the different proceedings, they're all siloed. And so we're trying to bring them all together, which I don't think the puzzle pieces fit right now, but there's a lot of things to go through. So thank you for listening to my mental gymnastics story. And I really do appreciate what you guys are doing.

MR. PETLIN: You're absolutely right. It's a

complex puzzle. We are trying to deal with the complexity through a variety of different planning processes to break down silos. I think the DER Action Plan is a prime example of that where we try to understand the linkages between the different proceedings.

So for example, how does rate design affect storage? If the rate design people are not talking to the storage people then we're not going to figure that one out, but now they are and that's because of what we're doing with the DER Action Plan. We're trying to break down the silos. We're trying to make sure the grid service people are talking with the storage people and integrating. So it's complicated and it's overwhelming, but we are trying to take an approach that is integrative, which is a departure from the past.

MS. SHAW: Good morning. I'm Polly Shaw, VP of Regulatory Affairs at Stem. We're the largest behind-the-meter provider of software-driven storage. Our commercial industrial facility is headquartered in Millbrae. Thanks very much for entertaining some comments.

I want to applaud you. I want to suggest an area that may be missing and give some high level comments on other aspects that you started touching on this morning. Sorry, the coffee hasn't kicked in, so I've got to use my notes.

I think, first and foremost, we really applaud the interagency coordination here. We truly understand that you're tackling extremely complex issues. And these are really sophisticated challenges to design and solve, so thank you. There's been a lot of progress on interconnection improvements. Having the ESDER Phase 1 and the creation of DERPs coming out and also the IDER Proceeding identifying some distribution services. So thank you and kudos on that.

When we look at the fabulous state policies that have been developed in California, over the next few years that are going to deploy thousands of behind-the-meter projects, we -- and actually it will become a big engine, we think, economic engine and jobs creator. We are a little bit worried about one area that seems to be missing maybe from the EPIC plans and the storage, which is permitting consistency.

Stem is the largest provider of behind-the-meter projects. We've got 630 projects in the pipeline and installed, and most of them in California. We can attest that every single city and county treats permitting for storage completely differently. Where one might do over the counter and online, the other ones may throw four codes at you. The cost may go from $128 to $3,000 per project. It will be great if the EPIC planning could include some

gathering of best practices and dissemination and include that in the roadmap as well, since we all know that that would help reduce labor costs and the project development costs for the good of the state.

AB 546 led by Assemblymember Chu, is trying to pass a bill that would include the gathering of best practices and dissemination. And then some streamlining to make the processes more consistent across that state. So thank you if you can include that.

Otherwise, I guess we want to give a little bit of high-level feedback on the challenge of the delays that are keeping the behind-the-meter storage from becoming a marketplace, moving from mandates and incentives to truly marketplace. For example, Rachel touched on the IOU evaluation, specifically the cost effectiveness methodologies that are not transparent. We appreciate your work to try to make these a lot more transparent and publicly available.

Multi-Use Applications, the first draft proposal, took two-and-a-half years. And it's still, we would suggest, too high-level and vague in some areas to be executable. So we look forward to working with you on some specific recommendations there.

On DERP, it seems that there has been a fair amount of progress for DG, but not specific to storage.

For example, the ICA Analysis really looks at storage as a generator using hosting capacity, rather than looking at ways that can help free hosting capacity.

Finally, on the non-wires alternatives, there have been some proposed pilots, as well as seeing the PRPs (phonetic) 1 and 2, out of Southern California Edison, which is great whereas the New York utilities have already launched a dozen commercial solicitations. We're looking forward to seeing some little bit more timely progress there.

The final comment that we would say is it may benefit the storage roadmap to include in more research about how storage can benefit the state greenhouse gas and RPS goals. And maybe a little bit more detail on some concrete milestones and timelines for those milestones to help us understand where we're trying to get to and how these proceedings are going to move in maybe a little bit more market-timely pace.

Thank you. Thanks for considering.

MR. ROSTOV: Hi, Will Rostov. I represent the Sierra Club in the Storage Proceeding. And I actually have a question, before I ask my question I wanted to respond to the power-to-gas. The reason power-to-gas isn't in the storage roadmap is because it's been litigated two or three times and each time, power-to-gas has not been considered a

storage resource.

And the one other point I want to make about renewable gas, which is a misnomer, is idea of taking renewable energy and making methane, which is a potent greenhouse gas is not a way to solve our climate crisis. We need to reduce greenhouse gases by 40 percent. Creating new methane from renewables is not a good idea.

And to my question, I'm trying to figure out how the Energy Commission's, I think it's called StorageVET, your methodology for evaluating storage relates, if at all, to the common evaluation protocol that's being developed, or it has been developed in the PUC proceedings.

MR. GRAVELY: I'll give you the first part of it and then bring in others.

The first part of it is this model was developed as a result of two previous models that were analyzed as part of 2514. So it was the intent was to come up with a way to look at the different use cases, look at the application of storage and then come up with a consistent response from there. How it fits into other models, I'll have to refer to the PUC on that, because I don't know.

MS. MCMAHON: Certainly, the kind of closest analogy or I can't think of the right word, but anyway StorageVET relates most closely to Multiple-Use Applications. So it is meant to be a tool for a storage

provider to understand combinations of values, so net once we finalize the Multiple-Use Application framework. And we've been talking about this somewhat, so I'm not committing anything to say this, but in any case to update StorageVET with the values that are ultimately determined. And the framework that is ultimately determined for MUA, Multiple Use Applications being MUA. So that a developer can actually utilize that specific to the California market. Does that help?

MR. ROSTOV: Yes. So it's more for the developer as opposed to for the utilities to provide information about what they're doing with storage?

MS. MCMAHON: Right.

MR. ROSTOV: Okay. Thank you.

MR. MCLAUGHLIN: Good morning. This is more of an information item. My name is Larry McLaughlin. And I work for the community college system in California. I'm a Regional Director in the Inland Empire Desert Region, have 12 colleges that I'm responsible for working with advanced transportation and renewable energy-related programs. But also have responsibility for a couple of state level programs and that's what I wanted to tell you about this morning.

We have an energy storage curriculum that has been developed recently and is being used to train faculty

across the state in energy storage, so that they can have the knowledge and the resources they need to share that information with their students. We see this being integrated into electrical programs, certainly solar construction, building, architecture. There's a number of programs that would relate to and be appropriate for them to start teaching students about this topic.

We've conducted training in October, up in the Bay Area and have conducted training for faculty in the L.A. Area. And in August, we'll be working with the California Energy Storage Alliance to include some training at the ESNA Conference in San Diego. So we've been very excited about that. We just wanted you to be aware of our progress.

The second project I wanted to tell you about is that we're developing information and education for developers, property developers, contractors, building owners and managers on microgrids. We're partnering with the Stone Edge Farm Microgrid, at Stone Edge Farm Winery to put this program together. We're calling it The Microgrid Institute at Stone Edge Farm. They do a lot of education, a lot of teaching and demonstration out there currently. And we see it as the perfect venue to bring developer and builder types in to learn, at a high level, what microgrids are all about. We expect to have our first offering this

fall. And again we're very excited about that and just wanted you to know that these educational programs are in progress. Thank you.

MR. O'DONNELL: Good morning, everyone. Arthur O'Donnell. I'm a Supervisor in the Safety and Enforcement Division, here at the California Public Utilities Commission.

And in my experience, I had both Rachel's job, as the Lead Analyst on Energy Storage Procurement, and Gabe's job as Supervisor of the Grid Planning Reliability. And the roadmap jointly developed with the ISO and the Energy Commission was about the last thing that I did, before moving over to SED. So I want to commend everyone on the amazing progress that is discernible from looking that document with scores of issue areas and barriers that we perceived.

And I've continually been amazed at how much work has been going into this in order to make the Commission's larger policy of energy procurement a success, right? Because that's really what it was about. And I think that the challenge going forward is to keep up with the market. The market is outpacing you in a lot of ways, such that the Legislature continues to now see energy storage as a solution to a problem in putting out higher expectations. You know, AB 2868, that added another 500 megawatts to the

storage target. SB 700, which is devolving the SGIP Program into an energy storage incentive program.

One element of this that I think is crucial, and I continue to work on it, is ensuring the safety of these systems. And so one thing I would urge our sister agencies to continue to set very high expectations for the safe operations of storage as they participate in these markets. The ISO has been a little bit passive in that it defers to the utility and contracting process. I'd like to see safety considerations in your participating generator agreements in your interconnection agreements.

For the Energy Commission, a lot of the work in storage safety has been done at the Department of Energy, working with Sandia Labs. We are very concerned with proposed cuts to that agency. That storage work could be a victim of that and so I would just urge you to continue to look at where those gaps are. And how you can help in your funding authority to continue the safety advocacy to make sure, because it really is only going to take one untoward incident to have everybody questioning the value of this new part of the marketplace. And we know that it can work. It's just the technologies are going to continue to evolve and the expectations are going to continue to evolve. So thank you.

MR. PETLIN: Thanks, Art. It was always great to

be thrown into storage with you and then have you leave and go to SED. But you've always been really helpful and being like a founding staff to a lot of the initiatives. So thank you.

This looks like a great opportunity to open up the phone lines and see if anyone on the phone would like to comment. Do folks on the phone have questions or comments?

MR. NESBITT: Yeah, George Nesbitt. Can you hear me?

MR. PETLIN: Yes, go ahead.

MR. NESBITT: George Nesbitt. I'm a HERS Rater as well as a contractor focusing on energy-related retrofits and installations.

So I guess two things. The first is the issue of balancing say the individual's need versus say (indecipherable). So the need of a certain person wanting to do storage, so more could be a different whether it's a generating system or a storage system versus the Grid. And the cost on the Grid and how do we plan, and actually plan to put the resources we need where we need them as opposed to having people wanting to put them where they want, which might actually drive up costs.

So really whether we need to consolidate authority to less different agencies or whether you need to

work better or how well are we able to tell someone, "No. You can't do that there. That's not the right place." Or how do we tell them where we want it done in the first place, so that they can spend the rest on a project that will get (indecipherable).

So if you have any comment on that, I'd appreciate that. And then I have another issue.

MR. PETLIN: Thank you for the question. This is Gabe Petlin. I'm going to talk to you a little bit about the distribution resource planning proceeding and how it is getting at your question. So we recognize the role of DERs is increasing. The penetration is increasing. Some of the DERs do receive ratepayer funding to cover some of their costs. There's incentives. And so currently, we do not base any of those incentives on locational value of resources.

So what we are trying to do in the DRP Proceeding is to increase the granularity of our ability to identify optimal locations or DERs, based on their value in avoiding costs on the Distribution Grid as well as the bulk system. And that can then inform sourcing of DERs. So that's sort of step one. And we are midway in that step. We are going ahead with procurements that have identified some optimal locations for DERs where they could displace and avoid a known, planned investment in sort of traditional grid

infrastructure. And so the theory being that they could displace that at a lower cost. So that's one example of how we would sort of guide DER procurement in places where it can have the most value.

A much more difficult step that goes beyond that is once we have completed the locational net benefit analysis tool, for the whole Grid -- and that's still arguably a year away -- then what do we do with all that information? How does that feed into, for example, the Integrated Resource Planning Proceeding? Or how does that feed into future policy proceedings such as NEM 3.0, which is planned to be visited in the future or SGIP incentives for storage.

So we don't have the answer to how we would -- we're not telling people not to put DERs on the Grid. But we are starting to at least identify where they're going to have the most value.

And the next step is to really have better information, better tools to understand value and location. And there's a number of things we can do with that, but it's too early to say what we will do with that. But the idea is we're always looking to make the DERs have more value to the Grid and to the ratepayers. That's the ultimate goal of our proceeding.

So thanks for the question.

MR. NESBITT: Yeah. So my sort of another question is the whole, because I'm a HERS Rater and I'm primarily in the residential field and behind-the-meter is everything I do. So NEM of course, allows any electrical customer to become a generator. And as far as I know, there's never been any restriction on say battery storage for backup. It's essentially not connected to the Grid, when the Grid goes down. Now, although I don't necessarily understand how we are -- I guess the Storage Grid is I guess perhaps more regulated as far as what you can do -- storage becoming a big issue.

The problem with metering is that the individual customer has lost sight of their actual electric consumption, because most systems haven't monitored for the production separate from their net bill. Although systems and inverter manufacturers, as well as third parties now have lots of systems to actually combine your data with your inverter data to actually show your load and your production in that.

But we've also lost the ability to know what our electric load is on the Grid, because CAISO and the other balancing authorities only see the net load. And so we don't see behind the Grid really as a resource. And yet I think we need to know what that is in that, that change in the system load has impacts as well as on the Grid side

renewables, the duck curve. And they actually both play into the duck curve.

So net metering (indiscernible) is everyone's ability to put in a system regardless of the impact on the Grid. And then we have a policy that we're pursuing, the whole net zero energy home and them commercial buildings, which will mean a large increase in buildings that have PV systems that are producing energy when we may have an excess of capacity.

So we especially in some areas have lots of new development. We may be putting a lot of resources on the Grid where we don't want it or don't need it, or that it might cost more. So we need to think about net metering and whether storage is required, how that plays out. So I guess that's it for now.

MR. KLAUER: So this is Peter Klauer from CAISO, just a comment to that, so what you're talking about is true.

And the way we look at it is our ability to forecast the load is becoming more challenging, right? Because you could argue that as consumers like you and me are putting solar on the roof and batteries in their garage, load is no longer a conforming sort of set of numbers related to weather or the economy, right? Load is becoming, I would argue, as much a commodity as generation.

