

BEFORE THE
CALIFORNIA ENERGY COMMISSION

In the Matter of) Docket No. 14-IEP-1B
)
2014 Integrated Energy Policy) Workshop re: Transportation
Report Update (2014 IEPR Update)) Electricity, and Natural Gas

ELECTRIC AND NATURAL GAS VEHICLES
IN CALIFORNIA

CALIFORNIA ENERGY COMMISSION
HEARING ROOM A, 1516 NINTH STREET
SACRAMENTO, CALIFORNIA

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Reported by:
Peter Petty

APPEARANCES

Commissioners Present (*Via WebEx)

Janea A. Scott, Lead Commissioner for the 2014 IEPR Update
Lead Commissioner on Transportation
Robert Weisenmiller, Chair
Karen Douglas

Also Present at Dais

Carla Peterman, Commissioner, California Public
Utilities Commission (CPUC)
Steven Berberich, California Independent
System Operator (CAISO)

CEC Staff Present

Heather Raitt, IEPR Lead
Mike Gravely
Silas Bauer
Jim McKinney
Rey Gonzalez

Presenters

Heather Sanders, CAISO
Mark Higgins, CESA

Panelists (* Via WebEx)

Adam Langton, CPUC
*Camron Gorguinpour, Department of Defense
Paul Stith, EV Grid, Inc.
Steve Davis, KnGrid
Greg Haddow, San Diego Gas & Electric (SDG&E)
Felix Oduyemi, Southern California Edison (SCE)
Amy Myers Jaffe, UC Davis ITS
Rosa Dominguez-Faus, UC Davis ITS
Tim O'Connor, Environmental Defense Fund
Simon Mui, Natural Resources Defense Council (NRDC)
John Shears, Center for Energy Efficiency and
Renewable Technologies (CEERT)
George Minter, Sempra Energy
Todd Campbell, Clean Energy
Julia Levin, Bioenergy Association of California (BAC)
Karen Hamberg, Westport Innovations
Henry Hogo, South Coast AQMD

APPEARANCES (Continued)

Panelists

Erik Neandross, Gladstein, Neandross & Associates
Chris Shimoda, California Trucking Association (CTA)

Also Present

Public Comment

Stacey Reineccius, Powertree Services
Valerie Wynn, Pacific Gas and Electric Company (PG&E)

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P R O C E E D I N G S

JUNE 23, 2014 9:36 a.m.

MS. RAITT: Welcome to Electric and Natural Gas Vehicles in California. This workshop is part of the 2014 IEPR Update.

I'm Heather Raitt, I manage the IEPR Unit. I'll begin by going over the usual housekeeping items. First off, if you're missing a pair of sunglasses, let me know. The restrooms are in the atrium, and please be aware that the glass exit doors near the restrooms are for staff only and an alarm will sound if you try to go through them. The snack room is on the second floor at the top of the atrium. If there is an emergency and we need to evacuate the building, please follow the staff to Roosevelt Park which is across the street, diagonal to the building.

Today's workshop is being broadcast through our WebEx Conferencing System and parties should be aware that you're being recorded. We'll post the audio recording on the Energy Commission's website in about a week and the written transcript in about three weeks.

I'll briefly go over our agenda. This morning we have opening comments from the

1 Commissioners and executives on the dais,
2 followed by two presentations on Electricity, and
3 then a panel on the role of Battery Electric
4 Vehicles and Smart Charging on the Grid.

5 Before breaking for lunch, there will be
6 an opportunity for public comments and questions
7 on the morning presentations only. We'll return
8 after the one-hour lunch break for presentations
9 and a series of panels discussing topics related
10 to the use of natural gas as a transportation
11 fuel. At the end of the day, there will be
12 another opportunity for public questions and
13 comments.

14 Since the agenda is very full, we request
15 that presenters please limit your comments to the
16 allotted time to ensure that all have an
17 opportunity and the time needed for their
18 presentations.

19 Also, we are asking parties to limit
20 their comments to three minutes during the public
21 comment period. We'll take comments first from
22 those in the room, followed by people
23 participating on WebEx, and finally from those
24 who are phone-in only.

25 For those in the room who would like to

1 make comments, please fill out blue card and give
2 it to me. When it is your turn to speak, please
3 come to the center podium and speak into the
4 microphone. It's also helpful to give the Court
5 Reporter your business card.

6 For WebEx participants, you can use the
7 chat function to tell our WebEx Coordinator that
8 you'd like to ask a question or make a comment
9 during the public comment period, and we'll
10 either relay your question or open your line at
11 the appropriate time. For phone-in only
12 participants, we'll open your lines after we've
13 taken the other comments from folks in person and
14 on WebEx.

15 Materials for this meeting are available
16 on our website and hard copies are on the table
17 at the entrance to the hearing room. We
18 encourage parties to submit written comments on
19 today's topics and the comments are due at the
20 close of business on July 14th.

21 The public notice that is the hard copy
22 on the table and posted on the website provides
23 instructions for how to submit public comments.
24 And I'll turn it over to Commissioners for
25 opening remarks.

1 COMMISSIONER SCOTT: Great. Thank you,
2 Heather. Good morning and welcome, everybody, to
3 the 2014 IEPR Update Workshop on Transportation,
4 Electricity and Natural Gas.

5 I am pleased to be joined by my fellow
6 Commissioners Douglas and Weisenmiller, and also
7 by today's guest, President of the California
8 Independent System Operator, Steve Berberich, and
9 California Public Utilities Commissioner Carla
10 Peterman.

11 I think we have another interesting and
12 informative day lined up to discuss the
13 intersection of electricity, natural gas, and
14 cleaner transportation. And we have a great set
15 of vehicles out front for you to see and to
16 drive, so please be sure to spend a little bit of
17 time checking them out.

18 I look forward to today's presentations,
19 I'm going to keep my remarks short because we've
20 got a lot of great presentations, and I will turn
21 to Commissioner Douglas for any welcoming remarks
22 that she might like to make.

23 COMMISSIONER DOUGLAS: Well, I'll just
24 join Commissioner Scott in welcoming everyone
25 here. I'm looking forward to the workshop.

1 CHAIRMAN WEISENMILLER: Again, I'd like
2 to welcome everyone here and thank them for their
3 participation today. Obviously, one of the
4 things that is really important to deal with in
5 the climate change context is greenhouse gas
6 emissions, transportation is about 40 percent of
7 our greenhouse gas emissions, so it's very
8 important that we look at cleaner or Zero
9 Emission Vehicles there. Our transportation is
10 also a key part of our air emissions. I remember
11 a chart I saw last week from Barry Wallerstein
12 which basically was looking at sources of
13 pollution in the South Coast and sort of at the
14 top of the list was heavy-duty vehicles. So
15 again, I think moving forward in this way is
16 dealing with both our air quality challenges and
17 our greenhouse gas challenges, and certainly
18 building off of our electric system. Thanks.

19 COMMISSIONER SCOTT: Mr. Berberich?

20 MR. BERBERICH: Thank you, Commissioner
21 Scott and thank you for having me here today. I
22 will keep my comments brief because our Heather
23 Sanders has a lot to say and I don't want to
24 steal her thunder, but let me just say this:
25 Electric Vehicles have tremendous promise for

1 Grid operators and the ability to provide
2 ancillary services, as well as to soak up
3 generation that may otherwise have to just be
4 disposed of, that we would get from clean
5 generators, solar, and wind. So if we do this,
6 though, Electric Vehicles can be a great boon to
7 the Grid, but they could also be quite
8 detrimental to the Grid if the policies are not
9 closely aligned. And so today I think the
10 critical thing we can do is think about those
11 policies and the alignment of them so that
12 Electric Vehicles can truly be unleashed for
13 their full promise.

14 COMMISSIONER SCOTT: Thank you.
15 Commissioner Peterman.

16 COMMISSIONER PETERMAN: Thank you. Good
17 morning, everyone. Thank you, Commissioner
18 Scott, for including me in your IEPR Workshop. I
19 was delighted to see the IEPR this year focus on
20 transportation because we're recognizing, of
21 course, the increasing intersection between
22 transportation and our Electric and Natural Gas
23 markets and supply.

24 At the California Public Utilities
25 Commission, we have an open proceeding that's

1 looking at a lot of issues related to alternative
2 transportation, and really not only how to
3 mitigate the impacts of electric and Natural Gas
4 Vehicles to the Grid, but to have our utilities
5 play an active role in facilitating their roll
6 out. So I think it's a real testament to the
7 coordination that needs to happen across agencies
8 that you have three present here today on the
9 dais, and particularly we're doing some vehicle
10 to grid integration work with the ISO, and so
11 looking forward to the presentation today. And I
12 encourage all of you to take what you learn here
13 and feed it back into our proceeding. Thanks.

14 COMMISSIONER SCOTT: Great. Let us turn
15 to our first set of presenters. We will start
16 with Heather Sanders.

17 Heather Sanders has worked in the
18 wholesale side of electricity for over 15 years
19 in consulting and software. Formerly the
20 Director of Smart Grid Technology Strategies, she
21 was responsible for demonstration, research and
22 promotion of Smart Grid and other technologies
23 supporting ISO reliability, market efficiency and
24 transmission utilization objectives. Her focus
25 now is on advancing policy that enables the

1 incorporation of distributed energy resources
2 that include distributed generation, demand
3 response, energy storage, Electric Vehicles, and
4 microgrids. She also leads an internal ISO
5 corporate initiative entitled "Grid Evolution
6 Readiness" that studies the impact of renewable
7 integration, evolving operational needs and
8 resource requirements, smart grid technology
9 integration and pilots, and renewable
10 forecasting. She holds a B.S. in Electrical
11 Engineering from South Dakota School of Mines and
12 Technology and an MBA from the University of
13 Utah. Welcome, Heather.

14 MS. SANDERS: Thank you, Commissioner
15 Scott. And thank you for having me here. Mike
16 Gravely contacted me and asked me to really set
17 the stage for what it will be like in operating
18 the green grid of the future.

19 And so while a lot of you are familiar
20 with a Duck Curve and what we're going to need
21 for the future operation, I wanted to take the
22 opportunity to frame it up for you before we go
23 into how Electric Vehicles can best contribute to
24 helping manage the green grid.

25 All right, so to talk about this, let's

1 think about the resource mix needed to maintain a
2 reliable grid, needs specific capabilities in the
3 right place, at the right time. So what, when
4 and where.

5 Focusing on what first, the Duck Curve,
6 the infamous Duck Curve shows us what?
7 Historically, we focused on meeting peak and we
8 went about procuring resources that helped us
9 meet peak because the rest of the time of year,
10 if we could meet peak we would be fine. So we
11 just needed to have enough generation there to
12 meet peak.

13 Times are changing. We now have a
14 resource mix that includes variable generation,
15 as well as controllable generation. So what we
16 do at the ISO is we exactly match supply and
17 demand every second to make sure we keep the grid
18 reliable.

19 So what the Duck Curve has changed is not
20 looking at the load curve on its own as the only
21 source of variability, but now it's looking at
22 the net load curve because that's now your
23 variability. So you have load, variable load, we
24 want to make sure we can meet what consumers need
25 at the time, subtracting the generation sources

1 that help contribute to meet that need that are
2 now variable, wind and solar. So we come up with
3 this net load curve. This shows us now what the
4 ISO must have, what the grid operator must have
5 in terms of resource mix, to manage this green
6 grid.

7 So a few years ago, the ISO said, well,
8 okay, we're getting these renewables on, we need
9 to start helping people understand how things
10 have changed from an operating mix. What the
11 Duck Curve specifically brings out, now these are
12 net load, you have megawatts on the Y axis and
13 hours of the day on the X axis, what it shows us
14 is the load shape. Now, in the middle of the day
15 as you go through time, adding more and more
16 renewables, specifically solar, you see less need
17 for resources in the middle of the day. You also
18 see on the two ends in the morning, with that
19 significant down ramp, and then in the afternoon
20 the significant up ramp, a need for what we call
21 "ramping capability" which is the ability to
22 decrease generation on line, or increase
23 generation on line, as the sun rises and sets.
24 So ramping capability is the first thing the Duck
25 Curve shows us.

1 The second thing you see down there in
2 the belly of the Duck is this over-generation
3 risk. Now, this is coming just as a result of
4 the fleet we built to meet our needs for peak.
5 Now, those resources have minimum operating
6 conditions. So when they come on, they have a
7 minimum level that they need to operate at. You
8 know, they come on, they have to heat up, it's
9 just a characteristic of how the existing fleet
10 operates.

11 So what happens is we bring all those
12 resources on in the middle of the day, or when we
13 need to, so that they are ready for when the sun
14 sets and they can ramp up. So what happens now
15 is we have those, and there's about 12,000 to
16 14,000 megawatts of those base load resources
17 currently on the system, and then if you have
18 significant solar coming on, now you have more
19 supply than you have a need for it. And that
20 will result in negative prices, and that will
21 also result in curtailment of renewables at a
22 last resort to manage that over-generation.

23 So the two things from "what" that the
24 Duck Curve tells us, we move to net load, we need
25 ramping, and we need to be able to mitigate the

1 over-generation risk.

2 Where? Nothing has changed about where.
3 Historically we needed to focus on where the
4 resources were located and we continue to need to
5 focus on where the resources are located. This
6 is because we don't build transmission to serve
7 every piece of load from a centralized generator.
8 We trade off the ability to transport energy into
9 the local need areas using our transmission from
10 central generators with the need to build local
11 generation. So "where" has always mattered and
12 it continues to matter.

13 With the retirement of the San Onofre
14 Generating Stations, SONGS, a bright light was
15 shone on the "where." We got people much more
16 interested in understanding what local
17 effectiveness factors are, local capacity
18 requirements and capabilities. So we will
19 continue to focus on "where."

20 Okay, "when"? Back to the Duck Curve.
21 This is a spring Duck, so the when you need
22 energy has changed significantly. In the spring,
23 peak is not from noon to six, it's pretty evident
24 you get to 2020, peak is not from noon to six.
25 But let's look at the flock of Ducks. This is

1 January. In January, you see a double hump, so
2 the peaks are pretty much the same, which
3 requires you to meet an upward ramp, a downward
4 ramp, another upward ramp, and another downward
5 ramp. In February, you see similar curves, the
6 Duck starts to emerge toward the end of the
7 month, spring Duck, as you see you get a lot of
8 generation in the middle of the day, loads are
9 still low. Moving into April, you start to see
10 that belly rising, and into May and June and July
11 and August, the summer months, the belly is gone.
12 What you see about these is this maximum
13 continuous ramp that you need. So you still need
14 that generation that continues to provide energy
15 through the day to meet the summer months.

16 Okay, so now September, also a peaking
17 month in California, very similar. In October,
18 you begin to see the Duck reemerge as loads go
19 lower, November same thing, and in December you
20 see the double hump again. Now, the double hump
21 in December is much more significantly steep than
22 in January because we have a lot of Christmas
23 lights and we're very festive here. So here we
24 need to again emphasize that the fleet needs this
25 ramping capability.

1 So we've talked about the "what" and we
2 need flexibility. I want to hit on what
3 flexibility means. So flexibility is the ability
4 to start and stop quickly. It's the ability to
5 operate at zero or minimum load, it is the
6 ability to continuously provide output, so you
7 will hear us talk about what in the terms of
8 availability, duration, and speed. So
9 flexibility is a need to be available when it's
10 needed, a need to be as fast as the need is, and
11 a need to be able to last as long as that ramp
12 is. So we'll have a lot of different resources
13 that are able to contribute. And then we have
14 the "where" and we've covered that, and then the
15 "when." And for resources to have with intra-day
16 ability to be flexible in when they operate, that
17 will help contribute to the reliable management
18 of the green grid. So that's all I'm going to
19 cover now, just to set the stage, and then as we
20 move into the panel about how Electric Vehicles
21 contribute, we'll talk more specifically about
22 how Electric Vehicles provide each of these
23 capabilities. So thank you.

24 COMMISSIONER SCOTT: Great. Thank you
25 for that terrific setting of the stage.

1 We have one more setting of the stage
2 presentation before we go into our panel, and
3 that is Mark Higgins. Mark brings a deep
4 wholesale energy market experience to Strategen.
5 Mark's career in the energy industry has focused
6 on renewables, project development, and utility
7 regulatory strategy. Mark most recently served
8 as Pacific, Gas and Electric Company's lead on
9 electric transmission policy work at the
10 California ISO where he worked on formulating
11 PG&E policy on energy storage, demand response,
12 generator interconnection, and transmission
13 planning issues. Prior to PG&E, Mark was
14 Director of Utility West at Sun Edison. His
15 responsibilities there included management of
16 California utility-scale project development
17 strategy and execution.

18 Mark also has a strong private equity
19 venture capital and investment banking
20 background, including placing over \$125 million
21 in equity for publicly traded companies while at
22 Roth Capital Partners. Mark holds a Master of
23 Pacific International Affairs from the University
24 of California San Diego and a Bachelor of Arts in
25 Government from the University of Notre Dame.

1 Welcome, Mark.

2 MR. HIGGINS: Thank you very much for
3 having me. I really appreciate the opportunity
4 to come speak with you today.

5 So I'm Mark Higgins from Strategen
6 Consulting and California Energy Storage Alliance
7 (CESA). California Energy Storage Alliance
8 represents over 80 companies that are operating
9 in the range of energy storage technologies from
10 bulk resources, pumped hydro on the large side,
11 down to EV charging infrastructure companies on
12 the behind-the-meter side, so a very very wide
13 spectrum of companies.

14 So Heather did a fantastic job of framing
15 out what are some of the issues we're facing and
16 of course the issues are really driven by
17 California's State's greenhouse gas reduction
18 targets, which are 80 percent reduction of our
19 1990 emissions by 2050.

20 Now, what's interesting about this is
21 that about half of our GHG reduction targets need
22 to come from grid De-carbonization and
23 transportation electrification. And what's
24 really interesting about those two sectors is
25 that, when you look at them, if you put in place

1 the right policies, transportation and
2 electrification can actually be quite
3 complementary to cost effectively solving our
4 Grid De-carbonization system challenges that
5 we're facing.

6 And actually EVs are already starting to
7 make quite an impact on the state's load
8 situation. This, I think, is probably
9 overstating the case if we put in place the right
10 policies you're going to get a lot more kilowatt
11 hours that you have available, but you're not
12 necessarily going to have to contribute a lot to
13 the peak kilowatt system needs that you're going
14 to have from EVs.

15 So Heather talked about the Duck and, of
16 course, we know that it's not a Duck, it's a
17 flock of Ducks, as she's fond of saying now, I
18 think. And I think what's interesting about
19 storage and EVs in the context of this is that
20 they're really flexible resources and they can be
21 really responsive to what market signals they're
22 getting. And in fact, this chart right here is
23 actually an aggregation of publicly available
24 data on public charging stations from ChargePoint
25 and Ecotality. And what you see here is that

1 actually even just the way that they're operated
2 today, they're quite complementary to raising the
3 belly of the duck, and helping reduce some of the
4 ramping needs by sopping up that energy. And
5 this is just workplace charging, public stations.
6 So that's without any major policy change, and I
7 think that's really interesting because it shows
8 that they're already contributing.

9 Now this chart right here is actually -
10 this is actually a snapshot of my own personal
11 house on a random day last week. I have a *Nissan*
12 *Leaf* at home and I have it set to charge at 11:00
13 p.m. because that's when the time of use rates
14 drop. So, snap, at 11:00 p.m., my load shoots
15 way up. Now, if you get into a neighborhood
16 where you've got a high penetration rate of EVs,
17 you know, this could be a problem, but vehicle to
18 grid integration could be a great solution for
19 this. You help smooth out overnight, raise up
20 the load during the middle of the night, and
21 that's without any fixed storage you can put in
22 place a really great solution for that. So Smart
23 Charging at home really makes a lot of sense. Of
24 course, nobody is going to do that unless there's
25 economic incentives for them to do so. Nobody

1 wants to pay more for equipment at home that has
2 all these capabilities if they don't have the
3 right rate structure, if there's not market
4 incentives to enable them to actually recoup some
5 of those costs or even make some money off of
6 Smart Charging.

7 So just a little bit more on vehicle to
8 grid integration benefits. So Heather talked
9 about the what, where, and the when. There's
10 another way to look at what a resource can offer
11 and what its value is in the market, so benefits
12 are basically reflected in market products, and
13 how much value a resource has depends on its
14 duration, its speed, and its availability. And
15 some of the benefits it can solve is managing the
16 Duck Curve, providing ancillary services, that's
17 on a bulk system. And actually on a local system
18 it can also provide a lot of benefits in terms of
19 voltage regulation and phase balancing, peak
20 shifting.

21 And then one of the things that I like to
22 think about is it actually provides a lot of
23 benefits from the rates standpoint, as well,
24 because if you can better utilize the resources
25 that we have out there, you're going to be able

1 to lower consumer costs. Not only are you using
2 more kilowatt hours for the fixed cost
3 infrastructure that you have out there, but
4 you're helping better utilize existing generation
5 that you have out there, fossil generation, in
6 particular where you've got minimum loads, and
7 you want to get that utilization up so that you
8 can lower the capital costs per kilowatt hour
9 that's generated; as well, when you're using your
10 fossil resources effectively, you're actually
11 lowering the emissions per kilowatt hour, as
12 well, that are coming out of fossil generation.
13 So there's great benefits from a rate standpoint,
14 there's great benefits from a consumer cost
15 standpoint if you're increasing the utilization
16 in a smart way of the electric grid that we have.

17 So just back to those characteristics, so
18 on the duration side if you're able to sop up
19 some of that energy at the bottom of the Duck,
20 the belly of the Duck, you're lowering the need
21 for minimum dispatch and ramping of fossil
22 generation, and you're reducing the need to
23 curtail renewables, and you are basically
24 creating a more cost-effective system. On the
25 upside, you can lower consumer costs by reducing

1 the need for peakers, you know, if you're able to
2 discharge at the top of the head of the duck, I
3 guess it would be.

4 Storage resources can really address
5 system needs also through their speed. A lot of
6 storage resources that are out there can be very
7 very fast responding and so you can deal with a
8 lot of the ancillary services, frequency
9 regulation, a lot of the things that we need to
10 deal with, and particularly EVs and EV linked
11 storage can help address that.

12 And then availability. When you're
13 looking at VGI-enabled EV charging stations,
14 obviously EVs are only being driven a very small
15 fraction of the time, there's a lot of time that
16 they're either connected to the system, or
17 they're parked somewhere, or they're charging,
18 that a VGI-enabled system could actually help
19 contribute to the system needs.

20 Now in some of the use cases, it actually
21 may be complementary to add in some fixed storage
22 as well because you can solve some problems
23 without having to create consumer behavioral
24 changes, as well as increasing the availability
25 of the resources that are there.

1 So we do see stationary storage in some
2 use cases as being quite helpful when you're
3 looking at VGI-enabled systems because it can
4 really help deal with the availability issue.
5 And it actually solves a lot of other problems,
6 too. Consumers, we all know they don't really
7 want to change their behavior. When you're
8 looking at this type of a scenario, you don't
9 really need storage because you can smooth things
10 out through a VGI-enabled system. All I really
11 care about is that my car is charged in the
12 morning to go to work.

13 But when you're dealing with this type of
14 a situation when you have a lot of HVDC chargers
15 all installed together, you've got the higher
16 kilowatt capacity Level 2 chargers, you could end
17 up actually triggering a lot of localized system
18 issues. You've got a higher load impact that
19 could trigger a lot of network upgrades, so if
20 you add in storage, you could reduce that. And
21 then you also, in certain use cases when you add
22 in fixed storage you don't have to change
23 consumer behavior because if there are use cases
24 where you're getting a lot of consumers coming
25 in, they want to charge quickly and then get out,

1 having fixed storage there to help address the
2 demand impacts there can be really helpful and
3 smooth that out so you don't create a lot of
4 peaks that then end up creating a lot of local
5 issues, even if they're solving bulk system
6 issues.

7 And actually rate redesign alone can't
8 keep up with EV adoption unless you create a more
9 dynamic schedule, kind of what the SDG&E pilot is
10 looking to do where you have dynamic pricing and
11 that would help address a lot of those types of
12 system problems, because you don't just have
13 everyone turning on at 11:00 p.m. And of course,
14 as you saw from Heather, the Ducks change every
15 year and are changing quite quickly as we move
16 forward, so if you have a static rate structure
17 that can't be adapted very quickly, you know,
18 what may be good two years from now is not
19 necessarily going to be good four years from now
20 or six years from now.

21 So what are some of the roadblocks to VGI
22 policies? That boulder, yes, is one of those
23 roadblocks. We think the first thing is, in
24 creating the right market incentives you have to
25 have some form of rate reform, you need wholesale

1 rates for wholesale market participation
2 application. If there's a system out there
3 that's charging, in order to enable providing
4 services into the wholesale market, that charging
5 has to happen at a wholesale rate. Retail rate
6 treatment is for end uses, not power resale.

7 And then, of course, on the
8 interconnection side, this is really challenging
9 right now because there are so many different
10 tariffs out there that could apply, oftentimes
11 you're seeing multiple tariffs being applied, you
12 have load interconnection tariffs, you have Rule
13 21, you have the wholesale distribution tariffs,
14 and it's been very confusing for developers to
15 identify the right tariffs to apply under and
16 that actually qualify them for the right types of
17 treatment that they're looking for. And also, a
18 lot of times developers are finding that the
19 interconnection costs that are under the existing
20 tariffs don't really reflect the unique
21 characteristics of their systems to be able to
22 manage the load impacts that they're actually
23 having. They're very, I'll say 20th Century,
24 where you're having hardware fixes for things
25 that can actually be solved through software

1 today. You know, we live in the 21st Century and
2 the ISO has an amazing software dispatch tool
3 that solves a lot of the wholesale market
4 conditions. There is software out there that can
5 solve a lot of the localized impacts, as well, in
6 managing the demand of EV charging stations on
7 the Grid. We shouldn't have to solve everything
8 through expensive hardware fixes for new EV
9 charging facilities out there when it can be
10 solved through software.

11 So retail rate design for the end use is
12 also I think a very important thing, particularly
13 for V1G applications. You want to create the
14 right dynamic kind of pricing to incent smoothing
15 out the load and not creating the demand impacts
16 on a localized basis. You want to be able to get
17 a way to ultimately reflect localized system
18 conditions in whatever incentives you're creating
19 out there. Market participation is also a
20 continuing challenge and there's a lot of reform
21 that needs to happen in order to enable cost-
22 effective metering telemetry for the ability of
23 these systems to participate in wholesale
24 markets.

25 And then I think the last point is

1 really, you know, this area of our Grid is
2 changing so rapidly, it's great that there are
3 utilities out there that are doing pilot
4 programs, but we have to get past those pilots as
5 quickly as possible because, if we don't, all
6 these technologies are going to be left in the
7 dust. And you're going to have a massive roll-
8 out of EVs and the charging equipment that is out
9 there is going to be -- I don't want to say this
10 -- but it could be dumb equipment that doesn't
11 really have the ability to change its usage based
12 on the market signals that it's getting. So you
13 don't want to go from a situation where we have a
14 one, one and a half percent of vehicles that are
15 sold today that are getting charging equipment
16 installed, and that's not smart equipment, to
17 maybe 10 percent five years from now or 10 years
18 from now, and those consumers are still
19 installing those timer-based systems that don't
20 really have the ability to respond to market
21 signals. But we're never going to get to that
22 point unless we roll out programs throughout the
23 Grid, and not just for pilots, that enable those
24 kind of responsiveness to market signals. So we
25 really encourage the utilities -- pilots are

1 great, but we've got to get past them quickly.
2 So the good news is that the Grid is not going to
3 break, EVs are going to contribute -- EVs are
4 already in certain circumstances contributing to
5 solving some of the Grid problems. But through
6 the right policies, we can really really make EV
7 charging and vehicle to grid integration quite
8 complementary to meeting our statewide GHG
9 reduction goals, as well as through some of the
10 system challenges that we're seeing on the Grid.
11 So thank you very much. I appreciate, once
12 again, the opportunity to come speak with you
13 today. And if you have any questions, here's how
14 you can get in touch with me. Looking forward to
15 the panel.

16 COMMISSIONER SCOTT: Great. Thank you
17 very much, Mark. These are two terrific stage
18 setting presentations for us. Do we have any
19 questions from the dais on the first two
20 presentations? Nope? All right, before I turn
21 it over to Mike Gravely to get going with our
22 first panel, I just want to remind folks that
23 there is an open proceeding before the Public
24 Utilities Commission, so it's just a gentle
25 reminder to all of our participants not to go

1 into any specifics of cases you may have pending
2 before them, but to stay general as you make your
3 comments. And I will turn to Mike to kick off
4 the panel.

5 Mr. GRAVELY: Thank you, Commissioner
6 Scott. So the panel we have before us today is
7 going to kind of go forward with what we have
8 just heard from both the need and the
9 opportunity, and since Electric Vehicles provide
10 a challenge, there's a goal in California to have
11 a minimum of 1.5 million vehicles on the road by
12 2025, that's a large projection of growth so that
13 becomes a charging challenge for the customers
14 and also an opportunity.

15 So today we're going to hear from
16 different speakers on projects that are out
17 there, from the utilities on what they're doing,
18 and we're going to look specifically at where are
19 we today in Electric Vehicle charging, both what
20 they call V1G, or Smart Charging, as well as V2G
21 where you're using the vehicle for vehicle
22 integration, and also just addressing the issues
23 associated with that.

24 Our first speaker today is from the
25 Public Utilities Commission, Adam Langton is

1 actually managing -- we've heard before about
2 this Alternative Fuel Vehicle proceeding, so he's
3 the staff lead for that proceeding, and he's also
4 been very active with the Governor's Office in
5 the Zero Emission Vehicle Initiative in the ISO
6 led projects, and also the cap-and-trade for the
7 electric sector. So he is a regulatory voice and
8 is going to give us a little idea of where the
9 PUC is going and the issues, they think. Adam?

10 MR. LANGTON: Thank you, Mike. And thank
11 you, Commissioner Scott, for inviting me to be
12 here today.

13 I'd like to just give a little kind of
14 regulatory perspective here and talk a little bit
15 about the opportunity and some of the challenges
16 that we see in making vehicles a grid resource.

17 We saw this slide in Mark's presentation.
18 This is just a simple calculation of what the
19 load from Electric Vehicles could look like,
20 taking the CEC IEPR Forecast and projecting out
21 what Electric Vehicle load could look like, and
22 we have a mix of hybrids and BEVs on the Grid.
23 And this shows by 2025 us reaching the Governor's
24 target of getting 1.5 million Electric Vehicles
25 on the road in California by 2025, and if that

1 happens we have about almost 8,000 megawatts of
2 load from Electric Vehicles. If they were all
3 charging at the same time, and was all happening
4 on peak, it would represent a 15 percent increase
5 in peak energy usage. That's probably an
6 unlikely scenario for reasons that I'll talk
7 about in a minute, but it is something to be
8 mindful of.

9 As we saw in Heather's presentation, the
10 peak seems to be moving later into the evening
11 around 6:00, 7:00, 8:00, and that's when people
12 are returning home from work, so you have the
13 potential to have a lot of these vehicles
14 charging at that time and contributing to peak.
15 Well, there's an opportunity here to make sure
16 that that doesn't happen and to charge in such a
17 way that it's actually providing Grid benefits.

18 Another note on this is that the state
19 has a number of initiatives that are aimed at
20 reducing emissions, GHG emissions, in the State
21 of California by 2020, and also by 2050, are some
22 of the target dates. Electric Vehicles are one
23 of the few initiative elements that are actually
24 going to result in an increase in electricity, so
25 that's why this challenge is so important because

1 there's an opportunity both to reduce the
2 emissions, but also do it in such a way that we
3 get benefits to the Grid.

4 This chart shows the -- and we already
5 saw this also in Mark's presentation -- and it
6 looks like my titles are missing, but I can kind
7 of fill you in. That top wedge there, that black
8 wedge, is the amount of time that people spend
9 driving, about four percent of the day is when a
10 car is driving. And that green wedge is the
11 charging time for if you take that average car
12 and you're charging it with a Level 2 charging
13 station, you're spending about 10 percent of your
14 time charging. So the other 86 percent of the
15 time your car is waiting. So that presents two
16 opportunities for us, one is that we can charge
17 that vehicle in such a way that it's not
18 contributing to peak and that it's helping us to
19 meet other Grid balancing needs, that's one
20 opportunity, and the second opportunity is that
21 you could potentially discharge the battery to
22 the Grid to provide energy storage, and then have
23 enough time to recharge it in time to meet all
24 your driving needs.

25 A couple of limitations to this, so the

1 fact that your driving doesn't -- as you are
2 probably aware -- it doesn't happen in one wedge
3 in your day that happens at the same time, it's
4 spread throughout your day. And because the
5 vehicle is driving, it's moving to different
6 parts of the Grid which makes it more difficult
7 to interconnect it than a traditional stationary
8 resource which is always at the same spot on the
9 Grid. And also a vehicle is pretty small
10 relative to the overall need that Heather talked
11 about that the Grid has for balancing, when we're
12 talking about at the thousands of megawatts; an
13 Electric Vehicle is a few kilowatts, maybe 10
14 kilowatts, perhaps higher than that, which looks
15 really small relative to the overall Grid, which
16 presents a challenge for integrating them into
17 the wholesale market.

18 But then, from the local perspective,
19 when you're looking at the local grid in a
20 residential neighborhood, an Electric Vehicle is
21 actually very big. That load can be equal to
22 what a house load is. So when you buy an
23 Electric Vehicle, you're potentially increasing
24 your neighborhood load by an additional house, so
25 that can constrain the transformer in the local

1 distribution system. So that presents kind of
2 opposite challenges that we see.

3 Just a little more context on driving
4 behavior. This is a breakdown of where cars are
5 throughout the day, hour by hour, based on the
6 National Household Transportation Survey, and
7 what's interesting here, and then I wanted to
8 point out is that cars spend a lot of time at
9 home at night, that's kind of obvious, and the
10 other interesting component here, though, is that
11 the cars spend a lot of time at work, as you can
12 imagine. They are, just by looking at this
13 graph, you're seeing a big increase in cars
14 arriving at work, that's that middle section,
15 that dark blue area there, around 8:00 a.m. or
16 so, and then that starts to taper off and it kind
17 of dramatically tapers off maybe around 5:00.
18 And what's interesting about this is that it kind
19 of aligns with what we see the Duck Curve need in
20 the spring and fall, as Heather talked about,
21 that we have this net load dropping around 9:00
22 a.m. and then increasing around 5:00 p.m. So
23 it's during that whole time that we see a lot of
24 vehicles at work. And they've already driven to
25 work, so they probably have a need to charge up.

1 So there's a particularly interesting opportunity
2 there where we could use workplace charging to
3 kind of help fill the belly of the Duck and, as
4 Heather talked about, help levelize this curve
5 and reduce some of the integration costs.

6 Other opportunities are meeting that
7 evening ramp when the solar is coming off, we
8 have vehicles, then, at that time that are
9 traveling from work, going home, and they have
10 the potential to help us meet that ramp in the
11 evening. We want to avoid the peak hours that we
12 see after that ramp. And then at night there's
13 potential opportunities to integrate wind
14 resources at night when we occasionally get wind
15 spikes, so having that nighttime charging
16 available could be scheduled to address those.

17 And then the other opportunity at night
18 is to avoid overloading the local distribution
19 system by potentially staggering the charging
20 that vehicles are doing on a given transformer,
21 doing some kind of scheduled charging,
22 opportunities like that are worth exploring
23 because they can help reduce utility costs.

24 I want to talk about the two primary
25 types of VGI that we see. And I actually want to

1 introduce a third type that kind of blends
2 between these two types and helps us understand
3 some of the complexities to integrating this
4 resources. So this is just a graph showing this
5 middle line is a vehicle that is not charging,
6 and what this shows is the potential charging
7 range for the load up to a max charging level
8 here shown as 6.6 kilowatts, but vehicles can go
9 higher than that.

10 If a vehicle was receiving a signal, its
11 charging behavior could look something like this,
12 this is just meant to be kind of representative
13 of what a vehicle could look like when it's
14 charging. That blue area is the charging level,
15 you can see that it increases, stays steady, and
16 then drops off, drops off for a while, there's a
17 couple spikes, drops off again, there's another
18 spike, and then it's done. And this is over some
19 period of time. This time period, I didn't
20 specify the scale on this because it could be
21 many different scales, we could be talking about
22 a scale of one day, so this could represent one
23 day of charging where it's getting a signal not
24 to charge during certain points of maybe the
25 morning or the afternoon to avoid certain

1 congestion periods, it could be spiking up and
2 down in response to Grid signals that are
3 happening throughout the day. This could also
4 represent charging in just one minute, so this
5 whole length of that black line could represent
6 60 seconds. And so this vehicle could be getting
7 signals every few seconds which happens for
8 frequency regulation, and it could respond to
9 those signals by increasing its charging rate, or
10 decreasing its charging rate. Vehicles can do
11 that pretty quickly and we think that charging
12 like this, making these kind of changes in
13 charging, it isn't damaging to the battery and
14 doesn't necessarily affect the cycle life of the
15 battery.

