JOINT AGENCY WORKSHOP

OF THE

CALIFORNIA ENERGY COMMISSION

CALIFORNIA AIR RESOURCES BOARD

In the Matter of:)
)
AB-1007 Fuel Cycle Analysis (FFCA))
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CALIFORNIA ENERGY COMMISSION

HEARING ROOM A

1516 NINTH STREET

SACRAMENTO, CALIFORNIA

FRIDAY, MARCH 2, 2007

9:02 A.M.

Reported by:
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CALIFORNIA ENERGY COMMISSION

James D. Boyd, Vice Chairman, Presiding Member
California Energy Commission

Peter Ward, Advisor to Commissioner Boyd

Gabriel Taylor, Advisor to Commissioner Byron

Susan Brown, Advisor to Commissioner Boyd

Tim Olson

McKinley Addy

Contractors

Mike Jackson
Stefan Unnasch
TIAX

CALIFORNIA AIR RESOURCES BOARD

Michael H. Scheible, Deputy Executive Officer

Barbara Fry

EXPERT and PEER REVIEW PANEL

Alan Lamont
Dave Rice
Lawrence Livermore National Laboratory

Anthony Eggert
University of California Davis

Alex Farrell
University of California Berkeley

ALSO PRESENT

Al Jessel
Global Marketing Solutions
Chevron Products Company

ALSO PRESENT

Tom Fulks
Mightycomm
Neste Oil
Diesel Technology Forum

Sam L. Altshuler

Patricia Monahan
Union of Concerned Scientists

Bonnie Holmes Gen
American Lung Association

Catherine Dunwoody
California Fuel Cell Partnership

David Modisette
California Electric Transportation Coalition

Todd Campbell, Mayor
City of Burbank

Richard J. Plevin
Energy and Resources Group
University of California

Mark P. Sweeney
Energy and Utility Consulting

Kate Horner
Bluewater Network Division
Friends of the Earth

Michael L. Eaves
California Natural Gas Vehicle Coalition

Gina Grey
Western States Petroleum Association

Gary Herwick
Transportation Fuels Consulting, Inc.
on behalf of Renewable Fuels Association
and National Ethanol Vehicle Coalition

Luke Tonachel
Natural Resources Defense Council

ALSO PRESENT

Edwin T. Harte, Jr.
The Gas Company
Sempra Utilities

Tim Hunt (via teleconference)
City of Santa Barbara

I N D E X

I N D E X

P R O C E E D I N G S

9:02 a.m.

MR. ADDY: Thanks for coming to the workshop on the full fuel cycle analysis on the AB-1007 proceeding. The focus of this workshop is to present the work products of the full fuel cycle analysis. Please review the background information about the workshop we have out there on the table.

My name is McKinley Addy; and I'm with the fuels and transmission division here at the Energy Commission. I co-lead a full fuel cycle analysis effort for the AB-1007 project. Barbara Fry of the California Air Resources Board is my counterpart.

Before we begin and get to Commissioner Boyd and Mike Scheible, the Deputy Director of the Air Resources Board, I'd like to take care of a couple of administrative items.

First, an announcement for many of you not familiar with the building, the closest restrooms are just outside the doors to my left. There is a snack bar on the second floor under the white awning.

If an emergency occurs and the building

is evacuated, please follow employees to the appropriate exits. We'll reconvene at Roosevelt Park located diagonally across the street from this building that way. Please proceed calmly and quickly, again following the employees with whom you are meeting to safely exit the building.

I'd like to acknowledge the peer reviewers and expert panelists who will be participating in our workshop today, Professor Alex Farrell from the University of California Berkeley, who is also the co-director of the group developing a framework for California's low carbon fuel standard.

Alan D. Lamont, researcher at Lawrence Livermore National Lab. David Rice, a researcher at Lawrence Livermore National Lab. Anthony Eggert, a researcher at the University of California Davis, who is also a member of the low carbon fuel standard team.

They will be responding to presentations made by our contractor, as well as sharing their insights about issues or questions you might have about the full fuel cycle analysis.

I'd also like to acknowledge Guido Franco, Suzanne Phinney and John Wilson of the

Energy Commission who make the peer review activity possible.

