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CALIFORNIA ENERGY COMMISSION

STAFF WORKSHOP

In the Matter of:	) Docket No.
	) 15-IEPR-10
	)
2015 Integrated Energy Policy	) WORKSHOP Re: Revised
Report (2015 IEPR)	) Transportation Energy
________________________________	) Demand Forecasts

CALIFORNIA ENERGY COMMISSION

THE WARREN-ALQUIST STATE ENERGY BUILDING

ART ROSENFELD HEARING ROOM

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

TUESDAY, NOVEMBER 24, 2015

10:00 A.M.

Reported By: Peter Petty

APPEARANCES

Commissioners Present

Andrew McAllister, Lead Commissioner, 2015 IEPR
Janea Scott, Lead Commissioner, Transportation
Robert Weisenmiller, Chair

Staff Present

Heather Raitt, IEPR Program Manager
Shawn Pittard, Public Adviser's Office

Panel Presenters (* Via telephone and/or WebEx)

Elise Brown, Demand Analysis Office
Aniss Bahreinian, Demand Analysis Office
Marshall Miller, Aspen Environmental Group
Jesse Gage, Demand Analysis Office
Bob McBride, Demand Analysis Office

Public Comment

Joshua Cunningham, CARB

I N D E X

I N D E X (Cont.)

P R O C E E D I N G S

November 24, 2015 10:06 a.m.

MS. RAITT: So good morning. Welcome everyone to today's IEPR Workshop, Commissioner Workshop on the Revised Transportation Energy Demand Forecasts. I am Heather Raitt, the Manager for the IEPR.

A few housekeeping items, there's restrooms in the Atrium. There's a snack room on the second floor. If there's an emergency and we need to evacuate the building, please follow the staff across the street to Roosevelt Park.

Today's workshop is being broadcast through our WebEx conferencing system and parties should be aware that you're being recorded. We'll post a WebEx recording in a few days and a written transcript in about a month.

We're planning to have presentations from staff through the lunch hour and then take public comments. We'll be limiting comments to three minutes per person and take comments first from those in the room. And if you would like to comment, please give our Public Adviser Shawn Pittard a blue card.

Then we'll move on to those on the WebEx. Please use the chat function to tell our WebEx Coordinator that you'd like to make a comment during the public comment period. And then we'll take the phone-in only comments after that.

Materials for the meeting are available at the entrance to the hearing room and also posted on our website. They weren't posted until just recently, so if you looked earlier they should be there now.

Written comments are welcome and they are due on December 8th and the Notice provides information about how to submit comments.

And with that, I'll turn it over to the Commissioners. Thank you.

COMMISSIONER MCALLISTER: Great. Well thanks, Heather.

Okay. We are taking another step in the inexorable march towards finalizing the IEPR. And I want to thank everybody for being here. I'm Andrew McAllister, the Lead IEPR Commissioner and on Energy Efficiency. And pleased to be joined with the Lead Commissioner on Transportation, Commissioner Scott. And really looking forward to hearing about the progress that we've made with the Revised Transportation Energy Forecast.

So I think those of you who are here, and probably on the phone, are well-schooled in where we are and what's happened before, and what the plan is. So I won't recap any of that, but just to say that as we -- I want to just highlight the importance of this, because I think the IEPR and really the policy environment in general is a complex landscape, lots of pieces of the puzzle. And what we're, I think, working mightily on across the agencies and certainly within this agency is making sure that all the pieces fit together.

And the transportation energy forecast is really a key part of that, which sort of in some ways you might say it's kind of modest now, because of the actual numbers today are a small part of energy demand. But we know, and certainly policy is directing us to follow this path. We know that its impact and its role within not just electricity, but also natural gas and energy policy, in general, is only going to get bigger. And it's going to get bigger fast.

So transportation, obviously, is the biggest single piece of the climate problem in terms of emissions. And obviously, it's California -- a lot of vehicle miles traveled. And so manipulating or encouraging that sector to shift to lower carbon solutions is no mean feat. And so it's a big challenge. I think we're up to it and we're seeing a lot of incredible developments in the marketplace that are really indicating that it's happening now.

So getting a handle on all the uncertainties there and how quickly and how much and what ways it's going to accelerate is really important. And so I think the

Demand Forecast and the team obviously is aware of these challenges and issues and working hard to encompass them in the analysis. So I want to thank the team and I really appreciate all of your effort, looking forward to hearing what you all have to say. Thanks.

So Commissioner Scott?

COMMISSIONER SCOTT: Thank you, Commissioner McAllister. Good morning, everyone.

I'm Commissioner Janea Scott. I'm Lead on Transportation and I would just kind of highlight what Commissioner McAllister said about all the pieces fitting together and the natural gas system, the transportation system, and our electricity system are all starting to -- maybe blend is too strong of a word -- but converge on one another as electricity starts to fuel our cars as we have more natural gas fueling our vehicle as well.

So I'm very much looking forward to seeing the revised forecast today. And I'll also highlight, as Commissioner McAllister did, the role that transportation plays in energy demand across our state. It is an important component and transitioning to the zero emission solutions and cleaner forms of fuel and transportation is going to be a big component for California in meeting both its clean air goals and its climate goals. So the role that transportation plays can't be understated.

So I will stop there and look forward to this morning's presentations.

MS. RAITT: First is Elise Brown.

MS. BROWN: Good morning, Commissioners.

I just want to introduce myself. I'm relatively new to the Commission. My name's Elise Brown. I'm the Manager of the Demand Analysis Office, which is part of the Energy Assessment's Division. For those of you that are unaware of what DAO or Demand Analysis Office does, we do the Demand Forecast for natural gas, electricity and also transportation energy.

Today we'll be presenting the results from the revised transportation forecast. I have to thank staff; they've done an incredible job. There's been a few challenges along the way and they've worked very hard and diligently to get to this point.

I just want to walk people through the agenda. We're going to start off with Aniss Bahreinian's presentation. She'll introduce the six different demand cases that were modeled and then move into transportation electrification.

That will be followed by a presentation from Marshall Miller with UC Davis on off-road transportation. And when I first heard off-road I think of ATVs -- maybe that's just being from Utah -- but it actually means things like ports and forklifts, etcetera.

Then we'll move on to the light-duty vehicle forecast presented by Jesse Gage where there's a lot of action, so look forward to that.

And then the medium and heavy-duty forecast from Bob McBride and then Aniss will summarize some major findings of the Forecasts in the end.

I do want to mention that we do have a staff report that is working its way through the publication process at the Energy Commission at this time. And it is not available yet, but it will be soon. And I'll be noticed by the Listserv. So keep an eye out for that. There'll be a public comment period for that as well.

So to keep us on time I'm going to turn this over to Aniss Bahreinian

MS. BAHREINIAN: Good morning staff, Commissioners, and staff from our sister agencies and the stakeholders. We are very happy to have you here on this Thanksgiving weekend when we gave up on all hopes to have anybody in this room, but it seems like we have a lot of interest in this topic.

So what I'm going to do today is start out the presentations with a discussion of transportation electrification. We will first have a brief introduction to the models used at CEC to forecast electricity demand, natural gas and electricity demand followed by a brief overview of different scenarios that we have designed for this forecast.

Then we are going to move to a brief discussion of what is typically considered as transportation electrification and the on-road, off-road distinction.

And then we end it in this presentation by discussion of -- a more specific discussion to then present assumptions that we have used to forecast zero emission vehicles. And we'll present a PEV demand forecast here, which will be later presented in more detail by Jess Gage.

Energy demand forecasting models at the Commission is composed of a number of different models. We are putting transportation energy demand here first, because we have bias towards our unit, not for any other reasons. Transportation energy demand accounts for all energy use for movement of people and goods by fuel type. So it is important to note that when we are forecasting transportation energy demand, we are forecasting it for all fuel types and for all sectors of transportation.

The off-road accounts for diesel and gasoline used in off-road applications of moving or stationary equipment, in different sectors of the economy, so sometimes we refer to that as off-road transportation electrification.

I just want to make it clear that traditionally energy -- well because we are in transportation and because we are talking about gasoline and diesel these two fuels cannot be accounted by any other unit like electricity or natural gas, and therefore we have to account for it. So whether or not it is used in transportation, we have been traditionally accounting for it. That's why the burden falls on us to talk about the electrification of all these off-road equipment, even if they are not used in transportation sector.

TCU or transportation, communication and utilities is another model at the Energy Commission that accounts for mostly stationary use of power in these sectors. The sectors include transportation, communication and utilities.

Commercial, industrial and agricultural -- these are three different demand models at the Demand Analysis Office that makes an attempt to forecast or generates forecasts for electricity and natural gas in these sectors. As we are going to see later, some of the off-road energy falls into these three sectors.

Residential is another big electricity user and so we also have a model for residential sector in the Demand Analysis Office that generates demand for electricity and natural gas for households.

For this IEPR we have generated six different demand cases. The first three that you see, what we refer to generally across different offices and units at the CEC, we call them common demand cases. We call them common demand cases, because we all use the same input data and we define these scenarios in the same way. That's why we call it common demand cases.

We have a high-energy demand case. And as you can see here, the high-energy demand case uses high income and population plus low energy prices. And when we say low energy prices we mean low energy prices across the board. That is electricity, gasoline, diesel, natural gas, hydrogen, etcetera.

For this particular -- for the revised forecast we are also making some changes as we are going to get into more detail later, so we are including two other inputs. One is preferences and the other one is the vehicle price, which is one of a number of light-duty vehicle attributes that we use in generating forecasts for transportation.

So in the high case, in the high energy demand case, we are also using what we refer to as high preferences for ZEV. And as we will detail later, what we mean by this is that we're increasing consumer preferences for ZEV vehicles over time in this scenario.

In the low energy demand case what we do is to use, again all of us across the office, Demand Analysis Office, we all use low income and low population. When it comes to energy prices however, we all use high energy prices. Again, this is high energy prices for all fuels. That means petroleum fuels, natural gas, hydrogen, and electricity.

When it comes to light-duty vehicles, in the low energy demand case we make no change in consumer preferences, keep them the same constant at their 2013 level, which was obtained by the survey we completed in 2013. When it comes to vehicle prices, in this case we are keeping their ZEV vehicle prices high in this case. So no attempt is made in this particular case to meet the ZEV Mandate.

In the mid energy demand case we are, of course, using mid value of everything. But also when it comes to preferences we are going to use high preferences for ZEV. And when it comes to vehicle prices, we are going to use a price path that we call it Transition 2050. We will detail that later in the presentation. Now, these are the common demand cases that are used across the Demand Analysis Office and actually the Supply Analysis Office as well. You find them the same way.

We also have -- traditionally we were part of Fuels and Transportation Unit. And one of the purposes of these forecasts is actually for planning. For instance, utilities may be using our forecast or demand analysis forecast for planning purposes. Likewise the ports may also have to do planning. For instance, how much storage do they need for petroleum that is imported into these ports?

So traditionally what we have had, we have had two cases. I mean, up to 2011 we have been generating two demand forecasts in Transportation Energy Forecasting Unit or we call it TEFU. One was high petroleum demand and the other one was low petroleum demand. As you can see here, in the high petroleum demand, like all the other demand cases we are using high income and high population.

But when it comes to liquid prices notice that the fuel prices next to each other, we exchanged the high and the low with each other in the high and the low petroleum. So in the high petroleum demand case we are using low petroleum fuel prices, but high natural gas hydrogen and electricity prices.