16 The other primary category that we see is
17 bidirectional power flow, or what I'm calling
18 here "battery discharge." So this is the same
19 signal, but now because the vehicle is capable of
20 discharging, when it gets that signal to stop
21 charging, in this particular example the battery
22 is actually discharging, and it is providing
23 power onto the Grid. And it's responding to a
24 signal for a need to have additional power on the
25 Grid. It can go down as low as -6.6 kilowatts or

1 essentially a supply of 6.6 kilowatts. And by
2 doing this there's a couple of advantages, 1) you
3 can provide services for a much longer period of
4 time because now you're charging and discharging
5 the battery; in the other example, when you're
6 just doing charging, eventually your battery is
7 going to get full and you're going to be done
8 providing services. You can go up and down, you
9 can respond to Grid signals that are asking you
10 to increase and decrease your charging level, but
11 eventually you will be full. But when you're
12 talking about bidirectional power flow, you're
13 less likely to have your battery fill up and you
14 can essentially look like any other storage
15 device.

16 The challenge here, though, is that when
17 you're discharging the battery, you are impacting
18 the battery life. You are reducing the number of
19 cycles that you can get from the battery and, as
20 a result, you're reducing the life of the battery
21 which is potentially creating a cost for users.
22 And it's not clear that the value for a user
23 discharging this battery for Grid services is
24 worth more than using those cycles to drive, it's
25 not known yet, we'd have to know more about what

1 the value of the Grid services are, we'd also
2 have to know more about the cycle life and how it
3 impacts the battery life.

4 But the third example that I wanted to
5 talk about using this particular battery
6 discharge example, so this is a graph of the
7 vehicle and the vehicle's charging and
8 discharging. If this charging were to take place
9 at a facility that had a very high load, let's
10 say that facility had a load that was constant
11 at, say, one megawatt throughout the day, if that
12 was the case, when this battery is discharging,
13 the meter is never running backwards, so what the
14 facility load sees is the facility load is
15 increasing and decreasing, but it's never
16 actually running backwards.

17 So from the vehicle standpoint, this is a
18 bidirectional resource. But from the meter
19 standpoint in this particular example that I'm
20 describing where you have a one megawatt load all
21 the time, the meter is never running backwards.
22 So from the utilities' perspective, it doesn't
23 necessarily look like a bidirectional resource,
24 it looks more like a load modifying resource.

25 So in that particular example, is this a

1 V1G resource? Or is it a V2G resource? From the
2 perspective of the meter, it looks like a demand
3 modifying resource. But from the perspective of
4 the vehicle, it looks like a bidirectional
5 storage resource. So this is just an example of
6 some of the complexity that we start to see when
7 we start to break down some of the use cases, is
8 that there are some mixing of the two examples,
9 and it really depends on what your perspective
10 is; the perspective becomes very important.

11 So just like a car has a frame and that
12 frame helps to organize the vehicle and where you
13 have passengers, where you have the drivetrain
14 components, and it provides support for the
15 vehicle, the regulatory framework provides a
16 similar function when we're talking about VGI.
17 And in the staff white paper we identified four
18 key questions that we thought were important to
19 addressing in order to create the right
20 framework.

21 The first question is define the VGI
22 resource, is the resource the actual vehicle? Is
23 the resource the charging station? Or is the
24 resource the facility? And this is important
25 because it determines where you want to

1 communicate, who you are communicating with,
2 where you're measuring the resource, so it can
3 drive a lot of how we regulate this kind of
4 resource. Who aggregates? So I mentioned that
5 the vehicles from the wholesale market
6 perspective are very small, so you probably need
7 to aggregate these vehicles to get them to
8 participate in the wholesale market. Who should
9 do that? Should the utilities do it? Should
10 third party entities aggregate? Or should we
11 have some kind of hybrid where the third parties
12 are aggregating to the utilities, and then the
13 utilities are aggregating to the wholesale
14 market. Or you could have other iterations along
15 those lines. And that gets to what the utility
16 role is in how we aggregate. There are
17 advantages to having the utility play a role in
18 this, but there are also advantages to having
19 third parties play a role.

20 And then how do we capture the
21 distribution benefits? So I mentioned one of the
22 benefits is at the local level where you're
23 avoiding distribution costs, how do we actually
24 capture those benefits? What are those benefits?
25 And then how do we make sure that they're flowing

1 back to somebody, to a driver, a facility, or a
2 charging station that's actually providing those
3 benefits?

4 And then the fourth question we
5 identified was ranking the primacy among VGI
6 activities. So there are benefits at the local
7 level, there are benefits at the wholesale level.
8 At times those benefits could be -- you could be
9 getting conflicting signals, so you could imagine
10 that a local circuit is looking for you to
11 decrease your load because it doesn't want to
12 overload a transformer at a particular time, but
13 you could also imagine at the same time that the
14 wholesale market is asking you to increase your
15 load because there is wind spikes on the Grid.
16 So if you have situations like that, how do you
17 rank different VGI activities so that we make
18 sure that we're maximizing the total benefit to
19 the Grid?

20 Having answered those four questions,
21 staff identified kind of additional
22 implementation questions that should be answered
23 once we've answered those primary questions. So
24 these questions that we see here kind of all flow
25 out of whatever the answers to the primary

1 regulatory framework questions are. So how does
2 a VGI resource interconnect? That will depend on
3 where the resource is located. What utility
4 tariffs do we need? That kind of speaks to what
5 the utility role is, are they an aggregator or
6 are they not? How are they capturing the local
7 distribution benefits? What kind of metering do
8 we need? So where does that metering need to be?
9 Who is it talking to? Communication requirements
10 would seem to very much flow out of where the
11 resource is located.

12 And then how do we make sure it's safe?
13 So one potential safety issue here, so I
14 mentioned this example where you have a battery
15 or a vehicle that is providing bidirectional
16 power flow, but the meter never sees that because
17 the meter is seeing this up and down in the load,
18 but it's never running backwards. You could
19 argue that the utility maybe then shouldn't
20 necessarily need to have a role in that because
21 it's just load modifying, it's not necessarily
22 reflecting the distribution system, it's not
23 flowing backwards onto the Grid. But it does
24 introduce a safety issue because if the utility
25 can't see where a resource is back feeding onto

1 the Grid, when the utility goes out to a
2 particular circuit, wants to do work on that,
3 they usually want to depower that part of the
4 Grid. And if they can't see that there's a
5 bidirectional resource on there that's
6 potentially sending electrons up from a facility,
7 that creates a potential safety hazard for the
8 utility. In addition, there's other safety
9 issues which are important for us to look at.

10 So what are some of the things that are
11 happening next? We have a few things going on
12 that I think are relevant to this process that
13 CEC and other stakeholders should be aware of.
14 We have an ongoing storage proceeding, and one of
15 the questions at the storage proceeding we're
16 looking at right now is looking at what the
17 definition of "storage" is. And this affects a
18 number of different resources and staff has
19 identified kind of a narrow definition of storage
20 and a broad definition of storage. And different
21 resources fall in as storage depending on whether
22 you're looking at the narrow or broad definition.
23 And the controlled charging is one of those
24 resources where it falls in under a broad
25 definition, it doesn't fall in under a narrow

1 definition. So right now staff is exploring
2 this, there have been workshops and comments on
3 this, so that's happening right now.

4 We also have an Alternative Fuel Vehicle
5 proceeding that was started in November, we had a
6 workshop in December, and since that time we've
7 been kind of evaluating the feedback that we've
8 gotten from parties in trying to identify the
9 specific next steps that we are going to use to
10 move that proceeding forward. And we should be
11 releasing a scoping memo soon that will have
12 those detailed steps and mention the specific
13 issues that we want to address, what the order of
14 those issues is, and the workshops that we will
15 be having.

16 So I would suggest keeping an eye out for
17 that and for anyone who is interested in this
18 issue, I think that would be a good chance for
19 you to learn more, but particularly valuable for
20 us to get your feedback on how we move forward on
21 those next steps.

22 And finally, there's a few pilots that
23 are underway that the Commission is working on to
24 help us better understand this. The DOD pilot
25 that is doing bidirectional power flow at a

1 couple different bases in California is one
2 example, and those pilots are really helpful for
3 us because it helps us understand what the
4 challenges are. It also has been helpful to
5 bring together the different stakeholders in that
6 process, so in the DOD project CPUC staff and
7 CAISO and the utility have worked closely
8 together to start to understand these challenges.
9 And I think that's going to be an important
10 component to moving forward on this.

11 I know that we've had conversations at
12 the staff level with CEC and CAISO to figure out
13 -- to make sure our efforts are all aligned on
14 this and to share information so that we can make
15 sure we're contributing to this process of moving
16 forward. So I appreciate that CEC invited us
17 here so that we could talk about this and have
18 our input and help collaborate on this.

19 A final thing I want to mention is that
20 CAISO has a road mapping process, they did one on
21 vehicle/grid integration, and they're doing
22 another one on energy storage, and that's another
23 example where we can bring not only stakeholders
24 together, but these agencies together to kind of
25 collaborate and make sure that our strategies are

1 aligned. That's all. I think we'll wait on
2 questions? Is that correct, Mike?

3 MR. GRAVELY: That's correct. We'll have
4 questions at the end of the panel here, so thank
5 you very much, Adam.

6 So our next speaker is Heather again from
7 us, and one of the things we work together with
8 is on this vehicle to grid integration roadmap
9 for the Governor's initiative, and Heather will
10 talk about some of the issues that have come out
11 of that, a little bit about the roadmap, and I
12 will remind our speakers, we have quite a few
13 speakers today, so do your best to stay within
14 the five to six minutes so we can get all the
15 speakers in. Thank you so much.

16 MS. SANDERS: Okay, great. Thank you
17 very much. I wanted to start first by building
18 on some of the things that Adam talked about. As
19 Steve laid out, it's really important to have the
20 policies aligned so that we do not further burden
21 the Grid by the Electric Vehicles and have the
22 opportunity to benefit from them.

23 And what I wanted to start out with is
24 just very practically describing what it takes to
25 do these different forms of Vehicle/Grid

1 integration. The first thing is I want to thank
2 all of you for participating in our partnering
3 Roadmap on Vehicle Integration as part of the
4 Governor's ZEV Action Plan last year. It really
5 helped us bring this common language of what did
6 we mean by "vehicle to grid," what do we mean by
7 V1G-V1G?" And so that roadmap has proven to be a
8 very valuable resource as we go through to enable
9 Electric Vehicles to provide Grid service. So I
10 want to thank the CEC and the PUC for your
11 partnership, as well as all of you for developing
12 that roadmap.

13 V1G. V1G is charge discharge, it's one
14 way power flow, one way signaling. It can be
15 accomplished in a couple different ways, it can
16 be accomplished through rate structures that help
17 people understand what they need to do, when.
18 And they will respond based on how it benefits
19 them.

20 The other way to manage V1G is to have
21 essential aggregator be establishing a program or
22 some other way that helps send the signals at the
23 right time. V1G can also be accomplished in the
24 wholesale market. Again, what we come to is,
25 what is the benefit for that vehicle, or for that

1 vehicle aggregation, to provide that service?

2 So in the wholesale market you can
3 aggregate a number of vehicles and come in as a
4 demand response resource, react to dynamic
5 signals from the market, and charge and reduce
6 charging, or stop charging as dispatched from the
7 market. Each of these require different
8 infrastructure, different metering and telemetry,
9 and different participation levels by the end
10 user, really the aggregator in the case of a
11 wholesale market participation. So at the
12 simplest level, V1G from a rate structure is just
13 helping people know, the end users as you
14 mentioned at your house, when does your off-peak
15 rate start? How am I benefiting from that? How
16 does it reduce my bill? That's one way.

17 The second way, through a utility program
18 and aligning the signals, the most important
19 thing is to align what is actually happening on
20 the grid at that time. So we talked about we can
21 get time of use rates seasonally positioned to
22 help with that, but the more we're able to
23 connect with what is actually going to be going
24 on in the system, whether it's locally on a
25 distribution system, or at a wholesale level from

1 a supply/demand balance, the better we're able to
2 leverage the capabilities that Electric Vehicles
3 have to manage the grid. Utility program,
4 aggregating that resource, providing some value
5 to the end-use customer to provide that.
6 Connecting the signals from the wholesale market,
7 what's going on, are prices high? Are prices
8 low? Are we in a contingency event?

9 The third way, into the wholesale market,
10 now this from a grid operator perspective is the
11 most valuable way because we have dispatch
12 capability for different resources, but it's not
13 the only way. Each of these require different
14 things. Pretty simply from a time of use, if we
15 individually are going to have Electric Vehicles
16 at our home and we're going to have time of use
17 rates, all we need is to know, we need to know
18 how to set up our vehicle timers to react, and we
19 should benefit from that rate structure.

20 The second way is for a centralized
21 entity, whether it's San Diego Gas & Electric's
22 pilot that they set forth, or another way to be
23 able to connect those, and I assume you're going
24 to talk about that pilot. Okay. We're very
25 supportive of that pilot because they took the

1 wholesale conditions and linked that with the
2 schedule for the charging and gave people a
3 choice to do that, so that's the second way. And
4 he can talk about what the requirements are for
5 someone to participate in something like that.

6 Now, when you get to a wholesale market,
7 and the reason participating in the wholesale
8 market is attractive is because it's another
9 revenue stream. It also provides the ability for
10 these resources to potentially provide some type
11 of capacity value, as well, RA, as we know it.
12 But what is required is much more because, as the
13 Grid Operator, you need to be able to handle
14 these resources to know when and where and how
15 much. So you get into the ability to I need to
16 know you're available, I need to be able to
17 dispatch you to react at the amount of response
18 we need, and I need you to react for as long as
19 that. So what you'll hear people say is, "Okay,
20 I've got a first interconnect." So if we have
21 our private vehicles, we can call up the utility
22 and say, hey, you know, I don't even have to call
23 you, I can just plug it into the wall, but if
24 you're going to provide Grid services, you need
25 to interconnect, and if you're going to provide

1 wholesale market services, you need to
2 interconnect under a Wholesale Distribution
3 Access Tariff -- we think. That's one of our
4 open policy items. In order to do that, you're
5 providing a service, a sale for resale, you
6 interconnect. There are studies because if you
7 are modifying the power flow on the system,
8 you've got to make sure that it's going to work.
9 So there's interconnection, there's
10 interconnection processes you need to go through,
11 there are metering and telemetry requirements.
12 Telemetry is a real time measurement of what that
13 resource is doing, it's real time. And then the
14 measurement, the metering, is the revenue side of
15 it, so you can ensure that the resource did what
16 it was supposed to do at the time it was supposed
17 to do it.

18 So I wanted to lay that out for you
19 because it's really important. When we start
20 talking about these things, there are a number of
21 ways to accomplish what we need to do, there are
22 different values to the customer, the aggregator,
23 and others providing these services, depending on
24 what you do. Most of this has been covered
25 already, but just to show why the ISO is really

1 emphasizing this policy alignment is there's
2 enough capacity out there today to serve the
3 Electric Vehicles, this is from 2012. This is a
4 Summer Load Profile. There is 8,000 megawatts of
5 capacity available to serve that charging if it
6 was at this time.

7 Here is what a typical winter load looked
8 like in 2012, again, you see there is capacity
9 available for charging through the day. Finally,
10 you get to our study period of 2020 and you see
11 even more capacity available during the day
12 because we brought the peaks up higher and the
13 dips are lower. So again, getting these policies
14 right and understanding what it takes and what
15 the value is to the end user will be key as we go
16 forward in developing what's needed.

17 So again, I emphasize this, if you're
18 participating as a Grid resource, a wholesale
19 resource, this is what is important. You know,
20 as participating as an aggregate in another
21 configuration it's important to ensure we meet
22 the needs of the customer, at the same time
23 understanding what benefits it can provide the
24 Grid.

25 So with that, I will turn it over to my

1 other panelists and look forward to your
2 questions later.

3 MR. GRAVELY: Thank you, Heather. I'm
4 sure we'll hear some questions at the end of the
5 panel here.

6 So as technology is, we're having a
7 little challenge, we have one person speaking,
8 Camron Gorguinpour from Department of Defense in
9 the Pentagon, he's on the phone, but I don't
10 think he has WebEx. He said he wasn't able to
11 WebEx, so see if we can bring him up.

12 Camron, can you hear us?

13 MR. GORGUINPOUR: I can hear you. Can
14 you hear me?

15 MR. GRAVELY: Yes. Thank you very much.
16 Okay, for those in the room and those online,
17 Camron Gorguinpour is the Executive Director for
18 the Department of Defense Plug-In Electric
19 Vehicle Program and they're looking at
20 transferring their non-tactical fleet from Fuel
21 Vehicles to Electric Vehicles, and it is one of
22 the biggest, if not the biggest, Electric Vehicle
23 demonstration programs in the world. Camron also
24 is a California-trained, his Masters and PhD is
25 from University of California Berkeley, and he's

1 got a long distinguished career working with the
2 Government and working with industry. With that,
3 Camron, I'll let you go ahead. Now, we can flip
4 through the charts for you, just tell us which
5 one you want us to change.

6 MR. GORGUINPOUR: Sure, that's great.
7 Thanks. And that's an overly gracious
8 introduction, thanks. So I'm sure that Adam and
9 Heather's slides were beautiful, unfortunately I
10 couldn't see them, but they were very
11 descriptive, so I feel like I'm there. Anyhow,
12 as Mike mentioned, I am the Executive Director
13 for DOD's Plug-In Electric Vehicle Programs, so
14 broadly my role is to try and figure out
15 strategies to expand the use of EVs within DOD's
16 non-tactical fleet of vehicles. But I'll spend
17 this period of time really talking about our
18 biggest project, which is the Vehicle to Grid
19 Pilot Program. So if we can go to the next
20 slide, the second slide.

21 Really, we are trying to operationalize
22 the use of VG technologies in our fleet. And so
23 we want to demonstrate and validate the
24 technology on both the vehicles and on charging
25 stations. We are developing now with Lawrence

1 Berkeley Lab a full control software system
2 that's being implemented and we're actually
3 trying to participate in ancillary service
4 markets and other demand response activities.

5 So ultimately what we're trying to do is
6 determine on a broad scale implementation is V2G,
7 something that we can use to mitigate the extra
8 cost of using EVs, can we add operational
9 capabilities to our installations, and frankly,
10 just logistically, can we make it work with all
11 of our requirements to participate in the market.

12 So if you go on the next slide, slide 3,
13 we are now opening up on five bases around the
14 country, two in California, and then in Texas,
15 Maryland, and New Jersey. The idea here was that
16 we wanted to look at different ISO markets to see
17 how the processes might be different and to gain
18 experience across a range of different markets.

19 In California, the Mountain View Army
20 Reserve Center activity was just recently
21 launched, we're grateful to the California Energy
22 Commission for providing financial support to
23 Berkeley and to PG&E to launch that effort. I
24 think the key difference with Mountain View and
25 the other bases is that at Mountain View we won't

1 be participating in the frequency regulation
2 market, it will be more demand response
3 activities being coordinated by Pepco. The other
4 four locations will specifically be in ancillary
5 service and in frequency regulation markets.

6 Obviously, other than just the market
7 participation, we were looking for demonstrating
8 the technologies in a variety of different
9 operational settings, climates, terrains, and so
10 forth. And L.A. Air Force Base is probably going
11 to be the first to come on line. And I think as
12 many of you know, it will be the first federal
13 facility to replace its entire fleet of vehicles
14 with Plug-In Electric Vehicles, and the vast
15 majority of those will be V2G-capable. So we
16 have already started delivering vehicles and
17 things are going through testing right now with
18 the associated charging stations, so again
19 hopefully by the fall we'll be live in CAISO's
20 market. And the other bases are likely to come
21 on line just shortly after that, maybe trailing
22 by a month or two, just based on delivery
23 schedules for vehicle and charging station
24 vendors.

25 So if you go to slide 4, along the lines

1 of vehicle vendors, this is the mix of vehicles
2 that we are expecting for all of the bases
3 really, though LA is the only base that's going
4 to use all five of these vehicle types, so just
5 starting from the top there, EVAOS is a
6 California-based company, they do a retrofit on F
7 series pick-up trucks where they convert it into
8 a Plug-In Hybrid, and so that vehicle will be
9 used on at least four of the bases.

10 Moving on to the right, another
11 California-based company -- actually, now that I
12 think about it, most of these are California-
13 based companies -- EVI based out of Stockton
14 again, actually with California Energy Commission
15 support, they are developing a Plug-In Hybrid
16 Heavy-Duty Truck, so we are getting four of those
17 delivered to LA Air Force Base. At the bottom
18 right is Phoenix based in Ontario. And there is
19 one small shuttle bus requirement at LA; because
20 we're replacing all the vehicles, we had to go
21 out and get a bus, so Phoenix is producing that
22 for us. That will be a fully electric bus. Of
23 course, we have the Nissan *Leaf*, which will be at
24 all five locations, and then on the left VIA
25 which is a Utah-based company will be providing

1 passenger and cargo vans. So again, all of these
2 vehicles will be V2G-capable, and when you
3 consider other work the Army has done at one of
4 their bases in Colorado, you can add Smith
5 Electric Vehicle and Boulder Electric Vehicle
6 onto the list of DOD supported EV companies who
7 have developed V2G capability.

8 So we're pretty excited to have by the
9 end of this a healthy supply base, and I'm not
10 going to commit to any or all of these companies
11 to commercializing V2G technologies, but at least
12 we can say that they'll have the experience and
13 they will have done it. And so we think that's a
14 pretty exciting thing.

15 And on slide 5 here, the corresponding
16 charging stations, now some of these are non-V2G
17 charging stations because at LA we're replacing
18 all of the vehicles with EVs, there was a need
19 for some non-V2G-capable charging stations, so
20 the two in the center there, the AeroVironment
21 and the Eaton are non-V2G-capable. But if you
22 look the others, the Princeton Power unit and the
23 Coritech units, we now have two charging station
24 vendors with three different models, the
25 Princeton Power System is specific to the *Leaf*,

1 it uses the CHAdEMO connector, and that's a DC
2 charging station, so all the power electronics
3 are onboard the charging station. And then with
4 Coritech, those are the SAE charging stations and
5 we have an AC unit for some of the vehicles that
6 have the power electronics onboard the vehicle,
7 and then we have a 50 kilowatt DC unit for some
8 of the larger vehicles. So that one, the DC
9 Coritech unit, will be used only at LA Air Force
10 Base to support the EVI Trucks and the Phoenix
11 Bus. I should also mention the Princeton Power
12 System actually has the 30 kilowatt inverter
13 onboard, but would cap that to 15 kilowatts
14 because that is what Nissan would allow us to do
15 with the *Leaf*, is to max out at 15 KW. And then
16 the AC unit on Coritech has the capability up to,
17 I believe, 19 kilowatts, roughly.

18 So a lot of different models, a lot of
19 different capabilities and, again, all of these
20 are going to be going through testing at Southern
21 California Edison's EV Testing Center. We have
22 already begun and I think almost completed at
23 this point testing of the Nissan *Leafs* with the
24 Princeton Power Units, and next month I believe
25 we'll begin testing with the Coritech units.

1 On slide 6, this is really the brains of
2 the project. This is the software system being
3 developed by Lawrence Berkeley Lab, and there are
4 five key modules here that allow it to operate,
5 the most critical is -- well, I shouldn't say the
6 most critical, but the one that has the closest
7 connection to actual user interface is on the
8 left-hand side, the bottom left there, the EV
9 Fleet Management System. So the goal is to have
10 that module be the sole interface with people on
11 each of our bases and essentially it's a Zip Car-
12 style fleet reservation system, so people can go
13 in, they tell the system what time they need a
14 vehicle, what type of vehicle they need, where
15 they're going, and based on that it recommends a
16 vehicle capable of meeting the requirement. And
17 then it feeds back into these other modules to
18 plan a charging schedule, so on the bottom
19 center, that Grid Scheduling Module, that is
20 Berkeley's DER/CAM which is an optimization tool
21 that takes into account the tariffs and rate
22 structures for each of the bases, and then will
23 optimize the charging schedule to minimize the
24 cost, and I believe that's also the piece that
25 will structure the bids into the ISO markets.

1 And that communicates with sort of the central
2 control module, the EV Asset Coordination Module,
3 and in the bottom right is the Charge Control
4 Module, so taking the information on charging
5 schedules and bids, that bottom right segment is
6 actually the signal being sent from our server to
7 the charging stations, so again it's reading in
8 the charging schedule, it is reading in the
9 signal from the ISO, and then dispatching a
10 charge/discharge signal to each of the available
11 vehicles.

12 And then everything above the EV Asset
13 Coordination Module is Grid Interface, so we talk
14 to our Scheduling Coordinator through that top
15 module and then we also receive and transmit that
16 information to the ISO about how the vehicles are
17 actually being used.

18 So that's sort of a quick snapshot of how
19 the system is set up. I think it seems more
20 complicated than it is when you lay it out like
21 that, but we're pretty well into the software
22 development here. I think, again, probably by
23 July-August, we will have a fully functioning
24 system ready to be tested and then certified for
25 use in the ISO. So we're looking forward to

1 that.

2 We have had some challenges, this is all
3 very new stuff, very challenging stuff. So if
4 you go on slide 7, I think many of you know that
5 the CPUC passed a resolution, I guess it was last
6 year, enabling us to participate in the ISO
7 markets under a pilot tariff with Southern
8 California Edison, so we are definitely grateful
9 for them to have moved that along. But even
10 still, the process of interconnection, as many of
11 you realize, is particularly challenging. And
12 Southern California Edison has been a very good
13 partner, especially given sort of the novelty of
14 what we're trying to do, and a lot of this stuff
15 is right on the cutting edge in trying to work
16 through some of their bureaucratic hurdles and
17 frankly just figuring out what conceptually we
18 should be doing is a challenge. But we did note
19 particularly for LA Air Force Base and for a Navy
20 Installation which we are pausing right now in
21 terms of its implementation, but may very well
22 pick up later, that there were some common
23 challenges in the interconnection process. So we
24 conveyed those to SCE and they are developing a
25 plan to actually be able to address that more

1 proactively. So we're looking forward to seeing
2 how that all shakes out. But just to give you a
3 feel for the types of things that we experienced,
4 just going through those sub-bullets here on the
5 first major bullet point, internal coordination
6 between the different utility offices, what we
7 were trying to do engaged so many different
8 offices with within Edison that oftentimes I
9 think things were missed and we ended up having
10 to go back and redo things later; like an example
11 being telemetry where we had SCE approve all the
12 electrical infrastructure and we installed it,
13 and then a year later as we were going through
14 the interconnection process, it came out that we
15 needed to install telemetry on top of that, and
16 so there's a whole process that we have to do
17 that would have been cheaper and easier if we'd
18 just known upfront. And again, these are the
19 types of things that just sort of shake out with
20 any sort of new project.

21 We had a hard time on those next two
22 bullet points really understanding what the
23 interconnection process is and what the
24 requirements are, so there were many data
25 requests from us largely around our inverters,

1 but without knowing really what the process was
2 going to be, or what folks were really looking at
3 on the SCE side, it was difficult to provide the
4 correct data. And so we ended up spending a lot
5 of time just going back and forth with data
6 requests and, you know, DOD is kind of a big
7 bureaucracy also, so every time we get a data
8 request back, there's a whole churn that has to
9 happen and, you know, several months later
10 finally we got all the data to them that they
11 needed, but it was definitely difficult and it's
12 something to keep an eye out for, that we really
13 do need to have a much clearer description of how
14 to make it through the process and if there are
15 going to be requirements like data requirements,
16 or physical requirements like telemetry, that
17 those are better conveyed.

18 Defaulting to negative conclusions, I
19 think that's -- I guess what we're trying to say
20 is that there are, in a project like this, many
21 decision points and many things that don't
22 necessarily fit cleanly into normal buckets for
23 different regulatory requirements. And as with
24 I'm sure any utility, there's a default towards
25 the most conservative assumptions possible and

1 that can be limiting. And so we've been, again,
2 working with Edison and they have been very
3 helpful in working through some of these issues.
4 But again, it is a challenge. It's a challenge
5 trying to convey what we're trying to do and why
6 certain things that we're trying to accomplish
7 aren't necessarily going to devastate the entire
8 grid, for example. But anyhow, that's another
9 thing.

10 And one other point, and that's the last
11 point here, the lack of cohesion between the
12 utility and the CAISO requirements. So CAISO
13 has, in fairness to them, a very well defined
14 process, and they give you a nice spreadsheet
15 that you can sort of work through, but we found
16 that there were several duplicative requirements,
17 telemetry being one of them, metering, and then
18 the review process is duplicative. So we've had
19 to submit one-line diagrams for a system on
20 probably four different occasions between CAISO
21 and Edison, so the different folks can look at
22 the exact same thing, so we just felt there was
23 some room for improvement there to better
24 coordinate the different sets of activities so
25 that resource developers don't have to run around

1 in circles and repeat the same things over and
2 over again.

3 So those are basically the gist of the
4 interconnection challenges that we faced. We
5 have a great support network now with CEC, the
6 PUC, Edison, and some of our instate folks for
7 DOD, and so we're meeting roughly every month to
8 go through these issues on top of our weekly
9 calls with the PUC and CAISO, and SCE. So
10 there's no shortage of conversation in getting
11 this done, but that's really what it's taken to
12 really move this stuff forward and finally now I
13 think we're just about at the point where just
14 the last few wickets on telemetry and then I've
15 got to have our lawyers look at the
16 interconnection agreement and get that signed,
17 but that's all imminent, so within the next month
18 or two I think we will have finally gotten
19 through at least the interconnect process.

20 So anyhow, that's a general description.
21 I think I probably went a little bit over the
22 five or six minutes, sorry, Mike. But I will
23 shut up now and wait for questions later.

24 MR. GRAVELY: Okay, so you're able to
25 hang on for about 30 minutes or so for a question

1 and answer period?

2 MR. GORGUINPOUR: Oh, Yeah. Yeah, of
3 course.

4 MR. GRAVELY: Okay, so we'll get back to
5 you at the end. Thank you very much.

6 Our next speaker is Paul Stith from --

7 COMMISSIONER SCOTT: Mike, we've got one
8 question up here.

9 MR. BERBERICH: If I might. Steve
10 Berberich. Camron, Steve Berberich, the CEO of
11 the California ISO. I'm interested, and maybe
12 this is a question for Felix and Heather, as
13 well, but obviously this has been a
14 groundbreaking project and we're delighted to be
15 able to work through this process, but it's also
16 disconcerting that it's been so difficult. The
17 question is, have we resolved these issues? Have
18 we documented these issues? Do we have a process
19 now that is much more seamless? That's my
20 question.

21 MR. GORGUINPOUR: Yeah, I mean, I think
22 that we are definitely documenting the challenges
23 and certainly, you know, as I mentioned we have
24 many many meetings to resolve, so again, I've got
25 to highlight that, of course, doing something

1 like we're doing is -- challenges are going to
2 come up, you know, and that's something that
3 we've accounted for, and if we can take lessons
4 learned and apply them more broadly, I think
5 that's the best we can expect. So I'm very
6 comfortable that we have a path to resolve these
7 issues. I think probably the next step is going
8 to be to take these lessons learned and resolve
9 them obviously for the existing bases, but then
10 generalize that information and help improve the
11 process for everyone else I think is a big part
12 of our interest. I mean, we don't really think
13 it's going to be -- we want to demonstrate V2G
14 and how it works great for DOD, but from our
15 perspective it's not entirely successful if other
16 people can't do it. So I think we're on that
17 track, to answer your question. But obviously
18 still more work to do.

19 MS. SANDERS: So, Steve, let me respond
20 directly to make sure you're comfortable with our
21 understanding of these issues and what we're
22 doing. Electric Vehicle providing V2G as in the
23 DOD is another form of energy storage, and with
24 the recent decision around the energy storage
25 targets, we recognize energy storage is going to

1 have many of these same challenges. So what
2 we've done is partnered with the CEC and the PUC
3 to do an energy storage road mapping effort that
4 gets to what are these issues that are being
5 faced, lessons learned from what we got from the
6 DOD experience, and then really identify what is
7 the forum where we go address those issues, in
8 what priority. So we've taken in what we've
9 learned from Camron, we have in some cases
10 specific stakeholder efforts to address those.
11 But overall, we're embarking on this partnership
12 for an energy storage roadmap to ensure that we
13 are clearing the path for not just the one use
14 case of the V2G, but many more use cases of
15 energy storage to provide grid services and
16 capabilities.

17 MR. GRAVELY: Thank you, Camron, and
18 we'll bring you back on for the open discussion
19 period.

20 MR. GORGUINPOUR: Okay, thanks.

21 MR. GRAVELY: So our next speaker is Paul
22 Stith from EV Grid. And he's been with EV Grid
23 since 2013. He has a long distinguished
24 background in Electric Vehicles, distributed
25 energy storage, and renewable integration. And I

1 believe you also have a display unit for us out
2 in front of the building, if I'm not mistaken.
3 So Paul, go ahead.

4 MR. STITH: Very good. And I wanted to
5 thank you very much for the invitation to speak.
6 This is a rare opportunity to express our vision
7 for where we'd like to see the grid go with EVs
8 helping them in a dramatic way.

9 I want to first off start off to
10 something simple, is we couldn't ask for a better
11 Ambassador for Vehicle to Grid than the BMW Mini
12 E that's parked out in front. EV Grid was
13 entrusted with a large quantity of BMW Mini Es
14 after the field trials finished of the first
15 round in 2008 and 2009, and that culminated
16 ultimately with the i3 that's just now launched
17 so in their resume the Mini E's have a long set
18 of research that's been done for user preferences
19 with UC Davis, and now we're using them with
20 University of Delaware in other projects. So a
21 lot of credit to BMW and to that fun car.

22 So my thing is first off also to thank
23 Camron because he went before me, if he stole in
24 line, of course, and he highlighted all the
25 things that I don't have time to highlight in my

1 presentation, which are about interconnection and
2 all of the things and the challenges that we want
3 to take these great vehicles and plug them into
4 the Grid, and we don't want it to take a year and
5 a half in order to be able to do that after you
6 come home from the dealership or the fleet sales
7 company, if it's a large vehicle asset, this
8 needs to get easy, it needs to be as easy as home
9 solar, or easier. You can't skip any of the
10 steps because we are talking about energy flowing
11 back to the Grid. So thank you, Camron, for all
12 the work you're doing, we look to leverage that.

13 So a little bit about EV Grid and some
14 perspective is that we're uniquely qualified and
15 we understand batteries. We also understand the
16 process and how long it's been taking to get
17 vehicles on the roads, and particularly moving to
18 the next stage where we're using them as storage
19 assets.

20 EV Grid actually, the heritage is that we
21 built battery systems, including the one that's
22 in the Mini E and other boxes that are on the
23 roads today. We had a lot of projects that
24 unfortunately I don't get to talk about, but we
25 get advanced access to cells and we're able to

1 learn and understand a lot about battery
2 economics before the general population is ever
3 going to understand it. Based on that, I want
4 you to understand that we see where cells are
5 going and we know that the battery degradation,
6 the costs associated with that, is truly a non-
7 issue, and so I do want to make sure you
8 understand from our technical point of view, and
9 the access that we have, where we see the market
10 going. So I did want to throw that out there.

11 We are doing second life battery
12 projects, some of them supported by the CEC, and
13 working with our partners; when we go live with
14 those, we'll be able to talk a lot more about
15 which ones and where they are.

16 So it's a great opportunity and let's
17 talk a little bit about a couple of projects
18 after I show you the long road it took to get
19 here. So through the years, there's been a lot
20 of talk, and more talk, and a few demonstrations
21 talking about effectively 16 years from when the
22 concept came up through all of these various
23 steps and it started getting accelerated if you
24 look in, say, 2010 where you actually have a
25 J1772 connector that's going to start coming on a

1 number of the vehicles that are coming on the
2 road if something that is standardized. The team
3 at University of Delaware that we work with took
4 that connector and actually developed a
5 communications protocol that is compliant with
6 that coupler, and I'm happy to say that that
7 ability to use the pilot wire that's in every
8 coupler, actually was developed in 2010, is now
9 part of the J1772 standards so that there is an
10 open access to using communication architecture
11 over the existing plugs, and that's a pretty key
12 point that happened. In 2011, NRG teamed up with
13 the University of Delaware and began the Grid on
14 Wheels project. I'm going to be giving a couple
15 of updates on the Grid on Wheels project and also
16 a bus project that is actually using the same
17 technologies.

18 For all of the words of wisdom that
19 Camron was sharing, and what it's taken to get on
20 line, understand that last February we actually
21 had vehicles in on the East Coast providing grid
22 services and receiving compensation, so that
23 started in February and that project I'll give
24 you an update on, it's in a PJM territory, I'll
25 state that it's a little bit easier in PJM to

1 bring on small distributed resources, but they
2 have been on ever since, and we're expanding it.

3 So with that, I will talk about the Grid
4 on Wheels project. There's a lot of logos, it
5 takes a lot of hands, a lot of participation. At
6 this stage, the vehicle logos that stand out, of
7 course you have the Mini Es, and also Honda
8 joined this in December. They have a plug-in
9 Accord that is actually utilizing the exact same
10 coupler and the same protocols and same hardware
11 capabilities to link in. And again, a lot of
12 folks there to make this move forward.

13 The goal of it was really to show that
14 you can actually provide revenue to the owners,
15 and we look at that a lot and we want to make
16 sure that you return the value to the owners of
17 the fleet assets. They're fast responding
18 batteries. They come with the vehicles, you just
19 need a control architecture and, as Camron showed
20 you, again thanking him, there's a lot of parts
21 to that architecture, it's already up and running
22 in this pilot in the University of Delaware with
23 the driver preferences, with the grid scheduling,
24 with the asset workloads, and so forth. So being
25 able to support renewables is a key thing. And at

1 the bottom there was about whether or not we're
2 studying battery degradation and it is part of
3 that project plan.

