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CALIFORNIA ENERGY COMMISSION

In the Matter of:

Electric Vehicle Charging Infrastructure Assessment AB 2127	)))	Docket No.: 19-IEPR-04

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INTEGRATED ENERGY POLICY REPORT (IEPR) STAFF WORKSHOP

CALIFORNIA ENERGY COMMISSION

FIRST FLOOR – ART ROSENFELD HEARING ROOM

1516 9TH STREET

SACRAMENTO, CALIFORNIA

MONDAY, MARCH 11, 2019

10:00 A.M.

Reported by:

Gigi Lastra

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AGENDA

AGENDA

P R O C E E D I N G S

10:05 A.M.

SACRMENTO, CALIFORNIA, MONDAY, MARCH 11, 2019

MR. CRISOSTOMO: Good morning everyone. Can I ask you to take your seats so that we can get the meeting started? We're going to go live on WebEx right now, so if everyone can take their seats please.

So this is the time and place for the 2019 Integrated Energy Policy Report Staff Workshop on Implementing AB 2127, assessing electricity vehicle charging infrastructure needs. My name is Noel Cristostomo and I'm in the Fuels and Transportation Division at the Energy Commission. Thank you everyone for coming.

So just in case of emergency, please, everyone follow Energy Commission staff outside the building. We'll walk down to P Street and cross the street into Roosevelt Park and assembly, in case there is an emergency that requires us to do so.

To introduce the day, I'd like to start by highlighting my team members, Wendell Krell, Energy Commission Specialist, and Kim Ho, Fuels

and Transportation Division's Legal Student Assistant. And also throughout the room, you'll see familiar faces throughout the Energy Commission, including staff from the Energy Assessments Division and Research and Development Division as the scope of implementing AB 2127 requires us to closely integrate efforts across the demand forecasting and technology research areas of our work with infrastructure planning and analysis.

First, in the morning, we'll have nine presenters that will together overview of the arc of our proposed work. And topics will start broadly from our general legislative purposes and end with in-depth examples of technical modeling. So I will start with the legal background and process for AB 2127 implementation in phases, first in the context of the 2019 IEPR and ongoing through 2020.

I'll continue -- or our colleagues from ARB and the CPUC will continue and describe how AB 2127 dovetails with their work in vehicle and utility program regulation.

And next, we'll describe in depth how you'll need to collect the latest market data to

ensure that our analysis under AB 2127 is useful now and into the future and have colleagues from our research community provide examples of recent findings and highlight ways that you can contribute to ongoing infrastructure analysis.

After a break from lunch, we'll reconvene and prepare for an activity that intends to identify how stakeholders can contribute to the assessment. And so first, we'll review the meanings of terms used in the legislation to assist with this activity and that will let us more effectively work during the afternoon session. And I'll briefly highlight the need to enter the analysis with a system's approach in mind so that we can understand how the infrastructure elements work together.

And during this deep dive activity, I'm hopeful that it will be engaging and useful for collecting this information because there is a lot of data that needs to be collected to address the scope and we have to account for many related factors in this analysis. And so during this time, we'll have you have any afternoon breaks on your own during this hour and 45 minutes, and the deep dive, and then close by describing how to

engage and continue to support this analysis with your feedback as we move forward.

So on the topic of feedback, during public comments there will be three opportunities noted in the agenda. And if everyone -- if anyone went -- came early and was not able to pick up the presentations, they're available in the foyer outside. Feedback on those presentations will be available again during those noted times.

During your feedback, please use the microphone to benefit attendees on WebEx and for our court reporter sitting there. And introduce yourself and your organization.

Remote participants are muted, so please chat your question to the host or use the raise-hand button, so that your question can be asked.

And because there is a lot of material to present, please wait for questions until after the panels are completed so that we can ensure smooth transitions. And Kim will be assisting with timekeeping and showing five- and one-minute warnings for our presenters.

And so during these public comment periods to facilitate open discussion, we're not

going to be strictly moderating three-minute limitations, unless the queue requires us to do so. So please defer to the moderator, given the pacing of that specific section of the day. So please raise your hand if you'd like to raise a question, since we don't have the podium to account for the activity in the afternoon.

The workshop is being recorded and transcribed and these will be added to the IEPR Docket 19-IEPR-04 and posted online afterward.

So with housekeeping complete, we'll transition to a few opening remarks from leadership in the Fuels and Transportation Division, Kevin Barker, Deputy Director, and from the Energy Assessments Division, Matt Coldwell, who's the Office Manager for the Transportation Energy Demand Forecasting Unit.

Is Kevin --

MR. BARKER: Thanks, Noel.

Kevin Barker, Deputy Director, Fuels and Transportation Division. Good morning. Welcome everybody. Thanks for participating.

In today's kickoff for Assembly Bill 2127, the Energy Infrastructure Assessment, although the assessment isn't due until the end

of 2020 the work is critical right now in the EV space that we wanted to take up the issue in this year's -- at least start the issue in this year's IEPR. This is the first of three workshops we'll host this year on the bill and really encourage engaged participation to help shape and make the most of the assessment.

The EV adoption rate has really escalated and the infrastructure has not kept up with the pace. There are now more than 550,000 EVs in California and only roughly about 30,000 chargers, 20,000 of which are public charging. It basically equates to 20 vehicle per charger and the majority of those being Level 2 shows we're in great need of infrastructure solutions.

I've also heard anecdotes about long lines at DC Fast charging, which have been spurred by transmission -- or transportation network companies that make up about 20 percent of the charger and only a small percentage of the actual vehicles.

TNCs, like Lyft, are helping drive the clean transportation transition by offering options, like green mode, allowing passengers to choose electric vehicles. However, Lyft isn't

unveiling that option in California currently because of the lack of infrastructure and oversaturation of EVs.

The EV Charging Infrastructure Assessment will examine these issues and push the envelope of what's needed for up to 5 million vehicles by 2030. It will examine infrastructure needs as we decarbonize the ports and airports, a subject of next month's workshop. We'll look at optimization of charging and mobile charging, which are key topics to think through as we have limited funding resources.

Every week there are new products announced or acquisitions, which does keep us optimistic about achieving the scale needed to reach the state's goal.

I'm proud the legislature has put faith in the Energy Commission to pull off the monumental task of assessing the infrastructure needs. And I'm looking forward to working with everyone and hope today's workshop is productive.

Thanks.

MR. COLDWELL: Good morning everybody. So I am not Siva. Siva is my boss. He sends his regrets for not being able to be here this

morning. My name is Matt Coldwell and I'm the Manager of the Demand Analysis Office, which is part of the Energy Assessments Division.

So in the energy -- for context, in the Energy Assessments Division, one of our primary products is producing the state's -- or the California Energy Demand Forecast. And a key element of that forecast is the Transportation Fuels Forecast. And you know, for today's discussion, you know, we're -- it includes a forecast of -- you know, why it's important for today's discussion, sorry, is electricity, you know, forecasting electricity as a transportation fuel.

And so the reality is, and Kevin sort of touched on this, is that electric vehicles are coming and they're coming fast. And our Transportation Forecasting Team has the challenge of forecasting just how fast they are coming. And I see a couple members of our Transportation Forecasting Team in the back, so if you could raise your hand for me, Mark and Bob and Elena. Yeah. So if you have any discussions on our transportation forecast, those three are a great resource for you.

So, of course, the team incorporates several inputs and assumptions when forecasting the number of electric vehicles in California. And, of course, they're also continuously looking at ways to best reflect or best capture and reflect the changing EV market conditions in California.

So some of the recent refinements that they've made to the light-duty vehicle forecast includes updated forecast on battery cost and range, as well as a deeper dive into the effects of incentives and regulations and their impact on zero-emission vehicle uptake.

So currently the team is working on a new California vehicle survey that will soon be released that kind of keeps the pulse on drivers' preferences. And that survey, unlike the previous survey, has much more emphasis on the impact of the availability of charging infrastructure.

Also, the team is currently refreshing the vehicle attributes that they use, the vehicle attribute assumptions, both for the light-duty vehicle sector and the medium- and heavy-duty vehicle sector. And so that will -- should be

reflected in this year's transportation forecast. And so they're continuously look at update the information that we used on forecasting the market.

And then finally, importantly for today, the availability, location and type of charging are key inputs to the transportation forecast, given that consumer choice is really driven in part, at least, by the availability of charging and the consumers' comfort level knowing that there's sufficient charging infrastructure available to them.

So the Energy Assessments Division is really excited about the AB 2127 Infrastructure Needs Assessment. And one, it is ready to lend its expertise and services to help develop the assessment. And then two, of course, we look forward to being able to incorporate the information that's generated by this assessment into future transportation forecasts.

And so just a couple of things, just to finish with that I wanted to keep on everybody's radar is one of the -- part of the California Energy Demand Forecast, we do Demand Analysis Working Groups. And so we have a specific one

that we're doing on transportation where we gather expert input on some of the things that we should be considering in our transportation forecast, and so that's something that we'll be doing later this summer.

And then finally, of course, as I mentioned, we'll continue to coordinate with the Fuels and Transportation Division, and Noel and Kevin and their team, on gathering the insights from this assessment and incorporating it into our transportation forecast.

So that is all I had and so thank you very much.

MR. CRISOSTOMO: So thank you to Kevin and Matt for those introductory remarks.

So for my next presentation, I'll be reviewing the process and requirements coming into our AB 2127 assignment. I'll review the legislative background, how the AB 2127 assessment will dovetail with the current Integrated Energy Policy Report, and then highlight potential outcomes of our analysis.

So AB 2127 was passed amidst California's more than decade-long effort to mitigate climate change. And last year it was passed from the

legislature and signed by Governor Brown. And this was -- 2018 was a notable year for transportation because the Air Resources Board's greenhouse gas inventory reported that transportation continues to be the largest source of emissions and is increasing. And so when you account for tailpipe emissions, petroleum production and oil refining, it is the largest source of, more than half of, the greenhouse gas emissions in the state.

And more specifically, a different ARB report related to SB 150 found that the number of single-occupancy vehicles commuters is increasing, almost in every region, and housing demand is outpacing needs which is increasing commute length. So there's a lot of work to be done to electrify the sector.

And so to reduce the emissions, that electrification effort is going in parallel to a decarbonization of the power sector where by 2030, California has set goals through legislative direction and executive orders to deploy 5 million zero-emission vehicles, reduce greenhouse gas emissions 40 percent, and have the power system 60 percent renewable, on its way to

a 100 percent clean energy system by 2045.

This AB 2127 effort builds upon years of analysis and funding to enable the installation of charging infrastructure through the Commission's programs, like the ARFVTP and, more recently, the CPUC's oversight of transportation and electrification programs under SB 350.

However, more work is needed to make sure that the state's aggressive electrification goals are met. And so AB 2127 was codified in Public Resources Code 25229 which directs the CEC to lead a biannual stateside charging infrastructure assessment to meet the 2030 goals. Specifically, it directs the Commission to expand its electric vehicle infrastructure projections analysis to consider all necessary charging infrastructure, including charging, make-ready electric equipment, hardware and software, and other programs to encourage the option.

It also requires an examination, not only just of light-duty vehicles but all vehicle categories that are driving on roads and using highways, but also off-road vehicles, port and airport electrification. Further, it requires the Commission to examine future needs and

existing needs throughout the state, particularly in low-income communities. And during this process, it will require us to continue to engage our stakeholders, who are active in many proceedings throughout the state.

And so this workshop is a key effort -- key first effort in this process.

The tasks posed by AB 2127 are both broader and deeper in scope than the Commission's electric vehicle infrastructure projections analysis, which I hope many of you are familiar with, which quantify the charges needed for the personal light-duty vehicle sector by 2025.

And so on this slide, I highlight a non-exhaustive list of macro-level factors which influence the quantity and types of charging needed in the 2030 timeframe. So on the top row, I represent how policies that intend to reduce emissions, clean tailpipe emissions from vehicles, and plan for more sustainable communities could affect the modes and types of future infrastructure for transportation electrification.

In the middle row, cost reductions of the battery energy storage -- battery energy storage

systems, advancements in charging technologies with higher -- increasingly capacities for charging, and the three revolutions of automation, connectivity and sharing, these are all representative of how changes in the vehicle technologies' sector have the potential to change customer expectations related to infrastructure and improve access to cleaner mobility options.

However, actual outcomes for travel demand and emissions are dependent, particularly in that last box describing the three revolutions, are dependent on the extent that which electrification, automation and sharing are pursued together or independently of one another. I encourage you to look at a UC Davis report on the three revolutions.

And then on the bottom row, renewables are changing the underlying way that the grid, which will feed electric transport, is operating. And so our infrastructure will need to function differently in order to cost-effectively operate and connect to a smarter modernized electric grid.

And so all these macro factors are things that I keep in the back of my mind and want to

make sure we're cognizant of as we go down this analysis for the next roughly ten years.

So given these many factors effecting charging infrastructure and the needs as AB 2127 describes it, it's useful to think about how regulatory policy actions -- regulations and policy actions drive the supply of and can facilitate the adoption of new EV technologies.

However, it's important to recognize that these infrastructure needs and our policies to support infrastructure deployment are subject to market forces and whether the solutions that we are offering are compelling for customers. In addition, there might be factors that are hard to account for in our policy efforts and in our analyses due to high variability, for example, travel demands across regions, or real estate costs and transaction costs for customers, or those variables might be simply unknown because of the newness of the technology or a lack of understanding of how the mass market will -- how the mass market will respond.

And so therefore at this early junction, as we start AB 2127, we consider our effort to analyze technology and model the needed charging

infrastructure throughout California to be a process. It is one that will be informed and be an informant to the state's emissions scenarios and our best estimations of future outcomes by 2030. And this analysis is one that is -- will be one that's subject to learning by doing because driver behaviors and systemic factors that are, at this point, unknown may affect how we go forward, for example, in the second biannual assessment.

So how might this work in practice? Because AB 2127 became effective January 1 of this year and it requires the Commission to complete an assessment at least every two years, I outline here a proposed process to phase our assessment in conjunction with the IEPR.

So due to the large breadth and depth of the analysis required and the lack of complete information that is currently available to the Commission for all the different vehicle sectors that are listed and for all the infrastructure elements that are required in the assessment, the Commission will conduct the assessment in phases.

So implementing AB 2127 is a key part of advancing zero-emission transportation, which is

a primary topic in the 2019 IEPR scope. The IEPR overall will be finalized in January of 2020. So to meet this timeframe, Staff are today conducting technical and policy analysis as part of our ongoing work as part of the ARFVTP or EPIC and demand forecasting programs and are investing the development of technical models with our research partners. However, to acknowledge this greatly expanded scope, during the March to May timeframe, essentially now, we are going to have to collect information from stakeholders and develop scenarios to run with these models that are, again, currently in development.

This will allow a short time for analysis and drafting in advance of a June deadline for the IEPR, which must be assembled, reviewed and commented upon during the key three and key four parts of this here for approval late in 2019.

So during the next quarter, in support of this effort, the Commission will be holding several workshops that relate to our data collection effort. These will focus on on-road vehicles today and could include workshops related to the off-road sector, important airport electrification, recent developments in the

electric vehicle markets, and a workshop, potentially, on the grid impacts of charging.

So this is -- it is not likely that all the information germane to AB 2127 implementation will be available to us prior to this May deadline, as 2019 progresses the Commission will continue to collect input data and assumptions for our quantitative analyses. Again, these are in an ongoing development and we may need to complete more discreet technology analyses outside of the modeling efforts.

So due to the breadth of information that is required, these ongoing efforts will be relevant to a second AB 2127 report that the Commission will prospectively publish by the end of 2020.

So given the rapid timeframe for this first assessment, that its scope is part of the IEPR, we will be focused on a collaborative and applied analysis. And so what does this mean?

We will need to leverage information and feedback from you all because that will form the basis of an independent and objective technology assessment that meets the requirements of the legislation. These may include transportation

demand models similar to the current EVI-Pro tool. But given the additional elements that are subject to the Commission's review, these could also include technology surveys and site-specific infrastructure assessments, for example, for vehicle modes that operate more independently outside of a transportation network.

And lastly, we recognize the role of the assessment as a key part in answering pressing questions at several interagency and local efforts that need to understand the availability and sufficiency of existing infrastructure, the needs for additional new infrastructure to be built, and third, the sensitivities of the existing network and future projects according to changes in technology demand -- technology and vehicle demands.

And so with that, to set the stage, I'd like to turn it over to a series of presenters from my sister agencies, the Air Resources Board and the CPUC. And that will lead into a presentation from Wendell, which will lead into a presentation from our researchers.

So I'd like to introduce, in a series of presentations that can just rotate one after

another, Kathy Jaw from the Air Resources Board, Joshua Cunningham, Chief of the Advanced Clean Cars Branch, and Tony Brasil from the Medium- and Heavy-duty Technology Section at the ARB. And then Carrie Sisto from the Energy Division, Lead Analyst of the T.E. programs there.

So, Kathy, you can present here. Thank you.

MS. JAW: Thank you, Noel.

Good morning everyone. I'm going to begin the Air Resources Board's presentation today with an overview of our planning process, especially how we develop our mobile source strategy and what it looks like. Following me, Joshua Cunningham and Tony Brasil from CARB will present the implementation of our On-Road Light-Duty and Heavy-Duty Trucks Regulations.

At the core of our planning process are our goals related to climate, air quality and health. Specifically, over the coming decades, California will need to attain federal air quality standards for ozone in the South Coast and San Joaquin Valley in 2023 and 2031, and fine particulate matter standards in 2024 and '25.

Noel touched on several 2030 targets for

5 million ZEV deployment, reductions in greenhouse gases, and our renewable portfolios. In addition, we also have a petroleum use reduction by up to 50 percent, all in 2030. We also need to minimize the health risks, such as risk from diesel particulate matter, and other air toxins in our local communities.

Emission reduction from mobile sources are the key to meeting all our goals. Mobile sources include both on- and off-road mobile sources. For on-road, we have cars, buses and trucks. Off-road mobile source covers a wide range of off-road vessels, vehicles and equipment, for example, ocean-going vessel, harbor craft and cargo handling equipment at seaports, locomotives at railyards, aircraft and ground support equipment at airports, forklifts, and transportation refrigeration units and warehouses.

As showing in this chart here, mobile sources are the largest contributor of the formation of ozone, greenhouse gas emissions, PM2.5, and toxic diesel particulate matter. Consequently, significant cuts in pollutions from mobile sources will be needed to meet our goals.

But more importantly, given the interconnecting nature of California's goals, a coordinated planning process is essentially to address the interplay between pollutant and sources and to optimize a combination of regulatory and incentive-based programs.

Given what we discussed in the last slide, we need to look into the planning process as an integrated approach toward analysis and planning. This type of assessment allows us to develop how -- a strategy then to meet both air quality and climate goals can best complement each other. Specifically, the analysis helped to inform the scope and timing of needed advances in technology, fuel and energy sources in the interplay between measures, all of which guide long-term policy development and maximize program effectiveness.

The result of this analysis has informed a number of planning efforts at CARB, as I listed here, including State Implementation Plan, the recent Scoping Plan Update, the California Freight Action Plan, and the Short-Lived Climate Pollutant Plan.

The development of integrated strategy

relies on three elements. First, the success of current programs provide a blueprint for future policies and approaches. Second, detailed technology assessment evaluate the capability of technology and fuels that are becoming available today and advancements that are expected to occur in the near future. Third, scenario analysis provides a framework for a coordinated air quality and climate assessment by analyzing the type of technology, fuel and energy sources that will ultimately need to make up our vehicle and equipment fleet by the end of next decade.

So in the next -- ARB staff, in collaboration with South Coast, published a series of technology and fuel assessment reports for heavy-duty applications to understand, what are our technology options? In addition, CARB partnered with previous federal administrations, USEPA and NHTSA, on review of advances -- advanced light-duty vehicle technology as part of the midterm review released in 2017. The assessment identified technology performance, necessary fuel, as well as evaluation of market readiness, cost, environmental benefit, and current deployment challenges.

The basic conclusion of the tech assessment is that the technology needed to meet the state's goals are available. Zero- and near zero-emission technologies are available across various mobile source sectors and applications. And coupled with this technology advancement, cleaner renewable fuel can provide significant greenhouse gas and petroleum use reductions.

Informed by current program and technology assessment, the scenario analysis framework we developed, which we named Vision, enabled us to examine the magnitude and timing of the deployment of -- deployment that's necessary to meet climate and air quality goals.

Scenario modeling is an iterative process. Understanding the interaction informed further scenario analysis and how strategy can best complement each other. Models provide a unique opportunity to understand the intertwined nature of different policies. For example, deploy a greater number of light-duty battery-electric vehicles provide co-benefits across all pollutants and decrease petroleum use. At the same time the associate increase in electricity demand must be coupled with greater use of

renewable energy generations for climate goals.

