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CALIFORNIA ENERGY COMMISSION

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COMMISSIONER WORKSHOP ON CALIFORNIA'S ECONOMIC OUTLOOK

TRANSCRIPT OF PROCEEDINGS

SESSION 2

REMOTE VIA ZOOM

TUESDAY, JANUARY 31, 2023

1:30 P.M.

Reported by:

Martha Nelson

APPEARANCES

COMMISSIONERS

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J. Andrew McAllister, Commissioner, CEC

John Reynolds, Commissioner, California Public Utilities Commission (CPUC)

Genevieve Shiroma, Commissioner, CPUC

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Heather Raitt, IEPR Director, CEC

MODERATOR

Jill Pestana, Battery Lead North America at Accenture

PANELISTS

Sara Baldwin, Director of Electrification Policy at Energy Innovation

Mike Roeth, Executive Director of the North American Council for Freight Efficiency

Mike Sontag, Associate Director at Energy and Environmental Economics, Inc. (E3)

Gil Tal, Director at the Electric Vehicle Research Center, Institute of Transportation Studies, UC Davis

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P R O C E E D I N G S

1:29 p.m.

TUESDAY, JANUARY 31, 2023

MS. RAITT: Welcome back, everybody. We're going to resume our Commissioner Workshop on the California's Economic Outlook for the 2023 IEPR. I'm Heather Raitt, the Director for the Integrated Energy Policy Report.

Just a few quick reminders. We are recording this workshop today and we will have an audio recording posted later today, most likely there today, and a written transcript in about a month or so.

And we will have an opportunity for a few questions from attendees. So you can use that Zoom Q&A function to type in a question if you'd like to and one of our staff people will moderate the questions and read them out.

And we also have an opportunity for public comment at the end of the day and that will be three minutes per person. And if you wanted to make a public comment, you can use the raise-hand function to let us know, or if you're on the phone, you press star nine and that will let us know that you want to make comments.

And if you'd like to submit written comments, those are always welcome. And they are due on February 14th.

And so with that, I will turn it over to Commissioner McAllister, who's going to kick us off for this afternoon session. Thank you.

COMMISSIONER MCALLISTER: Thank you, Heather. And thanks to you and all the IEPR staff for a great day. This morning was an excellent sort of not-so-overview panel of the economic and demographic trends of the state and super useful just as a level-setting, you know, contextual understanding of all of the issues that we're going to deal with, all the really pressing critical issues that we are dealing with now and will continue to in the years and decades to come in terms of our clean energy transition, so that was super helpful.

We were, this morning, really pleased to be joined by President Reynolds from the CPUC, and Commissioner Shiroma. And thank you, Commissioner Shiroma, for joining us again this afternoon. And I see Commissioner John Reynolds, as well, has joined us for the panel this afternoon. So thank you both for being with us. Vice Chair Gunda and Commissioner Monahan will be back at some point during the course of the afternoon.

And so I guess I just want to say a couple things to set up this, the second panel, before passing the baton briefly to Commissioners Shiroma and Reynolds.

We talked peripherally about some of the

technology issues embedded in the economic and demographic shape of our state and how that's evolving forward. And this afternoon, we're going to really dig deeper into that directly, the technological aspects. We all understand that electrification technologies are electric technologies and the transition from fossil to clean electricity for the most part, certainly in a built environment, is critical to meeting our long-term chronic goals.

And so it really does, this came up a little bit this morning, it implies a fairly profound shift in our industrial policy as a state and as a nation. And I think we're starting to see that take place. And I'm very heartened by that because it really is a turn, a fairly sharp turn, abrupt turn in our economy.

And I think all of us are tasked with different pieces of trying to accelerate this pivot and really get these technologies out there and get them scaled in a way that's sustainable economically, and also that really does bring up the least resource endowed Californians. So the places where these technologies are needed most, how do we ramp up in those areas, hopefully first, and then really broaden to the rest of the economy, at least alongside?

So I think California has an amazing innovation economy that both develops new technology and then figures out how to best apply it, the business models that move it

forward, and get it to scale. And we need to do that in spades as we move forward. And so I'm excited about this technology panel and the market outlook that we'll hear this afternoon.

So with that, I think I'll pass the microphone to Commissioner Shiroma and Commissioner Reynolds from CPUC.

COMMISSIONER SHIROMA: Thank you, Commissioner McAllister. I really appreciate all of the efforts by your team at the Energy Commission. I'm looking forward to this afternoon's session.

I appreciate the focus on electric vehicles, electric vehicle infrastructure, because I'm fresh from the Global Transmission Second Annual Conference on Electric Vehicle Charging Infrastructure, which was held in South San Francisco, Burlingame, last week. And Commissioner Monahan was a keynote speaker. It is a, maybe you could call it aspirational, but it's a real goal in terms of what the Air Resources Board has set up based on the governor's executive order of electric vehicles being sold by 2035. If there are other milestones for medium- and heavy-duty, we are on our way. And that means the infrastructure investment that's necessary, the grid that needs to sustain the infrastructure, power generation, and so forth.

So it's an exciting time, and there's a lot of work ahead. And I appreciate the Energy Commission and the

staff there for organizing the workshop. Thank you for facilitating us.

I will need to exit for a short time, but I hope to catch most of the workshop. Thank you.

COMMISSIONER REYNOLDS: And I would like to echo the thanks to the Energy Commission for hosting this forum. I'm really excited for this afternoon's discussion. And I think that the prospects that new and developing technologies hold for how we can decarbonize our energy sector and drive cost efficiencies so that decarbonization is affordable for all Californians, I think it's really, really an exciting time, and we're poised for some tremendous advances in the future. We look forward to the discussion.

And I will also have to be stepping out later this afternoon, but I'm looking forward to the discussion.

COMMISSIONER MCALLISTER: Well, thank you, Commissioners. And I may have to come and go a little bit, as well, so hopefully we'll always have, you know, sort of at least a virtual quorum, more or less, listening in at the
Commissioner level. But of course, this will be -- you know, it's recorded, posted, and transcripts part of the IEPR process, so it will be a robust record if anybody who wants to revisit it. I certainly encourage everyone to

make public comments and put their views on all of these issues into the record so that we can take those into account as we go ahead and move forward.

So with that, I'll pass the mic back to Heather to introduce our moderator and the afternoon panel.

MS. RAITT: Thank you, Commissioners. Great.

So we'll move on to our first panel, and the moderator is Jill Pestana from -- Battery Lead North America at Accenture.

So, Jill, if you could just go ahead and get us started?

MS. PESTANA: Sure. Thanks, Heather. And good afternoon, everyone. Really excited to talk about this. Definitely agree with the Commissioner that it's an exciting time, and we have a lot of work ahead of us.

Today, our panelists are spectacular leaders in this industry. We have Sara Baldwin from Energy Innovation, Mike Roeth from the North American Council for Freight Efficiency, Mike Sontag from Energy and Environmental Economics, Inc., or E3, and Gil Tal from UC Davis.

And the way that this will work, just similar to the morning session, we'll have each of our panelists provide a brief introduction and discuss a little bit about their perspectives to start. And then after that, we'll

move into a Q&A session that I'll moderate.

So do we have the next slide from here? Thank you.

So just to introduce myself, my name is Jill Pestana, and I'm the Battery Lead of North America for Accenture. And Accenture is a large consulting firm. You may have heard of them. They do a lot of IT consulting and business management consulting. And more recently, we've been doing more work in the e-mobility space, as well as in batteries. And so that's why I was brought on to the team.

And if you go to the next slide?

I just want to share a little bit about my perspectives in this space and the challenges we have ahead of us. So I'm part of Industry X within Accenture which focuses on technologies. And there are so many challenges across this industry, whole ecosystem, from battery cell manufacturing, to mining, to integration of batteries into automotive systems, to charging infrastructure, and providing some solutions across all of those different relevant industries is what we do.

And when it comes to the shift we're seeing in California -- you can go to the next slide -- of course, we're seeing more and more electric vehicles on the road, and this is really motivating. You know, we have the Inflation Reduction Act coming up, and all of these are

leaning towards electrification; right? We have this set in front of us to tackle.

You can go to the next slide.

I just want to cover this pretty briefly, but one of the major trends, which is accelerated by the Inflation Reduction Act, is that there's so many gigafactories being built across North America. And you can see just a few, and these aren't all of them, across the United States, about 40 have been projected. And with this, this is to serve the demand for batteries, for electric vehicles. And the Inflation Reduction Act is pumping over $369 billion in tax credits and incentives. I'm sure many of you are aware of this trend.

And we can keep going to the next slide.

And here are just a few of -- a view of the timeline of this. And so, you know, a lot of people that I'm around know Tesla; right? Everyone knows about Tesla, and especially in California, lots of those on the road these days. But as you see, as we move into 2023/2024, we're going to see more and more gigafactories come online and more and more vehicles being introduced by OEMs. And this is going to be a trend that's just going to continue past 2030. And so this brings the need for charging infrastructure and other topics that we'll be discussing today in our seminar, in our workshop here.

So next slide from here.

And so with the Inflation Reduction Act, the trends that we're seeing is that this is really going to benefit the whole ecosystem in the push towards electrification. We're going to see consumers getting tax credits, which could motivate the purchasing of electric vehicles. We'll be talking about that a bit. We'll also see the impact on fleet management companies, which we'll be talking about that, too, I'm sure. And across the board from OEMs to clean energy manufacturing companies, battery, mineral, and material processing companies, and cell manufacturers and battery material processing companies are going to see a benefit and growth in those industry sectors.

And behind all of this, the Inflation Reduction Act requires that the batteries and cell materials that go into vehicles is sourced within the United States or from domestic supply, or from countries that are within free trade agreement protocols. And so we're going to have to shift our reliance off of China for all these materials and into more domestic or other companies, so -- or other countries, excuse me. So we're going to see this shift happening in the next decade.

Continue to the next slide.

And within my work, we're really helping

companies and organizations address these issues by introducing things like, I won't go into these, but the battery passport, battery recycling. We're seeing companies vertically integrate and forming partnerships, for example, between original equipment manufacturers, or OEMs, and with the cell producers. And there's a huge need for workforce training. So we're seeing a lot of companies partnering with universities to build this talent pool that can serve this industry, so lots of opportunities both in industry and also in education sectors.

Continue to the next slide.

And this is different in the U.S. versus in Europe and across other parts of the world, especially because the U.S. lacks a material mining supply chain. And so that's a key area of interest for the industry. Also, batteries are a industry development that is a strategic interest for the US from a national security standpoint.

We're also seeing more of those joint ventures, the partnerships between the OEMs and the battery manufacturers. And in the U.S., especially, we're seeing vertical and horizontal integrations between companies happening at the moment. For example, Tesla is a big one buying certain companies in order to make sure that they're securing their supply chain, which is really crucial for their success.

So those are just a few trends that I'm focusing on in my work. And I'll let Sara Baldwin like to introduce herself now.

Go ahead.

MS. BALDWIN: Great. Thanks so much, Jill. Appreciate that intro and really good context for the presentation I've got, which is largely focused on the Inflation Reduction Act.

You can go to the next slide.

So thank you to the Commission and the staff for the invitation to participate today. I'm Sara Baldwin. I'm with the Policy Team at Energy Innovation, which is a nonpartisan energy and climate policy firm. We're based in San Francisco, but we also have offices, really, all over the country now as we've become a virtual organization. So I'm actually based in Salt Lake City, Utah, just over the mountains.

So for my time today, I'm going to share the results of a new analysis that Energy Innovation did with the International Council on Clean Transportation, or ICCT, which we actually just published today, so it is hot off the presses. And I definitely want to acknowledge my colleague at Energy Innovation, Robbie Orvis, as well as Anand Gopal, and our full team at ICCT for the leading roles they all played on the modeling and analysis.

And because I didn't actually have a link to put in the slide deck, I'm going to throw into the chat the link to this report. So for those who want to dig in deeper, that's where you're going to find a lot more of the details.

And basically, this analysis focused on the impact of the IRA on the sale shares of new EVs for light-duty and heavy-duty vehicle sectors through the year 2035. And we looked at three different IRA scenarios, low, moderate, and high, and we compared those against a baseline scenario that excludes the IRA provisions just for the sake of comparison.

We've also included two additional scenarios for the light-duty sector to evaluate the additive impact of the state adoption of clean car standards, certainly led by California and the advanced clean cars rule, as well as the advanced clean trucks rule for the HDB sector. And I'll talk a little bit more about the differences in upcoming slides.

Next slide, please.

So we used a customized Excel model that's based on Energy Innovation's Energy Policy Simulator. And it's based on an analysis that we did last year, but the main difference is that we used updated data from ICCT on several inputs, including -- (coughs) excuse me, I'm

recovering from a cold, so I'm trying not to cough -- vehicle costs, battery pack estimates, charging behavior, future fuel prices, et cetera. So I'm really going to focus on the key findings and results. But as I said, the report, as well as the appendix slides that I've included all have more details on our methodology.

The IRA scenarios look at three core provisions in the IRA, marginal tax credits for clean passenger vehicles, 30D, commercial vehicle tax credit, 45W, and the advanced manufacturing production tax credit, 45X. We definitely recognize there are other incentives. In fact, Jill's slides included more of them. And the Infrastructure Act, as well, has more incentives and funding that could impact EV sales. But we wanted to really hone in on the different provisions here.

We also don't look at the used tax credit, and we don't account for the recent IRS guidance on the tax credit eligibility for leased passenger vehicles, so just as a few caveats as to what we're looking at.

Next slide, please.

So the modeling for the light-duty sector, of course, was the most complicated. The heavy-duty sector was pretty straightforward, but the new eligibility requirements for the 30D personal tax credit impacts both the vehicles themselves and the buyers.

So this eye chart, which you'll have access to and can look at in greater detail at a future time, looks at the low, moderate, and high scenarios that we modeled. And we factor in the various subcategories modeled and we factor in the various supply chain income and price caps and try to calculate an average credit value of these incentives, which then we assume is passed on to consumers. And then that, of course, impacts the vehicle sales.

We use the logit function and allocate new vehicle sales shares based on a discounted total cost of ownership, or TCO, across various technologies. And the TCO includes both direct costs as well as other monetized barriers, such as range anxiety, which we know, of course, is a factor. We assume a pretty conservative six-year ownership life and apply a 15 percent discount rate for future year expenses.