4 Today there are two locations, up to
5 nearly 20 vehicles came on line last year. Over
6 the summer months there are going to be 10
7 additional locations. Those will include actual
8 consumer residences and employees of the
9 university and other stakeholders that are taking
10 part of this, and taking these vehicles out on
11 the road using them in their daily lives.

12 There's another thing that's coming up using the
13 same technology to be aware of, using the NYSERDA
14 grant award, that will take this technology and
15 apply it toward vehicle-to-building, and so
16 that's something coming up.

17 So we really want to focus on it's live,
18 it's not the technology, it's more about the
19 policies we'd like to drive home on making it
20 easier to connect these resources.

21 The consumers that are participating
22 actually received an app that they run on their
23 phone that they schedule their actual interaction
24 with their energy storage platform, which happens
25 to also be transportation.

1 Something also to note is if you're doing
2 frequency regulation, the variations in state-of-
3 charge are really not that great and they're
4 short bursts, and they typically zero out with
5 the requests, and a workload can certainly be
6 scheduled that way across multiple vehicles.
7 Sixty-five to 85 percent of the batteries is the
8 typical state-of-charge that's being worked in
9 that's friendly to the batteries, it also leaves
10 you in a position to be able to schedule a charge
11 full trajectory with very little effort. And be
12 aware, these vehicles do have faster AC charging,
13 they're typically charging at 15 KW. That is
14 important for grid services, that's important and
15 you've seen it in Tesla and others, 10 KW for
16 example allows you to recover energy faster, it
17 also delivers more value when you're providing
18 grid services, so look at that trend as it
19 continues to go up. Adam had 6.6 kilowatts on
20 his chart which is typical today, we'll see those
21 going up, especially in larger trucks, Camron.

22 So five dollars a day is the mark that
23 has been set in the work with the fleet, you
24 know, this is a learning process. Just through
25 changes in the optimization in how you dispatch,

1 we are actually able to change the revenue by 20
2 percent -- not changing the vehicles, not
3 changing the actual state-of-charge -- but
4 actually just optimizing the vehicle dispatches.
5 So I wanted to make sure that everybody
6 understands this is something that is a learning
7 process and we're certainly learning every day.
8 For example, who would have thought that if you
9 have a Nor'easter roll in that your vehicle-to-
10 grid project is going to be a little bit on ice?
11 And that's literally that you want to consider
12 these things, that weather could affect battery
13 charges, for example, or extreme heat is another
14 one.

15 These are the vehicles that are in our
16 project. We don't have as big of trucks as
17 Camron. These each have capable onboard, through
18 the standards-based coupler, are able to control
19 the vehicles every four seconds in responding to
20 the requests from the grid operator.

21 The other area I want to talk about is
22 our work with the Clinton Global Initiative.
23 Today, in fact, in Denver one of our colleagues
24 on a project is giving a presentation at the
25 National Conference where the industry,

1 government and many hands come together and make
2 commitments. Ours is with National Strategies,
3 Ernst & Young, PJM, and NRG, to bring about the
4 viability of zero emission school buses that are
5 assisted by the financial boost of vehicle-to-
6 grid. That's a project that actually is national
7 in scope. There are five states that are part of
8 it, there's funding established in California,
9 South Coast Air Quality District, Massachusetts
10 has funding, and there are others that are coming
11 together in Illinois, Texas, and New York.

12 This project actually utilizes the larger
13 buses for a number of reasons that you're
14 actually having a chassis that is built to handle
15 more weight, it's also a bus platform that lasts
16 longer and may very well encounter drive train
17 replacement in its regular life, certainly the
18 maintenance costs go up, so there is some
19 economic tipping points that make these
20 particular sized vehicles. Certainly it can
21 carry a lot more weight. The bidirectional
22 chargers you can see, and in this one we're
23 looking at 60 kilowatt-type capabilities. So a
24 lot of energy being able to move in and out of
25 these for the purposes of recovery of the energy

1 and being able to go back to transportation, as
2 well as the value that you can provide.

3 One thing, safety is extremely important
4 and you'll see a crazy amount of effort going
5 into the safety initiatives as part of the
6 project, but the other bullet item here is that
7 we are working in a transparent environment where
8 the data that's being collected from the parties
9 that are participating are able to actually share
10 that. Ernst and Young, for example, is creating
11 a financial modeling that will come out as a
12 result of this. There are many hands, but I just
13 wanted to share that having a great goal to rally
14 around creates huge opportunities, opens doors,
15 school districts very much have many many
16 interests which I'll get to that make a lot of
17 sense for them.

18 If you hadn't already figured out, school
19 buses are an ideal platform for a lot of
20 different reasons. I've got lots of texts that
21 I'm going to just let folks read at their
22 leisure, but by and large they are very
23 predictable routes and, extremely important, is
24 that the owner of the asset, the location it's
25 parked, and the mission of the vehicle are all in

1 alignment so that you can get through some of the
2 early questions that Adam talked about; for
3 example, where is the resource? Is it the site?
4 Is it the EVSE? Is it the vehicle? When those
5 are all aligned, you can actually make progress
6 toward the market.

7 If you think about it, with 20 buses,
8 literally that is a megawatt of energy
9 capability. So think of how many school
10 districts might welcome the opportunity to have
11 that revenue towards their transportation and
12 other initiatives.

13 These projections are based on a PJM
14 market, so we're talking \$5.00 a day and
15 extrapolating it from the smaller vehicles to
16 larger size. Picture-wise, the spectrum going
17 from the small to the larger, the bus platform
18 uniquely transfers over into short haul trucking,
19 so all of the engineering that is being done is
20 actually available for other applications in the
21 Port Districts and other short 100-mile and less
22 short haul. If you think about everything that
23 goes from the coast to the Central Valley, for
24 example, in terms of distribution centers,
25 perfect application, the vehicle is going to be

1 parked again at its... V2G is something that is a
2 reality, it's just a matter of taking these
3 technologies and matching them up with policies
4 that work.

5 Some economics. A greater larger vision
6 for what we hope to accomplish with regard to the
7 V2G bus project. You're doing clean air, you're
8 going GHG reductions, you're helping schools with
9 budgets, and you're proving a technology path
10 towards the market access. There's also
11 certainly the local value streams that I also
12 want to make sure we cover, emphasize. Nothing
13 about this is easy, Camron already described.
14 This particular project is a place to gather
15 around, it's fantastic, the fact that we're doing
16 it in multiple states it makes it go across ISOs,
17 across states, and certainly gives it a different
18 appeal for partners to participate.

19 So I want to thank you. In this
20 particular picture, you can see this Mini E
21 outside, it just happened to park next to a
22 bidirectional looking sign, so I want to leave
23 you with that, that electrons flow both ways, and
24 it's a yellow sign, it's kind of a caution:
25 bidirectional is ahead, but I don't think there's

1 that much caution, it's just a little hard work.

2 Thank you.

3 MR. GRAVELY: Thank you, Paul. Our next
4 speaker is Steve Davis.

5 COMMISSIONER SCOTT: Hey, Mike, just
6 before you introduce the next speaker, we've got
7 about 20 minutes or so for the last three
8 speakers, so I'm sorry that you got crunched a
9 little bit, I just want to make sure that my
10 fellow Commissioners and folks have a chance to
11 ask a few questions at the end of the
12 presentation.

13 MR. GRAVELY: So we'd actually like to
14 try and get done in the next 15 minutes, if
15 possible, but 20 minutes is the deadline. So if
16 those of you who are speaking would keep
17 yourselves to five minutes.

18 Steve Davis is from KnGrid. He'll talk
19 to us a little bit about the work they've been
20 doing. He has extensive experience in this and
21 also in the Standards setting community. Steve.

22 MR. DAVIS: Well, thank you for the
23 introduction, Mike, and thank you, Commissioner
24 Scott, for the introduction, good to see you
25 again.

1 Well, I'm going to depart a little bit
2 from the ground-laying work that the previous
3 speakers have done for me. I appreciate that
4 very much. I'm very interested today to talk to
5 you all about Smart Charging Interoperability
6 Standards and what they mean to the State of
7 California and to the folks on the dais as
8 policymakers. So with that...

9 Okay, so I want to start by giving you
10 guys what I'm going to tell you, first of all, I
11 want to back up a little bit and talk about
12 California's VGI vision, then I want, at the risk
13 of putting you to sleep, talk about what a Smart
14 Charging Standard looks like, and then from there
15 I want to talk quickly about what the CEC can do
16 to support acceleration and mass market uptake of
17 this kind of technology.

18 So if you would indulge me, let's channel
19 Steve Jobs for the next 60 seconds if you would.
20 And let's imagine a future where we're 10 years
21 ahead and we're thinking of California's charging
22 ecosystem. So that charging ecosystem, what does
23 it look like? Well, I look at it from, taken
24 from no mean sources, the CAISO Strategic Plan,
25 statements by the Governor's Office, the CPUC

1 Energy Division, it kind of looks like this: any
2 PV owner can safely plug in AC Level 2 anytime
3 and anywhere and be dispatchable as a certified
4 resource. That certified resource can help
5 System Operators, whether it's Distribution or
6 Transmission System Operators, maintain reliable
7 service while we're achieving our State RPS and
8 Greenhouse Gas Reduction Goals -- if this sounds
9 pretty aggressive, well, it's going to get even
10 more so -- seamlessly, without confusing the
11 consumer or impacting their transportation needs,
12 and in a way that lowers their total cost of
13 ownership of the vehicle. So we're trying to
14 create a killer application here. And while
15 you're keeping those bullet points of what we
16 want in mind, that's simplicity. But at the core
17 of the network, we know there's quite a bit of
18 complexity. Right? So we have in that system,
19 we are going to want to impute into the charging
20 activities of those vehicles the conditions of
21 the distribution grid, which is going to be
22 Greg's primary concern. But we're also going to
23 have system-wide conditions as we go towards more
24 and more utility-scale renewables, and more and
25 more distributed renewables. So all this has to

1 be taken into account, and then at the heart of
2 that, in that blue circle, we need a distributed
3 energy resource that is certifiable as a
4 certified resource, no matter who we're talking
5 about dispatching it. So if that starts to make
6 you feel like you're playing 3D chess against Dr.
7 Spock, I get it.

8 So what does a Smart Charging Standard
9 look like? Okay, and I'll ask you to try not to
10 doze off here, but here we go: the good news is
11 one exists already, it is actually complete, it
12 was created by the ISO, through the ISO and IEC,
13 through a joint effort led by RWE in Germany and
14 Mercedes Benz. So that effort basically sought
15 to create everything that we're talking about in
16 that future vision. It creates a certifiable
17 resource by creating a power line, hardwired
18 carrier between vehicles running off the
19 production lines in series production, right,
20 there's no modification to any of these vehicles,
21 we're not talking prototypes at all; so that
22 vehicle knows how to communicate with the
23 charging station. And that charging station is
24 standard and now can communicate back to the
25 vehicle and find out what the consumer needs.

1 You'll notice there is an electric energy
2 meter -- I could take 10 minutes on this slide,
3 but since I'm running out of time as Mike warned
4 me, I've got to keep going -- but you'll see also
5 on the right-hand side, there are secondary
6 actors and in that blue circle you'll see a
7 demand clearinghouse which creates a channel
8 between any one of them and the distributed
9 energy resource. So we might have a fleet
10 operator trying to communicate in staggered
11 charging schedules based on prioritized departure
12 time and needed kilowatt hours. The Distribution
13 System Operator is going to need to collect all
14 the local distribution constraints and impute it
15 into a forward energy profile, again, without
16 undermining the value of the vehicle which most
17 buyers tend to rank at the very top its ability
18 to get them from Point A to Point B. Most buyers
19 tend to, you know, rank at the very top its
20 ability to get them from Point A to Point B.

21 So what happens when the vehicle connects
22 to the grid? Okay, steps one and two are pretty
23 basic, you have a Cable Safety Test and how much
24 power the charging station can deliver, and then
25 three and four is an Automated Authentication,

1 which is really cool, which means you just plug
2 in, the vehicle notifies the back end, it has a
3 valid account and the owner is paying their
4 bills, and then you get to five and six, and this
5 is the interesting part, and this is probably the
6 most important: the vehicle automatically tells
7 the charging station how many kilowatt hours it
8 needs. And through an input from the consumer,
9 they enter their departure time. Out of that,
10 that gets rendered back into the Demand
11 Clearinghouse, and the Distribution System
12 Operator -- in most cases -- it could be the
13 Transmission System Operator or an Aggregator,
14 will then impute all the grid conditions, and
15 getting to Adam's point about primacy of various
16 grid considerations, will suggest a forward
17 energy profile. So, "I need 12 kilowatt hours by
18 9:00 a.m. tomorrow." The Demand Clearinghouse,
19 once all this forecast data and local grid
20 conditions data gets input, comes back with a
21 forward energy profile suggestion, "Here are some
22 power levels and prices over time and a special
23 rate for wind power between 3:00 a.m. and 6:00
24 a.m. at three cents per kilowatt hour." So,
25 based on the consumer's preset preferences, okay,

1 "I'll adjust my plans, I'll wait until 3:00 to
2 5:00 a.m. and I'll take six kilowatts of power
3 for that two hours and get the energy I need."
4 That's important data for the System Operators,
5 particularly the Transmission System Operator who
6 is managing a market. You are not going to pay
7 that vehicle owner to curtail at 5:00 a.m. Why?
8 Because you already know their load is departing.

9 So this gives you system wide visibility
10 and intelligence about what the conditions are
11 for these distributed energy resources. And it
12 gives you the ability to know where you can bury
13 surplus over-generation, how deep that sink is,
14 and when it will fill up.

15 And then there's an ongoing process where
16 the System Operator can update about new
17 conditions, but the forward energy profile that
18 the customer agrees to at the beginning, it's
19 optional for them to move off of it. So I'll
20 underscore that.

21 Okay, so what we're talking about, and
22 through the good graces of the CEC, we're
23 demonstrating at UC San Diego, is smart cars that
24 you can buy today, so you see two of them here in
25 this picture, the Smart ED3 which we have on

1 display outside, the BMW i3, and we have
2 literally 20 more models coming into the United
3 States very soon that will be arriving on
4 showroom floors, rolling off the production lines
5 with this communication stack for bidirectional
6 communications with the grid standard. So you
7 have simplicity, automated and seamless consumer
8 experience, lower total ownership costs through
9 market participation, or DR Programs, killer app
10 transformation, which is what I think we're
11 really looking for as we try to get consumers
12 into mass market uptake, where everything just
13 works -- again, channeling that Steve Jobs, you
14 know, iPhone experience -- any car, any charging
15 station, plug-and-play, grid friendliness, the
16 collection of complete grid picture through
17 standards, dispatchability as a certified
18 resource, and then the flexibility to adapt to
19 regulatory climates as they change. The System
20 Operator, the control room at the CAISO has
21 confidence in this resource because they
22 understand it and they know when they pull the
23 lever it will actually respond. And Mike is
24 giving me the high sign here.

25 Okay, so what can the CEC do to support

1 acceleration? This is ticklish, but I'm going to
2 say it, I think we need to provide -- much in
3 support of what Mark said earlier -- we don't
4 want to go too much farther investing every day
5 in charging stations, whether it's consumers or
6 public money, in charging stations that can't get
7 us where we want to go. This can play a very
8 important role in greenhouse gas reduction and
9 firming a renewable grid, but in order to do it
10 we have to be Standards-based. So I would
11 encourage the CEC and the CPUC to move as quickly
12 as possible to say, okay, we're going to send the
13 market a signal, the automakers in particular,
14 because we can't afford to be dispatching by
15 brand. And right now, there's no clarity about
16 which direction they should go in terms of Smart
17 Charging Standards, and they're actively working
18 on it.

19 If we go down that road, we have, you
20 know, with the 15118 Standard, this is an example
21 of something that RWE has up and running today
22 where they're able to take forecast energy output
23 profiles from either granular small resources out
24 in the distribution grid, or rolled up with
25 charging clusters that could involve an entire

1 utility or entire balancing authority area. So I
2 think I've probably done the best I can in the
3 amount of time Mike gave me, so thank you very
4 much. By the way, real quickly, oh, well, that
5 picture didn't show up, but T Boone Pickens likes
6 to ask the question this way, "When is the best
7 time to plant a tree?" And his funny answer that
8 tickles us is, "Well, 20 years ago." The second
9 best time is right now.

10 So with CEC funding, we put up 26 of
11 these charging stations on the U.C. San Diego
12 Campus, they're up and running right now, and any
13 15118 vehicle can plug in and be communicating
14 bi-directionally with that charging station. So,
15 thank you very much.

16 MR. GRAVELY: Thanks, Steve. Our last
17 two speakers are from San Diego Gas and Electric
18 and from Southern California Edison, so, Greg, we
19 would like you to try to keep it as short as
20 possible so we can finish up in the next 10
21 minutes, if you would, yourself, and then Felix,
22 you get the chance to wrap it up, but fortunately
23 you have no charts, so I guess it's going to be a
24 little easier for you.

25 So Greg (Haddow) has got over 30 years of

1 experience in this industry and he's a Clean
2 Transportation Manager for San Diego Gas and
3 Electric and he's going to talk a little bit
4 about some of their plans with Electric Vehicles.

5 MR. HADDOW: Thank you very much. And,
6 Mike, thank you for the invitation, I really
7 appreciate it. And I do commend the CEC for
8 creating a forum for the exploration of
9 alternative fuel vehicles and, of course, the
10 CPUC for continuing to be in the front for
11 developing policy for alternative fuel vehicles
12 now and in the future.

13 Already, Mark and Heather have referred
14 to a proposal that we have before the CPUC, so
15 today I'm going to briefly describe what's in the
16 proposal and its benefits. But first let me set
17 the stage.

18 Obviously we're here today because we
19 believe transportation and electrification is a
20 long term greenhouse gas reduction strategy. As
21 Adam referred to it, and it's been referred to
22 several times, you know, the watch words are
23 Vehicle Grid Integration, it's viable, you've
24 already seen some examples, and it is an enabling
25 solution and we need to explore it.

1 The VGI pilots need to take place and I
2 know that, yes, let's get on and past the pilots
3 and get on to some programming, but we do need
4 scale and we do need exploration. We've already
5 heard about dynamic pricing and the need for it,
6 but it needs dynamic load management to
7 complement that.

8 We do believe utility leadership is
9 necessary at this critical point and mainly
10 because the utility itself has the grid
11 visibility, the ISO does not. We know about our
12 distribution system and we know and understand
13 how to use Smart Grid technology to get the most
14 out of it.

15 We believe, and again, it's outlined in
16 the paper that was part of the alternative fuel
17 vehicle proceeding most recently launched, and
18 Adam was one of the authors, there are some long
19 term net societal and ratepayer benefits that we
20 believe can be rendered, but we need to explore
21 it, we need to test it and see whether or not
22 that's possible, and so investments are needed at
23 this time to make that happen.

24 This is my obligatory -- here are the
25 stats on our region, and this proposal is

1 customized to our region and our region's needs.
2 As you saw in one of Heather's slides, there are
3 critical interests that we have in SDG&E's
4 service territory that might be different from
5 the rest of the state.

6 I'm going to skip through this, but the
7 watch words here are Efficient Integration of
8 Electric Vehicle Loads. This is something that
9 we have been sponsoring since the dawn of the
10 first alternative fuel vehicle OIR back in 2009.
11 It takes technology and, as you've heard several
12 times, it takes price and innovation and
13 education. But the wild card here is the
14 customer. You can give them technology, you can
15 give them pricing, but now we need to test and
16 see whether or not that pricing is attractive
17 enough for them to then participate in a VGI-type
18 framework.

19 I have two more slides. So this is the
20 content of our proposal, and I'll walk through it
21 very quickly. The proposal right now is
22 proposing a day ahead hourly rate that reflects
23 the changing energy and system, as well as
24 circuit level conditions, so changing prices in
25 energy throughout the day, as well as circuit

1 conditions and system conditions. This is giving
2 the customer choice and out of that choice they
3 can select and get the best price possible for
4 their vehicle charging needs. But it requires
5 enabling technology that's currently available on
6 the market today.

7 So the proposal also is asking the CPUC
8 to allow SDG&E to install the VGI enabling
9 charging infrastructure in two areas where we
10 have a long duration of parking time, multi-
11 family communities, as well as places of work.
12 And we've seen Adam had a chart that showed the
13 density of those duration parking in those
14 various locations; 50 percent of our residential
15 service territory is occupied by multi-family
16 residents, so that's a very unique characteristic
17 of our service territory, and it's an area that
18 really does need a solution for providing
19 charging for the residential customer.

20 This is a very important part, this next
21 bullet. We are dependent on third parties to
22 build, install, operate and maintain this
23 charging equipment to SDG&E's VGI standards. So
24 you've heard a lot of examples about the
25 technology that is in place today, we believe

1 that it's possible to turn to the third parties
2 to create this enabling technology that will
3 allow this VGI rate to work to benefit our
4 customers.

5 We've currently experimented with this
6 with our own employees on our SDG&E campus and
7 it's working quite well, but the technology that
8 we're using is about three years old, so we know
9 there can be some additional innovations realized
10 through this pilot.

11 So we're looking at 550 facilities in
12 total, it's actually going to be 550
13 installations because there could be more than
14 one at a facility, with 10 chargers each to
15 create scale economies at that particular
16 location, and the installation would take place
17 over a period of five years.

18 One of the features that we think
19 customers would enjoy, because we've gotten some
20 feedback on this, is that we'd have the EV
21 charging billed to the customer's SDG&E bill, so
22 to limit the scope of the pilot, it's just
23 focusing on SDG&E customers, and this will allow
24 whatever charging they experience during the day
25 or at home at multi-family, it will go to their

1 SDG&E bill. Multi-family, keep in mind, many
2 times is coming off a commercial rate. These
3 would be independent installations, each usage is
4 individually metered, and it would go directly to
5 the customer's home bill. That's an important
6 feature. The benefits are, you've heard all of
7 them today, again, reducing harmful air
8 emissions.

9 The second bullet is really important,
10 just imagine that future that we've been talking
11 about all day, where all of this usage and load
12 can come into the system without any upward
13 pressure on system capacity build out, at the
14 distribution, transmission, and energy capacity
15 level. Imagine that future, it's quite possible,
16 but with Vehicle Integrated Charging, it becomes
17 a reality. All customers benefit from that. The
18 best part about this, as you heard earlier about
19 the availability of renewable energy, this is a
20 load sync, these Electric Vehicles in large
21 numbers have the ability to be dispatched, that
22 is the load dispatched, to take that energy.

23 We do think we're at a critical point in
24 the market itself where we're concerned that the
25 market will stall, and we believe a pilot like

1 this would help stimulate the market and keep
2 that momentum going.

3 The other feature that you heard talked
4 about today is Plug-In Hybrids. Some of them
5 have a limited battery capacity and, so, during
6 let's say a commute to work, one leg of that
7 journey is electric, the other leg is gasoline.
8 So we need to be able to double those Electric
9 Vehicle miles if we can. Again, because of the
10 third party context that we're creating, it's
11 going to create jobs. And you heard earlier
12 references from Mark about the need for dynamic
13 pricing, well, this is a precursor to, we
14 believe, a long term dynamic pricing model that
15 will work for our customers' benefit.

16 We do believe this will help guide
17 Electric Vehicle policy in the future and we do
18 believe it's a stepping stone for the Vehicle to
19 Grid technologies that you heard talked about
20 today. And of course, it increases U.S. energy
21 independence. Thank you for your time.

22 MR. GRAVELY: Thank you. So our last
23 speaker from SCE will be Felix Oduyemi and he's
24 going to talk a little bit about the SCE's
25 transportation. He comes out of the

1 Transportation and Electrification Policy and
2 Strategy Section of SCE.

3 MR. ODUYEMI: I do promise I'll get you
4 out of here soon. I have no slides and I've
5 heard a lot of good recommendations today. At
6 SCE, many of you here have worked with me for
7 about 20-30 years, I see Tim Carmichael, who used
8 to drive an Electric Vehicle before he decided to
9 drive a natural gas vehicle. I see Todd
10 Campbell. These are folks who have been working
11 on this for a while. So I really don't have any
12 slides. I've heard everything I need to hear.
13 But the only thing that I want to remind you is
14 that at Edison we've been operating an Electric
15 Vehicle Technical Center since 1982, so we've
16 done a lot of work in this area. We have learned
17 a lot over the last 20 years and we've been
18 sharing experiences with all the folks in the
19 industry, so there's really nothing that I've
20 heard today that we've really not gone through.
21 We've worked with OEM's, we've worked with
22 battery manufacturers, we've worked with control
23 systems, Advanced Technology Lab in Westminster,
24 we've tested everything from transformers to
25 whatever communication or control devices, or

1 automatic load control systems that you would
2 need to actually make Vehicle Grid Integration a
3 reality.

4 Our concern, though, is this: we want to
5 make sure that whatever we do from a utility
6 point of view, because I have permission of
7 Peterman here, we have to justify our cost.
8 There will be a cost associated, for example,
9 with control technologies and communication
10 technologies that we've been talking about to
11 make all these things possible. Those costs need
12 to be factored into the equation before we
13 proceed with VGI, at least on the utility side.
14 All that talk that batteries may do whatever the
15 business models allow them to do, but from a
16 utility side we want to make sure that because we
17 invest in systems, whether it's in direct
18 systems, whether the front office or the back
19 office, we have to be able to ensure two things:
20 it cannot do any additional damage to the grid,
21 and it must be cost-effective for our ratepayers.
22 So no damage to the grid, and it has to be cost-
23 effective to our ratepayers.

24 I have 15 pages of talking points that I
25 prepared, but since I have three minutes I'm not

1 going to go through them, I know that I will have
2 the opportunity to cover most of these points
3 during questions. But I want you to know that
4 everything that we're talking about here today,
5 we did some math trying to actually deal with
6 Vehicle Grid Integration. We have 26,000
7 vehicles in our service territory right now, the
8 average driver drives about 40 miles round trip,
9 Volts constitute most of these vehicles, and from
10 my calculation they have a 35-mile range. Now,
11 it does mean that when that person gets to work,
12 they see they have 15 miles left, so if they do
13 plug in, they need to plug in for five miles to
14 make it back to work to drive all electric miles.
15 So the point I'm trying to make here is that the
16 amount of money you're going to be thinking about
17 is a penny to five cents from the customer side,
18 and for that penny to five cents per day, we're
19 going to build communication control systems that
20 will cost maybe \$5.00 to \$50.00, it may not make
21 economic sense and it may not be cost-effective.
22 We are looking forward to making these things
23 work, we have all the pilots, we've been working
24 with not just the DOD pilot, before DOD we were
25 working with the Advancement Grid Demonstration

1 Project, we also have other pilots that we have
2 been operating since 2004, and so we have some
3 experience and we look forward to working with
4 you all.

5 MR. GRAVELY: Thank you very much.
6 Before we turn it over to questions from the
7 dais, I just want to remind everybody, if you
8 weren't able to cover anything today during your
9 panel presentation piece, feel free to send us
10 written comments into the IEPR (docket), the
11 schedule will be posted here. We encourage any
12 additional information you want to provide the
13 IEPR Committee that you provide that in written
14 form for anybody on the panel.

15 And with that, I'll turn it over to the
16 dais for questions.

17 COMMISSIONER SCOTT: Great. Well, thank
18 you very much. This was just, I think, a
19 fascinating and really interesting panel of
20 experts. I thank all of you for coming to talk
21 with us. I will -- let me turn it over to our
22 guests and see if they've got some questions.

23 COMMISSIONER PETERMAN: Thank you. Yeah,
24 I'd like to start with a question and, first of
25 all, a disclaimer: I'm going to ask my question

1 and then I'm going to leave because SDG&E has
2 presented on an active application and the facts
3 are finally here, but I don't want to hear any
4 discussion about the merits so that I'm not
5 unduly influenced.

6 So my question relates to the interaction
7 with the automakers. A couple of the panelists
8 raised the need to provide market signals and
9 particularly some standardization direction to
10 the automakers in terms of having the vehicles be
11 suitable for V2G. Can you provide some more
12 specifics about what are the highest priority
13 standards that you think are missing and that if
14 we don't get them out there the automakers are
15 going to be, you know, not implementing these
16 changes soon enough into the automobile
17 engineering?

18 MR. DAVIS: Well, since you're looking at
19 me, I guess I'll answer. Yeah, this is Steve
20 Davis with KnGrid. When you talk about the types
21 of things and, again, getting back to that vision
22 where these are dispatchable resources, we've got
23 to have meter association and we have to have a
24 standard methodology for the vehicle to render
25 the data that's necessary for intelligent

1 dispatch and intelligent forward energy profiles.
2 So that Standards work is done, but the OEMs --
3 and I'm not going to speak for them here today, I
4 do know that there is one or two in the audience
5 and they are not all of one mind at this point.
6 That's why there is a need for a market signal
7 because if we're going to try and dispatch brand
8 by brand, we're going to miss the opportunity,
9 and Mr. Berberich is going to miss in his control
10 room, the opportunity to have real clarity about
11 a single virtual resource that would be the
12 bigger it gets, the better it gets. And I'm not
13 just talking about dispatch by the ISO, I'm also
14 talking about dispatch by Greg and his colleagues
15 in the distribution level handling instability
16 with...so, again, the automakers need to know -- I
17 think California has enough economic and market
18 clout with the automakers, as we've proven in the
19 past, that we can help them become clear about
20 where this is going. In Europe there is no
21 issue. All automakers in Europe, as well as auto
22 parts manufacturers in Europe, have signed on
23 with the European Commission to go with one
24 direction towards one common unique standard that
25 they're going to use. And that's 15118.

1 MR. STITH: Paul Stith with EV Grid. I
2 want to skip over the communications portion of
3 it and talk about a fundamental thing in the
4 signal that the OEMs do need to understand, and
5 that actually is the difference between bi-
6 directional and uni-directional charge/discharge.
7 The Vehicle Development Programs are five, six
8 years and more in the making and the fundamental
9 changes to vehicles that optimize by cost the
10 ability for a vehicle to discharge need to be
11 made very early on in vehicle development
12 programs. So that is a signal that we're looking
13 for from the policy process that will help us in
14 our conversations with each of the OEMs that
15 retain us for our expert guidance, they want to
16 know how the market will develop. I agree with
17 Steven that there's certainly going to be
18 opportunities and a need to pick and to encourage
19 interoperability among them. I don't know how
20 that's going to play out, but the fundamental
21 difference about bi-directional needs some really
22 early signals to go for the most value available.

23 MR. HIGGINS: This is Mark Higgins. So I
24 just wanted to actually comment on the economics
25 of providing those market signals again because I

1 think it's relevant here. As Felix just
2 mentioned, you know, it's a five cent decision
3 point and there's a lot of infrastructure that
4 you may have to build to get there. Well, really
5 that's just the constraint, you're just trying to
6 get to that charge point. And I found this
7 statistic really interesting, but NRG actually
8 told me, and this is something they told me I
9 could share, is that they're finding that their
10 systems that are operating, and these are systems
11 participating in the PJM market that are V2G
12 enabled systems, that they're actually generating
13 roughly five dollars per car, per day today, in
14 just participating in the ancillary services
15 markets. So obviously you have to get to that
16 charge point, but there are so many other things
17 that these vehicles can do and services that they
18 can provide to the grid that actually do make the
19 economics make a lot more sense, and I just
20 thought that that was a very compelling point
21 that I heard. And that's happening today. Thank
22 you.

23 MR. DAVIS: Can I just jump in for one
24 more second before Carla leaves us? Yeah, the
25 incremental investment to add the last five miles

1 is one thing, but let's all keep in mind, 70
2 percent of the action in charging is going to
3 take place at home or in a detached residence.
4 So that's actually where the biggest opportunity
5 for intelligent charging is, it's not in the
6 workplace or in public charging. It is in the
7 residential charging.

8 So Steve's investment in multi-unit
9 dwellings and as proposed there, I'm 100 percent
10 behind because that is where we're going to have
11 the biggest -- over time it's going to build as
12 market uptick becomes mass market uptick, but in
13 the early stages we need to invest in residential
14 charging, I believe.

15 MR. ODUYEMI: Yeah. The question
16 specific to OEMs, from about '94 to 2002, we
17 worked with almost all the OEM's at Pomona EV
18 Tech Center. And there was expressed a common
19 concern, one, they had proprietary requirements
20 that come along with their products, they are not
21 just going to open up everything just like that.
22 In the olden days, they were very very protective
23 of their technology, as well as they need their
24 communication devices on schemes that will
25 actually enable V2G of any type of Vehicle Grid

1 Integration. That's different now. They are
2 becoming a little bit easier to work with, they
3 actually are cooperating more with each other --
4 I see that Tesla is working with Toyota, and GM
5 is working with some other parties. In the olden
6 days, that was not the case. But what's needed
7 is a standard, like you mentioned. We need a
8 common standard, a Smart Grid Interoperability
9 Standard that they can all develop towards. All
10 utilities can get together and force the industry
11 to at least adopt one set of standards whether
12 they are for control technologies, or to meet
13 load control systems, cyber security systems, and
14 everything I've heard today where you're
15 introducing all the digital nodes into the
16 system, where they're actually not looking at the
17 cyber security implications of what we're talking
18 about, that's an additional cost. So, yes, most
19 of the charging will take place at home and they
20 still need to come up with technologies that will
21 actually operationalize all these benefits that
22 can be derived. But until the market becomes
23 robust enough, all that we're talking about is
24 not going to happen. The market is too new, it's
25 too nascent, we're talking about less than -- it

1 would not even be a decimal point in the number
2 of vehicles on the market. And so I will hope
3 that we focus our attention on building the
4 market first before we start to look at all these
5 benefits that may or may not actually come to
6 pass.

7 COMMISSIONER SCOTT: Great. Let me see
8 if I've got other questions here on the dais.

9 MR. BERBERICH: I have a follow-up to
10 Commissioner Peterman's question and then, Mr.
11 Davis, it's probably the best for you. Obviously
12 the automobile industry is a global industry.
13 I'm curious why we wouldn't just adopt that EU
14 standard here in the U.S., as well. Are there
15 holes in it? What would stop us from doing that?

16 MR. DAVIS: That is a very very good
17 question and it vexes me every day. But I will
18 say this, there is another standard that, while
19 15118 was rolling to completion, we have the
20 Smart Energy Profile, or SEP 2 Standard, that is
21 basically a residential domain standard and the
22 folks at Edison have been deeply involved in it,
23 and there is that potential that some of the OEMs
24 are leaning towards it, but nobody is -- it's not
25 there yet, number one, and number two, I think

1 when you've got automakers that have got global
2 scope, it would be really really nice for them to
3 have a global standard to look at. So this is
4 happening up, it's not growing up, so some of
5 this, I guess, you know, when you're dealing with
6 multi-cultural get togethers, and I'm on the
7 Infrastructure Working Council with EPRI and we
8 meet every few months, and also participate in
9 some of the SAE Committees, there is a lot of
10 sacred cows, of course, and as you can imagine.
11 So that's why I feel like California has got a
12 unique position because everybody is watching us,
13 everybody knows that this is where it's at as far
14 as the auto market is concerned and renewable
15 integration is concerned. So we have almost a
16 responsibility at some level to take some
17 methodical time, convene people, get it right,
18 but then say "this is where we're going." And
19 once we do, I think it will be a very helpful
20 thing to all the automakers. And one quick thing
21 I would say, if I may. I take issue with the
22 idea that it's not ready for primetime, or that
23 it's too early. The automakers, I mean, BMW is
24 sending vehicles off the production lines into
25 our market now with this standard in place,

1 there's several thousand across 18 countries in
2 Europe of these charging stations with this
3 standard in place. So this is not too early.
4 The security standards, the SAE J2931 is very
5 robust, so I'll just leave it at that.

6 COMMISSIONER SCOTT: I'll turn to the
7 Chair. Any questions?

8 CHAIRMAN WEISENMILLER: Yeah, a couple
9 questions. I mean, when I was in Germany it was
10 pretty notable there was not a lot of Electric
11 Vehicles on the highway compared to California.
12 So having said that, you know, and looking at all
13 of our problems trying to get standardization
14 around chargers, what chance do we really have to
15 get standardization in this area? There's
16 obviously a lot of competitive advantage that is
17 associated with these unique chargers, so, again,
18 how are we going to do that? What is the price
19 point? And how much operational experience do we
20 have at this stage in terms of batteries and cars
21 doing this over the life of a battery?

22 MR> DAVIS: Well, again, you're starting
23 to get into the Dr. Spock piece, right, so we're
24 a multi-level chess and we're trying to figure
25 this out. Part of what you say is about the

1 batteries, and I think you're hitting on
2 something that is very important, so the OEMs are
3 a long way from comfort about enabling V2G
4 technology. I almost kind of hate to talk about
5 it right now because what we're talking about is
6 modulated charging for several years to come. On
7 the other hand, if you recall the second to last
8 diagram, I said we want to map towards it and we
9 want to build up towards it. Every day that goes
10 by, we're putting in more charging stations that
11 can't get us there regardless of which bi-
12 directional standard you want, and I'm talking
13 bi-directional data now. So every day that goes
14 by, we're losing ground and the cost of rip and
15 replace, or double investments gets bigger and
16 bigger. We want to avoid that. And I guess the
17 good news is that, as I mentioned, 70 percent of
18 the charging activity again is going to take
19 place in the residents where most people are
20 still trickle charging. So we have a real
21 opportunity to go after the heart of the real
22 opportunity and without too much double
23 investment. And as far as Germany and the small
24 number of cars, yes, they're earlier so they got
25 out ahead. We were a little bit later.