This figure shows the general framework of the Vision model using CARB's official inventory, in fact, as a starting baseline, we can make assumptions at a sector or application level about when a new technology is introduced into the fleet, its effectiveness, and rate of penetration.

We also make assumptions about fuel and their feedstocks. Through this process the Vision scenario analysis allows us to better understanding the interaction of strategies across the full transportation system, both well-to-tank and tank-to-well.

The mobile source strategy proposed a suite of measures that represent a course set of actions to drive technology development and deployment. This action centers around expanding ZEV technology and continue to push for ZEV penetration, curbing vehicle miles traveled by smart growth and promotes shared mobility and active transportations, expanding the use of cleaner renewable fuel in the sectors that are anticipated to continue to operate on combustion technology. And both incentive and demo projects

support deployment of new technology.

Strategies identified during the planning process are the starting point for reg development. And Joshua and Tony will provide on the regulation side but before then I want to convey the scale and magnitude of changes needed in the light-duty vehicle and heavy-duty sectors to meet our goals.

So on this chart, it shows the two -- it shows two things. First, the area charts represent the projected population of vehicles by technology in California fleet. The yellow dashed line shows the sales rate needed for this population. The star indicates where the current regulation will get us in terms of sales. In this scenario, we get 4.2 ZEV by 2030. When coupled with additional ZEV that are needed for South Coast to meet our air quality standard, we need 5 million ZEV by 2030.

And this chart shows the transformation for heavy-duty trucks. In this expanded ZEV scenario, zero-emission trucks demonstration project and the requirement for ZEV trucks in local fleets helped accelerate the zero-emission truck into border truck sector post 2030.

This concludes my presentations and I would like to pass the presentation to Joshua.

MR. CUNNINGHAM: Thank you, Kathy.

Good morning. Appreciate the opportunity to present to the Energy Commission this morning. I want to start by building off of one of the final comments that Noel had in his presentation.

Our teams strive to work as closely together as we can. And one of the final pieces he noted was that we, at the Air Board, rely on technology assessments for infrastructure as it goes into our vehicle regulatory decisions, and it's absolutely true.

And so it's one of the things that I want to emphasize as I go through my slides is that we, as we develop two primary new vehicle regulatory efforts over the next couple of years, the update to the ZEV regulation for Advanced Clean Cars 2 Program that looks at regulations beyond 2025 for EV mandates, but then importantly the new Clean Mile Standard for idling vehicles. So both of these are regulatory efforts we're developing over the next couple of years.

And so there's an iterative process or a closed-loop process where our reg development,

where we focus primarily as our expertise on vehicle technology assessments, we want to make sure we're sharing some of our lessons and ideas and thoughts with the Energy Commission staff, both in the energy assessment, as well as the demand forecast teams.

But then we need to learn from the iterative process on the infrastructure assessments that come from the Energy Commission staff to inform our stringencies because critical for our Board to make decisions on new regulatory decisions, the stringency of our policies we have to evaluate are the barriers that inhibit us pushing at certain levels.

And so having a good sense of the infrastructure barriers is critical for our Board to be able to make our decisions to adopt the policies that we all see as necessary to move forward to meet our long-term targets.

So a couple of quick slides for context. Some of this has already been mentioned.

This graph shows the sales to this point annually for plugin hybrids, battery-electrics and fuel-cell vehicles. Last year, with the Model 3 coming to market, there was a big jump in

sales which is great to see. We'll have to monitor the market this year to see if we're able to maintain the sales rate, but an important year in 2018 for California.

But conveying something that I think Kevin mentioned at the beginning, that we now have over half-a-million plugin vehicles in California and a growing amount of need for DC Fast charging, you know, other infrastructure to support that.

Another quick context slide, Kathy's team, and she mentioned this a little bit, has just finished some updated well-to-wheel assessments that we're going to start using at the Air Board for some of our vehicle regulatory efforts. This incorporates some of the newer requirements for renewable electricity at the grid level. And so I highlight this because, as Noel mentioned, over half the GHG emissions inventory for California is transportation.

One of the key motivations for electric vehicles that I think we're all recognizing is the big bang for the buck per vehicle in California with our increasingly green grid and zero-tailpipe emissions. You get, for a few

number of vehicles, a larger amount of the GHG emission reduction, so that's why it's an absolutely critical strategy. But as I note here, infrastructure is an enabler that we need to move forward with.

Okay, a couple of slides to hit on my main messages.

So our current vehicles regulations for automakers max out in stringency by 2025, including the ZEV mandate. And our current projections that we updated a year or two ago for minimum compliance with the zero-emission vehicle regulation shows that we are going to get probably about 1.2 million ZEVs as a minimum from our compliance. With the sales that we're seeing next year -- or last year that we hope to see continue, we may exceed that which is good. But because our regulation only guarantees up to 1.2, 1.3 million vehicles by 2025, we absolutely see the need for increasing the ZEV requirements.

And so we've started a rulemaking process we intend to go to the Board with in the next two years. And part of that will be dwelling on some of these guiding principles. So our Advanced Clean Cars package includes regulations for

automakers on the ZEV regulation, which is the bottom piece of that pie, but also our Vehicle Greenhouse Gas Standards that effects all vehicles sold in California, and Low-Emission Criteria Emission Standards to address the criteria pollutants that go into forming ozone.

And so we've started to discuss with stakeholders these key principles, and I just want to dwell on a few that are most applicable to the ZEV requirements.

The second bullet there, we've have clear direction from our Board and from a lot of the stakeholders that as we develop the next round of the ZEV regulations, we want to strive to design the policy to increase the certainty on the number of electric vehicles you get for the credit structure that we have in place. As you may know, in our regulation, we have varying credits per car based on the range of the vehicles and other parameters. And we're getting direction that we want to make sure that certainly the vehicles that we get from the reg are more clear. And part of that is to help in the aid of signals for infrastructure planning and investments and other mechanisms.

The other thing I wanted to note, down near the bottom is, as we do our vehicle assessments, we're looking at what's happening globally. California is no longer the leading market for sales of EVs, which is a good thing in the big picture. And so we need to be aware of what the cost structures are looking at because of the market in China and Europe and Japan. So as Noel mentioned, we'll be all looking to some of the multi-stakeholder and multi-stakeholder inputs for our different proceedings.

Okay, I want to dwell on this next slide just a little bit. These are some of the key areas that, as we develop our ZEV regulation, we'll be focusing on. At the top, of course, doing our own new technology assessment for where battery costs are going, the battery scales for enabling longer range EVs, implications for different vehicle sizes. So there's a lot of great products coming out for the vehicle manufacturers and we're going to be making sure to have conversations with them and other stakeholders to get a sense of where the technology is going.

We just finished our recent technology

assessment in 2017 for a midterm review and so now we're restarting that with some fresh perspectives.

Working with the Energy Commission and others, continuing to evaluate consumer acceptance and preferences for EVs, clearly a vehicle with full-electric of fuel-cell vehicles are dependent on the infrastructure, and so making sure we have an understanding of how that is an inhibitor or enabler for choice for the vehicles.

The vehicle regulation for ZEVs has a clear split between battery-electric and plugin hybrids, so we want to make sure we're taking a newer look at what are the trends by industry for plugin hybrids as a piece to the puzzle, versus maybe focusing on pure ZEVs. And again, at the bottom there, noting that infrastructure is a piece that we want to partner with the Energy Commission on as we go through these proceedings.

A slide on some of the new trends. It was noticed early, ride hailing. As part of our Clean Mile Standard and vehicles regulations, we need to have a better sense of what these trends will look like and apply for electrification and

for the VMT at the whole fleet level. And so the notes are meant to just convey that as you look at the implications for ride hailing and automated vehicles where a lot of those, as they roll out, will be in-ride hailing fleets, with Kathy's team and others are the Air Board, we're starting to get a sense of looking at the total VMT implications, what is the shift, as you have high-mileage daily vehicles, what is the shift in amount of those cars that are smaller? Are they younger in age?

But the specific implications for electrification is that we need to get a sense of, as you have high-mileage daily vehicles, how many of those can be pure electric? And what does the infrastructure requirement look like to enable those kinds of vehicles? Luckily, we're seeing the ranges increase in those vehicles but high-mileage fleets have a unique need on infrastructure, as was noted earlier. And so these fleet-wide implications then feed into some of our work on the vehicle regulation decisions.

A couple of notes on the second big policy area for regulation that we're developing. This comes from new statute that we received. In

the fall, Senate Bill 1014 was passed. It is a requirement that the Air Board develop a new regulation on ride-hailing fleets. So it will be the first light-duty fleet regulation that we're developing on the new unique fleets that are emerging. It primarily requires that we develop a requirement for a declining emissions per passenger miles traveled as the key metric. But a sub-target that I'll note in the next slide is electrification. That was a clear direction from the statute that we need to be considering and pushing for electrification as a part of that compliance.

I think the key motivation for the statute is recognizing that ride hailing is an important mobility option, but that we need to understand what the implications are for emissions. And then the Air Board is motivated to ensure that we are looking at the congestion mitigation and other strategy we can take advantage of with the policy to enable that.

So short on time, I just want to acknowledge that these are some of the key principles for our Clean Mile Standard. In addition to the electrification target that we

have we're looking at maximizing pooling, maximizing connections to transit to reduce overall VMT to reduce the need for some of the higher-mileage vehicles.

But this is a key area. We had our first workshop a week ago or so. And I look forward to stakeholders engaging with us on this process.

So finally, a couple of key timelines. So both of these regulatory efforts are moving forward in parallel. The statute requires that we come to our Board with a Clean Mile Standard a bit earlier than we probably will with our vehicle regulations. We're likely to be going to our Board at the end of next year on the new Clean Mile Standard. And then a little bit after that for our Advanced Clean Cars 2 vehicle regulations.

And we're, at the Air Board, looking to carefully harmonize these. So we're considering provisions in the vehicle requirements that would then enable technologies that the vehicle manufacturers can bring to market that could be used in the fleet standards for ride-hailing fleets. So those two ideas are core as we develop these rules together.

A slide on the Low-Carbon Fuel Standard regulation that was passed this fall. Noel has wanted us to just point this out, that there was an important provision added to the regulation that provides additional Low-Carbon Fuel Standard credits for the capacity installed and certain kinds of long-distance ZEV fuel infrastructure, particularly hydrogen and DC Fast charging. And we're already seeing some optimistic uptake by fuel providers recognizing that this is an enabler for additional investments.

And so from the vehicle regulatory perspective, this is important. So we need as many enablers for infrastructure growth, not just state investments but private investments, to support the vehicle markets.

And I think I will finalize with this slide. This is just kind of a summary that our vehicle regulations are going to have to focus on some amount of EV charging infrastructure assessments. We want to rely on the Energy Commission as they finalize some of their specific network needs. But as an input to that, we will be updating our vehicle technology assessments. We're going to be aiming for

pushing the ZEV regulation towards the 5 million ZEV target or higher. And we are cognizant of some of the longer-range batteries that are coming to market. So all of these parameters will be taken into consideration, collecting our inputs, working with Energy Commission staff, and then looking to learn from the infrastructure assessments that come from it.

Last slide. We at the Air Board have started to go through a reorg at the agency. And so I just want to leave this as a takeaway note that we recognize that there's a need for us to think a little bit differently going into some of these new mobility strategies, the VMT strategies and investments there. For us to really reach the long-term targets in climate mitigation, we have to start thinking in a more multi-disciplinary way. And so we are reorganizing a number of our programs such that internally we're thinking across silos to try to address this.

So let me finish there and invite Tony up.

MR. BRASIL: Thank you, Joshua.

I'm Tony Brasil, Chief of the Transportation and Clean Technology Branch. So

I'm going to give you an overview of what we're doing in the regulatory space and a little bit on incentives here at the Air Resources Board.

So there are a wide range of zero-emission buses and manufacturers already in the heavy-duty space. And a lot has changed in the last few years and we expect a significant growth in the market in the relatively new future. There is a growing battery-electric truck market in the Class 3 through 8 category, right now in the 2B category which is just slightly bigger than pickups. But nearly all conventional truck manufacturers have zero-emission truck commercialization plans announced, most of them by 2021.

There are a number of trucks out there already by a number of manufacturers. And what we think is one of the reasons it's changing as quickly as it is, is the total cost of ownership we believe is already comparable to diesel for zero-emission buses and in the next five years is likely to be comparable where the vehicle meets the application or the need. And so as we continue to move along we'll look at that in more detail.

The next couple of slides are just some graphics to kind of show you there's a wide range of buses already out there. Most of these are commercial. Some are pre-commercial phase right now. And then in looking at kind of the truck and shuttle bus market there's -- the top half of this slide represents the vehicles that are commercial. The ones kind of in the middle are nearly commercial but they're kind of in the demonstration phase with plans for being fully commercial. And then the demonstration ones are planned and we funded some of these to gain experience with those, and so this is why a lot is changing. And as you can see, there's a wide range of vehicle types and uses in the heavy-duty space that are being anticipated by manufacturers.

So when we look at our regulatory strategies, doing similar things to what we're doing for light-duty, but here we're trying to increase this first wave of zero-emission heavy-duty technology into commercial use. We are focusing kind of on the urban driving, stop-and-go, centrally-fueled type fleets as our initial focus on our regulatory efforts. Long term, we

would look, of course, at opportunities to fueling for longer distance travel, but not at this time.

And then generally the experiences we're seeing I the light-duty, medium-duty and bus spaces is all translating to truck uses and it's actually a very interesting dynamic.

On this graphic, I just wanted to give you, in the yellow, kind of representing what we're doing in terms of zero-emission in the non-light-duty space. We do have the Phase 2 GHG little box there because that does have a multiplier for manufacturers that produce electric vehicles. They have a multiplier that they can take advantage of to spread out their compliance costs in meeting Phase 2. And, of course, with Phase 2, that's improving efficiency overall for trucks themselves, so that would ultimately reduce fuel use compared to not having that regulation.

So in 2018, we have the transit regulation for zero-emission buses. That was approved last year. I'll touch on that one. There's an airport shuttle regulation that's currently being considered by our Board.

Advanced Clean Trucks is the one my particular group is working on. We are also planning to take that to our Board at the end of the year. And then on the far right, we are also planning for zero-emission fleet rules and for drayage trucks in part as a category that we've told our Board. And then below that, we're just kind of showing you, also related is off-road equipment that I know is not the topic of today's meeting.

So for our transit regulation, I just wanted to give you a highlight. And this was approved in December. What it has is a rollout plan that transit agencies need to submit by 2020 for the large transit agencies. It will lay out what their plan is to put in infrastructure and how many buses they're planning to go to zero-emission on their timeline. Similarly, small fleets would be later, so that would be a resource that would potentially be available. It does have a zero-emission bus purchase requirement, showing it here.

So as you can see the requirement would begin in 2023 where a quarter of the purchases would need to be zero-emission. However, the regulation is written that if there are 1,250

buses purchased by the end of 2021, we would actually postpone the start of the regulation until 2025. So we do actually believe that there will be 1,250 buses purchased by the end of 2021, which is much higher than what is required because the requirement doesn't even start in that point in time. And I think that's a factor in ultimately planning and estimating.

And why I say that is this graphic here shows you and has the numbers of how many buses are already in operation, how many orders have been placed, and over 700 have already been awarded and planned. And this was the end of last year roughly, so I'm sure more have been added and more are on the road than this actually shows.

And then the last graphic on the buses, since we have the most information, this slide represents the commitments that transit agencies have formally announced that they plan to be ahead of the regulation in many cases, most of them by 2030 to have a complete transition to zero-emission.

I would like to note that Antelope Valley Transit, you see there, in a matter of months,

they will have made a complete transition in about a two-year time period, so they will be fully electric. And it's about 80 or so buses that they have at their depot.

And so now to shift over to airport shuttle proposal. This went to our Board earlier this year and there's a second hearing for a final decision. But the basics of the proposal is to require shuttles that serve airports, the larger airports, to become zero-emission. You see there that in 2027 is when a third of the fleet must be zero-emission. So that's a purchase requirement, that's a third of the fleet needs to be converted at that point in time.

To get to that 33 percent with normal replacement cycle the purchases would, in essence, need to be close to 100 percent of purchases starting roughly next year. Otherwise, they will have to do accelerated replacements.

And then in Advanced Clean Trucks, so this is our effort that's effectively a manufacturer requirement for a certain portion of sales to be zero-emission in the Class 2B and above categories. Right now we're into the regulatory process, working through what that

proposal will be shaped to be. But right now we're looking at the 2024 through 2030 model year. And what we discussed last year is our proposal that there would be roughly 38,000 zero-emission trucks required by the 2030 timeframe.

But what we're doing now, too, is we're going to make it mandatory for fleets to report information to us so that we can follow up with fleet requirements of some sort to then require the purchase of those vehicles as well. So both of those items will be considered late 2019. The fleet rule requirements would be subsequent years.

And then one more on the trucks. As I mentioned, on drayage, the ports actually have their own plans to effectively have zero-emission trucks serve the ports by the 2035 with a fee-based approach. We're participating in that process and understanding how their rate structure would do that and looking at how can we transition drayage trucks to zero-emission or zero-emission operation as part of that.

And then to kind of switch out of the regulatory perspective directly, we do look at what else is happening in the market and it

greatly influences what we think we can do in our regulatory proposal, I think as Joshua mentioned. So the utility programs that are supporting transportation electrification is actually reducing the barrier to infrastructure in having it installed. It's very important as part of our proposal. And honestly, how things have shaped out, we do believe that our proposal can actually be more aggressive than what we discussed last year as a result.

Low-Carbon Fuel Standard for heavy-duty vehicles works a little differently in that whoever is dispensing the fuel is, in essence, receiving the credit. So since we're talking about depot charging fleets the fleet would actually receive a credit.

What that means today is that the LCFS program effectively is offsetting most or all of the electricity costs, so you effectively can be discussing a zero-cost fuel for charging overnight. During the day might -- if you pay a little more, then that will vary. Now this is using the $125 per credit. Today the credit value is considerably higher. So the dollars per kilowatt hour would actually be higher than I'm

showing here.

And then lastly on our policies on funding programs, we kind of look at a spectrum. There's demonstration projects that have been funded to get early technology demonstrated to get to that pilot phase to become pre-commercial. The pilot projects, we have several hundred vehicles that we funded, tractors and smaller vehicles and buses that are either pre-commercial or near commercial, different technologies. So we're actively trying to accelerate the market and bring those particular vehicles to the point where they can become commercial.

And then lastly, in the commercial category, we have the Hybrid Voucher Program that is a direct rebate to the purchaser. It's handled at the dealer level and so that's regularly funded. Last year there was a $125 million added to it. It's a first-come, first-served basis, a very streamlined process to get vehicles. And then lastly, the Volkswagen Beneficiary Trust, that's about $423 million, is attributed for heavy-duty incentives, and so that's just starting to roll out this year.

So as kind of -- I've touched the

incentives are an important part of encouraging early action. What's happening with the vehicle and infrastructure investments clearly shapes the way we look at what we can do in terms of our regulatory approach. Charging and hydrogen fueling standards are being developed and coming along, so that's furthering the market, but we still do need to see continued progress for a full transition. And we are looking at where can we make a full transition to zero-emission as part of our policies? And that does include, clearly, broader access to infrastructure.

So just in closing, there's our contact information. And I appreciate your time. Transition to the next speaker.

MS. SISTO: Thanks for all that great information from the Air Resources Board. And thanks to the CEC for having this meeting today. My name is Carrie Sisto. I'm an Analyst with the Public Utilities Commission, focused on transportation electrification. And I'm just going to give you a bit of an overview of our current programs and our work ahead to work with the CEC and the Air Resources Board to meet state goals for vehicle electrification.

This slide gives a pretty quick overview of what we've approved to date and what we're currently reviewing at the CPUC. So since 2014, we've approved about $1 billion in authorized transportation electrification spending. This is coming from the -- largely from the large IOUs, so that's Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric. There's about just over or close to $210 million being spent on light-duty charge ports at workplaces and multi-unit dwellings that should install up to 13,500 charge ports. There are also some pilot programs that are designed to address identified barriers under SB 350 that are -- these programs are designed to identify ways to electrify port equipment and some of the off-road vehicles that we're trying to identify constructive ways to electrify moving forward.

Last year the Commission approved two -- as Tony just mentioned, we approved about just over $550 million for SCE and PG&E to spend to electrify about 15,000 medium- and heavy-duty vehicles. And I recently learned that PG&E has partnered with CALSTART to work on coming up with a way to align their medium- and heavy-duty

infrastructure programs directly with the heavy-duty vehicle infrastructure -- or Heavy-Duty Vehicle Incentive Program that CARB runs to help align those fleets that are participating in PG&E's program to get quicker or more expedited access to those vehicle incentives as a way to kind of align the two incentives that the state agencies are helping facilitate.