Especially as we move to things like time-of-use rates and the cost conscious consumer is installing storage in their home to take advantage of those rates. So to your point, it is becoming more and more difficult, certainly at the consumer level, to forecast accurate loads. And that's a very important function that we rely on and it's becoming more and more of a challenge.

We are working, the ISO is working closely with the utilities, I mean not necessarily behind the -- well, it is behind-the-meter, but it's not automated. But we work with the utilities to understand how much PV has been installed. Because when a storm front moves in or fog moves in and suddenly a residential area is under clouds, we at the ISO see the load spike. And we need to be prepared to deal with that.

So we are entering a time where it's more of a challenge to forecast and to make sure that we have the right amount of reserves and the right amount of resources available, but so far we've been able to stay ahead of it. But it is an interesting time, because I think consumers more than ever have the ability to manage their loads. And will continue to do so, which will continue to impact our ability to maintain reliability.

So I think one thing to note too, is that we recognize load more and more as a commodity. We are

working to change our resource model, so that we cannot just curtail load, for example, through DR, but actually manage the load. So if we need to increase load, we can do that as well and send appropriate signals either through the utility or to transmission-connected loads, like hydrogen creation.

Yeah, so it is evolving and it is a challenge, but so far we're kind of --

MR. NESBITT: It seems like we need to be able to capture information better from behind-the-meter of the production and actual load. And then of course, with the push to electrify transportation as well as potentially even buildings we're adding. And of course that can have a positive negative effects, but yeah it's quite complicated.

MR. KLAUER: Yes, that's good input. Thank you.

MR. PETLIN: I think we have enough time for one more question or comment, either from the room or from the phones. Does anyone else want to jump in?

Okay. Why don't we mute the phone? We're going to have one more in the room.

MS. DE LEON: Hi, good morning. Thank you for having this session. My name's Niki de Leon, from Kitu Systems and we are a network provider. We also work with the VGI Roadmap process and VGI Interconnection Working Group.

I just wanted to comment on the L.A. Air Force Base project, and also there's a school bus project in Torrance, which is part of the SCE territory. And the need to align the interconnection process for bidirectional PEVs with what's happening in the Smart Inverter Working Group and also other distributed resources.

We're seeing, as others have pointed out, multi-jurisdictions. And I have not seen a modified Rule 21 or WDAT process proposed for electric vehicles. So I'd like to see either an alignment or a specific call out for what electric vehicles with these bidirectional functionalities can expect as they're going through the interconnection process within either local utility processes or in the application through into the wholesale market. Thank you.

MR. PETLIN: Thank you.

I'll be interested to hear from the VGI presenters in the afternoon, their deeper thoughts about interconnection issues and bidirectional. So I'll just say briefly that we expect in the near future to have a successor Rule 21 Proceeding kicking off sometime this year. And that's an opportunity to get that issue raised and possibly included as a scoping item. So be on the lookout for that, if that is an issue that's important to you. You can try to insert that as one of your proposed scope issues. But again I'd like to hear more in the

afternoon, on a deeper level on this issue about this issue to better understand it.

All right, any other comments for Rachel or me or Mike? (No audible response.)

Great, well I think that would then conclude the Storage Roadmap discussion. Thank you very much, Peter, Rachel and Mike. And thank you all for your participation.

We're going to transition now into the Demand Response and Energy Efficiency Roadmap. And we're going to call up Delphine Hou from CAISO who is going to lead that presentation, as well as any other CPUC, CEC staff that are going to support that presentation. So handing it over to you, Delphine.

MS. HOU: Okay. Good morning. My name is Delphine from the California ISO. I'm very excited to be bookending your lunch hour. Actually, I'll let folks go around the room. We have representatives from the CPUC as well as the CEC and let me start off with the CPUC. Bruce?

MR. KANESHIRO: Hi. Good morning. I'm Bruce Kaneshiro. I'm with the Energy Division here at the California PUC. I'm the Supervisor for Demand Response Programs and Policy.

MR. HUNGERFORD: I'm David Hungerford with the California Energy Commission, Research and Development Division. And I supervise the demand response research

that's going on through EPIC.

MR. KLAUER: I'm Peter Klauer, from the California ISO. I'm the Smart Grid Solutions Manager and I get involved in these new technologies and the integration into the ISO markets.

MR. GRAVELY: Mike Gravely, from the R&D division of the Energy Commission. My focus is on the Grid and energy storage and systems integration.

MS. HOU: Great. We will also have an additional speaker, Martha Brook, from the CEC afterwards.

So I wanted to provide sort of a grounding, kind of a status update and a little bit of looking into the future with regard to the Demand Response and Energy Efficiency Roadmap.

So when we created this roadmap, back in I think 2013-2014, we were dealing with a couple of emerging issues. First of all Demand Response and Energy Efficiency, a lot of it was fairly new, especially from the CAISO side of integrating it into the market. So a lot of the goals and activities that were embedded in this roadmap is really about how do you reflect these resources into the various planning processes. So specifically, for the Energy Commission it was for the Integrated Energy Policy Report, for the CAISO the Transmission Planning Process. And at the time for the CPUC it was the Long-Term

Procurement Plan. So there was a lot of effort revolving how do you think about demand response and energy efficiency. At the time, we were also dealing with the massive SONGS outage, so we wanted to make these resources operationally relevant.

In addition, there was this idea that, especially from the ISO, when we consider these resources, we wanted to put them at as level a playing field as possible, meaning could these resources actually substitute for not only SONGS, but other resources that we have in our market. So as Peter had mentioned before, regardless if we're talking about storage or other resources in the system, specifically for CAISO we like to think of this as much as technically possible as an interchangeable resource that provides us not only with energy and capacity, but also helps us maintain reliability. So that was some of the core things that the agencies were dealing with.

So I won't go through the large matrix of specific action items. We'll have that posted after the workshop, which we'll update for the specific action items under each agency, the progress that we've made. And I think speaking for the agencies, I think we've made a lot of progress in getting through the major goals and action items of that particular roadmap.

So here, I just wanted to give you the

highlights. So the grounding is that's the situation we were facing back in 2013 and '14. How do we operationalize? How do we plan with demand response, energy efficiency and consider that in our processes. In addition, we were starting to grapple with some of the newer issues that we see today, which is the large penetration of renewable resources. So we were seeing sort of the development or the beginnings of the now, I guess infamous, duck curve. So we wanted to have that as a consideration. How could demand response and energy efficiency help us deal with those kind of forward-looking issues? And I think we've been fairly successful in establishing the groundwork for that.

So in our first goal, to ensure consistent assumptions, that was largely done through the Joint Agency Steering Committee (JASC). It actually started with an energy efficiency discussion. It was a letter from Senators Fuller and Padilla, asking the agencies to kind of sit down and really integrate and true up how we account for energy efficiency.

But as Peter mentioned, often times at the CAISO, when we tried to look at these resources we didn't want to silo it. So actually, the JASC has really kind of grown into its own in considering not only energy efficiency, but demand response. A lot of the behind-the-meter resources

that are even developing today like electric vehicles, behind-the-meter PV.

So JASC has really been instrumental in getting the agencies together. That was back in the 2013-'14 timeframe, but moving forward it's also been really exciting to have the Air Resources Board join JASC. And then moving forward now we're going to be looking at, instead of the Long-Term Procurement Plan we're going to be looking at IRP impacts from SB 350. So again, JASC has been a great forum that was developed back for this particular scenario, but it continues to be relevant going forward. So a lot of coordination was done through the JASC.

In addition, JASC has sort of spawned off other working groups and processes, but it's a good way for the agencies go get together and align what we're doing. So the roadmap called that out and it's been very successful.

And our second goal has been modifying the load shape, mitigating over-generation. Again, that's related to the duck curve and to moderate the ramping needs. That's a lot of sort of CAISO concerns embedded in there, as some of you may know. And that's been very helpful for us and specifically in looking at demand response in a more, I guess very specific way. You know, we've had specific programs for flex alerts, using that for our

system reliability. Back in 2016, I think we got over 500 megawatts of response just from calling the flex alert on a hot day. So that's been very successful in having that be a customer-driven response, but helping the Grid with our reliability needs.

A really good joint coordination that we had was in thinking about the periods when we have overgeneration and potentially periods when we would welcome some demand reduction. CAISO and the CPUC had worked together in the CPUC's proceeding, in the time-of-use OIR. So we were able to provide our operational data to the PUC.

I know the CEC has been very active in this area as well, with their energy maps. And I think David Hungerford is going to come up and talk a little bit later about some of the work that the CEC has been doing, regarding GFO-15-311. I'm getting that number right? Okay, excellent, getting the nod for folks on the phone.

So that's been very good in terms of helping the agencies coordinate some of those operational needs. And we look forward to having that kind of - not only consider what the needs are, but to really start seeing either demand response or energy efficiency and certainly other resources responding to some of the groundwork that's been set up for this particular goal.

The third goal is clarifying needs for DR and EE.

Again, this goes back to the different planning processes. For CAISO in particular, in our transmission planning process particularly after SONGS went out, we really wanted to grab all of the resources we could to replace what SONGS had been providing. So certainly looking at the loading order in the state we wanted to make sure that demand response, energy efficiency were kind of front and center in that.

That's also very connected to the IEPR and working through the CEC and understanding where all those numbers come from and the CPUC for the DR side. So for the CAISO side, what we did is we kind of laid out what we thought of DR. How that could be integrated into the transmission planning process. A lot of work went into the IEPR to take energy efficiency and really break it down into a granular specification, so that you can take that information and then put it into the transmission planning process, so it becomes very much integrated. So it's not just energy efficiency that's out there. But it's energy efficiency broken down to the substation level, so that CAISO can integrate it into our planning.

So rather than planning for load that might grow, you would actually take off some of that load, because of the presence of energy efficiency and again layering into that demand response and other behind-the-meter resources.

In addition, at the CAISO side we strengthened our rules in terms of considering the reliability needs, the must-offer obligations of these resources. So again, putting it into planning, establishing the ground rules for how these resources operate in the hopes that when they do come in to the CAISO, we basically put them on a level playing field with other resources that we typically see, such as the thermal generators.

The fourth one is to ensure resources are procured. And looking at the timing of it, again I think the CEC has done a lot of work in this area in the data collection side making sure we understand what the data is and how successful the programs are. And again, a lot of work was done here to take the energy efficiency down to the bus level. And I think maybe folks from the CEC may touch upon this later, but this work continues, especially when we consider SB 350, AB 802. So that's going to be important work that we continue with going forward.

The last point I'll touch on is the fifth goal, DR program pilot participation. There's been a lot of work there. So once you kind of establish what the DR may look like, especially on the CAISO side, you realize there's some exceptions you need to make because not all resources are structured the same. So we've done a lot of work on our side and Peter's been involved in a lot of work to kind

of streamline our processes, try to understand how best to get these resources into our market.

So we've had, since 2010, a model that looks at economically-bid demand response. Since 2014, we've had a model that looks at reliability-based demand response and we've had SCE participate in that since 2014. We've had PG&E start to participate in that, in 2017.

And the good news is that after having laid the groundwork, through this roadmap, we are seeing these resources participate in the market. So we had an event on May 3rd, that some of you may be aware of and we did cover demand response that day and we did get response to help us with the reliability issue that we had on the Grid, with load coming up very quickly and the CAISO depleting our reserves too quickly.

So there is a great example of having walked through the basic concepts of the roadmap, the basic goals of having it in planning, establishing what the needs are and what the characteristics are. And then finally using it operationally on the CAISO side. I think that's been a really successful outcome of the roadmap and the interagency cooperation that we have here.

So again, I'll let the CEC speak for some of the piloting. I know the CPUC has done a significant amount of work in looking at the DR programs. And also establishing

an auction mechanism of having more participants and providing not only more participation, but perhaps more innovative ideas into the marketplace to look at strengthening demand response.

So again, I'll conclude my time here on the podium, but the idea is that this roadmap, I think was very useful in helping us establish some groundwork. But as we move forward, we have new challenges, we have new processes that we're still trying to align with IRP, with SB 350 and who knows what else is going to come at us from the Legislature. But really, we're at the stage where we think we've gotten to a level of maturity where the resources are in the market. And we're just finding ways to kind of get comfortable with how they operate and how they may be used to be sort of a larger part of our generation fleet.

Okay. With that, I'll hand it over to Martha Brook, from the Energy Commission. Thank you.

MS. BROOK: Good morning, I'm Martha Brook, with the California Energy Commission. I'm the Technical Advisor to Commissioner Andrew McAllister. Andrew McAllister is the Energy Efficiency Lead of the Energy Commission. He's also been a very active lead our policy reporting in the past and has a strong interest in demand response, which is why I'm here today.

So Andrew's message to this group, and to the

efforts to update these roadmaps, is that he is concerned that we have the potential here in the state to potentially overinvest in relatively expensive infrastructure technologies and systems. Because we haven't yet, really have promulgated a robust marketplace for the relatively less expensive, but highly distributed demand response and demand responsive technologies.

So certainly we want to see a roadmap that maybe has more market certainty, in terms of what we heard earlier about the milestones and timelines. So that the marketplace can understand how their business models need to react to rates and other market signals. So that we can have a really robust distributed resource market in the state.

And the other thing I'd say from the Energy Commission's perspective, where we sort of get caught in terms of the cart coming before the horse a little bit, is we have a very robust stakeholder community for the evolution of our Building and Appliance Energy Efficiency Standards. And we have now, for the last maybe 10 or 12 years, have demand response requirements in our Building Standards, for example. And we would like to do more. Our stakeholders would like us to do more in that area. Where it's a really opportune time to invest in communication technologies and energy efficiency technologies at the time

that the building is designed and constructed.