And so this snapshot really just shows the side-by-side comparisons. And then at the very bottom there is the average incentive value of both the 30D and the 45X combined incentive over the 2023 to 2032 time frame, so it's a pretty big range between 3,400 or all the way up to 9,050.

Next slide, please.

We also, as I mentioned, analyze the additive impact of state adoption of clean car and truck standards.

We want to ensure that we weren't just looking singularly at the federal landscape because, of course, through California's leadership over the years, as well as many other states that have joined California, we've seen a considerable uptake in clean car standards and now clean truck standards. So we apply the -- in the light-duty sector, we apply two different scenarios. One that looks at just California adopting ACC2, and then the other one looks at an increased state adoption, approximately 20 other states, assuming that those who have adopted ACC1 also go on to adopt ACC2.

And for all scenarios in the heavy-duty sector, we really only assume that all states that have adopted the advanced clean trucks rule do that, and we don't assume any other growth there.

Next slide, please. And actually, you can go to the next slide.

So our topline research findings are as follows.

First, we see that IRA is definitely a result in faster market growth and higher EV sales shares for both light-duty and heavy-duty markets than we would have seen without the IRA, as illustrated by these two graphs. And don't worry, I have both of them in the next slide, so you can get a closer look.

But basically, the graph on the left for the

light-duty sector compares all three IRA scenarios layered with that additional ACC2 state adoption scenario in a couple of cases. The bottom line in both graphs represents the baseline growth trajectory without an IRA and assumes only California adopts ACC2. So you can see the differential between the high line, which is the high scenario, with a lot of states adopting ACC2, and the low line, which is basically where we were before IRA was passed.

And so we see that by 2030, EVs could compose between 48 percent and 60 percent of all new sales, reaching a high of, potentially, 67 percent under the IRA high scenario.

The graph on the right is the heavy-duty sector. It shows the sales, the aggregated sales weighted average of different heavy-duty vehicles, and that ranges from about 39 percent to 48 percent of sales in 2030, and potentially up to 52 percent of sales by 2032.

Next slide.

So again, taking a little closer look at the light-duty sector graph, we see that under the IRA moderate scenario, with an increased adoption of ACC2, EVs could comprise around 60 percent of all new light-duty sales by 2030. So that's a substantial growth relative to the baseline.

And of note, we did do a sensitivity analysis without the California adoption of ACC2, not shown here, but we found that it would reduce national light-duty EV sales by about two percent if you took away the ACC2, so not huge but definitely a sizable contribution relative to California's role in the vehicle market. And unsurprisingly, the non-ACC2 states did see growth under our different increased adoption scenarios, but they lag those that adopt ACC2.

Next slide.

The third takeaway from our analysis is that the IRA is really expected to accelerate new sales of commercial heavy-duty zero-emission vehicles across nearly all heavy-duty vehicle classes. However, we definitely see a different range depending on the type of vehicle class, so ranging from a lower end of 11 to 17 percent for long haul tractor trucks, and a high end of 70 to 77 percent for Class 4 to 5 rigid trucks in 2035.

We also find in our analysis that battery-electric technology is going to continue to dominate, even in the heavy-duty sector, even with the new IRA incentives for hydrogen. And that largely has to do with economics, both economics for the vehicles themselves, but also for the fuel.

Next slide, please.

And this is my last slide, and then I'll wrap up.

So from our results, we've identified the following top findings.

First, the IRA, definitely a gamechanger for the road transportation sector, and can and will definitely achieve high rates of electrification over the coming decade. I think Jill's slide with the map of all the announced battery production facilities and processing facilities is exactly what this policy was intended to accomplish. We're already seeing announcements and investments being made, and that's only likely to continue because we have a ten-year duration, which we've never seen before.

However, in the context of climates, these rates of electrification are still going to fall short of what we need to reduce the road sector emissions for a climate-stable future.

Third, as noted, we expect battery EVs to still play a dominant role over hydrogen in decarbonizing road transport. And we see that the federal greenhouse gas standards, both for light- and heavy-duty vehicles, are going to be an important backstop to ensure that the IRA has a longevity beyond its expiration, as well as any future market changes. And of course, continued state leadership is going to amplify the benefits and impacts of

the IRA.

And finally, and really important, perhaps a good pivot for this conversation today, we definitely acknowledge that additional actions from governments and industry are going to need to overcome existing barriers to electrification. Incentives alone are not going to move the market, particularly in the heavy-duty sector, an enhanced focus on really strategic deployment of charging infrastructure, more near-term investments, and collaborative efforts to ramp up manufacturing and domestic supply chain, and other things needed to really ensure that we don't see similar lags in the industry's ability to meet these new eligibility provisions.

Next slide, and that is my final slide.

So with that, I'll conclude and say thank you for the opportunity and look forward to questions.

MS. PESTANA: Thank you, Sara. That was such a great introduction and really digging into the effects of the IRA. It's really exciting to see all the growth happening, so thanks for highlighting that.

Our next presenter, do we have slides for anyone next or --

MR. ROETH: I don't know if it's me. This is Mike Roeth.

MS. PESTANA: It can be.

MR. ROETH: I don't have any slides.

MS. RAITT: Yes, it's Mike, and then we don't have slides for Mike, I don't believe.

MS. PESTANA: Okay, great, Mike. Take it away, Mike Roeth.

MR. ROETH: Yeah, thanks. Thanks. So my name is Mike Roeth. I lead the North American Council for Freight Efficiency. And that fourth word, freight, is, you know, where we focus our work on. We've been active for about 12 years now and we work on all classes of trucks across U.S., Canada and Mexico, so really Class 2, all the way up to Class 8, with a big focus on Class 8. I mean, those trucks, smaller numbers, you know, burn a lot of the fuel and create a lot of the emissions that we experience. So we do maintain a pretty big focus on class eight.

And I'll say right away, a lot of people misunderstand Class 8 a lot. It's not just sleeper tractors crossing the country. Class 8 can be yard tractors, terminal tractors that only operate around, you know, a freight terminal. They can be smaller tractors, often called city tractors, as many of you know, but those operate at quite low miles.

And we did some work the last couple of years, trying to find out exactly how many miles these heavy-duty tractors do. And of course, there are tractors that do

1,100, 1,200 miles a day that are either driven by teams or by slip seating with two drivers in the truck on both shifts. But what shocked me, maybe shocked a little aggressive, what surprised me was how many of these tractors operate, you know, at 100 miles or 150 miles or 200 miles. It's really a lot bigger level than a lot of people think. So these are city tractors in maybe beverage delivery where there's long times at the at the grocery store or at the pub for, you know, beer and beverage and so forth, and as well as some, you know, groceries and others.

And you know, as much as we think it's a 24/7 world, a lot of these stores and delivery areas don't allow overnight deliveries. And that might change with electric -- kind of a spoiler alert -- that might change with electric with their quiet operation. But right now, you know, these trucks, you know, as many of them do have lots of miles, we're range anxiety, and there are real operational challenges with these electric trucks, there are early adopter segments that don't have some of those challenges.

So a couple of other quick thoughts.

Runonless.com is a great place to see real-world work of trucking and that we that we do at NACFE. So runonless.com, check it out, the past event in 2021 was 13 electric trucks from, you know, Class 3 delivery van in

Manhattan all the way up to 4 or Class 8 tractors really maximizing the, you know, the range that's available by a say a freightliner, eCascadia, Volvo VNR, BYD tractors, et cetera. And what we found was a lot of benefits for the fleets in these electric trucks, driver attraction and retention, because drivers freaking love these trucks. I try not to use the word freaking as an adjective, but they really love these trucks. And this will be a huge deal for the fleets as they understand how this will help attract truck drivers all the way down to the package delivery all the way up to heavy trucks, I'm convinced of that.

But we have many challenges that are emerging. And as you slice away the onion, or peel away the onion, and get down to real practical challenges for companies trying to deploy these trucks, these are becoming really big. So I know infrastructure, you know, when we're trying to charge a 500, 600, 700 kilowatt hour battery pack, that's a lot of energy that's needed when we start to look at depots of 1025 100 trucks, you know, in many of these areas that we're talking about here.

Other kinds of just a few examples. I mean, we're also finding that a lot of these end-user fleets who buy and operate the trucks do not own the depot where the trucks are domiciled. So it may be at a leased warehouse, or it might be at a manufacturing plant where they are

operating the trucks to deliver things out of that manufacturing plant. So it's becoming a real critical challenge of who puts the infrastructure in place, even at the depots, let alone as we start talking about public charging of these big trucks, so those are a few things.

Another constraint that's emerging is weight. And you know, I've said many times, well, fleets just -- you know, keep a few diesel trucks to haul the heavier loads around and don't worry so, and use the electric trucks for the lighter loads.

You know, what we keep finding, and we sort of knew this, but carriers don't know how heavy that trailer is when they get hired to go pick it up. Now, of course, there's weights on the bill of lading and so forth, but what we're finding is that those are incredibly inaccurate. One fleet told me that every load that they ever hauled, thousands and tens of thousands of loads for a particular customer, every one of them was at 20,000 pounds, two zero comma zero zero zero. So my point is that they don't know how heavy that load is and they can't just simply send out the diesel truck to get it.

Two final thoughts, and then I'll get off.

One is we have analyzed various market segments for the use case for electric tractors. We issued four reports last year, it's on runonless.com. And basically,

vans and step vans, we think it's -- mic drop -- infrastructure will probably be the key challenge with fast adoption. But those e-commerce last mile delivery trucks will be electric and it will happen -- it can't happen pretty quickly.

Then we move into heavy-duty yard tractors that I mentioned, not a big market, but one that's really poised for electrification and I think will happen faster than we thought.

And then we get into some challenging areas of medium-duty box trucks and heavy-duty tractors. The medium-duty side, there's just a lot of different kinds of trucks there, some with lift gates and street sweepers and challenges around the design of those trucks to be able to move to electric. You know, a simple box truck with some lights, yes, that can be electrified easily and will probably be a quick ramp up.

And then I get to heavy-duty. And these return to base, regional haul heavy-duty tractors, you know, with realistic range right now by the manufacturers of 200 to 300 miles. And yes, you know, people will say, hey, Tesla proved that they can do 500 miles. Yeah, I was there. I've seen that, you know, I've seen that truck, I've been through that data, and that was a really best case scenario of lower highway speeds, good weather, and so forth. So

the realities of this 200-, 300-, and maybe we'll get to a 400-mile range, but you know, that that's really challenging in the heavy-duty side.

Lastly, I don't think I've said lastly yet, but lastly is hydrogen and other technologies. So I think Sara might have mentioned it, or maybe it was Jill, but a lot of challenges around hydrogen. It's not simply if a battery truck can't work, go buy a hydrogen one. From fueling to the complexity of the truck just, you know, we've said a lot of a lot that the battery electric vehicle is very elegantly simple compared to diesel. This hydrogen truck, and hydrogen fuel cell truck in particular, gets very complex with pretty big cooling systems and rather exotic control systems, as well as packaging all the tanks, et cetera, et cetera.

And then there's other technologies that are starting to scale while we're moving to electric with renewable fuels, renewable natural gas, natural gas all and of itself, potentially hybridization. I bring that up to close, but there are just a lot of solutions, some of which are available now, the low carbon fuel standard helps support some of that, and others will be available later. And you know, the whole industry is dealing, the trucking industry with, which we're very close to is dealing with, almost a deer in the head like kind of thing. Where do I

go? What do I do? How do I get there? The good news is the trucking industry is very committed to sustainability, actually, I think faster than I would have said just a couple of years ago.

So I'll pause there. Sorry that was a little bit long but thanks for listening.

MS. PESTANA: No, Mike, I was eating up all that information. That's excellent. And thanks for stating all these challenges in the trucking field. It's really interesting to hear that versus the light electric vehicle and electric vehicle industry. Thank you.

And now we'll move on to Mike Sontag.

Mike?

MR. SONTAG: Thanks, everybody. I've got some slides, if we could toss those up there? Great.

So good afternoon, everybody. Thank you for the opportunity to speak. My name is Mike Sontag. I'm an Associate Director at Energy and Environmental Economics, or E3 for short. We're a consulting firm based out of San Francisco. We do a lot of work with the different California state agencies on our electricity sector planning.

Let's go to the next slide.

Today, I'm going to be talking about the building electrification technology outlook. And I wanted to set

the stage here just to say that California has some very aggressive building electrification targets. This chart here on the lower right are the statewide emissions kind of progressing from today through 2045, and we have this carbon neutrality goal from the California Resources Board Scoping Plan. The CARB also has a statewide Implementation Plan to comply with federal smog standards.

And what's consistent between these two plans basically is a, you know, near or total phase out of the new sales of gas furnaces and gas water heaters by 2030, which is a really big change in a short amount of time from today's world.

The chart on the lower left here shows the sales of space heating appliances. Blue is heat pumps, which is going up quite aggressively. Green is gas furnaces, which is going down aggressively. This is, you know, the new sales in a given year. So for retrofits or new construction, how many are installed that year? And you know, again, this is just like a very large change in a pretty short amount of time and a lot to iterate there.

If we go to the next slide?

So you know, kind of looking through that lens, how do we actually get there? I think it's, you know, these four major building blocks, I'll have a slide on each of these, it really requires a new level of ambition and

coordination across them. So it's the underlying technologies, how we can fund all of this, getting the labor to actually do all the work, and then looking at equity for this as well.

Let's move on to the next slide.

So first on technology, my general take on this is that, particularly for the residential and small commercial sectors, you know, the core technology of heat pumps is ready for mass adoption, particularly on air. You know, this is -- air-sourced heat pumps are a, you know, globally mature technology. Even within the U.S., per AHRI, last year more heat pumps were sold than gas furnaces even. It's really, you know, kind of the way that California and the wind of winter was developed. We have all this gas infrastructure and the trades have kind of grown up to support that as well.

For heat pump water heaters, it's a slightly newer technology. You know, the underlying technology of like compressors and refrigeration loops is not new. The form factor is. You know, it's been more for the last 10 or 15 years, I think, so some learning on that as well. But, you know, again, the underlying technologies are pretty much there. And I mention this more through the lens of how much we could expect for cost declines on the equipment side in the future, just knowing these are, you

know, pretty much at the scale that they'll be needed at going forward.