We've heard a lot of discussion about the need for an increase in fast charging infrastructure. So PG&E will be spending about $22 million to help support up to 50 new fast charging sites, and that would be about 234 new ports for fast charging. And then we have several applications still under review at the CPUC, including one from SDG&E that's very similar to the one that we approved -- the ones that we approved for Southern California Edison and PG&E last year. And then also an extension of SCE's Light-Duty Program that could provide another 48,000 charge ports at workplaces and multi-unit dwellings.

And then beyond infrastructure, we've been focusing with the utilities to identify rates that make sure that the added load

associated with this huge uptick in the number of EVs that are charging is being integrated to the grid in a way that provides grid benefits, so finding ways to encourage customers to charge during off-peak hours, either overnight or in the middle of the day, so to ensure that the infrastructure isn't overtaxed by the adoption of these electric vehicles.

It was interesting to see some of the presentations from the Air Resources Board this morning because it's clear that this is something that's gone on at other state agencies but hadn't yet at the CPUC.

So over the past seven months or so we've been working at the CPUC to develop a new order instituting rulemaking to help identify the clear role for the investor-owned utilities investments in terms of how much of the statewide transportation electrification goals should be the responsibility of the utility ratepayers, how much of that cost should be borne by utility ratepayers? And it's great to have the CEC's help in terms of identifying the needs for the infrastructure. And it's also great to have the ARB's regulations to help push forward different

types of vehicles to help meet our state goals.

But we at the CPUC are trying to identify programs that the infrastructure that is being rolled out by the investor-owned utilities truly does bring forth third-party participants and investments from private entities so that the state funds are not -- are being complemented by business opportunities that accelerate the state goals on a broader level.

AS part of this rulemaking the Energy Division is working on developing a transportation electrification framework that will be intended to guide future investor-owned utility investments. This is something that we are working on as agency -- as CPUC staff. And we'll also be calling on -- we already have been and will continue to call on people from the other state agencies who are working very hard on these existing assessments because we're definitely not in the -- we don't have the capacity at the CPUC to be doing our own assessments and we'll definitely be piggybacking on any work going on, both at the CEC and the Air Resources Board.

The main goal of this framework is to use

existing state analyses to help prioritize the future proposals that will be coming forth from the investor-owned utilities. And we also want to come up with a strategy to help expedite the CPUC's review of future program applications.

So this is just to illustrate how our process went along. Currently at the CPUC, we've had, you know, a pretty consistent application rate of about three or four to five per year. And we're able to kind of evaluate them and process them and get them to slot into a process to figure out a way to meet our state goals.

But as more and more different state goals keep being piled up and different proposals keep coming in at a larger -- with larger budgets at a faster rate, we're starting to need to take a step back and evaluate. This is something that Kathy even brought up in her process. She was talking about identifying the different building blocks and coming up with a framework. So this is just to illustrate, that's all we're trying to do with our transportation electrification framework. We're not trying to slow anything down necessarily. We're just trying to provide clear guidance so that when applications come in

they fit with all of the other state agency efforts that are already underway and are more complementary.

And Noel asked me to highlight a few specific areas in which the CPUC will be leveraging the AB 2127 assessment. And I also think that a lot of the information we're gathering from the IOU programs can help facilitate the ongoing biannual assessments for AB 2127.

So while the transportation electrification framework that we're developing and the current rulemaking are ongoing prior to potentially having much learning from the initial assessment, I do want to emphasize that the framework that we would adopt, that the CPUC might adopt moving forward, is going to also be updated regularly. So this, as Noel mentioned, this AB 2127 will be updated at least every two years. And I think that that is a consistent thing across all of our state agency regulations, that they're consistently going through modifications based on new analyses and new learning.

We're also trying, at the CPUC, to ensure

that the charging stations installed by the programs supported by the utilities are utilized as much as possible and in ways that provide grid benefits. So as we identify the most appropriate locations and types of infrastructure that's being installed we want to design utility programs that can encourage different demand response programs or rate designs that encourage off-peak charging, and as well as combing charging stations with onsite storage or renewable energy that can help ensure that the load associated with the increased vehicle adoption is being managed appropriately.

And I think one thing that we are trying to keep in mind at the CPUC is that we want to prioritize investments that are critical to meet the state and environmental adoption targets, but we also want to make sure that our -- the programs approved by the CPUC are aligning with the regulations being adopted by other state agencies to support the rollout of the vehicles that are needed to meet the state goals.

I mentioned briefly that we have some data collection requirements associated with the investor-owned utility investments. We have

this. Hopefully you'll be able to access these slides. There's a link here, the data collection template, and it's also available on the CPUC website. But that gives you an insight into the types of data fields where we'll be requiring the IOUs to be reporting from the investments that they're currently deploying. And those data collection templates can be updated as needed based on the data needs for the different state agency assessments that are ongoing.

And so I have here, we welcome feedback from anybody who's involved on additional data categories that we would -- we could potentially include for these IOU investments moving forward.

And then this slide just has a few of the interesting successes that we've heard from some of the investments from the investor-owned utility programs so far. There has been a pretty good reach into multi-unit dwellings which is a key barrier. It's been very difficult to get charging stations deployed in apartment buildings and that's a really key sector in California to get access to charging, either at home or at workplaces. So that's one thing that we've found that IOU investments can help support that. And

we've also identified that some of the more innovative rate designs that the utilities are deploying have been successful in shifting charging demand to times of day that are beneficial to the grid.

So that's all I have an did think I'm out of time. So there's my contact information and I welcome any feedback or questions.

MR. KRELL: Good morning everyone. Unfortunately, I don't have a Tetris slide, but I can tell you that I'm going to be brief, so that may wake you up a little bit. For anybody at home, you can go ahead and stand up. For everybody here, we're going to get right into this.

As we progress through the workshop, please note that we're touching on the same topic several times today and we're trying to reinforce the understanding of this. It's pretty complex.

This section of the presentation will illustrate key relationships between the different groups, the activities and the data sources. Preparation for the data collection activity this afternoon is what we're doing right now. And these next set of slides should help

you get ready for that, this afternoon's activity.

The data collection tool, we call the scoping matrices, and you may have picked those up at the door or they're posted online right now. It's a living document. We plan to use this document to track and -- track the data collection process and record what we're doing and make sure that we capture all the different areas.

The data collection methodology is fairly comprehensive but pretty straightforward as well. The overview provides a visual reminder of the steps, this overview, and the means to identify and eliminate wasted effort. In other words, we don't want to gather data that we can't use. You know, the last thing we want to do is spend a lot of time on data that won't end in analysis and reporting when we're all said and done.

So the arrows on the left-hand side kind of show the flow of data from beginning, you know, where we're looking at the different forms and surveys, the interviews, even this workshop and the data that is generated from it. And we're making sure that we're, you know, looking

at it in a qualitative and quantitative fashion and that we're, obviously, sensitive to any confidential issues that come up. But we're taking this data and we're going to analyze it in a way that's going to give us something that we can report on later on.

And we've mentioned the IEPR but the IEPR is only one source of reporting that's going to happen, one output of this data later on. There's also, you know, the Transportation Energy Demand Forecast, which you heard a little bit earlier. This will feed into that, I'm sure. And other things that our sister agencies are doing, this is going to feed into that.

The other thing that we've talked about today is the different groups. And if you look at the right-hand side of this chart, we've talked about, you know, the Fuels and Transportation Division, which I'm in, the energy assessments, research and development, but also the interagency counterparts that make up, you know, he CPUC and the Air Resources Board. And all these different groups will feed data through the things that are already going on and things that are upcoming in the next ten years to this

scoping matrix, which is in the center of this slide.

The scoping matrix will also take in data from the surveys and forms that come from this exercise and from this effort that we're doing here at the CEC, and the one-on-one interviews, and the workshops that we're doing, like the one today and the two more this year, as well as things that are still out there in the wings that are just developing that we haven't, you know, fully become aware of yet or things that are in demonstration mode right now. All these things together will feed the scoping matrix. And there's probably a box on this slide that should be here that shows things we haven't even thought of right now.

The scoping matrix itself, as you may be wondering, the one you have in your hand has some boxes filled in, some boxes are empty. We've gone through several different versions of this. The ones that we'll use this afternoon are completely empty and the reason is, is this is something that's beginning. It's a living document and we didn't want to stifle imagination this afternoon. So if there's anything, you

know, online as well, but anybody in the room that sees anything that they want to comment on during this afternoon's exercise will be able to look at these examples and be able to say, you know, you should be thinking about this or you should be thinking about that.

But we've also looked at the flow as we go through this exercise. You'll notice the boxes at the top, they have a section that's underlined. And from the data itself on the left-hand side through the analysis on the right-hand side the data has got to flow. It's also got a time element. Is the data available today? Is it not available today? So these things are all very important as we look through these different sections of the scoping matrix and we apply it to the sections that are called out for in the bill itself. The vehicle categories and the infrastructure elements are listed down -- across the top and down the side. So we're doing to take this format and apply it this afternoon for the very first time.

So feel free to, you know, give us your feedback. People online will be able to, you know, chat or raise their hand. And Micah here

will be able to pass the information on to the group.

The data use itself is something that Noel talked about earlier and this first biannual assessment will be done in two phases, the one for the 2019 IEPR and then the follow-up in the 2020 cycle. And we want you to think of that when you're putting together the data in your minds for use later on, especially the assessment activity this afternoon, because we need to find out, you know, what data is available now that we can actually apply, you know, between now and mid-May and what data, you know, is going to be available later on, or we should hold for later on. The data may be available now but it's so raw that we shouldn't really try to force it into this first cycle.

So think about these things as we're going through this exercise. So you've got the box along the top you've got to think about. And this is the second box. You know, is the data available now? And then, secondarily, should we use this data?

And that's about all I have for this, you know, portion of the presentation. I'm trying to

keep things on schedule and moving pretty quickly. But I'm going to let Kadir come up and take the next session and talk about the analysis.

MR. BEDIR: Good morning everybody. If you are having a hard time from the time change, you are not alone. I'm still trying to wake up. Luckily, I have my talking points. So Wendell did a great job outlining our proposal for data collection.

My name is Kadir Bedir. I'm an Air Pollution Specialist at the EV Infrastructure Unit and I led the first staff report on EV infrastructure projections last year.

Before starting this panel, I will briefly discuss why applying up-to-date information is critical within models of transportation system and infrastructure. Then I will introduce our collaborators from NREL, LBN and UC Davis. They will highlight their recent research and learnings related to this work and they will highlight their ongoing upcoming research that will benefit from your participation and as we implement AB 2127.

To give you a brief background, my team

published the first 2025 analysis last year in March 2018 and held a workshop two months later to hear from our -- excuse me -- to hear from our stakeholders. The EVI-Pro modeling tool used in this analysis was developed from a technical support contract between NREL and the CEC's ARFVTP program. Here it is on my slide. And you see, on this slide, you see a snapshot of our report published last year.

In developing EVI-Pro, which took about two years to complete, NREL and CEC staff worked collaboratively progressing from a basic framework to the development of a MATLAB model. And we kept very close communication with weekly meetings and we get data to develop scenarios, eventually inform the Governor's Executive Order B48-18. However, as new policy priorities and technologies continue to emerge, we definitely need more of this kind of close collaborations with our research tech support providers and our stakeholders to provide analysis and extend projections to 2030 and beyond.

Through the AB 2127 process and with your involvement, we are confident that the new assessment will deliver actionable insights for

EV infrastructure deployment across California. We continue to collaborate with NREL.

So I think it's time to invite my speakers. In the following presentations our collaborators will highlight their recent findings. And I will turn the mike over to these presentations.

First, Eric Wood, Vehicle Systems Engineer from NREL, who has been my closest collaborator. And we will have a presentation from Colin Sheppard, a Transportation Scientific Engineering Associate from Lawrence Berkeley National Laboratory. And you may have known Colin from his groundbreaking work with BEAM modeling framework. And finally, we will have Gil Tal, the Director of the Plugin Hybrid and Electric Vehicle Research Center at UC Davis, whom I had the chance to work in the same working space for about five years before coming to CEC.

And following Gil's presentation, we will open it up for questions for all of this morning's presentations.

I will turn it over to Eric.

MR. WOOD: Cool. Thank you, Kadir. See if I get the presentation lined up here. Great.

So my name is Eric Wood. I'm with the National Renewable Energy Lab in Denver, Colorado. I'm going to talk a little bit about today on some of the projects that we have at NREL ongoing around electric vehicles and charging infrastructure.

As Kadir mentioned, we collaborated starting about two or three years ago on development of the EVI-Pro model. This slide shows a schematic of the model. Essentially what this model is trying to do is take travel data from a statewide travel survey in California, about 50,000 vehicles included in that survey, and then simulate electric vehicles driving around in that travel survey and attempt to resolve charging behavior in order to establish consumer demand for charging infrastructure, and then finally make projections on charging infrastructure required to meet statement electric vehicle goals.

And so this framework really focused originally on personally owned human-driven light-duty vehicles. And you know, as we go forward into the next round of development, I think there's a number of areas where we could

use this framework to evaluate, including autonomous or transportation network and shared vehicles, as well as medium- and heavy-duty vehicles.

So the primary output of EVI-Pro are infrastructure projections. But since we're resolving individual travel days with a relatively high resolution, we're also able to output charging load profiles at different levels of aggregation. And through some DOE-supported work, we've been able to work closely with Colin Sheppard and his team at Lawrence Berkeley National Lab, as well as some researchers at Humboldt State University and actually compare EVI-Pro and BEAM Models in terms of the charging load profile that they generate.

This site shows a graphic of load profiles from each model with relatively strong agreement in terms of the overall magnitude of charging load and the shape of the load. And so for this exercise, we really tried to tune both models to have a consistent set of inputs. And Colin will speak more to BEAM in a little bit, but fundamentally the two models take very different approaches to resolving charging

infrastructure and charging behavior. Yet somewhat surprisingly and fortunately for us, we were pleased to find that the models still had relatively strong agreement in terms of the magnitude and shape of charging load profiles.

So this is part of some DOE-supported work currently. And as part of this effort, we're working to develop an online platform where users can come in and utilize these models to develop their own load profiles based on their own assumptions for the type of vehicles, what infrastructure is availability, and some simple assumptions around consumer charging behavior preferences.

We're also working with Colin and his team, and he might mention this, as well, on trying to integrate some of the infrastructure or modeling concepts of EVI-Pro into BEAM. We know that the Berkeley team has done a fair amount of work on charging infrastructure and behavior already and BEAM better trying to take advantage of an opportunity through DOE to work closely together add have really, I think, benefitted certainly from that working relationship.

In addition to DOE-supported work, we

also have EV evaluations going on in a number of individual cities. So this slide shows some simulations using EVI-Pro that predict charging load profiles under different scenarios. The primary client for a lot of these studies are electric utilities, and so we're trying to characterize EV charging load and charging demand and then integrate that load into a number of NREL-specific models, including capacity expansion for trying to forecast how generation assets might evolve over time relative to new and changing loads, including transportation loads, using these with cost production models to look at how generation assets are controlled during a day to respond to potential flexible EV charging, and also interfacing with distribution models to look at local effects of how EV charging could be affecting the local power system.

The first round of infrastructure assessments using EVI-Pro specifically focused on destination charging. And so long-distance corridor charging was not explicitly considered.

During the next round, we've discussed with the Energy Commission potentially doing model development around long-distance travel and

capturing fast charging along highway corridors. I think we're eager and interested to visit with the folks from UC Davis to talk about how this idea could potentially leverage some of the work they've done around the GIS Planning Toolbox, you know, which has been a great tool.

I'll go ahead and skip this slide and come back to it.

So we've mentioned TNCs a few times. We haven't done a lot using EVI-Pro yet in the TNC space but we've done a little bit through some DOE-supported work. This slide highlights a dataset from Austin, Texas that we were able to embed into EVI-Pro to simulate charging infrastructure requirements for TNCs. There's not a lot of publicly-available TNC data currently out there right now, and so this is one of the few datasets that we've worked with so far.

And you know, two of the big findings, I think, from this work are that, not surprisingly, TNCs drive more daily miles than you would see in a personal vehicle on average. And so for the same vehicle, fleet distribution arrange type, you see higher infrastructure requirements for

TNCs.

But we also ran some sensitivities around availability of home charging, you know, with the idea that potentially a lot of TNC drivers might live in high-density urban environments or in apartment buildings where they might not have access to home charging, and also found that to be a very strong lever in terms of how much demand TNC drivers might have on a fast charging network. You know, whether or not they have that home charger makes a big difference.

And so in some DOE-supported work, we're trying to gather a better quantitative description of what residential charging availability looks like at the national level.

This slide is actually specific to some California data. This is all data from the American Community Survey, from their public use microdata samples. And what we've done here is try to develop an estimate for the light-duty stock in California along three dimensions, along household density, residence type, and tenure. And the graph is probably too small for most people to read but I'll point out a couple things that are interesting to us in terms of challenges

for residential charging and EV adoption.

So this analysis suggests that about one in five California vehicles are owned by someone that lives in an apartment building. Maybe about one in four are owned by someone that lives in a high-density urban environment where residential package might be a challenge for them to charge their electric vehicle at night.

And it also points out that about one in three California vehicles are estimated to be owned by someone that is currently renting their residence. And so if there was electrical upgrades that might be necessary for residential charging, that person might not have the autonomy or the authority to invest in their own residential charger themselves.

So we think that there's a lot of different layers that go into residential charging availability. This data highlights some of those layers.

We're also working on conducting a residential parking survey nationally right now to try to further enhance this analysis to understand, for each of these different combinations, so someone maybe that you say lives

in a high-density environment and rents an apartment, what kind of access to residential parking do they have? Are they parking in a private garage, on-street, in someone's driveway? You know, things like that to try to inform what their access to residential charging might look like.

And then finally, we've done a fair amount of work, as well, on the analysis of cost of electricity for EV charging. This slide highlights some work of some of one of my colleagues, Matteo Muratori, who's been using the utility rate database to look at rate structures across the U.S. in terms of both the fixed energy and demand charges and look at different technologies, including photovoltaics and onsite energy storage, how those could be leveraged to decrease the cost of electrification for fast charging.

We're currently updating this project in collaboration with researchers from Idaho National Lab to try to develop kind of a full characterization of the cost of charging to consumers that includes both residential, workplace and public charging, and then try to

use EVI-Pro to resolve how much of each of those types of charging we might expect to see in different parts of the country.

And so kind of a quick run-through of NREL research in this space. I think my slide poses questions but I don't think we actually have time of questions, that comes later; is that right? Okay. Great.

So I'll turn it over to Colin now and let Noel coordinate getting him on the phone.

MR. SHEPPARD: Can you hear me okay?

MR. CRISOSTOMO: Hi, Colin. We can hear you. I'm not sure if you'll be able to control the screen from here. We're sharing right now. If you can tell me when to move forward or we can do the ball handoff. Okay. Yeah, so if you just let me know when to advance the slide, we have you up next.

MR. SHEPPARD: Great. Hey, everybody. I'm Colin Sheppard from Lawrence Berkeley National Laboratory. I'm presenting on behalf of myself and Samveg Saxena and Doug Black. We were all involved in doing work around EV modeling, EV adoption, EV infrastructure analysis. I'll sort of touch upon what all of us are doing, and I'll

try to do this all as quickly as possible.

You could go to the first slide.

So the primary work that I'm involved with, as some of you know, is developing and applying a BEAM simulation model. The BEAM simulation model and framework was actually developed first as a model just to do analysis around personally-owned EVs and the charging infrastructure interactions that they would have and trying to understand in a spatially explicit way, what are the opportunities and challenges associated with getting people to the chargers, as well as what are the opportunities for leveraging the flexibility inherent in people's EV loads in order to serve or provide resources or services to the grid.

The BEAM model is now expanded in scope considerably through supported work by the Department of Energy under the Smart Mobility Consortium. So now in BEAM, we are simulating all modes across the transportation system. And we are doing this in the context of travel demand modeling.

So we simulate people walking, biking, driving alone, but then also we simulate taking

transit, people riding in ride-hail vehicles. And people can take -- they can drive to a transit station, they can take a ride-hail to a transit station. The ride-hail fleet can be human driven, it can be automated.

We have pooling happening in our transit, in our -- sorry, in our ride-hail system. And then we very recently also enabled the simulation of shared bikes, shared vehicles of all types, but that would include shared cars, shared bikes, shared e-scooters, and these could be all in a docked or a dock-less configuration.

I just want to then say that, okay, so all of this is happening inside of the BEAM model, but then, as well, under the context of smart mobility we are closely coupling our model with other models.

So as Eric mentioned, we're working with NREL in order to, basically, use EVI-Pro as a way to cite charging infrastructure for the BEAM simulation. We are working with -- we are also working with NREL in order to embed more detailed vehicle energy charge -- energy consumption models inside the BEAM simulation.

And we're working with UC Berkeley on two

fronts, one, the relationship between vehicle automation and traffic flow is something that will change and there will be higher capacities on our roads and freeways and we are embedding that information into BEAM. And then we're working with the Urban Sim Team in order to couple BEAM to urban sim and be able to resolve the interactions that happen between the transportation system and land use.