I also want to thank all of the stakeholders with whom we've met and dialogued with over the last few months to get to this point. We listened to your desire for transparency and participation in the AB-1007 process, particularly on the full fuel cycle analysis. We hope we are meeting your expectations. We appreciate your contributions from groups like Cal ETC, the California Natural Gas Vehicle Coalition, Western States Petroleum Association, the Environmental Coalition, people from the Propane Education Council and I believe the Western States Propane Association, as well.

Later on I'll have a list of some of these stakeholders, as well as some of the briefing dates that we arranged to talk about the full fuel cycle analysis with you.

There will be ample opportunity for workshop participants and those on the phone to comment, both after each presentation and during the extra time we set aside for commenting. Please sign up if you wish to comment beyond the question-and-answer period after each activity.

To manage the time well, each person will be allotted about five minutes to speak. I will start with those who requested to comment or present by February 27th. Next we will take comments from people who indicate their desire on the sign-in sheet or one of the comment cards.

For those participating by telephone we will allow you to comment when you indicate your desire to do so at the appropriate time.

We plan to continue reviewing written comments until about March 16th this year. We'll follow the agenda as closely as possible. Now I'll turn things over to Commissioner Boyd and Director Mike Scheible.

VICE CHAIRMAN BOYD: Thank you, McKinley. And welcome, everybody, to this joint workshop between the Energy Commission and the Air Resources Board.

As McKinley indicated, I'm Jim Boyd, Vice Chair of the Commission, but maybe more appropriate to this gathering today, the Chair of the Commission's Transportation Fuels Committee.

I'm just going to say a couple of words --

UNIDENTIFIED SPEAKER: Jim, your mike

isn't working. Is it turned on?

VICE CHAIRMAN BOYD: It's on. Do you hear it? I can hear it. I guess I just have to, as I always advise the staff here, swallow the microphone. I guess I'll have to do it, myself. The ones up there are more sensitive, so you've spoiled us.

In any event, presuming everybody heard what's been said so far, welcome, you, welcome those who may be listening in to this workshop. I am Chair of our Transportation Fuels Committee. My Associate Member, Commissioner Jeffrey Byron is out of town today on an obligation that was made before this workshop was scheduled. And his Advisor, Gabe Taylor, is here and will say a couple of words in a few minutes.

A lot will be said today about the genesis and background of this particular study, so I'm not going to duplicate what I presume a lot of the presenters will be providing to you. But as, let's just say, a policy person who's been around a very long time, I was kind of reflecting on -- I reflect on this subject all the time. And I was going through kind of a litany of forcing functions through drivers for the -- down through the decades with regard to alternative fuels interests of government in California.

And I thought I would just replay them for you; if nothing else, to humor myself if it doesn't interest you. But, those of you who know my background are not surprised by this first statement that air quality frankly is probably the oldest and most perennial and persistent drivers for California agencies looking at the issue of alternative fuels in California, literally for decades.

And because the Energy Commission and the Air Board have always been joined at the hip because energy supply disruptions brought to us by OPEC down through the years have also been occasional drivers for the California Energy Commission to get deeply involved in the issue of alternative fuels in pursuit of energy security, that is supply security, through energy diversity.

The long-standing partnership between our two agencies was created, again, decades ago. However, whenever OPEC quit jerking our chain and energy security went away, air quality became the number one driver. But our two agencies have been partnering literally for decades on that question.

As we come closer to the current day, California's much more frequent price volatility issues began to interest everybody in the question of what's going on with our single sole supply of transportation fuel. And as, after multitudes of studies looking behind the issue for criminal or illegal behavior, everyone has finally concluded that in reality it's the market; that Californians voracious appetite for transportation fuel and the ever-increasing VMT of California drivers put us in a position where demand seems to almost, on a daily basis, outstrip the supply of finished transportation fuel. Which is reinforced the idea that we're really in precarious situation depending on a single source for our transportation fuels.

Then along came 9/11 and the issue of international security, which brought a whole additional group of interest groups, and interesting interest groups, to the table with regard to concerns about our dependence on a single transportation fuel supply. And in the meantime, by then, a host of various studies have taken place.

And finally, and perhaps certainly the

biggest driver of current time is adding to all of the above, is the subject of climate change.

So, you put all those together, there's quite a momentum, a very significant forcing function causing all of us in this room, as well as our two agencies in particular, to pursue the question.