The other thing on the technology side I wanted to call out was the transition to incorporate low- and ultra-low, lower potential refrigerants. For those of you who haven't seen it, it's pretty stark to see how large of a footprint refrigerant leakage actually has. You know, if you were to replace a gas furnace with a heat pump, some order of, you know, probably 30 to 60 percent of the emissions from a gas furnace is the CO2 equivalent from the refrigerant leakage if it's not captured appropriately at the end of life.

And so I think a lot of attention and more attention, frankly, needs to be put on how to, you know, make this transition as aggressive or as quick as possible, such that by the time we're installing, you know, larger amounts of heat pumps that we're using, you know, the least impactful refrigerants as possible.

And I want to make sure we're not taking for granted, too, that, you know, we can pull the lever and use it in refrigerants. It might take some time for the market to learn how to tune systems like that and kind of some retraining of the workforce to support that.

IF you'd flip to the next slide, please?

I wanted to look at capital costs a little bit,

especially, you know, with the Inflation Reduction Act and a lot of that. So my general take on this, I think there are a lot of opportunities on the air side for heat pumps. This chart on the bottom left here shows some data from a report that E3 did a couple of years ago. We had a professional cost estimator come in and see, you know, for different regions of California, how much it would cost to install, you know, a counterfactual mixed fuel home versus all electric appliances.

The chart on the bottom left is for air. So if you stack up the whole column, it's the equipment and labor to install a gas furnace and an air conditioner. The middle column is for a heat pump. If you were to be replacing both the gas furnace and the air conditioner, it's a great opportunity to save some capital costs there.

But, you know, there's only so many instances of those in the state. And if we're looking at 100 percent sales, we're going to run into issues, too, where you might just be replacing a furnace, you might just be replacing an air conditioner, you might have additional electrical infrastructure upgrades that need to happen, too, that can make that incremental capital cost a little bit higher. And I think that's where the incentives should be kind of flowing towards and addressing that.

For water heaters, you know, you don't get this

opportunity of replacing two devices with one device. So you know, I think it is just a little bit more expensive, particularly if you have to run new wiring for that. And you'll notice that the scale of these axes is a little bit different and that the difference between them is only, you know, a couple thousand dollars, which is a little bit more easy to overcome with an incentive.

With the Inflation Reduction Act, I think for the lower income brackets where it's a direct incentive, it's on the right order of magnitude to make these balance out. If you're in the land of tax credits, I think it's substantial for a heat pump water heater and I think more likely to move the needle there relative to some of these heat pumps for space heating where the cost can just be a little bit bigger delta.

I also added here in these charts data from the recent tech program that's going on right now for what the average cost of some of these systems are, so a little bit higher than I think what our study from a couple years ago expected. I'll be curious to dig in, in the future, of kind of what's driving those discrepancies there. That's from the last couple years of data.

So if you hop to the next slide?

So thinking about, you know, the incremental costs to fully electrify comes to this, how much money is

it going to be and where are we going to be able to find that from?

In 2021 the CEC had a Building Decarbonization Assessment Report. I think the order of magnitude for funding gap here is on the order of $10 billion to $40 billion. You know, the programs that we have up and running right now are on the scale more of, you know, hundreds of millions of dollars, which is a great start. These programs have been discovering a lot and are really impactful. But the scale of these current programs does need to increase substantially in order to kind of meet the need for infrastructure, particularly if we're going to be transitioning the market so quickly.

I think the Equitable Decarbonization Fund, which is a new policy that you have to really start flowing money through, is, you know, on the order of $1 billion. It's going to be a great start, but I think we need to see more of what needs to happen.

You know, there's a lot of different potential funding sources from, you know, conventional sources of use for energy efficiency funding for programs and incentives. You know, I think a lot depends on the political capital for how much we can pull from there. I think a lot of this is going to need to come from private financing in some way. So you know, I think some work needs to be done to

figure out how to make those connections there.

And I think unlike the, you know, market transition of rooftop solar, it was able to rely on a lot of good credit from homeowners. You know, if this is a full market, there's going to be the full distribution of, you know, credit scores in that. We need to find solutions that can, you know, reach the people that might not have good credit or might have no credit at all. You know, the IRA certainly helps in this, as well, with the incentive, but some there too.

And then the other thing I wanted to mention on this is rate design reform. You know, I don't have any slides on this for ongoing utility costs, but it's certainly a really large component of people's decision to electrify or not.

Then I'll do a plug for the CPUC. They have a big public workshop later this week about Assembly Bill 205 for rate design reform that better reflects the marginal cost of electricity and retail rates. And I think it will bring down the operating costs of some of these systems.

And then lastly on this, you know, not just on a homeowner lens, but as far as electrical infrastructure for the grid, both in front of the meter and behind the meter, you know, it's going to need to be upgraded on a scale that we have not been doing recently. And so I think a lot

needs to be considered about how we fund that and how efficient that can be between when an upgrade is triggered and when it actually is upgraded.

Can you go to the next slide?

So then on the labor point, you know, whereas I think the technology is pretty mature, I think that the labor force here is still kind of getting comfortable with these technologies. And you know, it's important to consider that there's a lot of -- a big distribution of small businesses. It's a lot of hearts and minds to win over through all of this. And a lot of contractors might be less familiar with installing this and, you know, potentially pricing in some risk in case they get called back.

And so, you know, I think a lot of tech's been doing a good job of contractor outreach. I think I'd like to see more of that, as well, to expand that workforce, train both the existing and the needed future workforce for that.

And on the electrical side, again, you know, really the way I see this is just you need a big force of electricians going through and upgrading all of your, you know, in-house wiring, grid scale, capacity, and the distribution networks to be able to handle all this coming load, both in building electrification and electric

vehicles as well. You know, the situation I would hate to see is for a heat pump water heater, for example, you know, if your gas water heater goes out and you would love to get a heat pump water heater but it's an emergency, I don't know if -- you know, you wouldn't want to wait for three weeks in order to give you a cushion out to run a new wire, wait for 240 volts and have that take too long. It needs to be a faster turnaround for that.

If you'd go to the next slide?

And then lastly, the equity lens, there's a lot that could be said about this, but the way that I see this, you know, again, through this view of we need to have full market adoption in new sales, 100 percent in new sales in 2030.

The big hurdles on this are, you know, first, that over 40 percent of the state residents rent the home they live in, and then slicing the data a different way where 40 percent of the residents live in multifamily or attached unit homes. And you know, in a rental situation, you have the split incentive of the, you know, of the party covering the capital cost is not the one thing for the ongoing utility bills, in a multifamily situation, you might have, or just an attached unit, the technology configuration might be more difficult to do. You might have more parties involved with the person controlling

about how to cover the capital cost of that.

And really in either case, you know, I think that speaks a lot to the importance of rate design, and then also codes and standards and, you know, making sure that, you know, folks that are renters are receiving good equipment and are not facing an undue amount of burden to keep their homes as a part of this. So I think more needs to be explored in all of that and how to address these markets if we plan to reach that in such a short amount of time.

If you'd go to the next slide?

And so then kind of wrapping this all together, you know, again, I think really the summary of this is just that we need to see what the next step and ambition is for the state's existing programs. We need to look at all the different ways we can fund this and, you know, tap those as much as we can.

Codes and standards has a strong role to play in this. I've been focusing more on retrofits. You know, we have robust codes and standards for new construction, but how can we flow that through to the retrofit market as well?

And then, yeah, you know, you got to gear up the workforce, tackle these issues on equity and, you know, see as we upgrade our electrical infrastructure, making sure

that's an efficient process across the state too.

And that's it for me. So thank you, everybody.

MS. PESTANA: Thanks, Mike. That was an excellent overview of the electrification of building industry and all of that's included there.

For our next panelist, we have Gil Tal.

Gil, would you like to go for it?

MR. TAL: Yeah, thank you. I'm really happy to be here.

Can I have my slides, please?

I was trying to -- we're going back to electric vehicles, and I was trying to pick some topics that will be both like the most important, but I think underrepresented or that we did not talk about enough in the last year.

And I was surprised to see that -- I think that my slides were just down in the same .pdf, but if not, I can share.

And I'm kind of surprised to see that I think I have different conclusions on some of the trends that are happening right now, and it will be great to have the discussion later.

Should I share my slides? So --

MS. RAITT: If you can just bear with us a moment, we'll get them.

MR. TAL: Yeah, no problem. I have it open, so

if --

MS. PESTANA: In the meantime, I just really --

MR. TAL: Okay. Go ahead. Go ahead, Jill.

MS. PESTANA: Oh, I was just going to say, in the meantime, I've really enjoyed how the panelists so far have brought together these different aspects of electrification. And we can see that the challenges that we're facing are intersectional and carry across multiple different industries.

And here we go with Gil's portion of the presentation. Thank you.

MR. TAL: Great. So let's jump to slide two.

So we also take a really close look at ACC2, and we are looking at the EV market for the last 15 years and see a lot of incentives, and only now we see a lot of cars. And there is a strong belief that in order to see supply, you need to force it in the market. And we believe that ACC2 will force the supply, and IRA and other incentives will help them purchase, but without it, it will not happen.

So the blue line is where we expect California to be, and we are talking here on a fleet share. The yellow line is where we expect other ACC2 state to be a little bit behind California, while all the other state will be way behind California.

So if we are going to the next slide, it's all about supply. The limiting factor in the next decade in the U.S., we believe, is supply. The demand is here and the incentives are here and this is great. But without the supply, we will not see the market growing that fast.

This is one scenario for 2030. It's just an example showing what we expect. We expect the U.S. market to be a little bit more than 5 million cars, and also America to be more than 6 million. And the production will be also 5.8 million, so it's kind of almost -- the U.S. production will be 4.9 million, it's almost one-to-one. But that's not the way that the car industry is working.

A lot of the cars in the U.S., that are made in the U.S., will be exported, and many cars from other countries will be imported into the U.S. And the amount of vehicles we will have in the U.S., electric vehicles, it very much depends on the regulation and the incentives in China, in Europe, and in other countries. If they will have better incentives or stronger regulation, they will see more cars.

So if we move to the next slide, this is kind of my first take for us to discuss today. This is what we expect to see on the road in the U.S. ten years from now. Three out of ten cars in California will be electric, but only six out of ten in many -- some states, which means

that when we talk national level, maybe we are not doing the right balance of incentives, of infrastructure. Also, maybe used cars will flow out of California to the states that will have much more supply. But we strongly believe that if you don't have a ZEV mandate or a similar tool, you will not see the cars in your state. And that will create all kinds of policy discrepancies that we need to talk about. So that's the national level.

And by the way, we also believe many cars will flow south to Mexico.

Now let's dig or dive into the state level and go to the next slide.

As much as we like everyone to drive electric tomorrow, electric light-duty vehicles need to be purchased by the new car buyers first. And this is only later start going to the other groups. And we have here six different segments in California. On the left is the MUD. The tenants on the right is the single family housing and different income levels. And today, most of the electric cars are owned by the single family, more than $200K. But this is not a big group. Altogether, this group owns three million cars in California.

The largest group is still single-family, but the one that make between $75,000 and $200,000. This group own nine million cars. And that's this huge group that will

start 2025 and after the largest growing EV owner group.

The other groups will either wait a little bit longer, buy first cars. Their first electric car may be used. And we expect other groups to start growing only after 2030 and become a major part of the EV market in California.

Now if we go to the next slide, that creates a very interesting discussion when we talk about infrastructure in California or in the U.S. Here we said, well, how many fast chargers you need? If you have three electric cars in your house, only one of them will probably do long trips and need fast charger. The other two, probably not. If you have one electric car and one gas car, maybe the long trip, you're still going to do with your gas car. So you're not depend on it.

So the blue line is this one EV in a mixed household. The gray line is two EV-plus household. And the orange line is EV-only households with high dependency. And it's very important to look at who do we serve and in what year and how these things will grow. As you can see only in 2030-plus, we'll start see high dependency on EVs when there will be more and more people in California that will have no other option but driving on electric.

And the next slide, please.

So this is kind of putting it together. Between

'25 for today and 2040, we have more and more households that have less access to home charging, more MUDs, multi-unit EV households, and higher dependency on infrastructure, on driving, on electric. Now I picked three discussion points for that, so my next slide, and this is where I picked these points that I think that are not discussed enough today.

Today in California, households who purchase their second and third EV are much larger market share than households who purchase an EV in an MUD. The market is growing. The first, the most growing market, of course, is people who buy their first electric car, one EV in a household. The second is this household. These two-plus EVs in a household. It's a very fast growing market, much faster than MUDs.

And this is just an example that I took photos on my way to work on my bicycles: three Teslas, EV only household, three PHEVs household. These guys, actually, I talk to each one of them. They buy it because of the sticker, the three PHEVs, and the mix of EV and PHEV household to have maximum flexibility.

Next slide.

Another discussion point is, okay, this is cities, how do we electrify rural California? And here I wanted to talk about three examples of rural California.

You probably noticed that it's not only California, but it's the same idea.

We have the low-income desert. That's rural, but that's going to be very, very challenging to get the power there.

We have our nice cabins up in Tahoe and other areas of California. These ones are empty 300 days of the year, sometimes more, and then they have Teslas on the weekend. In specific season, they have a lot of electric cars. Who will pay? How do we electrify this area? How do we create enough capacity for these weekenders and seasonal?

And then the third rural California part will be our farming parts. And they, in many cases, have enough power, but do they have the ability to buy these cars and when and where? That's the second discussion.

And the third one I think I have here, if I remember my slides right -- next slide, please -- is home charging. Sixty percent of the new EVs are being used for commute. Forty percent are not. That was a couple of years ago. Now only half of the EVs are being used for commute. In the future, we believe that 40 percent of the EVs will be used for commute; 60 percent will stay at home. Home charging can be the place for daily smart charging, it can be the place for vehicle to grid, or at least vehicle

smart charging and using the home electricity for the home charging for our dark curve and so on. So really important to put more attention to daytime charging and smart charging at home.

And I think that I will skip two slides down. Next one. Well, we can stop here.

And just to say that we need to think much more about dependable smart charging, not just how many and where, but how to make it dependable, reliable, and smart.

And the other thing is that incentives need to start shifting from who will buy the next car to how we make sure that everyone will benefit from having electric cars.

So I will stop here. Thank you.

MS. PESTANA: Thank you so much, Gil.

So now that we've completed the introductions of our panelists, we can move into our panel portion. And thank you so much for those of you who have already listed a question on the Q&A. I'm going to be saving those Q&A questions until the end, so around 3:40. But to begin with, we'll start with just going through some questions for the panelists.