So the -- so this full suite of models working together will allow us to, if we resolve what's happening all the way down at individual vehicle levels to the network and traffic flow happening, to the traveler profiler, what mode people are going to choose to take, what route are they going to take, et cetera, and then up into the medium- and larger-scale behavior and system dynamics, like where people are going to choose to live and work in the future in response to the changes happening in our transportation system.

So we're really looking to wrap our arms around the whole system and have a fully integrated, dynamic travel-demand capability that allows us to then investigate all of these big

questions that is on everybody's mind about, really, where is our transportation system headed in the next few decades?

You can go to the next slide.

So going back then to -- or sort of jumping to a different topic, so our first work with BEAM involved doing flexibility analysis. And we coupled BEAM to the PLEXOS model and did an analysis for the State of California. I presented on those results last year, during the workshop that was mentioned.

One just variation on that work that I thought was interesting to bring up now is we did do an analysis about load flexibility and where does it happen in the system? So you know, it's pretty much all in the residential sector right now. And we asked the question, well, given that people have their vehicles at work in the middle of the day and we want to soak up that midday sunshine, what happens if we just add a lot more charging infrastructure to the workplace system? And you can see that we get increases in the flexibility in the load but it's modest; right? Especially in comparison to the residential sector.

So I still think that when it comes to smart charging and thinking about placing the load at the right time of day there are substantial challenges, I think, ahead in terms of really leveraging the opportunity we have to sort of use these fleets of vehicles in order to do that.

Go to the next slide.

I think one of the biggest opportunities, though, is maybe to not ignore private vehicles but to really start focusing on the shared vehicle fleets because these fleets have this inherent flexibility if they end up automated and controlled by single entities where you can have excess vehicles in order to also help manage some of the demand for charging and the flexibility about the timing of that charging.

So these are some just examples of an analysis we've done with BEAM where we were studying DC Fast Chargers in the San Francisco Bay area and then looking at the performance of the ride-hailing fleet, assuming it was automated and electric, and how does that performance change as we add more and more DC Fast Chargers?

The red lines in all these figures are

what the sort of baseline metric would be for an ICE vehicle that didn't have any constraints around charging. And then we have a, you know, 75-mile range and a 150-mile range fleet of vehicles. And you can see, as we add more chargers to the system, we can sort of bring these metrics closer and closer to the ICE baseline. And then we can do other analyses like this where we would say, alternatively, how many more vehicles would you need in order to achieve this same level of service?

So one of the sort of advantages of the framework we have is that if you look at like the number of customers served, right, this is sort of bottom blue second from the left plot, you can see that, you know, if you go from ICEs to EVs or if you don't have enough charging infrastructure and if your demand is elastic, which is it in the transportation system, you don't get as many customers, you don't serve as much demand. And you really need to be modeling both sides of the equation in order to understand these kinds of dynamics.

Next slide.

I'm just going to mention this GEM model.

This is a new model we've developed, also under DOE funding, called the Grid Integrated Electric Mobility Model. I think what's particularly interesting about this model is that this is a partnership between LBNL and UC Davis. We've working with Alan Jenn at UC Davis. And we are making use of the outputs from EVI-Pro as one of our modeling assumptions. And we're basically trying to get at these problems, both from a top-down and a bottom-up approach, so we're using bottom-up models, including EVI-Pro, including the RISE model, which I won't have time to go into, but this is another shared automated EV supply model.

And then we're using those to come up with reduced form models that go into the GEM model which is sort of a top-down model.

If you can go to the next slide?

It allows us to answer questions, such as how much infrastructure would we need? And what would the makeup of the fleet be for a shared automated EV fleet? And this is a national analysis, so we're doing this by division across the country but it includes California as its own division within our country. And you can see

that, you know, there are tradeoffs between the number of vehicles you have and how much charging you need and what level of charging you need. And there are tradeoffs between the range of the vehicles and the number and type of chargers that you need. And this model is able to, you know, bind these all together into one analysis.

And what it also does, if you go to the next slide, is plan when these chargers are going to be charging. And so here we're varying the fraction of vehicles in the simulation that are private versus shared, so private is red, shared is all of the rest. And as we go from all private to all shared, you can see a pretty dramatic difference in the overall load shape. And it turns out that both in our shared assumption, we're assuming there's more actual pooling, more people in vehicles than in the private assumption, but then, also, there's more flexibility in the shared fleet than there is in the private fleet.

Next slide.

And then if we do something similar where there's a 50-50 split between the private and the shared fleets but then we go from zero percent of

the private fleet is engaged in smart charging to 100 percent is engaged in smart charging, we also see very dramatic changes in what the load shape looks like. And while it looks like the load is spiking under a 100 percent smart charging scenario, if you go to the next slide, you'll see that the reason for that is that we're actually making use of the smart charging to almost totally flatten the load across all of these regions in the country.

So this is net load broken out by generation fuel type. And the top group of plots are without smart charging, the bottom group are with smart charging. And you can see a pretty dramatic capability when you have fleets of this size. And this is really assuming that the entire fleet is engaged in some sort of demand-responsive charging, you can almost total flatten the net load which we think is really interesting.

Next slide.

So not only are we doing a lot of work around modeling and simulation but we also are engaged, through the CEC, in demonstration projects. So this is an example of actually

coordinating the charging of a fleet of vehicles at a parking garage in collaboration with Alameda County. And there's been a lot -- this is -- Doug Black has been leading this and he has learned a lot, so that, technically, it wasn't that difficult for him to achieve this or their team to achieve this.

But the most challenging part had to do with all of the human interaction, as well as the logistics around scheduling a fleet of vehicles to charge at these chargers when you have fewer charges than there are vehicles. So we hope to always stay tightly connected with people who are gaining this kind of real-world experience when we do our modeling.

And then the last slide just touches upon some recent work that Sam Saxena has been engaged in where they've been trying to quantify the demand for hydrogen, but also electric refueling, for medium- and heavy-duty buses in California. They've been doing this by leveraging the MFAC database which does have temporally-resolved fueling demand from medium- and heavy-duty vehicles. And they are taking that sort of aggregated demand and then disaggregating it

using some assumptions and coming up with probabilistic models of how individuals might behave, assuming what their refueling preferences might be, and then using that to then come up with an aggregated load profile at the end.

And we think this is maybe a promising sort of first-cut analysis that can be -- help to serve this sort of ongoing analysis that needs to happen for planning for medium- and heavy-duty charging in California.

So that's all I have. I've gone a little over. I apologize for that.

MR. CRISOSTOMO: Thank you, Colin, for presenting. And apologies that you weren't able to make it.

But at this point, we'll transition to Gil and Alan.

MR. TAL: Great. Thank you. Thank you for having me here. I will share my time with our Research Director Alan Jenn and try to go really fast through a couple of slides, so you'll have to excuse me for skipping some interesting results.

And, actually, I will start with this slide that many of you have seen many, many

times. The Plugin Hybrid Electric Research Center was started with a CEC grant 12 years ago. And we do a lot of data collection. It's a lot of piecemealing of many different grants, many different projects, many different NDAs and data sources, but it's all here. A lot of data that is already here, coming from the infrastructure, from the vehicles on the road, from the drivers and the owners of these cars, and we keep doing it all the time. Most of my presentation today will be about incorporating that into the modeling that we are doing that was presented.

I will start with how much people are using plugin vehicles. There's a lot of new papers coming based on the 2017 National Household Travel Survey, actually, the California add-on. If you dig a little bit into the California add-on the data collection will stop, more or less, recruiting vehicles in 2016 and all of the plugin cars there are from 2011-2012. And they say -- and they're only based on, more or less, Nissan LEAFs from the first generation and a couple of Volts. So please be careful with citing this 2017 based on 2012 dataset. Plugin vehicles are doing a lot of miles. Most of them

are doing more than 12,000, including BEVs and PHEVs, without getting into too much details.

Asking the drivers today about where do they use their cars, where do they plug in them in, they mostly plug them at home. It's home, home and work, home and other. If you have a Tesla, you kind of combine home and other places. Very few people are not using home.

And in 2018, I added a question to the survey: If you are not using home, if you are one of these four percent that are not using home, what's going on there? And looking at that, we find that about 15 percent of the BEVs who are not using home have a charger at home. About 40 percent of the BEVs who are not using home have Level 1 opportunity at home but they are just not using it because they have options. And then we have people who cannot use home. It's kind of going all the way to left to no way. But even the people who are not charging at home today can do it if they need to and want to.

I'm saying that because we are talking today about public but putting more funds into home charging saves installing public chargers. If people can charge at home, they don't need to

charging in public that much and we need to coordinate this discussion.

A similar discussion on fast chargers, you know, we are talking a lot about how much we need fast chargers, but most of the BEV owners in California are not using it, not because there are no chargers around, because they don't have a need for it. If you look at Volt drivers, 90 percent of them did not use it even once in the last month. It's not that they never used it. They use it two, three, four times a year. Everybody's used it once or once -- once or twice after buying the car but then they don't see a regular need for it.

So when we go to the modeling approach we should not just look at the data coming from our surveys, and I'm talking about 27,000 EV owners in California, we should try and see if our assumptions about how people would use these cars are aligned with what people are actually doing and why we have some discrepancies there.

Tesla owners, these are model X and S, it's free. It's all free. They can go and do their shopping, they have their coffee and get charges, but 70 percent of them are not trying

even to use fast chargers. So we need to kind of work on our assumptions on that.

We have this big eVMT, what we call the eVMT Project, sponsored mostly by the Air Resources Board, but also by some funds from the CEC and a little bit from the DOE, where we collect date from hundreds of vehicles for a full year around California. This is just a teaser. We have everything about these cars, SOC at the beginning, end time, location. That, for example, is just kilowatt hour per session by vehicle type. These are only BEVs in our study. Nothing more than just a teaser for kind of coming up to our modeling efforts later.

Another one of these teasers is about frequency. All of our models are talking about people charge once a day. From all the hundreds of vehicles we collect data, we couldn't find even one car that was charged once a day, not even one. The vehicles are charged much less than that. And when we have longer-range cars, we charge even less. If you drive a Chevy Volt, if you drive a Tesla Model 3 long range, you don't charge more than once every three days. And now the behavior is much more complicated

because when you charge only once every three days, you have more capability to choose where you do it, when it's cheaper, when it's more comfortable, and so on.

This is a group of 6,000 PEV owners, 2017, who have all the options. They have home charger, they have workplace charger, they have it all available to them. And this is what they actually do over a week of data collection. The top, the left one is BEVs, the right one if PHEVs. And we are presenting it as function of range of the vehicles. Probability is function is range.

For BEVs the range is not changing much. Short-range BEVs and long-range BEVs, there is about one-third probability that they plug in at home in any given day and, also, a little bit lower probability that they will plug in at work on any given day. These are people that have both options, home and work. When range is going up there is much higher probability that they will not plug in at all on a given day; that's this, going up. And there is much lower probability that they will charge in more than one location. Public locations are always very

low and it doesn't really change that probability.

Now when we look at plugin hybrids, we see a very interesting story here. About a third of them will plug in at home, regardless of the range of the car. Of course, the probability for doing more than one place dropped dramatically, that's the line that dropped. But the probability of charging at work is climbing from about 10 percent to 30 percent when range of the car is going up. So when people have more range, we expect them to charge less.

But with plugin hybrid, when people have more range, the positive utility of plugging in and getting free electricity at work is going up. When you can get more every time you plug in at work with a 40-mile-range car, you get much -- you save about $1.00. When you plug in a ten-mile range car, you save about $0.10, $0.20. People are much more likely to plug in at work when they have longer-range vehicles than shorter-range vehicles.

All of that behavior is very important for the modeling because we have more flexibility here. Pricing is important. Time limit is

important. We all know we hate these four-hour time limits. But that's also a call for one more important, I think, policy consideration.

We are now talking about workplace charging and home charging but we are surveying people based on a different question. We surveyed them based on charging while at work. And charging while at work should happen not only at your employer's parking lot but most of it or many times it should happen at a public charger, like what we have here in the City of Sacramento, even better, at the light rail station far away from downtown.

We should install workplace chargers at the BART station. We should install workplace chargers at public transit stations, at park-and-ride station locations, because this where people commute to. And by installing chargers by the employer, we actually encourage them to drive all the way to work instead of doing this better VMT calculation that the CARB people were just talking about earlier, so changing this discussion from workplace charging to charging while at work.

I think that I will move to Alan's two

slides.

If you want to come up here and present them?

Alan is leading our work on the vehicle grid integration. He's doing most of our research or a lot of our research on TNC.

MR. JENN: Thank you, Gil.

So speaking specifically about infrastructure developments, we just launched a two-year project to look specifically at the integration with distribution infrastructure. And this is something that we'll actually be working on, and hopefully with some support from CEC and some local utilities.

So the first sort of task is to look at the landscape of distribution infrastructure, and so we're working with the Integration Capacity Analysis tool to do that, coupling distribution infrastructure and charge installation. And so here I think one of the big strengths of what we're doing is to couple what Gil was talking about with a lot of the behavioral elements that we're able to use, empirical behavior elements, with the data from the Integration Capacity Analysis tool. And then lastly, we're hoping to

develop pricing and policy levers in order to sort of maximize benefits to the system.

And then another sort of small data overview for this new aspect of demand in TNCs, what we're trying to look at is specific infrastructure deployment to meet TNC demand. Okay, so this map on the right-hand side isn't a sort of model. This is actually empirical data about where electric vehicles in TNC services have demand for services, so where they're picking up passengers. And you can see this sort of growing very quickly over time, over the last two years.

There are also dots, red dots corresponding specifically to charging events and charging amounts by TNC vehicles charging to fulfill those demands. And what you can see is that, yes, in some areas there are some correlation between where the pickups are happening, where the demand is, and where the charging is. But that colocation isn't necessarily prevalent in all areas. And we've done some analysis in L.A. and San Diego, as well.

And so we are currently sort of trying to

develop a model to help build out the DC fast infrastructure to better align with the TNC electricity demand. And this is important; right? Because if you minimize the discrepancies between the charges and the riding demand, then you are, one, increasing profitability for drivers and thereby incentivizing electrification in these services and, two, you're decreasing the deadheading that's needed for the vehicles to travel to charging the vehicles, which will be a benefit from an energy and emissions perspective.

And so that's just the small preview of what we're doing on the TNC demand portion for infrastructure development. Yeah. And that's all we have.

MR. CRISOSTOMO: So at this point I'm going to introduce Kim Ho, our intern, again, to help with moderating our questions before we break for lunch. We'll have maybe around 15 minutes.

So, Kim, go ahead.

MS. HO: Hello everyone. So at this time, we will be opening up the room for any questions, comments on the overview topics we have covered this morning. We have about 10 to

15 minutes for three to five questions, depending on time. We do want to get you out of here for lunch on time. And then for any folks who have questions, we will have a mike passed to you. Please introduce yourself and the organizations you represent.

For folks on WebEx, please use the raise-hand feature or request to be muted.

And so we're going to start with the two questions we have onboard.

So the first one is to address any questions you have on the process, and this refers to the breadth of the AB 2127 requirements and coordination required of it.

The second one is about also the depth of the analysis process. So -- and then the second question touches on the purpose of gathering useful data for electric vehicle infrastructure alignment.

And taking the limited time that we have on the first cycle, what topics are of greatest interest to you and that could inform the Energy Commission to prioritize.

So at this time, please raise your hand if you have questions.

Yes. So I have -- I see the first one, the second one.

MR. PINGLE: Hi. This is Ray Pingle with Sierra Club.

So it seems to me that, you know, the optimal charging scenario for individuals that have vehicles is charging at their residence or wherever they live and because that's has benefits to them. They don't have as much transaction time trying to find charges and charge. It's beneficial to the grid because they can charge overnight where it doesn't impose as much demand on the overall generation of electricity. And it's cheaper.

So I think anything that you all -- by the way, I think this is phenomenal. This is a phenomenal workshop. And it's really delightful to see how well all the agencies are coordinating together. But I think anything in the analysis that is done that can provide all the policy support possible for enabling charging at a residence would be very beneficial.

And then the other comment is that in addition to forecasting demand and so on for charging, I think that some additional outputs of

this process could be informing the various agencies of opportunities for legislative, regulatory incentive policies and procedures that could enable this.

Thank you.

MS. RAFALSON: Oh, is this -- okay, the green light is on.

Hi, Sarah Rafalson from EVgo for the third time. And thank you, CEC, for organizing this today.

First and foremost, we're a fast charging provider. And I was glad to hear a lot about the discussion of ride-hailing mentioned several times today and would just like to emphasize that any needs assessment should consider the increased eVMT from light-duty fleets, and ride-share in particular, which increases drastically the need for DC Fast Chargers. And we've put a lot on the record about some of our utilization data in the last year, so including a report we filed at the CPUC just last week. But in metro areas in particular, we're now seeing fast chargers being used ten-plus hours a day.

So in regard to the second question on the screen, I would just also like to emphasize

the need for gaps to be assessed by utility territory, which is right now something that is not available in the current EVI-Pro model. And from our perspective, that's led to a smaller proportion of fast chargers being estimated, specifically in applications at the CPUC. So we have this 10,000 fast charger goal but it's not segmented by utility territory. So I think that would help to right-size future applications.

And I think just last on grid benefits for light-duty fleets in particular, that was raise a couple of times, too, and I would be happy to talk afterward and share some data that we've shared with other state agencies, but fleets in particular are charging a lot during peak solar, even without any price signals. So I'd be happy to share that with anybody following this presentation today.

MR. MCMILLAN: Hi. Good morning. Good afternoon. There you go. Hi. My name is Ian McMillan. I'm with the South Coast Air Quality Management District. Very much appreciate all the work that's going on, all the coordination amongst the agencies. It's very encouraging to see.

I think to get to the second question here about greatest interest, down at the South Coast, you know, our primary problem is nitrogen oxides. That's not really so much from the light-duty fleet. It's mainly from the medium- and heavy-duty sector and off-road sector that we're seeing that real challenge on nitrogen oxides. And so when we're looking at what are the greatest needs that we have down at South Coast, it really is on that larger -- those larger vehicles.

And when we've talked to a lot of folks in industry, you know, the needs that are there on the, you know, sort of the energy need that's needed on a facility basis, for example, you go to a, you know, warehouse or something like that, they might have on one building a draw of several megawatts that they need, just a few vehicles. And that's dwarfs a lot of the need that we're talking about on the light-duty side, especially when you start thinking about that at scale.

And so we really would encourage a lot of this effort to look -- the level of detail that's been put into the residential and the light-duty sectors of looking at the needs there, that's

really impressive and definitely needed. But we think an equal effort is needed on the heavy-duty side, especially given the trade gateway that is in Southern California for the entire nation and how goods flow through that area. So we really encourage a lot of focus on that larger sector. And we look forward to working with everybody here to try to, you know, figure out how those scenarios might look.

So thank you.

MR. CRISOSTOMO: Thank you.

MS. HO: We have maybe two more questions, two or three. Anyone else from this side?

MR. PINGLE: Ray Pingle, Sierra Club.

Just one other comment or suggestion is to the extent that industry, the EVSE chargers and networks, the ChargePoints, Greenlots, EVgos of the world, to the extent they're willing to share data with you, that could be additional datapoints to help do forecasts.

And also, on the net-demand side for EVSE, to the extent they're willing to share or publicly announce their commercial plans to provide chargers in various locations, that would

help you inform what the net need is beyond that for public infrastructure.

Thank you.

MS. HO: Thank you for all your questions.

So if, Noel, you can go to the next?

So at this time, before we break out for lunch, we like to take an account for how many participants are interested in each sector. So if you can please just raise your hand for, first, it's the light-duty vehicle.

That's -- are we counting? Yeah, that's a lot.

Medium-duty vehicle? And it can overlap. You can be part of both. Okay. Thank you.

And heavy-duty vehicles? Okay. So, great.

MR. CRISOSTOMO: So it looks like maybe 70-30 split between light, and then in combination, medium and heavy.

And so just so that we are returning from lunch in an organized fashion, we're going to partition the room a little bit better to accommodate sector-specific breakouts so that we'll be able to get into the depths that are

needed during the afternoon. So please look for the appropriate table tent according to which sector you're interested in discussing and kind of seat yourselves on that side of the room or at the tables, actually, after lunch. So we'll reconvene at around 1:20.

And thank you, presenters, for remaining on time.

And thank you, audience, for going through our grueling list of nine this morning.

We'll reconvene back at 1:20. Thanks everyone.

(Off the record at 12:18 p.m.)

(On the record at 1:30 p.m.)

MR. CRISOSTOMO: Okay, we're going to call the meeting to order and go live on WebEx. So welcome back from lunch, everyone. Thank you for finding a seat at one of the tables for our breakouts this afternoon. We will have a brief presentation regarding definitions in order to kind of set the stage a little bit more before we do our sector-specific discussions.