1 MR. ODUYEMI: Edison doesn't own any
2 charging system and we don't -- we have not stuck
3 to any charging technology. I have to say that.
4 However, I believe, yes, we will be stranding a
5 lot of investments if we do not come up with
6 standards that will inform the technology that we
7 deploy. And stranding investments is not going
8 to be acceptable, I'm sure, to the Commissioners
9 here on the dais, as well as the CPUC because we
10 have to justify those investments on behalf of
11 our customers. And so there lies our challenge,
12 which is why we are very very aggressively
13 involved in the development of communication
14 standards for EV. Some of these standards have
15 yet to be finalized, we still have a lot of angst
16 with many of the stakeholders and when NIST was
17 running the program, it was actually going a
18 little bit well, but now you have SGIP which is a
19 voluntary organization, so the whole process has
20 kind of deviated not in a very positive direction
21 as far as we're concerned, and Edison has taken a
22 step back from participating in the standard
23 development efforts. So hopefully we will get
24 back engaged and the utilities should be more
25 engaged in that process because, until that's

1 done, we're just going to be building different
2 things that may not necessarily be sustained in
3 the future.

4 MR. LANGTON: Just one more thing on
5 that. From my perspective, it's not clear where
6 we need the standards, like exactly where those
7 need to be yet because -- I understand Steve is
8 talking about like having the vehicle have a
9 standardized way to talk to the charging station,
10 but you could under certain models -- the
11 charging station could be the resource and it
12 could talk to the user through some kind of --
13 the driver through an app or something like that
14 on their phone, and there may not be a need to
15 talk to the vehicle. So from my perspective it's
16 just not clear where the standards exactly need
17 to be and it partially depends on where the
18 resource gets defined.

19 CHAIRMAN WEISENMILLER: Well, certainly
20 part of the global vision would be also the
21 utility grid, or distribution, or transmission
22 talking. So, again, that's another set of
23 complexity which at this point, you know, as
24 we're just dealing with the grid we have, trying
25 to keep it solid, so how do we build it out to

1 enable.

2 MR. LANGTON: Yeah, so it's kind of like
3 we have all these different communication
4 pathways and I think we need to figure out
5 exactly where the standards need to be. In some
6 areas we may say, well, we don't need a standard
7 here. I just -- I don't know the answer to that,
8 but I think more probing on that might be
9 valuable for all of us.

10 CHAIRMAN WEISENMILLER: Certainly in
11 folks' written comments, I encourage conversation
12 on that.

13 COMMISSIONER SCOTT: I will say thank you
14 again to our fantastic panelists. This was a
15 really interesting discussion and we probably
16 could have spent all day on it, but we just have
17 the morning session. I will underscore what the
18 Chair said and also what Mike Gravely asked, if
19 you have studies or surveys, you mentioned the
20 roadmap, please make sure you send that to us.
21 Felix, you mentioned you have 15 pages of great
22 thoughts you want to share, please make sure you
23 get all of that information to us.

24 We did say that we would do a little bit
25 of public comment this morning, so if anyone has

1 urgent public comment that they would like to
2 make right now, they won't be here in the
3 afternoon and they won't be submitting something
4 in writing, please make sure you've got the blue
5 cards to our terrific IEPR team who is right over
6 here, and we will take a couple comments before I
7 encourage you all to go and visit and drive the
8 vehicles that are out front. We've got a great
9 set.

10 MS. RAITT: We don't have any blue cards
11 yet and we don't have anybody raising their hands
12 on the WebEx at this point.

13 COMMISSIONER SCOTT: Any other pressing
14 questions here on the dais? Okay -- oh, we've
15 got one here.

16 MR. REINECCIUS: My name is Stacey
17 Reineccius. I'm CEO of Powertree Services. I do
18 want to say that I thought the presentations
19 today were very informative. There are a couple
20 of points from the point of view of a company
21 that is actually deploying now three megawatts of
22 distributed storage with Integrated EV,
23 thankfully with some support from the CEC through
24 two separate grants that we've received so far.
25 One is interconnection is absolutely the choke

1 point right now. We have been negotiating our
2 interconnections for two years and that has been
3 a constant restart process with the different
4 utility personnel involved, and as an area that
5 absolutely is a roadblock and needs to be
6 clarified.

7 The second and related to the
8 interconnect is that the accounting for energy
9 used when taken at the retail level, but then
10 released back whether it's from an EV, or whether
11 it's from a stationary storage device at that
12 location, is the primary sticking point within
13 the interconnection process, it's the counting
14 for that energy that is taken and then released
15 within five minutes. And that can be a real make
16 or break. So that level of detail has to be
17 understood.

18 The other point I want to disagree
19 respectfully with SCE, this is not a five cent
20 question, this is an electrification of
21 transportation question. Cars are getting faster
22 and faster in their charging and the vehicles are
23 getting larger and larger in their batteries.
24 Tesla has really set forth some great examples of
25 the change in operating characteristics and

1 behaviors when you go to large batteries that can
2 charge faster. The closer and closer you get to
3 the gasoline experience, being able to get a
4 week's worth of fuel or several days' worth of
5 fuel in one session, the more rapidly vehicles
6 are going to be adopted. And that is the model
7 that we are building out against and that I
8 encourage you to think about. It's not a five
9 cent transaction, this is a full tank of fuel
10 transaction that goes on. Thank you.

11 COMMISSIONER SCOTT: Thank you.

12 CHAIRMAN WEISENMILLER: I guess we should
13 get on the record while we have Camron on the
14 line, how long have you been in the
15 interconnection process for the L.A. Air Force
16 Base?

17 MR. GORGUINPOUR: Well, I mean, how long
18 have we been in the extension process, kind of a
19 vague question, we have been working this project
20 since maybe 2011, really, middle of 2011. We
21 actually formally submitted our W (indiscernible)
22 application about a year ago, keeping in mind
23 that when we submitted it, it was under the Fast
24 Track process (laughing). Then, about a year
25 later we are close to getting this all sorted

1 out.

2 MS. RAITT: Commissioner, did you want to
3 check the phone lines?

4 COMMISSIONER SCOTT: Let me take one
5 comment from Paul, and then I think what we will
6 probably do, because we've got to have a hard
7 stop with the vehicles and their availability,
8 that we will break for lunch after Paul, and then
9 we can pick up with the rest of the comments in
10 the afternoon public comment session.

11 MR. STITH: I just wanted to say with
12 regard to interconnection, it's all going fine
13 until you state that there's a battery involved.
14 As soon as there's a battery involved, all bets
15 are off in terms of the timing. We're in the
16 middle of helping some of our clients through
17 interconnections, you have solar, some who don't,
18 I'm in the middle of processing and starting my
19 interconnection for my Electric Vehicle that I
20 want to do V2G, and even though it falls under
21 the 30 kilowatt limit and it qualifies for the
22 fast track interconnection, the moment that the
23 vehicle has an opportunity to dispatch power, all
24 bets are off and it becomes an advanced zoo
25 project whereby it needs to get investigated from

1 all angles, even if it's a 10 kilowatt or a 20
2 kilowatt, or as we have coming up a 60 kilowatt
3 vehicles. So you take a vehicle purchase and
4 you're trying to extract value from its
5 interaction with the grid, and you could buy a
6 vehicle and spend two years working through that
7 process, we'll need something better that
8 approaches the fast track for solar residential,
9 five, ten days, otherwise it will be extremely
10 difficult to see the value from the vehicles that
11 can dispatch power.

12 COMMISSIONER SCOTT: Well, let me just
13 say thank you again to our excellent panelists
14 and to Mike for his great moderation. And please
15 go out and check out the vehicles, there are a
16 bunch of them and will be neat to look at, and we
17 will resume in an hour.

18 (Recess)

19 (Reconvene)

20 COMMISSIONER SCOTT: Welcome back,
21 everybody to the afternoon. Let's turn to Silas
22 Bauer and to Jim McKinney who are going to kick
23 us off this afternoon.

24 MR. BAUER: Good afternoon. My name is
25 Silas Bauer. I am the project manager for the AB

1 1257 Report. I work in the Natural Gas Unit in
2 the Electricity Supply and Analysis Group here at
3 the Commission.

4 The purpose today is for us to gather
5 feedback from our panelists and from you on the
6 challenges and opportunities to natural gas as a
7 transportation fuel here in California, both for
8 the AB 1257 report and obviously for the IEPR,
9 the 2014 IEPR Update.

10 I'm going to give you a little background
11 on the bill and how we're approaching this
12 report. The bill itself, Chapter 749 of the 2013
13 Statutes, asks the Commission to identify
14 strategies to maximize the benefits obtained from
15 natural gas, including biomethane, as an energy
16 source. It identifies 10 topics that we need to
17 cover and that a number of other agencies need to
18 coordinate with in this process. And it's due to
19 the Legislature by November 1, 2015.

20 The 10 areas of focus, obviously natural
21 gas is a transportation fuel; it also points out
22 natural gas in the resource portfolio; natural
23 gas is a low emissions resource in biogas;
24 natural gas is an end use efficiency energy
25 source; natural gas infrastructure, storage and

1 pipeline and system reliability; and natural gas
2 in Zero Net Energy homes. There are also a
3 number of crosscutting topics, specifically
4 electric and natural gas industry implementation.

5 So one point on this. We want to get
6 feedback today from panelists and stakeholders
7 about what you think the challenges and
8 opportunities may be for the industry in making
9 Natural Gas Vehicles more accessible in
10 California or helping the market along.

11 The bill also looks at jobs development
12 and then how state and federal policy can
13 facilitate any of the proposed strategies. And
14 this last one, evaluating the economic and
15 environmental costs and benefits of proposed
16 strategies, including lifecycle greenhouse gas
17 emissions based on -- and obviously this is the
18 important part -- authoritative peer reviewed and
19 science-based analysis or in consultation with
20 the State Air Resources Board.

21 So what we're asking of stakeholders is,
22 if you think that you know of any research on the
23 environmental or economic costs and benefits of
24 natural gas, please docket it for us and then we
25 can go through it and use that information in our

1 report.

2 So the Report Work Plan, obviously what
3 we're working on now is this transportation
4 section, partially why we're here today. And
5 we're using any information that we get today,
6 any feedback, as part of our report process.

7 After today's workshop, there is another
8 workshop on July 14th that is focused on CHP,
9 Combined Heat and Power, that is outside of the
10 IEPR process but is coordinated through the
11 Electricity Analysis Office; in fall or winter of
12 2014, we're planning on having a workshop on
13 fugitive methane emissions and lifecycle
14 greenhouse gas emissions. We're targeting that
15 date so we can try to get as much feedback from
16 ongoing studies as possible, and there are, I
17 believe -- and I can be corrected on this by Tim
18 O'Connor -- but 16 studies the EDF is in the
19 process of working on, and then a number of
20 studies both funded by the Energy Commission and
21 through the ARB. And so we're trying to get as
22 much information back as possible before we have
23 that workshop. And obviously Fugitive Methane
24 Emissions will be touched on today, we're having
25 a few presentations on that; ZNE Buildings and

1 Efficiency, early 2015; Natural Gas
2 Infrastructure Storage and Pipeline Safety; and
3 in the summer of 2015, about one year from now,
4 we're going to have the workshop on the Draft
5 Report for AB 1257. And I want to note that
6 we're having one workshop for most topics in the
7 report. That workshop on the Draft Report will
8 be a chance to add any additional information on
9 transportation or any of the other topics, so we
10 encourage you to come to that workshop, as well.

11 So after that early summer first draft,
12 we're looking at the workshop in mid-summer,
13 early fall, revisions, and then obviously get the
14 report to the Legislature by November 1, 2015.

15 As you already know, the transportation
16 section of this report is coordinated with the
17 2014 IEPR Update. All the other sections will
18 also be coordinated with the 2015 IEPR, and there
19 will be descriptions of what's going on with the
20 report in that IEPR, and then our final report
21 will be separate from the IEPR.

22 So prior to this workshop we had a number
23 of conference calls with utilities and NGOs to
24 discuss what they would like to see in the AB
25 1257 report, specifically in the Transportation

1 section. They were all very helpful discussions
2 and in the process we got a lot of feedback that
3 helped to form our panelists today and the topics
4 they'll be talking on.

5 So some of the feedback we got: heavy-
6 duty vehicle and freight sectors are where the
7 biggest opportunities seem to be for Natural Gas
8 Vehicles. Obviously we'll have a panel on
9 fugitive methane emissions and this is an area of
10 concern for a lot of people, and so we're looking
11 at all these studies trying to figure out what is
12 a viable number for the amount of methane that is
13 leaking out of the system.

14 Biogas, you'll hear a bit about biogas
15 today. And obviously emissions targets in the
16 South Coast Air Quality Management District and
17 the San Joaquin Valley Air Pollution Control
18 District, these are two areas that were noted
19 again and again as areas where Natural Gas
20 Vehicles could make a difference with the
21 emission targets.

22 So stakeholders, we strongly encourage
23 you to log comments on the public record today,
24 or file comments in the docket. And this goes
25 throughout the process for all other aspects of

1 the report, as well. So we'll be looking for as
2 much feedback as possible as we go along. And my
3 contact information is at the bottom. We're not
4 taking questions right now, so this slide is
5 slightly misguided, but please take down my email
6 and my number, and if you have any questions
7 about this report feel free to contact me. And
8 now I'm turning it over to Jim McKinney.

9 MR. MCKINNEY: Good afternoon, everybody.
10 I'm Jim McKinney. I'm Program Manager for the
11 Alternative and Renewable Fuel and Vehicle
12 Technology Program in the Transportation Division
13 of the California Energy Commission. Welcome.
14 Let me add my thanks to our panel; I'm really
15 excited about the panel today, so excited I'm
16 banging the microphone. And I just really want
17 to acknowledge the policy leadership of
18 Commissioner Janea Scott for pulling together the
19 IEPR focus on transportation policy issues and
20 alternative fuels and vehicles this summer. So I
21 think we're just generating a tremendous amount
22 of information, good input from our stakeholders.
23 I also wanted to say welcome back, Commissioner
24 Peterman, and then Steve from CAISO, it was good
25 to meet you earlier, as well.

1 So what I want to do is just kind of set
2 the context for how natural gas figures in our
3 transportation system here in California today.
4 I think a lot of you have seen this slide before,
5 it's what I call the Nation-State Statistics for
6 the California Transportation Sector. So we are
7 currently I think the eighth largest economy in
8 the world, we have one of the largest fuel
9 markets, one of the largest vehicle fleets in the
10 world, and they generate a lot of greenhouse gas
11 emissions, as our Chairman said this morning.

12 About 40 percent of all GHG emissions in
13 California come from the transportation sector.
14 So for on-road transportation, that's about 168
15 million metric tons of CO₂ equivalent.

16 On the vehicle side, so over 26 million
17 cars, about one million trucks, and kind of the
18 interesting factoid on the trucks is that it's
19 about three, three and a half percent of our
20 total vehicle fleet and it consumes most of the
21 diesel figure you see there, so they are
22 consuming about over three billion gallons of
23 diesel fuel per year, so that's about 16 percent
24 of the fuel that we use.

25 But in terms of criteria emissions,

1 greenhouse gas emissions, and particulate, it's
2 up to 25 percent of the total, depending on which
3 of the criteria emissions or emissions factors
4 you're looking at. So trucking is a critical
5 part of our economy for goods movement out of the
6 ports, getting things to markets both here and in
7 the inland areas, but we think it's something we
8 can really tackle in terms of pushing out
9 petroleum, bringing in alternative fuels would
10 make a lot of sense.

11 There are a lot of niche markets in the
12 trucking industry, so it's really important to
13 match the fuel type with the technology, with the
14 drive train technology, and really match the duty
15 cycle. And I talked about fuel, you can see the
16 stats here on alternative fuels, so corn-based
17 ethanol is still by far the predominant
18 alternative fuel in California, so over a billion
19 gallons of that.

20 But I look at the stats for natural gas
21 on the LCFS Compliant Report from U.C. Davis, so
22 we're running just over 100 million gallons a
23 year in diesel gallon equivalents for natural gas
24 fuel in the truck sector and that's about
25 comparable with biodiesel and renewable diesel,

1 so again about 100 million gallons.

2 So it's a good start, we're moving the
3 meter away from zero, but it's a long way to go
4 to make some meaningful dents in the sector here.

5 Also, another good fact, so on the
6 station side, we've got over 650 CNG, LNG, or
7 RNG, so that's Renewable Natural Gas stations
8 here in California. About 400 or so, maybe 450
9 of those are private and the balance are publicly
10 available stations. And with that, I want to ask
11 my colleague from the Research Division, Ray
12 Gonzalez to come up and say a few words about
13 what they are doing in the research sector. And
14 then I'll pick it back up again.

15 MR. GONZALEZ: Thanks, Jim. My name is
16 Ray Gonzalez, I'm with the Research and
17 Development Division's Transportation Research
18 area; I'm the Technical Lead for the
19 Transportation Research area.

20 Jim asked me to present a couple slides
21 that kind of highlight our major initiatives and
22 also describe some projects that support those
23 initiatives.

24 Our transportation research area focuses
25 around supporting electric drive and Natural Gas

1 Vehicles and I'll be presenting obviously the
2 natural gas vehicle slide. The major topics for
3 our research include vehicle technologies and
4 includes engine development, onboard storage, and
5 we also cover fueling infrastructure and the
6 production of Renewable Natural Gas as a
7 transportation fuel.

8 The first initiative on this slide is the
9 Development and Demonstration of Ultra Low
10 Emissions, High Performance Spark-Ignited Natural
11 Gas Engines. We have a \$1 million project with
12 the Gas Technology Institute who is partnered
13 with Cummins Westport to develop a 6.7 liter
14 natural gas engine. This engine leverages the
15 successful Spark-Ignited Sociometric Engine
16 technology that is currently available for the
17 8.9 liter and the 11.9 liter Cummins Westport
18 engines. This project should be completed in
19 2015 and we will look to further advancements of
20 this engine as it gets into the beta and pre-
21 commercialization phase with opportunities to do
22 integration and demonstration efforts.

23 One of the items that we had gotten
24 feedback from, from the Engine OEMs, is that
25 natural gas engines, the current natural gas

1 engines available were meeting the 2010 standards
2 quite easily and what that led to was an
3 initiative for us to look at advancements that
4 target NO_x reductions that get down to 90
5 percent. And so we funded a project that is
6 coordinated with South Coast Air Quality
7 Management District and Southern California Gas
8 Company to look at projects to reduce NO_x levels
9 under 90 percent while keeping performance at par
10 and the other emissions also at par. And this
11 was again a \$2 million effort from the Research
12 and Development side, but as well we have some AB
13 118 funds that were also applied to the same
14 project, and that funding is to support the
15 demonstration efforts.

16 Now we've done other engine development
17 work and so I've included a note here that shows
18 that we've done active engine development work
19 from 12 liter on up to 15 liter. And one of our
20 strategies is to look at the portfolio of
21 products that are available and basically plug
22 the holes and look for engine development work
23 where there isn't any in the market and in order
24 to drive a good market availability.

25 Natural Gas vehicle Onboard Storage: we

1 have a project, in fact, we took a project to the
2 June 2014 Business Meeting just last week, and
3 we're targeting the absorption technologies for
4 activated carbon, and the idea or the strategy is
5 to get to a conformable storage tank design and
6 this, in particular, would fit well with our
7 light-duty vehicles and this is the biggest
8 challenge for passenger cars. And this
9 technology that is successful would also enable
10 better home refueling because they would be
11 refueling at a much lower compression rate.

12 The next initiative is Natural Gas
13 Vehicle Hybridization. This is another
14 initiative that had projects that were presented
15 in the June 2014 Business Meeting. This was a
16 total of \$2.7 million for three projects and this
17 is a very interesting and exciting area for our
18 Natural Gas Vehicle research and development
19 work. This is the first time we've attempted to
20 integrate battery electric into the natural gas
21 platform. One of the objectives of these
22 projects is to target the lower efficiency modes
23 of, in particular, Sociometric Natural Gas
24 Engines, and that being part-load, as well as
25 looking at opportunities to reduce idle.

1 Natural Gas Fueling Infrastructure
2 Improvements: this is an initiative that we hope
3 to have a solicitation released in mid-2014, and
4 this is going to target improvements in the
5 economics of compressed natural gas fueling
6 infrastructure, as well as looking for
7 opportunities for the performance of the station
8 and also addressing any fugitive emissions.

9 Advanced Ignition Research is an
10 initiative that will have a solicitation that
11 will release in mid-2014. And this was an
12 initiative that was basically provided by
13 feedback in one of our workshops where,
14 recognizing that there is a barrier to the
15 ignition of methane, we are targeting innovative
16 opportunities to improve combustion. And this is
17 going to lead to better performance and higher
18 efficiency of natural gas engines. And again,
19 the two solicitations should release mid-2014.

20 The next initiative is an initiative for
21 Renewable Natural Gas production and we are
22 currently supporting four projects that are
23 developing Renewable Natural Gas with co-products
24 or co-benefits, and the idea is to use the co-
25 products or co-benefits to offset the cost of

1 Renewable Natural Gas so that it could better
2 compete with conventional natural gas.

3 That's a list of our initiatives. We
4 currently fund at approximately \$4 million per
5 year and this has been an ongoing effort over the
6 last six to seven years. Thank you.

7 MR. MCKINNEY: Thank you very much, Ray,
8 for walking us through the investments from our
9 Research Division and different pieces of the
10 natural gas supply chain for transportation.

11 What I want to do here, I'll go through
12 these slides quickly, is just situate the way we
13 pay for natural gas in an ARFVTP or AB 8. So as
14 you can see from this slide, we're at about half
15 a billion dollars in total investments to our
16 program since '09 and '10, over 312 projects, so
17 natural gas and propane is about \$82 million, 16
18 percent of our total funding, and our biogas
19 investments are in the biofuels section, and I've
20 got more information on that.

21 Here is another way to slice it. So the
22 purple part of the histogram is natural gas, so
23 you can see on fueling infrastructure under \$20
24 million in investments; on the vehicle side about
25 -- I think we're coming up on \$50 million there.

1 And so typically the way we work with AB 8 or
2 ARFVTP is that we do a lot of focus on the pre-
3 commercial phases, and it's our colleagues at the
4 Air Resources Board that take over, say, when
5 electric drive or fuel cell technologies get to
6 commercialization. That's not the case with
7 natural gas, so actually a lot of our money goes
8 into vouchers for commercially available natural
9 gas trucks here in California.

10 So in the truck sector, this is about a
11 third of our total funding for the reasons I
12 stated earlier, so you can see now we're at
13 nearly \$50 million in investments in our natural
14 gas trucks, so that's about \$2,300 total that
15 we'll be able to put on the road, and then
16 another 600 trucks from the earlier investments
17 we did with propane.

18 On the infrastructure side, again, it's a
19 modest number, about \$17 million for about 62
20 stations, and there's a handful of LNG and RNG
21 stations mixed in there, as well.

22 On the demonstration side, we've got four
23 projects, so not a lot out of the 36 total, but
24 there's some good ones. Ray already mentioned
25 our co-funding the low-NO_x engine development

1 project that Henry Hogo will tell us more about
2 since South Coast is on point for that. And
3 we've done some work with Cummins Westport for
4 the ISX 11.9 liter Class 8 Engine, which we feel
5 is an important market niche. Then GTI is doing
6 a plug-in LNG tractor for drayage applications
7 down on the ports in Southern California, which I
8 think is also really interesting.

9 On the Fuel side, so here you can see our
10 biogas investments, we've got 12 projects just
11 under \$40 million and I think everybody knows
12 here biogas has got just about the lowest carbon
13 footprint for commercially available alternative
14 fuels coming in between 10 and 12 grams per
15 megajoule, so again about 85-90 percent below the
16 carbon baseline.

17 I just want to show a few slides from the
18 benefits report that Dr. Melaina presented at our
19 last IEPR workshop. So what this does is he and
20 his team at NREL looked at over 200 projects, a
21 good chunk of our portfolio, so \$426 million
22 there. What you can see here, these are what we
23 call Expected Benefits, so assuming everything in
24 our portfolio, sort of the half billion dollars
25 there, is built out and run through its design

1 life at its design capacity, these are the
2 expected benefits through 2025; this chart shows
3 carbon emission reductions. So the green bar
4 there is vehicles and commercial gas trucks, or
5 the darker wedge there, so you can see kind of a
6 modest contribution, about 11 percent of the
7 total GHG emissions through 2025 in the truck
8 sector, and it's actually ZEV trucks or Electric
9 Trucks; and in the medium-duty sector that kind
10 of come on strong later, that's where you get the
11 continuing uptick in the bar there.

12 On the Infrastructure side, this is
13 really where CNG/RNG really shines. You can see
14 over two-thirds of the benefit there is from
15 natural gas, again, that's the blue bar. And
16 remember, this is only \$17 million out of our
17 portfolio, out of \$500 million. So a pretty good
18 return on investment on that.

19 And down on the bottom you can see our
20 biofuels investments, so biomethane is the light
21 colored wedge, up there between twelve and one
22 o'clock, so about 10 percent of the total GHG
23 benefit from that.

24 This chart shows it a little differently,
25 you can see how it plays out, so I've highlighted

1 the natural and renewable gas. So again, the way
2 this works, the way it works in these projections
3 is that we're assuming the demand for trucks will
4 continue to grow, that market will grow, and the
5 throughput will continue to grow in 2020 and
6 2025. On the truck side, trucks have a
7 relatively short half-life in terms of their
8 optimum efficiency when they're going to fleets,
9 so we see the big part of the benefit there in
10 the early years between 2015 and 2020 on the
11 vehicle side. And then for biomethane you can
12 see as those facilities come on line in 2020 and
13 contribute a nice amount.

14 So I again am just very excited about the
15 panel that we have today. We've got this broken
16 into three basic groups, so we're going to talk
17 first about kind of very general market supply
18 issues, kind of supply/demand balance, so Amy
19 Myers Jaffe from UC Davis will handle that part
20 of kind of the kick-off presentation. And then
21 we'll have a series of speakers talking about
22 methane escapage, so Rosa (Dominguez-Faus) and
23 then the representatives from the three
24 environmental NGOs that are here with us today.
25 And then we're going to switch to kind of the

1 mid-part of the supply chain, so station
2 development, and we'll also have a speaker
3 talking about biogas there. And at the end of
4 the day we'll talk about end use, so how do the
5 fleets work, what do they need, what engine
6 designs do we need to really make this market
7 continue to accelerate.

8 Silas and I have put together six key
9 questions for the panelists and we don't expect
10 all of you to answer all of them, but clearly
11 these tie to your specialties.

12 So first and foremost, kind of what are
13 the market opportunities for natural gas as a
14 transportation fuel and, second, and I think this
15 really kind of gets to the heart of the policy
16 discussion about natural gas and it's pluses and
17 minuses, shall we consider it as a near term low
18 cost bridging fuel with moderate environmental
19 benefits? And I would propose that that's really
20 kind of the classic interpretation for natural
21 gas in the transportation sector. And I think,
22 as we're going to hear from Sempra and some
23 others, there's a very different business model
24 and policy model out there, what they call
25 "greening up the supply chain."

1 So the second option is, what is its
2 potential as a ZEV caliber truck fueling option
3 with the potential to meet the same environmental
4 performance standards as electricity and
5 hydrogen? And I know that's a little provocative
6 for some folks, but if you look hard at the
7 numbers and you look at the supply mixes for
8 biogas and green hydrogen getting into the
9 pipeline, the potential is there in my view.

10 How should policymakers and regulators
11 consider the long term potential for natural gas
12 as a transportation fuel, given the risk and
13 uncertainty associated with methane leakage and
14 potentially higher carbon intensity values? This
15 is the other part of the key question in this
16 policy discussion.

17 Number four, what are the opportunities
18 and constraints for using biogas Renewable
19 Natural Gas at a commercial fueling scale in
20 California? We've got some serious issues with
21 AB 1900 in opening up the pipelines to biogas in
22 California, we need that to open the market.
23 We've also got some feedstock constraints,
24 there's a finite amount of organic feedstocks
25 available in California. The current information

1 from UC Davis, they're estimating about 660
2 million diesel gallon equivalents for biogas if
3 we can optimize the resources we have now.

4 Turning to the fleet side, what changes a
5 natural gas engine design and sizing options are
6 needed to make natural gas trucks competitive in
7 California and the West? And when can we expect
8 sizeable numbers of vehicle products?

9 And lastly, what do the fleet operators
10 need from OEMs and government policymakers and
11 regulators to make natural gas trucks a
12 competitive alternative to diesel fuel trucks?

13 So again, I am very very pleased with the
14 panelists we have today and, with that, I want to
15 queue up Amy Myers Jaffe's presentation. Do you
16 want to come up here, Amy, and speak?

17 So Amy Myers Jaffe is currently the
18 Executive Director for Energy and Sustainability
19 at the University of California at Davis
20 Institute for Transportation Studies. She is one
21 of our leading experts on global energy policy,
22 geopolitical risk, and energy and sustainability.
23 Along with her appointment at ITS, she also has a
24 joint appointment with the Graduate School of
25 Management in the ITS. She is Associate Editor

1 for the *Journal of Energy Strategy Reviews* and
2 serves on the Editorial Board of the *Journal on*
3 *Economics of Energy & Environmental Policy*, and
4 prior to coming here to California she headed up
5 the Energy Forum at the Baker Institute at Rice
6 University in Texas. So welcome, Amy.

7 MS. MYERS JAFFE: Thank you. It's a
8 pleasure to be here. Thank you for this
9 opportunity to talk to the Commission and to
10 stakeholders. Natural gas is sort of an
11 interesting emerging topic, I think, and biogas
12 even more so. And one of the things I'm going to
13 talk about today I think is going to surprise
14 people a little bit because I'm going to talk
15 about the commercial context, which everybody
16 thought was very favorable; and then I'm going to
17 talk about why, even with the commercial context
18 seeming very favorable the market is not
19 developing at the pace that maybe some people
20 thought it would, and talk a little bit about
21 why.

22 So I think the first step just in sort of
23 giving a general overview, I would say over the
24 last year, and especially here in California, and
25 I would be happy to take some questions on that,

1 there's been some question about whether the so-
2 called shale revolution was real or not and
3 whether or not we would have just a temporary
4 boost in natural gas supplies, or whether it was
5 going to be a lasting trend line.

6 I brought the U.S. Government Department
7 of Energy Map, and for those of you who may have
8 seen this map in the past, I just want to sort of
9 call your attention to something interesting
10 because, had I presented this map a year ago,
11 some of this would have been here, and a lot of
12 this, and this would have been here, and you
13 would have had a little bit here on the
14 Marcellus, but the build out of all this resource
15 here, these new resources, the size of the
16 Marcellus, a lot of this Niobrara play which is
17 just starting out, and the movement all the way
18 up into Canada and down into Mexico was not
19 indicated on this map a year ago, and it's not
20 theoretical, these are plays that are being
21 drilled and are being developed.

22 And of course, the Monterey is here on
23 the map and we've had a lot of controversy in
24 California over the past few weeks about whether
25 the Monterey is or isn't producible and whether

1 the U.S. DOE's estimates are too high or too low,
2 and I think what I would tell you is that in
3 California there is some question about how much
4 of the oil has migrated away from the source rock
5 in California and how much hasn't, so that's part
6 of the controversy that makes people have
7 different opinions. And then of course there's a
8 wide range of opinion as to how producible it's
9 going to be.

10 So what I would say to you on California,
11 and I'll show you some slides in a minute, is
12 that when I talk about the supplies that are
13 going to come from Texas and people are looking
14 at the Eagle Ford play and also now this Permian
15 Basin play is going to be a giant play, and just
16 to give you an idea of the scale, when the Eagle
17 Ford first started being drilled on the oil side,
18 people thought that it might be able to produce
19 350,000 barrels a day of oil and now it's getting
20 to be close to a million barrels a day of oil,
21 and on the Permian Basin, the new theory is that
22 it might be able to get up to as high as three
23 million barrels a day. So we're talking about
24 giant basins with giant production. Same with
25 the Marcellus out of Pennsylvania.

1 So we're now seeing that there's a
2 tremendous amount of potential, but it's a
3 technology play. And in California the companies
4 are experimenting with different technologies and
5 so far not that many people have been successful,
6 and so you're getting this sort of downsizing of
7 what the potential is based on the sort of
8 commercial lack of success. But what I would
9 tell you is in the Barnett, which was the first
10 play, there were analysts that said that the
11 natural gas there could never be produced and
12 there would be no liquids production whatsoever,
13 and we now all know the end of the story which is
14 that it turned in to be a very big and successful
15 play. So I just think it's very dangerous to
16 base what you think might happen in 10 years,
17 five or 10 years, on the basis of what companies
18 have accomplished or not accomplished in their
19 first couple years of drilling because there's
20 probably not enough information.

21 So I brought this chart, this is the
22 chart from the Energy Information Administration
23 about what the outlook has been and where the
24 expansion has come from, so you can see that
25 these areas like the Permian, the Bonespring, and

1 the Wolfcamp, which are just starting to grow now
2 and are expected to grow much more in the future,
3 how much the Eagle Ford has grown, and then also
4 for natural gas just how much expansion in
5 production we've seen since 2008 until current on
6 natural gas from the Marcellus. When you see
7 something like the Haynesville, one of the
8 reasons that the Haynesville is not growing as
9 much is not because the resource isn't there,
10 it's that it is a dry gas and the companies don't
11 want to seek dry gas because it's so much more
12 profitable to have gas that is combined with
13 natural gas liquids and crude oil, so you're just
14 seeing investment dollars shifting from one place
15 to another.

16 When we look at California, the target is
17 definitely going to be oil and so I don't expect
18 us to see a giant increase in the amount of
19 natural gas that's going to be available by the
20 development of the Monterey, the Kreyenhagen, and
21 some of these other plays. The thinking is that
22 a lot of the material that will be produced in
23 California is going to be liquids.

24 So given that, we have done some
25 projections working together with the Center for

1 Energy Studies at Rice and our expectation is
2 that California will be bringing in its gas from
3 other areas. A lot of new supply is probably
4 going to come from Canada and then also
5 continuing supplies coming from the U.S. Mid-
6 Continent and Texas, and we don't see a big
7 increase coming from California maybe in the near
8 term, but over the long run we don't see the
9 shale as playing out as becoming a major supplier
10 for indigenous fossil gas.

11 Demand by sector, again, using that same
12 modeling we don't see a large increase in demand
13 coming from transportation, there's *some*
14 increase. But we do see an increase in
15 industrial use and also to some extent, and maybe
16 it's just a leveling off of power generation, not
17 a big expansion there as well.

18 So what's the theory, then, behind why
19 people are so excited about natural gas and
20 transportation? And part of that comes from what
21 I talked about, which is we have a giant resource
22 base for natural gas, not necessarily here in the
23 state, but definitely across the United States
24 and Canada, and people are basically projecting
25 that natural gas could be sort of like diesel

1 fuel was for the Class 8 trucks; in other words,
2 it started out very slow for diesel, and we had
3 this sort of S curve formation where, you know,
4 the more parties that shifted to diesel, the more
5 it gained momentum until we got to the point now
6 where the entire industry in the trucking
7 industry has switched to diesel. And so the
8 question is could that happen in natural gas and
9 would that be desirable? And if that is
10 desirable, what would it take to get out a lean
11 part of the curve and get yourself up to the
12 higher penetration?

13 So we've looked at that using an
14 Optimization Model with GIS mapping capabilities
15 and we're using that model to not only determine
16 how the build out would look and what role
17 California would play in sort of a national
18 market, but also to look at what some of the
19 commercial barriers are to the development of a
20 network.

21 So first and foremost, the parties that
22 would switch to natural gas from diesel fuel have
23 to believe that the current gap in prices is
24 going to be lasting; and with all the turmoil in
25 the Middle East, maybe that's looking a little

1 bit more realistic than it might have if I'd
2 given the talk three months ago because there is
3 a lot of oil coming out in the United States, so
4 always a little difficult to make forecast
5 predictions. I think it's probably a safe bet to
6 assume that the price of natural gas will stay
7 low, with the exception of seasonal outbursts in
8 New England if we have a very cold winter, but I
9 think we can expect that the supply is there to
10 meet whatever demand growth there is going to be
11 because it is so abundant. And then the oil
12 price, it's very hard to talk about that
13 uncertainty. I would say that certainly this
14 year the price of oil is likely to remain high
15 given the turmoil in other parts of the world and
16 the problems between Russia and the Ukraine.

17 But as you can see, even looking at these
18 sort of average projections and forecasts that
19 come from the DOE, and these are very typical,
20 there's a lot of uncertainty and even for the
21 next year, you know, the uncertainty for oil
22 supply is that the Intranet global market might
23 see an extra two million barrels a day from OPEC,
24 or turmoil in the Middle East might curb to have
25 a three million barrel a day loss. And when

1 you're talking about a five million barrel a day
2 swing in oil supply, there's no amount of extra
3 drilling in the United States that's going to be
4 able to close that gap. And if it turns out that
5 a lot of oil comes out of the Middle East because
6 the turmoil passes easily, then we could have the
7 price of oil collapse, and the flipside could be
8 true if we get a lot more disruption coming out
9 of the Middle East and we could see a much higher
10 oil price.

11 And so we've tried to construct a model
12 that would be able to capture those uncertainties
13 and do sort of a boundary analysis letting you
14 know under certain conditions what would the
15 market development look like. So the first step
16 is to do work, which we did, which is to look at
17 how many years it would take, or how many months
18 it takes given the cost of the vehicle and the
19 amount of vehicle miles traveled for Class 8
20 Trucks to break even by switching to fuel. And
21 we used a \$4.00 diesel gallon price assumption
22 for doing this particular exercise, and it really
23 basically shows that for the very long haul Class
24 8 trucks, the breakeven is under three years and
25 that makes it fairly commercial for a venture for

1 a fleet and shippers.