But without that certainty in the marketplace, it's harder and harder for us to justify that it's cost effective within a building construction construct to make those investments, even though we really want to do that. Again, we need more market certainty in the state, so that we can justify those investments.

And if you think about it, we haven't done any of that at all in our Appliance Standards. But again if there was a marketplace for two-way communication then we could begin to explore standards for demand response capabilities within appliances that are sold into the state. So that's just one example or a few examples of where we could do more again if we continue to partner and update these roadmaps and keep working on progress.

And we are doing a lot at the Energy Commission to support the JASC and other activities that we've heard about this morning. The most exciting one probably is an update to our data collection rulemaking, where we will be getting more granular data, after the conclusion of that rulemaking process, because it's needed for our long term demand forecast, our integrated resource planning, and also our tracking and reporting of progress on energy efficiency.

So that's all I have to say. And I'm happy to be

here today. Thank you.

MR. HUNGERFORD: Thank you, Martha.

I'm going to give you a brief overview of a research solicitation that we put out under the second EPIC Investment Plan in 2015. And research projects that are funded under this Plan started work about -- the research projects we've funded under this solicitation, some of them started last summer, some of them started later in the fall. And so we're just getting rolling, but this will give you an overview of what we're trying to accomplish.

As some of the other speakers have mentioned, one of the issues that we've been looking at with demand response is how to solve the chicken and the egg problem of demonstrating that large numbers of small resources can actually have a reliable contribution to meeting some of the Grid's needs. And the questions of how to operationalize those things, what kinds of loads are interested in participating? What kinds of things customers are interested in participating? What level of engagement they are likely to have? What kinds of constraints and needs that we might discover in trying to operationalize all of that, and how do we actually demonstrate that it's really working? Especially when we don't have direct telemetry over every single light bulb or air conditioner.

So we conceived of a solicitation that would try

to address some of those things and it's based on the idea of a transactive signal. The idea of a transactive signal is the idea that customers in real time could understand what the market was like, and then buy and sell electricity at their choosing. The idea is that those actions people would take would be based on economic principles. And that there would be information exchange between the operators, providers and prosumers, which are producers/consumers. Think of a house with PV as a prosumer.

But it's not as complicated as all that. Think of it more as a proxy price signal that varies in real time and that you can automate response based on which direction the price is going and the magnitude of the price. And what kind of effect, over the entire system, that might have as thresholds for participation are met among thousands of consumers and tens of thousands of devices. Compared to the existing system of reliability demand response where the system is like a car being driven with only an accelerator that you can press or release to speed up or slow down, reliability demand response is like throwing an anchor out of the back of the car and it slams you to a stop. But it's a big chunk of reduction in load.

Whereas, this is more like adding brakes to the car where you can actually have something you can step on lightly or hard to make the system slow down. And then

release it as soon as you need to speed up, possibly even in real time.

So, the first idea of the solicitation was one, to develop a transactive signal, some kind of proxy signal just to test the idea out. It's going to be a proxy. What gets included and how that evolves, this might provide a base for it, but how that evolves in the real market we don't know yet.

But it could include everything from existing ISO markets. And some sort of transactive prices underlying that to including information like emergency needs or a specific sub-lap of even circuit level information or even forecasts of wind production or forecasts of solar production or even marginal carbon emissions on the Grid at any one time. And so that kind of information translated into the marketplace could affect what consumption is on at any one time or not.

So we have two major categories of projects under this. One is following the bifurcation and the demand response proceeding, is experiments looking at participation as supply side resources and the existing ISO market. And the proxy demand resource market, for example, or the DRAM Proceedings.

The first one is with BMW of North America. They are looking at trying to understand what their customers

might be willing to do with moderating the charging on their vehicles. The vehicles will have some intelligence in them that will be able to understand what the customer wants in terms of how much charge he needs, when he comes back to the car and at what time. And then the proxy signal could be processed by the vehicle to understand how much charging and when charging needs to be done. And try to optimize the costs for the customer, the amount of charge that goes in.

Instead of plugging in and charging all the way until full, it might know that if it's plugged in in the afternoon, or if it's plugged in in the early evening and there's a steep ramp going on, that it can moderate its charging. And still get the consumer home by not giving it a full charge, but giving it a 70 or 80 percent charge. And they're testing out consumer tolerance for this sort of thing.

They're also looking at some of the basic issues that we don't have a great handle on yet, which is where the cars are when, when they are plugged in, and what sort of tolerance the customers have for dealing with this sort of thing. How much of it needs to be automated? How much they need to - is it going to be like a Nest thermostat where it sort of builds an understanding of the customer's needs and that's okay with them, or do they want more

control? It'll be an interesting experiment. And they're making available a fairly large number of BMW owners, so this test is going to be a really interesting test of the initial marketplace for electric vehicles. Because it's actual vehicle owners rather than fleets or something like that, which is not going to be the way everyone else will be doing it.

The second project is under the Center for Sustainable Injury -- Center for Sustainable Energy in Southern California -- apologies folks, for those that are listening. What they're looking at, they put together two portfolios of customers.

One, is they're putting together right now a group large commercial customers and K through 12 schools. And trying to understand what kind of demand response capabilities those customers have, what kind of loads they're willing to contribute, when they can contribute load reductions, when they're willing to have their loads moderated or interrupted. And how that actually -- they're trying to operationalize, in a way, to try to understand how the customer's needs are going to be met while trying to meet Grid needs.

And they're going to be comparing results under existing tariffs, under upcoming tariffs or tariff designs. For instance the time-of-use rates, some of the time-of-use

rates we're going to be seeing in the near future. And under this transactive signal idea. And seeing whether there's a shift in the types of loads that can participate under different kinds of scenarios and incentive structures. And what kinds of response they see, both in terms of performance and customer interest and behavior.

The other is with the same research goals, but with hotels, which have some very interesting energy needs. And very potentially useful patterns for the Grid, given when needs actually are at the hotels. For them, there's a tradeoff between efficiency management and load management that they're trying to explore and trying to figure out what they can do. One of the techniques for example, would be to use the hotel rooms themselves as thermal storage. And so the idea of pre-cooling parts of the hotel, sections of the hotel, and then dropping them off during the ramps to try to provide resources to the Grid.

The third, again participating as a supply side resource, is under OhmConnect. And this is quite a different project. This is empowering prosumers to access wholesale energy products. They have over 12,000 customers signed up through social media platforms to participate in load reduction events. I myself have, because I'm managing the contract signed up for it, although I don't get free thermostats or anything.

But the customers get these notes in text messages or emails, whatever they prefer, or they can get them over other platforms, Twitter and Snap chat, and other things. And they get a message that says, "In an hour, we're having an OhmConnect event and it's an Ohm Hour and we want you to reduce your load by as much as you can." And then they award points based on whether you actually successfully reduce load compared to your baseline. Or you get points taken away if you actually consume more. I lost all my points the day my wife left the air conditioner on a couple of weeks ago when no one was home.

But it's an interesting platform and an interesting idea. And it's testing some of the ideas. It's testing a whole set of different incentive structures and approaches to engaging customers that will be very useful, even for different kinds of demand response activities. This idea of how do you engage with people? How do you understand what their needs are? How fast do you wear them out? And how fast do they get bored with it? What kinds of things do you have to do to keep them involved? And then, ultimately, what kind of load reduction do you actually see and measure out of this large number? Is a statistical estimate over a very large number of consumers more reliable than an estimate for a single consumer that has a non-zero probability of failing to

perform. So we're very interested in how that goes.

They're also providing automation to some of their customers in providing signals. And they're providing it could be a thermostat. And the brand escapes me, but they're putting in plug load strips that are automated for this sort of thing.

So our second group is looking at the demand side resource, and this is when we think of it as a little bit more basic, in trying to understand consumers. And what we have is five different projects over a wide variety of different customer groups, using different approaches. And all of them have in common that they're going to use this transactive signal to test all of the -- to test either a sub group of their customers or their entire customer group and see what kind of response and performance they get.

But also looking at the customers' needs under different tariff structures. And even one of the products that will come out of this, and the [solicitation's] Group 1 research, is to make recommendations based on the learnings that they have with their customers on what types of incentives and what types of structures wide varieties of customers are interested in. And what differences and commonalities there are, and what are issues for the consumers, and what they're willing to actually do.

The first one, I'll go over these sort of quickly, is with Electric Power Research Institute. This one is a large number of small loads approach. They're testing a number of different end use devices, thermostats, plug loads. They have customers with electric vehicles. They have customers with solar and even some with storage. Most are either small commercial or residential. And smart inverters and even thermal storage.

And they're going to try to operate these loads. They're dividing them into groups using different scenarios, different incentive scenarios. Part of the money in all of these is bill protection for the customer, so that they can participate without getting hurt compared to their regular existing tariff. And so they're going to be exploring what different kinds of customers do and what kinds loads actually work and what kind of load reduction actually works. And again, fatigue for the customers, over a period of time.

The Alternative Energy Systems Consulting is doing a different set with a higher focus on residential. And the customers that they have involved have a variety of DERs. They have customers with solar and customers with storage. And they're focusing a lot on tariff structures and trying to understand what might happen under the upcoming residential TOU rates that are supposed to start

somewhere in 2019.

And Universal Devices is doing a behind-the-meter energy management solution. They're focused on the idea of how to manage load in an automated way. And so they're focusing their effort on building algorithms that meet the customers' needs.

And the final one with UCLA, is focusing on engagement strategies with customers. How do you get people to participate? How do you get them to participate at a sort of a basic level in demand response? And they're testing a number of different approaches on customer engagement.

And so I think that pretty much covers what we're doing in that solicitation. Thank you for your time, questions?

MR. GRAVELY: Well, we will break for lunch here, come back at 1:00 and go into the public comments for the Energy Efficiency/DR Roadmap and answer any questions we can for those interested (indiscernible) parties.

So we will close the line. And we'll start back at 1:00 o'clock. For those here, we'll be back in the room at 1:00 o'clock.

(Off the record at 12:03 p.m.)_

(On the record at 1:06 p.m.)

MR. GRAVELY: So this is Mike Gravely from the

Energy Commission just kind of helping to host today's session. I want to introduce Bruce Kaneshiro who's been working DR at the PUC for a long time. And he'll make a few comments and then we'll go into public discussion and public comments.

MR. KANESHIRO: All right, thanks Mike.

Hi, Bruce Kaneshiro again with the California PUC and Energy Division. And I just wanted to maybe kind of go back to the DR/EE Roadmap and first --

UNIDENTIFIED SPEAKER: (Indiscernible.)

MR. KANESHIRO: Oh, okay. No, this is the slide that I want to be on.

So yeah thank you Delphine and David for sharing your perspectives on this Roadmap. I just want to make my comments brief. I think David and Delphine did a great job of summarizing work to date. I just want to share a little bit about the PUC's perspective on this Roadmap.

And as Delphine mentioned, demand response back in 2013 wasn't visible to the ISO at least as a dispatchable resource in its markets. And that's been a strong emphasis for the Commission as well as the CAISO to move DR into that world. And that has occurred. As Delphine mentioned, there's DR now participating. Edison was one of the early adopters. They started integrating their programs in 2015 and the Commission has set a

deadline by January 2018 that the other utilities have all of their supply side DR integrated as well. And that's already begun, so it's a great accomplishment. And we want to thank the CAISO for working with us in moving that along.

And we also had third-party demand response providers doing the same thing. As Delphine mentioned, there was an auction pilot that was adopted by the Commission that's been running now for a couple of years. And third-party demand response providers that win a capacity contract through that auction are also integrating bidding their demand response into the market.

So there's been a lot of interesting learning that's been going on. And I guess I would just say, to emphasize if we look at this slide number five is an important one as far as going forward, we want to increase DR and public participation in the ISO market and develop operating experience. And that's happening now. And as the utilities and the third parties are learning how to do this, how to move their DR and bid it into the ISO and get dispatch awards from the ISO and respond, it's important to get feedback about how that's going. And what are the challenges with that and what refinements need to be made to CAISO processes perhaps and CAISO rules regarding DR as well as their own utility programs and how the programs are

set up and how third parties are set up.

And trying to find this important, I guess middle ground you might say, because some of these programs that are being bid in have long legacies behind them. They've been around for, in some cases decades. And they've been developed under certain rules, under certain assumptions that are different or have to be changed as a result of being integrated into the ISO. And so there's a lot of learning and as you get into it and as we're learning, there's many details that either were assumed or just thought to be perhaps minor. But actually they turned out to be challenges for the DR operator.

So I would just emphasize that as we keep moving forward we don't want to claim victory yet although there's great progress made. But I think we need to keep working and refining this as that point says, provide feedback for policy refinement is very important. So and that's for both the DR operated by utilities as well as the third parties. They're all in the same boat in terms of learning this new world.

I mention the DRAM Pilot (phonetic) and again, it's growing. There's a lot of interest for our demand response providers and so the question is, what's their role moving into this new world of DR? And for years and years the utilities have basically controlled the lion's

share of demand response. Now, demand response providers are entering the California markets. A lot of them are interested in participating through this auction mechanism. The megawatts have grown. We started with about 40 megawatts that were under contract for 2016. Now that's grown to about 125 or so this summer. And now the utilities are running a third pilot for deliveries in 2018.