Panelists, are you ready for your questions? Alright, I see nods and thumbs up. Awesome.

So I think the conversation so far has started

mostly with electrification, and so I'm going to start with questions around that. Let's first dive into freight and delivery.

So the question is: With online shopping, e-commerce dramatically increased during the pandemic, and it's continuing to be a more frequently used option for consumers, so has this caused a net increase or decrease in vehicle miles traveled, or VMT? For example, many people go to the store and purchase many items and combine their errands to several stores. By contrast, you have Amazon deliveries, which may sometimes be smaller and more frequent. However, those deliveries can potentially be tied to routes that evolve less overall back and forth.

So has this caused a net increase or decrease in the vehicle miles traveled?

MR. ROETH: Yeah, so I suppose that can start with me, or maybe isn't for me.

You know, I think it makes a lot of sense what you said. I mean, we're seeing a lot of more delivery to homes, and that ought to cause more vehicle miles traveled, in particular for that final mile where, you know, in cars, we were already out anyway, most days, and now we've also got trucks delivering to our home while we're out near the stores. So there's a lot of that going on.

Now how that -- you know, how big of a deal is

that with respect to emissions and fuel consumption, you know, is a good question because, you know, we have efficiencies that we're gaining in other parts of freight movement, whether it's like hub-and-spoke, you know, distribution warehouses to local sorting centers and so forth, we've got some improvements in productivity and efficiency in other areas.

So you know, I'm sure there are some academic studies and some other places that are, you know, that are looking at this. And I think, you know, as we continue to evolve in our climate work and in our freight work and so forth, we'll learn more about whether this is something that should be, you know, really dealt with. I mean, there are ways to approach this. I mean, the old locker idea, you know, where maybe the package doesn't come all the way into the subdivision or can be picked up at, you know, a common place where we're coming in and out, you know, bus stations, other places, I could actually see maybe return, you know, in an interest. So, we'll see.

I think it makes sense, but I'm not so sure it's an area we should panic on.

MS. PESTANA: Excuse me, I'm muted.

It's interesting with the supply chain challenges, too, because we're seeing this decrease, manufacturers are seeing a decrease in demand for their

products. And so is the weakening of this demand alleviating the upward price pressures that we've been experiencing across the board?

MR. ROETH: Yeah, it might somewhat. I mean, you know, my whole time in freight, it's been about time and cost. And so when do you need your freight there? And you know, and then how much is it going to cost to move it? And so, you know, the more urgent this freight is, the higher costs. And generally, that's because in that case, we're not filling the truck up.

You know, if you get into, you know, very express types of modes of travel, you know, you'll see trucks delivering goods half full. If you have more time -- you know, I was on the phone with FedEx today, you know, they've got FedEx Ground, FedEx Express for different solutions for how quickly you need the goods there. And I think there will be and should be a more logical thinking around, you know, how quickly do I need it, and can I take more time if we if we have more time in it?

And you know, from the supply chain standpoint, I think as we come out of some of these challenges, and, you know, the quote unquote "horrible recession" might be in front of us, that might cause more consolidation of freight, more productivity and, you know, improve the situation rather than, you know, just get it there fast,

because I'm out of it, and causes more fuel to be burned and more cost in the whole network.

You know, this efficiency and productivity also can create less trucks. And so if we have less trucks, we have less congestion, and that helps our overall, you know, communities as well.

MS. PESTANA: Definitely really interesting effects we're seeing.

So I guess moving on to electric vehicle concept, we've had a few of our panelists comment on these. So as we've heard from the talks, just concerns with charging infrastructure, both for just consumer vehicles, but also for freight vehicles. Also charging costs is another concern of consumers. We have range anxiety for electric vehicles, and uncertainty about the federal incentive applicability, et cetera.

So for any of the panelists who'd like to answer, where do you feel like we are in terms of overall EV adoption and consumer interest in EVs?

I know Gil talked a little bit about this, but maybe you guys can comment a little deeper.

MS. BALDWIN: I'm happy to have Gil go first since this is his area, for sure.

MR. TAL: So I think that in California, we are behind the early adopters, these guys who buy the car just

because it's new. Now we are getting into more mainstream consumers that need to make sure that it's the right decision for them. And it's not just because it's new. It's not the Google Glass, we will buy it now and figure out how to use it later. It's something that needs to work for them.

We are lucky to have enough cars around that help people make these decisions because they have friends, neighbors, family that already have the car and they know how to use it and they know that it's fit for them.

Two caveats here. We have some communities around California that don't have the neighbors, they don't have the friends. And for example, we see that the used cars are staying next to the new cars. So some communities are not enjoying them because they don't know what they can do for them. They just stay there.

The other thing is that soon we will start to get to people who are not benefiting from it, but ACC2 will push more of these cars. So we have a couple of years of just enjoying it before we'll need to solve this really higher barrier, I believe between '27 to 2030, so something over there.

Yeah, so at the end of this decade, more.

And, Sara, do you want to comment at all on the effects of the Inflation Reduction Act?

MS. BALDWIN: Yeah, I'm happy to jump in. I'll just add one other point to Gil's excellent point, which is, you know, last year, California saw about 19 percent of all cars sold being qualified zero-emission vehicles, but that also includes hybrids and plug-in hybrids. And so I think if you're looking kind of wholistically, is the movement just an EV only plug-in movement? No. Right now it's still a dual fuel movement. And so I would expect the transition to begin to shift more towards pure EVs.

But also, you know, just on a cost basis, we're seeing plug-in hybrid vehicles because you have two systems to maintain, they become more costly over time. And no doubt, California is leading in the nation still, and I expect that only to continue.

And you know, I think, you know, our analysis certainly showed that the Inflation Reduction Act is going to be an additive and beneficial impact on top of state leadership. And I'm hopeful that more consumers, as they see more of these vehicles begin to get -- and as more models are rolled out, which we know is happening certainly in the light-duty sector but needs to happen more so in the medium- and heavy-duty sector, that we're going to see, begin to see more of these tipping point moments here in the next decade. But I absolutely agree, we have barriers yet to overcome.

And I'll just point out, you know, on the multifamily housing challenge, this has been a topic of conversation in California for some time. And in fact, I think Gil and I participated in a workshop nearly three years ago on this topic that the CPUC hosted. And I admittedly haven't tracked, you know, updates since then to find out what has been prioritized, but I believe that is one of California's biggest challenges. And candidly, more states are going to be having this challenge, too, as there's a lot of infill development happening all over.

MS. PESTANA: Yeah, I find it interesting too, talking to OEMs and asking them, you know, what are your needs in developing these next generation electric vehicles that are going to be on the market? And a lot of them have concerns about like, how can we make this a seamless experience for consumers? And how can we encourage them that, you know, this makes a better option than the ICE cars, the internal combustion engine cars that they're used to?

What are some of the barriers you see, at least from the consumer side? And how do you think that policy can help mitigate those kinds of barriers that consumers face towards electric vehicle adoption?

MS. BALDWIN: Gil, do you want to jump in?

MR. TAL: I will just pick two points here. One,

because we are at a CEC workshop, we will -- and we already have a problem with cost of electricity, even for home charging. I don't think we have the right tools for managing it. And both for home and for MUDs, if you pay for driving on electric more than you will pay for driving on gas, we have a problem.

We have tools for disadvantaged communities. We don't have good tools for renters. We don't have good tools for many Californians that are already paying too much. It's too much. Paying with driving on electricity is more expensive than driving a hybrid car in many rates in California today. That's like my number one more important than more chargers, more public chargers in the ground.

Second, we do need more chargers and we need reliable and dependable network because we will have more household that will have electric only and they need a dependable network that they can jump in and drive anywhere, anytime.

MS. BALDWIN: Yeah, I agree.

MS. PESTANA: Yeah. Excellent point.

MS. BALDWIN: And I would just add the ability to not just drive anywhere on your day-to-day commute, but the road trips that people want to take, the longer trips that they want to be able to do, whether it's up and down the

state or across the country. I am confident given the huge dollars behind the Infrastructure Act and the National EV Charging Network that we're going to begin to see a transformative landscape for EVs nationally and correlated strongly with our existing highway system. And I think that's going to be really game-changing for folks to just see it when they pull over when they're getting gas, they're like, oh, I can charge here, whereas that was not -- that has been the case.

And I actually just took a cross-country road trip this summer, so I can attest that you are keeping track of your gas station distances, especially certain places in the country where it's a long distance to get to anywhere, so you don't want to run out of gas. So the same applies, nobody wants to run out of a charge, and that's got to be a priority.

MS. PESTANA: Definitely. And it's interesting to see how, you know, the economics of installing chargers is -- it's hard for an independent company to just build the chargers, and so it really has to come from larger established players. And I think Mike Roeth was talking about this with freight, even with charging at the depots, making sure that we're getting the kind of funding from these, either the OEMs or from other bigger players in the space to build up that infrastructure. And definitely the

IRA is helping with that.

And kind of on that note of linking consumer interest in electric vehicles and adopting that, we have new technologies like bidirectional energy charging, so you can -- the feature where you can charge your car from your home, but also charge your home from your car.

And I was curious, Mike Sontag, if you want to chime in here and share, how do consumers feel about this and how likely is it that people will be using these kinds of technologies?

MR. SONTAG: Yeah. My personal view on that, you know, E3 has done a fair amount of work on, you know, vehicle-to-grid charging and vehicle-to-home charging as well. You know, I think it's a mixed bag on the vehicle-to-grid. There's going to be enough of a value proposition there to really entice many customers. But for vehicle-to-home, I think it's actually a huge selling point that's going to be really popular and uptake.

And probably, you know, my personal view is that that's what would drive the adoption of the technology that would enable vehicle-to-grid, if that makes sense, you know? People are already spending a lot of money on a Tesla Powerwall, for example. And if you get that effectively for free, just by getting a better inverter for your house, I think it's going to be a really popular

product.

MS. PESTANA: Go ahead, Sara. Yeah.

MS. BALDWIN: Thanks, Jill. I thought I'd use the raise-hand function as to avoid that.

So I definitely agree with Mike there. One often overlooked piece of this B2G or B2X opportunity are the technical standards that are necessary to ensure that the equipment is safe and that can run safely with the grid. There are very smart folks who work on existing IEEE 1547 standards and those certifications within UL. They are looking at this topic. And I know that California is an active leader on this topic and has been at the leading edge of IEEE standard adoption, but that has to continue.

And I think it's probably got to double down relative to where the technology is on the vehicle side. We are not there yet on the standards and integration into existing interconnection and grid safety standards.

So I will say, an organization I used to work with, excellent resource on this. Another resource I'll pop in the chat, but they're called IREC and they've done a lot of good thinking on this. So I'll put that in there for the host to share with everyone.

MS. PESTANA: Yeah, thanks for sharing that.

I definitely want to echo that the safety standards across this industry need to be updated even for

pack safety and development. A lot of them are historically rooted in lead-acid batteries or other battery applications that aren't necessarily vehicle applications. And so we're seeing greater causes of recalls and things like that with -- just we need some more stringent safety standards across the board.

So I'm really glad you brought that up. And that's something that I think California could be a leader in, especially. The whole world looks to us, right, for policy development, which is an exciting place to be in. So thank you for sharing your perspectives on those.

So I have another question. So when it comes to partnerships between companies, like you have -- we need the charging infrastructure; right? Do you anticipate that we're going to be seeing more partnerships that integrate charging companies with the original equipment manufacturers, like for example, the ChargePoint and Mercedes-Benz partnership, to create their own fast charging network in North America?

And I'm curious, aside from just consumer vehicles, also with the freight industry, what do we see any partnerships forming there?

MR. ROETH: Yeah, let's talk about the freight first.

Yes, I think there will be a lot of partnerships.

This is a transformation. And I was thinking about chiming in, in that last conversation, around, you know, vehicle to grid. I think there are lots of benefits of electric vehicles. But we don't need to be aggressively working on all of them right here at the nascent times.

I think, you know, I mentioned it in my opening that there's a lot of benefits to these trucks, but we have to figure out how to crawl, walk and run with them. And what I mean by that, and this is -- you know, we just may not be able to deal with everything that the technology is bringing in the early times.

Which brings me to this, to answer your question, Jill, I think we need collaboration early on here. I mean, this -- you know, trucking companies are used to stopping at the truck stop and not having to deal with, you know, charging and the charging in there at their sites. I mean, they do a little of that today with, you know, depot fueling, but they're getting into a lot of areas. I mean, trucking fleets don't know their utility, they just pay their bill, and they don't even know how to talk to the utility about the kinds of power levels we're talking about here.

So I think that's where the collaboration opportunity exists. I think early on here, a lot of consultancies, a lot of, you know, the truck manufacturers

partnering with some chargers early on here in the whole process will be very important.

We can't, though, forget that, you know, these freight haulers, they're businesses that are hauling freight and making money and surviving, one against the other. And so over time, they're going to want to, you know, break apart some of that one plate -- what is it, one-stop shop or that sort of collaborative sort of maybe trucking as a service model that -- or that's emerging. I could see that emerging and then, you know, some of it will continue, but some of that might sunset as these trucking fleets say, oh, wait a minute, I'll, you know, I'll learn how to deal with charging, I'll learn how to do with parking, I'll learn how to, to work with my utility on rate structures and so forth and so on. And they're going to want that just business management and they'll kind of take it back over time, if you will.

And I just think all that's real healthy, but I don't think they can do it here in the front end because of the dramatic changes that these electric vehicles are causing for their operations. It’s too much to learn and do too quickly.

MS. PESTANA: Very interesting.

Yeah, go ahead, Gil.

MR. TAL: So I think that your question is great.

It's adding this point that the main benefit we have for moving to electric transportation is also our main problem with infrastructure. It's really cheap, electricity is a very cheap commodity, and we don't have a good business model for our public infrastructure. And your question or your idea about collaboration, that's the business model. That's where we need to find more revenue sources for our public infrastructure.

The big box store told me many years ago, the reason they have a pharmacist there, it's because you wait 15 minutes or 20 minutes for your prescription to be ready and you buy something else. For the same reason they put Level 2 chargers, free Level 2 chargers for two hours, because you will stay another 20 minutes, you will already buy something when you are there.

The OEMs will sell more cars if they will have good partnership with the charging infrastructure. Tesla is making money, not from the chargers, they're making money from selling more cars. So an OEM that will have good partnership will sell more cars.