In the low petroleum demand case, we do the reverse. We are using low natural gas electricity and hydrogen prices, but high liquid prices -- liquid fuel prices -- which is basically petroleum fuel prices.

When it comes to income and population, like all the other low demand cases we are using low population and income.

Finally, for this IEPR we have added a sixth scenario. We call it high alternative fuel and vehicle demand or high AFV. The difference here is that in this case notice that almost everything else is the same as the low petroleum demand case except for income and population. So in this case, we typically, as you are going to see later in the workshop, we generally generate the highest number of alternative fuels and vehicles. So we use high income and population for the high AFV demand case.

When it comes to transportation electrification this is a slide that we used in February of last year. We divided them into on-road and off-road. For the on-road we have the personal vehicles when it comes to electrification. We have public transit, urban and high-speed rail and we have goods movement and activity trucks.

When it comes to off-road we are talking about mostly stationary use of petroleum fuels such as gasoline and diesel for port power, for airport power, and for other equipments that are used at the ports, sea ports or airports or other activities such as agricultural. There are a lot of equipment in agriculture that use diesel, for instance.

And there's a lot of equipment that are not consistently registered with DMV data. So we have this uncertainty about the registration with DVM data, some do and some don't, like forklifts. We can't say that we have those numbers with 100 percent accuracy, so we put all of those into off-road category.

So whenever people talk about transportation electrification they typically refer to the use of electricity in on-road and off-road movement of people and goods. And as we have discussed already, the on-road includes light-duty vehicles. And this presentation is going to have a focus at the end on the light-duty vehicles. Marshall Miller of UC Davis is going to discuss the off-road applications.

So what are the plug-in electric vehicles? Plug-in electric vehicles typically refer to PHEVs, plug-in hybrid electric vehicles, and battery electric vehicles. These are prominent in electrification, so a big chunk of transportation electrification happens with PEVs.

The electrification also applies to NEVs or neighborhood electric vehicles, but in this forecast we treat NEVs separately. We have a separate growth model, because mostly they are not allowed really on the highways, because of the speed limit that they have. And it is not so much of a choice for the household between an NEV versus a light-duty vehicle that we define as everything else.

Most of the PEV scenarios discuss or focus on light-duty vehicles, so again to the exclusion of NEV. And one of the reasons we have a focus on PEVs is because we have our own behavioral models that allow substitution between vehicles of all the different fuel types. And we use our behavioral models to generate these forecasts, which are actually quite detailed.

The key inputs that drive PEV demand are vehicle prices, fuel prices, fuel economy, range which is more sensitive for PEVs, incentives -- that is government incentives -- but as we have seen in a case of a lot of the vehicles you also have private sector incentives where they would offer discounts on different vehicles in order to take them off the lot. So you also have those.

We have consumer preferences that play an important role and we have the choices of vehicle class, which is kind of often overlooked by a lot of people. And we are going to discuss that later: choice of vehicle class and models.

We have generated a preliminary demand forecast and many of you were present in our previous workshops, so the question is what is different in the revised forecast? In the revised forecast as opposed to having just one scenario, which is what we used to have for vehicle prices we now have three different scenarios for vehicle prices. We also have three different scenarios for makes and models. And we have included two scenarios for range.

When it comes to consumer preferences in the preliminary forecast we only had one scenario. We kept everything constant. In this case for the revised forecast we have two scenarios: one in which we keep preferences constant over time and another one where we increase preferences. So what we have done in this forecast, we have added more input scenarios that are more favorable to ZEV vehicles in the mid and the high demand cases.

Zero emission vehicles in the three common energy demand cases are defined in this manner. So notice again, this is in a way related to the previous slide on the six scenarios, except that we are becoming a little bit more specific here.

In the high energy demand, as we discussed already, you're using high income and population. You're using low energy prices for everything, for all energy forms. We have high ZEV preferences and what that means is that we are increasing preferences for zero emission vehicles. And I want to emphasize that zero emission vehicles also include plug-in electric vehicles, PEVs. So whatever applies to ZEV also applies to PEVs.

Now, in the high energy demand case our ZEV prices converge with gasoline prices in 2030. So we make our ZEV vehicles be the same price as a gasoline vehicle price in every class of vehicle where they are available by 2030.

In the mid energy demand case we have mid income and population and energy prices. We are going to continue the same high ZEV references that we use in the high demand case. The difference here is that the ZEV vehicle prices converge with gasoline prices in the mid case also, but not in 2030. Rather in 2050, so we have a slower decline rate in ZEV vehicle prices in the mid demand case compared to the high demand case.

In the low energy demand we are using low income and population, high energy prices for all forms of energy, low ZEV preferences which basically means we are keeping the preferences constant at their 2013 level. But when it comes to ZEV vehicle prices we are starting out with the actual prices in 2014, but we are keeping the price increments of ZEVs over the gasoline vehicle constant over the entire period.

So we assume that there is no technology changes resulting in a decline in ZEV vehicle prices. This is only an assumption. So do we have any grounds to say that there are increasing preferences for ZEV vehicles or for PEVs? We have more data on PEVs than we have on FCVs. As you can see here the line before the last one, which is hydrogen, we have almost 0 percent of vehicles that are in a commercial market that are FCVs by 2014.

But we have more penetration of electric and plug-in hybrid electric vehicles. As you can see here between 2011 and 2014 there is a growing share of these vehicles. So there is an increase in the percentage in the penetration of these vehicles.

Is this all related to consumer preferences? Not necessarily, not all of it is related to consumer preferences, because there are all these factors that could claim to consumer choice, but we can't confidently say that consumer preferences definitely have something to do with it. There has been an increase in consumer acceptance of PEVs over time, over this period of time even as the incentives have been working their way out in the market.

Notice also, just for clarification, I just put down the new vehicle sales in the last row and that is important, because the more new vehicles we sell the the more of the new technologies are going to enter the market.

As you can see here, the new vehicle sales are going up from almost a million in 2010 to a little over 2 million in 2014. So there is definitely growth in the new vehicle sales, which is related to a number of factors including the vehicle turnover, economy and other factors. So even with the growing new vehicles sales, still the share of the PEVs has been growing in the market indicating that consumers are gaining more acceptance of these vehicles.

So is there grounds for increasing consumer preferences. I would say yes. Exactly how much should we increase them, I can't answer that, but we simulated something that would take us closer to meeting the ZEV requirements. I should also add that keeping them constant over time is also arbitrium, but that's what we have been doing over the last several IEPRs.

So why are we lowering the prices for ZEV vehicles? In a sense, we were inspired by National Research Council's 2013 study that came to the conclusion -- including over 50 field experts coming to the conclusion that retail price equivalents are required to get closer to the gasoline vehicles if they are going to make transition to alternative fuel vehicles. That was their conclusion.

So as you can see here --

COMMISSIONER MCALLISTER: Aniss, can I ask you a quick question if I could?

MS. BAHREINIAN: Sure.

COMMISSIONER MCALLISTER: Could you go back to the previous slide there? So I guess I'm not expecting you to have looked at this issue in detail, but I think it's worth pointing out that given the Volkswagen scandal it turns out that there are some technical issues with getting high-performance diesel engines that are clean enough to meet our Emission Standards generally.

And I guess I'm wondering if staff has thought about what that might mean for the -- you know, it's only 2.5 percent here in 2014. But to the extent that people are looking for alternatives that sort of give them that package of attributes that are both clean and performance and high performance, how do you think that might play out in the marketplace going forward?

It seems like it might actually impact -- to the extent that we might've been thinking that diesel was going to accelerate in terms of its adoption that may not now be the case. But I guess it depends on the technology development that the manufacturers were able to do, but it doesn't look very positive at the moment, right?

MS. BAHREINIAN: But you’re absolutely right, it came kind of later in our forecast cycle, so we haven't really accommodated that per se. But as you can see here when it comes to light-duty diesel doesn't really have a big share of the market anyway, so it's a smaller share. It has been increasing, but a smaller share of the market.

From what really I have read in different articles, it seems like the manufacturers are actually responding to that themselves. Like Volkswagen, I heard that they are actually turning to some of the EV -- they're turning to the EV technologies. So it seems like it kind of has expedited manufacturers' response to these by producing more EVs, making them available on the market.

COMMISSIONER MCALLISTER: I guess I'm looking at the use of the table. This is a great table, lots of food for thought in this table. But if you look at hybrid, diesel, plug-in hybrid, and electric and you add all those up that's over 10 percent: 3, 4, 5, right so that's like 12 percent. That's pretty amazing actually. I mean, that's not even close to the majority, but 1 in 10 is now -- those are real numbers and you can imagine really scaling up from that pretty quickly.

And so if you sort of assume that individuals are buying these vehicles, because it has -- you know, they can have their cake and eat it too. And that they can have good performance as they define it, but also have a feeling that they're clean and they're responding to sort of the sustainability attributes as well.

You know, I think a lot of people bought these diesels, because of that package of attributes and they got 50 miles to the gallon, right? So they're feeling a little defrauded and we all know people who had -- my sister and my mother both have those Jetta Wagons. And people are taking it personally and so I think that may actually help kind of the cultural case to move towards alternative fuel vehicles of all types. So I mean, I'm hopeful about that, I guess, I don't really know.

But in any case I think it's really heartening that over 10 percent have some of the sustainability attributes. And it's growing.

MS. BAHREINIAN: I should also add that in some of the studies that have been completed by UC Davis and others, they have noticed that the people who are tuning into EVs and PHEVs are actually those who own hybrid vehicles. So there could also be a movement from hybrid into EVs and PHEVs or into ZEV vehicles in general. So even if there is a decline, for instance in that category, that could be made up by increasing the ZEV vehicles. So there are all kinds of substitutions that take place.

(Coughs) Excuse me. Just for everybody here, I'm not communicable. (Laughter)

COMMISSIONER MCALLISTER: So bring that woman Mucinex. That's what I thought.

MS. BAHREINIAN: Yes, I did. We did that too and it is helping.

So this from the NRC study, and actually also displayed by David Greene in some of his work on transitioning to AFVs in California. The NRC study was a national study and David Greene also used this and he made a presentation in 2014 at the Energy Commission.

As you can see here -- notice number one, that this is for passenger cars -- NRC used a model that is called a LAVE-Trans Model. And the LAVE-Trans Model basically has low resolution when it come to vehicle classes. They basically have passenger cars versus light-duty trucks. Now, I'm mentioning this, because in our model we have 15 different classes of vehicle total for passenger cars and light-duty.

So Sierra Research also used LAVE-Trans both in 2013 and in 2015 IEPR. And they used that model to project some of the attributes and then they ended up breaking it down into different vehicle classes for us, because it is not immediately transferable from one model to another model.

As you can see here, the prices -- first of all notice these are the 2009 dollars, not the 2013 dollar because the study was completed a while ago. And they noticed that BEVs in this graph have the highest prices. They have the highest prices. FCV has a lower price than BEVs. We know that the current market condition actually says otherwise, so what we have done this is just a guide. As you can see here, the prices would converge approximately around 2050.

What we have done, we started with the actual market prices in 2014. And we are using those 2014 to make a transition to 2050 and to 2030. So the numbers that you see on the vertical axis here, these are the vehicle prices. As you can see here it is the hydrogen actually that has a higher price in this class of vehicle. Again, remember we have 15 different classes of vehicle.