And so the question is, as third-party demand response providers gain more experience and gain more of a market share, should the Commission move to that type of paradigm? And the Commission in a decision last year indicated that there was great interest in that, but we need to evaluate to see if demand response providers are performing. So when they get dispatched by the ISO are they delivering the megawatts just as an IOU program would be expected to do. And so that's an analysis that's going on here at the Commission. The Energy Division is doing that evaluation.

One of the key aspects of that is the performance of these resources in the ISO market. And so we'll have the results of that by the middle of next year, which would speak then to going forward sort of the role of third parties and the mix of DR that's being provided.

And then the last point I'd want to make is going actually to number 4 back on our slide, ensuring that

resources are procured and developing to meet capability, timing and location needs. And for years demand response has always been defined as reducing, shedding, load during the peak hours. And it's triggered maybe once or twice a year, maybe ten times a year depending on what program you're on. But it's always about reducing load for maybe a two-to-three hour period of time in the afternoon, getting that load shed down during the peak.

But as, I think has been discussed quite a bit already this morning, the Grid need is changing. And so how can DR change with that Grid need? Do we need to repurpose DR in its functions or add new functions to it? And one idea that's come out has been discussed now and in the proceedings, it's been discussed actually in a potential study that Energy Division produced last year is repurposing DR, so that it could be a resource that helps with the duck curve in that it could be used to help increase load when there's over-generation on the Grid. And so that's a whole brand-new concept of DR, but there are studies indicating that that's where DR could help. Or help with the steep ramps that occur either in the morning or afternoon, but it's changing.

But if you change it that way, of course that results in new terms and conditions and new expectations for customers as well as DR operators like the utilities

and third parties. But that to us is a very important policy area that we're just beginning now to understand and move toward. It's been discussed again, at least in a conceptual level in a DR potential study. But now we're reaching the point where, okay well if you were to change that then what are some of the design features of that? How would it work? How would you compensate customers? Are there ways to do that through retail rates as opposed to market products in the wholesale market?

And so those are the issues that we're beginning to struggle with, trying to understand and work with the CAISO, with the CEC and of course, stakeholders in our proceeding as to bringing in, you might say, a new generation of DR. Not necessarily to replace all the shed DR that's out there. We think there's probably a place for all of that as well. But to repurpose some of it and maybe repurpose maybe quite a bit of it, as the Grid continues to change. So that I guess there's yeah, a new generation of DR.

So those are some of the may I say future roadmap or policy areas that the Commission is looking at. So I think that I'll stop there, because I don't want to take any more time from the public comment period. So that's it.

MR. GRAVELY: Okay. We'll open up the room here.

Any questions or comments on the Energy Efficiency or DR side of the roadmap? Come up to the mic here.

MS. MIN: Liang Min, Lawrence Livermore Laboratory. My question is first I tried to draw the link between Transactive Energy and also demand response on the wholesale market as CAISO mentioned. Then the question is where does Transactive Energy fit into the wholesale market? It seems like the FERC 745, most logical (indiscernible) is participate as demand response, because we talk about wholesale market demand response.

If that's the case, how can we realize the full value of Transactive Energy participating in the wholesale market demand response? What specific case, the transactive signal you mentioned from EPRI, what does it look like? How frequent is the signal, is it hourly based, is it five minutes based, or is it four second based? Now, if that will make a big difference in terms of how can it get to the value from different market products or service, so that's my question?

MR. HUNGERFORD: Well, I'll start by saying that that's exactly the right set of questions to ask. And there is a fundamental question of how some sort of Transactive Energy system can fit, given the current market design or market structures and the way current rates are designed. Those are some of the questions that we're

trying to ask in some of these research projects.

And under the next EPIC research plan under the EPIC investment, the Energy Commission's EPIC Investment Plan Number 3, we're going to be pursuing some of the questions that are left after these projects are finished. The particular problem with trying to make a transactive system fit within the current ISO markets is being addressed by one of our projects: the Universal Devices Project being led by Ed Cazelet and so he's working on trying to solve some of those problems.

And one of the things that's going to come out of all of these projects, because one of our tasks was to try to understand the institutional and regulatory barriers to developing the kind of demand response that's possible to provide and that the system needs, is to evaluate where the problems are. And to make suggestions for either situations that need to be addressed further, or even suggestions for how to improve the current systems. Adjustments to the ISO markets and requirements for example, potential changes to Public Utilities Commission policy and rate design, but all of those things. And this is all supposed to feed into that process of growing and learning and trying to find how to do that.

MR. GRAVELY: One thing, (indiscernible) that here in some sense is that the Transactive Energy concept

or the signal itself is also considered regional. In other words when we get into higher and higher concentrations of just DER, you could need a regional signal in addition to a statewide ISO type signal. So you could actually solve the problem at the local level, utility level, community level before it got to the point where it needed support from somewhere else.

So one of the research questions is how do you do that? Again, in this particular research project we developed the signals hereby (indiscernible) response to the same signal we could compare that the seven or eight different projects, how they respond to a same signal as opposed to (indiscernible) --

Anyway, so I'd like to answer your question: what's the future of Transactive Energy or how do we use it? I think there are at least two areas. One is regional Transactive Energy and how this can be managed through the utility through their loads. And then the question becomes things like smart inverters, do they respond quickly to a voltage signal or are they responding to signals from the ISO that's forward looking, that tells them what's going to happen versus what's happened right this second.

I do think at least in our perspective, if we can work it out, that's one way of getting DR back into the marketplace where it has more of a role. Because if we get

the transactive signals ready and a DR response automated I think we'll find that it's still the most cost-effective product on the marketplace.

MR. HUNGERFORD: And I neglected to answer part of your question, which Mike just reminded me of, is that the EPRI project that's developing the transactive signals could be used for this set of projects. It's just getting underway and the questions they're asking are the questions you are asking. How frequent does it need to be and how is it constructed? And all of the participants in the other projects, all of the other projects, are serving on a technical committee that's helping EPRI define the specifications for the signal. And for both communication and information.

MR. GRAVELY: Go ahead.

UNIDENTIFIED SPEAKER: (Indiscernible) (Off mic.)

MR. BEEBE: Bud Beebe with the California Hydrogen Business Council.

Just to note that one part of the hydrogen solution for the future includes electrolyzers. And they're a great demand response resource. They can respond immediately. They should be warm, so they need to have some load all the time. But they can respond really immediately and they can soak up very large amounts of capacity, so that's all great but they need to have a good

price signal, of course. And we would hope that as you go forward with this that you consider how electrolyzers can enter into these markets and be given the right signals.

And also a particular issue with the electrolyzers of the size that are likely to be looked at initially of many, many megawatts are possible in this response. But you're going to looking at onsie, twosie megawatt-type installation and they're going to probably not be situated on the Grid or excuse me, on the Transmission Grid. But they'll be out on the Distribution Grid, and so you have to think about rate structure that allows these things to operate essentially at wholesale rates or some sort of a market situation that approximates that.

So that's an issue that we've had out there for a while and appreciate your consideration of it.

MR. GRAVELY: Thank you.

Other questions from the room?

(Recording: The Conference is now in talk mode.)

MR. GRAVELY: So anybody online, speak up with your name and organization and you can ask your questions.

MR. NESBITT: George Nesbitt, HERS Rater, can you hear me?

MR. GRAVELY: Very weakly.

MR. NESBITT: Okay. I don't know why.

So demand response has always sort of been a reaction to (indiscernible) where there's not enough higher demand. And --

(Audio cuts out continuously.)

MR. GRAVELY: We're having a hard time hearing you, because you're breaking up. Would you just say again who you are and where you're from and we'll try it again?

MR. NESBITT: Well, see I'm also getting an echo when I speak into the phone. Got it.

MR. GRAVELY: One choice would be to just type in your question and we can read it off, if you just type it into the chat section. It may be simpler to do that if you want, because we're having some communications issue with your mic.

(Pause to handle audio issues.)

MR. GRAVELY: So one thing we will add here for the group here is that (audio recording interrupts) is similar to you'll see in the VGI Roadmap as well as the Energy Storage Roadmap, we did go through and look at the different actions. And we're putting together what the different agencies are doing. It's just the timeline didn't work, so we'll be posting that in a few days. It'll be available on the website where all the presentations are, so it will be a future in a few days for the future. And it will be available for anybody to comment on before

the 27th if there are any questions at all just on the different actions, where we stand, and what's being done.

So if there are no other closing comments from Peter or anybody?

(No audible response.)

Okay. Thank you. Then what we'll do is we'll go ahead and transition to the Vehicle-Grid Integration Roadmap. And we'll have our two presenters come forward for that, and change seats.

(Pause to set up next presentation.)

MR. GRAVELY: Go ahead Noel and Kiel, you can introduce yourselves here and go ahead and start with that.

MR. CRISOSTOMO: So my name is Noel Crisostomo. I am an Air Pollution Specialist with the Fuels and Transportation Division of the California Energy Commission.

MR. PRATT: My name is Kiel Pratt. I'm a Project Manager in the California Energy Commission's Research and Development Division.

MS. CHARLES: And I'm Melicia Charles. I supervise the section that covers transportation electrification in the Energy Division at the CPUC.

MR. CRISOSTOMO: So Kiel and I will be giving the Gap Analysis and update of the VGI Roadmap. This is kind of a tag-team presentation and then we'll transition to

kind of a similar format of open-ended Q&A from the audience.

UNIDENTIFIED SPEAKER: Say your name again, I missed it.

MS. CHARLES: It is Melicia Charles. You can call me Mel, Mel Charles.

MR. CRISOSTOMO: So the Vehicle-Grid Integration Roadmap was developed in I think late in 2012, early in 2013, throughout almost an entire year published in 2014, in February. So it's been a little bit over four years since we've been working on this issue in earnest.

Just to give the audience a context about how much has changed in the EV space since then, this was a key activity coming out of the ZEV Action Plan from the Governor's ZEV Executive Order, which in 2012 called for infrastructure to serve 1 million zero-emission vehicles on California's roads by 2020, leading up to the deployment of 1.5 [million] zero-emission vehicles by 2025. Those figures were roughly in alignment with the ARB's ZEV Mandate, which required roughly a 15 percent penetration of new vehicle sales being ZEV by 2025.

Since then with SB 350 and the recent effort under the midterm review where the ARB was reviewing the ZEV Mandate this past April roughly, the ARB has since set more goals on the order of deploying 4.2 million zero-

emission vehicles by 2030 in California. And this is in alignment with other state level targets where the goal by 2050 is to have all vehicles sold in California be a zero-emission vehicles, which are again a plug-in hybrid -- or sorry, not plug-in hybrid -- battery electric vehicles or fuel cell electric vehicles.

So during this timeframe the agencies were working in somewhat isolation around different EV programs. I'll give a rough overview of what those are. In November of 2013 the CPUC released a white paper on Vehicle Grid Integration, which was a kind of a complement and an attachment to the then new Rulemaking R.13-11-007, which was supposed to explore Grid integration policy, infrastructure programs, new rate design, education outreach among other efforts at the CPUC.

In addition, the California Energy Commission was kind of in the midst of starting its investments in the Electric Program Investment Charge. There was a decision that was authorizing a new generation of R&D in succession to the PIER Program. One of the key projects outside of the EPIC portfolio, but definitely part of the R&D Division's efforts were supporting the Los Angeles Air Force Base in its Vehicle-to-Grid Project. And in that time the Commission had to work together with -- the CPUC and CEC had to work together with the CAISO to establish

some exemptions to existing demand response rules. Where the really only way of establishing a retail connection or a connection to the wholesale market from a retail customer behind-the-meter was through an exemption to the Rule 24 Demand Response Program.

In addition, the Alternative and Renewable Fuel and Vehicle Technology Program had been investing in chargers throughout the state. The ARFVTP now comprises around a quarter of the state's funded infrastructure. And back then the CAISO had not yet begun in earnest its initiatives in the Energy Storage and DER Program or the Metering and Telemetry Initiative. The VGI Roadmap very much benefits from all the progress that we've heard in both the EE, DR and Storage space and DER space that were presented earlier today.

So what did we set forth intent on doing in the VGI Roadmap? There were three major interrelated tracks, each with activities and shared agency responsibilities. And so because unlike some of the roadmaps there weren't specific agency actions, these kind of blend together since a lot of this is new and represents advanced technology. And we needed to collaborate on the space.

So the first track was to determine vehicle-grid integration value and potential in which we are going to understand these cases in different charging situations.

Management of the load and whether it's a demand response type smart charging, controlled load, or a storage discharging load -- refining all of those combinations in different charging spaces whether it be in the home or the workplace at different levels. We are supposed to help iterate between how those actually impact the Grid and what value we can place on it from an avoided cost standpoint.

That red track was leading into our need to develop enabling policies, regulations, and business processes, to liberate that value in programs that are targeted to consumers. And define the requirements really of those programs. We would then use that information to inform our policy and in implementing chargers and rebates for vehicles throughout the state. And those were also going to lead into further refinements of technology in terms of communications, charging power, vehicle technology as well in order to make this a more liquid market. And to continually improve the performance of our resources.

I went over these pretty broadly, but we'll get into the next few slides in terms of more specific goals. Again, as we were seeing with first introductions of electric vehicles on the mass market scale roughly in 2010 and 2011 we did not know very well how customers were using these electric vehicles. They were informed primarily through some early pilots that were funded by the DOE in

the Recovery Act. And the utilities in San Diego and cities in -- San Diego Gas and Electric and the City of San Francisco and I believe Los Angeles were beneficiaries of those ARRA funds that informed our charging behaviors. Because we did not how big of a resource this is, we needed to understand what types of Grid services would be available given charging patterns.