The business model, some people ask me, what's the business model? The business model for a good charger is the -- my subscription to my gym. They really hope that I will not show up every day, just pay for it every month.

So all of this collaboration, that that's the

future of the business of public infrastructure. So it's very, very important and we need to help with any policy we can help it happening.

MS. PESTANA: Yeah, and it's interesting to see the different approaches. Like I was commenting a little earlier about Tesla's strategy is just to kind of vertically integrate and buy all these companies to secure that supply chain and they have their certain parts of that business that generate most of their revenue, while as other companies are forming just more partnerships, they're not necessarily buying other companies, but they're forming those relationships that ebb and flow over time.

So I definitely think it's interesting to see these business models evolve in this industry and thank you so much for highlighting that.

From here --

MS. BALDWIN: If I may? If I may, Jill? Just one other quick point, just to resurface it because it is another rather esoteric piece of this puzzle. People are not paying close attention necessarily to what the U.S. Department of Transportation is doing on this EV charging network, but they are, in effect, providing a suite of new standards for all federally funded charging networks, which I'm really hopeful will create a greater consistency of experience for all charging users because right now it is

not uniform. You can have a very different experience depending on if you're charging a grocery store, your gym, your sidewalk charger, and in some cases you may find surprise, you didn't actually get a charge because that particular charging unit was down that day.

So I'm hopeful that with, again, greater standardization will become not only greater predictability, but also more cost-effective deployment of more uniform chargers across the country.

MS. PESTANA: Yeah, I'm glad you brought that up. I see, too, that when -- in these national federal level conversations about charging, you know, they talk about what are the pain points, and oftentimes it's hard to know why chargers are even failing to begin with. And so having these more established standards will bring light to what are the issues and how can we improve the experience for people, and that can definitely accelerate adoption. So yes, definitely hear you on that.

I want to shift a little bit to solar and battery storage. So do any of you have any final remarks on more of the consumer electric vehicle or freight electric vehicle state? Alright.

And again, for those of you listening in, feel free to fill out the Q&A. We'll visit those at the end of the conversation. I welcome any questions. There's no

dumb question or lame/stupid questions here. All questions are great, so ask away.

So moving on to solar and battery storage, in December 2022, the California Public Utilities Commission voted to approve NEM 3.0, a new net metering policy that will ultimately reduce the monthly energy bill savings for new solar owners. So based on the Inflation Reduction Act, would this increase the adoption of solar rooftop adoption for consumers?

No one is chiming in here.

Mike, do you have anything to add?

MS. BALDWIN: I'm just getting out my ten-foot pole.

MR. SONTAG: A bit of a lightning rod to chime in on. I haven't seen much modeling, you know, balancing the tradeoffs between NEM 3.0 and the IRA to really have much more (to take on it, other than that, you know, I know that consumer economics under NEM 3.0 for new solar owners won't look as good initially. And you know, I'm sure that the IRA will continue on with some tax credits. We'll suppress that for a little while.

I'm not sure if anybody else has a chance to chime in on that?

MS. BALDWIN: Yeah, I mean I think that metering, especially in California, but everywhere has been for its

existence a controversial policy, depending on how you look at it. But it was really, you know, not to go back to the origin story of net metering, but it was put in place to be simple and to be very straightforward on purpose. Because at the time, 20 years ago-ish, when the first net metering rules were put in place, the world was a simpler place relative to what it is today, especially with respect to distributed generation.

I do think to your question, Jill, that certainly, you know, the IRA incentives will be helpful in getting more distributed solar deployed. But it is really important that we're not sending adverse or conflicting messages with state policy or regulations about solar and its value if we want folks to adopt it. And I recognize that that's really been the push-pull conversation for many years. Do we want it or do we not? And how much? And who should get it? And where should it be? And how should we calculate the benefits? I do think that like you can get a little rabbit- holed on the topic if you're not careful.

I think from I think from a resilience standpoint and from a community and neighborhood and household resilience perspective, we absolutely need to continue doubling down on distributed resources. We know that our central station systems fail. And when they fail, they fail big. So distributed resources, whether you love them

or hate them, are part of the future. And we want to make sure that more people can benefit from them when there are outages, when there are events that cause, you know, catastrophes that affect people.

So that's how I continue to look at the distributed resource opportunity on the horizon.

MS. PESTANA: Yeah. Thanks for outlining that.

When it comes to solar, how big is this market in California?

And another question on that is: Will low-income incentives drive adoption of rooftop solar?

I know we talked a bit about how incentives are definitely necessary to enable people to afford electric vehicles. I would assume that it's this case in solar too. So does anyone want to comment on this?

MS. BALDWIN: I don't want to keep jumping in, but I would just observe that some of the same barriers that EV charging faces with respect to multifamily, as well as renters, you see the exact same challenges, split incentives, et cetera, for solar. So great that there are directed incentives for lower-income households, renters, rental situations, multi-units, but really addressing the underlying core issues in those scenarios is going to be more important than just throwing money at the problem.

MR. SONTAG: Yeah, I think about that a lot as

well, Sara, on what to do about multifamily and renters and whatnot. How can they get to the same benefits of distributed solar that other folks can? There's a lot of barriers that I think, you know, for different things that I think incentives alone won't necessarily fix. And it's getting more -- better to take more of the wholistic view like of what does the clean energy system of, you know, 2045 look like, and what role does distributed energy have to play in that, and then sort of figure out where to place it within the system from there.

MS. PESTANA: So what would you say --

MR. ROETH: You know, one thought there, you know, with these -- a lot of these freight facilities are big; right? They got a lot of rooftop. So the idea of solar, you know, is a big idea for resiliency of the trucking system and other things.

I think that kind of falls into that really tough situation I brought up a little earlier around, I hate to throw it back out there, but, you know, crawling, walking, and running. I mean, we don't expect a one-year-old to run; right? So we just have to -- you know, just what is too much to bite off? Because it's like, I see it every day, well, I have this challenge with electric vehicles. Well, then just do this or do that. And then you add this and that and the other, and now you've got a program that's

so complex that you just can't program management, manage it; right?

So it's how much, you know, like how much is enough for the early deployments? And then how do you add in some of these other complementary actions and technologies, solar would be one of them, to, you know, to help with the electrification, vehicle electrification?

It just needs to be done smart, I guess, and take advantage of the complementary technologies and complementary strategies that can be done. But be careful not to bite off too much is my -- because, you know, it can -- you know, these programs can get big by adding on more and more and more instead of taking more phased approach.

MR. TAL: I will throw in something that is right for electric vehicles and for solar panels. Low-income households always, in many, many cases, pay more because you cannot put the upfront investment. You need to spend a lot of money in order to save in the long run. And low-income households cannot buy a more efficient AC or a better house or electric vehicle or put solar panel and end up paying in the long run more than the higher-income households.

And we need to fix it in general in society. And it's not in solar panel issues or electric car issues.

It's much bigger than that. And I think it's really important to keep taking this wide perspective and find ways to improve it.

MS. PESTANA: Yeah. Thank you for bringing that into the conversation, Gil. I mean, we need to see that wages are kept so that people can earn a standard of living and make sure that people have access to their -- you know, get their needs met across the board, so thanks for bringing that up.

I guess from here, does anyone have any more comments on solar? Any comments on the commercial side? I know a lot of companies, for their ESG goals, are implementing solar as a solution to cut down on their carbon emissions overall for their business. And so we may see a lot more growth in that aspect when it comes to solar in the industry. Alright.

I'd like to touch on building electrification. This is just for you, Mike, I guess. So given the recent experience of the SB 1477 Tech Build programs, are you aware of any underrated issues that may hinder the scaling of building electrification efforts to meet California's clean energy goals? And what are the possible remedies?

MR. SONTAG: Yeah. So you know, I think a lot of credit goes to Energy Solutions and Appendix Dynamics, who have been running the tech program and putting out a lot of

great publications and data on that.

You know, I kind of touched on this in my talk earlier, but I think in particular, again, your workforce training and just bringing all of these different contractors up to speed who would be willing to go to door-to-door and be recommending heat pumps to folks, there's a lot that needs to happen to get everybody there. And I think it's a big part of the program that, you know, they're finding some challenges on just, you know, getting the full breadth of contractors for that.

And then again, on the install costs, you're kind of placing it high with the labor. But you know, it is a little bit higher than, you know, you would have expected building up the data from like equipment costs, you know, what is the prevailing way? How many hours would it expect to take just from other bottom-up analyses I've seen?

And so seeing what other complications are arising in some of these installations, as well as, you know, again, speaking to the contractors and how much risk they might be pricing into this is like, you know, I'm not quite familiar with the system, if I get called back two or three times, this is going to put me underwater really quickly. So how do we get those folks comfortable enough that they're, you know, pricing a lot more flatly and aggressively?

MS. PESTANA: Do you see any movement towards this talent development in the workforce? And if so, what are the different strategies you see for this?

MR. SONTAG: From where I sit, I don't touch that too much. I'd be curious if anybody else has heard this. But you know, one of the popular ways of doing program design is more of a midstream program where you incentivize the, you know, the HVAC contractors to be recommending the systems and whatnot. And I've heard some counter to that being that, you know, when the incentives dry up, it can be a little bit rocky or just, you know, big step changes for the business. So sometimes those are popular, sometimes they're not, to jump through those hoops. But I think ultimately it's a great way to engage contractors on that.

I'd be curious, if there are others, if you have other thoughts on that?

MS. BALDWIN: Yeah. I would point to California's Building Decarbonization Coalition, which has a pretty effective campaign, as I understand it, called The Switch Is On. And it's largely geared towards homeowners, so it doesn't necessarily reach out to the commercial sector. But it's, you know, a combination of energy education kind of fundamentals. And then really the value add, I think, of this campaign is that it really helps both homeowners and contractors connect and mutually understand

this opportunity and the benefits. And as I understand it, it's going pretty well, so I would point that I would point folks to that as a good example.

And, you know, I think also within the IRA, as well as within the Infrastructure Act, and different appropriations that are going to be coming down the pike through Department of Energy, keeping an eye out for new grant programs. I know for certain that Congress, with its multitude of programs, had very much intended workforce to be a huge component of these investments, and they want to not just, you know, talk the talk, they want to really walk the talk.

So look out for those grants opportunities, look out for those funding, targeting both states, as well as local governments. And I think California is a state that could absolutely benefit from tapping into those resources to build out this broader education and professional development campaigns for the workforce.

MS. PESTANA: That's really interesting to hear. I really want to check out that site, The Switch Is On; right? That sounds really good.

MS. BALDWIN: Yes. I will send this link today. I'll send that to others. You can share that with others on the call.

MS. PESTANA: Thanks. Yeah, I see in the battery

industry for training the workforce for gigafactories, historically companies will actually partner with local community colleges or universities and establish programs that people can take related to those job tasks. So I know I myself went through the entire California public education system and know that there's a lot that that can offer, as well, for people in workforce training, as well as trade schools, of course, probably more so than a university system for a lot of these roles, which is great because we really need workforce development, not just in the university system, but also trade school level, even high school level programs as well.

So I'm sure you can comment here at the university there.

MR. TAL: Yeah. No, this is really important, and it's true for charging infrastructure and it's true for housing and home electrification and everything.

I just actually wanted to close the loop on the topic back to something else that we are studying, which is the distribution network. We find more and more that with electrification, with vehicle transportation electrification and housing electrification, the stress on the distribution network will be much higher than what we initially expected, and the cost and the timing and the location.

We have a partial solution, which is smart charging. Today, we are always talking about smart charging as a way to reduce greenhouse gases and talking about smart charging correlated with generation of electricity. But smart charging in the local distribution network is also really an important opportunity and untapped yet.

For example, if in your small cul-de-sac, three people have electric cars and the new F-150s with 19 kilowatt chargers and so on, it will be very important to start to manage these chargers together. And it's an opportunity. It's an opportunity, especially if we are doing it for the houses and we're doing all of these upgrades all together.

MS. PESTANA: Go ahead, Mike.

MR. SONTAG: Oh, yeah, I was just going to say with the managed versus unmanaged charging, too, I think this kind of applies to building electrification just in rent design, Gil, to your point earlier, too. I'm really curious to see where that is all going to go and I guess what pricing we can incent to people to manage that better such that, you know, it is cheaper to serve those new electric loads than what we currently are on the grid. We can, you know, maximize the capacity factor of the grid and use that to put downward pressure on the rates, you know,

for participants to keep their volumetric costs lower to make charging and space even cheaper and, you know, kind of let them be self-sustaining.

I think there's a bunch of different mechanisms one could use to manage all of that, but I think it's something that needs to be explored more.

MS. PESTANA: Thanks for sharing that.

Oh, go ahead.

MS. BALDWIN: Sorry, one more thing, Jill. I keep interrupting. I apologize.

I think it's really important to keep in mind that building electrification is not just buying an electric appliance or piece of equipment. It’s really a whole -- it should, ideally, be a whole-home approach, because the more efficient that home is and the more weatherized that home is, whether it's, you know, really old or even moderately new, will fundamentally determine how much one is going to pay for their bills. So high rates don't always equal high bills if you have a really efficient and well-functioning building, but those are more rare than common.

So I'm excited about the opportunity for building electrification as a movement to actually lead people into the exciting world of energy efficiency which we’ve been, you know, hammering on for years and years, but it really

is the place to start.

MR. ROETH: Yeah, I'm glad you brought that up, because that's across all segments. I mean, we -- you know, it's just -- you know, the -- I'm going to say something I don't know that I want to say, but all of these exciting technologies have taken away, I think, possibly have taken away just good energy efficiency practices.

So you know, with trucking, for instance, we follow 85 technologies on tractor trailers. These are diesel tractor trailers that can save fuel. And we know that the average truck out there is at like six-and-a-half mile per gallon. But you know, we talked to, you know, hyper truckers with the latest technology getting 9, 10, 11 miles per gallon, and that's just basically energy efficiency things.

And too often when we look at electric or other technologies, we're like, okay, well, that's the -- that's what we'll focus on now and we'll quit worrying about aerodynamics and idle reduction and good tires and all the things in my world that are energy efficient. Same for homes. Same for businesses. And it's really important.

And for electric vehicles, it matters with range and weight and all those savings. If we can be more efficient -- it's not sexy, it's not, you know, what the fast companies and the Inc. Magazines follow, but we have

to stay very vigilant there -- I think I'm echoing the other speakers -- and not get caught up in them, you know, fancy new things and keep working on it. And there's fancy new things in energy efficiency. It's just sometimes not what we want to go work on.