So for the compact class hydrogen prices actually have higher prices than EVs and PHEVs. But nonetheless all of those are going to converge with the gasoline vehicle prices in our price path, in our price scenario that we are using for the high energy demand case.

Also notice that these prices are in 2013 dollars as opposed to the previous slide that was 2009 dollars. And notice too, that this is for a compact class of the passenger cars. It is not for all passenger cars. We generally use compact and mid-size, because those are the vehicles that are sold the most in the State of California. Those are the predominantly sold vehicle classes in California.

So notice that these prices are approaching to be equal to the gasoline vehicle prices in 2050. We are slicing the price path from 2015, actually 2014, to 2026 to use in our forecasts. So our forecast doesn't go to 2050. Oh sorry, actually in this case this is the high energy demand.

ZEV vehicle prices approach gasoline vehicle prices in 2030, not 2050. So for the high energy demand we are approaching ZEV vehicle prices that are approaching gasoline vehicle prices in 2030.

This is for the same class of vehicle, compact class, again in the same dollars, 2013 dollars. This time this is a mid energy demand case. In this case, our ZEV vehicle prices converge to gasoline vehicle prices in 2050. So as you can see, if you compare these two graphs with each other you can see that in the high energy demand case when the prices converge in 2030 we have a faster decline rate. Look at the slope of the lines and you could see that they drop faster compared to this one. Again, we are slicing off the 2015 to 2026 or 2014 to 2026 to use in our forecast.

How about the low energy demand? In the low energy demand case, what we are doing we are keeping the incremental prices of ZEV vehicles constant at their 2014 levels. So what the sales-rated average price of these vehicles were in 2014 in comparison to gasoline vehicles we're keeping those prices constant over the entire forecast. Not the prices constant, but the price difference is constant.

As you can see here gasoline prices are slightly increasing over time and so is the case with electric and hydrogen and plug-in hybrid electric vehicles. They all move together.

What is also important are the vehicle class choices. This often overlooked in many studies. Like for instance in the NRC they have the two classes of compact cars and passenger cars and light-duty trucks. It is important to note the differences between different classes. And the reason is that once a family decides to buy a vehicle in a certain class they most likely are going to stick to that class.

If you're a big family and you're going to buy a minivan it is not really likely for you to move into a compact car. So what you want is another minivan that is an EV or FCV or PHEV. If there are none available you are not going to buy it, because your mind is set on minivan. So availability of these vehicles in different classes are of significance.

This is something that we found actually. In our 2013 survey we noticed that consumers are more likely to stick to their vehicle class choices than to their fuel type choices. Consumers were more willing to switch between fuel types than they were to switch between classes. This was an important finding that we had in 2013.

So what does that mean? That means for instance if somebody wants a mid-size sports utility, the figures in the middle, then they are going to just buy those vehicles. There is nothing in fuel cell, nothing in PHEV available. And it will not become available according to the forecast that we have. The red numbers here are technology, introduction, and schedule as projected by Sierra Research. So those numbers, they are telling us that a compact sport utility vehicles are introduced in PHEVs in 2017, but not in mid-size sport utility vehicles.

If somebody wants a heavy sport utility in 8,500 to 10,000 they have no choice in the ZEV vehicles and they have to stick to gasoline if that's what they want.

I should also bring to your attention that all the black numbers that you see are the actual numbers that we have in the DMV data. Although most people think that EVs are a recent product they are not. They have been in existence for a very long time. As you can see, for instance, in the subcompact class we have had EVs. We have a 1966 EV in the 2014 DMV database.

So what are we using here? We are using the Air Resources Board's ZEV most likely scenario cumulative sales. That's also important to note, because what ARB has is cumulative sales as opposed -- and most people are just adding those up and a lot of people consider those as on-road vehicles. The fact of the matter is that vehicles come into the market and vehicles leave the market.

There are accidents for instance, taking some vehicles out of the market. And there could be vehicles that are entering from other states or there are vehicles that could be leaving the state. There are all kinds of things that could happen, but nonetheless we use the cumulative sales from ARB as the ZEV most likely scenario. Why do we use this? Why not use the ZEV credits as a lot of people may question. Actually a question did come up.

The reason is that the ZEV credits really apply to the manufacturers. And what we have here is a demand forecast. Our consumers are not concerned about ZEV credits. Our model does not allow a break down by manufacturers. When we are talking about classes in our models we have what we call in economics, we have a generic car. We don't care if it is from Toyota or Tesla or Nissan or what have you. We have a generic brand of vehicle.

And our consumers, our fictional consumers, for them it doesn't matter where the car is coming from. All of the ZEV credits however are applied to different manufacturers depending on their sales volume, so we can't really use that in our model. We do not have a vehicle supply model to use this for.

In order to use the ZEV credits we have to have a vehicle supply model and maybe at some point, hopefully, we can join forces together with ARB and create a new vehicle supply model. That's my dream. I have been talking about it for a long time, so I better say it.

So notice here in this graph that PEVs are a huge share of the ZEV vehicles. Notice that FCVs are a very small share. PEVs are a huge share and even among the PEVs and the ZEV most likely, so now a very large portion of it is actually PHEVs. Notice however, that this ends in 2025.

If you go to other work by ARB, like if you look at the Vision Model, project into 2050, you will notice that by 2050 the PHEVs are not going to be the prominent force here. So actually after 2025 these numbers according to what ARB has envisioned actually are going to go down. In place of that, we are going to have more and more and more FCV and PEVs.

But we are stopping at 2025 and our forecast stops at 2026, so perhaps in the next IEPR forecast we are going to look into that and accommodate.

The ZEV, most likely we are not the only ones who are using this. Actually, there was a study completed for CalETC, Electric Transportation Coalition, by ICF. And they also used the ZEV most likely. They created ZEV-based scenarios, three ZEV-based scenarios. In the low case that they created they have a 50-50 split between PEVs and fuel cells. So that was their low PEV case.

The ZEV most likely was their mid-case, kind of like what we use here, sort of. And ZEV times three, so that is the ZEV most likely times three was their high case. It is a nice -- ZEV most likely numbers are actually a pretty nice point of reference for a lot of people who do study these figures.

So here is our PEV demand forecast and this is the number of on-road vehicles. As you can see here in the low energy demand case our PEV exceeds the ZEV most likely scenario's PEV. So what you see, the dashed line, are the PEVs in a ZEV most likely scenario. And our forecast of PEVs actually exceeds the number of PEVs in the ZEV most likely scenario through 2022, but if falls below after that.

In both the mid case and the high energy demand case Energy Commission's PEV demand forecast exceeds the ZEV most likely scenario in all years, over the forecast period.

Well how about mass transit and freight? We are just going to briefly talk about this. Bob McBride is going to talk more about them later, but we have direct electric that is used in light rail. We have electrified rail. And it is projected to, for instance the commuter rail between San Francisco and San Jose, I think, is projected to be electrified starting at 2019 with the high-speed rail. We have trolley buses. All of these are using direct electricity.

In addition to those we also have electric transit and school buses. The numbers are not very high, but they are there. And they are projected actually to grow sometime in the future. And we have incorporated those into our forecasts.

We also have EV trucks. Many of you have heard of Frito-Lay trucks and UPS and Fed-Ex and all those. We also have EV trucks.

When it comes to long distance we have high-speed rail and the catenary truck that we are talking about, that's not really yet a long distance. It is only a one-mile E highway demo case, but it can happen sometime in the future. We don't account for that though.

Questions, comments?

COMMISSIONER MCALLISTER: Great, thank you.

MS. BAHREINIAN: Any questions?

COMMISSIONER MCALLISTER: Anybody have any questions? Yeah, so I think we're good. That was very clear, thank you.

MS. RAITT: Okay. Thank you, Aniss.

So next is Marshall Miller. Oh, I'm sorry.

COMMISSIONER MCALLISTER: Yeah, so what's our schedule here? Are we going to do public comment?

MS. RAITT: We were going to do public comment at the end after everyone.

COMMISSIONER MCALLISTER: Okay. Although I will ask is there anyone in the room from our sister agencies, date service? (phonetic)

You're from ARB, right? Okay. Maybe we want to actually let ARB up and our other -- if you would like to go ahead and make comment that would be fine.

MR. CUNNINGHAM: Thank you for the opportunity to present. Aniss, excellent work, Commissioners, Joshua Cunningham with Air Resources Board.

First, I want to say thank you to Aniss and your group for showing the overlay with the ZEV most likely compliance scenario. It's important for the ARB and the CEC to be aligned on those projections. We recognize there are different methodologies and reasons to have alternate scenarios at the Energy Commission, but it is important to show at least where the regulatory forces may be showing cases.

A couple of questions, well on that point first I would ask you to look at the ICF study and just ensure they do show -- or you're saying that they show a ZEV compliance -- a 50-50 between plug-ins and fuel cell vehicles. Just make sure the regulation actually has a cap on the amount of plug-in hybrids that are allowed to be in compliance. So the split in the regulation is actually on pure ZEVs, which would include batteries and fuel cells in one category and plug-in hybrids in a second category.

So they're showing a split as 50-50 make sure that the PEV category in their split accounts for the cap on plug-in hybrids. So that for true compliance you could not have too many plug-in hybrids in that category and still meet the rule.

A question on your costs, do the projections on the costs account for incentives or is that factored off model, so that you're accounting for consumer impacts? And do you also assume phase out of incentives, federal and state, at different time periods in the future? So that's kind of a key question that I would have as it relates to the impact on consumer demand.

And then one other question on the table that you show for the sale splits up to current years. You show gasoline and ethanol split. I assume that 9.8 percent ethanol is actually the E-10 fuel blend, so those are actually combined conventional vehicles or are those flex fuel vehicles that are (indiscernible) FFVs?

So those are my questions and comments. Thank you.

MS. BAHREINIAN: Thank you very much, Joshua. And thank you for attending our workshop.

On the ethanol question those are flex fuel vehicles actually and these are of the stock of light-duty vehicles.

On the incentives we are keeping incentives constant at their current levels for the entire forecast period, which may not be a realistic case but we have kept it constant.

MR. CUNNINGHAM: Okay. I can understand that that's a scenario. Keep in mind that the federal incentives, unless the rule has changed, have a specific cap on when federal incentives go away by the number of cars sold by each auto company. And we're projecting that it'll probably start hitting in the next couple of years for GM and for Nissan and not too far afterwards for some of the other manufacturers.

And then the state incentives, of course, are at the discretion of what we do at the state. But it's dependent on the GGRF Funds and how much money we can put towards the federal incentives is the much bigger one that has influence.

MS. BAHREINIAN: Yes. And one alternative could be that the manufacturers themselves could be cutting the prices. Because if you look at the transaction prices -- I mean, the previous workshop we had presented the transaction prices -- the tendency is that when they want to sell their vehicles they would have to give discounts.

But we don't -- those are the dealer incentives and the manufacture incentives that we do not account for.

But our 2014 sales-weighted average prices do account for all of those discounts. So we start with the reality of 2014 and move our way up.

(Off mic colloquy.)

MR. MILLER: Okay. I’m Marshall Miller. And I'm going to discuss the off-road transportation electrification. And this is work done with the Aspen Environmental Group.