Next, the VGI value is important to understand how capable automakers and charging providers would be in building the functionality for smart charging in both cars and infrastructure. These together would inform how big of a market this would be and how kind of countable this resource would be in both the ISO market and eventually distribution global markets.

While we listed "formulate VGI business models," one thing I should note is that third parties were very active in the development of the VGI Roadmap. And so we do not intend to establish a business model exactly, but as I'll show in the next slides a key part of VGI is to make sure that these efforts are actually reducing the costs of electrification and making it more economic. Ultimately, we're not doing this to be better Grid resources. The ultimate goal is to really accelerate adoption through the most effective use of electrification as a dual purpose device. So it's really about getting this value back to

the customer.

Each of these tracks conclude with RD&D and I'll provide some examples of efforts in pilots toward those points.

Track 2 has these goals, so one key element was ensuring coherence between state policies, programs and national standards to make sure that we weren't creating a California- or United States-only market. It's more apparent given what we've observed in the past week with the U.S. repeal of the Paris Agreement. But the economies of scale in battery technology were much un-anticipated in the rapid scale of cost declines. And so we wanted to make sure that the products that we were building for VGI here had relevance to the national programs. And stretched beyond California since the ARB's historical role has been to induce larger markets.

In addition, these next three related goals of VGI were to identify the means and criteria for our charging infrastructure, to establish technical qualification requirements including the references to national standards. And the next section of goals describe how, because vehicles are inherently a mobile energy resource as Mike had mentioned earlier and as Niki had referenced in her question, there were no existing means of clarifying where these are in the Grid to the precise level

as what Peter's referenced throughout the day. In identifying, dispatching and verifying how these essentially mobile batteries are acting as both resources and customer mobility devices.

Track 3 in enabling technology development was again, in order to help us better understand how the resources work both as a transportation device and as a Grid device. And our intent here was to understand how different approaches to communications, charging control, incentive design, dispatch, incorporation in building facility energy management systems and fleet operations, understand how all those are put together in order to create a DER from an EV.

So in the next slides I'll be providing some of the actions that the agencies have taken in terms of Track 1 and Track 2 and then Kiel will be concluding with Track 3 in some of our next steps.

So first with the VGI electrical system impacts, as you can see we have and had a real plethora of existing research funded through a variety of efforts at the investor-owned utilities through demand response programs and the Electric Program Investment Charge administered by the CEC. I should also note that there are other EV programs coming out of the IOUs funded through EPIC that are also informative.

The Los Angeles Air Force Base has kind of been a marquee program for all of the agencies, given it being one of the earliest manifestations of our interagency efforts to both fund the vehicle technology, design new tariffs or examine how interconnections work for these behind-the-meter loads that are accessing the wholesale market. While also managing relationships with the utilities in which they had never done something like this before. So kudos to Edison in particular, in facilitating the Air Force Base's more than year-long operations in the wholesale energy market.

In addition, the NRG Settlement included some R&D technology funds, which are informing how projects on the ground can be integrating both EV fast charging and battery storage and photovoltaics to manage the demand charge associated with operating high-power charging. In total, the utility programs in combining new rate designs, understanding the customer responsiveness to dispatching EV load and testing different types of communications pathways have been very informative to the three agencies in understanding how to put this all together.

A key element in succession to that is determining how to kind of productize and monetize that potential benefit into something that is available for automakers, charging providers and utilities and customers

to work together in making a product that actually reduces the costs in electric vehicle. And so while this remains an outstanding question there's been a number of different potential inputs to inform how we value our Grid integration resource from an electric vehicle.

And so the E3 and LBNL DR potential study under the DR Proceeding at the CPUC did some analysis on electric vehicle benefits. I think they were estimating the cost at around $40 per megawatt hour of demand response. There was also a recent NREL publication on the national economic value of electric vehicles. They do include a smart charging component there.

And I guess as I start mentioning the labs through this set of bullet points and others, I should note this interagency effort really stretches beyond just our California counterparts and utilities and companies. We've very much tried to engage as much as we have the capacity to, to reach out to National Labs and the Department of Energy in coordinating our technology efforts with the Grid Modernization Lab Consortium on smart electric vehicle and grid integration. And the -- yes that's the main group.

Part of that DOE group is Berkeley Lab's software called VGI-Soft, which was supposed to develop kind of a modular set of analytical tools to understand how travel behavior fits into market operations. And ultimately can

be combined into a value that can be allocated across different actors that are responsible for liberating that value ultimately to a product.

And lastly, on that line both of the Commission's efforts in resource planning, whether it be identifying the conditions on the Grid, the procurement options and overall plans, those are critical for understanding how a utility would value a resource like this.

Similar to that VGI value element, the market potential element is very much connected. One additional point that I would add to that is the fact that the Energy Commission is completing an EV infrastructure projections model to determine the amount of charging stations that are needed by station type and by sector type, in order for us to better understand how the effect of longer-range PEVs, higher power charger technologies fit into the departures and arrivals of California households.

As you can see with the incomplete and very partial list of different companies there's been, in this timeframe, a proliferation of different ways of liberating the value of this lower cost -- and in our opinion -- superior technology to customers in different segments. And then in terms of R&D as previously mentioned we have ongoing efforts in EPIC. The sub-metering protocol, which would allow for billing off of nonutility grade customer-

owned meters as well as the more hardware and technology validation efforts and modeling efforts by the DOE's Grid Modernization Lab Consortium.

In Track 2 those again regard enabling policies, regulations and business processes. And the major action that is embodying ensuring coherence between our state policies and programs with standards is kind of a follow-on to a recommendation in an SB 350 ruling from the CPUC last year. There are recommendations around what types of communications technologies should be included in utility proposals to ensure that our future infrastructure is not stranded from a technology functionality standpoint.

The agencies, actually yesterday convened another session of the Communications Protocol Working Group, which is engaging with utilities, manufacturers of charging equipment and vehicles, software providers, aggregators and other interested parties. We're working together in order to put this all together since enabling dispatchability and understanding how much energy is being used, when it’s used, and who's involved in completing that chain, all of that needs to be assembled together in order for EVs to be successful Grid resources.

As I alluded to on an earlier slide, the next three points are very much connected. And to be high level about this explanation, since there are so many different

programs, the way that we are operationalizing these Track 3 activities are through different utility rate programs and charging infrastructure programs. So there are some very innovative rates that were developed through the applications for light-duty vehicle infrastructure, particularly San Diego Gas & Electric grid integration rate, which has a wholesale pricing as a commodity base that is dynamic and changes on the hour. And actually if the day-ahead forecast is more than a cent per kilowatt hour off in forecasting error, it is treated as a renewable integration signal. And on top of that it adds circuit level critical peak pricing all in a dollars per kilowatt hour rate, which is critical in order to avoid demand charges that are a key critical challenge to electrification, especially at low load factors. Yeah, fully volumetric charges are interesting as part of that rate.

In addition, CEC investments are embodied through the ARFVTP Program and the EPIC Program, in which we're coordinating to ensure that the efforts are aligned in terms of making sure that the technologies are effective. And avoid stranding to the extent possible. And also the ISO initiatives that we've spent a lot of time on in earlier sessions. The ESDER, DERP, and MRE (Metering Rules Enhancement) are very applicable, equally applicable to

electric vehicles in their endeavors to serve as distributed energy resources.

Submetering is potentially seen as a key element in clarifying the settlement of EVs that are operating across different levels of the Grid. And so for a behind-the-meter retail customer that is operating at the wholesale market, Peter's prior references to the authority having jurisdiction, setting metering requirements, is a key point of measurement since it is at the load level, at the EV-specific level.

One thing that has kind of evolved and wasn't originally included within the VGI Roadmap was the Division of Measurement Standards's EV fueling systems regulation. This is coming out of the Department of Food and Agriculture. They use NC Handbook 44 requirements for accuracy in terms of what is permissible in selling EV electricity or charging electricity in the public sphere. And another recent thing in progress around settlement is how the Low Carbon Fuel Standard might be using charging infrastructure level metrology in order for them to verify the use of electricity, because currently it is being estimated.

Verification is a little bit repetitive of earlier points since these blend very much.

I guess with that, I'll turn it over to Kiel to

talk about R&D.

MR. PRATT: Good afternoon. Kiel Pratt with the Energy Commission's Research and Development Division. I'll be presenting on the enabling technology development track from the VGI Roadmap and helping to wrap up this presentation.

So we intend to tee up the best series of questions and discussion for this session after this presentation. That's our goal, so this list is obviously not exhaustive. And as you can see per the note on the bottom right, underlined activities indicate those that are in progress. And clearly this technology development is in progress and needs to be looked at from many angles.

Vehicle-grid integration uniquely ties together different entities and business practices that were siloed previously. And I can talk about several instances of that in terms of the need for organization and coordination and prioritization of our research.

So Noel had mentioned the VGI Communications Protocol Working Group, which is intended to look into the standards and protocols used, and find their best match for different vehicle-grid integration use cases. And the findings from that will bear on the CPUC's Alternative Fueled Vehicles Rulemaking as well as the three large investor-owned utilities' transportation electrification

applications as well as the Energy Commission's Integrated Energy Policy Report. So there's a lot of work going on there.

I was at the meeting that occurred yesterday. And something that I found compelling is you can look at use cases and many different possible value streams. But really kind of 80 percent of the impact is going to come from 20 percent of the value streams from the use case. So in terms of the prioritization function, it bears mentioning that a relatively small number of principal values apply to use cases. And that's something to know for the research and the products that each research project is going to deliver and where they are applicable.

From the Energy Commission's Research and Development Division's perspective, some of our recent work has been on developing the third triennial EPIC Investment Plan. And that's a pretty well-timed activity in terms of looking at the research needs. And if you want to look at that draft investment plan, which the Energy Commission has submitted to the CPUC for comment and for possible approval later this year, you can look at its Section 3.2 where there are a couple of sub-initiatives dealing with the next stage of research for vehicle-grid integration. And also the need for battery second use.

There are lots of developments that are occurring

as far as battery capacity. And even the potential for the personal vehicle ownership model to change with shared, connected and possibly even autonomous vehicles. And those developments could have implications for these vehicles' interactions with the power system. Maybe they would be able to charge at more opportune times at higher rates, or slower rates depending on what is needed.

So the vast differentiation of research objectives is something to note also. If you recall the Demand Response and Energy Efficiency Roadmap, my colleague David Hungerford earlier today presented a solicitation and showcase of individual projects from that. It would be overwhelming if we were to try to do that here. Under the first EPIC Investment Plan there were seven projects dealing with vehicle-grid integration. From a recent solicitation under the second EPIC Investment Plan there were nine projects, and that's not even counting the BMW Demand Response Project that David Hungerford had presented.

So what needs to be emphasized is that the value of vehicle-grid integration has many applications depending on the type of driver, the type of vehicle, the communication that is needed, and the facility configuration in its interaction with the power grid. So there is a need for this fusion function. It was mentioned

in an earlier presentation that the Distributed Energy Resources Action Plan serves this kind of fusion function lining up the different proceedings that different initiatives line up to. This very workshop also serves that fusion function.

And so we'd like to set up the discussion for your comments and let us know about the research priorities. And any other ideas on the progress that we've gone through here so far. Could we go to the next slide, please?

So we'd like to know if the progress is in the right direction. I didn't drill down into particular projects, but there are a number that are either continuing or proposed for funding. I think it's exciting that the most recent solicitation has two projects for municipal bus fleet electrification. Because that is a very interesting, powerful but difficult problem to solve, because not only do you have facility issues but your bus route might overlap different jurisdictions. And so if you do any kind of on-route charging, you may have to modify your operations for the utility rate schedule in that part of your bus route.

And a lot of entities and businesses, as part of their plan, are looking at local considerations such as this in lining up which variables are the most effective to

deliver value.

And are we on course to meet the SB 350 electrification targets? We know about the Governor's executive orders as far as ZEV adoption. Taking a wider view of policy, possibly the binding constraints you might say, might in some cases be clean air mandate attainment in certain geographical areas. Or the amount of transportation electrification and vehicle-grid integration that is implied under a very high renewable portfolio standard mandate. You would want that electrical load and the ability to time-shift load and generation in concert with the Grid needs. And vehicles would be perhaps a necessary component in that high level of renewable penetration.

So there are a number of actions and a fusion function that is needed for aligning our research priorities even within the Energy Commission and across the EPIC and the Alternative and Renewable Fuel and Vehicle Technology Program. And then outside across agencies, with a collection of California agencies interacting with our federal counterparts and international actors. I'd say that the vehicle-grid integration technology itself is sort of a metaphor for this cross-cutting configuration. Which makes it complicated, but makes it able to deliver value in a new way.

And I'm ready to wrap up the presentation and we can open it for comments. All right, thank you for your attention.

MS. CHARLES: I think you guys had a very detailed and comprehensive presentation. I did want to touch upon just a couple of things from the CPUC perspective in terms of the role of VGI and the VGI Roadmap. So basically just at a high level, the CPUC's work this year is driven a lot by SB 350, which had a mandate for the CPUC to direct the investor-owned utilities to file applications proposing programs to support widespread transportation electrification that would ultimately support our long-term greenhouse gas reduction goals.

And so in response to that, Commissioner Peterman issued a Assigned Commissioner Ruling directing the IOUs to do just that. And Noel already alluded to it, but within that ruling there was the intent to foster a record and develop a record on vehicle-grid integration. And so it began at first with a recommendation in terms of communication protocols, which then evolved into the VGI Working Group, which was mentioned in the previous presentation.