So I'm glad you guys about that. It's important in all the areas we're working in.

MR. SONTAG: And echoing on that, as well, just joining the efficiency bandwagon it's, you know, while we have the customer touch points, I think it's important to do that.

And kind of the next place where my mind jumps on that, too, is making sure that there's a good financing option available for that at the end of the day. Like, you know, I've been in the same thought process, it makes sense. Like if you're going to do one thing, you may as well do everything. But you know, it increases the amount of like upfront cost, and I don't want that to be a reason that someone decides not to do anything at all. And finding some good way to finance that such that you spread the costs across that and kind of like, you know, maintain monthly savings and have a nice efficient building that's comfortable, you know, being able to tap into that, I think is important to get the financing part right.

MS. PESTANA: Definitely. Yeah. Thanks for

bringing up these important topics.

I'm going to shift a little bit. We're nearing the end of our question. So the last topics I want to touch on, there's three more, so telecommuting, transit, and affordability.

So for telecommuting, so pre-pandemic, about five percent of the California workforce telecommuted, and what's changed since then? And what do you anticipate it to change further in the short term in the long term?

MR. TAL: Telecommuting was my first transport -- or second transportation research, way before electric vehicles, 20 years ago. Following Professor Pat Mokhtarian, she used to be in UC Davis for many, many years. Now she's in Georgia Tech. And what she was teaching us, and it seems like it's happening here, if people commute less days a week, they will commute -- the few times that they do it, it will be much longer, moving up to a total or something like that, getting a bigger house because they only need to drive once or twice a week. If people don't commute, then they drive more in the evenings or drive more to other purposes. And in general, over 30 or 40 years that she's doing it, the benefits of telecommuting are always kind of eroded by human behavior.

So I'm not saying it's not going to help a little bit, but it's always kind of changed less than what we are

hoping that it will change. And I think that we already kind of see the post-pandemic kind of going back slowly to what it was before with some minor benefits that stays.

So I will -- in the '70s in L.A., they said, we don't need to build new roads, people will work from home and telecommute. No, it's not going to happen.

MS. PESTANA: Thanks. Yeah, it's interesting to see the trends and how a lot of it's driven by the companies themselves and what they want for their employees. So it's really company-to-company. Like I know at Accenture, we really stand for sustainability. And there's been large cutbacks on even like flying to go visit a client is now being policed a bit more. Policed is a bad word for this, but I mean just like cutting back on those kinds of travel just to cut emissions. And in fact, working remote is encouraged to cut emissions as well.

I'm not sure if you all have any perspectives on what you've experienced with different modes of this telecommuting or not, and where you see it going in the future? Do you think more and more people will continue to telecommute and more types of work, for example, may influence that?

MS. BALDWIN: I mean, I would jump in and observe that, as somebody who used to do a lot of travel for business in air flights, primarily, that I'm seeing more

and more hybrid conferences being made available, this workshop being, of course, all virtual. You know, it could have been a choice to convene everyone in person and all the flights and driving that would have been required.

But I do think that there is an awareness, A, that it's more accessible to have a virtual option, and that it allows for greater participation for more diverse stakeholders, which is, of course, core to a lot of other goals with respect to equity and diversity inclusion. Awesome. We want to keep doing that, especially public forums.

But I also think there's a recognition that not every event and conference has to be an in-person, that we can have good discussion, like dialogue, without having to, you know, get on an airplane and go through that rigmarole. So I'm hopeful that will continue.

MS. PESTANA: Yeah. Great. I've seen big impacts, especially amongst people who are minoritized in their workplace actually enjoying having -- working from the comfort of their own home. And I agree, for this workshop, it was nice to be able to participate from the comfort of my home. Thanks for the coordinators to arrange that I'm sure everyone attending is also grateful for that, though it would be nice to meet everyone in person at the same time, though. We'll have to do that another day.

And moving into public transit. So public transit use is down because of the pandemic but we really should be encouraging more public transit to cut emissions. So I'm curious what your thoughts are on the future of public transit?

MR. TAL: I can try as the transportation guy.

we need all-of-the-above kind of solution. We need to reduce VMT. And the way to reduce VMT is not to stay -- not only to stay at home, we just talk about actually staying at home as a good opportunity option, but not only to stay at home but actually to get to our destinations with other modes. So a good public transit is the backbone of reducing VMT.

And we need to do it with connecting our public transit with TNC, with smart transportation. We will not have these old school buses coming to every neighborhood. But now we have the tools to do it, so I hope that that we will see much more of that.

Of course, all of our buses and all of our public transit will be electrified soon, faster than our light-duty and heavy-duty trucks. Public transit will be the first to be 100 percent electrified in California.

MS. PESTANA: Thanks. Yeah. And just to clarify for listeners, I didn't realize what this initialism meant, but VMT stands for vehicle miles traveled.

And do you think, I mean, we talked about road trips earlier, will more public transit be developed that can be used in place of like shorter road trips or will personal vehicles remain the dominant form of personal travel?

I mean, my big question mark is, what's going to happen when we get autonomous vehicles? Because this whole electrification of vehicles is leading towards making autonomous vehicles and fleets of those, and will that be affordable for consumers? I mean, this is going to be a big disruptor when it comes on. And we're seeing more and more developments in that area.

MR. ROETH: Yeah, I think Gil, I mean, Gil said it nicely, I think we have to really think about -- you know, this is complex. And so wherever we can share rides, wherever we can share freight, I mentioned that earlier about, you know, trucks crossing with one box on it, maybe because of speed needing to get there, and how are we going to consolidate? That's going to be really high on our list of priorities. I don't know how you do that. I don't know, you know, policy wise and technology wise.

But I think, you know, the technology that's there to match capacity and demand, right, so you've got a bus and it's, you know, and you can be confident that that bus is going to be at the bus stop, you know, at 3:05, and

it's a 22-minute ride and I know I'm going to be there. That's one of the reasons why we take cars. One of the reasons why we ship, you know, one, you know, one truck from location to location and not try to add more freight is because we have the confidence that it's going to get there when it does, it's point to point.

And so I think, you know, we have technologies really helping in that way, mode shifting. You know, in my world, rail, let's get let's get off of these long haul trucks and consolidate and go on rail where, you know, one locomotive is pulling hundreds of cars versus one tractor pulling one trailer.

So I think, yes, we need to take advantage of that. How that actually happens, I don't know, but yeah.

MR. TAL: I will take two examples. I want to give two examples of kind of how it can happen. We talked about this, not the commuter, but the longer one. And we are talking about the high-speed rail, but it's going to take a while. Meanwhile, instead of flying from San Francisco to L.A. or from Sacramento to L.A., if we can incentivize four people to jump into an electric vehicle, and it will be semiautonomous, so on Highway 5, they don't really need to work hard to get there, that's saving energy for everyone.

So automated vehicles can be -- can help with the

solution, can reduce VMT, reduce, so instead of four cars or flights, we have one car and so on. But we need the policies to incentivize people to do it to push them to do the right thing. They need to know that it's fast, they need to know to know that it's cheap transit.

Today, we incentivize workplace charges, a lot of workplace charges, chargers that are owned by the employer. Workplace chargers should be at our transit station. So if we're talking about the Bay Area, every BART station, they need to be workplace chargers. So we will stop at the BART and take the BART or any other transit into our destination, so we will get -- we will charge during the day, plus we will take transit and drive more -- drive less, plus. So we need to think about how to combine these park and ride locations, transit locations to shift both charging and driving less.

MS. PESTANA: Yeah, that's a really good point, that it's going to take a variety of these technologies working together to cut, you know, emissions on a whole and improve the energy efficiency. And also just to make it simple for consumers to navigate these processes and technologies in a way that incentivizes them to use these tools at their fingertips.

Does anyone else want to comment on the -- we touched about it a little bit, the high-speed rail? And do

you feel like this is going to be developing? Where is this technology currently?

MS. BALDWIN: I will just jump in and say I'm not a rail expert. However, I sound a bit like a broken record with the continued mention of the Infrastructure Act. But again, tons of money allocated for the buildout of our existing rail system and, you know, upgrading it because there are a lot of older rail networks. But you know, depending on where you are in the country, a train or rail is really a non option. Here in Utah, it's really not. I mean, we've got a little light rail that goes up and down and throughout our valley. But on the East Coast and D.C. area and, you know, where there's a closer knit set of states and cities, it's integral for commuting.

So I feel like as we've got more and more growth happening in particularly western states, that's an opportunity for good early thinking about rail and anticipating that growth, as opposed to building it with a car in mind, and then trying to fit a rail system on top of that. That's always harder. So you know, to the extent California has places that is seeing -- that are seeing more growth now and projected into the future, you know, considering how to expand rail in those areas now is definitely the place to start.

MS. PESTANA: Yeah, thanks for sharing that. And

we see so many good examples of rail, both in the United States and abroad. I was just in Australia and I was just amazed how I could hop on a train and just get everywhere I needed to go without a vehicle there, even though it was a pretty remote part of Australia, so it's definitely possible. And I do see a lot of the public wants something like this, so I hope that we can work towards that. That's my personal opinion, I would say.

And as for affordability, it's become a hot topic, of course, especially because we need lower-income people to have access to these technologies to encourage the electrification and adoption of them. And so we talked a bit about the affordability gaps in households and how that it's affecting EV buying habits, and also for solar, and also for home electrification.

I'm curious if anyone wants to comment any more on how we can make sure that people, consumers, can afford this technology and adopt it?

MR. SONTAG: Yeah, I just wanted to give another plug for rate design on this. And to try a little bit more depth on that before, you know, rate design is a little bit complicated, but basically the amount of money that you need to pay in order to operate the -- or, you know, maintain the fixed costs of the grid, you know, the volumetric portion that pays for the energy and, to some

extent, the capacity as well.

And we put a lot of funding of things into our rates that, you know, I think that are all well and good, but things like wildfire costs and whatnot. I know the state's looking to reallocate those to more of a fixed charge, which, you know, might be a tough pill to swallow in some ways, but I think it opens the door to scale the fixed charge up based on income bracket, as well as putting less pressure on the volumetric rates where we would be charging our cars and, you know, pay for electricity and whatnot. I think it's a huge lever for the state to pull on to, I don't know, energy affordability, affordable for everyone across the income spectrum.

MR. TAL: So low-income in electric vehicles, of course, incentives is really important, and some something that you can just put money on and help people buy these cars, and then they can save using.

But I would like to add two additional things. So rate structure or the idea that we need to make sure that it doesn't cost people more to charge just because they don't own their house. It doesn't cause them more to charge just because they cannot install a charger at home or have solar panels all over the roof.

So finding ways to help people get the same benefit from electric cars, even if they're not living --

and that's the point here -- even if they're not living in disadvantaged community. Because sometimes we have these nice borders and everyone inside we can give them the benefit, but there are a lot of low income people who live in mixed communities and are flying under the radar when it's come to that. So we need to find tools to help everyone. This is one thing.

The other is just, again, because otherwise we will not talk about it, warranty and end of life. There are questions here about batteries end of life. The person who takes the highest risk of buying electric car is the last owner. If you buy an IC, a gas car, when you buy a ten-year-old gas car, you know that you may or may not need to put $1,000 on it in the first year of ownership. If you buy an electric car, it's way worth zero if the battery will die on you and it's a big risk.

So we need to help with better warranty, better systems that will help the last owner get the benefit of electric cars. The first owner, they will sell it before it will go out of warranty. So this is something that can help disadvantaged communities, and later everyone in California, when these cars will get closer to their end of their life and will be cheaper for everyone to use.

MS. PESTANA: Yeah. Thanks for roping in that end of life of batteries. And we have one of those

questions in the comments. So we can go back to that once we're in our Q&A session, too, to talk a little bit more.

I want to open up the end of this. So we just have a few more minutes before we're going to go to Q&A. So do any of the panelists have any closing thoughts they would like to share?

MS. BALDWIN: I can jump in, Jill, and it's a bit related to the last topic on affordability. I think for certain, utility regulators at the state level play an integral role in ensuring that, particularly, monopoly utilities are governed prudently, and that investments are wise and that we aren't burdening consumers with excess costs that are not additive to the ultimate goals that the state is trying to achieve with policy. And that goes without saying for those who know regulation, but it does not always occur. So just constantly hammering on that message within our regulatory paradigm, I think is really important.

One other piece there is that there's like kind of this broader umbrella of affordability and energy issues. We've lived through the last two years. We all know what inflation feels like and looks like. But there are some folks who are literally at the edge of a shutoff of their electricity or their gas. And during COVID, we put a halt to shutoffs and disconnections. We're starting

to see a new trend where that's happening and it's happening really quickly. And it's putting a lot of people in an extreme scenario ordering on homelessness and other really horrible situations.

So I think reexamining the approach that we take with utility shutoffs and disconnects is and should be a fundamental piece to all of these other great energy technologies, strategies and policies that we're looking at. That cannot be left out. We know that it worked and we've got to keep paying attention to that.

So those are my final remarks.

MS. PESTANA: Thanks Sara.

Would anyone else like to give a final remark here?

MR. TAL: I will be happy to throw in something. I think we live in a great times now that everyone is pulling in the same direction and pulling really hard. And you know, the CEC, PUC, CARB, all the state agencies. And everything we talked about today, all these things that we think can be done better is just because we are running really, really fast and we are, you know, trying to drink out of this fire hose and it's really moving fast.

So first, I really think that we're not saying all of that because things are not happening, because they're happening and they're happening in a very fast

pace, which is a great time to be in.

But if I need to ask for something that is kind of missing in the big picture is that when we put this new money in, when we have these new policies, at least when I was a student, they told me the next is implement, monitor update, implement, monitor, update. And I think that many times we are flying blind. We don't have enough of this monitoring, updating, and keeping this loop and making our decision based on actual data, maybe because we are doing so much of it and so fast, but we need to remember this kind of closing this loop again and again.

That’s me, the researcher, saying more research is needed, but, yes.

MS. PESTANA: I love it. I'm a researcher, too, so I concur. I concur.

MR. SONTAG: Yeah. And I think going on Gil's point, too, I really appreciate what both you and Sara said. You know, we're just going to be moving so fast, aggressive action is needed, and that feedback loop needs to be quick. And I think that, you know, puts a lot of onus on program administrators and whatnot to be collecting great data such that we can learn from it quickly and then re-implement it also quickly as well. But the feedback loop has been slow historically. You know, I want that to be as efficient as fast as possible.