Our two agencies, back in the earliest days of this decade, produced the joint report, as required by AB-2076, on how to reduce our dependence on petroleum. That was a real popular report in some quarters. But we've lived with the message of that report ever since.

The Energy Commission, in its 2003 Integrated Energy Policy Report, first one ever done, tried to drive that point home even more dramatically, at least from the standpoint of energy security. Our present Governor's response to that report was to ask for alternative fuels plans, biofuels plans. He then agreed that he was going to support and sign AB-1007, which provided a longer term schedule for producing an alternative fuels plan, that is June of this year. And we first produced a biofuels plan.

And then, of course, we've had AB-32; and the latest addition is the Governor's low carbon fuels standard initiative, which suddenly makes today's topic even more interesting and relevant than perhaps it might have been to many people. It's always been part of the requirements of AB-1007. And it's something we started quite some time ago. But, my, how it's become very relevant to the debates of the moment.

So, that's a little history of perhaps where we find ourselves today. And an indication that there are a multitude of reasons why we are having the discussion we are having today; and why it's so incredibly important to this state, if not this nation, if not this planet.

And therefore, in pursuing the alternative fuels plan under AB-1007, we were to address the idea of diversifying our fuel portfolio in consideration of environmental economic and technical factors. And that's what you're going to hear a lot about today.

So, with that, I would like to invite Mike Scheible, my long-time friend and Deputy Executive Officer of the ARB, who's here for Chairman Sawyer, to say a few words. And then

I'll ask Gabe Taylor to say a few words for his boss, Commissioner Byron.

And let me just, Mike, delay this a second to -- we don't have nametags up here. Some people may be wondering who all these folks are. I'll just strain my lapsing memory a bit, and I think I still remember the names of all the people I've known for years.

Barbara Fry, who's already been introduced. Mike and myself. Susan Brown, who's my Advisor. Gabe Taylor, who's Advisor to Commissioner Byron. Peter Ward, my other Advisor. Tim Olson, manager of this effort. And our ever present court reporter.

Mike.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Thank you, Jim. And it's good to be working here in partnership with you. Congratulations on your reappointment. We didn't know you would be here, and I'm very glad you are.

VICE CHAIRMAN BOYD: Why am I here?

(Laughter.)

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: I asked the other person in your life why do you let him do it. And she said she just couldn't control you.

VICE CHAIRMAN BOYD: All right.

(Laughter.)

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Anyway, good morning and welcome and thank you. Thank you for being here and participating. And thank you for all of the input that you've given so far to staff. I've looked forward to this day. I was thinking about reviewing the documents as they came out, and I said, no, I'm just going to wait.

It's clearly critical, this work is critical to AB-1007 and our looking at meeting the legislative requirements for the bill in terms of an alternative fuel plan for California. We had hoped to make it into a very meaningful document. It doesn't always happen with just a legislative mandate.

But the passage of AB-32 and the Governor's launching of the low carbon fuel standard initiative clearly makes all of this work critical. It's got to become the foundation we build upon and show us how do we design a plan, how do we get that effort going.

So, I'm just heartened that we're here

today and we have looked at what I think is a great progress report and also want to hear all of your comments and reactions to it. So, thank you for coming.

VICE CHAIRMAN BOYD: Gabe.

MR. TAYLOR: Good morning. My name is Gabriel Taylor. I'm Advisor to Commissioner Jeffrey Byron. As Commissioner Boyd mentioned, Commissioner Byron was unable to make it, and he asked me to pass along two points.

First and foremost, he sincerely apologizes for not being here. He is fully engaged in this AB-1007 work and he's very interested and regrets not being here.

And second, I want to assure you that any comments and concerns that are raised, I will provide a full report to Commissioner Byron; and he will be well informed on this effort.

Thank you.

VICE CHAIRMAN BOYD: With that, I think, McKinley, we're going to turn it back to you to act as our master of ceremonies. I have one last comment. I want to commend the staffs of both agencies for the hard work they've done. I want to commend our consultant for what I consider to be, under the circumstances, a significant and a very good product.

And I want to commend all the stakeholders and all the interested parties who have, on a regular basis, interacted with the staffs of the agencies and with the consultant. I've been very pleased and impressed with the degree of activity and interchange and cooperation that has taken place.