And the one thing I would say about that is the working group is working really hard. It's a multi-agency

effort between the CEC, CPUC and ARB and many stakeholders, a couple of which I see here. And that is working in parallel with the CPUC's consideration of the IOUs' transportation electrification plans. And the intent is that this working group will go through the process of figuring out whether or not we need a protocol. What protocols to use. Trying to answer these questions related to VGI and then bring recommendations to the CEC and the CPUC. And in the CPUC's case, those recommendations will be considered and possibly included in our proceeding. So it's part of the whole with regards to that.

The other piece is I did want to mention the DER Action Plan, which Gabe mentioned and Kiel just mentioned. There are a couple of visions within the Action Plan that directly relate to VGI and one of them is a vision that says, "EV charging systems, mobility and driving behaviors can be predicted and overseen by grid operations." There's a second vision that says, "Non-discriminatory market rules for mobile electric transportation resources should support customer mobility." And so again the work we do with regards to the VGI Roadmap, whether it be the working group, whether it be all these activities that they basically laid out will help us move forward with regards to all of this.

The last piece I would say is that I very much

related with -- I don't know quite what the word is to the question or the comment earlier about trying to get your arms around all that is going on. And I would offer that these roadmaps, I think all three of them, are one way to get your arms around it. Whether it be assigning roles to different agencies or figuring out what questions we need to answer, in addition to the Action Plan. And so I do believe that the agencies are working very, very closely together to really think through these issues comprehensively with regards to VGI and transportation electrification. And I would also say storage and DR and energy efficiency.

And that's it for me.

MR. GRAVELY: Okay. Thank you.

And then in the back of the room there is a handout here that has a summary of the different actions that are in the roadmaps with information on the current status and the activities there or references of where to go to the latest activity in those areas.

So any other comments before we -- I'll open it up for public comments. So if you have comments just come down to the microphone here, identify yourself for the record. As I mentioned earlier we are having this recorded. We have a court reporter here recording everything, so be sure she can hear your name and

organization and we'll be glad to respond to any questions you bring forth.

MR. TAYLOR: Good afternoon. My name is Dean Taylor, Southern California Edison. I have some specific comments on the VGI Roadmap, but maybe before I get into that I wanted to just step back a moment.

One, just to compliment on doing working groups, I think that is so valuable. I've been doing this several decades and working groups are rather rare. I was active in 2013 in doing the VGI Working Group, and now in this VGI Communications Protocol Working Group it's such an extremely complex topic. It's so hard to get your arms around it. It's so important -- not to have like a court reporter in the room -- and to have this roll-up-your-sleeves kind of thing where everybody's getting together. I mean, we're learning the VGI Communications Protocol Working Group just how enormously complex it is just to get our arms around it. To have the right framework, to talk to each other, and it just is really refreshing to see that.

It's also very refreshing to see all the agencies work together. You know, if we go back several decades it wasn't always the case, so it's hard. It's hard to break down siloes. It's hard to look at thing from multidisciplinary approaches and do all that.

The other thing I thought since you did mention SB 350, before I go into VGI Roadmap I'd want to step back and I always like to go for the big picture, which in my mind is GHG and air pollution reduction. So I think people, especially outside of CARB and CEC have a hard time wrapping their minds around how big the transportation sector is. I mean, when you add in refineries where 50 percent (indiscernible) transportation sector, or 50 percent of the GHG, you know, 80 percent of the NOx and 95 percent of the particulate diesel matter. Plus there's other air toxics and disadvantaged communities issues.

I mean, it's just so huge that it's hard to -- so for example, just getting an EV on the road in almost every utility service territory you're getting 80 percent reduction, because gasoline and diesel are just so carbon-intense. So VGI in plain English, is really just optimization. And once you get those, how can you get more pollution and air reductions beyond that 80 percent? But just getting the cars on the road is awesome, so that's one of the -- we can't forget that.

And we have to be careful that anything we do in VGI doesn't end up stifling adoption or stuff, because that is the first order of business, just getting the vehicles on the road.

And then it's interesting now that we're also in

this new integrated resource planning effort that was another part of SB 350, it's interesting to kind of compare renewables and energy efficiency compared to EVs. And it's pretty stunning, per kilowatt hour you get three times more GHG reductions from getting that vehicle. And when you get into NOx it's huge. You know, it's like light-duty vehicles is like eight times more NOx [reduction] than getting more renewables or energy efficiency. And when you're getting into heavy-duty it's even more dramatic, like 30 to 60 times more NOx [reduction].

So it's just we put enormous effort, sometimes it seems, on to the renewables and energy efficiency. And I think that's mainly just because they've been at it for 30 or 40 years and these are much newer. But they offer enormous progress. I mean, imagine if we had 4 million [EVs] and the amount of Grid services that they could provide is awesome. And then at that time you'd probably have a million used batteries. I mean, there's just so much huge potential out there that we can look forward to. And figuring this out is critically important.

I'll make myself some notes, so I don't forget, but I kind of asked earlier are we on course? And unfortunately, the answer is no. We only have a little over 300,000 EVs in California. To hit these targets of 4 million is just going to be awesome, but the additional

work that needs to be done is stunning. And on the other hand, globally we're doing pretty good. We just hit 2 million EVs on the planet. You know, I think Southern California Edison probably hit 100,000, and half of the EVs being sold in the nation are here in California.

But when you look at things like I was just meeting somebody over at lunch about China and buses, I mean they have at least 60,000 buses and trucks there. We don't even have 1,000 here in California. So there's certainly more that we could be doing on that big question, are we on course.

But getting down to more nitty-gritty on the Roadmap, it seems like we have at least 100 people involved in the VGI Communication Working Group and we're like kids in a candy store. There's tons of things, we're not possibly going to get everything done, so it seems like it needs to bleed over into a follow-on effort. So the follow-on effort, my recommendation is that we update and kind of continue the working group with the express purpose of updating the VGI Roadmap. It's been four years, there's tons of changes in agencies, tons of new technologies both with charging stations, a lot of things that didn't exist four years ago.

You know, if you look at the CARB Report where we're going to have another 20 long-range EVs on the market

in the next five years, we're going to have another 20 long-range hybrids on the market. So it's just there's a lot going on technologically. It just seems like time to re-do the whole roadmap and all the things that we didn't get done as part of this next four months on the working group, bleed it over and have another working group to update the roadmap.

As far as things in the roadmap, the one thing that it seems we're hearing a lot from the automakers is that they want to know more on what is the value. And what is the prioritization of the value and what is the market potential of the different values or the risks. We keep on saying yeah, you can have standards, but it doesn't necessarily mean that you're going to solve the question of getting the various automakers and others really involved to extract the value.

And frankly, they've been asking that question for a really long time and we need to have more effort to better define what is the value. What is the market potential? And prioritization both near-term and long-term, because what you might want to prioritize now might be different to Noel's point yesterday, that when you have 80 percent renewables you might have a different prioritization value.

And just to better understand the business cases

and the cost benefit tradeoffs I'd also recommend more work on surveys to bring in the customer side. Or maybe small pilots to understand what is -- the customer is key to all of this and there's a lot of very interesting tradeoffs from a customer perspective that need to be explored. Like, do they want central control or customer control? Do they want to move their car or not move their car? And on and on, and I'm not going to go into detail there.

Also you had a whole section in Track 3 of the VGI Roadmap, there's tons more work to be done on enabling policies. And it isn't just market type reactive activities, but I was in a call to one of the subgroups this morning. And they were talking about planning activities. In other words, there's a lot of things that can be done on a customer site, like say if you had a home energy management system you might have all this interaction between your solar, your storage, and your EV. And the Grid would never see any of that. That's just things that you can do that will benefit the Grid on your purchase decisions and your interaction of your home energy management system.

Similarly, in the parking lot you could have things like power sharing or power sequencing that would never end up -- we wouldn't see that as kind of invisible to the Grid. It's just good purchase decisions on the part

of the site host or the home. These are all things that really help on that.

And other things in enabling policies were mentioned in Noel's presentation. Things like really good rate design or demand charge policy or maybe even allowance policies or possibly even incentives for different types of technology. So it isn't just setting a standard that you influence the market. You can influence people's purchase decisions by requiring maybe different incentives for different objectives.

Another thing is the issue of -- this kind of fits in the category of being overwhelmed all the time -- is the issue of we need to have better convening of all the different data experts. I say that, because frankly the different people who have a lot of data, be it the automakers, the charging station companies, the utilities, the national labs, the universities, are not doing a good job of talking to each other.

Recently the White House, under the prior Administration last December had a White House EV "datathon" where our National Trade Association put together a list. It is just stunning how much we don't know. And it's just really, really basic stuff and it's because we don't have enough of these kind of working groups where we're all talking to each other. So whether

it's the Energy Commission or the all of you or somebody, but I think there's so much we can gain by just voluntarily convening ourselves to talk. You know, rather than having requirements and frankly there's some press-back on why would you regulate during Title 20 or other things like that. When you could do a more voluntary approach and get a lot of this data collected, because we're kind of drowning in data now.

Imagine what it will be like in several years when we have all this huge amount of data from the utilities and other sources. So convening us to have a more ongoing, call it the data geeks group, where we all get together and understand the markets better.

A couple of things, to wrap up, I did like some of the categories and tasks in the Storage Roadmap. So maybe we could kind of compare and they had some very interesting bucketing and actions. So is there something to learn from the VGI Roadmap by comparing it to some of the other roadmaps.

Also maybe because vehicles are so different, I would maybe consider bringing in especially CARB and GO-Biz. And CARB is obviously the vehicle -- has huge knowledge there. GO-Biz has some very specific things regarding infrastructure on their plate.

I heard, just lastly I'll wrap up by saying that

I heard some other interesting comments this morning on jurisdictional domain issues, permit streamlining issues. So there may be some other things that could be part of a broader VGI Roadmap to get into that.

Sorry for so many comments, thank you.

MR. GRAVELY: Thank you. Other questions?

MR. SCHLOSBERG: Hello, all. My name is David Schlosberg. I'm with eMotorWerks. We're an EV charging hardware, software and energy services company. And I just wanted to commend the folks on the panel here. I think we've engaged with all of you in the different aspects of EV, VGI, just incentivizing the electrification of transportation.

Specifically just two comments. One is around development of the market, which is the participation frameworks with the ISO, so the ESDER Initiative. A lot of great work has been done that's allowing electric vehicle, ourselves, I assume BMW as well, taking advantage of some of the things that have already been created through the ESDER Initiative. And I think that there's more to be done to further unlock electric vehicles.

It kind of happened without our attention, but I think some of the baseline alternatives will be helpful for electric vehicles. Understanding that these are driving peak loads, but don't necessarily happen every day over the

last ten days. And that also just some of the ways that we measure electric vehicle dispatch is obviously very different from a weather-sensitive load, so thank you for considering those issues in the ESDER Initiative going forward.

Also, I just -- there's been some talk of electric vehicles and thinking about electric vehicles as we manage the distribution system. And I don't know that enough attention is being paid towards that. If we achieve our goals on ZEVs that's going to become a real issue, equivalent or greater than some of the issues around rooftop solar. And I would say that maybe San Diego with their VGI rate potentially gets at that. But questions around whether customers will adopt that with their whole home, whether they're appropriately engaging third parties to enable customers to really adopt that technology and use it like they would use a smart thermostat that already kind of manages all that behind the scenes.

And that all the utilities should be actively thinking about how they create programs and incentives and tariffs to engage electric vehicles to be solutions for managing the Distribution Grid going forward, rather than waiting too long. And then having a debate of can we invest in the Distribution Grid? Can we allow people to continue to adopt electric vehicles? And have utilities

done everything they could in their power in advance of those issues. So just wanted to make sure that's in the framework of the roadmap.

MR. CRISOSTOMO: Yeah, to respond to your last point, David, and I think this also captures the points about reassignment Dean was mentioning in the overall value of VGI. I saw an Elon Musk tweet yesterday where he is going to place the superchargers all with batteries, all with solar, obviously with the recent acquisition of Solar City, but eventually disconnect them from the Grid. So let's think about that for a second, disconnecting an array of superchargers from the electrical grid connection. Because it's either faster, cheaper and definitely cleaner, immediately than trying to go through the interconnection process and dealing with demand charges.

That I don't know if the tweet was received with as much fear, at least I started to think about it in terms of kind of a fearful thing. If we started to see a lot of defection, at least from a fast charging standpoint such that it was off-Grid. And if that ends up being a nontrivial amount of electrification with that energy use, then how does that affect the utility? I think that throws a challenge to everyone working in this space, to think about how we're designing this. And the need for whole systems design.

MR. GRAVELY: Go ahead.

MR. HALL: Good afternoon, everyone. Jamie Hall with General Motors. I'll just run through a couple of quick things, first I want to say I agree with Dean Taylor from Southern California Edison about how encouraging it is to have these kinds of discussions. There's definitely a lot of moving pieces and all the stuff is interrelated.

I was at the VGI Work Group discussion yesterday too. I wouldn't say that I personally felt like a kid in a candy store, but I did feel like, "Wow, we've got an awful lot to do here." And I unfortunately missed the storage portion this morning, but I imagine that some of these issues came up there too. And definitely agree with Mel that we need to take a comprehensive approach to all of this.

I won't take a position on whether or not you need to do a new roadmap, because I know that you have a lot of work to do. But there is definitely enough going on here to fill several reports, so I just want to focus briefly on two quick things.

One, and Dean already touched on this, figuring out the value -- you know this is a key part of the roadmap -- this really is sort of first and foremost in our minds. As an automaker, and as I talk to people throughout the company, that's the first question that they always come

back to. So the more that we can do on that front to really make this clear and better.