MS. PESTANA: Definitely. And on that note, I just want to add, too, that there's so many services out there that are being built and currently in use to monitor KPIs and analytics across the board. And I'm happy to have conversations about what those tools are because there's a lot of new developments when it comes to data management and analytics that can be used to manage different stakeholders and manage different KPIs across the industries, especially as partnerships form.

And we have, you know, the charging stations and the EVs and different players all around the ecosystem that all have their data inputs. And we can look at efficiency from a bird's eye view and a big picture. And it's exciting to see the development of these kind of cloud solutions to monitor and track that data.

Mike Roeth, would you like to give a closing remark?

MR. ROETH: Since everybody else closed, I have to as well.

And so I think transparency, and just to build on the data, we don't have time to make even the smallest of mistakes. And I don't want to say that we have to be perfect here, but we do need to be real thoughtful. We can't be putting good-enough technologies or, you know, even bad technologies; right? For all the technology

salespeople out there, really make sure that you're helping the customer be successful. Don't try to put a square peg into a round hole. That's just not going to work here. And that's going to gob up the whole system. So kind of a motherhood and apple pie comment there.

But I think it's really important to understand your customers, customers understand the technology providers, and then really fit the technology right. I see it in trucking all the time, start and stop for hybridization, aerodynamics for, you know, long high-speed runs. I mean, some of that's very logical. But often times people are wanting to sell stuff and maybe uninformed buyers are buying stuff that's not right for their use.

And then we need successes. We need to get this right and transparency around that. And you know, people doing the right thing for the success of the end user is really important here.

Thanks.

MS. PESTANA: Thank you. I totally agree with that sentiment. And I mean, there's so many lessons that can be shared across these industries that I think having conversations like this can really help, as well as others. And I definitely agree with, you know, you want to be sure that the customer is being served in the end so that we can make sure that people's needs are being met with this new

technology. It brings so many opportunities for the public to have access to, you know, having their needs met in new and better ways than what we have previously, as well as help with human health because of pollution effects and cutting carbon emissions and different kinds of impacts on the environment. So really making sure that, you're right, that we're coming out with good technologies that -- Sara, like you said, standardizing technologies is also important along that route as well, which we're starting to see more of a trend in that, which is great.

Any last remarks before we go to Q&A? I'd like to leave plenty of time for that, so this is great.

Alright, I guess we can go to Q&A. And we started answering a question earlier, or I'm going to answer the questions asked in the online first. We had a couple.

MS. RAITT: Actually, Jill, if we could go to the Commissioners first, that'd be great?

MS. PESTANA: Oh, yeah, of course.

MS. RAITT: Okay. Thanks.

MS. PESTANA: Of course.

MS. RAITT: Thanks.

VICE CHAIR GUNDA: Thank you, Heather,

Thanks, Jill, for moderating an excellent panel again.

Gil, it's always a pleasure to see you, Mike, Sara and Mike. It's just really great comments.

I'm just kind of thinking and it's kind of like a full university graduate school credit. It's like the enormous amount of detail that you just kind of constructed in this. And there's so many pieces to kind of pull from. And I guess you guys did a really good job, you know, framing, you know, both the constraints, but also the opportunity with the electrification.

So I wanted to focus on the area that I work on, which is the electricity planning and the reliability portion. And, oh, Commissioner McAllister is here, so he can kind of dig into kind of the building side as well. So just at the system planning, maybe a couple of questions, both on the modeling as well as how do we plan electrification well.

So first on the modeling side, you know, you all kind of alluded to the need for data, using data, and then to kind of like having, you know, better projections in our planning and having an iterative way of doing this; right? So I want to share one background information, you know, if you're not following the reliability portion, and then ask the question. So the background is on September 6th, last year, we had this enormous deviation in demand because of extreme heat in California; right? So the CAISO system saw

a deviation of about 7,000 megawatts from what we would expect on an average day in September. That was two LADWPs on the top of CAISO system. And the way we got through that was really, you know, the text alert that went out and then, you know, resulted in a huge amount of demand drop, and then we were able to coast.

So as we think about the electrification, you know, what are your thoughts on -- I mean, you already touched on this a lot, but if you could synthesize, what are your thoughts on making sure the electrified loads are really grid-friendly from a system design, not only from resource planning and resource adequacy perspective, but also the opportunity to get through these extreme days; right? So if there's an amount of demand flexibility we could think about in resource planning, and then there's an opportunity in terms of demand drop and load shed in terms of getting through the extremes, if you could comment on, you know, the sectors you think about and how do we kind of plan that better?

MS. BALDWIN: I'm happy to jump in. But I also know Mike has looked at this, and his group has looked at this extensively. So I have a couple of thoughts on that.

The first is, you know, of course, the utilities, electric and gas, go through their typical planning processes, which help inform priorities for investments.

But I feel like, as somebody who's been an observer of those processes across the state, those can be a little rote at times and a little less honed in on what's actually happening on the ground. And it's definitely kind of the role of regulators and stakeholders who are participating in those planning processes to push the utilities to model scenarios that are reflective of today, not just history.

The other piece of that, and it's more directed to the electrification trends that we know are coming is, are we aligning electric utility planning with gas utility planning assumptions? Because I think in most instances, in most states, planning for a gas system is occurring over here and planning for utilities is happening -- or excuse me, electric utilities is happening here, and ne'er the twain shall meet.

As we begin to look at those two systems concurrently, we may identify opportunities for synergies and certainly for cost savings. Because right now we're asking consumers to pay for both systems and both have assumptions around pretty much exponential growth and never ending investments. So looking at those two opportunities in the near term, I think is a great place to start.

To your point about these extreme events and what needs to be done to manage them, I feel like that is a big question and one that's very, very important, and one we've

only begun to scratch the surface on because we've just never seen the scale of the events that we're now experiencing on a regular basis, so we don't have the history to draw from. We don't have, you know, oh, I know how we handled this back in 1982. No. Like we're really living through an era in which the extremes are more extreme.

You know, I do think modeling can play a role in helping us understand that. But I also feel like a lot more education at the consumer level to help them understand that they are going to play a role in helping to manage the grid. It's not maybe as extreme as like a prosumer type framework, but to just begin to have those conversations with consumers. But, yes, there are times when they're going to call on you for demand response to not charge your EV or what have you. And that's, sadly, that's a new paradigm.

So those are my thoughts.

MR. SONTAG: Yeah. My thoughts on the reliability part, especially, I see everything through the demand side in this. And you know, the way that I would see tapping into, you know, the text message that you mentioned, Commissioner Gunda, it was remarkably effective. But I don't know if you could rely on doing that every time to like send out the mass text and cross your fingers.

And I think the way to like tap into that same market, or like the same sense is if there's any way to, you know, get people to commit ahead of time, like if they receive some amount of money, that they would shut off some amount of loads, you know, similar to what we used with electric generators, if they get into things, if they don't perform, then they get some sort of penalty on that. But you know, I think that's the way to ensure some amount of reliability for that.

And you know, as you're mentioning, like, yeah, the extreme events are going to happen. And you know, if we really want to like get a deep resource on that, that we don't necessarily need to build out, I think that's probably the best way to tap into that.

MR. TAL: Yeah, I think you asked the $6 billion question. Just kind of the two cents for the $6 billion.

I think that we need to build the capacity for smart management. And building the capacity is, on the modeling side, looking at light-duty and heavy-duty distribution and generation together from distribution all the way together, which is really, really hard. Really understand where this, you know, six Tesla are showing up on the same small street. And there is the distribution with heavy-duty nearby. And we have a capacity issue, but we don't want them to charge when they are at home because

of the generation and the greenhouse gases. And we have the tools to do it, but we haven't started. We're now kind of looking at this elephant, each one, touch it from a different side. And smart charging today is only about generation. It's not about distribution, but we will have to combine all of these pieces together. So one side is modeling.

The other is creating the tools. I think that today we are going for very expensive tools, so all of our Level 2 have to have internet and so on. So we need to create the tools. And when we have the solutions, we can start operating this tool. It's not that we're not doing these things, but kind of need to align them all together.

MR. ROETH: Well, those were six Tesla semis with a megawatt hour battery pack each you were bringing up; right?

MR. TAL: Yeah.

VICE CHAIR GUNDA: So I just want to ask one follow-up question and I'll pass it to Commissioner McAllister.

Sara, I think you touched on this a little bit. So one of the criticisms we got right after -- I think, Mike, you also touched it -- you know, it was like, is electrification going to be really a good policy? You can't keep the lights on and then you're asking to

electrify EVs. I mean, there was a lot of split in the media, rightfully so; right? I mean, the questions, regardless of where they're coming from, the questions are important to answer.

Have you kind of looked into this, which is, you know, Sara, from your point of view, you talked about education of the future system, kind of like making people aware of that and setting as expectation. This is how the future is going to look like. And so you play within that future.

So have any of you, any of you, looked at data, anecdotal evidence that, you know, the consumers are generally okay with these changes in system and understanding the status is going to be difficult, or are we going to have to, you know, futureproof this a little bit more through policy? I mean, I just wanted to get your thoughts on that. Because that's my biggest fear is that we are going to lose momentum because we are in transition in so many places and might just have a perfect storm of disaster.

MS. BALDWIN: Yeah, really good question. I have not done any research with respect to where consumers sit with understanding not only just the gravity of this future scenario we're facing with all the new technologies, as well as reliability threats and so on and so forth, but I

do think that, on the whole, people are more aware of these events, you can't ignore them anymore.

And furthermore, climate change is very much front and center, whereas even just a few years ago, even in California, I would say, you know, the awareness among average consumers is higher than it's ever been before the climate change is real, it's happening. And this is our new normal is quite a bit abnormal.

But to your other question, and kind of the first part of it, we've done, Energy Innovation and in partnership with UC Berkeley, as well as GridLab and other organizations, have done quite a lot of modeling around, can we do a 90 percent clean grid with high electrification? NREL did something. We did something. I mean, we've done, you know, I wouldn't say enough modeling, but we've done sufficient modeling to this point to say, actually, yes, we can achieve a 90 percent clean grid with high electrification. And also that the cost to do so on the distribution side is not going to be overwhelming for consumers.

But I think where we are lagging and lacking is that models don't speak to experience. And so what needs to be done to help people get comfortable with this concept and have that direct experience with the change that needs to happen? That's where I'm, you know, constantly

searching because people want to have proof of concept before they buy in. So we're asking them to sort of buy in and then we'll give you proof of concept. So there's a little bit of a cart before the horse, I think, especially at that system level, the CAISO level, the ISO and utilities that are planning for these large system investments.

So I don't know quite what the solution set is there. But I know that that's the gap that exists.

MR. SONTAG: I'm optimistic that people will get it. You know, looking back to the hot days this summer, it was only really a couple hours that the grid was that stressed. And with enough warning, someone would be able to, if they needed to run the laundry or charge their car, I think would have been able to do so.

Yeah, I think the education that needs to happen, and I'm just saying, you know, people getting it, you know, with the drought and like just interacting with our natural world, like knowing that there is a finite amount of resources, I think people get it as far as like water goes, and we'll be able to extend that to electricity.

And I think other education stuff that probably needs to take place, too, is just to what extent do I need to be shifting my behavior around? Like, you know, do you need to turn off your entire house in order to keep the

lights on for everybody else? I don't think so. But you know, do you not want to like boil your tea and like charge your car and turn on every appliance then, you know, as well? Like, you know, kind of what's the expectation of what is a good grid citizen for that? And I think demonstrating that to folks would be a helpful piece.

I think that the media was able to spin things way out of control, just like California's lights are all going to turn off, and really that was obviously a very extreme representation of that situation.

MR. TAL: Yeah. We surveyed EV owners in California and they were totally not worried about the things. Now we are surveying people from the last two weeks, you know, the power outs we had in Sacramento, and it's looks like the people that are less disturbed about it are the EV owners, people who understand EVs. The people who are really worried about it are actually living in Texas, so we shouldn't be so worried about all of that.

But kind of if we do look at what we need, we probably will need to invest more in infrastructure. Because right now when you ask me how many charges we need, I said, oh, a car needs to be charged for six hours every three days. But if we want people to be flexible, they will need to have more charging, they will need to be connected to the charger more hours, and then to charge

less hours. So we need to calculate how much more infrastructure we need.

MS. BALDWIN: Yeah, and I would just add one more thing which I mentioned in our earlier comments, but I do want to reiterate, that there has to be a role for distributed energy resources on the system to help people feel more confident. And those who are able to afford rooftop solar and battery storage, awesome, but we need to make that more universal, more mainstream, and at the community level so that we're not, again, just relying on these big systems, oh, I hope they hold on. But no, we're saying, hey, we're going to actually decentralize to the point where we can have good backup systems for individuals, for communities, for community centers, for hospitals, and so on and so forth.

So I think it's a bit of a returning to some of the conversations that happened, you know, 15 years ago, where distributed generation was just becoming part of the conversation. Well, now we're back to, this is actually going to play a bigger role than we allowed it to today.

VICE CHAIR GUNDA: Yeah. Thank you all. Thank you so much for your comments and just to have your time.

I'll pass it to Commissioner McAllister.

COMMISSIONER MCALLISTER: No, this is great. This is along the lines of what I was going to ask as well.

So, you know, thanks everyone for your presentations. It's been super helpful and super useful.

I mean, I guess, you know, I think to Mike's point, but others have made it, you know, like the low duration curve, the piece of the low duration curve we're talking about is this tiny little point up there. And you know, historically, that's been the subject of like, okay, how many, you know, how much huge investment should we make just to avoid, just to sort of keep that peak, you know, satisfied or supplied?

And so I think I'm maybe on the hopeful end of the spectrum in terms of the ability of the demand side to come to play in there. And I guess, I mean, I'm kind of detecting a little bit of skepticism in this conversation about whether people want to -- are going to agree to modify their behavior.

And I want to just ask about -- there's a ton of stuff I want to ask, but I want to particularly ask about sort of strategies for mobilizing this load flexibility. And I don't think we quite have the lexicon figured out. You know, LBL helped with that report. But it's not all -- like not all demand responses create equal; right? And so there's a component of this that's permanent load shifting kind of load flex. And then there's the demand response, like once a year, kind of, you know, event based supply

side, whatever you want to call it. And so those are very different.