So I look forward to that in the future as we now cross over the horizon into this new future. McKinley.

MR. ADDY: Thank you, Commissioner Boyd. Now we'll have Barbara Fry and Tim Olson to say a few words about the requirements of the fuel cycle analysis process.

MS. FRY: Well, we've been working closely with the CEC and stakeholders and TIAX. We wanted to be assured that we were providing the latest information that we had from ARB for the fuel cycle analysis, so they do have our latest onroad and offroad vehicle models and data to use for the analysis.

We've been very pleased with the input we've had from the stakeholders. We understand that this will be an ongoing process in that in the future as new information becomes available it will need to be updated. But I think we're making some really good headway in reaching our first cut on a good analysis.

MR. OLSON: Very good. My name is Tim Olson. I'd like to describe just briefly some of the AB-1007 steps that we're planning here from this point on. And then a couple other comments on the fuel cycle analysis.

There is a -- if you don't have, back on the front table there there's a two-page description of where we're going to be going over the next few months on AB-1007. I'm going to try to summarize some of those things now.

As many of you know, the legislation AB-1007 requires us, direct us to prepare a plan on how to increase alternative fuels in the state, covering three milestone years, 2012, 2017, 2022. In our deliberations over that we felt that we also needed to expand that into some future dates, and we're looking at 2030 and 2050. So there's kind of a lengthening of the timeframe for this.

We are directly responding to the goals that have been set in the petroleum reduction plan adopted under the 2076 report back in 2002/2003. This is, in essence, a way to reach -- achieve those goals. That's what we're expecting to produce out of this plan.

And in addition to that this analysis, part of the analysis that -- several parts of the analysis we're doing under this report will be used for the low carbon fuel standard development, too. Particularly what we're talking about today, the full fuel cycle analysis, and some of our scenario storyline work that's underway and expected to be completed within the next month.

Just to give you kind of a flavor of what we're expecting to have in the plan, the full fuel cycle analysis is a key part of it. And, as you may know, it takes into account greenhouse gas emissions, criteria pollutants and toxics and water and soil impacts.

Another ingredient of the plan will be the scenario storylines I referred to, where we describe the conditions and circumstances needed to maximize penetration of any of the alternative fuels in the California's transportation sector. So that scenario process will try to quantify the magnitude, the timing, the significance of the market penetration.

The conditions and the circumstances we expect to include the need for incentives, standards, other government programs or policy mechanisms, technology advances, macro-economic environment, investment requirements, geopolitical factors in some case. And then material equipment, capital costs, and to the extent we can do this, expectations for economy of scale manufacturing that may reduce costs.

And then, of course, there's some other factors relevant to individual fuels and technologies.

So, in many ways we're using the scenario process to characterize kind of a business case for any single option.

Incentive analysis also is a key part of this. We want to know specifically who needs an incentive, why they need it, how long they need it, how much is the incentive, and then what's it going to cost to us. We also want to know what's going to be effective.

And another aspect of that scenario is instate fuel production. What can we produce in California to maximize economic impact of what we can do in California.

And there are some -- the law also asks us to look at consumer behavior. We're looking; we've got some fleet surveys, I think some of you in this room have responded to them. Over 1300 fleet managers have already responded to the survey, whether they use alternative fuels or don't; and why they do or why they don't.

Eventually the storyline scenario will come to an economic analysis; and we want to know what, under these circumstances conditions, what's the best way to minimize the cost to the state. And we want to determine statewide impacts.

We've agreed to use an EDRAM model that we use in a lot of the AB-32 and other policy forums. And the report plan will include recommendations.

This process we're going through will include several meetings, individual meetings, and, of course, at least one more workshop.

And that's kind of a description of the overall report.

Just a couple other comments about the full fuel cycle analysis. This is the first blush. We're not intending today, this to be the final thing that we're presenting.

As we go through individual meetings and we have ten different workgroups and we have pretty frequent meetings with many of the stakeholder groups. We're expecting that we will get some more insights and comments from you today and after this workshop that we'd like to consider in modifying what we've prepared so far.

If you have -- you can make comments today. We'd like to get as many comments in writing put into our docket. And we'd like to meet with you in some cases if there's more extensive type of dialogue that's required.