The purpose of this study is essentially to estimate the total electricity demand for off-road vehicles and stationary applications, things like truck stops or at-berth ship visits, for the next ten years. We've produced a low, medium and high scenarios for electricity usage for each category of these vehicles or applications over the next ten years.

Okay. There's seven categories or off-road categories considered in this study: truck stop electrification, transport or trailer refrigeration units, forklifts, port cargo handling equipment, airport ground support equipment, utility work trucks and shore power. And when I discuss each of the categories, I'll give just a little more information about what each of these are.

The methodology used for the calculation of the electricity demand is relatively straightforward. We started with trying to understand the present fleet stock of either vehicles or applications, number of truck stops. There's basically a number of vehicle types within each category. So, for example, utility work trucks have both small and large bucket trucks. There's a variety of forklift classes.

So for each of these categories, we try to understand a number of different vehicle types that fit into the category, and then do the calculation for all of those. And then sum them up.

We estimate the stock growth over the next ten years. We estimate the vehicle or application activity -- that is, vehicle miles traveled or hours over the year -- and then try and understand the fuel economy. That would be in miles per kilowatt hour or kilowatt hours per hour.

Then a really important part of this is the estimate of the percentage of electrified vehicles or applications in the fleet over that ten years.

So at the present time, there may be a certain percentage of electrified vehicles. And we try to understand instead of -- as the number of vehicles in the fleet increases, does that percentage of electrified vehicles increase and if so how much? And we have different percentages for each of the scenarios: low, medium and high.

Now this estimate is actually fairly difficult to do. What we did is we looked at current reports, recent activity, regulations. We had discussions with stakeholders. For example, staff on the ports, staff from ARB. And for each of the scenarios low, medium and high, we basically tried to understand what would the percentage of electrification be ten years from now.

Once we determined that, we made the simplistic assumption that the increase year-to-year would essentially be linear. So if there were 0 percent today, 20 percent ten years from now, each year there would be an increase of 2 percent. And that's unlikely to be exactly true, but it's hard enough to understand or estimate the percentage ten years from now. It would really be impossible to try and get a reasonable percentage estimated year-by-year.

Okay. So there are three scenarios: low, medium and high. The difference in the scenarios basically boil down to two things: differences in stock growth (from low, medium and high scenarios) and differences in percentage electrification. And it turns out that the range of these estimates is basically dominated by the percentage adoption of electrification.

The stock growth was basically determined using data from the U. S. Bureau of Economic Analysis for

California counties. And they projected three growths: a baseline, a low and a high. And we used those three in our low, medium and high scenarios to basically project the increase in the stock growth.

And the differences are fairly low. The low scenario had about a 2 percent per year increase. The baseline was 2.3 percent. And the high was roughly three percent. So you see about a 1 percent absolute difference between all three scenarios. On the other hand, the percentage of electrification can differ by 30 or 40 percent over the low-to-high scenarios. So those tend to dominate.

Now in determining the percentage of electrification -- as I mentioned, that's difficult to do. It's basically a judgment call. The medium scenario was, in a our understanding, the best estimate. So talking to stakeholders, looking at reports, looking at what's happening on the ground right now. We tried to understand what would be expected, what was the most likely scenario out during the next ten years.

The low scenario is really closer to a lower bound. It isn't an absolute lower bound, but basically we looked at what was available today, what are the present regulations? And we assumed all categories would meet those regulations. And then we extrapolated, but assumed that the electrification would fall short of what was our best estimate, the medium scenario.

In the high scenario we had aggressive assumptions. Essentially they're doable, but they're very much higher, or they're higher than expected. So the low and high are not really well defined. Again, it’s a judgment call, but it -- and it's not a complete bound the highest you can imagine, lowest you can imagine. But it's a, I think, in our view a reasonable bound on what to expect.

Okay. The next set of slides I'm going to describe the general methodology used for the demand forecast for each of the sectors. There's going to be some numbers and some details in these slides, but I'm going to focus on those. I'm really going to focus on just the general methodology.

So for truck stop electrification these are trucks that can stop, say overnight or for some signification period of time. And rather than running an engine, say an APU, for their hotel loads they can actually plug in. So it's an electrical load that drives heating, cooling, radio, TV, or whatever.

The Department of Energy, Alternative Fuels database lists 224 electrified spaces in California at present. Southern California Edison inventory, estimates the total number of truck stop spaces. And then from the California Transportation Electrification Assessment Study we took an average load for a given truck when parked at one of these spaces. This would be an electric load.

COMMISSIONER SCOTT: Just a quick clarification there.

MR. MILLER: Sure.

COMMISSIONER SCOTT: So it's 224 electrified spaces in California out of a total of 9,282 total truck stop spaces in California?

MR. MILLER: That’s correct

COMMISSIONER SCOTT: Okay.

MR. MILLER: At least that's the numbers we got in the DOE database and the estimate of the inventory.

COMMISSIONER SCOTT: Okay. Thank, you.

MR. MILLER: And then project out, for the next ten years, the two things we did is look at the potential increase in the number of electrified spaces and the potential increase in the capacity factor.

So capacity factor is basically you have 24 hours of an electrified space available. A truck may stop there, plug in for six hours. After that truck leaves, another truck may plug in for eight hours. So the capacity factor is basically the percentage of time a truck is actually plugged in, using the load, out of the total time.

And so you can see for the low, medium and high scenarios we increased the number of electrified spaces or the capacity factor. In the low scenario, we made the assumption that there would be no increase in electrified spaces. But there is an increase in the capacity factor. So there is an increase of electricity even in the low scenario.

For transport refrigeration units, these are trucks that can be equipped with an electric or ETRU. And when they stop, they can plug into an electric stand-by and therefore use an electric load.

In order to estimate the demand -- the stock, I'm sorry -- we looked at the ARB TRU emissions database and got numbers for the present number of TRUs. We assumed that ETRUs, electric TRUs, can plug in roughly 30 percent of their operating time. Other times they either don't have the capability of plugging in or they're driving or whatever.

For TRUs there are four classes based on horsepower. Three of them are based on horsepower and the forth class is out of state. The assumption is the vast majority of those are the largest horsepower, greater than 25 horsepower.

From the Cal TEA study, and discussions with ARB staff, we estimated the power usage while stopped and plugged in, of the various -- of the different classes in terms of horse power.

This table shows for each scenario: low, medium and high -- and for the TRU types based on horsepower or out of state -- our assumption for the percentage of electrification ten years from now.

So you can see in the low category, we assumed no increase in electrification, in percentage of ETRUs. And we also assumed no out-of-state trucks would basically use electric TRUs. For the medium, there's a fairly significant increase in percentage electrification, in the high a slightly higher increase.

You'll notice in the high case we actually do assume that some out-of-state trucks will use ETRUs and then in-state, or perhaps out of state, plug-in.

The reason we do not assume that there's any percentage of ETRUs for out-of-state trucks in the low and medium case is that since these trucks drive some reasonable amount of time out of state -- and the understanding is that it is much more difficult to find appropriate electric stand-by to plug in out of state than in California -- those truckers would have much less desire to pay the money to purchase an ETRU or upgrade to an ETRU. And perhaps only some of them again in the high case might decide to do that.

So for forklifts there are a number of classes, classes 1 to 3 or electric forklifts, classes 4 and 5 are internal combustion engines. Those can be gasoline or diesel.

To determine the current stock we looked at a market intelligence report for sales data. That gave sales -- I can't remember -- going back to 1980 or so. And we used that to estimate at present what the current number of forklifts in each of the classes would be. We also used that sales data to try and understand the percentage, at present, of electric versus ICE forklifts.

And we used the Cal TEA study to try and understand the electricity usage per year. There's a mistake on the slide. These should all be megawatt hours, not kilowatt hours. But that gives you the electricity usage for the various classes or horsepowers.

And then for the scenarios in the low scenario, we assumed that the percentage of electric to ICE forklifts basically remains the same. So people make -- they upgrade their fleets, they increase the number of forklifts, but the percentage is basically the same as its been in past years.

For the medium scenario we assumed that that ratio increases, such that 15 percent of forklifts that previously would have been purchased as gasoline or diesel forklifts will be purchased as electric forklifts.

And in the high scenario that percentage increases to 25 percent.

Okay. So for port cargo handling equipment we looked at three vehicle types or including cranes: yard tractors, forklifts, rubber-tired gantry cranes.

We used the ARB Cargo Handling Equipment emissions database for the present stock and activity in hours for these three vehicle types. And then in order to calculate the electrical energy usage we used the Tiax Report that estimated the power use for each of these vehicle types.

This table shows, again for the three scenarios: low, medium and high, what are estimates for percentage electrification in the next ten years. And you can see that the numbers below are relatively modest. And by the time you get to high they're significantly higher.

The reason that RTG Cranes is smaller than tractors and forklifts is that tractors and forklifts, you can buy a single tractor or single forklift and replace an ICE version of that fairly easily.

For RTG cranes, there's much more planning involved. It's not a question of replacing a single crane. It's generally a question replacing a region on the port and so that's a much more difficult and significant modification. And so we assumed that the percentage of electrification would be lower for those.

So airport ground support equipment, these are things like baggage tugs, belt loaders, cargo tractors, forklifts, vehicles that move people, cargo, luggage, food, things like that around the airport.

In order the estimate the current stock, we used an airport cooperative research program inventory estimate. That was for the country. And we used FAA employment data to estimate the percentage in California.

There's an LAX report on the possibility of transitioning to electric equipment on the airports and that report gives the energy usage, both for electrical and for diesel or gasoline, for each of these vehicle types at least on their airport. And we used those energy estimates in our calculations.

COMMISSIONER SCOTT: I have a question for you on this and also with the forklifts.

MR. MILLER: Sure.

COMMISSIONER SCOTT: Is there a hydrogen fuel cell component here? And I ask that just because I've seen at a kind of like a grocery store facility -- and they had all hydrogen forklifts running around the facility -- kind of taking the goods and the boxes from one place to another.

And on the ground support there's a really interesting project in Memphis where they're using hydrogen fuel cell kind of baggage support equipment. And I'm not sure if those are pilots and one-offs or whether those have a large enough percentage to be calculated in your calculations here.

MR. MILLER: They generally are small, but the reason we don't look at them is that if you use hydrogen, that does not contribute to electricity demand.

COMMISSIONER SCOTT: So you're focused on the plug-in part, kind of the electricity component?

MR. MILLER: Right, the base, right.

COMMISSIONER SCOTT: Yeah, okay. I got it.

MR. MILLER: Either plug into the grid or basically a battery-electric vehicle that eventually gets plugged into the grid.

COMMISSIONER SCOTT: Right. Okay, I got it.

MR. MILLER: Now, of course hydrogen, in order to produce the hydrogen you might up your electric load. But we did not consider that here, because that's an indirect effect.

COMMISSIONER SCOTT: Thank you.

MR. MILLER: Okay. So to understand the percentage of electrification at the airports for the three scenarios: low, medium and high we looked at some studies of present electrification, or reports of present electrification, at various airports. And Ontario and San Jose both have significant electrification. The report at LAX indicated that roughly 37 percent of its ground support equipment were electrified in 2013.

So in looking at state-wide we assumed that roughly 20 percent was electrified now. And then the increase would be relatively modest in 2025, but could get fairly significant at the high end.