2 So one of the things that made everybody
3 excited about the Class 8 vehicles shifting to
4 some kind of natural gas fuel, or some kind of
5 alternative fuel, is that putting in the fueling
6 infrastructure is easy because there's like, if
7 you look at those red lines here on this map,
8 it's limited, there's a limited network, you
9 aren't having to do - it's not the same thing as
10 trying to propel passenger vehicles where you
11 have to be on every corner in every major city.
12 You have these clear routes, we know how many
13 miles the trucks have to go before they stop, we
14 know what the average distance is for travels on
15 each of these routes, and so for a commercial
16 enterprise there's a very predictable market to
17 develop. And California plays a very key role in
18 the distribution of goods, as does Texas and the
19 Great Lakes Area. So, again, a company that
20 wanted to have a strategy to work on the
21 infrastructure and the marketing of natural gas
22 into heavy commercial transportation, commercial
23 transportation, seems to have a high potential
24 because it's really a finite number of routes,
25 concentrated markets in key states, and it leaves

1 a lot of potential to getting something off the
2 ground.

3 So we built an optimization model to
4 identify how the build out for LNG and CNG supply
5 chains, whether that can be a sustainably
6 commercially profitable venture and, if so, what
7 would be the most cost-effective supply chain
8 configuration. And so the model gives two
9 choices, one is to go through what we call Small
10 Scale LNG Manufacturing, which then is
11 transported on by truck to about a 350-mile
12 radius through LNG refueling conventional
13 stations; the other option is transport by
14 natural gas pipeline, and that could also be for
15 biogas, and then coming out to new technology
16 like the GE LNG In A Box, or CNG In A Box where
17 you're having these modular stations that could
18 be attached to an existing truck stop and you're
19 bringing the station technology remotely. That's
20 a more expensive option than doing Mini LNG, but
21 it has two advantages, one is it takes two years
22 to build a scale-up mini LNG plant, so you can
23 address immediate demand and not have to try to
24 get a customer to agree to a chicken and an egg
25 plan to meet you with demand in two years, and

1 then also it could be used as sort of a fill-in
2 technology: if it's commercial, to put the plant
3 in a certain place, in another place, but if
4 there's some holes in your roof then you have
5 this GE or some other vendors are also making
6 that same technology. You have this option to
7 put these slightly more expensive stations sort
8 of in the middle.

9 So to figure out -- because that's a very
10 complicated set of choices for the market -- so
11 to figure that out takes a computer, memory, and
12 we use the network analysis to look at what were
13 the most profitable routes, what would be the
14 highest concentration of build outs, and where
15 would be the most profitable places to start the
16 network? And the interesting thing about our
17 early findings is that, surprisingly, even
18 natural gas fuels, we start with LNG that have
19 between \$1.00 and \$1.50 per diesel gallon
20 equivalent price advantage, it needs some kind of
21 assistance for us to get the computer to build
22 out the network. So that was, I think, a little
23 bit surprising and maybe even depressing when you
24 think about the more beneficial alternative fuels
25 such as how hard it is even with a fuel cost

1 advantage to get past the chicken/egg problem.

2 What we found was that the success of
3 these networks was that it was highly sensitive
4 to where we started the initial penetration rate.
5 So if we just pretended that we were Walt Disney
6 and we instead of starting at one percent of the
7 market existing, we could change that and say,
8 okay, let's say we woke up in the morning and
9 magically it was 10 percent penetration in the
10 market, or 50 percent penetration, then the
11 impetus for the market to build out itself and to
12 have more and more commercial players join into
13 these networks becomes very rapid. And I think
14 that that's going back to the S curve for diesel
15 fuel, you know, that's borne out by the
16 historical experience with diesel.

17 The second thing that, when we go back
18 and do the analysis about why the computer didn't
19 choose to build in different places, or how could
20 it didn't just build all these stations across
21 America because the computer doesn't have to
22 worry about a fleet thinking that they're not
23 sure what the price of oil is going to do,
24 because the computer is more confident. What we
25 found was that basically the infrastructure costs

1 for the stations and for many LNG are still a
2 little bit too high to make it very compelling.
3 And of course that problem is not unique to
4 natural gas; it's going to be a problem in
5 hydrogen, going to be a problem in some of the
6 other fuels, which is just the higher cost to put
7 in this infrastructure. And, you know, who is
8 going to bear that cost? Is it going to be the
9 station developer who is going to put that cost
10 onto the fuel purchaser? You know, who is going
11 to bear that cost?

12 So I want to show you a few graphics of
13 some of these results just so you can get a
14 visualization on it, and then I can talk just
15 briefly to leave time for Rosa Dominguez-Faus to
16 talk about the methane leakage issue, just talk
17 very briefly about what might be the commercial
18 path forward if the path forward is not going to
19 be government intervention.

20 So we did some what I call static runs
21 which is instead of having a dynamic solution
22 where the computer programs out every possible
23 station, we picked particular penetration rates
24 as a starting point, and then like imagine us
25 just taking a photograph instead of running the

1 computer to the end conclusion. And you can see
2 the difference between what is built out under
3 the existing stations and liquefaction plants
4 under one percent penetration where really truly
5 it's a pretty thin network and maybe not
6 attractive to shippers to have to worry about
7 whether the fuel will be available. But you can
8 see at 16 percent you still to get important
9 corridors like in California, around the Great
10 Lakes, up and around Pennsylvania and New
11 England, and even a bit around the sort of
12 Houston Port. So that's interesting and, of
13 course, at 31 percent penetration, you see a
14 fairly substantial build out and a substantial
15 build out in the Mini LNG, both in California,
16 again around the Great Lakes, around Houston, and
17 in New England. So it shows you that if you got
18 past the chicken/egg problem, it becomes a very
19 commercial venture to build out the rest of the
20 network.

21 So putting that in a different way, where
22 this has to do with what stations are profitable
23 or not profitable, and at different penetration
24 rates, assuming there would be no subsidy for the
25 stations, and again you can see a lot of red dots

1 versus at the higher penetration rates you start
2 to see sort of the network develop out more fully
3 with less unprofitable stations. When we run the
4 same scenario and start with a 50 percent subsidy
5 on the station costs, again you see that under
6 the current situation where the market is under
7 one percent penetration that's not all that
8 helpful, but as you move to the higher
9 penetration rates, you know, it's kind of hard to
10 see it, I'll flip it, you can see that it's a
11 little bit more thickly populated than without
12 the subsidy and many more less unprofitable
13 stations which shows you that ultimately it's
14 very cost sensitive if GE or one of the
15 manufacturers would have a big breakthrough in
16 the cost of the technology, that would make a big
17 difference.

18 And in thinking about what do these
19 results mean, I think another issue that one has
20 to look at is, what is the business model under
21 which the suppliers are going to try to sell the
22 fuel under this system? So right now the way
23 suppliers have been going about it, natural gas
24 producers and other parties like GE and so forth,
25 the risk has all been on the fleets, right?

1 "We'd like you to buy this truck for a certain
2 amount of money, and we're going to provide the
3 fuel for you, and you will take on the risk, and
4 the gap between your current diesel fuel price
5 and the natural gas price is going to work in
6 your favor. And you should take on this risk.
7 And then after we're sure you've taken on this
8 risk, then we're going to build these networks to
9 supply you." Or, if you're a station developer
10 like Clean Energy, you're taking on the whole
11 risk yourself and you're just hoping that, you
12 know, build and then it will emerge. Right?

13 So the interesting thing to think about
14 from thinking about the oil industry's history,
15 not in this area, but in other parts of the
16 industry, you know, the question is maybe the
17 pricing model is not the way people have thought
18 about it. In other sectors in the oil industry,
19 one of the things that people have done is people
20 have brought in what I call a "risk party," so
21 you might bring in a financial player, or a bank,
22 or some kind of a trading company and they put
23 together a derivative swap where the fleet
24 purchaser is not taking on the price risk, nor is
25 the station and natural gas developer, but the

1 price risk is taken by a third party that makes
2 profit on trading that risk at the upside, right,
3 of the price if it over-performs. We've seen
4 that done in the oil industry and Gulf of Mexico
5 when people who were afraid to do these very
6 expensive projects they would bring in a
7 financial firm to take the price risk. So we may
8 see over time different kinds of pricing packages
9 if it turns out that price subsidies are not
10 going to be an option and if there's a desire to
11 move to this program apace of all parties and
12 government. It may be that there needs to be
13 sort of a different business model for thinking
14 about how the costs are going to be hedged away
15 and incentivized.

16 So just a moment, just a little bit on
17 our initial assessments on Renewable Natural Gas.
18 So this comes from the California Biomass
19 Collaborative and they've looked at the existing
20 potential in the state to develop Renewable
21 Natural Gas and we've made an Infographic that
22 makes itself explanatory in terms of there being
23 sufficient supply to meet the current level of
24 natural gas consumption in the state, so it gives
25 you sort of an idea of the relative supply versus

1 the current demand, anyway.

2 Okay, Rosa?

3 MR. MCKINNEY: Okay. Thanks very much,
4 Amy. Our next speaker is Rosa Dominguez-Faus,
5 who is a Post-doctoral Fellow at the UC Davis
6 Institute for Transportation Studies. Rosa
7 obtained her PhD in Environmental Engineering
8 from Rice University with a dissertation on
9 Biofuels, Water and Climate, and her current
10 research is around sustainable energy production.

11 And if I could just do a time check with
12 Commissioner Scott because I understand some of
13 our guests will need to leave?

14 COMMISSIONER SCOTT: I think we're okay.

15 MR. MCKINNEY: Okay, great. Rosa?

16 MS. DOMINGUEZ-FAUS: Yes. So today I'll
17 talk about methane leaks and I would like to
18 start with a video from the EPA that is showing
19 with infrared cameras where these methane leaks
20 are occurring.

21 So in here you can see with the naked eye
22 that we don't really see any gas leaking, but
23 then if we apply -- and those are like they are
24 trying to measure -- this is EPA trying to
25 measure, but if you apply the infrared cameras,

1 then you can see the gas. We have many examples
2 throughout the supply chain. This is probably a
3 processing facility, and then you can see this
4 black smoke which is just the methane as seen by
5 the infrared camera.

6 We can also see if we apply -- so that's
7 another example and those are the measurements,
8 the CO₂, sort of bottom up measurements that they
9 take, some more methane examples, and I want to
10 show -- next would be a distribution
11 infrastructure measurement, let me just bring it
12 up a little bit, and then you could see they're
13 trying to take measurements off a manhole and you
14 couldn't see anything, but now with the infrared
15 camera, you can see that there are some
16 interesting leaks, and once they open that, it
17 looks really bad.

18 Some pipelines that must have been burst.
19 And also they're using these cameras to monitor
20 storage tanks in production areas, so that would
21 be an uncontrolled leak, an oil well that's also
22 leaking some natural gas, and there will be also
23 some natural seeps. Basically this technology
24 can allow us to detect where these leaks are, so
25 that will be the challenging data that some

1 people think the authorities or the agencies
2 don't know where these leaks are occurring, but I
3 just want to show that it's happening.

4 So anyway, methane leaks. Is natural gas
5 good or bad? Natural gas burns a little cleaner
6 than coal or petroleum, it has less Mercury
7 particulates, etc., but it also has less CO₂
8 emissions when burned. But then these methane
9 leaks might negate any climate benefit that you
10 can have by burning natural gas.

11 So what we do is a lifecycle analysis to
12 compare. We basically translate methane
13 emissions to carbon dioxide equivalents by
14 basically attributing a global warming weight
15 that's very dependent upon the time horizon you
16 use; for example, the IPCC recommends that you
17 use like a 100-year time horizon and in that time
18 horizon methane is between 20 or 30 times more
19 potent than CO₂. So many people have done this
20 lifecycle analysis and they have concluded, you
21 know, natural gas is better or worse than coal
22 when you take into account both CO₂ and methane.
23 And there's been a lot of differences in the
24 results. And what I'm going to show here that I
25 think the differences depend more on the

1 assumptions that people have used in their method
2 than in the actual values. For example, many
3 might have heard of Howard from Cornell who
4 criticized gas development, particularly shale
5 development, and he showed that natural gas is so
6 much worse than coal, and for the most part it is
7 due to the fact that he is using a 20-year global
8 warming potential, so it's giving methane a
9 higher weight. Why? Because methane is more
10 potent than CO₂, but it's shorter lived, so it
11 does more warming at the beginning and it's
12 better in the long run because it has less CO₂,
13 all the methane disappears and then you're left
14 with less CO₂ than with other alternatives. So
15 when you take his analysis and then use the 100-
16 year revolving potential and to standardize it
17 with the other studies, you see that the
18 difference is not as big.

19 Other parameters that affect the results
20 are the efficiencies in converting the energy you
21 assume. If you are comparing sort of an old
22 natural gas turbine with the best coal powered
23 generation technology, then you're also
24 penalizing natural gas, but that's not an apples
25 to apples sort of comparison, right? Like you

1 have to compare either best case natural gas to
2 best case coal, or worst case to worst case, or
3 average to average, and that's not what's
4 happening, right?

5 And so what this is showing is basically
6 all these studies put together, and for the first
7 part we have shale gas used to produce
8 electricity, conventional gas to produce
9 electricity, or coal, and those are over all
10 lifecycle emissions, right, all converted to CO₂
11 equivalents. Two things to look at here:
12 basically gas, either shale or conventional, is
13 better than coal across the different studies,
14 and the other thing is that CO₂, which is the
15 blue part of the bar, is still the significant
16 part. So CO₂ that comes from burning the fuel,
17 it is still the biggest contributor to the
18 emissions, not so much leakage, which of course
19 there is some and it would be the green part and
20 should be minimized.

21 So what is the leakage rate that puts
22 natural gas at parity with coal? How much
23 methane has to leak for it to be as bad as coal,
24 right? So again, different studies using
25 different methodologies have come up with

1 different leakage rates. Richard Muller from
2 Berkeley estimates using a somewhat different
3 approach, a Muller Approach, that I think needs a
4 little scrutiny, it hasn't been peer reviewed,
5 but he says that as high as eight to 14 percent
6 methane leakage still makes natural gas at parity
7 with coal, so anything below that would make
8 natural gas more favorable. The more standard
9 approach using the 100-year global revolving
10 potential that last one uses estimates that this
11 breakeven leakage rate is six percent, and the
12 thing that we're using, this 100-year global
13 revolving potential, is like the benefit is going
14 to happen really didn't, we might have more
15 warming now. And another study that is not using
16 this 100-year global revolving potential, but
17 using global revolving potential right now, so
18 that would be the leakage to have a benefit
19 starting now and even better in the future is by
20 Alvarez, and he estimates that a 3.2 percent
21 leakage rate is still acceptable. Above that,
22 then it is bad, but 3.2 or below we should be
23 switching to natural gas.

24 And that was for power generation. For
25 transportation, it's a different picture for two

1 things: first, because the difference in exhaust
2 emissions between natural gas and petroleum fuels
3 is not as big as the difference is between coal
4 and natural gas, so there's less to make up for,
5 and then because the results will change, right?
6 So about the same immediate benefit methodology
7 for transportation, what Alvarez finds is the
8 leakage rate for light-duty vehicles is 1.6
9 percent and for heavy-duty vehicles is 1.0
10 percent.

11 Now the heavy-duty vehicles is really
12 basically just using a bus, it's not for heavy-
13 duty trucks and other applications of natural gas
14 and transportation, or off-road uses, it would be
15 a different one that would require a different
16 lifecycle analysis.

17 So which one is the actual leakage rate?
18 According to official estimates, EPA, basically
19 it's around 1.5, it could be 1.7, depending on
20 how you do the calculation because EPA gives you
21 how much methane is being leaked, and then you
22 have to divide that by how much natural gas is
23 produced, and then you have to assume how much
24 methane is in the natural gas, so this 1.5 could
25 be 1.7, for example. But anyway, this is like a

1 number to keep in mind.

2 But EPA has been very criticized by using
3 emission factors that are outdated and that are
4 not taking into account all the emissions that
5 there are. So there's been lots of studies that
6 are trying to make their own estimates with
7 different methodologies, down versus bottom up,
8 and it's really hard to have an idea. There is a
9 wide variability across the different studies
10 because they apply to different basins, some of
11 them include natural gas and oil, some of them
12 just attribute to natural gas, and there's
13 differences in operators, etc. But there's been
14 this scientific literature review published in
15 the *Journal of Science* and by Brandt from
16 Stanford and other collaborators including Bob
17 Harris at the EDF, that have done this analysis
18 based on a compilation of all these studies, and
19 their best estimate is that the actual leakage
20 might be 25-75 percent higher than what EPA
21 thinks, so that would put the actual leakage rate
22 in 1.85 to 2.63 percent, right?

23 So what if we apply this leakage rate,
24 let's say like EPA 1.5 corrected is something
25 between 2.0 to 2.99, and let's use 2.5 to see what

1 would be the benefit of switching gasoline or
2 diesel to natural gas.

3 So what this is showing is that there
4 would not be an immediate benefit by switching a
5 light-duty vehicle right now, but there would be
6 one in 40 years because of this reason, right,
7 like natural gas leaks more methane, which is bad
8 at the beginning, but eventually you will have
9 less CO₂. That is, I think, a relevant point.

10 For heavy-duty diesel vehicles, the
11 benefit will come so much later, but again I
12 think we need to understand that this is just a
13 bus that was running on diesel, that it's been
14 converted to a CNG bus, and there are other sort
15 of assumptions in these analyses that I think
16 might be more relevant than the actual methane
17 leakage, which is for example a 20 percent
18 penalty in fuel economy by switching from a
19 diesel compression engine bus to a CNG spark
20 ignition bus. So it's really not the fuel, it's
21 the technology, right?

22 And to illustrate that, I have run the
23 Grid Model which is the standard LCA model, Life
24 Cycle Analysis Model for Emissions, and what I've
25 done is gasoline compared to CNG in the first

1 row, these are compared to LNG, second row, so
2 first column will be incumbents, and second and
3 third columns will be natural gas, both at the
4 2.6 leakage, so the high sort of leakage
5 estimate, and the only difference between the
6 second and the third column is that the third
7 column has no fuel economy penalty and the second
8 column has the 20 percent fuel economy penalty.
9 So what you see, if you compare first and third
10 column, there is an advantage to both using CNG
11 and LNG, substituting gasoline and diesel,
12 respectively, given the best estimate of our
13 leakage rate right now. But if you give it a 20
14 percent fuel penalty, of course it looks worse,
15 right? So that's one thing.

16 And the other thing, you have to look in
17 all of these graphs I'm showing, the emissions
18 come from the different segments in the Life
19 Cycle Analysis. The first column will be
20 Feedstock Emissions that will be natural gas and
21 crude oil production, the next column will be
22 fuel emissions converting these commodities to
23 the final transportation fuel, and the third
24 column will be vehicle operations and those are
25 exhaust emissions. The fourth column is the

1 total. So you want to compare the total column,
2 right, which is what I just did, compared total
3 for gasoline to total from CNG with and without
4 the fuel penalty. But what I want you to see is
5 that, again, a majority of the emissions come
6 from the operation of the vehicle, so that's why
7 the fuel economy has such an important role,
8 maybe even a bigger role than methane leaks. And
9 of course, even if you convert everything to CO₂
10 equivalents, you still have this difference
11 between methane and CO₂; one has a higher warming
12 at the beginning and CO₂ will accumulate over
13 time so you will have more warming in the end.

14 So this is a debated strategy, whether
15 you should focus in mitigating one type of
16 emissions or the other, right? So what I'm
17 showing here, it's an IPCC graph that shows you
18 estimates of temperature change based on
19 different types of emissions. So the blue line
20 is the reference scenario, the emissions as they
21 are today. The green line would mitigate CO₂
22 emissions, so that would be equivalent to
23 favoring natural gas right now because it has
24 less CO₂ emissions, even though it might have
25 more methane. The orange line will be mitigating

1 methane type pollutants, so you will have less
2 methane at the beginning, but maybe more
3 emissions at the end. That would happen if you
4 use coal, you have less methane emissions now,
5 but then you will have more CO₂ accommodation.
6 And the purple line is basically mitigating all
7 sorts of emissions, which is what of course
8 everybody recommends.

9 But what I wanted here to show you is the
10 green and the orange. Again, the green is
11 mitigating CO₂, so that will be favoring natural
12 gas, and the orange is not favoring natural gas.
13 So you see that the two lines cross, right? At
14 the beginning the green line has more warming
15 because there's more methane, and then around
16 2008, it crosses the line where you would be
17 emitting more CO₂, right? But then after that
18 there is a shift, so you will have more warming
19 now if you use natural gas, therefore more
20 methane, but you will have less warming in the
21 future even though you have more methane now.
22 So, I mean, that's still debated, so that's a
23 decision that I guess policymakers need to make
24 where, you know, natural gas is better or worse.

25 MR. MCKINNEY: And Rosa, if I can ask you

1 to move to completion here?

2 MS. DOMINGUEZ-FAUS: Okay. So the final
3 thing I want to show and speak about is what we
4 are doing in terms of controlling these methane
5 leaks. So not many people are aware that the EPA
6 has different programs, they're called STAR
7 Programs as for natural gas, for coal, for intake
8 methane, and basically it is a guidance program
9 where companies voluntarily adhered to the
10 program, and then the EPA tells them where the
11 majority of the leaks are, what the technologies
12 are, what the costs, etc. So as we can see, the
13 big pie chart is showing that the majority of
14 methane leaks come from the oil and gas sector,
15 and then the other pie charts show you in the
16 different segments in the supply chain where the
17 majority of the leaks come. So we see that in
18 production, as well in venting and flaring, and
19 pneumatic devices, and in the other part of the
20 system is mostly compressors.

21 So the EPA also shows you a list of
22 technologies, costs, potential benefits, and
23 therefore you can calculate a payback period.
24 Most of the technologies have a relatively low
25 payback periods, a few months to a few years.

1 And this is a voluntary program that has achieved
2 reasonable levels of reduction so far, but it's
3 just voluntarily. But Obama is trying to make
4 one of the technologies in that list compulsory
5 after January 2015, maybe 2016, they're still
6 debating when to start it. And that's the green
7 completion, which is basically controlled
8 emissions at the drilling and fracking sort of
9 time. But this is only sort of pre-production
10 and production states, there are many others.

11 So what I want to show you is the
12 accomplishments so far with the natural gas STAR
13 program. Over the years it's been capturing
14 around 1,100 Bcfs of natural gas. Last year, or
15 in 2012, which is the last date I have, it was
16 66. That's still pretty low, it's just about 10
17 percent of what is actually being emitted, but
18 you have to realize this is sort of a voluntary
19 program that, you know, if we are capable of
20 regulating these, then everybody controls the
21 emissions, then we should be able to achieve
22 better reductions. The majority of reductions
23 have been at the production, what is shown in
24 blue in the pie chart, and transmission sort of
25 segments. And there's two examples here that

1 showed the incentive that these companies have in
2 applying these technologies to capture energy.
3 Basically Devon Energy at the production level
4 and Northern Natural Gas at the transmission
5 level. Both achieved significant levels of
6 recovery, which translated to millions of dollars
7 in profits, and in case of Devon, that was
8 equivalent to three percent of your annual
9 earnings in 2010. So that's a strong incentive
10 for companies.

11 MR. MCKINNEY: Great. Thank you very
12 much, Rosa, and Amy too. So that's kind of the
13 academic contribution to our panel today. Thanks
14 to both of you for kicking it off and I think
15 really setting the stage both for supply and
16 market issues and methane leakage.

17 Were there any questions from the dais
18 before we go to the next phase?

19 We now have three speakers from different
20 parts of the Environmental community, so first up
21 is Tim O'Connor from Environmental Defense Fund.
22 Tim is the Director of Environmental Defense
23 Fund's California Climate Initiative in San
24 Francisco. Since joining EDF in '06, Tim has
25 been engaged with state regulatory agencies and

1 Legislature on implementation of AB 32, with
2 particular focus on heavy industry alt fuels and
3 vehicles and compliance. And Tim's education
4 includes a Master in Environmental Management
5 from Duke and a law degree from Golden Gate
6 University. So, Tim?

7 MR. O'CONNOR: Thanks, Jim. And
8 Commissioners, thanks for the opportunity to
9 speak today. You'll see in my presentation
10 there's a lot of information, there's about 30
11 slides of which about 15 of them are really just
12 for information so that they could be submitted
13 sort of into the record, a lot of it is about the
14 studies that EDF is doing, so I won't go through
15 each of them word for word, but for reference
16 back. And also, Rosa and Amy, thank you so much
17 for your presentations, a lot of great
18 information back to refer to.

19 So EDF has been engaged in natural gas
20 work for the last several years and as the
21 science has emerged around the contribution that
22 methane emissions has to global climate change,
23 and looking at what is both a 20-year time
24 horizon at possibly 84 times of CO2 and really in
25 the first year over 120 times that in terms of

1 the contribution of CO₂, methane really has
2 emerged as a very significant contributor to
3 global climate change.

4 And when you look at really what that
5 means, looking at the IPCC data, you can actually
6 tell that upwards of one-third of the current
7 warming that the planet is experiencing is from
8 methane, from emissions of methane into the
9 atmosphere. And if you also were to look at what
10 control of methane can do in terms of bringing
11 down the leakage of natural gas, if we were to
12 actually implement all the cost-effective and low
13 cost strategies that are available in the oil and
14 gas sector across the U.S., that would actually
15 surpass all of the pollution reductions for
16 global warming pollution that you would get from
17 full implementation of the EPA 111D program
18 between now and 2030. And so this is not an
19 insignificant amount of emissions we're talking
20 about.

21 Rosa did talk about a paper that Ramon
22 Alvarez, a scientist at EDF did and had in PNAS
23 back in 2012; we updated the data from that paper
24 using the most recent IPCC estimates and,
25 actually, because of the global warming potential

1 now finding to be much higher, you can actually
2 see that the leakage that can occur in order for
3 natural gas to serve as a climate benefit
4 starting in year one has been reduced. So if you
5 look at it as natural gas being used to replace
6 coal, based on those AR5 estimates, you can only
7 have 2.7 percent of the natural gas leaking into
8 the atmosphere from the full lifecycle for it to
9 have an immediate climate benefit. And this is
10 not mean that if you have 2.7 percent or greater
11 leaking that it isn't a benefit to replacing
12 coal, it just means that in the first year as we
13 move out further and further down the time
14 horizon, it takes just a little bit longer for
15 natural gas to become a climate benefit and
16 really we should sort of pay attention here to
17 that bottom number for the heavy-duty diesel as
18 we saw pretty significant penetration rates being
19 planned possibly for the sector.

20 You can tell that a very low leakage
21 rate, you start to question whether in year one
22 you have climate benefit. And so this really
23 just means we need to be reducing natural gas as
24 much as possible in order to ensure that climate
25 benefit.

1 So who really knows, though, how much is
2 leaking? I think we heard that there's a fair
3 amount of information out there that shows that
4 some estimates are possibly lower than the actual
5 emissions rates, some are higher.

6 And so to try to really evaluate the
7 science around natural gas and methane, we
8 embarked on a partnership with over 90 academic
9 institutions and with 16 studies with several
10 business collaborators to evaluate really the
11 science around leakage. We broke this out into
12 five different portions of the lifecycle and have
13 tried to evaluate the emissions on the value
14 chain from each of the individual components
15 there. And there's a couple folks in the room
16 that we've been working with, whether it's in the
17 distribution side, or whether it's in the truck
18 side, or whether it's in the upstream production
19 side. And so I have not been the lead
20 collaborator from EDF, that has really been the
21 responsibility of a gentleman named Drew Nelson
22 and Ramone Alvarez, and they wanted me to extend
23 their thanks and gratitude for all the industry
24 partners that have been working with us, and all
25 the academic institutions that are really giving

1 this a lot of credibility.

2 They're all planning to be published or
3 submitted for publishing by the end of 2014, and
4 it involves a pretty significant effort, both it
5 has fly overs, also has vehicles that are
6 outfitted with various equipment and technology,
7 and really does involved academic institutions at
8 really ever part of the chain.

9 And when you look at the various studies,
10 what are we really looking at here? What does
11 natural gas leakage equate to? And if you just
12 look at a 1.2 percent leak rate from across the
13 U.S., you can really tell we're talking about
14 significant emissions, and we use so much natural
15 gas throughout our economy, we are really talking
16 about billions and billions of dollars of money,
17 of revenue that has otherwise leaked into the
18 air, or on a greenhouse gas basis equivalent
19 emissions equal to 112 million cars just from 1.2
20 percent worth of leakage.

21 Some might say, "Oh, 1.2 percent leakage,
22 that means we've kept 98.1 percent in the pipes,
23 that's pretty good." Well, no, this actually
24 means that we need to be driving further and
25 further down those emissions in order to make

1 sure that we're both keeping the economic benefit
2 and the climate benefit of natural gas as a fuel
3 source.

4 And just to take a quick step back, you
5 know, EDF has always tried to focus on where the
6 science lies and so this presentation is not
7 meant to say, you know, natural gas leakage is
8 too high, therefore we should not be using it as
9 an energy source, or that it means that once we
10 get to a certain threshold, then it's good. This
11 is all just saying we need to be driving
12 emissions lower and lower, as low as possible, in
13 seeking reductions and leak tightness throughout
14 the value chain, and not pre-judging various
15 technologies until the science really comes out,
16 but really trying to make sure we understand the
17 science and reduce the emissions wherever
18 possible.

19 So the next 16 slides are actually about
20 the methane studies. The first two are ones that
21 we have already published, the UT Study and the
22 Colorado Study really are sort of in the oil and
23 gas space looking at what are the emissions, and
24 both of them have sort of found that emissions
25 can be significant in the fields and comparing

1 the traditional inventories, finding that
2 emissions are probably somewhat higher than in
3 past.

4 Now these are not ordered in the order
5 with which they'll come out, most of them will be
6 submitted for publication by the end of this
7 summer, hopefully in time for this to be fully
8 into the docket. And again, I'm not going to
9 read through these, but just so folks have the
10 information. For this particular purpose, we're
11 looking for the vehicle side of the equation
12 really to highlight the ones where I think it's
13 most relevant and, indeed, this one, the
14 Washington State Study looking at the
15 distribution system and where along and
16 throughout the distribution system leaks are
17 occurring and what are the emissions I think is
18 going to be rather relevant for what we're
19 looking at here as natural gas, is fed further
20 and further into the economy for filling up
21 vehicles.

22 The Boston Local Distribution Study
23 really sort of looks at a different type of
24 system, one that has a lot more cast iron and
25 older pipes, and I think what we'll see and

1 people have been seeing from Boston, is just a
2 lot higher emissions throughout the system than
3 you would in, say, a much new system that is
4 maybe built more on plastic and piping.

5 Jumping forward, I think we'll go to
6 number seven, this is looking at again mapping
7 across urban areas throughout the U.S., really to
8 identify how utilities map their systems and
9 where the leaks are in those systems, and really
10 how we develop a good rapid response network for
11 being able to identify and fix the
12 infrastructure. Probably the most relevant one
13 here is the West Virginia study on pumped wheels
14 and looking at sort of what are the emissions
15 both on the vehicle and in the refueling station.
16 And again, the folks from EDF decided, when I was
17 talking about this, they said I can't actually
18 present any data for these studies since they're
19 all under review right now, all the data has been
20 collected, is being evaluated and prepared for
21 submission, and I'll be submitting them into the
22 record once we're done.

23 And finally, probably the most important
24 ones as we get into transmission and storage is
25 obviously relevant and Indianapolis is going to

1 provide us another one, but slide 15 is really
2 putting all the data together, you know, what
3 does the full lifecycle emissions from various
4 usages tell us from these studies? And I think
5 as we look at not just the EDF 16 studies, but
6 also studies we've already seen starting to get
7 developed in the Central Valley Region of
8 California, the stuff that the Energy Commission
9 and ARB are coming out with, we hope to really
10 sort of put a finer point on where are the
11 emissions inventories in relation to actual
12 emissions. And as we try to sort of move away
13 just from the science of what are the emissions,
14 similar to the NRDC Study I think you'll hear in
15 just a second, we hired an ICF consultant to do
16 an evaluation of what are some of the emission
17 reductions opportunities in the natural gas
18 sector, and we created sort of a McKinsey style
19 cost curve looking at the costs, as well as the
20 reduction potential at various points along the
21 value chain. And from this, we developed really
22 kind of a cost-effectiveness infographic, if you
23 will, showing that -- and if you look on this
24 chart on the right-hand column, everything that
25 is in green where it has a little green dollar

1 sign, that's everything that's actually cost
2 negative, the cost savings immediate per million
3 standard cubic feet reduced. And everything that
4 is also in the gray, the less gray bubbles, the
5 cheaper it becomes. And so you can see that
6 actually based on the ICF work, which looked at
7 the whole value chain both from the upstream
8 production and from the midstream and the
9 downstream, that although emissions are likely to
10 grow over the next five to 10 years, and a lot of
11 that is going to be coming from infrastructure
12 today, we can actually cut methane emissions at a
13 very low cost in a very high percentage through
14 technology that exists right now. And when you
15 look at what this is in terms of cost savings, at
16 less than a penny per thousand standard cubic
17 feet produced, you can have significant
18 reductions and really from day one many of these
19 pay for themselves.

20 And so we have a webpage which is devoted
21 to our methane studies, that's identified here in
22 the presentation. And really this is just meant
23 to be a backgrounder on the kind of work that
24 we're doing. But also if you look at sort of
25 what ICF is finding, what others in the industry

1 are finding, what the industry partners
2 themselves are finding, is that even though
3 methane of course is and natural gas is quite
4 cheap compared to where it was in the past, and
5 maybe folks want to be producing liquids as
6 opposed to dry gas, there is both an economic
7 benefit in savings, as well as a huge climate
8 benefit for being responsible for this. And even
9 though in California if we may not be doing much
10 dry gas development and fracking for that gas,
11 you know, it's coming here. We are the
12 beneficiaries of oil and gas production across
13 the U.S., and in order to be good stewards for
14 that energy that comes to California, we really
15 need to be responsible in how we use it and in
16 our system as we move forward. Thank you very
17 much.

18 MR. MCKINNEY: Thank you very much, Tim.

19 COMMISSIONER SCOTT: A quick clarifying
20 question before you step away. Thank you, Tim,
21 that was a fantastic overview and it's music to
22 my ears to hear that we'll get all of this into
23 our docket when it's ready. On your slide 8, I
24 think it was, where you were showing the 1.2
25 percent leak rate, is that across that entire

1 supply, so that's an average across the supply
2 chain?

3 MR. O'CONNOR: Yes, that's correct.

4 COMMISSIONER SCOTT: Okay. I just wanted
5 to check. Thanks.

6 MR. MCKINNEY: Great. So our next
7 speaker is Dr. Simon Mui with the Natural
8 Resources Defense Council. So Simon is a Senior
9 Scientist and Director of NRDC's Advocacy and
10 Research on Vehicles and Fuels in California.
11 And over the past six years, he has engaged in
12 various state and regional efforts to cut climate
13 pollution from the transportation sector. Simon
14 is a native of California and has an
15 undergraduate degree from U.C. Berkeley and
16 received both a Masters and a Doctorate from MIT.
17 So welcome, Simon.

18 DR. MUI: Hi. Thank you, Commissioners
19 and thank you for organizing this workshop, CEC
20 staff. Great to see the IEPR workshops really
21 delve into some of the issues that are actually
22 challenging to understand, some of the
23 controversy with some of the natural gas leakage
24 issues. You know, we've had some great
25 presentations already, so I'm going to try to

1 skip over some of the areas that may be
2 duplicative or covered already. We've got a
3 great background in terms of what Amy and Rosa
4 presented in terms of the overall inventories, as
5 well as the market assessments and lifecycle.

6 So one thing to remember with the natural
7 gas production is that we're talking about oil
8 and gas production really in terms of leakage, in
9 terms of methane emissions, with the majority
10 being actually from the gas production, but oil
11 production being a major part as well. Most of
12 the emissions occurs upstream at the production
13 site overall, so for gas production, about two-
14 thirds, based on EPA's inventory as in for oil
15 production basically the majority happens at the
16 crude oil production site.

17 You know, just on oil production, I
18 thought it would be helpful to show an image of
19 the significance of some of the methane leakage.
20 Here we have the Bakken shale compared and I
21 think this is probably for energy wonks, you
22 know, sort of been circulating quite a bit, but
23 it does show that flaring is quite a major issue
24 with some of the oil production, as well. And
25 here, Bakken North Dakota, I think Amy showed

1 some of the geographic locations compared to
2 Chicago and Minneapolis during the nighttime, but
3 what you see is the flaring essentially lighting
4 up the state, enough so that you can actually
5 view it from satellite imagery; this one is from
6 NASA and NOAA. This image is down in Texas,
7 Eagle Ford Shale, showing in the red lines the
8 kind of corridor of shale production compared to
9 Houston and Dallas Lights.

10 You know, there's a lot of knowns and
11 unknowns right now and what we do know is that
12 methane is a powerful global warming pollutant.
13 We know that the emissions are growing. And what
14 we did in 2012 was start looking at the
15 technologies to address the methane leakage, and
16 what we do know is that this is eminently
17 controllable. The leak in profits studies which
18 I'll talk about showed that 10 cost-effective
19 technologies alone could address really most of
20 these emissions. Where we need a better
21 assessment on better information is really the
22 inventory which Adam Brandt, Stanford, and a
23 variety of other researchers at Harvard and
24 elsewhere conducted a study recently that
25 published in February, showing that the EPA

1 inventory may be underestimated by 25 to 75
2 percent.