McKinley mentioned March 16th as a deadline he'd like to receive comments on the full fuel cycle. We'd like to hear from you, if that's a hardship we'd like to hear from you on that and whether you need additional time.

But I think at this point I'll just -- that's my comment and I'll turn it back to you, McKinley.

MR. ADDY: Thank you, Tim. At this point we have a chance to ask any questions you might have about what you've heard so far from Commissioner Boyd and Deputy Director or Executive

Officer Scheible. Only on what you've heard so far; nothing on the presentations to come.

Okay. And before I get Mike Jackson up here, I'm very big on acknowledging people, and so I'd like to put up a list of some of the people that have been a part of this effort to get us to this point.

From the Energy Commission, the Air Resources Board, and of course, our list of peer reviewers. And just a comment about my colleagues at the Air Resources Board. They have been more than helpful in this process. Every time we wanted something they provided it, Barbara and her team, Narci Gonzales, Jose Gomez, Ben Deal, Analisa Bevin. And, of course, the list of other people that you see there. So I'm very pleased to acknowledge them.

I also want to acknowledge the stakeholder groups and different entities that we've interacted with throughout this process, as well. This doesn't mean that you endorse the work so far, it just means that we've been in contact with you; you've given us inputs; you've given us your contributions; we've listened to you. And I want to acknowledge that.

Finally, to get to this point, as a result of the October 16th workshop, many of you requested greater transparency and the opportunity to give some inputs. And for the full fuel cycle analysis we convened specific briefings that lasted, I think, between an hour and a half to sometimes three hours, and still people had things to say.

But for the electric drive group we met with them on 12/6 and for the other groups, as you can see there, different times. So, we've expanded the participation in this effort, and hopefully by the time we get out the final product people will have felt that they were a part of the product.

I'd like to now get Mike Jackson up here to give us the summary results of the full fuel cycle analysis work.

MR. JACKSON: Thank you, McKinley. Good morning, everybody. Can you hear me in the back? Okay.

My name is Mike Jackson; I'm with TIAX. And first of all, I think I need to acknowledge the number of people on our staff that worked on this project, including Stefan Unnasch, who is here, Jenny Pont, Matt Hooks, Larry Waterland, Dan Rutherford, Mike Chan and myself.

We were asked to accelerate this as much as we possibly could, and to meet this date. And I think we've done that. So, it was a lot of hard work on our staff's part, but hopefully these results will hold up to the review comments that you people have here today.

So, what I want to do is provide an overview of the methodology that we developed for doing the full fuel cycle analysis. I want to give you a little bit of introduction to that. And then walk through a little bit on the methodology. I'm going to give you example results for one analysis year, that's 2012. And then I want to end with some summary comments.

And this has already been said, but Assembly Bill 1007, Pavley, which is titled, air quality alternative fuels, the California Legislature stated in that legislation that the production, marketing, distribution and use of petroleum fuels causes significant degradation of public health and environmental quality.

Two, that clean alternative fuels have a potential to considerably reduce those impacts.

And are important strategies to attain air and water quality goals.

Three, that the research, development and commercialization of alternative fuels have the potential to strengthen California's economy by providing job growth and helping to reduce the state's vulnerability to petroleum price volatility, as Commissioner Boyd talked about in his introductory comments.

Both agencies, CEC and ARB, recommended in their report to the Legislature that reducing California -- their report to the Legislature, which was titled, reducing California's petroleum dependency, that the state adopt a goal of 20 percent nonpetroleum fuel use in 2020; and 30 percent by 2030.

AB-1007, the Legislature is now requiring the Commission, in cooperation with ARB and other state agencies, to develop and adopt a state plan to increase the use of alternative transportation fuels.

An important part of that plan is to include and evaluation of the alternative fuels on a full fuel cycle assessment of the emissions, of criteria pollutants, air toxics, greenhouse gases, water pollutants and any other substances that are known to damage human health and impact on petroleum consumption.

In the context of this legislation, alternative fuel means a nonpetroleum fuel, including electricity, ethanol, biodiesel, hydrogen, methanol or natural gas. We expanded that list, as you'll see when we go through this a little bit. And the plan set goals for 2012, 2017 and 2022. With the staffs of ARB and the Commission expanding that to more the out-years of 2030 and at least some glimpse at 2050.