So during this presentation I'm going to describe how we're interpreting the identified elements of the infrastructure assessment which

are, quote, including but not limited to chargers, make-ready electrical equipment, supporting hardware and software, and other programs. So I will include, also, in this proposal an effort to leverage our sister agencies' work from a Vehicle Grid Integration Working Group and lead into the activity by describing the importance of examining these individual infrastructure elements in the context of broader transportation and energy systems.

So this is kind of a basic slide but really important to the Commission as we embark on this analytical effort because the legislation is not specific about what it means when referencing charges. And in common language, we've found that these four terms, connectors, EVSE or off-board charges related to AC or DC provision of power into the vehicle, infrastructure, and station are often comingled, so shorthand, like charging infrastructure or charging stations, become kind of a very confusing term to handle.

So the intermixing of those concepts is intended to be segregated here in these four parts of this bullseye, shown hierarchically from

the top to the bottom, from the smallest unit, which is the connector which you insert into a vehicle inlet, to the largest, which is a station which is an actual address in the Department of Energy's use of the term. And so we'll go into further example about what we're trying to get at and what we mean because defining these terms will help us have better discussions.

So as many of you know, there are two types of EVSE that operate at lower AC voltages, Level 1 which can plug into a 120-volt outlet, and Level 2 which is connected to a 220-volt service. Both Level 1 and Level 2 EVSE, or electric vehicle supply equipment, use the SAE J1772 connector for conductive transfer into an AC-DC charger onboard the vehicle which converts the AC power from the grid into DC power that's usable by the vehicle's battery.

And on the left -- or right-hand side of the page, we have a DC Fast Charger which operates at higher AC voltages, maybe 480 volts, and uses three-phase power, and uses an offboard AC-DC charger to direct electricity directly into the battery.

And so there are three types of

connectors for fast chargers, going left to right, the SAE combined charging standard, the Tesla connector, and the CHAdeMO connector. And it's important to note that these are commonplace in on-road light-duty vehicles, and to some extent heavy vehicles, but it is not intended to exclude other forms of charging matter continuing to emerge for other segments.

So we'll be going into an example as to why it's important to use consistent terminology to describe connectors, EVSE, chargers, charging infrastructure and stations, as depicted here. This is particularly important to account for existing chargers or EVSE deployed throughout California.

So in searching for an example to describe during a workshop, I looked for recently commissioned installations and figured I haven't seen Electrify America's website yet. And so I found something that was recently energized which was also tracked by the Department of Energy and PlugShare. So these are excerpts from websites by EA, Electrify America, PlugShare and the Department of Energy, which all describe the same installation with different terms.

And so from left to right the DOE says that there are ten outlets at this site, not specifying the number of different connectors. According to PlugShare there are ten CCS stations and one CHAdeMO station. And according to Electrify America there are nine CCS stations and one CCS CHAdeMO station. And so what does this mean when we're trying to account for up to 250,000 stations to support electric vehicles under the executive order?

This is -- these are all trying to describe this middle point at the 2774 Livermore Outlets Drive address in Livermore, California, these are the premium outlets where actually the station, according to the Department of Energy, has an address describing several groups of EVS, its DC Fast Chargers, including the one that I'm describing from Electrify America, but also two from the EVgo network.

Specifically to Electrify America, there are ten DC Fast Chargers at ten parking spaces to serve ten vehicles, despite the fact that each charger has two connectors. So in total at this EA installation there's one CHAdeMO connector and 19 combined charging system connectors in total.

And for the ten, they are split between the power capacities that they're capable of serving with 8 150-kilowatt DC Fast Chargers that are CCS alone and 2 350-kilowatt DC Fast Chargers that are able to serve CCS and CHAdeMO, where one of them is, and if you squint here, a 2 CCS charger and one of them is a CCS and a CHAdeMO charger.

And so given this amount of potential confusion, how would be quantify the capabilities of these assets to serve California vehicle drivers' needs?

So let's take a step back. The electric vehicle infrastructure projections model quantifies the EVSEs, namely the Level 1 and Level 2 EVSE, and DC Fast Chargers needed to serve the power capacity demanded by an EV given an individual vehicle driver's energy requirements, how that demand for an EVSE or charger would coincide with other drivers in the county and, third, accounting for increasing power ratings over time.

So to quantify the capability of this Electrify America installation in this context, let's consider that a 350-kilowatt station serving the very right-most parking space on the

previous page depicted here on the left. So looking at the PlugShare details the charger has a power rating of 350 kilowatts. And assuming no losses in the AC-DC conversion the 350-kilowatt rating could be the feeder size for that charger, meaning that only one car that might need 350 kilowatts of input power would be able to serve that -- be served by that charger at a given time.

So for the sake of clarifying, what if there were two chargers -- there were two parking spaces situated around that DC Fast Charger, where, for example, a Porsche Taycan could charge at 350 kilowatts, as it's expected to do so in the media, and a LEAF were to park at the other parking space serving -- being served by that charger? And if both the Taycan and the LEAF were requesting their respective connectors full output power, how would be account for that charger?

So for EVI-Pro to correctly account for that demand, both chargers, both the 350-kilowatt CCS and the 50-kilowatt CHAdeMO, would need to serve their full output power, meaning that the charger would need to be federal with

infrastructure that can support the sum of 350 kilowatts and 50 kilowatts. So in other words, in order for this charger to count as two the feed would need to serve the full power demanded by the two vehicles if they were to come and arrive at this charger at the same time.

So the idea of delivering power demanded by the EV is even more important when considering a case where power is fed among several connectors and shared among a given EVSE. This is often the case for Level 2 EVSEs with multiple J1772 connectors, as displayed on the right.

For example, what if this charger was installed at a workplace where two coworkers' EVs demanded the full capability of the J1772 at 19.2 kilowatts and both were to plug into this EVSE, perhaps installed in the middle of two parking spaces? If the EVSE shares 19.2 kilowatts among both of those two coworkers' vehicles that EVSE would have to power share and only be able to meet half of the EVs' demand, in other words, 19.2 divided by two. Therefore, the loading at those two vehicles would be reduced compared to what they actually needed which might induce the demand for another EVSE,

Taking a step back out of these details, it's important to consider how parking configurations and power sharing and the connector capabilities are described. And so when we are counting EVSEs and chargers, this quantification should account for, first, the maximum connector capacity and account for, for example, reductions in throughput that would delay service given the parking configuration or power management objectives because that would induce the demand for an additional charger. And in addition, actual user behaviors with this infrastructure should be accounted for.

If you have read the EVI-Pro report from 2014, this management of the infrastructure has a high influence on the sharing potential of the equipment and, thus, the network size that's, in total, needed for the state.

Sorry.

So the power feeding in the charger is a core concept of the second part of the assessment, the make-ready electrical equipment. So in the bullseye shows at the beginning of the slides, the make-ready electrical equipment could be synonymous with the infrastructure because it

underpins and supports the chargers and EVSE. The make-ready is all of the electrical equipment up to but excluding the EVSE or the charger and terminates at the EVSE's junction box. In programs, this definition commonly includes electrical panels, conduit and wire, meters, service drops, and secondary service transformers.

However, we have heard anecdotally, particularly in large DC Fast Charger plazas or for prospective heavy-duty charging fleet installations that the make-ready has also needed to include upgrades to the primary circuit or even the substation, especially where capacity is aged or limited.

Note that there are two configurations of make-readies here showing a premise meter and an EVSE meter, or an EV service meter, which relate to the existing service being the focus of the charging installation or a separate service dedicated to electric vehicle load alone. In both of these cases, submetering of EVSE or charger-specific loads is technically feasible today and it's described in more detail on the next page.

From a program standpoint, we indicate the effect of the SB 350 transportation electrification programs where cost that were previously dedicated to an individual customer that were located specifically behind their meter are now eligible for recovery in distribution rates across many customers in a non-dedicated fashion.

Thinking about data collection, make-ready electrical equipment data is extremely difficult to acquire due to the site-specificity of design and the fact that no, to our knowledge, databases exist of charging infrastructure buildouts describing a component-level analyses. The integration capacity analyses published by the utilities, mentioned earlier, are a good start. However, they're not specific enough to support a full component-level analysis at the statewide level.

The last specifically-identified aspect of the analysis is supporting hardware and software. For scoping at this time, we interpret this to mean the supporting in hardware and software of the EVSE or charger itself and not specifically the hardware and software of a make-

ready infrastructure.

And so as show on this slide on the right we highlight several physical and transactional functions which we can examine the hardware and software and understand the needs of the charging equipment. As an example, listed here, potential hardware and software analyses could include the compatibility of chargers, charging controls, electrical safety, meter accuracy, network connectivity, load efficiency, secure authentication, secure payment, and other items that are not listed. We're open to stakeholders' comments on what additions could be considered here.

Following the previous reference to EVSE-based submetering, I show an example of how hardware and software could be overlain onto these infrastructure elements. So, for example, if the EVSE had the capability of measuring charging load itself, it could communicate to a variety of actors, including a local energy management system, and communicate through a service meter back to the utility in order to associate that EV-specific submeter to a customer's account.

In addition, it could communicate to a meter data management agent or an automaker original equipment manufacturer to similarly associate with a service meter and communicate subtractive billing with a utility, or in the case of utility submetering, the counting of that EV load could be directly associated with the AMI and reported back to the utility's meter data management system.

The goal here for hardware and software is to organize and complement existing efforts, for example, those promulgated by the Division of Measurement Standards and local governments or permitting departments. But we also want to provide a common resource for stakeholders who have yet to implement electrification in an organized fashion. And so we list here examples of government agencies and industry associations which are promulgating relevant standards through their jurisdictional efforts.

In particular, a key here is the need to identify the needed hardware and software for future vehicles and close any analytical gaps to ensure that our future charging infrastructure is effective in meeting upcoming requirements that

can be anticipated and for planning future infrastructure procurements.

And so this takes us kind of a little bit of a wrap-up where we need to work with common definitions. And so build on prior analysis shown in the prior slides, these represent -- these initial ideas represent the Commission's experience, research and review of technical reports and utility programs. But in order to move towards a common dictionary, we are preliminarily focusing on the output of the Interagency Vehicle Grid Integration Communications Protocol Working Group and their draft final VGI Glossary of Terms. And while it is not finalized or adopted by the CPUC, it serves as a useful starting point to propose definitions.

And so the Energy Commission staff will plan to refer to portions of the VGI Glossary and refine and further develop those terms as part of the AB 2127 analysis to make sure that stakeholders are able to understand what we're discussing.

And before we transition into the discussion groups, it's worth talking about how

these interactions between factors are working together. It's important to use something like the VGI Glossary as a dictionary. But it's important, even more so, to understand how to speak with these terms in the way that we use nouns and verbs to form sentences and paragraphs and the conveying of coherent thoughts. So in this manner, it's important that we account for the interactions between the factors that I described and counting them within the system's approach that I described this morning.

Fundamentally, infrastructure needs are a subset of the vehicles used, the overall travel demanded, and other factors. And infrastructure decisions, like power, location and utilization, are subject to tradeoffs. And likewise, vehicles that are used are subject to modal shifts and the technologies that are commercially available. And so even at a higher level the types and locations of economic activity will be the fundamental drivers of travel demanded.

And so therefore, it's important to consider infrastructure as part of a broader set of vehicles and travel. And so we think that a pathways and systems' analysis is critical to

account for these factors. Our researchers earlier had highlighted this and I'm hopeful that everyone is starting to understand the importance of these.

But as you might recall from the EVI-Pro analysis, one pathways analysis that was described in that report was the alternative pricing scenario where we were able to model a difference in preference based on the price of Level 2 and public DC Fast Chargers, which would quantify the differences in deployment between a colocation of high-power chargers or heavily distributed lower-power chargers at individual residences.

Examining infrastructure pathways is warranted, not only in the context of the transportation system in which it is serving but also the energy systems that actually support the infrastructure. And so AB 2127 accounts -- allows the Commission to analyze elements of infrastructure aside from the three items defined previously, chargers, make-readies, and hardware and software.

As described earlier, when accounting for a charging assets ability to serve the demand of

an EV, several assumptions must be made -- taken into account, for example, the constraints of the site or objectives in the users' behaviors, parking configurations, and the grid itself. Thus, the product differentiation depicted here of different charging solutions currently available on the market is the natural result of these constraints of available power, parking configurations, and the user's intent.

For example, these charging solutions, for example, the Envision Solar one on the left, the FreeWire Mobi immediately to the right, or the EV Smart Technologies lamppost charger don't have make-ready requirements at all. Because of these, they have substantially different use, insulation and power operational requirements that can be deployed to support the EV targets that we have and decarbonization goals at a much different rate than conventionally-designed infrastructure, and so they require different analysis.

Furthermore, Staff believes that it's prudent to respond to concerns highlighted in other forms about the resilience to the grid for electric vehicles. And so I highlight the

definition of transportation electrification from the Public Utilities Code to remind you that transportation electrification means the use of electricity from external sources of electric power, including the electric grid. This is important to describe the importance of emerging charging pathways that use electricity from external sources, including DERs, like storage or even fuel cells.

And lastly, our analysis of other programs was important -- given an analysis of other programs, it's important to track the pace and breadth of programs to determine if the investments are keeping up with serving the needs of new EVs in the system.

And so to transition, we're going to have a few moments of public comment, again moderated by Kim, our Legal Intern.

MS. HO: At this time we have about five minutes to open the floor up to discussion.

The first question is about enhancing our community process and contribution for the VGI Glossary of Terms.

And the second question refers to how can we establish agreements in setting common

definitions, vehicle and sectoral terminologies, and shared resources?

So if anyone has comments, questions, now is the time.

MR. CRISOSTOMO: So, Karim, I think there are two mikes on the table somewhere, so free to use the ones that are situated at your table.

MR. FARHAT: All right. Hi everybody. Karim Farhat from PG&E. So I have two comments which I will make, hopefully quickly.

The first one is both, in our opinion, both the terminology and the accounting methodologies when it comes to EVs and EVSEs should be aligned with whatever exists in the DER ecosystem. So we need to make sure that the terminologies that we're using with other DERs are consistent to the extent possible with the terminology that we're using with EVs. And the same also applies to the accounting methodologies.

Now we do realize that, you know, EV and EVSE have specific unique aspects associated with them and that's fine. If there is no terminology or accounting methodology that exists today within the DER ecosystem, then we can do that but

we need to make sure that whatever exists can be leveraged.

So a couple of examples on that is, for example, ideally, we wouldn't have anything in terms of terminology or accounting methodology that would contradict what exists in the MUA and how the multiuse application describes DERs. Another example is smart invertors. So all of these, we need to make sure that there's alignment in terminology and accounting methodology between them.

Comment number two, I know I really appreciate the way that you have detailed kind of how things can go wrong in the accounting of the resource. In my mind there might be terminology that is related to accounting the resource specifically, and there might be terminology that is more related to describing things accurately, but it doesn't necessarily affect the accounting of the resource; right?

So, for example, if I'm talking about two ports and I'm only accounting for one of them, that obviously accounts my ability to do forecasting for the resource. But if I'm calling the EVSE a charger or I'm calling a charger an

EVSE, that's more of an accuracy of the description but it doesn't necessarily affect the accounting itself.

So for the sake of simplifying this effort, again, to the extent possible, given the breadth of studies that we have seen this morning, maybe we can -- both are important but maybe we can prioritize, focusing on the terminology that if we get wrong, then the accounting would be wrong. And then for the terminology that is related to accuracy, that would be like second here.

Thanks.

MR. CRISOSTOMO: And, Karim, if you have any specific decisions or papers that describe the MUA and DER definitions, please let us know.

MR. FARHAT: Sorry. On that note, I would refer to the MUA proceeding final report that was published. There is, I think, some description. Maybe it's not a final report but I know that there's an MUA proceeding and there's a report that was issued there. I'm happy to follow up in details of what that report is. But there is some description that existed in that report. It will be like a good first step to

just like make sure that whatever is there is not kind of free invented.

MR. CRISOSTOMO: Thank you.

Ray?

MR. PINGLE: Hi. Ray Pingle, Sierra Club.

So it may be that the collective we needs to keep a superset of all the detail needed, both for utilities, for charging, for users and so on, but then develop specific subsets depending on who the audience is. So if you're a driver there may be certain amounts of detail you don't need to use but certain things, you really, you want to know if a resource is going to be shared or not, for example. You want to know if there's one or two parking spots available to that EVSE. So the idea is to have a superset but then subset for different users.

MS. HO: We have time for maybe one or two more questions.

MR. CRISOSTOMO: Okay. Thank you for those comments.

Okay, so the reason why we set up the day and the room in this format was to kind of lead up to this point. Coming from an overview from

the legislation context, from regulatory agencies on their implementation on charging infrastructure programs and vehicle regulatory programs, going deeper into why we need to organize data, analytical examples, and most recently, defining terms, we want to go -- we went through these in order to -- in order for you to think about how all these systems are starting to interact and lead into this working session.

And so the purpose of this data collection deep dive is threefold: first, to provide answers to the data requirements that are listed in the matrices that were served through the service list earlier this week; second, to allow for stakeholders to suggest resources that would improve the viability of our analysis, including volunteering yourself or colleagues to assist with further discussions in the case that, for example, no public information is available since it is confidential and proprietary; and then third, to identify important considerations, concerns or challenges with this analysis.

And in order to do so, we've broken you up into different vehicle segments. And I'm

hoping that you've already chosen a seat at the appropriate table for light-, medium- or heavy-duty vehicles. And during this breakout session, you'll actually see toward that second point a clipboard circulating that looks like that, allowing you to identify yourself as a participant in the AB 2127 process.

Furthermore, we thought it would be important and effective for people to actively participate in a way that was simply not reading assumptions into the microphone at a queue. We thought that would be pretty boring for folks. So during the next 90 minutes, we're going to break this into two parts.

Energy Commission staff will facilitate each of the areas for the different on-road vehicle sectors, again, light-duty vehicles, medium- and heavy-duty vehicles. And we're using some terminology from the Federal Highway Administration posted in the middle of the room to delineate the different vehicle segments.

We'll have facilitators and notetakers from the Commission, myself and Kim in light, Tim Olson and Wendell Krell in the medium-duty vehicles, and then Ben De Alba and Adeel Ahmad

from -- in the heavy-duty vehicle section. We're all staff in Fuels and Transportation Division.

And there will also be staff working from the R&D Division and Energy Assessments Division keeping track of specific notes that they work on in terms of site analysis or EVSE technologies or forecasting.

So we'll be breaking out into about an hour into facilitated sessions and then reconvene to offer summary reports, based on this breakout. During this, we will identify information gaps and analytical needs and additional questions and ideas upon which we can follow up.

And so at this time, we're going to kind of get started. But as an example of how we'll be working with the matrices that you have in hand that you picked up in the foyer and the boards that are posted in the room on foam core, there are three major questions that you'll be responding to in the vehicle sector that you're interested in.

As Wendell described at the beginning in the morning, the matrices are organized by infrastructure assessment element, chargers, make-readies, hardware and software and other

programs. And then for each of those parameters that drive infrastructure needs, we'll be looking at three major questions.

First, is the information available? If yes, please list any sources that you'd like to suggest, or, no, identify means to collect the information. And we'd like to see any market information, reports or databases offered. Again, we're not necessarily starting from scratch but we want to hear what you guys are interested in, not to give out all the answers. We didn't want to minimize the need for stakeholder input by leaving things mostly blank.

Second, we'd like to detail the inputs that would affect the need for the different infrastructure elements that I've named before. And as examples, in the second column there are specific parameters that can be important factors in determining infrastructure requirements and different pathways.

Third, we'd like to identify considerations that we should keep in mind as potential pitfalls or suggestions to refine our analysis and improve its relevance and make suggestions about how to analyze a particular

section of the infrastructure assessment.

And fourth, on your handouts there are -- there's a blank row, just to represent that we do not intend to suggest this is an exhaustive list of everything that we could analyze but are you -- it's supposed to symbolize how you're able to provide additional suggestions for information to collect.

And so while, during this hour, we won't necessarily need to go through every single line item, we want this to be a free-flowing discussion facilitated by the Commission staff where the facilitators will be taking notes and tracking the discussion on the foam core boards. And you can keep notes on your own in the handouts that we've printed out.

So at this time, we can break out and then try to reconvene in about an hour. But before we do that, are there any key questions?

MR. FARHAT: Sorry, Noel, not a question, just a comment. I just want to make sure that I spoke very accurately on the comment that I made before, so let me just be very specific.

My comment about the alignment between EVs on -- and other DERs on the accounting

methodologies and the terminology was specific to the VGI aspects of the EVs. Obviously, the EV space is side. It's much wider than VGI. So I was only referring to, as long as we're talking about EVs and modeling of EVs as a grid resource and within the VGI ecosystem, then this is where I'm talking about the alignment.