3 In terms of leakage assessment, we have
4 to know just how much, and from where, and
5 studies from EDF will be really vital to
6 providing more information for scientists and
7 policymakers to evaluate really the things like
8 fuel cycle assessment, what is the GHG emissions
9 in Natural Gas Vehicles versus diesel vehicles?

10 And what I show here is basically just
11 some slides from the default assumptions from the
12 recent GREET -- this is Argon's model -- between
13 GREET 2012 and GREET 2013. And the real
14 difference is really the EPA inventory
15 assessments of leakage, and basically I think
16 Rosa commented that the earlier study had a
17 higher emissions leakage and the latest study had
18 lower. We expect those numbers to go up
19 potentially given some recent studies, including
20 grant studies. But the short study is that
21 vehicles fueled with fossil base, and I clarify
22 fossil-based natural gas may have higher or lower
23 emissions basically. This is over a 100-year
24 timeframe and the one caveat is this is for --
25 GREET evaluates passenger vehicles, so this is

1 not for the truck side, but basically you'll see
2 similar results from heavy-duty because it really
3 comes down to the fuel economy differences.

4 In the red you see here is basically the
5 methane from the upstream emissions, and they can
6 be higher, in this case we've got about I believe
7 three percent in the bars on the left-hand side,
8 and then basically the reassessed EPA numbers,
9 which is one and a half percent.

10 And I think we talked a little about it,
11 but basically their sensitivity, of course, to
12 things like timeframe to which global warming
13 potential utilized as you evaluate these
14 emissions, these fuels, and obviously if you're
15 concerned about near term impacts in terms of
16 global warming, like Tim has talked about from
17 EDF, you'd be looking more at the right-hand
18 side, and if you're concerned more about the
19 longer term 2,100 type scenarios, you'd be
20 looking more at the left-hand side.

21 What's important, though, and this was
22 not included in the packet, so I'll send an
23 updated slide for the website, but basically one
24 of the important stories, I think, is that
25 regardless of where methane leakage is, fuel

1 efficiency, the type of source for the gas,
2 whether it's fossil biogas, is very important
3 regardless of where the methane leakage is. And
4 the reason is because if you are in a scenario
5 where you're trying to get deep reductions, you
6 know, frankly fossil natural gas might not get
7 you there, that you really do start needing to go
8 towards high efficiency vehicles, as well as
9 bringing in your carbon intensity significantly
10 down. And so I don't think most studies I've
11 seen haven't really necessarily disagreed with
12 that, but here you see the potential for things
13 like biogas from animal waste, biogas from
14 wastewater, landfill gas, being pretty 90 percent
15 and even negative in some cases, and mainly
16 because that is methane that would have been
17 released anyhow into the atmosphere, so utilizing
18 that, capturing that has significant benefits
19 climate-wise. I think one of the questions which
20 Amy addressed is potential volumes and
21 limitations in terms of blending them into the
22 pipelines, blending them over time, what is the
23 timeframe of that?

24 As I said before, our study in 2012
25 really identified just 10 technologies and just

1 looking at 10 profitable technologies, what we
2 found was that, versus a no control case, versus
3 a no standard case, it resulted in over 80
4 percent reductions in the methane leakage from
5 these technologies if they were deployed. This
6 does not look at feasibility, this is not a
7 technical feasibility study, but it did look at
8 the potential reductions. And what it found was
9 similar to other results, the discussion around
10 green completion, so basically having closed loop
11 systems for the liquids and gasses that come out
12 during a completion of a well, really critical.
13 This is now being what we would say partly
14 regulated under EPA's New Source Performance
15 Standards, which actually regulates volatile
16 organic compounds, which is not a direct control,
17 but actually has co-pollutant benefits for
18 methane.

19 So what the next slide shows here is that
20 many of these technologies are in fact -- the
21 pay-off period in many cases is two years or less
22 for these 10 technologies. And so there's a very
23 short payback period. So one of the things that
24 I'll mention is that critical in all this is
25 cleaning up existing fuels production. So the

1 EPA Regulations going forward right now are very
2 critical, making sure that existing sources, as
3 well as new sources get covered, that methane is
4 directly regulated, and that facilities are
5 actually given a list of technologies that are
6 essentially identified and needed. We see all of
7 those things as being very necessary to
8 controlling methane emissions.

9 And one of the major reasons why a lot of
10 these technologies haven't been deployed goes
11 back to, while the companies do have very high
12 capital internal rates of return, so they are not
13 willing to even in some of these cases fund
14 projects if the capital is more profitable in
15 other areas, and this is a very challenging area,
16 but in terms of environmental benefits there are
17 tremendous benefits to regulating these types of
18 emissions. We really shouldn't be wasting
19 methane like this.

20 Finally, I think Rosa commented that
21 vehicle efficiency is critical. And so
22 regardless of the fuel type that you utilize,
23 regardless whether it's fossil-based diesel,
24 whether it's natural gas, even electricity, you
25 really want to have policies that drive vehicle

1 efficiency to improve because that's where you'll
2 get a big bang for your buck. Fuels switching to
3 lower carbon intensity fuels where you can is
4 critical, as well, to the long term climate
5 goals.

6 And, you know, backing up a little bit,
7 even in the heavy-duty space, thinking more about
8 transport modes, about efficient transport modes,
9 the balance between trains and barges is very
10 critical, as well. So that is my presentation
11 and if you have any questions, I'd be happy to
12 follow-up.

13 MR. MCKINNEY: Thank you very much,
14 Simon. Our next speaker is going to be John
15 Shears. John is CEERT's Project Team Leader for
16 Clean Transportation Issues including vehicle
17 technologies and alternative fuels. He is well
18 known to us here at the Energy Commission for his
19 work on our Advisory Committee for AB 118, and he
20 is also on the Boards of the California Fuel Cell
21 Partnership and California Plug-In Vehicle
22 Collaborative. So, welcome John.

23 MR. SHEARS: Good afternoon, everyone.
24 Good afternoon, Chair Weisenmiller and
25 Commissioner Scott. And thank you for the

1 opportunity to speak to you today on the issues,
2 the challenges facing us in developing natural
3 gas opportunities in the future.

4 I just want to take a slightly higher
5 level approach to start, put this more in sort of
6 the broader climate context in looking at what's
7 going on with methane globally. In the southern
8 latitudes, it's dominated by biogenic sources and
9 in the northern latitudes, where population
10 dominates, the emission sources are dominated by
11 anthropogenic sources, and especially the natural
12 gas and oil industries are an important emission
13 source in the northern latitudes.

14 I just wanted to show what's going on
15 with methane in terms of global average
16 concentrations as of late. During 1999 through
17 2007, it seemed like methane emissions had
18 plateaued and some type of equilibrium had been
19 arrived at within the global bio geosphere, and
20 then in 2007, methane emissions started to climb
21 again. The climate researchers that work on
22 methane and its role in climate have posited that
23 not only due to feedbacks that they can assess
24 indicating that there are greater emissions
25 coming from the tropics, largely from wetlands,

1 they've also posited that the northern latitude
2 oil and gas industries' recent uptick in activity
3 is responsible for this resurgence again in the
4 increasing emissions trend for methane.

5 So if we look at the global inventories
6 for emissions, just highlighted here coal, oil
7 and gas essentially are an important signal here
8 in the northern latitudes, especially agriculture
9 is also an important source of emissions if we
10 look at the most recent EPA inventory, it also
11 confirms for the United States that the oil and
12 gas industry and the coal industry are important
13 sources of methane emissions.

14 And I wanted to touch on the fact that,
15 yes - actually, not touch on, but stress in my
16 talk that, yes, while there are indeed practical
17 ways of monitoring the natural gas infrastructure
18 and the oil and gas infrastructure systems, and
19 there may be cost-effective ways of dealing with
20 emission sources, that we're talking about a
21 scaling problem here. When we look at the total
22 scope of the infrastructure, and here what I'm
23 highlighted are facts in terms of the number of
24 facilities, miles of pipelines, number of storage
25 facilities, compressor stations along pipeline

1 systems, etc., from the EIA website, it still is
2 a significant task to be able to monitor and
3 police everything that is going on nationally and
4 also within the state. So I just included one of
5 the maps from the EIA website to sort of give you
6 a visual on the extent of infrastructure and the
7 associated compressor station system, and this in
8 fact is really data the EIA hasn't updated since
9 2007-2008.

10 Now we're dealing with the oil and gas
11 boom and, as these projections from the EIA
12 Annual Energy Outlook suggests, we're going to
13 have massive increases in production, and also
14 we're going to have to have matching increase in
15 infrastructure to keep pace with that production.
16 I've included some numbers on well drilling rates
17 from a recent paper that technically is not in
18 print yet from researchers in the UK doing an
19 assessment of oil and gas industries around the
20 world as part of an analysis for oil and gas
21 industry prospects in the UK. Clearly, the U.S.
22 has the dominant activity globally in terms of
23 drilling activity. When we look at the number of
24 oil and gas wells, according to this same study
25 with the UK-based research using EIA data, there

1 are over 2.5 million wells that have to be dealt
2 with and tracked, and for Alberta, I've taken
3 some of their data and updated it from other
4 sources in Canada, just in Alberta alone they're
5 just shy of 360,000 wells in Alberta alone, that
6 does not include British Columbia, Saskatchewan
7 and Manitoba that also has some activity, and any
8 offshore activity in Eastern Canada. So all of
9 these wells also have to be policed and
10 monitored. And then the gas pipeline system is
11 also expanding rapidly to keep pace with
12 increased production.

13 In California we have nearly 80,000 oil
14 and gas wells that have to be policed, most of
15 the straight up natural gas wells are in Northern
16 California, those are the blue dots, leaded and
17 natural gas production in Southern California is
18 what is called associated gas that is collected
19 as part of oil drilling.

20 So I want to focus on Adam Brandt's and
21 his co-author's paper from earlier this year,
22 which has been highlighted by Rosa and I think
23 both Tim and Simon also mentioned Adam's paper.
24 In his paper, he and his co-authors reviewed 200
25 other studies that were in print, that had

1 already been published, whether peer reviewed
2 academic journals, but also technical
3 publications that had been published by reputable
4 consultants and the like, and they had calculated
5 this 25-75 percent higher emissions rate over
6 what the EPA inventory would indicate. At the
7 same time, they offered cautions in that -- and I
8 highlight in red -- current inventory methods
9 rely on key assumptions that are not generally
10 satisfied. And if you go to read their article,
11 the articles actually pointed at policy people
12 and regulators, and they want to stress to folks
13 that there are a lot of problems right now with
14 the literature that's out there and there need to
15 be improvements in the way both researchers and
16 regulatory agencies need to work with industry to
17 get a better handle on what's going on. The EDF
18 efforts are certainly going to be very helpful,
19 but probably there will have to be much more work
20 done even beyond that. I think the EDF work
21 basically kicks off and hopefully addresses a lot
22 of the concerns that I have listed here, I won't
23 read them off because everyone else can read,
24 there are a few pages, but the one thing I would
25 like to highlight, too, is that they did note

1 that the problem seems to be a problem of super
2 emitters. But even with that, that still
3 requires that you are vigilant and are monitoring
4 the systems thoroughly and on a regular basis so
5 that you can actually detect or develop some way
6 of predicting where you should be able to locate
7 breakdowns in the system so that you can locate
8 those super emitters. I didn't get into the
9 issues around the debate in the research and
10 industry literature about failure rates at capped
11 and active wells, there's quite an extensive
12 debate going on there, so that's an example of
13 where you might be able to develop a way to
14 predict where you should go to revisit wells, to
15 make sure that they don't fail and start having
16 emissions problems.

17 I've included the changes and the
18 emissions factors from the IPCC, so right now
19 U.S. EPA and CARB traditionally have been using
20 the global warming potential from the 1995 second
21 assessment report, whereas in the current
22 assessment report, if we look at the updated
23 significantly higher global warming potential, at
24 some point industry and regulators are going to
25 have to address, you know, how that adjusts, you

1 know, how we all work together. Both Simon and
2 Rosa included some of these adjustments in their
3 work, so that was helpful.

4 And then I want to touch also on the
5 issue that methane is an important air pollutant,
6 not just a greenhouse gas pollutant, but it has
7 different roles depending on whether you're
8 talking if it's located in the stratosphere, in
9 which case it's a problem for maintaining ozone,
10 whereas in the troposphere, or down at ground
11 level, it actually is involved in the cascade of
12 reactions that can increase ground level ozone.

13 So when we're looking at drilling
14 projects, and this is taken actually from the --
15 I took the graphic from InsideClimate News the
16 list of sources at the developing well pad from a
17 report just released by the Alamo Area Council of
18 Governments, and I'll provide an updated slide
19 deck with that reference for the Energy
20 Commission and for posting to the website, but
21 they highlight all of these issue areas as being
22 problematic for local air pollution. You know,
23 granted, here in California we tend to regulate
24 air pollution emissions a little better, but
25 still any increased activity around Monterey

1 shale will be of concern to the local communities
2 and Southern California.

3 So with that, I'll just finish again with
4 the Ramone Alvarez, et al. notation about again
5 using the technology warming potential as opposed
6 to global warming potential, but that the old
7 calculation, whether we're talking 2.7 percent,
8 as Tim updated us, or the 3.2 percent that Rosa
9 mentioned, roughly a 3.0 percent leakage rate
10 could negate the benefits of natural gas relative
11 to a clean coal power generation facility. So we
12 need to get a better handle on this and work
13 together to make sure that we don't just provide
14 fleeting attention, but that we maintain
15 vigilance on this going forward. Thanks.

16 MR. MCKINNEY: Great. Thank you very
17 much, John. Commissioner Scott, that concludes
18 both kind of the academic and environmental part
19 of our program. Did you have any questions from
20 the dais or the Chairman?

21 COMMISSIONER SCOTT: I do. I have a
22 clarifying question, John, from you on your slide
23 about the IPCC assessment of the global warming
24 potential of methane. And it's just up here on
25 the top with the global warming potential in 100

1 years, and it says "with CCFB and without CCFB"
2 and I just didn't know --

3 MR. SHEARS: Oh, sorry, with Climate
4 Change Feedback, Without Climate Change Feedback.

5 COMMISSIONER SCOTT: Thanks a lot. Thank
6 you for that. And I also wanted to invite
7 Valerie Winn from PG&E to come and just give us a
8 word or two on the early detection program that
9 PG&E has going on, and then I'll turn to the
10 Chair to see if he has any questions.

11 MS. WINN: Good afternoon, Commissioners.
12 Thank you for letting me speak on these important
13 issues because methane leakage is an issue that
14 we've been looking at, and while we don't have
15 really hard numbers yet on the methane leakage
16 from our system, we are looking for ways now that
17 we can begin to reduce those emissions. And
18 really reducing those emissions goes hand in hand
19 with our enhanced safety program because, as we
20 are looking at how to safely operate and maintain
21 our system, part of that is improved leak
22 detection. And we have been one of the industry
23 leaders in new survey techniques. We have a
24 Picarro System that is one thousand times more
25 sensitive than earlier technologies at detecting

1 leaks. And so we've been really pushing that
2 technology out there and getting really good
3 results from it.

4 One of the things that we are concerned
5 about, though, is that as we're looking to reduce
6 methane, it's getting the regulatory support that
7 we need to really advance these programs. For
8 example, in our recent General Rate case, we had
9 proposed to do leak surveys once every three
10 years and the Proposed Decision that we just
11 received last week would have us doing the
12 surveys once every five years. And so we really
13 think that there are benefits to doing these leak
14 surveys more frequently. And we're hopeful that
15 we could identify and repair those leaks more
16 quickly than what we may get in the General Rate
17 case.

18 We also think that there are certainly
19 areas for increased research and development in
20 this area, and we look forward to working with
21 the CEC and with other partners on research in
22 that area. Thank you.

23 COMMISSIONER SCOTT: Thank you. Any
24 questions from the Chair?

25 CHAIRMAN WEISENMILLER: All right, I

1 wanted to thank everyone for their presentations
2 and certainly encourage everyone as reports are
3 ready to file those with the Commission in the
4 docket, and I'd also encourage your participation
5 in our ongoing research in these areas to, again,
6 make sure that we're developing a strong database
7 for California on these issues.

8 I would note, yeah, when PG&E did the
9 leak detection tour for me, and I don't know how
10 many others have seen that, it's pretty
11 impressive technology, and my question was how
12 fast we could do it. And particularly moving on
13 from the neighborhoods to areas where there's
14 potentially high consequence, you know, of trying
15 to do those surveys. So it was sort of shocking
16 the PUC went from once every three years, I would
17 probably be happier if it was like two, to five.
18 So, anyway, that's something for those of us
19 concerned about not methane as a greenhouse gas
20 issue, but also safety, that you may want to
21 weigh in on that.

22 MR. O'CONNOR: Thank you, Chair
23 Weisenmiller. This is Tim O'Connor from
24 Environmental Defense Fund. And indeed we've
25 been really evaluating what are the best

1 practices for leak detection and how are various
2 utilities across the U.S. doing, and I think what
3 we've seen is, depending on the age of the
4 utility, depending on how rigorous they are and
5 the regularity with which they perform detection,
6 you actually do have a demonstrable change in the
7 amount of leaks in the system. And so the more
8 you check them, the more you are able to find
9 those and reduce those.

10 We've been working on a bill actually in
11 the State Legislature that's aimed specifically
12 at leak detection and repair, and we think it has
13 an opportunity for making it through the
14 Legislature this term, SB 1371, and as that
15 progresses we'll be alerting the Commission where
16 it's going and so that it's in the docket, as
17 well.

18 CHAIRMAN WEISENMILLER: That's great, and
19 obviously one of our other common issues is to
20 make sure the cast iron pipe is out of San
21 Francisco, and I think PG&E has made good
22 progress on that, but that is certainly one of
23 the more significant issues is the type of pipe.

24 MR. O'CONNOR: Yeah, and in that vein, I
25 do know that recently Con Ed up in the service

1 territory in the Northeast actually just received
2 funding to replace, I believe, all of its cast
3 iron pipes, or very significant portions of it.
4 So across the U.S., there's a real focus on cast
5 iron piping and the need to upgrade and remove
6 it.

7 COMMISSIONER SCOTT: Great. Well, that
8 was a terrific panel. Again, we just have so
9 many experts and just a lot of great interesting
10 information and a lot to take in, so please do be
11 sure, as the Chair has said, to send us all of
12 your studies and data and information so that we
13 can take in all the underlying work, as well.

14 I'm going to turn it back over to Jim for
15 Panel 3, but I'm just going to note that I
16 appreciate everyone's indulgence today with a
17 very ambitious agenda that we have, lots of
18 speakers, lots of great information, and so to
19 make sure that we get through it all Jim is going
20 to be a task master and start waving at you when
21 you get close to one or two minutes left in your
22 presentation, just to make sure that we get to
23 hear from everyone as we continue through the
24 day. So that's for that. I'll turn it back over
25 to Jim.

1 MR. MCKINNEY: Yeah, and actually
2 Commissioner, I'm actually going to lunge off the
3 table when we get past the 12-15 minute mark.

4 So Silas and I are sharing moderator
5 duties this afternoon, so Silas is going to
6 moderate panel 3.

7 MR. BAUER: All right, so Panel 3 is
8 going to look at Natural Gas Supply and Sales.
9 We have three presenters, panelists, George
10 Minter from Southern California Gas Company, Todd
11 Campbell from Clean Energy, and Julia Levin from
12 Bioenergy Association of California. Just to
13 follow-up on Commissioner Scott's point, please
14 as much as you can try to keep your presentations
15 to 10 minutes just for the timing overall.

16 So starting off with George Minter,
17 George is currently the Senior Director of Policy
18 and Environment at Southern California Gas
19 Company. He is a Public Policy professional with
20 35 years' experience in energy and environmental
21 affairs, policy development, communications
22 strategy, and political advocacy. George is the
23 father of two grown children, married, and lives
24 in Pasadena, California. He is a Phi Beta Kappa
25 and Honors Graduate of the University of

1 California at Berkeley. So, George?

2 MR. MINTER: Thank, you. One of my kids
3 is an environmentalist and keeps me on the
4 straight and narrow, so... I guess that's why you
5 must have put that in there. He's following in
6 his dad's footsteps, actually.

7 Mr. Chair, Commissioner, thank you. I
8 think I'm here to kind of provide a broad
9 overview where we think the gas industry is
10 going, needs to go, and where the gas company,
11 Southern California Gas Company, is headed. And
12 I think that Todd will be providing a lot more
13 detail with respect to the transportation market
14 opportunities and growth, and then Julia of the
15 Biogas/Biomethane potential and opportunity.

16 We start from the perspective that we're
17 an energy company providing natural gas, and
18 we've got to address energy use, we've got to
19 reduce our emissions, and that means we've got to
20 work on technology and we've got to drive
21 emissions down on technology, but we also have to
22 look at our fuel and we have to drive the carbon
23 content down on our fuel. We see many of the
24 state's planning documents really focused on
25 electrification of energy end use, it's focused

1 on de-carbonizing the electric generation sector.
2 Our focus is to develop near-zero zero equivalent
3 technologies, technologies that are power plant
4 equivalent, or electric generation equivalent.
5 To do that, we've got to reduce emissions, we've
6 got to also address our fuel.

7 Decarbonizing the pipeline is the future
8 direction. We need to go from geologic supply to
9 biologic supply and ultimately to hydrogen,
10 hydrogen blends, and synthetic methane. Now,
11 that's a long term future, but I think it's
12 important that we direct ourselves to that long
13 term future. But there's also a short and a mid-
14 term, and it's really important, particularly for
15 Southern California Gas Company, which has 80
16 percent of its marketplace in the two extreme
17 non-attainment regions in the United States, the
18 only two in the United States, and that's the San
19 Joaquin Valley and the South Coast. And the
20 problem is ozone. And the problem with ozone is
21 NO_x. And here you have a chart that looks at
22 South Coast NO_x emissions and you've got almost
23 90 percent coming from the transportation sector.
24 We already saw the pie chart where 38, almost 40
25 percent of GHGs are coming from the

1 transportation sector.

2 So we have a dual problem and I think
3 it's really important for energy and
4 environmental policy and planners and
5 commissioners to realize that it's a dual
6 problem. We have a short and mid-term NO_x
7 problem, criteria pollutant, it's governed by
8 federal law, and we have a longer term GHG
9 problem in California governed by state
10 requirements for 2020, AB 32, and the Governor's
11 Executive Order for 2050, but it's a much longer
12 timeframe on the GHG front.

13 I think many people would say that living
14 in the South Coast in the L.A. area, particularly
15 in poor communities, would say driving down ozone
16 is a priority. Certainly it is with short and
17 mid-term, these are federal requirements. We
18 have a 2023 requirement and a 2034 requirement,
19 and both of those are long before the 2050
20 requirement for GHGs.

21 Where is it at? It's at trucking, it's
22 at transportation sources. Transportation is the
23 problem, it's the NO_x problem. And if you look
24 at the top 10 emitters in the South Coast, heavy
25 duty diesel truck far and away exceeds any other

1 source of emissions. That's where the problem
2 is, but that's also where the opportunity is.
3 And the opportunity is great, and we've heard
4 some of that discussion today, we'll hear much
5 more of it tomorrow.

6 But it isn't just trucking, it's all of
7 the transportation sources. And if you think
8 about goods movement, it isn't just trucking but
9 it's rails, it's locomotives. It's also marine,
10 it's shipping. It's also the other areas of
11 goods movement which would include a lot of the
12 equipment movement, the power requirements for
13 equipment movement.

14 If you look at just the goods movement
15 sector, we're looking at about 40 percent of all
16 the emissions in the South Coast. What's
17 exciting -- and I'll get to methane emissions and
18 what I think is the positive story behind the
19 story we just heard on methane emissions, which
20 very briefly is everything is headed in the right
21 direction, which means emission rates will go
22 down because of all this concern and attention --
23 but what's exciting is that the marine sector and
24 the rail sector are making inquiries today and
25 quickly want to move to LNG fuels.

1 When you look at the volumes, rail is a
2 very significant volume, but marine just eclipses
3 in terms of volume and in terms of emission
4 reduction potential, eclipses the amount of LNG
5 that would go into long haul trucking. When you
6 complete displace your bunker fuel which is very
7 very dirty, much dirtier than diesel, with LNG,
8 you have tremendous emission benefits, not just
9 obviously NO_x but GHGs as well.

10 And we just had an interesting meeting a
11 month ago with the Port of Los Angeles, they're
12 meeting with us, and I'm trying to understand our
13 supply capability, our delivery capability, high
14 pressure transmission lines to deliver into the
15 port, they are asking us where are we going to be
16 building our liquefaction facility to refuel the
17 marine demand and to utilize that to provide
18 refueling for the locomotives originating out of
19 L.A., as well as to have in the harbor area
20 liquefaction to supply LNG for trucking. And
21 that's happening now. We actually are working on
22 that and looking at how you do liquefaction, and
23 they actually have a vision. Their vision was we
24 want a small scale low head liquefaction facility
25 on every pier, and we want that to provide LNG

1 refueling at every pier for every ship, as well
2 as to provide the natural gas for fuel cell and
3 micro turbine that will provide 100 percent shore
4 power. That was kind of their vision. That's a
5 pretty exciting vision.

6 What's driving NGV growth? And I think
7 that, Todd, you'll get into this a lot more,
8 there is a continuing price differential, the NO_x
9 emission requirements in the South Coast and San
10 Joaquin Valley would really drive the use of
11 natural gas in the truck market, and I think over
12 time the pressure to reduce GHG will also move us
13 toward natural gas.

14 This is very simply sort of what
15 comprises the price differential, it's important
16 to note here that the commodity price for natural
17 gas is a smaller component in the overall price
18 of delivered natural gas as a transportation fuel
19 than diesel. We think even if the commodity
20 price would double, that we would only see about
21 a 50-cent per diesel gallon equivalent price
22 differential. So we anticipate, and other
23 speakers have said, that over the long term there
24 will always be a price differential. And clearly
25 the truckers and the rail companies and the

1 marine companies are seeing this. In Europe the
2 shippers are already moving to LNG, we're seeing
3 inquiries now in the United States, it will
4 continue.

5 And this actually is work that was done
6 by GNA, Gladstein Neandross and Associates, on
7 our behalf looking out over time on the price
8 differential, looking at sensitivities, and
9 basically documents for us that the price
10 differential will continue to remain a driver.
11 Natural gas pathways aren't just for the short
12 term, and I think again it's important to
13 emphasize we need to move in this direction to
14 get the NO_x emissions we need to get to meet
15 federal requirements in Southern California. And
16 that's short and mid-term. But over the long
17 term, we need to de-carbonize the pipeline to
18 address the GHG reductions. Well, how do we do
19 that? Well, I indicated we move from geologic to
20 biologic. We've got to build our biomethane
21 opportunity. We've got to develop green pathways
22 for hydrogen. And we've got to look at hydrogen
23 blends and Methanation. When you look at
24 renewable gas, and I think one of the earlier
25 speakers had a similar chart, this is based on

1 the carbon content value under the LCFS program
2 and ICF did some work for us, and basically
3 renewable natural gas has a very low, lower than
4 average electric generation carbon intensity, and
5 even a negative carbon intensity, depending on
6 the type of renewable natural gas.

7 The view here is that we've got to move
8 renewable natural gas into the pipeline, it can
9 be a hydrogen stream for hydrogen use, it can be
10 a methane stream for pipeline use, it can go to
11 transportation, it can also go to other uses,
12 electric generation, it can go to normal
13 household natural gas heat-oriented, water
14 heating, space heating, clothes drying, even
15 cooking. That's sort of the biologic fuel.

16 Now people ask, and I don't know, Julia,
17 if you're going to get into this, but people
18 said, "Well, what's the volumes?" And the DOE
19 and the National Petroleum Council have done
20 studies and it looks like it's 17-20 percent of
21 the throughput could be displaced by existing
22 biologic resources, landfills, wastewater
23 treatment, dairy, Ag, Woodland waste, urban
24 waste, we're looking at what's the next 20
25 percent and the pathway for biodiesel and

1 biofuels that the ARB has kind of laid out is
2 also a biomethane pathway, I mean, biomethane is
3 the pre-stage to biodiesel, to liquid biofuels.
4 And our view is if the transportation market
5 moves to gaseous fuels, as we see it will move,
6 that biomethane will be the choice for
7 transportation use, not liquid biofuels. So we
8 see the potential of going from 20 to 40 percent
9 de-carbonization just from biologic resources.

10 But the real mid to long term challenge
11 is how do we produce hydrogen and how do we
12 methanate hydrogen and put it into the pipeline.
13 And I think that we're coming into a situation
14 that Germany and the European Unions came into
15 several years ago. They had an over-supply of
16 electricity, it was challenging the transmission
17 system, they were offloading some to Sweden, the
18 federal government stepped in and said, "Look, we
19 need to opportunistically identify where there
20 are constraints in the system, instead of
21 shutting down -- this was a wind resource --
22 instead of shutting down turbines, let's continue
23 to run those turbines at night, direct that
24 electricity to power electrolysis of water which
25 produces hydrogen, and then we have green

1 hydrogen pathways, and you can have hydrogen for
2 direct use, but you can also then
3 opportunistically take CO₂ pathways, captured CO₂
4 from power plants, from industrial operations,
5 and methane that hydrogen and direct it right
6 into the natural gas delivery system.

7 We think that, just to come to a close,
8 there are things that regulators can do. Let's
9 not do technology mandates, let's set performance
10 standards, and let's move us to meet those
11 standards. We're developing, as was indicated
12 earlier, a 90 percent lower NO_x engine, that
13 engine is going to be commercialized and I think
14 we have a representative talking about that
15 engine. What we need now is deployment. How do
16 we increase the adoption rate of that engine? We
17 need deployment dollars, not R&D, not
18 commercialization, but we need a funding for
19 deployment to reduce the capital cost, to bring
20 the adoption rate up, and to give us the shorter
21 term NO_x benefits.

22 I think that what I've laid out in short
23 version is a view that natural gas, methane, the
24 natural gas distribution system will be here to
25 stay for long term, that it's a foundational fuel

1 that we need to think of natural gas not just as
2 fossil gas, but as both biological as well as
3 hydrogen blended, as well as methalated gas.

4 We have a study that E3 has put together
5 for us, it's not yet ready for primetime, but it
6 will be in about a month, we'll submit it for the
7 record, which basically looks at de-carbonizing
8 the pipeline mixed with electrification, a
9 balanced approach which gets us to the 2050 GHG
10 reduction goal faster and cheaper than an
11 electrification approach. So I think it's
12 something that the Commission will be interested
13 in, particularly in the 1257 report.

14 A second study that will be completed in
15 a few months with Environ and with GNA looks at
16 adoption rates, at what kinds of incentives for
17 deployment will increase adoption rates, and what
18 time frame to get us closer to the NO_x goals for
19 2023 and 2034. And we hope to be able to present
20 that, as well, as part of the record, not just
21 for the IEPR, but also for AB 1257.

22 I'd like to just comment on the methane
23 slides. I think I began by saying, look, the
24 good news is we have a focus on the problem, and
25 we're going to fix the problem, meaning we're

1 going to drive emission rates down. You know, we
2 were one of the first utilities, actually we were
3 the original signer of the natural gas STAR
4 Program with EPA in the mid-'90s. Mary Nichols
5 actually headed the Air and Radiation Office of
6 EPA, Ann Smith, former CEO, was the signer of
7 that document. We've been focused on methane
8 emission reductions, and I think now the rest of
9 the industry is focused, and I think that
10 regulatory focus, better science, better
11 information, and better technology will drive
12 those emission rates down. And I think the
13 science that's being developed through all of
14 these studies will get us a better answer. And
15 the science is complicated. Ground level
16 measurements that establish factors for material
17 and equipment may not actually factor in
18 problems. Surface level and air level, or top
19 down kind of emissions monitoring may not
20 distinguish adequately between biogenic and
21 petrogenic sources, or amongst the different
22 types of petrogenic sources. For example, the
23 mapping study with EDF, we're talking with a
24 professor from Colorado State and, you know, he
25 was very clear on how they were going to

1 differentiate between biogenic and petrogenic
2 sources, but was not aware that, for example,
3 there's ways that you can differentiate from
4 petrogenic sources. He says, well, all the
5 petrogenic source is either oil or gas, or
6 natural gas distribution, and in Los Angeles
7 that's simply not the case, there's tremendous
8 amounts of ground level methane that is seeping
9 from methane deposits; we were in an oil and gas
10 producing region long before we were a city, and
11 it's not the oil industry, and it's not the gas
12 distribution system; in fact, when we identified
13 a methane leak in the last several years using
14 the Picarro and other technology, we go out to
15 that leak and about 50 percent of the time that's
16 not our pipeline gas, that's other petrogenic
17 sources of methane -- in the L.A. area. So
18 there's a lot of science that still needs to be
19 perfected. But I think what's really important
20 is to take a step back. Tim talked about and
21 wrote in the Sacramento Bee the other day that 30
22 percent of shoreline pollutants, including
23 methane, is our GHG problem. But when you really
24 look at greenhouse gas emissions and you look at
25 the gas system and what its share is, the overall

1 greenhouse gas emissions, it's about two percent
2 of all GHG emissions nationwide, and this is
3 based on the EPA inventories. And if you break
4 that down by the EPA inventories and, granted,
5 there's some concern with those EPA inventories
6 that the factors are faulty and that they maybe
7 are higher, but if you break it down the
8 distribution company is about four-tenths of one
9 percent of the problem. So it's really a very
10 very small part of the problem, and yet we're
11 doing a lot of work to try to capture all those
12 methane emissions.

13 Another way to look at it is let's just
14 look at all the methane emissions, natural gas
15 systems, separate it out from the oil systems,
16 it's only about 25 percent of the problem, so
17 agriculture is the single largest, coal mining,
18 landfills, very significant sources, so it isn't
19 just the natural gas system.

20 We're participating in all the studies
21 with EPA, with GTI, with several California
22 universities, with EDF, we're part of the
23 distribution study, we're part of the
24 transportation Wellhead to Wheel Study. One
25 thing that we know from reading the production

1 study and from looking at the preliminary results
2 on the distribution study, there's wide regional
3 differences. On the production side, there's
4 differences based on age of system and region;
5 East Coast have higher rates because they're
6 newer production systems, they don't have closed
7 loop systems, they're still in the production
8 mode. West Coast supply basins are more mature,
9 have recovered more gas. We saw that in some of
10 the pictures where you see a lot of the methane
11 emissions are coming from Bakken or Marcellus,
12 the newer producing regions. That's important
13 when we look in 1257 and we do our natural gas
14 report and we look at full cycle emissions that
15 we should look at California emissions. We
16 should be looking at western supply basins,
17 western transmission systems, and western
18 distribution systems. On the distribution side,
19 I think you heard Tim say it, big regional
20 difference, big difference is age of system and
21 in this case, the older the system the leakier;
22 East Coast systems versus West Coast systems,
23 higher leakage rates from the east, much lower
24 leakage rates in the west. The preliminary
25 results from the EDF study have SoCal Gas at

1 about .3 percent of throughput, very low leakage
2 rate, pretty consistent actually with what we
3 report both to ARB under the AB 32 requirements,
4 as well as to EPA under federal requirements. So
5 in this case, the EDF study has corroborated our
6 emission factors.

7 Now part of the reason is we have no cast
8 iron pipe, period, there is no cast iron pipe in
9 our system. Now, San Francisco does, they're
10 working to eliminate it, but we have none. And
11 all of our steel is being replaced over time as
12 we replace it with plastic pipe, which has a very
13 very low emissions factor, a very low leakage
14 rate. I think if you look at more plastic, more
15 protected steel, the less cast iron pipe the
16 lower your emissions rate. So in 1257, we really
17 ought to factor that in. We shouldn't be looking
18 at national emissions rates, we should be looking
19 at western supply basin transmission systems and
20 also distribution systems. And also, the
21 breakdown of the data is there in the study, so
22 that's kind of good news. That's it.

23 CHAIRMAN WEISENMILLER: Thanks. George,
24 one thing for the record is, what percentage of
25 economic activity in the South Coast is goods

1 movement? I keep thinking 18 percent.

2 MR. MINTER: I can't answer that figure,
3 I can get back to you.

4 CHAIRMAN WEISENMILLER: If you could get
5 back to us that would be good. Also --

6 MR. MINTER: I did hear one
7 representative of goods movement say, well, it's
8 the only industry we've got left in Southern
9 California.

10 CHAIRMAN WEISENMILLER: That may be the
11 other part of the story. The other part is I
12 think you alluded to the South Coast SIP 2023
13 deadline?

14 MR. MINTER: Yes.

15 CHAIRMAN WEISENMILLER: Again, just to
16 get it on record. Thanks.

17 MR. MINTER: Thank you.

18 MR. BAUER: Thank you, George. Next we
19 have Todd Campbell from Clean Energy. He is the
20 Vice President of Public Policy and Regulatory
21 Affairs. Previously, he has been the Policy
22 Director of the Coalition for Clean Air, and
23 Mayor of the City of Burbank. At Clean Energy,
24 he is a key architect in promoting federal, state
25 and local transportation strategies that help

1 reduce overall operational costs while meeting
2 tightening federal and state regulatory criteria
3 for air and greenhouse gas emission standards.
4 Mr. Campbell is a Director of the Coalition for
5 Clean Air, the Energy Coalition, and the
6 California League of Conservation Voters. He has
7 a B.A. in Government from Georgetown, a Masters
8 in Environmental Management from Yale, and a
9 Masters in Public Policy from the University of
10 Southern California. Thank you, Todd.