And two, just thinking about how to keep this simple for customers. And I know that this sort of should be obvious, but people often jump to really cool future scenarios that maybe are not always thinking about what's going to be simple for the EV driver who's never been to an EV conference. And is not one of us and definitely would not be a kid in the candy store at these discussions.

For this all to work the way we want it to, we really need to get to scale with these vehicles. And from our perspective sales are going quite well and things are definitely picking up, but not at the scale that we need for EVs to really play a major value in sort of supporting the Grid. So to make that happen we've really got to focus on basic, basic things as part of this comprehensive approach. And that's what can we do on the incentive front? What can we do around rate design to make sure that people are indeed saving money when they go electric? And how can we keep going with the efforts that are underway to build out the infrastructure?

And the last thing that I'll just throw out there, I don't know if it came up earlier today, but I haven't heard it mentioned yet, what is the role of hydrogen in all of this as an energy carrier? And how do

those vehicles play into this whole discussion? So maybe a topic for another day, but I think it's important. Thank you.

MR. MIN: I'm Liang Min with the Lawrence Livermore National Laboratory. So my question is about I heard a lot of discussion a half hour ago regarding the communication protocol about electrical vehicles. Is there any discussion about cybersecurity concerns on the V2G perspective?

The reason why I've brought this up is when I entered this room this morning, I got a new product alert from DHS, regarding the new research. They realized that there's a limit to the consequence in terms of cyberattack on electrical vehicle charging stations alone, because there's a lot of the protocols we're talking about are Internet-based protocols. And a lot of electrical vehicle charging stations are Internet connected. So I want to learn from the working group, has there been any discussion about cybersecurity around the V2G perspective?

MR. CRISOSTOMO: So I'll have to answer this in a kind of an unofficial off-roadmap perspective. So for the Air Force Base, the Base in Los Angeles, the command needed to go through a very rigorous development process to allow for their third parties Akuacom, LBNL, to work together and develop the software in order to manage their fleet.

MR. PRATT: That's called an authority to test certification.

MR. CRISOSTOMO: Right, so they had to go through a military-grade set of security requirements to allow for external control to occur according to the AGC, the CAISO's automatic generation control signal. That's one of our primary forays into the understanding of cybersecurity for VGI in an official agency capacity. And I say that, because cybersecurity wasn't -- I don't believe identified as a key activity or subset under the goals that we highlighted.

However, I know I'm personally starting to look deeper into technologies that would allow for the protection of EV charging commands, based on Internet protocol communications. Perhaps it could be a critical part in our technology roadmapping process that Matt from the CEC will be launching later this year. But there are methods to protect charging from man-in-the-middle attacks, and external attacks that we definitely have to ensure to avoid potential catastrophic effects on simultaneous charging, in a geographically-concentrated area. I agree that it's needed.

MR. GRAVELY: So this is Mike Gravely from the Commission, on the Energy Commission. So cybersecurity is a topic that we're spending quite a bit of attention on,

and the Chairman of the Commission asks us a lot.

But it is a two-sided coin, in a sense that in our case doing public research, so you rapidly run into an environment that you need to be in a classified environment. So we don't go that way with the public.

We work with the utilities quite a bit. So I guess the general answer is it's a very -- it's in the news almost every day now, almost. So we've very aware of it. We do look at the different options, so in some cases you can do research about cybersecurity techniques. And it's not until you enter the classified codes, your other things, that it becomes classified. In some cases the strategy is actually intended to be sensitive.

So all I can say is it is a top issue. It's an issue that comes up all the time we address in our research now going forward. One of the tasks that we have going forward, is for the individuals to talk about how they are going to address cybersecurity. We don't have an approved solution or minimum or maximum. We just ask how they're going to address it and what their plan is if they have any attacks.

But again I think it is a topic that's very high on the priority list. But it's also a topic that's difficult to discuss in too much detail in a public environment, because it's intended to not give away what

you're doing to the people who are trying to do it.

MS. DE LEON: Good afternoon. My name is Niki De Leon and I work for Kitu Systems. We are an EV network service provider, as well as an integrator for the Internet Of Things.

I'd like to thank the panel again for discussing this roadmap. And echo what Dean was saying that we're very pleased at the collaboration involved with the VGI Communications Protocol Working Group. And the efforts on behalf of the CPUC, the CEC and the ISO to address grid-integrated vehicles.

I'll say I come from the energy industry and I'm an accidental transportation stakeholder. So I see the load capacity factor of electric vehicles as a huge opportunity to take advantage and help support the integration of renewable resources on the Grid. That said, I also want to be aware of the customer satisfaction with EVs to build the number of EVs in California and nationwide. So I think it's important to strike a balance and acknowledge both halves of this issue.

As mentioned earlier during the Energy Storage Roadmap, we're asking for clarity from the CPUC regarding access of grid-integrated vehicles to the DSO and ISO services and markets specifically with regards to Rule 21 and bidirectional vehicles. The IOUs' definition of Rule

21 has been a barrier specifically to projects such as NSI School Bus Program and the NRG Settlement V2G projects and other RD&D projects throughout California.

I'd like to mention that some of these vehicles have capabilities to provide more than energy services. That there also are smart inverter capabilities to support reactive power and volt/var control. So we're talking about a multiple-services resource here at the vehicle level. I welcome your thoughts on how overlapping access requirements for energy storage inverter technologies, especially storage of the stationary and the mobile type, can be addressed specifically through Rule 21 method.

And lastly, I'd like to make a comment about the submeter program. I think this is different than the Submeter Protocol that Noel had mentioned before. But the CPUC Submeter Pilot Program, Kitu as a meter data management agent (MDMA), would like to support this CPUC Submeter Pilot Program as it enables electric vehicle tariffs for residential customers. And it’s lower-cost than deploying additional infrastructure through utility-grade meters.

And as the MDMA, we can attest to the customer interest in this program. And EV drivers have expressed high interest in the (indiscernible) ability in charging and it allows for multiple tariffs at the residential

level. So we support that program and we hope to see that Phase 2 is successful and that it continues to come to a fully developed program in the future. Thank you.

MR. GRAVELY: Thank you.

Anybody else in the room with comments?

MR. PETLIN: Hi, Gabe Petlin, from the Energy Division. I'll also echo I thought that was an excellent presentation. I think the Roadmap is really clear and important. I have one small question and then a sort of bigger question. I'll just fire them both off.

The smaller question is, while it's super important to look at the roadmap and put in place all the different pieces of the puzzle to enable more grid value from electric vehicles, are there low-hanging fruit from existing electric vehicles that we're not fully tapping into? That's sort of the first question, in terms of getting more grid value out of these existing vehicles.

And then the second question, someone had asked the question whether the Roadmap needs to be updated, refreshed. And I don't have an opinion about that, but I would just ask if there is going to be some successor roadmap on vehicle-grid [integration], should it be about overall electric vehicle adoption? I mean, as we heard that we're somewhat behind reaching the goal, so if we really want to reach the goal maybe we need to have a

broader roadmap. And make sure that vehicle-to-grid is a piece of that, but the larger question is about how we're going to meet that goal. Because it's ultimately about the customer adopting an electric vehicle, whether or not they optimize it for the Grid. We have to get more vehicles on the road, so those are my questions. Thank you.

MR. GRAVELY: So Noel, you might have mentioned it, but there is a roadmap the [Energy Commission] Transportation Division has for the infrastructure piece that they are managing. It may be worth looking at the new ARB goals for infrastructure in VGI, and thinking about maybe, as we go forward.

One of the questions the Chairman asked, when he asked to set this panel up, was to determine if there were some future actions or changes. So this may be a point in time where integrating, as you mentioned before, the different areas into a consolidated roadmap, maybe official as an action to think about and discuss on the 30th or 29th, when we have the next workshop.

MR. CRISOSTOMO: Right, so as some of you know, I was previously at the CPUC Energy Division working on grid integration. But as I transitioned over to the [Energy Commission] Fuels and Transportation Division my key task, which remains in progress, is the development of the statewide EV charging infrastructure deployment strategy.

Which intends to be that fusion function as Kiel was mentioning, between both technology, and reducing adoption barriers to the deployment of sufficient charging to allow for more freely-accessible charging and use of EVs.

So the VGI roadmap, in and of itself, is a bit incomplete. And there were some claims that we are putting the cart before the horse when we developed the roadmap. But the theory of grid integration then, and remains today, is that if we don't lay the groundwork for getting the rates right and getting charging stations economic as a result of getting the rates right. Preparing customers to be familiar with the need for flexibility in the load given the fact that -- I mean we didn't notice then, but given the fact that time-of-use rates will be mandated in 2019 -- all those are kind of basic things that nevertheless are critical for grid integration.

And so while we are capacity-constrained in terms of infrastructure, and the number of vehicle resources that would be even able to participate in markets, the need and foresight that the agencies had then to be prepared for potentially higher rates of adoption than were expected, I think remains a critical element to reducing overall costs. Not only to the drivers themselves, but to the ratepayers and taxpayers who are increasingly being asked to support the electrification of not only light-duty vehicles, but

eventually medium, heavy, off-road vehicles, aviation, rail, maritime. And so that is, as Dean said, 50 percent of our emissions.

And so there is a public policy consideration around who should be responsible for the upgrades related to the electrification of the transportation sector. So if we don't do it intelligently, we might be in a case where we're thinking several years down the line that if we only were able to load-level and have the functionalities to load-level. Because those were critical lessons that were learned from Europe, especially when they started to think about what would happen when they would shut down their nukes, put a feed-in-tariff online, and have the European Commission regulate the carbon emissions from the transport sector?

A basic conclusion was that intelligence was needed. And so that's kind of an enabling function and the primary role for VGI. Thoughts on that?

(Audio issues.)

UNIDENTIFIED SPEAKER: Not on what you just said, but I was just thinking about your question, Gabe. And so the VGI Roadmap is one of the activities of the ZEV Action Plan, which came out of the Governor's goal of 1.5 million vehicles on the road by 2025. So it is part of a more holistic plan.

But I think to Noel's point, in terms of where we are today, which involves more than vehicles and all these different layers, I think if we were to have some successor to the roadmap I would want to answer the question of where would that fit in the context of the ZEV Action Plan? In the context of existing activities at the CPUC, the DER Action Plan, what Noel's going to be working on? And where would it be able to add value? I know that there are gaps there, but I think that's something we do need to think about, knowing that there are these sort of high-level plans.

And things have been updated. Other things need to be updated, but just really understanding where would a successor to the roadmaps fit within the current landscape.

MR. KLAUER: So also on the -- this is Peter Klauer, California ISO, on Gabe's comment about low-hanging fruit in terms of some of these smaller resources, notably the electric vehicles and with other things I'm kind of surprised that we haven't seen more of. But I do know it's happening as more localized services from these vehicles, like building to home, how can I leverage my EV within my own power consumption integrated into my home use?

If I have PV on my system, I don't need to necessarily to go buy a separate stationary battery and put it in my garage if I have an electric vehicle that sits in

my driveway? You know, you can integrate it into your home in a way that helps you take advantage of time-of-use rates, it helps you provide backup power if the Grid goes down. I mean, I think there are a lot of use cases in that area that could also be used.

The work that we've done across the agencies for the L.A. Air Force Base is arguably the most complex configuration of a resource providing services to the transmission grid operator, but we did it. Technically, we did it. There's still some policy issues that need to get worked out to simplify, to make it easier, and to make it more cost-effective. But I do think you're on point in thinking what are some other uses and other value streams for these vehicles? Especially when you're talking about a single vehicle or maybe a couple of vehicles.

The real model for the ISO, and I think largely for the DSO, would be aggregations of these vehicles and fleets of these vehicles. That's where you get sort of the critical mass to help connect them to the grid. But I do think that customers will start to hopefully see additional thought going into "how can I make my vehicle or my battery serve me in other ways to help me manage my energy consumption?"

MR. CRISOSTOMO: And to add to the point around what you're saying with managing energy consumption, I'd

forgotten to add this to the presentation board, before I sent it off to Gabe. But related to customer interest in VGI-like services, I recently found a University of Michigan transportation survey finding that 73 percent of the 500 people that they surveyed throughout the United States, including a number of people in California, that 73 percent of the sample preferred optimized charging versus on-demand charging. Sixty-five percent of that sample preferred renewable-based optimizations versus a time- or price-based optimization. And even this surprised me, 84 percent preferred a vehicle that could have the capability of back-feeding into the Grid.

And so I think there is consumer willingness to participate in these types of programs. We might need to kind of localize those results to California and cross them with our portfolio of EPIC, ARFVTP, and demand response pilots that we've been talking about briefly today. But I think that we'll find just naturally that of the CVRP participants, the Clean Vehicle Rebate Program participants funded by the ARB, that a quarter of them already have solar on their homes, so there are low-hanging fruits in that respect. That vehicles, if timed to charge when solar production is available, that's a key thing that we would need to figure out technically how to measure.

MR. TAYLOR: If you don't mind, I wanted to add I

think we probably can do both the sophisticated things that are relatively complex and the basic things. I'd like to kind of echo the comments from General Motors. In fact I've heard this from all the automakers that we should focus on a lot of the basics or I think the gentleman said the "low hanging fruit". So we do need to remind ourselves and step back. Do we have all the rates designed well? Do we have demand charges designed well? We hear that from the Air Resources Board a lot, that that's a major impediment for them to even consider adopting regulations more, because they don't feel the demand charges issue is solved.