MR. CRISOSTOMO: Okay. Understood.

Tim, do you have a question?

MR. OLSON: Yeah, more of a suggestion. This is Tim Olson, Energy Commission.

Given not many people here at the medium-duty table, there's a lot of common ground with medium- and heavy-duty. And it might be worth combining those areas for --

MR. CRISOSTOMO: Yeah. It's been half-an-hour since we've reconvened at lunch and we haven't gotten everyone back. So why don't we make some room and rub elbows with your heavy-duty brethren and sisters and combine that. We could also pick up an additional table if that would make more room. But I agree. Thank you for that, Tim.

Any other -- oh, yeah. And before we break out, and I will note that our light-duty

table will be transcribed, we'd like to make sure that our WebEx remote attendees are engaged and are able to contribute, albeit remotely. And so we invite everyone participating on WebEx to follow these instructions that will be posted up here for the next hour where they can chat ideas through the chat feature, and we will include them as part of our notes. And depending on the volume of such chats into the conversation, we'll be able to have our WebEx guru Micah running those chats into the live working group itself.

So after you guys resituate the table, we can get started.

Any other questions before we go? All right, let's go.

(Colloquy)

MR. RAFATI: Hi. I'm Tony Rafati with San Diego Gas and Electric. I am the Policy Manager for our Transportation Electrification Group. And my interest is in the light-duty charging infrastructure needs to align with the scope of our application that we would like to propose to the Public Utilities Commission.

MS. STRUTNER: Hi. My name's Maddy Strutner. I work with SDG&E, as well, in the

transportation sector. I'm an Analyst. And my ideas kind of align with Tony's.

MR. JENN: Hi. Alan Jenn. I am at UC Davis and interested in electrification of light-duty vehicles.

MR. DAYHIM: Muhammed Dayhim, SCE. I forecast the EV adoption. I will be interested to see how CEC IEPR Demand Forecast Group, how we will utilize this study.

MR. PALMERE: Mark Palmere, CEC. I work on our Light-Duty Vehicle Demand Forecast in the Energy Assessments Division. And I guess I'm here to just answer any questions you might have about what we use for our forecasting and our methodology, if anyone is -- was wondering here.

MR. FARHAT: Hi everyone. Karim Farhat with PG&E. I'm on the Clean Transportation Strategy Team. And we're here, like my sister IOUs basically articulated, we're interested, obviously, in the EV infrastructure and to see how we can help and learn about how to better model these.

MR. FUNG: Hi. I'm Matt Fung with the California Energy Commission's Research and Development Division. I help administer the VGI

aspect of EPIC program. And I'm interested to see, where are the data gaps that research can help fulfill?

MR. TAL: Gil Tal, UC Davis.

MS. WILLIAMS: Marissa Williams, California Air Resources Board. I work in the Advanced Clean Cars Branch under Joshua Cunningham, who presented this morning. So we're here, interested in CEC's efforts on EV infrastructure assessments to align with our vehicle regulatory efforts.

MS. JAW: Kathy Jaw, California Air Resources Board. Interested in everything that can get us to the 5 million, which is including the EV infrastructure.

MR. WOOD: Eric Wood, NREL.

MS. BHAMBRA: Banpreet Bhambra for CARB.

MS. GARCIA: Hi. I'm Katherine Garcia with Sierra Club California. I'm here with my colleague, Ray Pingle, and so he's at the heavy-duty table and I'm at the light-duty table. We both work very closely with leading programs for increasing electric vehicle infrastructure, both -- for both heavy-duty and light-duty, but I'm specifically interested in light-duty

infrastructure for low-income communities.

MR. CRISOSTOMO: Okay. So were people able to look at the matrix beforehand and do they have any reactions or items that they are particularly interested in before we start off on any particular segment?

So each of these is kind of organized in a way to understand how external factors, aside from the actual infrastructure itself, infrastructure element itself, is being driven with a new policy or regulatory requirement for energy storage advances in costs from like a demand-driven standpoint. And so there are many things that we have to account for as a driver of demand. That was like a common element in each arenas or element areas of the infrastructure assessment.

So why don't people provide some ideas or for examples of what is driving charger demand? We've heard a lot of them today. So I don't want to restrict the conversation to what we have on the page but there's a lot of brain power in this group and I want to be open to what you guys are thinking.

Staff from ARB, can you start us off?

Like what are the key regulations that are affecting demand for new electric vehicles and help us start off?

MS. WILLIAMS: This is Marissa. Are we good? I guess not. This is -- okay. This is Marissa Williams from the California Air Resources Board.

On the light-duty side, as the presentations this morning mentioned, there are two regulatory efforts that the Advanced Clean Cars Branch is leading, the first one being Advanced Clean Cars 2 which is looking at new ZEV requirements post-2025, so this would -- assessments going out to 2030 would definitely be -- we would want to be looking at infrastructure needs beyond the 2025 assessment that was previously done.

And then we also have our Clean Miles Standard Program which is looking at regulatory efforts, which may include ZEVs, as well, for TNC applications.

MR. CRISOSTOMO: So Marissa is saying number of chargers derived from regulatory requirements imposed under the Advanced Clean Cars Rule and the Clean Mile Standard Rule. So

taking that one down and I'll follow up with that.

So have -- what are the key kind of timeframes for driving the actual number of vehicles that would be coming out of these regulations? Is that -- are those vehicle quantities available yet? So I'm looking at the -- is the data available?

MS. WILLIAMS: Yeah. I mean, for new regulatory efforts for moving from 2025 to 2030, that's under regulatory development. So there might be some preliminary projections on vehicles that we might assume from new regulatory efforts. And then we have our current regulation, the Advanced Clean Cars Program, that has ZEV requirements. But I think as Joshua mentioned, that's always a moving target, as well, because there are multiple pathways for the OEMs to get credits.

So, yes, yes and no. we do have some projections of where the vehicle numbers are and probably to 2030, which would be for the assessment.

MR. CRISOSTOMO: Great. So that's a perfect lead-in.

So tell us more about the types of vehicles that might be considered and how you might be accounting for infrastructure credits as part of, for example, the Clean Mile Standard? Because those are really important parameters based on what your objective is. So if it's to achieve a certain number of vehicles deployed, that will drive infrastructure requirements, of course.

And as we've discussed in EVI-Pro Version 1, there's a huge sensitivity to the number of Level 2 chargers, depending on if you're going to maximize eVMT overall.

And for CMS, you're really interested in the number of fast chargers; right? So understanding whether the TNC vehicles are full battery-electric vehicles or plugin hybrids plays into that, as well.

So let's put down assumed fleet composition; right? Would you add any other major factors?

And then for the final column, let's -- or, Gil, do you want to say something?

MR. TAL: Some datapoints to your column. So as Joshua said, we know that we'll have about

1.2 million cars to 1.5 by 2025. We know that we will have -- probably half of them are plugin hybrids. You know, you can go to the forecast and get a little bit better number but based on the credits of the ZEV mandate. Out of the half that are BEVs, we will have probably three-quarters are Teslas, so we'll have about 250,000 cars around California that can use DC Fast Chargers that are not Tesla in 2025, cannot get into the exact numbers but that's more or less the ballpark numbers, and about 50 that can use the 350-kilowatt hour -- kilowatt chargers. That's my guess.

MR. CRISOSTOMO: So would it be appropriate to kind of abstract, long-range BEVs with fast charging capabilities are a key kind of influencer of charging infrastructure demand?

MR. TAL: Well, we have only the DC fast, not Tesla, are the one that this -- all of the chargers that we are investing in, or going to, all of the DC Fast Chargers. So, yeah. Um-hmm.

MR. RAFATI: So this is Tony from SDG&E. I think it would make sense to make this dataset -- or looking at this data will make more sense to make it a regional approach because I

know, at least from our service territory, we're not at 50-50, we're at more like 60-40 and moving towards the best--

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

MR. RAFATI: Yeah. Yeah. So it would make sense to look at it for each service territory to see what it looks like.

MR. CRISOSTOMO: Yeah. So I think that echoes what Sarah Rafalson from EVgo was really interested in.

MR. RAFATI: Yeah.

MR. CRISOSTOMO: So maybe we can create a new data requirement?

MR. RAFATI: As far as the new ARB regulations, I think one thing that is going to help drive the need for chargers is the new LCFS regulation change where it's going to create a new vehicle rebate that may potentially lead into the increased sales figures.

MR. CRISOSTOMO: Sorry, Tony, I'm going to have to catch up. So service territory level demand, we don't have that information yet; right?

MR. RAFATI: Well, we do --

MR. CRISOSTOMO: Or for the existing data, we would.

MR. RAFATI: -- have assumption. The existing, we do, yeah.

MR. CRISOSTOMO: You're pointing which way? Oh, I'm sorry.

(Off mike colloquy.)

MR. CRISOSTOMO: Sorry. So for existing, we do. For new, no, we'll need to make some assumptions about customer preferences, for example --

MR. RAFATI: Sales trends.

MR. CRISOSTOMO: -- incentives,

MR. RAFATI: Yeah, incentives and new models coming on.

MR. CRISOSTOMO: So let's -- so the incentives and sales trends, customer interests might be an analytical consideration; right?

MR. RAFATI: The model availability.

MR. CRISOSTOMO: Model availability.

MR. RAFATI: Yeah.

MR. CRISOSTOMO: What other factors might -- what specific kind of data inputs, what might we be interested in understanding service territory level demand? It's really BEV versus

plugin hybrids or other things?

MR. RAFATI: That and the percentage Tesla cars because I think sometimes we include all the Tesla models as part of our service territory demand and that may skew the numbers either way because they've going to -- they have their own dedicated network. So maybe some sort of a special treatment would make more sense.

MR. FARHAT:

What's the horizon for the study that we're talking about here? Like if we're talking about projections up to 2030 then a lot of the -- there's going to be a lot more EV models on the road that, you know, above and beyond Tesla. But if we're talking for the coming two years, then Tesla might still be a dominant player.

So I'm just curious to know, like what time horizon are we talking about here?

MR. CRISOSTOMO: Yeah. So while we're going to kind of close the spigot off by May, we're interested in any information that would be available for beyond that timeframe, obviously. And so if there are product turnouts that -- for example, Ford has set a goal to have, what, like 20 or 30 models or 20 BEVS maybe by 2025 or

something. If it goes beyond 2030 or has like a plan in advance of 2030, we're interested in any information that we can get available to us. But the 2127 requirement requires us to look at infrastructure needs to 2030.

MR. FARHAT: Okay. So we're basically looking at until at least 2030 by requirement of the study itself.

MR. CRISOSTOMO: Yeah.

MR. FARHAT: Okay.

MR. CRISOSTOMO: And then, Tony, you were mentioning something else, LCFS.

MR. RAFATI: Yes. The new LCFS -- what is the name of the rebate? Yeah, Clean Fuel Reward Rebate that's being worked on right now that's supposed to go live sometime in Q4 of 2019 will provide an upfront incentive for the purchase of new electric vehicles that could -- that should likely be considered if we're looking at projections of the number or cars and the number of stock in California by 2030.

I'm going to put that in my other program's box.

MR. RAFATI: Okay.

MR. CRISOSTOMO: When will those roll

out?

MR. RAFATI: Oh, the target is Q4 2019 before we go live. I'd like to emphasize the word target.

MR. CRISOSTOMO: Are there specific pieces of information that you're going to be collecting out of that program that would help inform how those incentives would drive adoption? Numbers of DC Fast Chargers funded? Numbers of vehicles adopted? Numbers of people enrolled rates? What are the metrics that we would -- we could count on?

MR. RAFATI: That is still being worked out with all the stakeholders, so there's not a lot of information there.

I think one key element that can be used is the rebate can be used to create cost parity between similar models of electric and ICE sooner than we anticipated. I know there are assumptions about cost parity coming in 2024 or 2025. But adding an additional $2,000 incentive could change that target.

MR. CRISOSTOMO: So cost parity would be the cost of the electric vehicle and then the cost for a similarly situated --

MR. RAFATI: Similarly situated, yeah.

MR. CRISOSTOMO: -- ICE vehicle?

MR. RAFATI: ICE vehicle.

MR. CRISOSTOMO: So those are -- so two parameters to help inform that could be those two things?

MR. RAFATI: Well, it's the availability of new incentives to drive down the cost.

MR. FARHAT: Yeah, and actually along the lines of cost, maybe not only the, you know, like the capital cost of investing in the car but also the total cost of ownership. So you can start from it all the way upstream by saying it's going to be the carbon pricing which is going to affect the gasoline price, which eventually is going to affect the total cost of ownership for the behaviors, and then the customers are going to make decisions accordingly. So it starts with, basically, carbon pricing.

MR. CRISOSTOMO: Okay. I'm going to add that to another kind of line item, carbon pricing that would affect TCOE?

MR. FARHAT: Yeah. I mean, carbon pricing, especially as it relates to how it's going to affect the gasoline price and the total

cost of ownership.

MR. CRISOSTOMO: So, Karim, I'm going to make you go through this with me. So is the data available on such greenhouse gas features for us to do that?

MR. FARHAT: I'm sure there's some form of data but I'm not aware of any specific source.

MR. CRISOSTOMO: What would we be looking for, dollars per ton and then translating that into avoided emissions for EV versus conventional vehicle; right? How would you go through that analysis?

MR. FARHAT: I mean, purely hypothetically, and I could be completely off on this, but --

MR. CRISOSTOMO: No judgment here.

MR. FARHAT: -- I would basically say it's basically looking at how the, you know, how the carbon pricing broadly or loosely is going to affect the cost of gas as opposed to the -- you know, and then you compare the cost of gasoline to the cost of electricity. And then from there, you would do a total cost of ownership calculation and then you prove that, you know, an EV has a much lower total cost of ownership than

an ICE. And that, you would say then, is going to drive more and more customers to adopt. Hypothetically, that's how I would go through the chain of reasoning about it.

MR. CRISOSTOMO: Do people have thoughts on Karim's -- the strengths or weaknesses of Karim's back-of-the-envelope methodology? What should we kind of keep in mind if we were to do such an analysis? Gas price fluctuations? Whether or not customers prefer TCOE as key input for their vehicle choice?

Mark, maybe you could talk to that a little bit, based on your research from the CVS?

MR. PALMERE: Yeah. So our -- we do have a vehicle survey that's published -- or conducted several years, usually it's about every three or so years. And one thing we do is calculate parameters that give -- sort of reveal customers, at least their stated preferences, on how important each variable or each attribute is in their decision making.

So, for example, here, one of them is fuel type. And we look at how important, you know, the type of fuel it uses is. Then we also have, for example, fuel prices. And then just,

you know, overall price, pretty much every vehicle attribute.

But, yeah, that is something that we have and we're conducting the current version of the survey this year. And, yeah, we do find it very useful for sort of understanding how -- what consumers value the most.

And in our past surveys, I can say this, we're still working on the current one and don't have the results, but in the past, we found fuel prices are actually not as important as some other things. For example, overall price, you know, even if over time it would save them money, consumers do seem more interested in the actual price they're paying along with the rebate and what they're getting back, not the idea of cheaper fuel over time.

And then, of course, on the other side, range, and range is also very important.

I guess that's a long way of saying, yes, that we do look at how important fuel type is to consumers and just how, like not considering the cost or anything else, just the idea of electricity versus gasoline versus, you know, flex fuel, hydrogen, all that, how important

those are to people. And we do it by number of vehicles they own, so we can distinguish a one vehicle household to a two or three a household. So we see like one-household vehicles are less incented for EVs just because usually EVs are bought -- are owned in conjunction with at least one other vehicle for longer transits and stuff like that.

I think I identified myself. This is Mark Palmere.

MS. GARCIA: So just adding onto that, this is Katherine from the Sierra Club, I know that the Union of Concerned Scientists has a calculator that kind of gets to this point of the cost of gas versus the cost of electricity but they don't actually -- they do it at a national level, and so they talk about costs but they also talk about how clean the fuel is. So whereas in California, we have a lot of renewable energy and then it kind of compares that to some other states that rely on coal. And then their point is that, you know, they kind of break it out nationally. So that's just one instance.

But when I think of total cost of ownership, I also think of, you know, maintenance

costs and how some EVs are cheaper. So when you said -- I don't know if that's another item to talk about as an incentive.

MR. CRISOSTOMO: Yeah. So it is a viable thing to talk about. But it would be good to think about how TCOE is considered in the lens of infrastructure. So thinking through that, how would you kind of go about not only thinking about the operational costs of the vehicle itself but put an infrastructure and charging bent on that? Do you have any initial ideas?

MS. GARCIA: So I didn't think I'd -- I wasn't going to elaborate on this particular line item. But you're right, I mean, infrastructure, thinking about -- yeah, infrastructure is the topic, and so that would make sense for total cost of ownership.

MR. DAYHIM: This is Muhammed Dayhim for SCE. Thank you, Mark, for explaining about the total cost of ownership.

So demand forecasting, they do a great job, they design a survey. I think one of the biggest issues right now, and since we are here, is the range anxiety. That's one of the main barriers of EV adoption. And especially as Tony

mentioned about the regions, specifically in Southern California, that's one of the issues. And SCE and I'm sure other IOUs are working very hard to build more infrastructure. And having more infrastructure, especially on public workplace, also multi-dualing -- first, let me actually talk about some workplace and multi-dualing. We are pushing really aggressively to install more charges which also help us to shift the load to the daytime. It will help us to procure true renewable sources.

And also, on the multi -- the second barrier, which I think is also very important, is lack of infrastructure, especially in multi-dualing. They do have that issue.

And also, another one is the lack -- customer awareness. I think customer awareness is pretty correlated with infrastructure. So many people do not know about EVs but if they see more EVs, more chargers around their neighborhood, they will become more interested in purchasing and trying to learn more about, especially -- so also, Edison is working, also building infrastructure in disadvantaged communities as well. Around 49 percent of our

chargers are installed in disadvantaged communities so far.

MR. TAL: I was just asking kind of an open question, if installing half of the chargers in disadvantaged communities will increase EV adoption or would slow EV adoption?

MR. DAYHIM: That's a very good question that can bring up -- technically, it will increase, if you're asking. It will increase the EV adoption, having more, especially so many people are not living in disadvantaged communities but they do work in disadvantaged communities, so they charge their cars. So this is very helpful to have more -- this is more workplace charging, so whoever is interested to buy electric car, they will have that infrastructure, have it available.

MR. CRISOSTOMO: So let's go kind of through that provocative question that Gil is describing.

MR. TAL: Let's stay with the one before because I have more provocative questions, even --

MR. CRISOSTOMO: Well, let's go with the disadvantaged communities' one.

MR. TAL: You want to start with that? Because I think that I'm looking for eight, nine years for evidence that range anxiety reduces EV adoption, and I don't have any evidence for that, for sure not with 200-mile plus BEVs and PHEVs and multi-car households.

So we have to -- that's what I was trying to say in my presentation, we have to challenge our assumptions first and put a number to them because we don't have evidence for that yet.

So which one you start with?

MR. CRISOSTOMO: So let's start with -- before we go into the disadvantaged communities' sub question, let's kind of challenge ourselves and ask: Are the chargers needed? Because you're suggesting that they're not. So how --

MR. TAL: Not that they're not needed but we need to put numbers on all of our assumptions, how many are needed and for whom and so on.

MR. CRISOSTOMO: So let's go through that exact one. The data requirements are -- let's say that again. How many are needed and for who?

MR. TAL: Yes, and for whom, yeah. Out of the accepted -- let's say that we'll have 5 million cars by 2030, that's a good goal to have,

how many people will need public infrastructure out of these 5 million cars?

MR. CRISOSTOMO: So I'm capturing local numbers of chargers, of what type, for which users. Is that a logic model or is that some sort of forecast? Is that available? Have you answered that question?

MR. TAL: No, I haven't answered it. I can't answer it. I can -- I answered it last time in 2014 and you need to update all the assumptions to come up with a good number for today. We totally underestimated the range of the cars coming back then and that's the main difference that I think we need to change.

We also overestimated how people would use fast chargers. And now we know a house will do 200 -- an average household in California is doing 5 trips over 200 miles a year and they're doing it with the largest vehicle in the household, not with the most efficient vehicle in the household. So altogether, we way overestimated demand for chargers in 2014.

MR. WOOD: Eric Wood, NREL.

Do we know, Gil, who's going to buy these 5 million EVs or did we know in 2014 who was

going to buy them if they were going to have chargers?

MR. TAL: That's another great question. Yeah, we were wrong about that, too. We thought that electric cars are like smart phones, everyone will buy one and we will get to the 5 million. Now we know that half of the new cars in California are purchased by 15 percent of the households and they will buy two or three or four plugins between now and 2030. And they will sell to the secondary markets. So this entire story of who will own them, we have no good model for that, nothing. We can say who will buy them again and again and again but how they will trickle, I don't have a good model for that.