11 MR. CAMPBELL: Thank you. And I have two
12 boys and a wonderful wife whose birthday is
13 tomorrow.

14 Good afternoon. Thank you, Commissioners
15 for holding this very informative forum. I think
16 it's really important that we talk about these
17 issues and update you and others, our friends in
18 the environmental community and other colleagues
19 in the industry. Really, what the natural gas
20 industry is doing, clean energy of course is a
21 fueling transportation provider for natural gas,
22 we do both compressed natural gas and liquefied
23 natural gas, and we augment our fuel also with a
24 product we call Redeem, we spent a lot of money
25 on that name, which is essentially our way of

1 saying Renewable Natural Gas, and I'll get into
2 that, as well. We have about 1,100 employees,
3 we're California-based, 550 stations and growing
4 nationwide. We fuel almost 35,000 vehicles per
5 day and we're very proud of that fact.

6 Some of the benefits with natural gas use
7 in the transportation sector under the Low Carbon
8 Fuel Standard, we're slated to almost get a 30
9 percent reduction in light-duty applications,
10 about up to 23 percent reduction in terms of
11 heavy-duty applications, and a few. Apply
12 Redeem, your numbers really go down, and it could
13 go down as far as 90 percent was one of the
14 estimates from landfill-based natural gas, or
15 renewable natural gas, and we see that as a
16 really prime fuel because, unlike other biofuels,
17 biomethane can be blended 100 percent, 90
18 percent, 60 percent, 10 percent. There's no SAE
19 restriction on the engines and, in fact, all the
20 ports in Los Angeles and Long Beach right now are
21 running 100 percent on biomethane. So those
22 trucks that were funded out of the Clean Trucks
23 program are achieving California's 2050 goals
24 today and I think that's something that's not
25 only significant, but something that the South

1 Coast Air Quality Management District and the
2 Ports of L.A. and Long Beach should be very proud
3 of with their Clean Trucks Program down there,
4 which in my former life as an Environmentalist,
5 I'm still an Environmentalist, but a formal
6 environmental member of the community, we used to
7 refer with Gail Rubin Furrer at NRDC to this area
8 as the Diesel Death Zone.

9 We're really looking forward to the South
10 Coast AQMD finalizing their in use study for
11 trucks. I think what's really important about
12 this slide is it shows averages of in use
13 emissions from clean diesel, which you can see
14 are the red bar and the yellow bar on the far,
15 that would be your right, and then the natural
16 gas technology which is the four bars from green
17 to that mustard color yellow. The key here also
18 is you see that .2 is the standard. The
19 exceedance level is .3 grams per brake horsepower
20 for nitrogen oxide emissions, which is a
21 precursor to smog. But I'm very proud to say
22 that, in the in use emissions analysis, natural
23 gas never exceeds even the .2 standard, in fact
24 in some of the outcomes for refuse you can see
25 it's well below the standard.

1 Another important measurement here, and I
2 apologize for the small font, but I didn't want
3 to touch the AQMD slide, I wanted to leave it
4 exactly the way they did it, so you could see for
5 Near-Dock emissions using clean diesel, the
6 Selective Catalytic Reduction (SCR) is not
7 working very well and you see a tremendous
8 increase in in use emissions for Nitrogen Oxides.
9 For the natural gas product, again, very very low
10 in terms of comparison. And so I think this is
11 really an important testament to what the Energy
12 Commission is doing through AB 118 and
13 potentially what can be done through Cap-and-
14 Trade monies in terms of deployment of natural
15 gas, or an alternative fuel technology that is
16 reducing both greenhouse gases and criteria
17 pollutants today in communities that need it
18 most.

19 There was a lot of discussion on this
20 topic, you know, how much natural gas do we have,
21 and it looks like we have about 200 years of
22 proved reserves based on 2009 energy use levels.
23 You know, I think what's really important, and I
24 think George kind of highlighted it, but I'll re-
25 highlight it, is that industry knows that it must

1 act with regulators, it must act with the
2 community, it must be able to reduce upstream
3 emissions. And I think you will see, you know, I
4 love the slide that George had with all the
5 studies that Sempra and SoCal Gas are
6 participating in, we are also participating with
7 the Environmental Defense Fund. We have several
8 colleagues here that are also participating in
9 that. The statement from our CEO Andrew
10 Littlefair was, "If I'm losing product, I want to
11 know about it because I'm not in the business of
12 throwing away money." So we have a keen interest
13 in being able to help recover some of the monies
14 that Tim estimated, \$1.3 to \$5 billion, we're
15 interesting in recouping that. We cannot move
16 forward without that kind of effort, so we are
17 cooperating.

18 And I also think, you know, the way this
19 country is moving the EPA and the Air Resources
20 Board, you know, working with local governments,
21 we're going to solve this and we're going to work
22 on it together.

23 I also think methane leakage is important
24 not just for Natural Gas Vehicles. I had a very
25 interesting experience with a fuel cell advocate,

1 an electric advocate, and I was asked about
2 fracking, I was asked about upstream methane
3 emissions, and I said the irony here is that
4 we're all in this together because the most cost-
5 effective way to create hydrogen is through
6 methane reformation. And 60 percent of
7 California's production comes from natural gas,
8 so it's not just about Natural Gas Vehicles, it's
9 about Electric Vehicles, it's also about Fuel
10 Cell Vehicles. And I think that's really why I
11 think we have a common interest in addressing
12 this issue.

13 Cost? Very very compelling. I looked on
14 GasBuddy and there's a Chevron station down the
15 street at Northridge, or Northgate Blvd. selling
16 gasoline at \$4.29. Now, George sort of talked
17 about this, but there's eight gallons per MMBtu
18 with natural gas, so that means at a price, I
19 think it was about \$4.53 on Friday per MMBtu,
20 that equates to about \$.56 of commodity. In
21 order for me to get to a price at the retail to
22 sell what's being sold in a gallon of gasoline
23 down the street at \$4.29, natural gas has to get
24 to about \$26.24. We're at \$4.51 or \$4.53. So
25 that gives you kind of an idea of how far we need

1 to go before we would even get to today's level.
2 I think the struggles in Iraq, you know, I think
3 we're going to see more geopolitical strife in
4 that region, you know, pushing a barrel of oil to
5 \$107.00, as Boone would say -- and Boone is one
6 of the founders of our company and I was very
7 happy to hear a Booneism this morning, you know,
8 "I'm for all things American," and I think that's
9 really important for us to be able to bring our
10 energy resources to home.

11 Growth in the industry has been a little
12 slow. You know, we have about \$142,000 Natural
13 Gas Vehicles in the U.S., but we're actually
14 seeing a tremendous uptick as we move forward,
15 especially in the heavy and medium-duty
16 applications. In fact, a national study chaired
17 by former Secretary Chu projects that NGV trucks
18 will make up about 43 percent of the trucking
19 market by 2050.

20 Natural Gas got its start through Clean
21 Air Regulation. A lot of this has to do with the
22 strong work of Henry Hogo and Barry Wallerstein
23 and Jack Broadbent, and all my other heroes when
24 I was an environmentalist, but what is the real
25 difference here is that, now that we're seeing an

1 economic proposition, you're starting to see more
2 engine manufacturers get involved, more
3 competition in the market, and specifically for
4 these sectors: airports, transit, refuse trucks,
5 rail, and ships. Of course, refuse, you know,
6 Chuck White, Waste Management's leadership, are
7 committing to pretty high numbers, I think it's
8 almost 100 percent in terms of new purchases.
9 The industry -- 60 percent is the number right
10 now of all new purchasers of natural gas refuse
11 trucks.

12 But here is an interesting statistic I
13 want to point out, the Big Nanu, I call it, is
14 heavy-duty trucks, and if you converted just
15 three percent of the heavy-duty trucks, it would
16 equate to the same amount as the refuse truck
17 market.

18 The network is growing, and this is Clean
19 Energy's network, we called it the American
20 Natural Gas Highway, and when it's done it will
21 be 150 stations coast to coast, border to border,
22 and our competition is going to fill in the dots
23 a little bit even more, there will be a more
24 robust network for sure. But we're partnering
25 with Pilot Flying J and other major truck stop

1 operators to be able to get an immediate access
2 to real estate, but also to kind of go where the
3 truckers are going, so it's a strategic move to
4 try to build this out.

5 And to Amy's point about station growth,
6 I would argue part of the slow start was that the
7 12-liter engine that a lot of folks were
8 expecting to come out was delayed a little bit,
9 so, you know, with delay of product for the
10 heavy-duty sector, you're going to have a delay
11 of adoption and that's just the way it turned
12 out.

13 This slide is again highlighting the
14 opportunity, 25 billion gallons for the trucking
15 industry annually, and you could see that's
16 clearly our focus. I think the statistics were
17 something like four percent of the vehicles on
18 the road makes up a significant portion of NO_x,
19 around 25 percent NO_x, I think it's 27 percent in
20 the South Coast. And the engine manufacturers
21 clearly see the opportunity, you see every
22 manufacturer in the trucking industry involved,
23 and you're starting to see light-duty
24 manufacturers getting to fleet services, you
25 know, vans, taxi-cab applications, and other

1 services.

2 And then Clean Energy is no longer alone,
3 we have over 80 competitors nationwide, some
4 pretty significant companies out there that are
5 also building out the industry, so I would say
6 that the most important way to advance the growth
7 of Natural Gas Vehicles is providing incentives
8 to customers because, if you're going to build a
9 sustainable station, you need customers to do
10 that. And that's really -- if you can even cut
11 the incremental cost of a natural gas vehicle by
12 50 percent, that's significant because it reduces
13 their return on investment that much quicker.

14 Moving along, I just want to quickly go
15 through what we thought was a very important move
16 for us creating Clean Energy Renewable Fuels,
17 which is our Renewables Division. We have a
18 significant investment in this industry.
19 McCommas Bluff was our first project and is
20 producing about 60,000 gallons per day. We have
21 another facility in Sauk Trail Hills in Michigan
22 and another one coming on line, North Shelby,
23 this is an old picture, so I apologize, it's
24 actually up and running and producing about
25 14,000 gasoline gallons per day. That investment

1 has a lot, about 14 million gasoline gallon
2 equivalents of Renewable Natural Gas in the
3 market last year, and we hope to get to about 150
4 million gallons of biomethane production in five
5 years, where the industry should be roughly about
6 550 million gallons nationwide.

7 More advertising. This slide, I just
8 wanted to kind of point out to you where
9 renewable natural gas in terms of production
10 costs, it's about \$8.00 to a little bit below
11 \$6.00 to produce. And that's important because
12 if you look at the price of natural gas, you're
13 saying, well, how can you move this forward? How
14 can you produce something that's more expensive
15 than fossil-based gas? Well, the key is
16 Standards like the Low Carbon Fuel Standard and
17 the Renewable Fuel Standard. Being able to get
18 that green premium makes all the difference in
19 the world for us to move forward. And what's
20 really impressive about this is that if we expand
21 from landfills and start going into using
22 anaerobic digestion, as Simon pointed out, we can
23 get to negative carbon levels which I think is
24 pretty phenomenal.

25 Part of the problem is the price, it's

1 not always predictable, makes it very challenging
2 for a producer to get investors to get excited
3 about something that you just don't know where
4 the price is, and so there's some very critical
5 strategies that we think we'll need to do to make
6 sure that the Low Carbon Fuel Standard remains
7 effective.

8 One unfortunate situation that happened
9 was about, I think, Muratsuchi's Bill, AB 2390,
10 that was opposed by WSPA, ironically, it was a
11 really good bill to help us be able to create a
12 green credit reserve and was championed by Waste
13 Management and other colleagues, and what that
14 would have done, it would have helped us create
15 more production facilities for biomethane by
16 providing some certainty for the investment
17 community. Also, price floors, price caps for
18 political annals for being able to do more
19 production facilities in this space, as George
20 Minter pointed out, we need to do it. It would
21 be very helpful. And also I think trying to
22 ensure that the 2020 ten percent reduction goal
23 is held, that the smoothing out of the compliance
24 curve does not mean that we're going to extend
25 out that goal because every time you extend it

1 out, every day that you extend it, it really
2 hurts.

3 So to conclude, I just want to show you
4 all the companies that are also adopting
5 sustainability programs, pretty exciting, that's
6 also helping drive the cost. But to conclude, I
7 just want to say the following: Natural Gas
8 Vehicles provide near-zero emission potential,
9 CEC and Air Resources Board, as well as the AQMD
10 are investing in engines that could reduce NO_x
11 emissions by another 50 to 90 percent, that's
12 really important. But also, I think that the
13 near-zero goals puts NGVs on par with ZEV
14 strategies because, remember, it's zero-emission
15 tailpipe, not Zero Emission Vehicle; you still
16 need to get that generation from somewhere and of
17 course renewables would be a part of that
18 solution, but just for renewables that would be
19 in the Electric Grid, biomethane will supplement
20 the natural gas side, as well. And I truly
21 believe upstream emissions will be addressed and
22 cost-effective solutions have been identified.
23 But more importantly, I think it's important that
24 natural gas vehicles and zero-emission vehicle
25 strategies complement each another, and I think

1 that's one of the shames about having oil and gas
2 because sometimes I think it would be really
3 helpful to kind of cut the gas part in between
4 the oil because the gas companies and the gas
5 producers have been very supportive and very much
6 want to work with the community and also the
7 regulators to solve the problem and ensure that
8 our climate future is one that we could be proud
9 of for our children. Thank you.

10 MR. BAUER: Thank you, Todd.

11 COMMISSIONER SCOTT: A quick question
12 before you step away, which is you mentioned that
13 you have Renewable Fuels in Texas and Michigan
14 and there was one other state on the list. Do
15 you have anything developed in California?

16 MR. CAMPBELL: Well, we're working
17 through AB 1900 with -- and thank you for the
18 support the Energy Commission has provided with
19 the Air Resources Board and working with the
20 Public Utilities Commission, and I believe once
21 we get that product process through, and George
22 and I have met several times and we both are
23 championing this through and we're going to have
24 projects. And as soon as we can get to yes, it's
25 going to be significant.

1 COMMISSIONER SCOTT: Thanks.

2 MR. BAUER: Next up we have Julia Levin.
3 She is the Executive Director of the Bioenergy
4 Association of California, an association of
5 companies, agencies and local governments working
6 to promote sustainable bioenergy development.
7 Prior to BAC, Julia served as the Deputy
8 Secretary of Climate Change and Energy at the
9 California Resources Agency where she chaired the
10 Governor's Interagency Bioenergy Working Group
11 and led development of California's 2012
12 Bioenergy Action Plan. Previous to that, Julia
13 worked with the Attorney General, Jerry Brown, to
14 defend California's Feed-in tariff and other
15 clean energy policies. And she has served as a
16 Commissioner at the California Energy Commission,
17 where she was the Presiding Commissioner on
18 Renewable Energy and Associate Commissioner on
19 Energy Efficiency. Julia received her B.A. from
20 Brown University and her law degree from Hastings
21 College of the Law.

22 MS. LEVIN: Thank you. You didn't
23 mention my kids. I just spent a couple days at
24 Disneyland with them -- on way too many
25 rollercoasters.

1 So good afternoon, everyone. I feel like
2 I always end up on the last or nearly the last
3 afternoon panel and I'm sorry. I wish I had
4 coffee or chocolate or something to offer
5 everyone.

6 So as Silas mentioned, the Bioenergy
7 Association of California represents more than 50
8 private companies, public agencies and local
9 governments working to convert organic waste to
10 energy. We work primarily on policy development,
11 but also on communications, industry best
12 practices, getting the word out about bioenergy,
13 advancing the research and understanding of the
14 science and the benefits and the challenges.

15 So I'm going to focus on three things
16 today and try to be brief because I know it's
17 late in the day: what the potential is for
18 bioenergy in California, what we're already doing
19 about it statewide, and what else needs to be
20 done.

21 So I think that you all know, I hope you
22 all know by this point in the day, that bioenergy
23 has enormous benefits for California. Above all,
24 greenhouse gas reductions, you heard about how
25 low carbon and sometimes carbon negative

1 transportation fuels are from bioenergy, from
2 biofuels, from organic waste. On the electricity
3 side, bioenergy can help smooth the duck curve
4 that you heard about earlier, it can provide base
5 load or load following, or even energy storage to
6 complement intermittent renewables. It can also
7 help address California's goals to reduce
8 landfilling of waste, very significant goals, and
9 now have a 75 percent diversion goal. Most of
10 how we get from 50 to 75 percent is going to have
11 to be organic waste diversion. And bioenergy is
12 a very beneficial use of that organic waste.

13 Bioenergy is also an in-state energy
14 supply. I agree with all the comments about the
15 benefits of fossil fuel natural gas, but
16 California is importing 90 percent of our natural
17 gas right now. If you look at bioenergy, if you
18 look at biomethane, it is coming from in-state,
19 thanks in part to AB 2196, but also because
20 organic waste is heavy, it's not very easy to
21 transport cow poop or food waste or other things,
22 we're certainly not going to be transporting
23 across state lines. Sorry for the technical term
24 of "cow poop," but... This is an in-state energy
25 supply and it's an important one to develop for a

1 lot of environmental benefits, also for economic
2 benefits. If we have an in-state energy supply,
3 we're not going to be exporting all those dollars
4 to Texas, Canada, and North Dakota, we will keep
5 the fuel and the dollars and the jobs in-state.

6 So what's the potential for bioenergy?
7 It's not going to overtake natural gas, it's not
8 going to overtake other fossil fuels, but it is a
9 significant potential in California. We produce
10 a lot of waste in this state. We have more
11 wastewater treatment facilities, more landfills,
12 more cows, more dairies than any other state in
13 the country. Altogether, we're landfilling about
14 16 million tons a year of organic waste, that's
15 just what we put in the landfills, that doesn't
16 include the animal manure, the agricultural
17 waste, forest waste. Altogether that could
18 generate 5,000 to 6,000 megawatts of renewable
19 clean electricity, that's 10 percent of
20 California's electricity supply, or 2.1 billion
21 gallons of transportation fuels, well over 10
22 percent of California's fuel supply, 2.1 billion
23 gallons. That's according to recent calculations
24 from Rob Williams and Steve Kafka at U.C. Davis.
25 And if you think about it, there was a

1 presentation earlier about how much diesel we use
2 in California, 3.3 billion gallons a year.
3 Biomethane could replace two-thirds of all the
4 diesel that we consume in California. And for
5 Henry from South Coast Air District, when you
6 think about not just the greenhouse gas benefits
7 of that, the NO_x benefits of that, but toxic air
8 contaminants, think about what one of the biggest
9 sources of environmental justice issues is in
10 California, it's diesel pollution, particularly
11 in certain urbanized areas, or areas with large
12 truck concentrations. We could replace two-
13 thirds of all the diesel consumption in
14 California with biomethane. This is enormous,
15 the potential cannot be overstated.

16 So sector by sector, and I'll go through
17 these quickly, the key number is the one that is
18 bolded, so just diverted organic waste, the
19 organic waste that we're currently putting in
20 landfills, could produce half a billion gallons a
21 year of transportation fuels, or 450 megawatts of
22 electricity, the equivalent of a large power
23 plant.

24 Landfill biomethane, even if we stop
25 putting organic waste into our landfills

1 tomorrow, and we're not, it's going to be a while
2 until we phase it all out, our landfills are
3 going to be producing biomethane for decades to
4 come. We need to capture, and not just do what a
5 number of landfills are doing now, which is
6 flaring it, so it's converted to carbon dioxide,
7 it's definitely less potent as a greenhouse gas,
8 but it's still a waste, a valuable clean fuel
9 that we could be using. So landfill gas could
10 produce another half a billion gasoline gallon
11 equivalents of transportation fuels, or 330
12 megawatts of electricity.

13 And by the way, the slide on the upper
14 right is the Altamont Pass Landfill, it's
15 operated by Waste Management and Chuck White is
16 here in the room. The CEC provided a grant to
17 Waste Management about six years ago, which built
18 the facility you can see in the picture in the
19 upper right, which is converting landfill gas to
20 13,000 gallons a day of compressed natural gas,
21 compressed or liquefied? Liquefied, sorry,
22 natural gas, 13,000 gallons a day, and in the
23 remainder of the landfill gas is being used to
24 generate about five or six megawatts of
25 electricity. I'm getting the numbers slightly

1 off, Chuck, you can correct me later. It's a
2 very significant source of energy.

3 The facility on the left is the new Clean
4 World Partners facility at U.C. Davis, it's both
5 taking diverted organic waste and landfill gas,
6 it's combining the two to produce electricity and
7 transportation fuels, and I believe the Energy
8 Commission also provided a grant for that -- so
9 thank you.

10 Livestock waste, well aside from the
11 fuels potential which is significant, dairy waste
12 and poultry waste is not currently regulated
13 under AB 32, so this is methane that is just
14 going straight up into the atmosphere as methane,
15 it's not even being flared like at a landfill or
16 a wastewater treatment facility. And if you look
17 at the picture on the lower right, you can also
18 imagine all the other benefits of capturing that
19 waste and converting it to energy. You're
20 reducing not just greenhouse gas emissions, but
21 other pollutants, odors, and a terrible nuisance.
22 So there are a lot of environmental benefits of
23 capturing this waste and converting it to energy.

24 And finally, wastewater treatment
25 facilities. California has over 500 wastewater

1 treatment facilities, about three-quarters of
2 them already have anaerobic digestion onsite as
3 part of their wastewater process. But only about
4 half are actually using the gas beneficially as
5 in for energy, mostly for onsite use. There's a
6 lot of potential still at wastewater treatment
7 facilities, especially if they do co-digestion,
8 meaning they take in some food and other organic
9 waste.

10 And Agricultural Forestry Waste, another
11 huge potential in California, we're the biggest
12 agricultural state in the country by far, one of
13 the biggest agricultural regions in the world, we
14 produce a lot of waste. Some of that waste is
15 still piled and burned in open field burning in
16 San Joaquin Valley, you know one of the worst air
17 pollution regions in the country, and yet we're
18 doing open pile burning in the fields. Same with
19 our forest waste. The utilities actually have to
20 trim trees around power lines in the Sierras, and
21 we do a lot of forest thinning defensible space
22 measures that produces a lot of forest waste.
23 I'm not talking about tree farms for biomass, I'm
24 talking about trees that have to be thinned or
25 forests that have to be thinned for safety and

1 other purposes, most of that forest biomass is
2 piled and burned. We could put it into a small
3 power plant instead and be producing electricity
4 or fuels with it.

5 So what are we doing in California to
6 develop more bioenergy? The short answer is not
7 enough. I agree with a lot of what George said
8 earlier about we're on the right pathway, but
9 we're not going to get far enough fast enough
10 with the current policies in place. I think
11 you've already heard a lot about AB 118 today. I
12 would just say, and Commissioner Scott has heard
13 me say this before, out of \$100 million, \$6
14 million for waste-based fuels is not enough when
15 you think about the fact that this is the lowest
16 carbon transportation on earth.

17 The EPIC Program, this is on the
18 electricity side, right now it is allocating
19 about \$27 million a year to clean energy
20 projects, but again that's a drop in the bucket
21 when you think about the fact that we're going to
22 need billions of dollars of infrastructure and
23 investments to really convert organic waste to
24 energy in California.

25 Cap-and-Trade Revenues. In the budget

1 that was just approved last week, there are a
2 number of pots of money that can be used for
3 bioenergy development, \$25 million at CalRecycle,
4 \$20 million at the Department of Food and
5 Agriculture, \$200 million for Clean Vehicle
6 Infrastructure at the Airport, \$22 million for
7 Forestry, it won't all go to bioenergy, but some
8 of it can. But again, this is not enough and
9 actually I totally agree with George, that I
10 think the state is going to have to help fund
11 this because right now biomethane just can't
12 compete with fossil fuel natural gas.

13 SB 1122 requires 250 megawatts of
14 bioenergy from small scale projects, that's
15 another driver for bioenergy. And then finally,
16 new pipelines standards. I'm sorry that
17 Commissioner Peterman is no longer here, the PUC
18 just adopted the most stringent pipeline
19 biomethane standards in the world, and again back
20 to George's comment at needing state support, if
21 we don't apply either ratepayer funding or public
22 funding or Cap-and-Trade funding to help defray
23 some of the costs of those new standards, we are
24 not going to see new pipeline biomethane
25 projects, which would be a terrible shame in this

1 state. But the costs of the testing and
2 interconnection and monitoring will be too high
3 without some support. So I would say a huge
4 opportunity right now and ask for the Energy
5 Commission and Air Board, and the South Coast Air
6 District's help is to convince the Public
7 Utilities Commission to use some of the gas
8 utilities' cap-and-trade revenues to help reduce
9 the cost of pipeline biomethane projects. It's a
10 very obvious source, there is no alternative to
11 fossil fuel natural gas except renewable natural
12 gas, but we won't be able to exploit that
13 alternative if we don't apply cap-and-trade or
14 other funding to bring down costs.

15 So the last thing that I want to leave
16 you with is, if you add up all these things, is
17 it enough? And I think the very clear answer is,
18 given how big these opportunities are to reduce
19 greenhouse gas emissions and other environmental
20 benefits, the policies and the funding programs
21 that we have currently available are not
22 commensurate with the benefit and the
23 opportunity, and I would just challenge the
24 Energy Commission in the next IEPR to think about
25 the possibility, or think about energy in

1 California as a three-legged stool: on the
2 electricity side we have a Renewable Portfolio
3 Standard, it has been phenomenally successful at
4 driving renewable electricity development over
5 the last 10 years; on the fuel side, we have the
6 Low Carbon Fuel Standard, which I think if the
7 oil companies would put their money into
8 development instead of their lawyers, and we
9 actually really implement the Low Carbon Fuel
10 Standard, that will move the fuels market
11 forward. We don't have anything like this on the
12 gas side. That is the third leg of California's
13 energy stool, there is no requirement for lower
14 carbon gas or renewable gas in California and we
15 need to address that third leg of California's
16 energy stool to really reduce greenhouse gas
17 emissions and obtain other environmental benefits
18 from the gas sector. So I think I will end with
19 that, and I'm happy to take questions before --
20 now or afterwards. Thank you.

21 MR. MCKINNEY: Great. Thanks very much,
22 Julia. So, Commissioners, that concludes our
23 second panel for the afternoon. Did you, the
24 Chairman, have any questions before we go to the
25 last panel?

1 CHAIRMAN WEISENMILLER: I don't think so.
2 No, we're running late, so we need to move on,
3 I'm afraid.

4 MR. MCKINNEY: Okay. With that, why
5 don't we just move right into the last panel?
6 And Karen, before you go to the ISO, so I know,
7 Erik, you have a flight at 5:00, or you need to
8 leave her at 5:00? Okay, I think you're okay.

9 So moving to the final panel for the
10 afternoon, we're going to be talking about
11 Natural Gas Engines, Trucks and Fleet Use.
12 Our first speaker is Ms. Karen Hamberg from
13 Westport Innovations up in Vancouver, so I think
14 you get the prize for the longest journey today
15 to present with us. And Karen heads up Corporate
16 Strategy, Competitive Market Intelligence,
17 Sustainability, Regulatory Affairs and Policy,
18 and I apologize to the last panel I'm not going
19 to read through all the bios, but Karen, thank
20 you very much for coming. We look forward to
21 your presentation.

22 MS. HAMBERG: Great, thank you. And
23 thank you for the opportunity to speak to the
24 Energy Commission today. I did plan to stick to
25 my 10 minutes, I'll do my very best to do so.

1 A quick word about Westport first, we are
2 an engine and vehicle technology company
3 developing the world's most advanced natural gas
4 engines and vehicles, headquartered in Vancouver
5 British Columbia. We're about 1,000 employees
6 globally now, about half of those are in B.C. and
7 we work with some of the largest automotive and
8 truck and off-road OEMs in the world, including
9 Volvo, Cummins, Caterpillar, Volvo Car, Volvo
10 Truck, Tatum Motors, GM, Ford, we seem to have
11 something going on with all of them.

12 So I did want to tell you a bit about
13 some of the work we're doing right now as part of
14 our Strategic Planning cycle. This is some
15 analysis that my team has been putting together
16 as we're really trying to understand this
17 criticism that the shift to natural gas is not
18 happening fast enough. If you read our Analyst
19 Reports, if you read media, if you read, you
20 know, seeking Alpha articles, there's all of
21 these criticisms that this transition is not
22 happening fast enough. And so the question,
23 then, obviously for us is, well, who is saying
24 that, and how fast do we think it could be
25 happening?

1 So as you know, in 2012, there were a
2 number of macro studies about the potential for
3 natural gas. Todd mentioned one of them with
4 National Petroleum Council, we also saw a big
5 piece of work from Frost & Sullivan, and another
6 significant piece of work from ACT Research. And
7 so what we did was we plotted all of these market
8 curves out to try to understand what the
9 potential market adoption rate could be. Now,
10 lots of these did go out 2035 to 2050, I capped
11 our chart at 2020, so we can really understand
12 the near term market transition that we are in.

13 And so then we said, all right, well then
14 how many actual vehicles are on the road now, or
15 heavy-duty truck, or bus, or refuse engines? So
16 if we look at 2012, there were less than 1,700
17 units. So this is sort of where Frost & Sullivan
18 had us, if we look at their different curves,
19 we're a little less than ACT Research, we're a
20 little higher than the NPC reference case. So
21 this market transition is indeed happening.

22 Now one of the next bits of work that we
23 did, then, all of these studies have so many
24 assumptions baked into them that really do
25 require some work to understand all the thinking

1 that's gone into it. And so we said, well, let's
2 look at rather than plotting just market share
3 over time, let's plot market share by fuel price
4 differential. So what we did then is we looked
5 at where all of these studies, all of the data
6 points said the fuel price Delta needed to be to
7 be to these Class 7 and 8 market shares, and
8 we're in this world right now, we're in this
9 world of advantages of, say, between a dollar and
10 two dollars per diesel gallon equivalent. So we
11 have the potential to increase market share as
12 long as we have these fuel price differentials.
13 But we also need other considerations around
14 infrastructure, vehicle cost and performance, and
15 customer confidence. So these are other bits of
16 work that we're starting to do as part of our
17 Strategic Plan.

18 But I wanted to share with you, for those
19 of you who may not be familiar with the Cummins
20 Westport product line, we have the ISLG which has
21 been in production since June of 2007, it's a 9-
22 liter engine sold primarily in refuse transit,
23 vocational, but some regional haul applications
24 as well; the ISX12G was launched last year, and
25 this was the engine that Todd spoke to about

1 really building out the infrastructure,
2 particularly the liquefied natural gas
3 infrastructure, so a larger engine, attractive to
4 more particularly heavy-duty truck users, and
5 this is the engine that really is driving some of
6 the significant adoption right now. And in 2016,
7 we will have a 6.7-liter engine that is going to
8 primarily target bus and school bus markets.

9 We also did have a compression ignition
10 engine, the Westport 15-liter that ran on
11 liquefied natural gas. It was suspended last
12 year primarily due to the fact that we have
13 another engine coming out with Volvo in late
14 2015, which is their 13-liter product, so I think
15 on the Volvo website if you look there, they've
16 announced that they're taking orders for that
17 engine, Q4 of 2015. So you see we have more
18 product, different product, we're starting to see
19 more engine choice for the different types of
20 fleets that may be looking to switch to natural
21 gas.

22 So because we were asked to speak to
23 opportunities, challenges, and threats, I think
24 I'll probably spend more time on the threats or
25 the challenges, and I actually did a much better

1 list when I was on the plane on the way down.
2 But let's go through these threats quickly here,
3 or these barriers. The erosion of the fuel price
4 differential, I think we've seen some quite
5 sophisticated analysis here this afternoon that,
6 given how much gas is available in the U.S. in
7 North America, and the cost of producing that,
8 that we do expect some stability in fuel pricing.
9 Another big threat is the slower than expected
10 market adoption. I think if we look at energy,
11 any energy transition, these things do take time,
12 they're difficult. We're in these early messy
13 days of it where we are learning many more things
14 that we need to know. There could be change in
15 regulations, or uncertainty around incentives and
16 availability, all of the discussion about the Nat
17 Gas Act in 2012 did introduce some uncertainty to
18 the market about whether or not these large
19 federal incentives would be available, so
20 anything that can introduce certainty around that
21 for fleets is important. Concerns about
22 hydraulic fracturing and GHG emissions, we've
23 talked about that, that's something that even
24 comes up in the discussions that we do with an
25 industry or to stakeholders, even as an engine

1 and vehicle manufacturer, it's critical that
2 these issues are well understood. And as Todd
3 said, the industry is working on that, both clean
4 Energy and Westport are part of the EDF Pump to
5 Wheels Methane Leakage Study.

6 The other barriers that I have wrote out
7 here on my table tray on the way down was that
8 we're still not quite sure of the number of early
9 adopters or the innovators that we're going to
10 have. For every waste management, UPS, Lowes,
11 Kroger, that are showing some real leadership,
12 there's probably a great number of other
13 companies that are very much waiting and seeing,
14 perhaps they're not the technology enthusiasts or
15 the early adopters, to use chasm theory, but they
16 are sitting and waiting and thinking, okay,
17 what's the experience been? How can this be
18 replicated in my fleet?

19 Most of the customer interest is still
20 highly dependent on incentives. We had some very
21 good exposure to this through sales of our 15-
22 liter product, I have less sort of real numbers
23 to give you with regards to the Cummins Westport
24 product line because we don't manage that sales
25 channel, but I do expect that it's high, that it

1 is still a significant driver for customers and
2 they're able to find creative ways to get
3 incentives for vehicles.

4 One other thing, too, that came up in our
5 planning cycle last year was that inexpensive
6 fuel does not seem to be enough. You'd think the
7 cheap fuel is going to be enough to drive the
8 sales, but because there are still upfront
9 capital and operating costs that need to be taken
10 care of, this is still a barrier to sales in some
11 degree.

12 And then this is also perceived, the
13 transition to natural gas is also perceived to be
14 complicated, so again you take the fleets that
15 are well-staffed, well-resourced, ambitious,
16 innovative, like Waste Management or UPS, that
17 really do want to transition, but there are still
18 things that we need to learn and understand about
19 upgrades to facilities, for maintenance, or
20 employee training, or even questions around just
21 CNG versus LNG, which is the right one for my
22 fleet.

23 The stability of the fuel price
24 differential, of course, still remains critical
25 to this, as well, as is the build-out of public

1 access infrastructure.

2 So this was a slide actually that was
3 taken from a presentation that one of my
4 colleagues gave to GTI last year, is how to just
5 generally accelerate market penetration. And of
6 course we touched on some of these things and in
7 the interest of time I won't go through each one
8 again, but there needs to be some work done to
9 try to enhance the economic value to end users.
10 This is a very compelling economic story, the
11 ability switch to natural gas, but again, giving
12 the incremental costs of the vehicle, the
13 likelihood that we need a sustained fuel price
14 differential, fleets are still looking for a way
15 to make the economics and the payback work for
16 them.

17 Also things that could be done to enhance
18 engine or vehicle performance are important, so
19 we're going to have more products available, so
20 we're having the seven liter spark ignition
21 engine offered through Cummins Westport, most
22 likely in 2016, and then we have the Volvo D13
23 HPDI engine operating on LNG available in late
24 2015, so we're having more product become
25 available.

1 And then also the work that CEC and
2 others can do to accelerate investment in
3 technology development, mainly around the
4 potential for natural gas to achieve these near
5 zero emissions, will be very important. Thank
6 you.

7 MR. MCKINNEY: Great. Thank you very
8 much, Karen.

9 Our next speaker is Mr. Henry Hogo from
10 the South Coast Air Quality Management District,
11 and Henry is currently the Assistant Deputy
12 Executive Officer in the Mobile Sources Division.
13 His career there has spanned 38 years, he is a
14 graduate of UC Berkeley. Welcome, Henry. Thanks
15 for coming up.

16 MR. HOGO: Thank you. And thank you,
17 Commissioners, for having us here to talk about
18 some of the drivers actually for the development
19 of next generation natural gas engines. Actually
20 George and Todd and others have spoken a lot
21 about some of the things that I wanted to speak
22 about, but I just want to give you a little bit
23 more detail of the issues that we face, and it's
24 more of a criteria pollutant in the ozone and
25 particulate matter exposure and air quality

1 standards that we need to meet.

2 This is a chart that George mentioned
3 earlier about the deadlines for meeting air
4 quality standards and the greenhouse gas goals.
5 You'll see that in 2023, 2025 timeframe, we have
6 an ozone standard to meet. We actually have a
7 newer ozone standard to meet in 2032 timeframe,
8 and we believe that EPA will come out with a new
9 Ozone standard that will probably be in the 2040
10 timeframe at this time. So as we see the
11 standards tightening up, we really have to reduce
12 emissions even faster in order to meet these
13 shorter near term air quality standards.

14 This chart shows what the top 10 nitrogen
15 oxide emissions are today. As you can see,
16 heavy-duty trucks are the largest with about 129
17 tons per day of NO_x emissions, followed by light-
18 and medium-duty vehicles and marine vessels, and
19 locomotives are in the fourth and eighth place
20 here. But what it points out is that mobile
21 sources are the primary contributor to our air
22 quality problem.