The fact that perhaps 50 percent could be electrified by 2025 was sort of based on this LAX study that showed that the cost for almost all of this equipment would be -- the cost to own and operate -- would be significantly less for the electric applications that were currently available. So given that cost is a pretty good driver, both the desire to be environmentally friendly and to reduce costs, we thought that there could be a significant chance to have a decent increase in electrification.

So the next sector is what we call utility work trucks. These are bucket trucks that drive to areas, will stop and do maintenance or installation of electrical equipment or electrical power at various sites around the State.

And the electrification is putting a battery pack on the truck. And then when it stops that battery pack can provide all of the power. So you can turn off the diesel engine and then plug into the battery pack and have that supply all of the necessary power while stopped at the worksite. And then at the end of the day the truck can drive home, plug into the grid, and have that battery pack charged up again.

Last year there was a movement by utilities across the country -- this was led by PG&E -- to try and get the fleet managers to pledge to buy a significant number of plug-in vehicles for their fleets. These are both plug-in in the sense of the work trucks, but also generic plug-in vehicles, just the light-duty vehicles. And we didn't consider those. But because of this movement, and because PG&E has actually indicated they have a strong desire to electrify 100 percent of their work trucks within the next ten years, there could be significant activity in this sector.

So for our various scenarios: low, medium and high, generally we assume PG&E would meet that 100 percent commitment, not in the low scenario, but in the medium and high. The other utilities Southern Cal Edison, SMUD, and Sempra would reach lower goals, but still significant goals.

So I just list here the percentage of

electrification, for example, low 36 to 44. And there are two types of work trucks, small and large, of these bucket trucks: 37 feet, 55 feet. So the percentages there are 37 and 55 respectively.

And then finally, there was a study by -- it was overseen by the Edison Electric Institute -- that looked at four bucket trucks, what the energy usage would be in electric mode, so for these hybridized trucks with battery tracks and also looked at the energy usage in the conventional mode, the diesel mode. And looked at the number of operating days a year, the amount of time spent at a worksite drawing load and so on. So we used those values in order to calculate the actual electricity demand.

So the last category is shore power. This is ships that will berth at California ports, and while they're at berth they have to run or use power for kind of hotel loads.

They can use their diesel engine, large diesel engine, onboard the ship, but there is what we call an at-berth regulation that requires that ships in port of certain type must use shore power, must connect to an electro load on the shore or use an approved alternative control technology.

And I list here -- the ships that we consider container, cruise or passenger, reefer and tanker ships.

And the at-berth regulation is listed there for the shore power by various years, what the different ships or percentages at ports, must reach. Those percentages go up a little bit for any port that receives Prop 1B funding.

So our scenarios basically assumed that although it's possible to use alternative control technologies, we assumed that the ports would actually upgrade to be able to meet this at-berth regulation. And so for low, medium and high scenarios we assume a fairly high percentage of electrification at berth.

And this table just shows from a Port Of Long Beach emissions inventory report average berth times for the different ship types, the average electrical load, and the total energy per visit for those ships. And that was used to understand the total electric load for shore power.

So the total off-road electricity demand forecast for those seven sectors is shown here in gigawatt hours per year. The three scenarios: red is the high, blue is the medium and green is the low. And it's not exactly linear. And there's a reason in technical details, but it general it's linear because of our assumptions that the percentage electrification would be increased year-by-year over those ten years.

And finally, we also calculated the avoided petroleum usage from the switch to electricity. And basically what we did is for any vehicle where there was a switch to electricity -- in other words it replaced an internal combustion engine vehicle for that particular year -- we looked at the petroleum usage, the diesel or gasoline usage, that that replaced vehicle would have used. And then we added up all the uses for all those replaced vehicles on a year-by-year basis.

And what's shown here in millions of gallons is your diesel gallon equivalent. So any gasoline vehicles we converted to diesel gallon equivalent in this graph.

Okay. Thank you.

COMMISSIONER SCOTT: I have one more questions for you?

MR. MILLER: Sure.

COMMISSIONER SCOTT: On the shore power slide, did you say whether or not -- so I see that there's the regulation that requires more ships to plug in as they get to your berth. Do you also account for the fact that we anticipate that the size of ships is going to get bigger and that more ships are likely to be coming to the port. Is that part of this calculation as well?

MR. MILLER: No. And that's true. There is definitely a trend toward larger sized trips (sic). Since we didn't know -- we didn't have access to an estimate of what the electrical load would be -- we used the estimates from that one study, which is for current ships.

COMMISSIONER SCOTT: Okay. Thank you.

MS. RAITT: Thank you.

Next is Jesse Gage.

MR. GAGE: Thank you, and good morning. I'm Jesse Gage and I will be covering the light-duty stock forecast in support of our overall transportation energy demand forecast. I'm going to be mostly hitting the highlights today, largely focusing on alternative fuel vehicles, because they are, of course, the hot button issue.

The comprehensive LDV forecast will be available in our staff report, once that hits the docket.

Let's start at the top. As I mentioned in the preliminary forecast workshop in June, overall light-duty stock in our model is largely determined by what we call the econ demo projections. That is state population, gross state product, income.

There are also high, mid and low-case projections for government and rental fleets, which are added to the personal and commercial stock models to obtain the overall light-duty fleet makeup.

Our six cases yield total light-duty vehicle stock projections in that range between 30 and 33 million LDVs by 2026. Note that the high AFV, the high alternative fuel vehicle and high petroleum cases, have identical total stock. As was shown in Aniss Bahreinian's presentation these two cases used identical econ demo projections. And they also imply the same government rental forecasts. Their differences instead lie in the stock makeup. As their names imply the high AFV case maximizes alternative fuel vehicles, while the high petroleum demand case posits where fossil fuels reign supreme.

Before we dive into the details of our stock forecast there's one interesting trend I'd like to call attention to. And it has implications for the makeup of the vehicle fleet in the short and medium term.

I've plotted here the percentage of vehicles in our database which are 11 years or older -- 11 years, because that's how long our forecast runs, 2015 to 2026. This percentage, nearly one third in 2005, increased markedly starting in 2009, in response to the recession, and stood at about 44 percent last year -- more than 12 million vehicles. What does this mean?

Well, if this trend continues or even regresses to the 30 percent levels seen previously millions of vehicles being driven in 2026 are on the road today. Maybe not with the same owner, maybe the same driving habits, but they'll still be around. This takes them out of fight for increased mileage due to future CAFE Standards or the push

ZEVs.

Let's face it. My '98 Corolla, if it's still somewhere out there in 2026, is not going to magically turn into a Mirai or Model S no matter how much I cross my fingers. Our forecast projects that between 8 and 12 million vehicles in 2026 are current extant, depending on the forecast case. With that let's begin the drill-down of the vehicle stock.

Before we begin with diesel and alternative fuels, let's start with the juggernaut of the vehicle fleet. Gasoline-powered non-flex fuel capable vehicles, as we know, currently rule the light-duty vehicle kingdom with nearly 80 percent of current new vehicle sales and over 90 of the LD fleet as a whole. And in the interest of making the following chart easy to read I've broken it off and shown the ensemble here.

It's an interesting dynamic with most cases seeing gasoline decline in four or five year's time. However in the high petroleum and low energy demand cases, gasoline LDV stock continues its rise unabated.

If we quickly switch over to the scenario breakout slide, Ms. Bahreinian's presentation, we can see the difference. The upward trending scenarios -- again high petroleum and low energy -- both use consumer preferences solely from our 2013 vehicle choice survey and no overarching assumptions as to the price of ZEVs.

And by ZEVs, I am including plug-in electrics as well as battery electrics and hydrogen as they do contribute to the ZEV mandate to an extent.

The downward trending cases use some combination of vehicle preferences favorable to ZEVs. They also use the more aggressive price reductions of ZEVs, namely the transition 2030 and transition 2050 scenario. And of course, fuel prices do have an effect throughout the cases. Taken together we can see why the two lower cases do not see a reversal of gasoline stock.

One last thing to point out here, is that the mid and high energy demand cases have nearly identical trajectories. But we saw earlier that the high energy demand case has greater total stock. This, of course, implies that the difference is made up by vehicles, which are not gasoline powered. Those extra vehicles are merely added onto, rather than replacing, gasoline vehicles -- at least in the aggregate.

With gasoline spoken for, let's take a focus on the mid case and take a look at the fuel makeup of the rest of the light-duty fleet. Stock for all of these fuel types increased throughout the forecast period although the growth rates do not necessary follow suit. Or as us math nerds like to say, "Positive rate of increase, but not always positive concavity."

Light-duty vehicle diesel stock deserves special mention as Commissioner McAllister mentioned. As stated before non-ZEV preferences were set in response to our 2013 vehicle survey and the various vehicle attributes developed in mid-September. And so the models currently have no way of responding to -- how shall we put this -- public relations nightmares on the part of diesel manufacturers. The conclusions of this are, as us math nerds would again say, "Left as an exercise to the reader."

Before we move on to concentrate on ZEV I'd like to very quickly show how we see the various vehicle classes break down over time. At least for the mid case as the splits for the other cases are similar. I simplified the 15 light-duty vehicle classes we use down to the four that I always think about, at least, when I think about light-duty. And they're shown as a stacked chart here.

The increase in vehicles, over the forecast period, stems from cars and SUVs and while light trucks and to a lesser extent, vans, see their stock actually wane.

So here we are at the one slide I suspect a lot of you are most interested in, total ZEV. And the question on most people's minds, "Are we or are we not on track to meet the ZEV mandate?"

I've plotted here the total light-duty ZEV.

Again, we're using BEV, PHEV, and FCV for all six cases along with what's known as the ZEV most likely scenario or MLS, which as Ms. Bahreinian explained, comes from the Air Resources Board. Note that since the MOS is geared toward the 2025 mandate neither the ARB nor CRC staff have made an attempt to extrapolate it to 2026.

COMMISSIONER SCOTT: Let me just note, MLS is the most likely scenario?

MR. GAGE: Correct. All six cases exceed the MLS through 2021. But after 2021 the low energy and high petroleum demand cases begin to fall short, topping out at about 1.2 and 1.0 million vehicles respectively.

Remember, these are the cases with relatively decreased consumer preference and higher prices for ZEVs, which explains the wide gulf between them and the rest of the rest of the pack, which range from 2.6 to 3.5 million ZEVs. And as a quick note, it should come as no surprise of the two cases that don't hit the ZEV target by 2025, are the same ones whose gasoline stocks didn't reverse their growth.

Finally, in the last set of slides, I wanted to show a breakdown of the light-duty ZEV stock for the highest and lowest cases of our ensemble, as well as the baseline mid case, which -- I guess is the baseline.

In all cases PHEV outnumbered BEV and FCV combined. And BEV is several times greater than FCV.

In the high AFV case PHEV dominates over the forecast period, but its market share peaks at about 75 percent in 2018 before losing ground. By 2026 the split is 65 percent PHEV, 27 percent BEV and 8 percent FCV.

The mid case is, of course, a much less aggressive growth curve with ZEVs combining with a hair over 2.5 million by 2026. However, the market share stays roughly the same, as it was in the high AFV case.

Finally, in the low energy demand case we have something much closer to a linear trend. There is also a greater proportion of PHEVs at the expense of both BEV and FCV. The split here is 77 percent PHEV, 18 percent BEV, and 5 percent FCV.