MR. FARHAT: Noel, after you -- do you still want to go through the disadvantaged communities? I have like a very, very broad point that I want to do which goes into multiple buckets here, but I don't want to circumvent the discussion on the disadvantaged communities.

MR. CRISOSTOMO: I do want to get to yours, Karim. I think that was sufficiently controversial, such that I want some answers on it.

Since we are -- so in the context, I don't know if you saw this, but in our flow of data collection we do have the IEPR that will capture a lot of this information for AB 2127. We're also tasked with our Benefits Assessment for the Alt Fuels Program. And as part of that, SB 1000 requires the Commission to look at disproportionate installation of infrastructure in certain communities or lack of infrastructure and to make recommendations to correct such a disproportionate deployment.

And so if we're simply looking at numbers of chargers per PUMA, public use micro access data geography, is that a bad thing to do? Is that useless?

MR. FARHAT: How many electric cars you will have in each PUMA or how many cars in general will you have in each one of them? How many new cars will you have in each one of them? If you will install 1,000 chargers for 500 cars model 1996, that's useless. So by using PUMA as our level of analysis, we are skewing the match of electric cars per charger.

MR. CRISOSTOMO: So you're saying where are new cars adopted?

MR. TAL: Electric cars. Plugin cars.

MR. CRISOSTOMO: New electric cars. And secondary or just --

MR. TAL: By 2025, let's say we will have 5 million cars. At least 2 million of them will be already with a second owner, maybe more.

MS. GARCIA: But adding onto what Gil was saying, you know, there are already currently plugin hybrids that are being sold on the secondary market. And if there are chargers in the disadvantaged communities, then we can ensure that the owners of those plugin hybrids will be charging them, rather than just filling up with gas. So I do think it's valuable to have the disadvantaged community outlying, even though we know that later on down the line when the conversations are on SB 1000, it will also be addressed.

MR. PALMERE: And the other -- another point, Mark Palmere again, this is speculative, not really based on our survey but just intuitively, if there are, you know, chargers in newer places, then people will be more likely to buy a PEV. Like it's just like if there's no -- they're not going -- it's like a chicken and the

egg situation where they're not going to buy -- where they'd be less likely to buy a PEV when there are no chargers and they're less likely to install a charger when there are no PEVs. So it's like you have to get it going.

But, yeah, in regards to our model, we looked at it at a statewide level. So, yeah, I mean, that's something that our model is, you know, working on because right now we look at, you know, average time to station, average time to charger. And in San Francisco there's -- you know, it's going to be like a minute or two. But in a more disadvantaged of more rural area, it's going to be a lot more.

MR. CRISOSTOMO: So I quickly tried to capture the discussion where we need to identify where buyers would be. We need to understand the secondary buyers or plugin hybrid electric vehicle drivers or the low-income drivers' preferences to maximize their electric miles, and markets describing the need to near societal norms that isn't possible unless infrastructure is provided. So I think that's a good kind of bow on the disadvantaged community one.

I think, Karim, I don't know if Alan was

before you or after you but --

MR. JENN: Yeah, although this is kind of jumping back to a subpoint to where they are located now or needed.

MR. CRISOSTOMO: Um-hmm.

MR. JENN: So I think there's a sort of fair bit of data and modeling on a lot of the public infrastructure but not so much on understanding how home charging is used. And so, you know, for example, in LCFS the utilities, the way you guys calculate based off of separately metered vehicles and then extrapolate that to the rest of the vehicles, right, that represents, you know, less than one percent of those vehicles. I don't know if any of the utilities can speak to the things that you guys are doing maybe to better understand the home charging patterns?

But, yeah, I think that, you know, in a lot of the academic modeling and studies, we need to do a better job of validating how that sort of, you know, 50 to 80 percent of people who are doing this are actually behaving.

MR. FARHAT: So on the last point about like, you know, how the EVs are actually behaving, maybe the one data point that I can

provide there is that you can track some of that, not necessarily only through a meter, but you can also track it through the EV itself through something like telematics. And we are getting data on how the EVs are behaving from the BMW pilot by the virtue that these cars are controlled by telematics so we kind of know when they are charging, when they are discharging. The meter is not the only way to track the behavior of the -- the charging behavior of the EV.

And you know, I think this is like kind of a field that is still evolving and we're still learning from the different pilots that we have. This the whole point, that we have a pilot.

MR. DAYHIM: I just one more point. Muhammed Dayhim from SCE.

So there is a joint IOU load -- electric vehicle load research report. It's about a few years, we published that. It's public. And this report will be published the end of the month, the updated one. So we studied and we looked at our EV load shapes which are the residential based on those EV rates we have from all of the IOUs and we publish that every year.

MR. TAL: Can you say something about the data source for it?

MR. DAYHIM: It's our own AMI data for each AMI data. So we publish that every year.

MR. TAL: Yeah. But how do you know, if I drive my Toyota Prius plugin or --

MR. DAYHIM: No, no. At home.

MR. TAL: -- how much I charging it?

MR. DAYHIM: It looks --

MR. TAL: At home.

MR. DAYHIM: -- at home. So those are the -- there's a rate called EV-1 rate for us, so we know if they have an EV. It's a separate meter, so, yes.

MR. DAYHIM: But we have that data, so --

MR. CRISOSTOMO: So let's do Karim real quick.

And then I also want to get your thoughts on how we can collect information on make-readies because that's really hard.

And if people had ideas about hardware and software for future vehicles, I think those -- that's a conversation that's pretty ripe. For example, all the new wireless charged vehicles that are coming online and automated

vehicles are expected in this timeframe. We should pay some time to it.

But, Karim, go ahead.

MR. FARHAT: Okay. So I have two. They were now, they're two broad points. And they might be a little bit too academic but bear with me here.

It might be only me but I think, I personally think there might be a lot of value to identify, first, like if we have some form of a very simple flowchart that says this is the data that we want to actually model and then from there work backwards into like, you know, because I am trying to get this number, this is what I need to calculate to be able to get this number, and then along the way, just like understand what assumptions we're making. Because now we have a list of factors but I don't exactly know how those factors are -- each one of those factors are being modeled and how they're resulting in an output.

So if you can also have some form of a flowchart or like, you know, a simple flowchart that says this is how the different data are going to be feeding into a model and this is the

ultimate output, that would be helpful.

The second one is, also, I feel like some parts of the conversation that we've been having today were around like this is what should happen, right, and it's driven by regulation, like this is what we actually want to happen. And other parts of the conversation are around this is what we think is going to happen but we're not really sure.

So again from a modeling perspective, it might be helpful to identify what part of this analysis we want to be prescriptive where we say this is what we want to achieve, this is what should happen, and what part of that analysis we want to be descriptive where we say we're basically, you know, just making a speculation here but we're not exactly sure what is going to happen? Because a lot of that will then bake into understanding whether some policies are going to be input into the analysis or are we are going to take the analysis and then inform policy as an output? So descriptive versus perspective and like, you know, are policies and regulations input into this analysis or are we using this analysis to inform policymaking?

MR. CRISOSTOMO: Just to respond to that, I'm putting them at the top since those are a little bit of meta treatment of the data. I agree that they are legitimate needs, we just haven't figured out what information we have to put into a modeling framework but we will be working on that.

And agreed, yes, we'll be taking scenarios from ARB in terms of trying to meet our 40 percent greenhouse gas emission goals example -- for example, but we'll also be describing the future based on things that are kind of market based and coming down the pipeline in terms of product, so it will be both.

MR. FARHAT: And just to make sure, this is not like really meant as a criticism at all. I think that a port for 2017 to 2025, like the previous study kind of alluded at that, where we said, look, this is what we are assuming. We're assuming a future where we have 5 million EVs and, accordingly, this is how we're making that analysis.

MR. CRISOSTOMO: Um-hmm.

MR. FARHAT: I think it would be helpful to just make that more explicit --

MR. CRISOSTOMO: Sure.

MR. FARHAT: -- and like make it just up front that these are the assumptions that we're saying should happen and, accordingly, we're going to predict everything else.

MR. TAL: I would like to follow up on Karim because I absolutely agree that we need to start with the basic question of when we would like people to charge? If we want them, for example, to take more of the duck curve in 2030, we would like to invest more in workplace charger or charging while at work. If in some areas of California, we would like them to do more overnight, we need to help installing home chargers.

So we need to start with them and then go to where. And I think is the where is where we need to put most of our effort, more than how many. Because, for example, with the DC Fast, we have these LCFS credits that are by capacity or by usage and it's very important to inform, you know, the right location, not just where the capacity is.

So start with when, go to where, and only then go to how many, in kind of prioritizing this

question.

MR. FUNG: This is Matt Fung with the Energy Commission.

I guess kind of just playing off of what Gil was saying, not only that, I think the next question after that is how to do it, as well? So that might be jumping the gun into the hardware and software portion as to how do we or what hardware or software requirements do we need for the charging infrastructure in order to make all that happen so they can smart charge or have bidirectional charging, as well?

MR. CRISOSTOMO: So thank you, Matt, for that transition.

In a few minutes let's go through some examples of smart charging and vehicle-to-grid, because that's a hardware and software thing. So let's kind of take a higher level step first.

So maybe we could ask: What are the smart charger functions that automakers and EVSPs are planning for? I think that's actually one of the listed things in the hardware and software section. It might even be less specific than that. Yeah, hardware and software design objectives.

So, Matt, do you want to take us through an example? What would make an electric vehicle charger smart?

MR. FUNG: So an electric vehicle being smart is, probably an example would be having the compatible communications with -- starting with an electric vehicle that can accurately and safely communicate the driver preferences between the EV and the EVSE. And then further upstream, the EVSE being able to accurately and safely communicate the grid signals, grid pricing, as well as the driver preferences upstream, as well.

So that's just kind of in a quick nutshell what I kind of imagine a smart EVSE to be.

(Pause)

MR. CRISOSTOMO: So communicate driver preferences between the EV and EVSE and grid preferences and pricing from the EVSE to the aggregator or the grid.

So is a demand for these functions kind of listed anywhere? Do we know where the market is headed in terms of which vehicles would have this or which utilities need this, et cetera?

MR. FUNG: Oh, I think at least in terms

of the vehicle OEMs, the VGI Working Group final report has a list of auto OEMs that are -- that list out which communication protocols they're going to be using. I believe a couple of auto OEMs have product roadmaps that they've described. It's all kind of out there but not in one centralized place.

And if anyone else has any other references, I'm more than willing to listen.

MR. JENN: Is this through OVGIP?

MR. FUNG: OVGIP is one of the communication methods. There's OCPP. There's Open ADR. There's SEP 2. There's ISO 15118. There's a whole host of communication protocols.

MR. CRISOSTOMO: So let's -- sorry for the interruption.

So auto OEMs' plans for products, EVSPs' plans for products would be a good source of information to gather. And then the parameters that you're discussing are the different points of communication; right? So what were those again?

MR. FUNG: So the different points of communication would be from vehicle to EVSE, EVSE to aggregator or a third-party, third-party or

aggregator to utility, and then EVSE to utility.

MR. TAL: And I've noticed that on your presentation you're missing -- I think that if we go 2030, EVSEs are going to be old -- smart EVSEs are going to be old technology.

MS. GARCIA: Old technology?

MR. TAL: Old technology, yes. We can move all the smart part into the vehicle, same as BMW is already doing, and save this double storage that we need smart EVSE with cellular connection and computers and everything and then a car that is as smart as this with cellular connection.

So all of the EVSE capabilities can be part of the vehicle and save a lot of money, not that ChargePoint would like to me to say it but it's the reality.

MR. CRISOSTOMO: So that's an uncertainty; right? So will EVSE capabilities be -- okay, so that's the question: Will EVSE capabilities be clinically implemented in EVs by OEMs.

MR. FARHAT: So this might be going back to my flowchart suggestion, but like, you know, not to beat that horse, but like totally agree

and appreciate how hardware design objectives and software design requirements are important for EV adoption but I'm just not sure what role they play and how we are going to model them in IEPR. So while I understand that they're relevant --

MR. CRISOSTOMO: Um-hmm.

MR. FARHAT: -- in the broader like, you know, EV deployment and EV infrastructure deployment, I'm just not sure if this is something that we want to put in a modeling study and how would that be captured?

MR. CRISOSTOMO: Oh, yeah. So to clarify, the transportation demand models, like EVI-Pro and BEAM, definitely have some -- Eric, correct me if I'm wrong -- basic assumptions around compatibility and like charger power requirements that are just imputed.

But I recall seeing things in earlier versions or reports about BEAM where Colin was actually able to model the sharing of a charger, assuming that it could be -- like it's plugs could be swapped, right, over time. And so EVSE management technologies and hardware requirements are relevant for that modeling because it affects the sharing potential and load capabilities.

MR. FARHAT: So it would basically be more along the ways of saying like, you know, we're going to make an assumption that this capability exists and then after, remodel that capability and look at its implication as we step back and we say, well, for this capability to actually exist, this is the hardware and software --

MR. CRISOSTOMO: Yeah.

MR. FARHAT: -- implementation of it.

MR. CRISOSTOMO: And then similar to or as a parallel track to EVI-Pro, we're doing some independent analysis of, for example, thought experience -- thought experiments for automated vehicles. What if we had workplace chargers that were wireless and had, by 2021, automated vehicles re-parking themselves because they're Level 4 and could operate in parking lots pretty seamlessly? That could increase utilization by many factors; right?

And so there's a bit of an unimplemented set of functions --

MR. FARHAT: Yeah.

MR. CRISOSTOMO: -- that can be prescribed into a model.

Eric, do you want to add something?

MR. WOOD: No. I think that that captures it well. And I think the sharing potential is a pretty key one that maybe wasn't very well resolved in the first version of EVI-Pro. So this idea that you could get multiple charge events on a workplace charger is something that we didn't get into very deeply in the first round. And I think Noel makes a good point about automation potentially enabling that.

MR. FARHAT: So on that note then --

MR. CRISOSTOMO: Sorry. Could you say that last part again?

MR. WOOD: I was just saying, I think you made a good point about automation, driving automation potentially enabling better infrastructure sharing.

MR. FARHAT: So on that note then, Noel, I just want to basically mention that it might be helpful to refer back to the same VGI Working Group final report by the PUC because they did have some conclusive statements about hardware requirements in future proofing. Even though the software piece of it and mandating-specific software was inclusive, I think they had solid

recommendations or like, you know, final recommendations on the hardware requirements. So it will be interesting to take that into account.

MR. CRISOSTOMO: Yeah. I will note, however, that the scope of that report had been kind of whittled down to just conductive, just publicly-shared EVSE, I believe, for light-duty vehicles. And so our task, as we've described, goes beyond that narrow segment of vehicle equipment, vehicles and equipment, so we'll have to take that as one part of a broader analysis.

So we have maybe five minutes. Let's talk about some make-readies. I'm going to put the utilities on the spot.

Muhammad, do you want to talk about Charge Ready or, Tony, do you want to talk about Power Your Drive, what you guys have found, how to do analysis at the, at least, county or utility level and how we might scale that to the state?

MR. RAFATI: For Power Your Drive, I think it's such a unique program that may not be the best model to apply to a public charging model because -- go ahead.

MR. CRISOSTOMO: Why do you think it's

only public charging?

MR. RAFATI: Well, I guess the PYD was one of the first programs out of the gate. And you know, we have a specific rate that has to be supplied. SDG&E owns end to end and we maintain the equipment, which is a big plus for the customers. And I'm not really like too heavily involved with the PYD implementation but I know that the utility offering an end-to-end solution is a very attractive model for businesses to have charging at the --at work. I think when the utility walks in and says, hey, we're going to come in, we're going to implement everything and you guys just use it after we're done, it makes sense for them.

MR. CRISOSTOMO: Okay. I think there was actually a line item about -- excuse me, sorry, I'm going to borrow that -- customer preferences for make-ready equipment design, so I'll take that down.

But I should also note that we're looking at all types of infrastructure, not just public in AB 2127, if that wasn't clear for everyone. We're looking at behind-the-fence customer-sited infrastructure, also in addition to private

plaza-type or workplace-type chargers, so everything is fair game.

But you're saying -- so where can we find more information about this? Semi-annual reports?

MR. RAFATI: Yes. We have a report coming out at the end of this month.

MR. CRISOSTOMO: I know cost per port has been a really key metric that's been contended a little bit.

MR. RAFATI: Yeah. The report comes out at the end of this month.

MR. RAFATI: Yeah. There's -- the Energy Division had some requirements of that.

MR. CRISOSTOMO: Any key takeaways around size or location or type of installation that are key takeaways at this point?

MR. RAFATI: No. I think I'll leave it to the report.

But I think one of the things that we've talked about is the utility ownership in areas like multi-unit dwellings make sense because that's a big barrier to entry. And it goes back to this how modeling of people charging their vehicles at home but if you live in an apartment

that you don't have access to charging, then where do you park -- where do you charge then? Which creates a whole range anxiety because if you don't have it at your workplace, at least in our service territory, the public charging is nonexistent. So if you don't have it at home or work, then you're not going to have one.

(Off mike colloquy.)

MR. CRISOSTOMO: Yeah. Can you say that again please?

MR. TAL: Yeah. I think that we can get 5 million cars without selling a BEV to someone who has no overnight charging or workplace charging. We should consider how many of these extreme cases we actually would like to serve. Is it a good use of our DC Fast charging?

MR. RAFATI: Well, I guess it goes back to the bigger question of are we trying to get to the policy goals of Senate Bill 32? Because 5 million would be probably not enough to reach the Senate Bill 32. I think SCE had some paper out that they wanted, what, 7 million in your service territory alone.

MR. CRISOSTOMO: No. It's statewide.

MR. RAFATI: Oh 7 million. So it's 2

million over the 5 million goal, so --

MR. CRISOSTOMO: Wait. Gil, you said something useful that I didn't capture correctly. You're asking how many vehicles do we want to serve without home --

MR. TAL: How many --

MR. CRISOSTOMO: -- and dedicated charging?

MR. TAL: How many BEVs that have no home -- overnight, I'm not saying home, overnight or workplace chargers? We would like to serve BEVs like that, we would like to serve. Is it a good policy goal to sell BEVs that will be solely served by DC Fast Chargers? They will only be able to charge to 80 percent or they will hang on the charger for hours. They will -- it just sounds to me like a very, very expensive solution. And maybe we don't want to electrify so many of those.

MR. PALMERE: Yeah. If I could really quickly, I know we're running out of time, Mark Palmere again, going off his point, one of the data sources we do use is the American Community Survey. And it has a lot of, you know, detailed demographic information. So we and -- I mean,

it's public data so any of you guys can look at it, too, look at, you know, what percentage, what is like the housing distribution statewide? And it's -- you know, when you look at all the people that do live in multi-unit dwellings, it's still we have over half live in single-unit dwellings.

So, I mean, not that public charging is unimportant but, I mean, there's still a big untapped market of people who could install home charging, kind of what I believe Gil was getting at.

MR. TAL: Half of the people and 80 percent of the cars.

MS. GARCIA: I do think there's a good reason to install multi-unit dwelling because, as Gil was saying earlier, most people do not charge every night, they charge every three days. And so if there is a good selection of -- if there are a few chargers in multi-unit dwellings, then that can be rotated among the group of people that live around the multi-unit dwellings.

MS. JAW: This is Kathy from ARB.

I guess it's more of over policy questions that our ultimate goal was past 2030 and meeting the 2030 goals and potentially 2050

and how we get there. And so it's maybe short term, cost effectiveness, but long term, where we need to go, that's everything, like need to take into consideration, not necessarily just the 2030.

(Pause)

MR. TAL: So I would like -- I just think it's a very, very good comment.

And kind of just as, you know, a thought exercise, electrifying the first 5 or 10 million cars in California is a very, very different task than electrifying the last 10 million. So we have, let's say, about 25 million and our discussion today is the first 5, and we want to carry, let's say, to the first 10, it's a very different task than trying to electrify the last 10 million cars in California. The guy with the no park -- no charging and no parking, the pickup truck in Humboldt County in the middle of the night, when we go for the last 10 million, we need probably a different discussion on the infrastructure so we kind of remember that.

MR. CRISOSTOMO: Yeah. That's a total valid point. Kathy's point is absolutely right, too. That's where the curve ball that I tried to

throw with the DER-based EVSE is one that could kind of disassociate the idea that every installation needs a make ready and needs to impose a lot of costs because it's fixed infrastructure, because it's a demand charging subject to principal agency problems, et cetera. So that's one of the reasons why component cost trends and alternatives are listed in this list of parameters.

But, yeah, we want to be sensitive to, yes, the transformation that's required and the fact that policies or the proposition that policies might change according to who we're trying to electrify. It's absolutely going to be a difficult problem for the whole 25th through 30th million EVs, 30-millionth EV in California. It's a different problem.

Any other thoughts about make-readies or other topics? This is a good kind of popcorn discussion. Any key sectors of the light-duty infrastructure segment that people want to focus on for this first year? What are good ripe pieces of information that we can use early on?