23 Despite the existing regulations that are
24 in place, by 2023 heavy-duty trucks will still be
25 the most significant level of emissions at 51

1 tons per day, followed by off-road vehicles and
2 marine vessels. So we see that we do need to
3 move forward and bring about cleaner emission
4 vehicles on the road as soon as possible.

5 To meet the air quality standards, we
6 have to reduce those emissions that I've shown
7 previously by another 65 percent by 2023 in order
8 to achieve the eight-hour standard at that time,
9 and another 10 percent, or 75 percent in total,
10 to reach the 2032 deadline.

11 In 2012, we worked with the California
12 Air Resources Board in the San Joaquin Valley and
13 produced a document called "Vision for Clean Air"
14 where we looked at a framework for air quality
15 and climate planning. We looked at how short,
16 mid, and long term visioning could be integrated
17 together in a multi-pollutant and multi-deadline
18 timeframe, and this serves as a resource document
19 for future air quality planned developments, as
20 well as the AB 32 Scoping Plan, and the upcoming
21 ARB Freight Sustainability Strategy. But also,
22 we want to make sure that we reduce air toxics
23 exposures as early as possible.

24 Seven key concepts that came out of this,
25 there was need for technology transformation,

1 early action, and the third one which is most
2 important is cleaner combustion engines. We
3 believe that -- I'm going to skip to this slide
4 -- which came out of vision document, which shows
5 that despite the fact that we like to see zero
6 emission technologies and near-zero emission
7 technologies come on line, they won't come on
8 line until the 2040 timeframe in any significant
9 number. That's our vision at this time. And
10 what you see here is that conventional combustion
11 engines are still going to be the predominant
12 engines on the road, even in the 2020-2035
13 timeframe. It was mentioned earlier there is
14 about .92 million heavy-duty trucks on the road
15 in California today; of that .92, about 600,000
16 are actually out-of-state trucks, so you can
17 imagine that in order to reduce emissions from
18 out-of-state trucks, these are really the ones
19 that are the conventional trucks that we have to
20 look at.

21 We worked with the California Air
22 Resources Board recently to develop what we call
23 optional NO_x and SO_x emission standards. These
24 are optional exhaust emission standards that set
25 early emission targets for development of

1 advanced engine control technologies, and the use
2 of these standards actually have a lot of benefit
3 for the engine manufacturers because it gives an
4 opportunity to evaluate engine performance early
5 before a mandatory standard is established, and
6 provides an in use experience with the new
7 technology. It also helps enable funding
8 incentives for these cleaner engines.

9 This is a slide that shows historically
10 what the mandatory standard levels are in black,
11 and the optional standards in the dotted blue
12 line, and between the late 1990's and the mid-
13 2000, the optional standards was actually about
14 50 percent lower than the mandatory standard.
15 And the only engines that met those standards
16 were actually natural gas powered engines because
17 they were inherently cleaner to begin with, and
18 it didn't take much more effort in order to reach
19 that standard. But as time went on and the
20 standard was reduced, the optional NO_x standard
21 dropped to about 30 percent of the mandatory
22 standard, and today we do not have any optional
23 NO_x standard until the recent action from the Air
24 Resources Board.

25 Given an idea what the optional NO_x

1 standards are today, the current standard for NOx
2 is .2 grams per break horsepower hour and the
3 first level optional NO_x standard is .1 grams and
4 it drops to 0.5 and .02 grams, and we have a very
5 good indication that actually the .02 grams
6 standard could be reached; in fact, one of the
7 projects that the CEC is funding for a micro
8 turbine hybrid system, the project proponent
9 indicated that they're around the .05 gram level
10 today. So we're seeing even today that these
11 standards could be reached.

12 I want to mention a couple of the
13 demonstration projects that we're working on with
14 the CEC, one is with the CEC, and Southern
15 California Gas Company, and it was mentioned by
16 Rey earlier, it's the commercialization of .02
17 gram NOx natural gas engines. This is a \$7
18 million project between the co-funding partners
19 to Cummins and Cummins Westport to develop a 9-
20 liter, 8.9-liter, and a 15-liter natural gas
21 engine. So these two projects are on a timeline
22 to have a prototype within the next couple of
23 years or so, and we identified project partners
24 with fleets and truck manufacturers to deploy
25 these engines and test their performance over the

1 next three to four years.

2 The Air Resources Board is also funding a
3 .02 gram NO_x engine development, and this is for
4 diesel and natural gas heavy-duty engine. This
5 is more of a laboratory bench work and is being
6 done with South West Research Institute this
7 time, and that project is slated to be completed
8 by the end of next year.

9 So we believe that the demonstration
10 projects and R&D work that's being done today
11 could lead to this next generation of cleaner
12 engines in the next four to five years.

13 I just want to summarize that early
14 commercialization of cleaner engines really do
15 provide projects that help meet near term air
16 quality goals, and it really helps develop an end
17 user confidence in product performance. And it
18 also enables the transition to longer term
19 advanced control technologies. We strongly
20 support the use of alternative fuels with hybrid
21 systems, and we think in the long run that that
22 is the way to go, and to move away from the use
23 of diesel fuel overall. With that, I'm going to
24 conclude the formal presentation.

25 I did want to comment, though, earlier

1 that John Shears mentioned that methane has the
2 potential to produce ozone. It is true that
3 methane does produce ozone, but in our earlier
4 analysis about 15 years ago, it would take a high
5 concentration of methane in order to produce
6 ozone on a level that would cause a health
7 problem. So we consider methane as a non-
8 reactive hydrocarbon when it comes to ozone
9 production. I just wanted to put that on the
10 record. And thank you.

11 MR. MCKINNEY: Great. Thank you very
12 much, Henry, and thanks again for coming up. And
13 I just want to acknowledge the partnership
14 between the Energy Commission and South Coast
15 AQMD, we've done a lot of good work together.

16 Our next speaker is Erik Neandross. Erik
17 is the CEO of Gladstein, Neandross & Associates,
18 which is a national consulting firm specializing
19 in market development of alternative fuel
20 technologies for on-road transportation and off-
21 road high horsepower sectors. And Erik oversees
22 GNA's day to day business operations, client
23 work, and strategic growth initiatives. So
24 welcome, Erik.

25 MR. NEANDROSS: All right. Well, thanks

1 for having me, given that I have a flight and I'm
2 one of the last speakers, I can just say "what
3 they said." Thank you very much.

4 I'll try to move through it because there
5 is some redundancy in here, but given that we
6 hadn't all planned this together, I think that's
7 a good thing.

8 So as Jim mentioned, GNA, we're a large
9 consulting firm and we specialize in natural gas
10 project development. We have been working in the
11 heavy-duty on-road transportation field for the
12 last 20 plus years, starting with one of the very
13 first commercial deployment projects, you see
14 Harris Ranch there in the middle with 20 LNG
15 trucks in 1999. Now we're working on a lot of
16 large scale strategic project planning and
17 implementation programs with companies like Frito
18 Lay, Waste Management, Rider, and others, and the
19 exciting part here is what we see as what is
20 often the case, what started in California with
21 maybe 10, 12, 15 trucks, is now moving on a
22 national scale and is now 100 percent of an
23 annual fleet buy for Frito Lay, or as close to
24 100 percent for Waste Management because they're
25 really seeing the benefits and they're

1 proliferating that beyond California's borders.

2 We've done a lot of work looking
3 strategically at corridor development projects
4 here in California and throughout the U.S. and
5 trying to figure out how do we get these markets
6 moving, and in the last couple years we've been
7 increasingly focused on off-road what we call
8 high horsepower projects, very very exciting
9 stuff and I'll talk a little bit more about it,
10 but marine, locomotive, mine haul trucks, gas
11 rigs, frack pumps, those kinds of things, just
12 huge consumers of fuel.

13 So we were asked to take a look at six
14 questions, so I've just broken my presentation
15 down to try to answer those. And the first one
16 is, what's the opportunity for natural gas as a
17 transportation fuel? In the heavy-duty space, we
18 think there's tremendous opportunity, there's
19 significant near term growth that we expect to
20 see happen where I think we're now at the part of
21 an early ramp in that market. It is, as Karen
22 mentioned, it's some of the early market leaders;
23 we hear a lot about the one percent and the 99
24 percent these days, that this is the one percent.
25 I think the focus now needs to be the other 99

1 percent. And the competitors to these market
2 leaders, as we've already seen, as I'm sure Chuck
3 would tell you, you know, Waste Management was a
4 clear leader, well, Republic Waste is now stepped
5 up to keep pace, and we need to see those sort of
6 competitive dynamics, and I think we'll start to
7 see those in the on-highway market.

8 One thing that we see with the fleets
9 that we work with is there is a fundamental
10 belief that that fuel price delta will be
11 maintained into the future, thus the reason that
12 they're going down this path. You've got to
13 believe that when Frito Lay says we're going to
14 go 100 percent natural gas in our on-highway
15 fleet, somebody along the way says, "What's the
16 risk of that delta collapsing or crossing?" And
17 there's a lot of confidence in the market in that
18 price spread continuing.

19 The other opportunity is in the off-road,
20 this high horsepower sector. This, I think, is a
21 huge opportunity for California. Virtually every
22 segment of the goods movement sector can run on
23 natural gas instead of diesel, and there's a huge
24 amount of potential criteria pollutant benefit
25 that can be realized in moving to a cleaner

1 natural gas, huge diesel displacement natural gas
2 fuel demand growth, greenhouse gas, diesel PM,
3 Black Carbon, that's sort of the grand slam
4 opportunity here, although I think Todd's slide
5 did a nice job of putting this in perspective as
6 far as total fuel use. One of the things that we
7 see with the high horsepower segment is just
8 concentration of fuel demand.

9 The other thing that we really get
10 excited about is the folks that make the engines
11 here, Caterpillar, GE, Cummins, they're all
12 moving down this path to offer natural gas
13 engines for this segment. Caterpillar has said
14 we believe that if you're running a high
15 horsepower product, you will be running natural
16 gas in the future, it's not a question of if,
17 it's when; it's not today, it's not tomorrow, but
18 it will be into the future, and they are working
19 on locomotives, they're working on the top three
20 largest mine haul trucks, drill engines, frack
21 engines, power generation, they're all in. And
22 they see this as a global phenomenon, this isn't
23 just North America, although the shale gas
24 revolution has started here, we're now seeing
25 export of that technology to Asia, to Europe, all

1 over the world. And Caterpillar obviously is a
2 global company, they don't make these decisions
3 on a whim, they believe that long term this is
4 where it's going. So that's pretty exciting.
5 Having been doing this for 20 years, struggling
6 to get meetings with truck fleets to say,
7 "Please, natural gas," to now see Caterpillar
8 sort of leading the charge and their competitors
9 is pretty cool stuff.

10 So I mentioned the huge fuel demand that
11 we see in this sector, and if you look at it on a
12 per unit basis, any one of these applications is
13 just massive. And what this means is that this
14 provides a terrific opportunity for
15 infrastructure development, to developing LNG
16 plants. In just one project, you can have enough
17 fuel demand to justify building a \$50, or \$100,
18 or we've done some analysis of \$500 million LNG
19 plants to support these kinds of operations.
20 That's huge economic investment that can happen
21 right here in California to build this
22 infrastructure, an infrastructure that once it's
23 built can then be supplied with Biogas in the
24 future when that day comes.

25 To just give one example, we're working

1 on a small container ship project, they have four
2 ships, they'll build two liquefiers, one in the
3 southeast, one in the Pacific Northwest. Those
4 two liquefiers will make about the equivalent of
5 today's LNG market demand in all of North America
6 -- one project, four ships.

7 So you can get a sense that if this
8 market really starts to move what that
9 infrastructure scaling would look like. And we
10 see this all happening here in the next five
11 years, all these off-road high horsepower markets
12 starting to ramp up and drive fuel production,
13 supply chain, infrastructure, the whole thing,
14 which will obviously then support the on-highway
15 market as well. So it's a bit of a reversal of
16 what we've seen to date, which is everything has
17 been on-road, it's now switching to sort of more
18 the off-road.

19 I have here a report that we just
20 authored for the State of Wyoming that looks at
21 what can the state do to get their high
22 horsepower segments working on natural gas versus
23 diesel. They see this as an economic development
24 opportunity, they've got a lot of natural gas,
25 they'd like to use it versus buying oil from out

1 of state, as someone mentioned that earlier, I
2 think the State of California probably could do
3 very much the same thing.

4 So I'll leave that here. George had half
5 this slide, Henry had a similar slide. You know,
6 the opportunity here for California is emission
7 reductions, almost every single major source of
8 NO_x emissions in South Coast and San Joaquin
9 Valley shown in this slide can run on natural
10 gas, can get us criteria pollutant emission
11 reductions. And that's something that I think we
12 need to pay close attention to.

13 The second question is longer term, is
14 they there with natural gas? Or is this a bridge
15 fuel? We think the answer to the two questions
16 that were posed is yes, assuming that the short
17 term is about five years and the longer term is
18 everything beyond that. We don't think natural
19 gas is a bridge fuel, we think it's definitely a
20 foundational fuel that we can continue to refine
21 and improve the technology. I think the one
22 thing that we really really need to pay attention
23 to today is we have buyers, we have customers
24 that are wanting to buy this product and put it
25 in their fleet at 100 percent of their annual

1 purchase. That is amazingly powerful and
2 something that we always have to remind
3 ourselves, and we hear a lot of conversations
4 about electrification and fuel cells, and that's
5 all well and good, and there's going to be
6 elements of that technology that we'll be able to
7 take advantage of, but I would just caution that
8 we just not get too distracted by the shiny new
9 truck with no tailpipe, given all the benefits
10 that we can offer with natural gas.

11 We looked at these five pathways and
12 George mentioned some of the work that was done
13 with the gas company, I'll leave this here for
14 the record, as well, this is a report we did
15 called "Pathways to Near-Zero Emission Natural
16 Gas Heavy-Duty Vehicles." And we've looked at
17 how can natural gas, building upon the foundation
18 that we have today, get to effectively the
19 equivalent of an electric truck, or fuel cell
20 truck. And there's five pathways that we think
21 that you need to look at to get there. I do
22 think that funding going forward, R&D funding,
23 should be focused in these directions. Again,
24 we've got buyers, we've got the ability to very
25 easily cost effectively transition this market to

1 near-zero emission.

2 We've looked at this also on the GHG
3 perspective and we think you can get to the 2050
4 goals again building on the foundation of natural
5 gas.

6 The third question, the policymakers,
7 what can policy do looking at natural gas long
8 term? And the question of methane, which there
9 has been great discussion today, I really liked
10 Tim's presentation; to me, that was very
11 reassuring, there's a lot of focus on this and
12 there are solutions. We fundamentally think that
13 this methane issue, it's an engineering issue.
14 We can identify the leaks, we can fix them, and
15 off we go, and we'll move on. So we don't think
16 that you should get -- there should be no pause
17 in the development of this market in any way,
18 shape or form. We need all options all the time
19 here in California. The methane leak issue will
20 continue to play out, we think that there's a
21 good end to that story, there's been mentioned,
22 you know, California is not the East Coast, the
23 Grid and utility infrastructure here, we do think
24 that these issues are solvable. One thing that
25 we haven't heard talked about today is carbon

1 intensity of diesel is also going up as we see
2 more unconventional oil sources coming into the
3 market, so we do have to keep that in mind, as
4 well. And long term, it's renewable gas, that's
5 a big part of the long term solution. We don't
6 have those same leakage issues when we talk about
7 renewable resources being developed in the state,
8 being transported in in-state pipelines, and used
9 here in the state. So the message is continue to
10 push and leverage the growth that we're seeing,
11 build that infrastructure, build the fleets
12 longer term, build the biomethane, the renewable
13 fuels, I think Julia's presentation did a great
14 job of highlighting the tremendous opportunity
15 for California to lead, to take these what are
16 otherwise environmental liabilities, turn them
17 into assets, create jobs, create economic
18 investment, to us this is the proverbial no
19 brainer, and a lot of resources should be focused
20 in this direction going forward. It is
21 expensive, unfortunately natural gas is stinkin'
22 cheap these days, and it makes these projects
23 really hard to compete. But that's where policy
24 and incentives, I think, can come in to help make
25 sure that we don't lose momentum in growing that

1 market.

2 Going forward into the future, one of the
3 things I wanted to just emphasize is, I think the
4 question should be how do we make these trucks
5 more competitive, I think they are competitive
6 now, but we can make them more competitive. We
7 do have basically one engine for Class 7 and 8
8 trucks today, it's the 11.9 Cummins Westport,
9 that engine can meet a huge huge segment of
10 today's trucking needs. We are going to have
11 more engines, that's going to be good, it's going
12 to help, but we are seeing this ramp up of
13 activity just with the one engine today, so more
14 is going to be better for sure.

15 I think Karen's slide did a great job of
16 showing the different studies and the different
17 cases. Generally, we see the heavy-duty OEMs
18 talking about we can get to 20 percent market
19 penetration by 2020, and that's national, that's
20 amazing, if we could really see that that would
21 be amazing. We are seeing lower emission
22 engines. Henry, you mentioned the funding
23 program with Cummins Westport to make available
24 this .02 gram NO_x engine in 2016, and
25 commercialization would be shortly thereafter.

1 One important note there, Cummins Westport has
2 said we'll do it, it's got to be the 8.9, which
3 is a refuse and a transit engine, it's not for
4 heavy-duty truck engine, so why not the heavy-
5 duty truck engine? And they said, "Well, why?
6 Why should we? What's the demand? What's the
7 market?" So as policymakers, we should keep in
8 mind why should they, it's good for the
9 environment, but will it be bought? Will someone
10 pay more for that? And I think in the refuse and
11 transit where there's much more of a sort of
12 public policy element, public dollars being
13 spent, there's justification. But in the heavy-
14 duty on-road truck, they're not quite seeing that
15 yet.

16 NGVs, they will definitely continue to
17 evolve, and this is heavily detailed in our
18 Pathways report, improved aerodynamics, engine
19 efficiency, electrification, those kinds of
20 things. But I think the thing for the state is
21 just to make sure that there is a clear signal to
22 the OEMs and to the fleets, the buyers, that the
23 state is going to continue to push the natural
24 gas path. This is a critical time and, again, I
25 want to make sure that we don't get distracted by

1 the shiny truck with no tailpipe. We need to
2 keep focus on this growing market and really make
3 sure that we do get there.

4 Lastly, the question was what do fleet
5 operators need from the OEMs and from Government?
6 The number one answer you get from the fleets,
7 well, how do we help you buy more trucks, they
8 say more infrastructure. We need more stations
9 to fuel. The more stations, the more trucks
10 you'll see. The other thing I think they need is
11 they need more buyers, they need other fleets to
12 jump into this. As the volume goes up, price
13 comes down, it all becomes more self-sustaining.
14 And I think that the state should be first in
15 line. California has a laundry list of policy
16 goals to meet, but I don't see the state
17 necessarily buying these vehicles themselves. I
18 think the state should be much more aggressive in
19 leading the charge because, at the end of the
20 day, orders drive priorities for OEMs and the
21 more trucks we get, the more cars we get, the
22 more options will be made available.

23 When we look at incentives, one of the
24 things that probably can be done is just, you
25 know, clear and consistent policies and laws so

1 we don't penalize natural gas, and on the grant
2 side, you know, there's probably some things we
3 can do to move beyond criteria pollutants to fund
4 co-benefits, GHG reductions, petroleum
5 displacement, in-state energy use, those kinds of
6 things as we look at the future.

7 A couple of last slides in summary, just
8 a quick look back to help look forward, when we
9 look at the refuse market I submit that this is a
10 market that was largely driven by the AQMD's 1190
11 rule starting in 2000, which was a bit of the
12 stick, but also with the carrots, the incentives
13 to go along with it, we saw that that refuse
14 market was a little bit slow to get up and
15 running, but ultimately seven or eight years we
16 started to see that curve take off. And what
17 happened was the fleet started to say, "Hmm, my
18 fuel bill is like 30 percent less than it was
19 last year, maybe I can do this. And what do you
20 know? When I go to the City Council in
21 Pittsburg, Pennsylvania, and say I'll collect
22 your trash with shiny new natural gas trucks,
23 they say let's do that." And we saw that market
24 grow to 65 percent, probably more than that,
25 percent of the trucks being purchased today in

1 the refuse market are natural gas. Can we see
2 the same thing in the on-highway market? We hope
3 so. As volumes go up, prices come down. We've
4 seen that in the refuse market, too. It's all
5 about volume.

6 Probably for us in the on-highway market,
7 one of the most exciting things that's happening
8 today is the shippers, the folks that are buying
9 transportation services, they do not own the
10 trucks, are going out to bid and saying, "I want
11 you, my carrier, my trucker, that I'm hiring to
12 be driving a natural gas truck when you show up
13 to my door." They realize that with an
14 inherently lower cost of fuel and a competitive
15 marketplace, they can drive cost out of their
16 supply chain. They're also getting a nice
17 environmental benefit. We've seen Lowes, 100
18 percent of their fleet operations, again, not
19 their trucks, contractors, they want to be
20 running on natural gas by 2020, 100 percent.
21 That's amazing when you think about the risk that
22 they're taking. The product doesn't get to the
23 shelf if it doesn't work. They're very confident
24 that this is going to work. Proctor and Gamble,
25 20 percent by 2020. Owens Corning, 50 percent by

1 2018. And the list goes on and on. So this to
2 us is very very compelling because this is the
3 refuse franchise model in the private sector.
4 And once you get Corporate American lowering
5 their cost of the supply chain and getting
6 environmental benefit, we think that that's the
7 wildfire that you can't put out. But they need
8 infrastructure, they need product, they need
9 engines, they need support to really make this
10 work, and I think that that should be a big
11 focus.

12 So our crystal ball says keep after this,
13 this is a good market and we think that this is
14 one of the ways that we're going to see this on-
15 highway market really start to ramp up in the
16 future. So in summary, stay the course, there's
17 some really exciting things happening in the
18 market today. You know, don't take your foot off
19 the gas. Continue to build. Push the
20 infrastructure, push the OEM products, you know,
21 Rome wasn't built in a day, neither is this
22 market. There's some huge potential benefits in
23 the short term with continued deployment,
24 continued replacement of old diesels with new
25 natural gas that are much much cleaner today, and

1 as we've seen in the next five years they're
2 going to get even cleaner on criteria pollutants,
3 on GHGs. There's a really good story here. So
4 it's an exciting time for the market and I
5 appreciate the opportunity to speak here before
6 you.

7 MR. MCKINNEY: Thank you very much, Erik.
8 Our next speaker and final speaker for the day is
9 Chris Shimoda and he's Director of Public Policy
10 for the California Trucking Association and he's
11 been responsible for their public policy
12 development and implementation since 2007.

13 I also want to thank Chris for his
14 patience. CTA has joined the Advisory Committee
15 for ARFVTP I think two years ago, and you really
16 bring kind of a real politic perspective to the
17 work that we're doing. So I really appreciate
18 everything I've learned from you about what
19 California fleets need to really start to really
20 undergo this transition. So, Chris?

21 MR. SHIMODA: Thanks, Jim. And thanks to
22 the Chair and the Commissioner for the invitation
23 to speak today. And I hope I have something
24 original to say about natural gas at this point.

25 I'll just jump right into it. You know,

1 if you hit the convention circuit at all in
2 trucking, you've probably heard a lot said about
3 natural gas and trucking over the last couple
4 years. At CTA, you know, staff got very curious
5 to find out now exactly what does our membership
6 think about natural gas and trucking. So we did
7 a survey, very informal, but illuminating
8 nonetheless last year, 91 fleets in our
9 membership, various sizes, the majority of the
10 responses came in between around 20 to 1,000
11 trucks, fleet size, which is I wouldn't say your
12 mega fleet, it's not one of your micro fleets,
13 it's really your medium to large trucking fleet
14 that is going to be not necessarily on the
15 bleeding edge of technology, but definitely
16 leading in certain spaces with technology.

17 So one of the things that we asked was
18 for the fleets to say now give us your opinion on
19 factors that either help or hurt the adoption of
20 natural gas and trucking. Not surprisingly, in
21 the helps category, obviously the price
22 differential between natural gas and diesel came
23 in by far number one as far as the results on
24 that came in. This was very surprising to me.
25 The second factor that our fleet said helped the

1 adoption of natural gas is actually the public
2 perception of tailpipe emissions from natural gas
3 trucks versus diesel. You know, our industry has
4 gotten beat up quite a bit over the past couple
5 of years, past couple of decades, really, due to
6 the air toxic issues with diesel emissions, and
7 so this was actually surprisingly a very large
8 motivating factor for fleets. And then finally
9 the availability of grants and incentives was
10 another motivating factor.

11 So on the hurts adoption in natural gas
12 category, this actually came as a surprise to me
13 that the number one issue holding back natural
14 gas in the perception of the people we surveyed
15 was still the availability of fueling
16 infrastructure near home terminals and freight
17 lanes, and we'll get back to this in a second as
18 far as why that may still be the case, despite
19 the fact that natural gas is the most well built
20 out of any all fuel infrastructure today.

21 Number two, hurting natural gas was this
22 issue of insufficient horsepower and torque with
23 the 8.9-liter engine, which was really the only
24 engine that anyone had experience with at the
25 time we did the survey. That may change with the

1 introduction of the 11.9-liter engine. You start
2 getting into the heavier applications up to
3 80,000 pounds GVWR, which is actually the legal
4 limit that you can carry in the State of
5 California, but there are some heavy haul
6 applications within the trucking industry that
7 are going to need a larger engine.

8 And then associated costs, not just the
9 cost of the engines, but also the training and
10 maintenance, bay retrofits, and some of the other
11 tangential costs was also something they said
12 hurt adoption.

13 So this question of the fueling
14 infrastructure, I wanted to bring up the fact
15 that there seems to be an expectation on at least
16 our membership's side as far as what adequate
17 fueling infrastructure is that may be a little
18 bit different from what you've heard today from
19 other speakers. The majority of our members,
20 their expectation is that if they transition to
21 natural gas, they're going to be fueling onsite,
22 fueling in retail, some are looking to use these
23 built out municipal facilities, but not a
24 majority by any means. And then this bottom bar
25 chart is the illuminating part to me, where as

1 far as the proximity where they expect a fueling
2 facility to be in comparison to their home
3 terminal, the vast majority expect fueling to be
4 within 10 miles of their home terminal, and so
5 this is a pretty high hurdle for anyone building
6 out fueling infrastructure to meet. I think that
7 one of the things that I know that we've had some
8 discussions with, with various policymakers, is
9 incentivizing onsite fueling may be something
10 that we want to look at in the near future for
11 for-hire fleets, similar to the mode that has
12 done in the past with the municipal fleets.

13 And then incentives obviously are going
14 to play a key role and we'll talk about this
15 again in just a second here. But the lion's
16 share of fleets, it's about 82 percent, say that
17 they would not purchase natural gas trucks in the
18 absence of an incentive, or that they would
19 purchase more and deploy more, more quickly if
20 they had incentives, rather than if they're
21 unavailable, and a full 55 percent of those
22 surveyed said, "We will not purchase natural gas
23 trucks without public incentives." So that is a
24 pretty significant number saying that Delta and
25 fuel cost simply just is not enough due to the

1 incremental cost of the vehicle.

2 So I wanted to concentrate very
3 specifically on this question, I think it's the
4 one that is most closely tied to the in use side
5 of the question of how we get these trucks
6 competitive. So, 1) I just have to stress
7 because this is something I'm actively living
8 today in the policy realm is that incentives are
9 key. The incremental cost of the vehicles, I
10 think I agree with some of the numbers that were
11 in earlier presentations, it's around \$30,000 to
12 \$40,000 on the retail side, you then incur an
13 additional tax penalty. This incremental cost is
14 still a major hurdle for fleets. Return on
15 investment has to be very quick in the for hire
16 trucking category because, especially in higher
17 mileage applications, you're burning through
18 those trucks fairly quickly, so you may not
19 realize some of the financial benefits if that
20 ROI doesn't happen very fast.

21 Current purchase incentives in the State
22 are extremely limited with the exception of the
23 CEC's buy-down program. There are no natural gas
24 specific trucking incentives in the state aside
25 from what CEC is doing. So I don't know if the

1 perception is that we're already doing a lot of
2 incentives for natural gas trucking, that's
3 really not the case, it's only about \$9 to \$10
4 million each year.

5 The tax issue. There's a roughly four
6 percent higher tax burden for natural gas trucks
7 than diesels, both bought new. It's something
8 that I know has been attacked in previous
9 legislation, it's probably something that
10 policymakers might want to look at again.

11 This question of certainty, I think this
12 is very important for the adoption and future
13 accelerated adoption of natural gas trucks, is
14 that there has been somewhat of a mixed signal
15 from California regulators on natural gas trucks.
16 Earlier, I think it was fall of last year, there
17 were some signals saying that, look, one of the
18 major air regulators in the state said we may
19 want natural gas trucking to go away completely
20 by 2050. And when you're talking about building
21 out a market, trying to use syrup, you know, the
22 paradigm of going from diesel and natural gas,
23 those kind of signals really are not helpful for
24 installing confidence in people making massive
25 investments in turning over their fleet. So I

1 know that some of the earlier panelists talked
2 about some of the outstanding issues. I would
3 say from the fleet perspective, the sooner some
4 of this stuff can get worked out and there can be
5 some type of certainty about what kind of
6 technologies are going to move forward into the
7 future, it would help instill that confidence to
8 really make these massive changes in people's
9 fleets.

10 And then finally, just something that is
11 definitely a key need for policymakers and
12 regulators is to understand the heavy-duty
13 trucking market. It is an interstate,
14 international type of business. We are competing
15 in 48 states. People run outside of California
16 as a regular course of their business. Fueling
17 infrastructure has to be national. I know
18 there's been a lot of talk about doing
19 technologies that would just service a single
20 corridor or a single subset of the industry.
21 Really, you're talking about engine manufacturers
22 that want to build for worldwide markets, truck
23 purchasers who are in multiple states. You
24 really want to understand that, when you're
25 talking about heavy-duty trucking, it's not

1 something that is done in small subsectors, but
2 really you're looking for -- and this kind of
3 goes to the next point -- a wide range of
4 applications. You want a technology that's going
5 to be flexible enough to do a lot of different
6 kinds of work. Heavy-duty trucks do everything
7 from 48 state long haul over the road, they do
8 heavy haul of heavy equipment to construction
9 sites, they support agricultural harvest in
10 fields, they do dredge trucking in Oakland and
11 L.A. and Long Beach, you may not know this, but
12 are completely different duty cycles. So we need
13 the kind of technology that can do what diesel
14 does today, diesel services all these markets,
15 with the kind of performance that's necessary to
16 get them done. Natural gas does have the
17 potential to get to those wide range of
18 applications.

19 And then finally, just when we're talking
20 about moving from applications like refuse and
21 transit over to heavy-duty trucking, especially
22 as you get outside of private carriers and into
23 the for hire space, just remember that this is a
24 very very competitive industry. We are what's
25 called rate takers, we don't set rates, we get

1 them from our customers, and so any alternative
2 fuel that you're talking about, if it's going to
3 have any chance of usurping diesel, it has to be
4 cost competitive or better on cost than diesel in
5 order for people in the for hire truck space to
6 really consider it as an alternative. If a for
7 hire trucker decides that he wants to take on a
8 new technology that, you know, you're increasing
9 your cost, that trucking company is not going to
10 be long for the world. So that's just the nature
11 of the market that we play in. So that's it.
12 Thank you for the time and I'd be happy to answer
13 any questions.

14 MR. MCKINNEY: Thank you very much,
15 Chris. So Commissioner Scott, that concludes the
16 panel presentations today and I just found it
17 incredibly informative, it's been a long day, but
18 I think highly valuable. So we'll turn it over
19 to you.

20 COMMISSIONER SCOTT: Indeed. Well, thank
21 you very much. I just want to remind folks, if
22 you would like to make some comments, please be
23 sure that you fill out the blue card and hand it
24 up to the IEPR Team so they can get it to me, so
25 that I know you would like to say something.

1 Jim, I would echo what you said, I just
2 feel incredibly lucky that I got to spend my day
3 learning from such a high caliber set of experts.
4 Thank you all so much for coming, for your
5 thoughtful and informative presentations. For
6 me, this was just a terrific way to start off the
7 week.

8 We're going to transition into public
9 comments, and you are welcome to stay. I know
10 folks have flights and things to go to, as well,
11 so if you need to dash out, that is okay as well.
12 And I have my first public comment here is from
13 Valerie Wynn from PG&E.

14 MS. WYNN: Thank you. Actually, I made my
15 comments earlier on the methane leak surveys, but
16 thank you.

17 COMMISSIONER SCOTT: Great. No worries.
18 Okay, I have a blue card from Quentin Foster from
19 Cal ETC.

20 MS. RAITT: Oh, Commissioner, he actually
21 said he'd go ahead and file written comments.

22 COMMISSIONER SCOTT: Oh, okay. Those are
23 the only two I have. Do I have other blue cards,
24 other public comment from within the room?

25 MS. RAITT: I don't have anymore.

1 COMMISSIONER SCOTT: Okay. Do we have
2 folks on the WebEx or on the phone?

3 MS. RAITT: We don't have anybody asking
4 questions from WebEx, but we'll go ahead and open
5 the phone lines. So if anyone is on the phone
6 and wanted to make a comment or ask a question,
7 now is the time, the phone lines are open. Okay,
8 it doesn't sound like we have any.

9 COMMISSIONER SCOTT: All right, well, let
10 me then just say, again reiterate my hearty
11 thanks to our excellent panelists. I really did,
12 I had a great day. I feel like I learned a lot.
13 I'm looking forward to looking at all the
14 additional data and studies and information that
15 you send us. This has just been incredibly
16 interested.

17 I wanted to send a hearty thanks out to
18 Commissioner Peterman and to CEO Berberich for
19 joining us for a large portion of their day
20 today, I really look forward to continuing the
21 partnership that we have in working with them. I
22 wanted to send out also a shout out, a huge
23 thanks to Lezlie Kimura-Zito and Lauren Greenwood
24 for putting together such a terrific set of
25 vehicles for folks to see and to ride and drive

1 over the lunch hour. I thought that was great.
2 And also to say thank you so much to all the OEMs
3 who brought those cars and vehicles to showcase
4 for us today.

5 I want to thank our terrific staff. We
6 had Mike Gravely, Silas Bauer, Jim McKinney, Rey
7 Gonzalez, my Advisor, Jim Bartridge, Heather
8 (Raitt), Lynette and Stephanie, as always, from
9 the IEPR Team who did a terrific job today. And
10 I just wanted to make a couple of wrap-up remarks
11 which will in no way capture all of the terrific
12 information that we heard today.

13 But to me what stood out is how
14 electrifying the transportation sector can help
15 us with the integration of renewables. We're
16 going to need much bigger numbers to really make
17 that work. I thought the flock of ducks that
18 Heather presented to us was a really good way to
19 look at it because it's more challenging than you
20 might think because it depends on the day, it
21 depends on the month, it depends on the weather.
22 And also, I think an interesting point is that,
23 when there is over-gen, can we make hydrogen or
24 other renewable fuels that can then go into the
25 pipeline? And that's something that a few folks

1 touched on and I thought was also very
2 interesting.

3 We learned that it is important to keep
4 our eyes on methane, otherwise it may have the
5 potential to dwarf any benefits that we get from
6 a fuel switch. We talked a lot about how to
7 detect leaks, how to fix the leaks, and if we
8 don't do that, otherwise people are wasting a lot
9 of money.

10 Then a couple things about Natural Gas
11 and Zero-Emission Vehicle strategies need to
12 complement one another. We heard about the
13 different options that we have with Renewable
14 Natural Gas, and learned really that what is
15 started in California has the potential to move
16 beyond our borders and across the nation, and
17 also across the world. And this is really
18 important because we're trying to achieve climate
19 goals, we're trying to achieve clean air goals,
20 and that's why we're talking about this
21 transformation of the transportation sector.

22 So those are my remarks. My sincere
23 thanks to all of the experts who brought this hot
24 off the press great information to us, and I'll
25 turn to the Chair to see if he has any closing

1 remarks.

2 CHAIRMAN WEISENMILLER: Yeah. Again, I'd
3 like to thank everyone for their participation
4 today, and encourage them to file written
5 comments. And, yeah, I think again the
6 transportation sector is really important, but as
7 you look at the pieces, it's going to be hard. I
8 think it's taken us a couple years to move one of
9 the Vehicle to Grid demos which is like 14
10 vehicles, so as we're looking at thousands of
11 megawatts of swing, it's like, okay gang, it's
12 really important to speed those things up a lot.
13 So anyway, but at this point obviously it's not
14 like you could say we've done a demo that's gone
15 the life of a battery, you know. So anyway,
16 there's a lot to do and a lot to do fast.
17 Certainly, again, thanks for your help today.

18 COMMISSIONER SCOTT: Great. Have a
19 terrific evening.

20 (Whereupon, at 4:59 p.m., the workshop was
21 adjourned.)

22 --oOo--

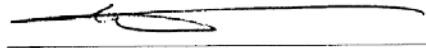
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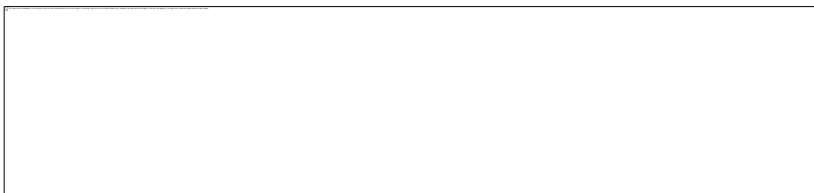
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