When you think about full fuel cycle analysis there's a number of emission events that occur throughout the cycle, and you have to start thinking about well, where do those things happen. And this shows the petroleum sort of pathway. I will show examples subsequently on alternative pathways. But for the purpose of just understanding a little bit about what the job is in terms of trying to figure out how you track various emissions throughout the cycle, let me use this as an illustration.

First thing is you have emissions that are occurring outside of California perhaps. So, for example, on the production of oil it may or may not be occurring in California. From a marginal perspective -- and I'll explain this more fully later -- most of the production or the next barrel of oil or next gallon gasoline is probably going to come from offshore, not onshore.

So we have to draw some boundaries. And one of the boundaries that we're drawing is the production is going to occur out of California. So those emissions aren't necessarily counted.

Also, when you ship or distribute, bring the fuel to California, most of that is happening in the ocean, not near our coast. So some of that is being covered outside of California.

Let's say you're inside California and you build a facility, well, with the California Environmental Quality Act, CEQA, you basically have to offset those emissions. So whenever we thought about a facility that had to be put into California, had to offset any emissions that were above and beyond best available technology. So that would occur in processing; it could occur in product storage, for example.

The next sort of step is well, what's happening in California. Well, this is where you start trying to count all the emission events that could possibly happen throughout the fuel cycle.

So, for example, as you bring the fuel, be it refined products, into California you're going to have some ship emissions which are going to impact California. These are from being near the coastline or actually being at the dock offloading, and there's emissions that occur there on the ships.

There's also, even though we have very stringent requirements in terms of siting and controlling emissions, bulk storage, there's still some emissions that occur during the events of moving fuel through that system. So it's not 100 percent efficient. It's pretty good, but not 100 percent. There's still some leaks that happen.

And then one of the bigger events that occurs is just distributing the fuel around. In the petroleum case, pipelines are very very efficient. But you still have to move product by the trucks. And the trucks have emissions, and they also have emission events when you're moving the product from the truck to the underground tanks at the station.

And, again, at the station we have stage two. We have ORVR on the vehicles, but there still is emission events that are associated with fueling and -- fueling not only the underground tanks, but fueling the vehicles.

And then finally the vehicle, itself. You're going to have not only evap emissions, but also tailpipe exhaust emissions.

And then finally you need to kind of keep track of what's happening relative to spills of product. And how that might affect the environment. And we tried to do that in this analysis, too.

So that gives you an overall idea of the scope here. The idea is to try to think and follow that fuel throughout its life, so to speak, from cradle to grave. And what are all the emission events that are occurring during that period. Not only from a greenhouse gas emissions point of view, but from criteria pollutants, what's happening to NOx, what's happening to hydrocarbon emissions, what's happening to CO, what's happening to diesel particulate. And how does that impact things like toxics, also important to try to follow that all the way through.

We made some assumptions regarding the marginal analysis for conventional fuels. And they are shown here. First and foremost, and this was the backbone of these kind of assumptions, came out of some of the work on AB-1007, excuse me, 2076, which was the petroleum dependency report. And subsequent work by the Commission on the IEPRs.

But, I think, as Commissioner Boyd pointed out, the refining industry within California is pretty much running at capacity. The assumption here is that no new refineries are going to be built, but that growth and demand will be met by supplying refined products coming into California.

So gasoline and diesel would be imported to California to meet the growth and consumption beyond the existing refinery capacity. Okay, so right there you're excluding all the refineries in terms of the emissions. There are no emissions associated with that. The refined products, be they gasoline or gasoline-blend components, or be they diesel or diesel-blend components, are imported by ships into California. Now, there is a -- that's the major assumption here relative to the petroleum side.

There is a potential issue that will have to be worked in the future, and that has to do with the fact that our instate production of oil is also decreasing. That means more oil actually has to be imported in to be refined. That step is not included in here.

Secondly, natural gas continues to be shipped into California, mostly from the North American supplies, either Canada or the U.S., itself. And if you're going to bring LNG into California then it's going to be imported by ships.

And then thirdly, the electric power is on the margin basis generated by combined cycle -- natural gas, combined cycle gas turbine plants. And then also utilities are meeting the California renewable portfolio standard, the RPS. So there's no hydro here, there's no other combustion, electric generation combustion sources that are being considered; nor is there any nuclear being added to this.