Are people knowledgeable in this area? And our experience has been, "No." There's a huge need for additional market education and outreach. Are the dealers capable and being good participants in this system, like they could be? Probably no, so there I just named four basics that we probably don't have near as good as we should. And there's more than the three IOUs. There's 50 utilities in this state, so how well are we doing on these basics? At the same time, certainly we can work on the more sophisticated things too, because it's important to do both.

MR. CRISOSTOMO: I guess my question and response would be, are there things preventing the utilities from

designing better rates? Would you care to elaborate?

(Colloquy off mic.)

MR. TAYLOR: I think that would be maybe a question if you did like this VGI Roadmap. You could focus on both basics and on the more sophisticated things, so that's a really good question. I think it's worth something maybe (indiscernible) us all today, but it's certainly worth exploring.

MR. PRATT: This is Kiel from the Energy Commission. What I can comment in response to that is some of these considerations might resolve into, you could say, "disbursed roadmaps." In other words, plans of action for facility owners or sites. What kind of value streams do they want to tap into? How much complexity are they willing to engage with, so they can make an informed decision on their own cost-benefit, both in terms of monetary costs in complexity, number of actions, number of interactions, within the facility and within the Grid.

MR. TAYLOR: I think we're all suffering from bandwidth issues. You know, whether you're the site host, you're the regulating utility, the regulator, we're all dealing with that. I mean, there's 120 actions in the ZEV Action Plan, what are the top 5? And nobody's ever told us that. It seems like we could do more focusing on getting a few things really well implemented and done.

MR. CRISOSTOMO: So one partial response to that is in interviews for the infrastructure deployment strategy, one of the challenges that EVSPs had consistently raised is that there are a number of factors that unless you tackle all of them simultaneously, the model is challenged. And so there is a need to prioritize those combinations of site effects and education. Site effects from the fact that you're giving up a parking lot, rates to ensure that electrification is economic; once you have a site, simplicity in responding to the rate.

And that's a potential opportunity for aggregators and solution providers to come in. And those key three things are really crucial. And every one of the people that you listed in your comment are involved or must be involved in some way. So yeah, I agree.

MR. GRAVELY: Other questions from the group, or online? Is there anybody online who has a question, identify yourself and then ask your question or make your comment.

(No audible response.)

MR. GRAVELY: Okay, not hearing any comments. Go ahead, and then we'll -- go ahead -- you can take us off.

UNIDENTIFIED SPEAKER: Are we --

MR. GRAVELY: Go ahead.

UNIDENTIFIED SPEAKER: Sorry, this is

(indiscernible) -- I just had a comment to --

(Audio cuts in and out online.)

MR. GRAVELY: I'm sorry, we're having a really hard time with the communications off of the WebEx, because you're breaking up. Okay.

MR. CRISOSTOMO: By text.

MR. GRAVELY: Just type it in or send it and we'll respond to it.

UNIDENTIFIED SPEAKER: Will do.

MR. GRAVELY: Any other questions in the room?

(No audible response.)

Okay. Thank you, very much. So again if you have a question, feel free to send it in through the question there.

So any last comments before the panel here, before you go? Anybody making any closing comments?

MR. PRATT: I can comment on a bit as far as the V2G (vehicle-to-grid) demonstration at Los Angeles Air Force Base and the really complex technical implementation that had to be done for that to work. It is a complex choreography in terms of the resource responding to the four-second interval automatic generational control signal.

And as far as our flexibility for research, it's fortunate that we had a military base willing to undertake this kind of effort. And with the fleet management

practices that it's able to bring to bear to incorporate this new type of fleet management practice and resource. Similarly, other research sites and test areas have special capabilities or higher EV penetrations. And so there is a lot of different efforts and different facilities' capabilities that feed into this early stage research and looking into the future and addressing the problems early.

(Off mic colloquy.)

MR. CRISOSTOMO: While we're getting that out, just a quick response to one of Nikki's questions. The reference to the Submetering Protocol, those pilots were eventually going to lead into the development of the protocol. So they are one in the same.

AUDIO TECHNICIAN: All right, so the question from Sean is a high-level comment. It is important to have roadmaps and these three have proven useful. As we look to the future we need to consider how to practically integrate these technologies and markets. And we should consider drawing a bright line between resources connected directly to the transmission grid versus an enormous number of small resources connected directly to the distribution system.

This raises the opportunity for the utility distribution system operators, or DSOs, to manage the interface between the two categories. This can address the issue of conflicting CAISO and local dispatch calls and

impacts, as well as managing multiple use cases for individual or aggregated DER and its participation in multiple markets while signaling to optimize application to the highest value service at any time. Establishing a single coordinating entity for DER within each distribution service area can go a long way toward opening up access between markers and these multiple DER resources.

MR. CRISOSTOMO: So I know that that's not specific to vehicles, but one thing that's on my reading list was published by More Than Smart yesterday about the T&D interface. Peter, are you familiar with that one?

MR. GRAVELY: Peter can address that a little bit?

MR. KLAUER: Yeah, well just a little bit. But there's this ongoing discussion in terms of what the future operation sort the Grid looks like. And the one vision is that the ISO extend its network ability and dispatchability down into the distribution systems.

The other end of the spectrum is that there is this emergence of a distribution system operator that can basically interact with the ISO at the T&D interface. And that's kind of what we're starting to see evolve now, is that discussion and kind of how that would pan out. I mean, I think it's safe to say that the ISO at this point in time does not have an intention to model the

distribution system and dispatch resources in their entirety at that level.

But what you're seeing is really an interesting time where there's a better understanding of the fact that the T&D system needs to be more integrated. And they need to share information and they need to collaborate and they need to build a system from top to bottom. And that's what you're starting to see. So I think the comment's a good one. And I think that that goes to speak in terms of where are these resources providing the most value at the lowest cost.

And yes, we can create technical pathways for them to participate at the transmission level, but you have to always ask yourself is that the right place for them to be and can they do that cost effectively? Are there other opportunities for them to provide services at different levels and what would that look like? So the work -- the More Than Smart group -- there's a lot of efforts going on right now, kind of starting to hash that out and talk that through. So I think it's a very relevant conversation.

MR. GRAVELY: Okay. Thank you, Peter.

Yeah?

MR. PRATT: I can say a little bit more about that too. The comment appears to be describing a kind of fractal-looking arrangement. And if you're talking about

alternatives, one being giving the ISO the ability to have a more fine-grained view into the Distribution Grid, but there might be issues with handling that amount of information.

Whereas, with the comment and as Peter was referring to, you may have another level. And it would be more of a fractal or self-similar model where the actors on each level deal with limited information bandwidths and have their own locus of control that they're responsible for. And that can go all the way down to the facility. You might have multiple energy systems interacting on a facility level.

And there are some hard constraints that you must optimize against, right? Maximize something, subject to constraints. And obviously your facility might have those, such as the need for reliability and minimizing the demand charge. And then at each level, as long as those constraints are met, you then have the means of optimizing and possibly providing services or flexibility up a level. And it seems to be a logical way to operate. It's just there are many paths to possibly get there.

MR. GRAVELY: So thank you very much for the panel here.

And then so I think we have a few minutes and Gabe, you can join us. And then since we have a few

minutes left in the public comments section, I will give people the opportunity to make comments on all three plans, or the earlier two plans. Just in case somebody in the room wants to make something for the record or make any comments that they didn't get a chance to make earlier, now is an opportunity to discuss any of the three plans.

(No audible response.)

MR. GRAVELY: Okay. I'm not seeing any takers and nothing online, it looks like from there.

So I guess we'll go ahead and you guys can stay here and move either one if you want. We'll just kind of wrap up here. Can you bring back the original presentation that just shows how to give written comments and stuff, the first presentation?

So for those of you online, again we mentioned we do have a court reporter here and the information will be put into written format and will be included on the website once it's finalized and the slides are all present.

And again there will be a summary workshop on DER. And again the definition of DER, the three roadmaps today: Energy Efficiency, DR (Demand Response), Storage, and VGI are all considered DER, as are other things such as renewables and CHP (combined heat and power) and other types of distributed connected resources. So for the purposes of moving forward, you can say again the PUC is

doing quite a bit of work in the area of the DER Action Plan, the DRP and the different integration plans. So in many cases we are addressing issues that affect all three of these roadmaps, not just a single roadmap. And we are also, as many of you know, we are developing a microgrid roadmap. We've had three workshops. We have two more planned. We expect to finish up that roadmap in time to be included this year also in the 2017 IEPR.

With no other comments, Gabe you want to -- we'll let you talk last or any final comments, Peter, before we go?

(Off mic colloquy.)

MR. KLAUER: So I guess the ISO was on the energy efficiency and demand response, so some of the takeaways I have is that we're continuing to work these challenges, right? So one is the continuous improvement in terms of incorporating demand response in planning and procurement processes. Another is to demonstrate greater utilization of DR to help with operational challenges that are being faced at the ISO level, in terms of the renewables and other goals.

We also want to look for opportunities to grow in our response capacity for system dispatchability. We can do that a couple of different ways. We can expand the base of load-responsive resources. We talked about the

extension of technologies into the appliance domain to help add to that base. We also want to look at, perhaps being able to manage load not just as a curtailment in typical demand response, but also load management in terms of increasing load at times of need.

We've had some interesting discussion on the role of the transactive energy and in terms of those solutions. And an understanding of how that will move forward in an ISO market setting, versus a regional market. It's likely that as that technology develops and matures, we'll start to see maybe some pilots of that in the distribution system. And I think ultimately at the end of the day, we'll start to see kind of that DSO / TSO interface start to build. And I think part of that will be based on some transactive type of solution.

Talk about hydrogen a bit. I think in terms of does hydrogen need its own effort? Does it need a roadmap? Does it need more attention? I think I can say that today I think hydrogen does have a role at the ISO as a participating mode. I know we've had discussions in terms of power-to-gas, where you actually create the hydrogen and then you incorporate that, maybe you're going just in fuel infrastructure.

The challenge there is that we're really talking about two different resources. We have a load resource and

then we have utilization of the hydrogen-created generation resource and often they are not located in the same locations. And that presents sort of a physical challenge in terms of grid operation. So to the point, why didn't the Storage Roadmap include some of those technologies? Part of it had to do with we're focusing on a single sort of technology or resource, a battery, a chemical battery that can actually act as both a load and a gen in the same location.

But I think it's a good comment. I think as California moves forward in terms of utilizing hydrogen, I think hydrogen is an excellent load for demand response and for other energy efficiency and demand response types of programs.

So that's what I took away from the energy efficiency and demand response side.

MR. GRAVELY: Just a quick summary, and I think in general the roadmaps discussions today have been that there a lot of activities. I would encourage anybody who wants to identify specific actions that weren't brought up today, that are not being addressed or want to identify specific actions that they feel there are (indiscernible) of what's being addressed. It just helps when I prepare this summary for our Chairman from that.

But in general it seems like we are progressing

forward. And mostly we kind of figured that VGI would be the one that's probably changed the most in the last four years compared to the other roadmaps. There are a lot of activities in all three areas.

So anyway, again I appreciate all your comments and recommendations. And again the period for this particular workshop through the 27th, feel free to send your comments in electronically. And if you want to mail them in there's an address that you can mail the comments in.

This again comes from the notice that provided you the information on how to come here or how to dial in. So it's all repeatable online.

MR. PETLIN: Thanks. I'll just say for the Storage Roadmap that looking back at the framework created around expanding revenue opportunities and reducing the cost of integrating and connecting to the Grid, and also streamlining and clarifying policies to increase market certainty, that those are still serving us well as good principles to try to look at when we try to enhance the value of storage.

And the tracks that we created: planning, procurement, rate treatment, interconnection and market participation. You can point to at least one either ongoing or specific proceeding for initiatives at either of

the agencies where those issues are being actively addressed, so I think it's a work in progress, but I think we have made some good progress on Storage.

Some of the comments from today that caught my attention as far as potential areas of focus would be the jurisdictional roadmap to interconnection, sort of mapping out the lines of responsibility across different jurisdictions between utility, FERC, CPUC and the CAISO.

I thought another interesting comment was permitting consistency across local jurisdictions. Now, that's certainly not something the CPUC works on directly, but maybe that's something the CEC can help support research and best practices across local jurisdiction.

And then the bidirectional interconnection issue for integrated vehicles, that's sort certainly an interesting one and could be possible to address in the new Interconnection OIR that we're planning to start later in the year. So definitely good ones to think about and we'll read the transcript and see what else there is.

Anyone else want to comment on their roadmaps in terms of taking these sort of last steps?

MR. GRAVELY: I'll just make one follow-up comment from the research area. We use these roadmaps to plan our future research and to design research projects. So in any of the three roadmaps if there are specific areas

of research that you consider very valuable, that are not being addressed, feel free to make those comments. So we can include those in our gap analysis and research plans, as we move forward with the research to support these activities.

MR. PETLIN: Great. Well, I want to thank all the three agencies for all their work in putting this together, especially Mike, for leading the overall initiative. But there's a lot of good staff collaboration to pull this together and make it very productive, so good job to everyone. Thank you very much.

And I guess we're going to adjourn with that. Okay, thank you. Thanks for coming today. (Applause.)

(The workshop was adjourned at 3:07 P.M.)

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

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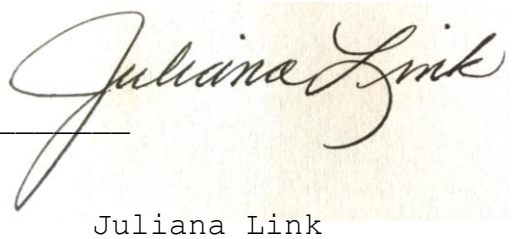

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