And with that those are the highlights of the light-duty vehicle forecast. The full forecast is in our staff reports and we look forward to including our major findings in the final Integrated Energy Policy Report.

I'll take questions at this time. Thank you very much.

MS. RAITT: Thanks, Jesse.

Next is Bob McBride.

MR. MCBRIDE: Good morning Commissioners, visitors, staff with us today, on the paltry vigil we're holding.

I'm going to talk about our modeling effort to understand future truck fleets. I'll touch briefly on what might unfold with transit buses. I'll be referring to the Argonne National Lab's truck model we used to project market penetration or adoption of alternatives, and of conventional fuel types for trucks. We've used it to project alternative fuels other than natural gas as well for the first time. I'll share some general observations and insights. And we'll look at trucks today and how forces included in the models shape fleets over the next 11 years.

So as a starting point here's the 2013 bus and truck fleet together, by size class and fuel type, according to DMV -- lots of diesel. Motor homes are mostly gasoline as we expect them to stay since these average only about 5,000 miles a year. Buying a diesel or alt fuel version in a motor home will just not pay for itself.

DMV shows 1,000 Class 4-6 electric trucks and buses in 2013, another 2,300 Class 4-6 trucks who are powered by natural gas. Together the electric and natural gas fleets are lead by UPS, FedEx, Frit--Lay. And these are delivery fleets on the street where Joe and Jane cell phone can see the large lettering clean fleet next to the company logo.

We saw about 1,600 propane or liquefied petroleum gas LPG trucks and buses in 2013, and recently noticed more in the 2014 DMV data. Unfortunately, this 2014 uptick came to our attention after our modeling was completed. We apologize and look forward to including LPG in future analyses since it appears competitive to CNG.

So we handle uncertainty by using a range of values for factors that influence fuel demand. Here is a chart, like the light-duty chart, much the same. Fuel price, fuel efficiency, economic activity and vehicle price are four of these factors.

The four cases on the left correspond to four of the cases we use for LDV. I'm not presenting two of those cases today. The low petroleum case has the same truck market penetration as the high alternative fuel vehicle case. And the high petroleum case is simply dominated by traditional fuels, end of story.

We use low, mid and high trends for economic activity and high for the high AFV case. Fuel and vehicle price run counter to the cases with high prices in the low demand case, low prices in the high demand case. High AFV demand case uses high vehicle and fuel prices for liquid fuels: gas, diesel, ethanol. And low vehicle price and fuel prices for gaseous fuels and electricity.

Fuel efficiency for all cases follow the Phase 1 EPA/NHTSA Truck Fuel Efficiency Rule -- Fuel Efficiency and

GHG Rule -- through 2018. The low demand and high alternative fuel demand cases also follow Phase 1, but also follow the EPA/NHTSA Truck Fuel Efficiency and GHG Proposed Rule from '21 through 2026. It actually plateau's in 2027.

So the alternative fuel bus population cases we used, and include: urban transit buses -- those on scheduled routes -- demand response -- which is paratransit and other -- and school buses. Bus and rail transit vehicles are not forecast within the models, but rather assigned as an input. Transit fare affects the transit share of travel, but the price of buses does not. And so bus price is also not in our model.

So we did illustrate two main trends: growth in natural gas and growth in zero emission buses. Our forecast period ends in 2026. So the 100 percent ZEV urban transit target for 2040 is regarded as a trend not yet accomplished. But the high demand case grows the ZEV bus fleet to represent the trend, which reduces the number of diesel and natural gas buses.

ZEV buses remain at current levels for the low demand case. And the mid demand case splits the difference between high and low.

So here's the truck population without the buses, also in 2013. We actively modeled the fuel types in six of the seven truck types with the motor homes remaining in the constant proportion. Otherwise, lots of diesel if 2013. Still Classes 3 and 4-6 have a significant fraction of gasoline trucks. About 3,000 refuse or garbage or recycling trucks and about 800 Class 7 and 8 single unit trucks. Most of these are actually used to transfer refuse and recycling from holding stations to landfills -- are in natural gas.

Runs of the Argonne Truck Version 5 Model confirm our intuition about how truck fuel types will change for the most part. High annual miles improve the chances for natural gas since enough fuel is used to pay for the cost of natural gas equipment.

Driving patterns with many stops will create a window for hybrids and/or battery electric trucks where we modeled them in Class 4-6. We expect this would also be true for Class 3 as well. Low annual miles will lead fleet buyers to gasoline in some cases, otherwise diesel will continue to be competitive in part due to the savings associated with the Phase 2 fuel economy rules.

Our new twist is the dedicated E85 Cummins engine with little added cost -- fuel economy comparable to gasoline and roughly the cost per mile of diesel. Demonstration was in a Class 5 van, but we modeled it for a Class 3. We anticipate the E85 engine will appear in the market after 2020.

So the Argonne Truck Model assumes fleet buyers follow one of these three curves for adoption given a pay-back period.

So on the left curve 60 percent of conservative fleet buyers would want alternative technology to pay off in under 16 months. Then over 80 percent of aggressive fleet buyers would buy an alternative technology on a new truck if it paid off within 36 months. For all of our truck model runs we assumed all fleet buyers to be aggressive by these terms.

So now, we start breaking trucks down by classes, starting with Class 3 trucks. We see big pickups, oversized vans and small box or stake trucks. I want to point out that the vans -- a lot of these are Class 2, but they can be outfitted with a suspension that puts them in Class 3. Sort of the same story, though.

Another refresher, here the fuel efficiency trends for Class 3s. I want to point out for the E85 I made a correction in this slide. They, in fact, do start off at the same point in 2020. Diesel is the most efficient and gasoline the least. CNG Class 3s are about 15 percent less efficient than diesels on a BTU basis. And the E85 version is just better than gasoline.

For all fuels, the Phase 1 Fuel Efficiency Standards come into play for 2014 to 2018. Phase 2 kicks in 2021 and continues through this forecast. So bottom gasoline, top diesel, natural gas sort of close to diesel, ethanol, pretty close to gas.

So here's the Class 3, just the E85 and gasoline truck adoption rates, to illustrate a point. Natural gas did not penetrate a whole lot into Class 3. And diesel is the heavy hitter. So we just want to look at these two.

Gasoline trends meet with intuition until about 2020 when the E85 truck kicks in. Interactions like this cause results that are counter to intuition. Notice the black solid line for the E85 mid case above the red solid line for the high case.

Differences between prices, both fuel and vehicles, drive market share, so high price doesn't always end up with the low demand. Also, we offset mid case vehicle and fuel prices from the fuel efficiency. So the vehicle and fuel prices for the mid and low demand cases are the same or pretty similar. Also the mid and high demand cases for fuel efficiency are the same or similar.

As a result adoption rates for gasoline in mid and low cases cross when the E85 kicks in. Still the cases as we've constructed them are rational, meaning that all the patterns in slide four hold true -- the chart of the cases. Except that two adjacent cases can take the same values. The results can make us blink, but recalling that the purpose of creating multiple cases is the capture uncertainty the results still define the range of plausible outcomes.

So moving on to 4 and 6, 4-6, 4,5 and 6 here are two slides -- oh, I've jumped ahead -- with this in mind we turn to Class 4-6 where diesel-electric hybrid, CNG, and battery electric trucks go toe-to-toe with diesel and gasoline. The blue truck on the right is a HINO, which I believe is a Toyota International Collaboration. That's a hybrid -- they also offer a diesel -- the hybrid's only 7,000 more than the diesel.

Here are two slides. And I'm going to flip back and forth a whole bunch. So this is one, the other -- two different scales, which are complicated. But it looks really messy if we put all five on the same slide.

Showing Class 4-6 fuel efficiencies orange is hybrid, black is diesel, blue is natural gas. They're from about 7 to 11 miles per GGE, so converted to diesel for GGE as well. And here gasoline is green and battery-electric red. Range from about 6 1/2 miles a gallon to well over 20.

Electric truck is impressive reaching over 22 MPG in all cases, even over 30 with the Phase 2 fuel efficiency. However the clump of four other trucks -- so we through the gasoline at 7-ish into this one -- still shows quite a range from gasoline at about 7, diesel-electric hybrid at over 10. And as always the Phase 2, the dotted line creeps up a bit, that's the low case. And the high alternative fuel vehicle case.

So, here I show just the diesel-electric hybrid. It gains between something like 9 percent and 17 percent of market share by 2026. But again, the cases are scrambled.

Diesel and natural gas in this case behaves as expected, but the Phase 2 fuel economy and low vehicle cost here boosts the low demand case hybrid more. And so that top line is actually in combination the identical or nearly identical high alternative fuel vehicle case with the low demand case.

The middle line, the blue line, is high demand. The solid black line at the bottom is the mid demand.

So combining two of the classes, 3 with 4-6 we see new trucks for the 4-6 battery-electric alongside the Class 3 E85 truck. Truck stock of these might be higher if we included both of these in both of these classes.

We basically wanted to see whether this model would fly with something besides diesel and natural gas. And also if we put the alternative fuels into maybe the best class for them to see if they would get off the ground, and in fact they do.

Since the spreadsheet form of the Argonne Truck

Models is limited to one baseline truck, three alternatives, had to make some arbitrary choices about what fuel type goes with what truck class. The E85 truck gathers some share of Class 3 even when introduced after 2020. Predicted market share continues to increase after 2026 pretty dramatically, but we're not showing that.

As you can see we split the Class 3-6 trucks into three graphs. And I'll flip quickly -- oops -- that's the first one. This is the second and third. So we're going to work on this one.

Natural gas adoption is higher than hybrid in these three cases, but in the low demand case they're pretty close. That's the dashed line. And they're in funny order. The low case only and really it's just the hybrids that are off there. The take away here is that both continue to grow in market share even side-by-side.

So despite economic growth in the same period, the huge numbers of diesels taper off by about 30,000 for each of the three common cases. The less expensive gasoline truck in Classes 4-6 may persist where users generate really low annual miles. They don't use those trucks, they might not affect the fuel demand as much.

COMMISSIONER SCOTT: But Bob, before you go on to that part, you mentioned that the cases in some examples are a little bit scrambled like on, I think its slide 17, the 2 of 3, that you showed. So the low case is actually higher than the mid case.

Could you repeat again kind of what your thinking is causing that scrambling?

MR. GAGE: What's going on?

COMMISSIONER SCOTT: Yeah.

MR. GAGE: Well, okay. So in this model, we actually had five fuels up against each other. And the vehicle price cases from Sierra Research were used for the low and mid case or I'm sorry, for the low case. And we used an in-house estimate for the high and mid cases.

The fuel economy flipped. We put their fuel economies in the low and mid case. And that mid case sort of went where it went, but I think it's the interaction of fuel price, fuel economy, vehicle price that's really causing this when you compare five types together.

It functions a little differently than the light-duty vehicle choice models. But I'd love to drill down into this. I look forward to having the time to drill down into this, so let's leave that as an open question. It's real factor in the models. I played with sensitivities and this is how it came up. So we'll do that.

COMMISSIONER SCOTT: Thanks.

MR. MCBRIDE: Sure.

So trucks over -- last turn to the heavy trucks over 26,000 pounds, the upper left is what we'll call a straight truck or a single unit truck. Upper right, a day cab tractor trailer, lower left and right a sleeper cab tractor trailer and a refuse truck respectively.