So I guess, you know, I live in an all-electric house and I have forked over control of my thermostat to one of these third parties and they -- and I've let them -- I've said, hey, go to town, you know, I'm happy to collect some credits, I don't want to worry about this. And you know, I was like, gosh, you know, they're not even calling me. They're not doing anything about thermostat because, you know, wouldn't I know? And so I logged on and looked and certainly, you know, whenever there's any issue at all, I'm being controlled. And I wouldn't even have been able to tell you, right, because I'm perfectly comfortable.

So I think there's a lot of that. There's a huge potential for things like that. And it largely depends upon not having people, you know, have to actively do something, but just them sort of getting -- sort of ceding some level of control in an automated way over their devices and having that ecosystem in place. So I guess, so far, I'm just pronouncing, I'm not actually asking a question.

So also just an observation, you know, that -- I mean, NEM came up and you all artfully avoided it. I don't want to go there either. But, you know, I think there is this question of like, look, if we are considering that the

distributed energy resources at the grid edge are -- we are considering those, and including, you know, demand side resource, we are including those in the definition of the system, then -- you know, and people are making these investments to improve their own reliability or whatever the reasons are, and if they're expecting some economic benefit relative to the cost of the grid, relative to their, their traditional utility costs, then they are going to, it makes sense that they would have to cede some control for those resources to contribute to the overall reliability solution.

And so there seems to be -- you know, I think some people miss that, that kind of appreciation that, yeah, there's a lot of private investment, you know, homeowners buy the solar and storage and everything, but it also, you know, it's with some expectation of payback. And it does make sense that there would be some commitment in order to actually realize that, that payback.

So anyway, my questions really have to do -- maybe there's a two-part question. One is just, you know, could you sort of talk about how you're thinking about automation at the grid edge in terms of as a tool for reliability? And I think it sort of is reflected in Vice Chair Gunda's question, too, but I think -- I can't remember who it was that brought up standards, you know,

IEEE and that kind of stuff. What sorts of issues and problems should we be trying to solve as the state to create that ecosystem and make it move forward?

And you might be aware of some of the things we're doing, like load management standards, et cetera, but I really want to kind of go sort of get your ideas about that. And is there any empirical work we could be sponsoring to really understand the -- you know, there's a fair amount of academic literature on this, but I guess just pragmatically, you know, maybe together with the other agencies, is there any empirical work we could do that would be really relevant to help answer this question about people's ability to shift load, you know, when push comes to shove?

MR. TAL: I will try to make the first crack at that.

First, I just want to say amen to your like idea of automating it. And as someone who studied behavior for 25 years, take the personal decision out of the equation as much as we can. Sign in for the program once, as you said, and that's it and never, never need to deal with it again. Every time you need to deal with it, there is a chance that you will opt out, so we need to make -- and if you ask, what do we need to study, we need to study how to make these programs that people will never, other than opt in

once, will never notice that they are part of it and minimize the interaction with the, with the customer. That's the number one rule. And you absolutely, 100 percent, right about it.

In my field of electric vehicles, I will give an immediate example of something that bothers me. I think, and I'm not sure if it's only the CEC or who should, we should not allow more than let's say 6.67 kilowatt home charger without managed charging. We don't want someone to put 19 kilowatts and his neighbor to put another 19 and the third neighbor put another 19 and all plug in at 5:00 p.m. when they come in at home. So we should find a way to mandate it. If you go over ten, or whatever number we decide, it's have to be managed. If you want to do it unmanaged, plug in and start immediately, do it slow.

And so it's not -- of course, it's a tiny piece of the story, but kind of like, I think, that we don't always have this final solution, one silver bullet, but this kind of policies, I think, can help.

MR. SONTAG: Also, I think, on the point for standards, I agree with what you're saying, Gil, that I think it needs to be as easy as like when you're installing a smart thermostat or EV charger, you like press a box on your cell phone once to say, I'm in, and then that is like the last customer interaction. You know, I think that

waiting until after someone's installed, it's probably going to cost way too much for customer acquisition for it to really make that much sense on a broad scale. And so ensuring whatever codes and standards we have are enough such that it's that easy when you do it, that there's -- you know, the OEMs are already synced up with a third party aggregator or a utility or something like that so that connection is already there.

And as far as like a data and modeling standpoint, I think the -- from where I sit at E3, the missing datapoint, we're trying to explore this in the CalFlexHub project, which is funded by the CEC with LBNL. But I think it's still not well characterized, either with or without price signals, you know, kind of relative to temperature and time of day, how much people will flex their load around and can do that.

And that's like the missing link to be able to circle that back around into the integrated resources plan proceeding and saying how much capacity we need on the grid. And having good hard data and certainty about how much load we can count on for that is what ultimately is going to get plugged into the IRP and gives it a more solid long-term revenue source to, you know, fund the, you know, adoption of standards or, you know, folks complying with that in whatever ways, you know, getting the pricing out

there for people to interchangeably like that.

MS. BALDWIN: I would just add the, we tend to focus a lot on the hardest to reach customers slash the hardest to convince customers. And I don't know that that's our best approach. And there could be an opportunity to explore the existing synergies with industrial customers who, in some cases, volunteered to make their demand more flexible for cost breaks and cost reductions.

There could be some really great synergies with fleet operators who we know are going to be charging during X number of hours. We know that's going to be a big load. Are they willing to modulate that for an exchange for credit for a benefit?

I think, you know, it kind of -- it somewhat goes without saying, but sometimes you have to say it out loud that not only do you have to make it easy for people, but you do have to make it beneficial. Asking people to do it out of the goodness of their heart sounds great. It won't work at scale. So what are we doing to tell people, this is a benefit to you? It may be nominal, but if somebody comes up to you and says, hey, you're going to get a credit on your bill every month because of XYZ behavior that we're going to automate for you, that's a sweet deal. As long as there's no fine lines saying, you know, you can't count on

service being there if you really, really need it. I think those are the kinds of programs to explore.

I always point to a Vermont's Green Mountain Power Program, because they have a really innovative concept of, you know, giving people rebates and incentives to, what they call, bring your own device, and it's combination of solar and storage. And basically, they give people money to install these at their homes or businesses. And it is an arrangement in which they can call on those resources when needed, but in other instances, they're just going to get an economic benefit and they can use it as needed.

So although it's a much, much smaller state, I think that that's one model to look at. And then I know that there are other models out there worth exploring that could be quite effective here in California.

MS. PESTANA: And I see what I see with -- as for what empirical work could be sponsored, for instance. What I see, for example, in Michigan is they're just getting a lot of funding for the University of Michigan to have like a charging program where OEMs can come and test their vehicles and whatnot at that facility. And they have a lot of battery capabilities in particular there.

And so that enters -- that opens up a lot of discussion and room for discussions around standards and

around those kinds of what do consumers need, what does the grid need, and how can we provide solutions there?

So I think the university system in California is incredible. There's a lot of work already in that area, and that could be an area to help bridge that gap, because there's so much research that needs to be done to figure out what the standard should even be. Understanding why electric vehicles are catching fire is an area that does need more research on because it's clear why it's happening. A lot of the time it's corrosion. But as far as what are the voltage and current thresholds to cause that ignition event are less clear. So more research to be done in those areas to establish those standards.

COMMISSIONER MCALLISTER: All really helpful. Thank you very much.

I don't have any other questions. I think we're basically at time. Maybe we can move to the public Q&A --

MS. PESTANA: Of course, public Q&A.

COMMISSIONER MCALLISTER: -- or public comment.

MS. PESTANA: So the first question, which we kind of already answered, "Do you foresee any regulation that" -- oh, wait. No, that's not the right session. Ready to go. Here we go.

"How are electric car manufacturers addressing issues with end of life handling of batteries?"

And I can comment on this, but Gil, would you like --

MR. TAL: You should probably take it, yeah.

MS. PESTANA: So there's a lot of different ways to address this. I'll say, in short, that Europe is ahead of this. There's a directive out, the Europe -- EU Battery Directive established in 2006. And there's an updated 2013 that mandates different protocols for recycling and reuse of batteries by certain years. And so they're developing what's called the battery passport system to track what are the materials inside of the batteries to ensure that they have a more efficient disposal.

I would also add that one of the ways to address end of life handling is to make sure that you're designing safe packs that last for their first life so they can be applied to their second life. So that's a major issue is a lot of times, sure, you'll make a pack, but it won't be even robust enough to last for its full intended first life, so more research in that area is needed.

And definitely in the U.S., we're seeing an uptick in recycling businesses coming online more and more. Economics is driving this. So the more that it's economically more incentive to get the materials from inside the batteries and use them in the electric vehicle industry, but also in adjacent industries, like the nickel

could be repurposed to steal, so these economic drivers are what's going to cause the recycling industry to blossom, so we're just at the initial stages of this.

But for now, end-of-life batteries are kind of housed in warehouses and waiting for their disposal or waiting for a second life. And there's a lot of people at work in that area.

Alright, we'll go on to the next question, unless anyone wants to add anything? Okay.

"Will there be enough lithium for all of the electric vehicles in your you are predicting?"

MR. TAL: Let's finish it. Yes.

MS. PESTANA: Yes.

MR. TAL: Yes.

MS. PESTANA: Yeah, I would say we're going to see a diversification of technology, so not just lithium ion, also sodium ion. And economics is going to drive that, so we're going to see a lot of different chemistries come online. And it's great that Australia, the biggest producer of lithium in the world, is a free trade agreement country with the United States, which is great for the IRA incentives there.

And our last question -- oh, did it answer live? Done. And then,

"In other words, what sustainable planning is being

done to ensure that there isn't a future significant hazardous waste crisis from the spent batteries generated from increase in EV deployment? We have to avoid trading one environment issue for another and just kicking the can down the line."

MR. TAL: I can add that Professor Alissa Kendall here from UC Davis is working on it quite a lot, and the State of California, working on tools to do it. We will need new legislation to make sure, for example, when you take a battery from a car today, it's automatically becomes a hazardous material, and you need all the different -- even if you're going to install it in another car, just by taking it off out of the car, it's a whole new set of rules.

Also ,recycling, we can move to new type of recycling of hydro recycling. So you have a habit in spoke when you use the first segment, first step just by making this inert material, and then you can ship it to the second location when you actually extract the materials that you can reuse later and so on. So there's a lot to do and it's already kind of walk in progress.

And for a change, I think that we have one topic that we will be able to fix and legislate before the problem is happening, because we have a couple of years. So we are lucky on that.

MS. PESTANA: Yeah, definitely, legislation will help.

And I would say, I would like to add that the lead acid battery industry is incredibly efficient. We have over 99 percent of lead acid batteries being recycled. So actually, the battery industry has a history of -- the battery industry has a history of great recycling and sustainability and low environmental impact, at least for that industry. And so I think I'm optimistic as far as ensuring that hazardous materials are maintained. And future chemistries we see coming on the market are reducing the use of toxic and hazardous materials. And so that trend in the industry itself will also be helpful.

Alright. Thanks.

MS. BALDWIN: I would just add one quick note. I know we're trying to wrap up. But I would just say that the emphasis on the domestic supply chain for electric vehicles and batteries definitely is not a free for all for the mining industry to ravage sensitive habitats and environments that we know should be protected. So this is not like, let's go back to 1800 and just have a heyday. This is the year 2023. We know that we can do things far more responsibly. And candidly, I think in the United States in particular, because we have environmental regulations in place, we know that we have a good process

to vet projects.

So I'm, you know, sensitive to those concerns. I think a lot of us are who look at this topic. But I'm hopeful that our existing and future regulations will ensure that we have responsible mining and extraction and processing.

MS. PESTANA: Excellent point. Alright.

MS. RAITT: I think that's all our questions, Jill, is that --

MS. PESTANA: Yes, we have finished our questions. And thank you all so much. This was incredibly informative. I learned a lot through this session. I'm sure all of us did. Thank you all for your time.

And thank you for hosting us, Heather.

MS. RAITT: Oh, thank you, Jill. Thank you so much. Really appreciate your time.

And Sara and Gil and Mike Roeth and Mike Sontag, so grateful for you being here and sharing your time and expertise with us.

And so now we will go ahead and move on to the public comment period. And so if anybody who is an attendee would like to make comments, now's the time. You can press the raise-hand function on Zoom, which looks like a high five, and that will let us know that you'd like to make a comment. And it's three minutes per person, one

person per organization, please. So we'll give folks a chance to just press that raise hand if you want to comment.

And then if you're on the phone and wanted to comment, you press star nine and that'll let us know.

Give it another second here. Raise-hand on Zoom or star nine on the phone.

Alright, Commissioners, it sounds like I'm not seeing any comments. We can wrap it up. That's the end of public comment period.

COMMISSIONER MCALLISTER: Well, maybe I'll just jump in, and Vice Chair Gunda, you can adjourn us. I don't think Commissioner Monahan has rejoined, so -- but thanks, Heather and Raquel and the whole team, IEPR Team, for putting together another amazing day.

We're sort of in this permanent revolution, and I know you live it every day, finish one IEPR and pick up with the next one. And the cycle is kind of inexorable, but really valuable, especially this year when we're going to be talking about some really relevant topics and, you know, continuing with the forward push of innovation on the forecast itself.

So both the morning and the afternoon panels were excellent. And just really kudos to gathering a group of experts that really complemented one another and really

helped to deepen the conversation on some really important topics. But, yeah, and then looking forward to all of the fascinating workshops that build upon this one become this year in the IEPR.

So with that, I'll pass the mic to Vice Chair Gunda. Thanks everyone.

VICE CHAIR GUNDA: Thanks, Commissioner McAllister. And I just want to reiterate your thanks to the IEPR Team. It feels like we just are in a perpetual cycle. Heather, thank you to you and your team.

I also want to just thank the panelists, all the public that took time to join us today and listen in. This is extremely helpful as we continue our conversation. But also to Nancy Tran and your team that kind of works foundationally on this element. So thanks, everybody.

And with that, I look forward to seeing all of you in the next workshop. And then we're adjourned. Thank you.

(Off the record at 4:09 p.m.)

CERTIFICATE OF REPORTER

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

And I further certify that I am not of counsel or attorney for either or any of the parties to said hearing nor in any way interested in the outcome of the cause named in said caption.

IN WITNESS WHEREOF, I have hereunto set my hand this 29th day of March, 2023.

MARTHA L. NELSON, CERT**367

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March 29, 2023

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