So those are the major assumptions regarding the conventional fuels.

Things that you need to consider. And

I've kind of said this already in terms of the overall view of full fuel cycle analysis. But you got to think about the vehicle exhaust; you got to think about the evap emissions and how they are changed or impacted by the production of various fuels and how they get delivered into California. So, delivery logistics, energy density all affect how they are brought into California either by ship, rail or being trucked around.

Fuel losses and impact on toxics such as benzene and polycyclic aromatic hydrocarbons are also important. And we tried to track that through the system. And I've already talked about this, but accounting, where do you draw the boundaries? California? U.S.? Rest of the world? And I'm going to try to, in the results I show you how at least what our assumptions were in terms of drawing those boundaries.

And then try to look at the impact of water pollution in California.

In all of this we were also evaluating the greenhouse gas emissions and you'll see the term GHGs here throughout this presentation. It stands for greenhouse gas emissions. And that is the weighted carbon dioxide, nitrous oxides, N2O, and methane emissions, CH_4, as weighted in their global warming potential.

Some thing that you can do that will reduce those emissions include having less carbon in the fuel; having something like a biofuels, which basically recycles the CO_2 through plant photosynthesis. Or improving efficiency from production through vehicle technologies. All those have an effect on reducing GHGs.

Just an example for various fuels, the carbon content relative to its heating value. And it starts on the left with biodiesel-20, a mixture of California ultra-low sulfur diesel fuel with 20 percent biodiesel.

Diesel next at 10 parts per million, and I'm not going to read through all these. Finally, going to the end, you can see some of the gaseous fuels like LPG, natural gas, LNG tend to be a little bit lower, not dramatically lower, but a little bit lower in carbon content. And provided the efficiency is roughly comparable you're going to get lower greenhouse gas emissions out of those fuels.

And then finally on the far right is hydrogen, which is zero. It's wonderful, but you've got to consider the full fuel cycle analysis, not just the vehicle. So you got to make sure that you're counting for how that hydrogen is produced, because it has emission events in itself.

Okay, I'm going to walk through now the methodology. The idea here was that the full fuel cycle analyses was to provide a basis for determining the energy inputs and emissions from various fuels and vehicle options.

In the context of AB-1007 this was really a screening tool. Right? I mean what we're trying to do here is say let's develop an alternative fuels plan, but let's not go down an alternative fuel path that necessarily gives us one benefit or one attribute, but then has another disbenefit or disattribute.

And I think, as was said in the introductory remarks, this becomes a little bit more interesting when you start thinking about things like the low carbon fuel standard where you actually can think about a credit that could be given for a given fuel path.

But in the context of 1007 it was really a screening tool. So the methodology, we think, will be able to be used as you further discuss these other policies that are evolving. But what you'll see in this is you have to think about this a little bit as maybe not getting into the total details that you would need for every single option or fuel option.

In other words, a lot of these pathways we have taken average numbers -- this is, for those of you who are familiar with the California emission inventory goals, like EMFAC, there's a lot of averaging going on. And many of these things are averaged. So if you wanted to do a specific fuel, a specific fuel cycle, you know, with given harvesting of land use requirements, fertilization, all that, that all has to be worked into this methodology. Not there yet. It's there in terms of averages, but it's not there specifically.

We think the methodology is okay to handle that kind of detail, but what you're seeing today is going to be more averages and not that kind of detail.

So, the objective here was to compare the various fuel options based on the impacts of fuel production and vehicle operation. And I'm going to show you a couple of vehicle scenarios. I'm not going to go through all the vehicle scenarios.

Fuel pathways included -- the major fuel pathways included petroleum, natural gas, coal, biofuels and renewable power. And the vehicles we talked about are light-, medium- and heavy-duty vehicles, as well as some offroad applications.

And we have worked with ARB and have emissions occurring from them, data on emissions occurring in 2012 for the entire fleet, or for new vehicles occurring in 2012. For 2017, 2022 and 2030, both onroad and offroad. So, thanks to ARB for all that information.