Long haul trucks took a fuel efficiency bump, up in 2014 with Phase 1 Standards and will take another to follow 2017.

The compression-ignited Cummins natural gas engine we anticipate will appear in the market when diesel prices go up. We start it in 2016. Note that the Cummins fuel economy mirrors, and is very close to diesel, not having that 15 percent fuel efficiency penalty, borne by the spark-ignited natural gas engines. So it doesn't matter whether you're CNG or LNG. It's all natural gas in the engine. What matters is whether it's spark ignited or compression ignited.

Low demand case, Phase 2 Fuel Economy Proposed Rule, the solid lines, upward after 2020. It's pretty amazing for the heavier trucks, it's dramatic. We've been asked, "Can you defend this?" Well, yes.

We'll see whether these rules get codified, get approved.

Okay. These are maybe the two most interesting slides. Market success is influenced by vehicle prices, sure. Solid lines are adoption rates. And the dashed lines show LNG truck prices minus the diesel truck price, so an incremental price.

So in the low and mid demand cases for 2016 if the diesel costs 1,000 then the LNG must cost 160,000.

High AFV and high demand cases represented by the dashed red truck price difference, decreasing with time, results in the solid blue and the red adoption rates. The higher price difference the lower the LNG adoption.

So here we look at the same adoption curve, the same four adoption curves as solid lines shown in this time and contrast to the difference between diesel and natural gas fuel prices. So the diesel price is usually higher, but you can see in that green line that it gets -- actually is lower until about 2022.

The highest difference, dashed blue, results in the highest adoption, solid blue and so one.

So the fuel economy for the refuse and recycling trucks looks like the long haul trucks with two exceptions. Garbage trucks stop frequently, get very low fuel economy. Also the spark-ignited natural gas engines have the 15 percent fuel penalty -- so what happens? Nonetheless, letting the market speak and work out for refuse and recycling trucks as the adoption rates for natural gas hang around current levels in the high demand case and rise to almost 90 percent in the low demand case.

Diesel dominates the Class 7 and 8 single unit trucks. I’m just pulling out natural gas here. But natural gas truck numbers in three cases -- well, let's see. Diesel dominates the 8 and 8 single -- oh, I'm sorry -- natural gas is the only one we're looking at, sorry. The natural gas truck numbers triple in three cases or in the three common cases, and they grow over an order or magnitude in the high alternative fuel case.

During 11 years of economic growth the number of Class 7 and 8 single unit trucks grows at a far slower rate than the economy. The high alternative fuel vehicle demand case shows a marked decline in the number. That's that dual line that sort of takes a lower trajectory.

And that's us. I'd like to take questions or comments now. Thank you.

COMMISSIONER SCOTT: I asked mine as we went along.

COMMISSIONER MCALLISTER: Great. Thanks very much.

MR. MCBRIDE: Yeah.

COMMISSIONER SCOTT: Thank you.

MS. RAITT: Thanks, Bob.

Next is Aniss Bahreinian.

MS. BAHREINIAN: What we are going to show in this presentation is the forecast of transportation energy demand. We have talked about all the different sectors like residential, commercial vehicles in both light-duty and heavy-duty. We also have talked in previous presentations about light-duty vehicle, for instance, in the government and rental sectors. And this presentation now is going to present a forecast of energy demand by all of these different sectors.

What we need to notice here is that one, as was shown actually in different presentations, why the population of vehicles typically grows with population and the economy. As the economy moves, as incomes grow, then so does fleet size or total population of light-duty vehicles as well as the heavy-duty vehicles and while those populations typically grow, with it also the VMT is going to grow.

So over time we have seen that total VMT in the State of California has been growing. Although when we are comparing it to the population and you get the per capita VMT we see that there are some declines. But out models do not accommodate some of the policies such as SB 375 that work on different land use plans aimed at reducing the VMT for the general public.

But if you look at the total VMT, which is really a foundation of fuel use, we see that total VMT grows, total stock of vehicles grow, over time. So the point here is that what causes the decline in fuel demand or in transportation energy demand is mostly the substitution between different fuels and the improvements in fuel efficiency.

So if you go the next slide this is a general presentation of nominal prices. These are not real prices, like in the past we used 2013 prices, these are nominal prices. And they put them right next to the fuel economy. And the fuel economy that you see here is actually specifically California. It is sales-weighted average for the State of California.

As you can see here the blue line represents the nominal gasoline prices and the green line represents the new vehicle sales MPG. You can see here that MPG continues to grow over time. You can also see that over all the increases in prices we see an increase in MPG. That is when it is more costly for people to drive their vehicles. They tend to choose the more fuel efficient vehicles.

You can also see, for instance, that as the prices come down consumers are going to start buying -- they relax on their purchases of new vehicles -- they kind of shift to the less efficient vehicles.

If you notice, for instance, in 2014 you had the decline in gasoline prices, gasoline and diesel prices. Notice that the fuel economy, the average fuel economy, also is declining somewhat. And this is in response to the lower fuel prices. It kind of makes people more relaxed in their choices of vehicles. They would use the less efficient larger classes of vehicles.

Now, these choices do not happen all in the same period. They could also take some time, because vehicle purchases are capital expenditures. And we don't automatically go out the door and buy new vehicles. It may take us a while.

This here, the graph that you see here, is the sales-weighted average. They may wait a year to buy that, but they do that anyway. If they see that gasoline prices continue to rise, if that's their expectation, then they are going to continue to buy the more fuel efficient vehicles. And as fuel efficiency goes down fuel -- I’m sorry -- as fuel efficiency goes up fuel consumption goes down.

So here is our on-road gasoline demand. As you can see here in almost all of the cases gasoline demand goes down. So even if the stock could be increasing somewhat you could still see that gasoline demand goes down and mostly that is because of the increase in fuel efficiency of the new vehicles.

If you look at the very low case here, the lowest lines -- of course all of these lines are intersecting each other -- if you look at the lowest line you can see that starting from 2015 with about 15 billion gallons of gasoline, by the end of the forecast period around 2026, we fall below 10 billions of gallons.

If the trend continues along the same line, and if you extend it to 2030, you could see that you kind of get close to what Governor Brown wants. In the new Executive Order he wants the petroleum fuel demand to decline by about 50 percent. So you can see that if you continue that line you get closer to what is in that Executive Order.

When it comes to the diesel demand, on the other hand, you could see that in the beginning at least diesel demand starts increasing, continues for a few years through 2019, but after that it sort of stabilizes, kind of. Not exactly, but it definitely doesn't increase at the same rate that it increases before 2019.

We have incremented a lot of the Fuel Efficiency Phase 1, Phase 2 Regulations in our forecast. In addition to that, we also have accounted for the growth of natural gas vehicles in our forecast.

And so you could see that, actually in two of the cases, towards the end you see actually a decline in consumption of diesel. Diesel demand, you should say, is primarily in the heavy duty sector. And it is primarily in transit and freight systems. So with the growth in the economy there's going to be growth in these activities.

As it relates to E85 I want to first bring your attention to the fact that E85 here is really E85. It's not ethanol, because as many of you know 10 percent of gasoline is really ethanol. That's not what we are counting here. And in the previous graph, when we are talking about gasoline we are talking about finished gasoline; it includes that 10 percent ethanol.

The E85 here is actually the E85. So who is using that?

Number one, in the light-duty sector we have flex fuel vehicles that can -- where the consumers have a choice between E85 and gasoline. Our model doesn't incorporate that choice in it, so we are going to have to do some kind of post processing in order to separate out how much of it is E85 and how much of it is gasoline.

So starting about 2014, in 2014 if you look at ARB's estimate of E85 consumption, and if you look at the total number of flex fuel vehicles, when you divide the total E85 by the total number of FFVs in 2014 we get something along ten gallons a year for each vehicle.

One can imagine that vehicles do not use ten gallons of fuel in one year. So you can imagine that majority of the fuel consumed by the flex fuel vehicles are actually gasoline and for good reasons. We don't have an extensive E85 station across the State.

And in previous years there has been some indication that sometimes consumers are not even aware that they have purchased a flex fuel vehicle even if there is a station.

So what we do here in order to make an estimate of how much E85 you are going to have over the forecast period we take E85 in 2014, and then we gradually increase the share of E85 for the flex fuel vehicles over the forecast period and beyond that, so that we reach a 50-50 divide in 2050. That is by 2050 our assumption is that 50 percent of the fuel used by flex fuel vehicles is E85 and 50 percent is gasoline.

So in this case as you can see -- while we cut that of course by 2026, because that's the end of our forecast period -- and as we can see here that there is an increase over the entire period in part because we are pushing that choice on to our consumers. Again, the model by itself does not accommodate fuel choice between the E85 and gasoline we exogenously force that choice to the consumers.

And by the way, we have also in the E85 -- in the heavy duty sector we have also dedicated E85 vehicles. And obviously when it comes to dedicated E85 vehicles they don't have a choice but to use E85. So the flex fuel vehicles in the light-duty sector have a choice between gasoline and E85, but dedicated E85 vehicles in the heavy-duty sector have no choice but to use E85, so all of those have been accounted for here.

This is a transportation electricity demand forecast. This adds up all of the electricity that is used in all the different sectors for transportation purposes. Most refer the movement of people from one location to another location. This includes light train. This includes trolley buses. This includes the EVs that were discussed in the heavy-duty sector, the BEV buses, and this includes EV trucks. And it also includes all of the PEVs that we have in our demand forecast of light-duty vehicles.

This is predominantly light-duty vehicles. The other ones do not have as big a share.

As you can see here, and we have been saying, our three common demand cases in the high energy demand. We have high EVs, high PEVs, but even higher than that is the high alternative fuel and vehicle scenario. You can see that in the high AFV we have the highest demand for electricity. Just as in our light-duty vehicle sector the highest number of ZEVs and PEVs are happening in the high AFV demand case, which is the sixth scenario we created this year.

COMMISSIONER SCOTT: Aniss?

MS. BAHREINIAN: Yes?

COMMISSIONER SCOTT: On this one I think it would be helpful to also have the megawatt hours on one of the graphics. In that way, when people are trying to cross-walk between the transportation one and the electricity one, they can have an easy comparison.

MS. BAHREINIAN: Absolutely. You're absolutely right. One of the reasons why we use DGE is it's like our common currency, because we want people to be able to compare different fuel consumptions with each other.

COMMISSIONER SCOTT: I agree.

MS. BAHREINIAN: But our sister unit or office, when they are presenting their forecasts, they always use gigawatts and megawatts.

COMMISSIONER SCOTT: Right. I think for this one it would be helpful to have both.

MS. BAHREINIAN: Yes, absolutely.

COMMISSIONER SCOTT: Yep.

MS. BARHEINAN: Both of them

COMMISSIONER SCOTT: Thank you.

MS. BARHEINAN: Thank you.

When it comes to transportation natural gas most of the activities here, just as in diesel, happens in the heavy-duty sector. We don't have too many uses for natural gas demand in the light-duty vehicle sector.

As was discussed in different scenarios for heavy duty we have used the Truck 5 Model, because we do not have a vehicle choice model for heavy duty. So instead we have relied on other models in order to estimate a market penetration rate for natural gas vehicles, for heavy-duty vehicles.

In 2013, and in the preliminary forecast, we have been relying on National Petroleum Council's use of Truck 5 Model on coming up with a penetration rate.