Eric?

MR. WOOD: I think we haven't talked a

lot about TNCs yet in this section and that was pretty prominent this morning. I'm not sure how to start that conversation but it seems worth pointing out.

MR. CRISOSTOMO: So let's go with the softball. Are Level 2 chargers useless for TNCs?

MR. WOOD: Is that a question I'm supposed to answer or we're going to answer later?

MR. CRISOSTOMO: It's for anyone. Because what we've been hearing --

MR. WOOD: I would say, no, if it's at a spot where they can overnight charge. Yeah. Like getting them residential charging might be more important than having a strong fast charger network. But it goes back to the business model of some of the people that are driving electric TNCs, right, the Maven EVgo model really incentivizes a lot of fast charge usage right now but we don't know what businesses might exist ten years from now.

MR. CRISOSTOMO: Just because I'm out of space, I'm going to put L2 versus DC Fast Charger discussion in hardware and software, so --

MR. WOOD: And there's probably a

parallel discussion to the personal EV adoption question on what rideshare demand is going to look like and how much mode share that will have five, ten years from now, as well. And that seems like it might be out of scope, actually, for this kind of effort to address. We might need to rely on other studies or other working groups to try to address that mode-share question.

MR. CRISOSTOMO: So you said, what's the profit motive for the network that they're offering, services too? And what is the personal ability or reason for their preference to adopt an EV in the first place. And you said something else after that.

MR. WOOD: Just the overall mode-share demand for ride-hailing is a big uncertainty in this kind of analysis, so what -- not only what types of charging or ride-hailing a driver might prefer but how many ride-hailing drivers are going to be in the state five or ten years from now and how much trip demand is there going to be?

MR. CRISOSTOMO: So how are we going to get that data?

MR. WOOD: I don't know.

MR. CRISOSTOMO: ITS? You guys are getting a good contract from CARB; right?

MR. JENN: No contract with --

MR. CRISOSTOMO: Three Rev?

MR. JENN: No contract with ARB but we do have some data about TNC usage but it's you know, probably a potential. But we can probably talk about how to make that work.

So, yeah, sorry.

And the other thing going back to this question about Level 2s versus DC Fasts, and this sort of points to the necessity to have both the empirical charging data and also sort of talking to the actual drivers as to the difference between what they actually need and how they're using it and the perception of what they need and what they think they need can play a different role in whether or not there is acceptance of those vehicles and TNC services.

MR. TAL: I'd like to add one point on TNC and Level 2. I absolutely agree, overnight, Level 2 TNC can save a lot of DC Fast charging events. And that's a call back to the need to include home charging as part of the analysis.

You can install more chargers at home and then you need less DC Fast Chargers. But if you don't include home in the policy and the analysis, you're just going to install more DC Fast Chargers and you don't have the ability to balance it.

So Level 2 TNC at home is a valid policy.

MR. CRISOSTOMO: Um-hmm.

MR. RAFATI: I think we should look at, also, as part of this analysis, at how many TNC drivers have access to home charging or have their own home where they could install equipment live in a multi-unit dwelling that has equipment for Level 2.

MR. CRISOSTOMO: Okay. In the interest of time, unless there's any other burning topics to discuss, we're going to reconvene with the other group and then do some summary report outs.

Do I have any volunteers for doing a report out?

Karim, I saw a hand.

MR. FARHAT: Not volunteering. Question: Is there going to be an effort to document or like, you know, is there going to be any form of document of the data sources that eventually the

CEC collects for this effort so that, you know, all other parties can leverage, as well, in their own analysis? That would be extremely helpful. So not only the analysis itself but the data sources that you guys have used for that?

MR. CRISOSTOMO: Yeah. So to the extent that they're nonconfidential and can be shared, yeah, our goal is to be as transparent as possible. We're a public agency.

So, okay, let's pause here and then we'll reconvene. If you need to go to the restroom, go now and then we'll come back.

(Off the record at 3:28 p.m.)

(On the record at 3:39 p.m.)

MR. CRISOSTOMO: If you could take your seat, we'll start to close the day with summaries from the breakouts, and then any additional questions that you guys have.

MR. OLSON: Okay. We're going to -- the mikes are not on.

(Off mike colloquy.)

(Pause)

MR. CRISOSTOMO: Okay, everyone, if we can get back to a seat so that we can do some summaries and then quickly close the rest of the

day with any open questions, we can hopefully get you guys out of this meeting a little bit early.

So for each breakout group, maybe we can start with the medium- and heavy-duty section, I'd like to help catch up the folks who were participating remotely with the learnings that were discussed coming from the postering session with perhaps a highlight of the follow-ups to collect additional information and any new analytical needs that were identified.

Tim, would you like to take the mike?

MR. OLSON: Yeah. So the way we -- oh, here we go. Can you hear me there?

So the way we started the medium-duty/heavy-duty was just providing a little bit of overview of where we are in the development and the market penetration of those vehicles. And part of that is we're definitely not as advanced compares to light-duty, as everybody knows. And the deployment is heavily incentivized right now with -- primarily by ARB and the vehicle incentives.

We think there are about maybe 1,700 to 1,800 all-electric trucks and buses in the marketplace. And for the most part those are

in -- the data that we've been gathering and the market penetration is primarily medium-duty Class 4 through 6 vehicles and a smattering of some of the Class 7 and 8 all-electric.

And so that's the initial learning experience we're basing our work on here. And, of course, we're expecting that to expand over time.

And so we asked, you know, when you kind of look at this from the standpoint of what's triggering, what do we really need to know in terms of data now and then over time? And one of those factors is do we -- what do we need to know about the growth rate, the number of vehicles and where they're located, physical location?

We know that transit is a big market penetration, and all-electric school buses. We know that there's some school buses that a few of the ports are kind of pushing the envelope on this with a lot of different kind of new products, but all-electric yard tractors, cranes, some other, some drayage trucks. But there's a significant -- out of those 1,700 vehicles, there's one significant player and that's FedEx, close to 1,000 vehicles coming on the market,

just with FedEx package delivery in California, managed by FedEx. And then there's -- part of that is a lease program under Ryder Trucks.

The build time on those trucks and those buses, from what we're hearing, is that -- and the average for diesel, by the way, is around 150 days to 240 days. We're hearing with all-electric, it's more like 400, 500, 600 days. So this point made earlier, you've got to have the infrastructure in place a year to a year-and-a-half, two years in advance of the vehicles, we still have some time but we really have to start tomorrow.

We also kind of posed these questions that were what do we know about the location? Well, it depends on those, for the most part, fleets. And we don't have a lot of information about drive cycle. We're making -- we're getting some information. We're making some guesses to a certain extent, meaning is there a specific route? Is there a -- is it a regional haul? With Class 4 through 6, it tends to be regional haul and/or specific route.

We also -- kind of the foundation of this was what do we know about the capacity for

charging for individual and collective number of vehicles at these sites? And what's the anticipated expansion and growth? So I'll kind of walk through some of the data sources we talked about and how we can get additional data.

But we wanted to know from that, who would be the suppliers? We went into this kind of corporate, who are the EVSE companies for the medium- and heavy-duty? And are there new players? And we think there are going to be some, even though this is, really, still a startup market.

And we also wanted to know from that, from the profile of the use charging of electricity, what the potential timing of that is on a daily basis and what that impact might be on the grid and what impact that might be in terms of storage, electricity storage, or revenue streams that might come from ancillary grid services or week-ahead/day-ahead imbalance markets on renewables? So these are obviously going to be bigger chargers and we were looking for data sources for that.

We asked a question about can we get a better knowledge and understanding of how this

might affect disadvantaged communities and income from where the vehicles are operating and charging? And also, will lower-income people benefit from the actual vehicle somehow? I suspect transit is one of those areas, meaning lower emissions in that local area, or there could be other benefits.

We also asked this question of we identified a number of sources, how do we optimize getting that information and what's really important?

And we -- there are a number of other kind of questions but I want to kind of walk through some of the kind of data requirements. We have them here listed as data requirements. And for the most part these things are -- this market penetration is driven by government interventions, but those government interventions are a source of data too. So some of these are requirements of these fleets or these vehicle owners and they're in the form of the ARB's truck and bus rules. I don't know what's the actual title of it but it's the pending upcoming regulations that will compel a certain number of vehicles that have to be all-electric.

Do you want to make a comment for --

MR. ARNEJA: Just listing some of those off, approved last December was the Innovative Clean Transit Regulation. Currently, waiting for the second Board hearing would be the Zero-Emission Airport Shuttle Bus Regulation. Later this year is going to be the Advanced Clean Truck rulemaking. And further down the timeline are drayage regulations and other potential fleet regulations.

MR. OLSON: And so there's data requirements on all that and there's a potential to share that from our AB 2127 planning standpoint.

We also deploy money here, and so do -- so does the ARB, so do air districts. And we are starting to attach data gathering requirements to those -- getting those incentives, and that's another kind of cross-reference.

We think that there's some other information that we know people are gathering. The ports and their clean air initiatives require data and there's going to be some cross-referencing there from the things like the Port of Long Beach Blueprint.

And we also think that there's a way to complement that with some tax data or -- that might be equivalent to what the Board of Equalization collects on fuel taxes. And that's one way we've tracked kind of petroleum and fuel but we need to look into that.

And we also know that the utilities, particularly the investor-owned utilities, have data sources that could be very valuable to all of us. So there's -- and that could be in the form of the integrated resource plans that each utility has to produce as part of the SB 350 requirements. And IOUs have to do this. The publicly-owned utilities, which is about a quarter of all the electricity sales in the state, can. Well, they need some guidance on how to do that. That guidance would be from the Energy Commission.

Yeah, go ahead, Wendell.

MR. KRELL: And we also talked about going outside of California and getting federal assistance on some free data out there, the National Transit Database, and other potential sources on the federal level, but also going to outside of the government and going to private

entities that are for-profit. And of course, that make take more time and money if the data is worth it but there's entities out there like Trucker Path that tells every trucker where the next rest stop is and whether they've got showers or plugin capabilities, things like.

So we've identified several different data sources, some of which are good now, some of which may take a year, some of which may take money.

MR. OLSON: And then there, let's see if there's some other -- I'm looking at -- we used kind of one of these as an expansion of -- potentially, LCFS credit data could be another channel as credits generated or capacity credits generated. And there's some other programs, the SB 454, the AB 617, the Volkswagen mitigation money that are being deployed down to local levels, emphasis on medium- and heavy-duty, at least for the Volkswagen money for local. And so there's a coordination task there that would occur with all those different sources.

And what else do we have?

And then, of course, some of the air districts, particularly South Coast, has some

requirements on data collection through either fleet rules or indirect review rules, those kind of things that you're going to see coming forward here very shortly.

So we have lots of sources. And it may be just a task, and I'm not saying it's an easy task, but it's going to be a task of coordinating and sharing some of that.

We think there are also lots of private confidential data. And we talked about this idea of kind of a similar program to what we have here at the Commission called the Petroleum Information Reporting Act.

In this case it would be focused on electric, or it might even be broader to other transportation alternative fuels. And that type of system is set up like this. We gather private confidential data in a very granular form and then we analyze that but only report it in aggregate to the public. And that could be a way of getting more granular on, particularly, things like cost and profits and that type of thing.

So those were kind of data-related things that we talked about, and then whether they're available or not? And not too many things that

are not available, it's because we haven't asked yet or we haven't set up a program yet. The difficulty in getting it, we're going to have to go through some experimental stages on that.

Let's see what else.

In terms of we asked questions about -- we went into some detail on cost discussion. And there was generally a feeling that, because we're at startup, the costs that are out there now may not reflect market maturity and that we're going to have to do some gathering of information over time to understand what triggers cost reductions on infrastructure, the make-ready, different components, Noel, that you outlined. And that, yeah, we kind of walked through some of those data sources that we had here.

And there's going to be probably a need for some kind of tracking and analysis of that periodically over time. And that cost could be not only operating cost and capital cost but it could be the cost to the consumer and the end user.

We also -- let's see, what else do we have on our list here?

We also talked about this where would the

charging occur? Because medium-duty, heavy-duty, you've got transit, you've got trucks, these are going to be primarily fleets, probably a lot of what we call the behind-the-fence or depot charging, not publicly accessible. And so there's this kind of question of, for expansion of that, utilities definitely have a roll in that, understanding what the cost and expansions might be, what that grid impact might be, and that we think utilities are a big source of data to help us with that.

We also want to explore whether there's any potential for crossover charging from one submarket to another. Not clear on the surface here whether that's a possibility but that's something that we think might be worth exploring.

And let's see, what else do we have here?

Some of those things might be, you know, are truck stops suited for any of this type of work, looking at an expansion? Some of it might be this kind of question: Is there existing capacity? What kind of upgrades have to occur? Who actually covers that cost?

And Tony Brasil, at the front, in one of the earlier presentations was saying that it

looks like LCFS credits alone could cover the bulk of the cost of this. And I think that's an assertion that's worth examining closely as we get more data. If it is, that's a pretty significant incentive and --

MR. CRISOSTOMO: All right. So do people have any additions from the group or reactions from the light-duty sector that you want to add?

MR. OLSON: One other thing would be we may have -- it's probably a good idea to couple all these data sources with onboard data collection, and maybe for certain types of submarkets or vehicle profile, vehicle drive cycles.

So anything else?

Wendell, do you have anything else, or any of the rest of the group, that you wanted to add?

Overall, here's one of the things that I posed to the group. Is it worth having kind of a workgroup created around this, that we don't just want to send out forms and say fill out the form and don't ask questions? Is this worth a workgroup to provide input into this process continually and for us to provide feedback? And

there was kind of an agreement, yeah, you need something like that, particularly with industry people.

MR. CRISOSTOMO: So that's a good transition. And I appreciate Paul, from ARB's Advanced Clean Truck Regulation Team, here. It's definitely an opportunity to pursue in the workgroup that you guys lead and the need to coordinate. So we look forward to engaging.

Bob, did you want to say something? Can you get to a mike?

MR. MCBRIDE: The most exciting thing I heard was the CALSTART and the HV program working together to conjoin the vehicle and infrastructure incentives. That sort of got lost. That was one of the first comments so it sort of got lost.

MR. CRISOSTOMO: Okay, so I guess I can review some of the light-duty sector stuff.

So kind of meta need that was found was a desire for all these parameters to be mapped in a flowchart to understand how they lead into one another and connect affect each other, and the need to be clear about what we are prescribing in

the future versus describing in terms of what is being observed in the market today. Because as we do analysis, it's potentially blending those two scenario-planning efforts with existing circumstances in the market. So it's important to be up front and transparent about how the modeling is taking into account expectations versus reality.

I agree with what, Tim, you were saying. There's a lot of questions about where chargers should go if they are needed and who could be using them. And because those are such broad questions, they apply to things like TNCS which was a major focus on the morning, serving multi-unit dwellings, serving workplaces or disadvantaged communities. And so each of those sectors are subject to kind of -- should be subject to stress testing or preconceived notions of solutions that are appropriate for those areas.

There were some controversial statements that were challenging our ideas of whether or not a TNC could -- or only could use a DC Fast Charger to support their fueling needs because that's kind of the existing thought in the market

right now. There are also ideas thrown out kind of debating what are the trickle down effects for the secondary market and how can we use that information about the used vehicles' purchasers, where they live, and which utility territories they live in to understand how infrastructure or incentive market interventions can assist with their adoption?

There was a good point around -- of a need to look at cost and how planning for this first set of 5 million vehicles might be different than the last 5 million vehicles in the state and the need to think about the tradeoffs and the location of needed charging and the costs, which raises equity questions.

And then related to hardware and software and the other programs, there was a good discussion about the need for the hardware and software elements to play into when -- or to play into how vehicles are able to use chargers because functions built into the chargers or the vehicles affect how usable the charger is, and thus the benefits in terms of electric miles served.

And that led into a discussion about the

ease of use for customer in terms of smart charging and where communications are going to support things like renewables integration of time-of-use responsiveness.

Yeah, and then there was a lot of questions about where we'd get the information. We might need to do some surveys or create new analysis ourselves, but there were some good pointers to new datasets that we can account for.

Would anyone else from the group add to that? Okay.

At this point, we're done with the kind of formal parts of the day before our closure with more information about how to provide comments, so we'll open up the mike for any public comments right now.

Hannah?

MS. GOLDSMITH: Thank you. Hi. Hannah Goldsmith with the California Electric Transportation Coalition. I just first wanted to thank the Energy Commission for putting this on today and starting this process. I think it will be really valuable.

And then I want to kind of echo the thing that Tim said about having a continuing working

group on data collection. This is something that CalETC and the utilities and automakers and others have brought up in the VGI context. But generally on infrastructure, it's just really important to ensure we're all on the same page and that we know what information is out there and what information we don't have and work together to move forward.

And then the last, yeah, the last thing I wanted to say is just kind of on assumptions. Many of the assumptions that we use today might be based on the experience of early adopter EV drivers. And I think we need to conscious of the fact that that isn't necessarily going to be the way that EVs are used in the future. And things that early adopters are willing to put up with are not going to sustain a long-lasting and accelerated market.

And so that ties into the availability of public infrastructure for the light-duty side and the need for that, and I'm just underscoring its importance, as well as, of course, the ability to charge or the workplace. But we do need to think about future experience of EV drivers, both on the light- and medium- and heavy-duty side and

what that looks like and how to ensure that we're supporting the market.

So thank you.

MR. OLSON: And, Hannah, you were suggesting that workgroup include both medium-duty, heavy-duty and light-duty too?

MS. GOLDSMITH: Yeah, I think that would be most valuable. I would leave it up to you, if you want to like divide it up. But there is -- there are a number of topics that overlap between the two that are lessons learned that could be gained on the medium- and heavy-duty side from the light-duty side. So it might make sense to have it be one working group that meets and discusses, you know, both topics in parallel or one after the other or something.

MR. CRISOSTOMO: Thank you, Hannah.

Any other comments, generally, about the day?

MS. GIYENKO: Elena Giyenko. I just have a general suggestion. This is the first workshop and I plan on participating more.

I think I'm kind of like who are we missing here? Who is not -- who are not here? And apparently, I noticed that there are no

trucking association representatives, there are no people that this eventually will, you know, know, like who will be impacted in the future. So maybe like invite, like engage them more.

MR. CRISOSTOMO: Thank you for that comment.

Do we have any OEMs in the room at this point? I know we had GM earlier.

Yeah, Ian?

UNIDENTIFIED MALE 3: I just want to follow up on that comment. I think it's not just the OEMs and the fleets but it's -- we're talking a lot about infrastructure, so it's the site owners and operators.

MR. CRISOSTOMO: Okay. So --

MR. KRELL: Noel, just quickly, just for the room, we know that there, at the highlight, there were 75 people online watching this, so there may be trucking agencies and somebody else out there with interests that have got their ears on this.

MR. CRISOSTOMO: Okay. So this is the final slide. This is next steps for written opportunities to file information for us. Comments on the workshop, on any of the material,

or questions that were highlighted throughout the say, whether it be the ones that were written in the deck or posed during discussions of the scoping matrix or thoughts that were offered verbally can be submitted in those comments. They should be submitted by the close of business on March 29, which is a little bit more time than we usually give for IEPR comments. Please use the Commission's online electronic docketing system. You can simply upload a .pdf into that online interface.

Looking forward, there will be additional workshops under our AB 2127 implementation work related to the off-road, port and airport electrification sectors. And other IEPR workshops alluded to at the beginning of my presentation will be scheduled for the second quarter this year. And if you didn't already know, AB 2127 materials are going to be served to four LISTSERVs identified there, the IEPR Transportation, AB 118, Alt Fuels Diversity, and the Disadvantaged Community Advisory Group. So please sign up for any one of those if you are interested in AB 2127 implementation.

To the points that were just raised, if

you know that -- if you know of manufacturers or fleet operators or enthusiastic site hosts, if you know of them, those types of stakeholders who would benefit from attending these workshops or engaging in the Energy Commission's effort, please do let us know. You can drop a card of list their name on the clipboard that has been going around. We would appreciate that because these are mostly common stakeholders -- or the people who are in the room are common stakeholders but we definitely want to hear back from those other ones that were identified.

And so to close, thank you for coming. This has been a, really, information firehouse day and we're going to try to collect as much information for our first 2127 for the IEPR. But as described earlier, we'll be working throughout the IEPR process for the next couple of years on this first analysis and we look forward to working with everyone on it.

And with that, I'll close the meeting, unless there's any other comments. All right. Thank you very much, everyone.

(The workshop adjourned at 4:13 p.m.)

REPORTER'S CERTIFICATE

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

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

IN WITNESS WHEREOF, I have hereunto set my hand this 9th day of April, 2019.

_____

Eduwiges Lastra
CER-915

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

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IN WITNESS WHEREOF, I have hereunto set my hand this 10th day of April, 2019.

_____

Myra Severtson
Certified Transcriber
AAERT No. CET**D-852