National Petroleum Council also used in their report the prices that were forecast by EIA in 2011, I believe -- the 2011 forecast of prices by EIA. You can imagine that 2011 forecast had decent prices, very high, natural gas was low. And therefore NPC's report had a higher penetration rate for natural gas vehicles.

In our forecast obviously with the new price forecast, with the revised price forecast, we have a much lower diesel price. And therefore the differences between diesel and natural gas vehicles have shrunk compared to what we had in 2015 and what we had in the preliminary forecast.

And therefore you can see here that the total natural gas demand forecast for everything ranging from heavy-duty to light-duty, in transit sector and in the freight sector, again we are achieving the highest natural gas demand forecast in the high alternative vehicles scenario or high alternative fuel vehicle demand case. We are achieving the highest percentage there, but still it is falling below 500 million GGE in 2026. And that is the highest number that we are forecasting.

I should also say that one of the limitations of the Truck 5 Model is that it doesn't allow you to go more than four fuel types in the modeling activity. So we can't really put all the different fuel types unlike our own model, our own light-duty vehicle choice model, where it allows all of the different fuel types to substitute for each other. The model, the Truck 5 Model, has that limitation. And so we are bound by the limitations of the model.

When it comes to transportation hydrogen demand forecast we are speaking entirely light-duty vehicles. So this is completely composed of the light-duty vehicles. And again, as you can see there, the highest hydrogen demand forecast goes with the high alternative fuel vehicle demand case followed by others.

You also see these kinks here and there? I'm sure you are noticing some of those kinks. It is because we also have applied the Governor's Executive Order. That is an order to the state agencies to purchase more of the

ZEV vehicles. So you can see here all these kinks.

And we are assuming a life of 11 years for government vehicles. We replace them after 11 years, so you can see that the fleet at the present time -- a lot of them are going to change hands or they are going to be replaced around 2023 or 2024 -- hence the reason for those kinks that you see in this thing. And a good portion of these hydrogen vehicles are in the government, because we are forcing government vehicles to move in that direction following the ZEV Regulations and the Governor's Executive Order.

COMMISSIONER SCOTT: I have one clarification for us to keep in mind as we go from here to the final, which I think is -- so on the transportation electricity demand forecast you mentioned that this includes all the electrified vehicles, so off-road, heavy duty, light-duty, all of that. And then on the transportation hydrogen it's just the light-duty vehicles. So I think when we put the graphs either in the report or someplace we'll kind of want to clarify which categories are included in each of the graphics.

MS. BAHREINIAN: Absolutely. I should also bring to your attention that the electricity demand does not include -- I should have mentioned that -- does not include the off-road. It does not include the off-road transportation percentage, so I need to make that. Thank you for that reminder.

COMMISSIONER SCOTT: Okay.

MS. BAHREINIAN: When it comes to commercial jet fuel demand forecast we do have our own behavioral model that generates a forecast of aviation demand and jet fuel demand. However, this time around, we were unable to use it due to staff shortages and so one of our colleagues has used a simpler method that does not rely on behavior model to forecast a jet fuel demand.

And as you can see here the forecast year is that jet fuel demand will continue to grow, but at a slightly lower rate compared to past, because of the gains in the fuel efficiency. So even in the commercial jet fuel demand, even there we have increasing fuel efficiency, and increasing in fuel efficiency slows down the growth rate.

Now here is our off-road diesel demand forecast. Traditionally, as we have said, we have been forecasting off-road diesel not really -- and also gas -- not really because all of it happens in the transportation sector, but only because gasoline and diesel are primarily the responsibility of our unit to forecast. Not necessarily because all of these are transportation.

Much of this off-road diesel is also used in agriculture, in construction and elsewhere, so it is not all transportation. And it is not all for movement of people. We made the attempt, this time around, to have a forecast of off-road transportation electrification, which was presented by Marshall Miller.

And for this forecast that you see here we are growing off-road diesel demand from what was in the EIA, which is what we have traditionally used. We used EIA's estimate of off-road diesel demand in California.

I should also bring to your attention that EIA includes rail and military in their off-road. We don't. We take those off, because we account for rail in our other models. And we also take the military out. And so this is everything that is in the EIA except for those two factors.

And we have grown this basically by the growth in the economy. So we say that as the economy grows, construction sector grows, agricultural sector grows, etcetera. And with it there is going to be a growth in diesel demand.

I should bring to your attention that these are unadjusted numbers, because we didn't have the transportation electrification in time to make adjustment to these, but in the final report we are going to have to subtract what has been electrified from these numbers. So please note that these are unadjusted off-road diesel demand forecasts.

How about electricity for high-speed rail? You have this estimate directly from High-Speed Rail Authority. This is what they estimate their energy consumption is going to be for high-speed when it kicks off in 2022. And we haven't added it to our own electricity demand. So the total electricity demand that you saw does not include that. But again, our sister unit, the electricity for electricity forecast, when they publish they are going to add this to the mid energy case and to their high electricity demand cases.

Questions, comments?

COMMISSIONER SCOTT: I asked all mine as you went along.

MS. BAHREINIAN: Okay. And you?

COMMISSIONER MCALLISTER: I’m good, thank you.

MS. RAITT: Thank you, Aniss.

So we'll go ahead and go on to public comments.

COMMISSIONER SCOTT: I don't have any blue cards here. Do we have any blue cards or comment from the room?

(No audible response.)

Okay. Do we have any one on the WebEx or the phone who would like to make a public comment?

MS. RAITT: Nobody on WebEx and so no, we don't.

COMMISSIONER SCOTT: Okay.

COMMISSIONER MCALLISTER: Do you have anything you want to add?

COMMISSIONER SCOTT: Well I -- oh, sorry. Go ahead, Josh.

MR. CUNNINGHAM: Thank you. All right, if you don't mind --

COMMISSIONER SCOTT: Can you come up to the microphone please?

MR. CUNNINGHAM: Joshua Cunningham, Air Resources Board, thank you again for a chance to add a few more comments.

Just to clarify, Aniss, when you gave your first presentation, you showed costs. And I think when you answered earlier this morning you said that the incentives are handled in the analysis. You have fixed incentive value for all future years. But to clarify, the graphic that you showed did not include the incentives, right? That was just your assumed retail prices of the vehicles?

MS. BAHREINIAN: So those are the --

COMMISSIONER SCOTT: Aniss, can you use your microphone, please?

MS. BAHREINIAN: Sorry. Yes the prices, the 2014 prices, which are the actual prices in 2014 that we used, those are what we refer to as transaction prices. And those are prices before the incentives.

MR. CUNNINGHAM: Okay.

MS. BARHEINIAN: And the incentives, as you know, some of them are monetary and some of them are non-monetary.

MR. CUNNINGHAM: Okay. That's helpful for clarification as we look at those two.

One of the issues that we're starting to look at, as we evaluate costs of the plug-in vehicles is the cost of the battery technology is coming down faster than we had expected, which is good. But then also for a good market mechanism the range of the vehicles are projected to go up in the next couple of years with the next generation of products.

So one of the things that you may want to consider is that as the kilowatt hours on the battery vehicles go up for range, even as the price of the kilowatt hours are coming down, the total price of the vehicle may not decline at the same pace or you may see a bump up as you assume that the battery size goes up.

So you may want to try to account for that if you're also making projections that the sales of the vehicles are going up in range, it needs to go up to see that happen. So we're wrestling with that ourselves in terms of how to project that, but I think we're going to try and account for that.

And the two last questions I had for Jesse on your light-duty vehicle stock presentation. And maybe this comes back to Aniss, in your ZEV projections, but we know that in your low case that is below the ARB likely compliance scenario.

But even in your mid case as I looked at the break-down of the plug-in hybrids versus battery electrics, I believe that even in that mid case that is not in compliance with the regulatory plug-in hybrid cap and the need to have all electric vehicles be at a minimum threshold. So that's something that you may want to take a look at. That you have a very large amount of plug-in hybrids, but your battery-electrics and fuel cells may not be meeting the requirements of the regulation even in that mid case.

But Jesse, on your presentation on the stock, could you -- I’m curious as to why in 2015 all of your cases don't start at the same point in terms of today's stock. Is that because you use a previous year as your starting point and you haven't adjusted for today's conditions?

MR. GAGE: That is correct, Joshua. We use 2013 as a base year and we actually forecast from that date. So 2015 there is already a small bit of divergence.

MR. CUNNINGHAM: Okay. All right, thank you.

COMMISSIONER SCOTT: Great. Thank you, Joshua.

Do we have any other comment in the room, just to double check? Okay and double checking no comment on the -- okay.

Well, let me -- and I'll let Commissioner McAllister make any closing remarks as well.

Thank you to the staff for the great presentations. We've come a long way between the preliminary and the revised, so I recognize the work and appreciate that very much. I also appreciate you keeping me appraised and updated at key points along the way, so that I can learn a lot more about this and continue to understand. So I wanted to say thank you.

I look forward to getting any additional comments that we get and getting kind of between the revised and the final, so thank you very much for that.

Let me turn to Commissioner McAllister.

COMMISSIONER MCALLISTER: Great. Yeah, so I won't repeat those, but agree with all of them.

I also want to thank Joshua for being here from the ARB. I think I really want to -- and I know that staff at the drop of a pin at every moment is also communicating with ARB and our other sister agencies, which I think is absolutely critical for this and all other issues that we're dealing with these days.

I would point out that one of our consistent themes across the presentations here is that right around 2020, '21, '22, '23, right in there, there are a lot of inflection points. And we have goals that are up here and current down here, so that makes a lot of sense.

But I think it really speaks to the fact that we have to keep our finger on the pulse of the marketplace going forward at each moment and really seeing what scale we're getting, how it's playing out, and really creating tight feed-back loops within this agency, across agencies, and just with our partners in the marketplace.

I know that Commissioner Scott is completely on top of this and knows all the people involved. But I think that as we move forward, over the next decade really I mean we're talking and beyond, we're sort of projecting a lot of big market movement in the next few years and with true scale starting to be achieved in the early '20s. And so really across the board with all the clean technologies we're talking about.

So that's very exciting. That's incredibly exciting. And it's very -- I think long term it's going to serve our state very, very well. And I'm really happy that we have the capable team that we have on this.

And I'm looking forward to making this an even more integral part of our various core forecasts. You know, the natural gas, the electricity for sure, and really keeping on top of all the nuance.

So thanks again and we're adjourned.

COMMISSIONER SCOTT: And oh, sorry.

COMMISSIONER MCALLISTER: Okay. Go for it.

COMMISSIONER SCOTT: I did want to also say thank you very much to Joshua Cunningham for being here, and a good partnership between Air Resources Board and the Energy Commission on this. And encourage us to continue that as we get between revised and final.

And let me just -- can I turn it to Heather for next steps? And then I'll let you return.

COMMISSIONER MCALISTER: Oh, yes. Go for it, yes.

MS. RAITT: No. I'll just repeat what I said before that the comments, written comments, are due December 8th and information is here in the notice for the workshop on how to file comments.

COMMISSIONER SCOTT: Thank you.

COMMISSIONER MCALLISTER: We're adjourned. Thank you everybody.

(Whereupon, at 12:31 p.m., the workshop was adjourned)

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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.

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IN WITNESS WHEREOF, I have hereunto set my hand this 28th day of December, 2015.

PETER PETTY
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Myra Severtson
Certified Transcriber
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