We looked at both new vehicle and blended fuel strategies for existing vehicles. And blended fuel strategies included things like increasing the ethanol content to 10 percent in reformulated gasoline. We looked at biodiesel, B-20, and some Fischer Tropsch fuels. We did a Fischer Tropsch diesel 30 percent. So, that is California ultralow sulfur diesel plus 30 percent of Fischer Tropsch diesel.

And then emission sources and boundaries. Criteria pollutants we were looking at; toxics; water impacts. Location of the sources, we tried to keep track of where they were happening, whether it was California, the rest of the U.S., North America or the rest of the world. And the global GHG emissions. Of course, the boundaries are the world there, so you keep track of it all the way from cradle to grave.

As most of us know, oil is a world commodity. It's concentrated in various locations throughout the world. And it moves through ships, through pipelines. It's refined. This kind of just gives you an overview of some of the movements of oil from the various locations in the world.

And oil's not the only thing that moves like this now. Refining is also a worldwide issue. And you can have refining flows that are occurring. For instance, the former Soviet Union, eastern Europe refining and providing fuels into Europe. And also them providing into China. China's probably going to be a large new home for many refineries. Some of that may even end up coming to California.

Now, of course, there's biofuels that are available these days. California's -- the

U.S. is a major producer of corn-based ethanol, now I think in the 6 billion gallons per year production or slightly over that. Brazil, of course, is neck and neck with us, except it's sugar cane-based ethanol. And other sources like palm oil, for example.

The question for us in terms of doing this analysis was where is the resource, where is the feedstock. Where is it going to come from? How much shipping does it take to get it from -- or production does it take to get it from where the feedstock is to where we're going to use it in California? And we tried to keep track of that kind of stuff.

You have similar kind of situation for gaseous fuels. Of course, the United States has a fairly large resource of natural gas, as does Canada. And we, in California, take advantage of that by importing much from the southwest part of the United States, as well as Canadian sources. Mexico also contributes.

But there's other sources. LNG, for example, is used in Japan, mostly coming from Australia. And finally you have remote natural gas being converted to Fischer Tropsch fuels which are going to basically diesel, which are going to blends in various locations throughout the world.

Again, the point is you got to keep track of where these fuels, what's happening with these fuels and what the distances are in terms of transportation.

Now, this gets to sort of what did we do, what was our scope. Well, our scope was to look at all the different fuel sources, feedstocks, on the left-hand side and convert them into transportation fuels on the right-hand side.

When you start doing that there's about 59 different pathways that we have looked at. And let's just pick one example.

If you take, for example, corn, and then that's going to fermentation. Fermentation is going to ethanol. But sort of shown in the middle there is what do you do with those byproducts that come out of that process. That's an important part of figuring out what the energy use is and making sure that you provide credits for those streams that are also part of the process.

So, the well-to-wheels, again being somewhat repetitive here, but we're looking at the energy resource, we've looking at the feedstock, the energy resource. We then take it to production. You've got to transport it; and you've got to distribute it and market it. And then you're going to use it in the vehicle.

And we're trying to keep track of all those steps, all those energy and emission events that occur through that process. So, we're including not only combustion, but fugitive, spillage, emissions, water discharges.

One thing that we did not include is the emissions of building that facility or the materials that you would need to build that facility. And similarly, the same thing for vehicle manufacturing are not included in this assessment. People have done that assessment and they estimate that those numbers, if you include them, are probably on the order of 10 to 15 percent of the energy anyway that's used.

So, what did we do? Basically are using GREET, which was developed by Michael Wang at Argon National Labs, as the backbone for this analysis. And what's shown there in the middle -- do you have a pointer, McKinley -- I think I can talk from here -- basically used GREET. We did get input from ARB relative to both the on- and offroad emissions, so EMFAC 2007 was used to give us data on the emissions for the existing fleets.

For existing fleets, as well as for new vehicles that would be introduced, we used the new offroad model to also give us a number of emission factors for quite a large number of different pieces of equipment. That sort of hurt our head a little bit, Barbara.

We modified GREET based on some of the things that happened here in California. Heating values, for instance; our reformulated gasoline is slightly different than the reformulated gasoline that you used in the rest of the states. Cargo capabilities are slightly different. Transportation modes are slightly different than what's used in other parts of the United States. And a lot of emission factors are, you know, California-specific that we really need to put into this methodology. And that's what we did in terms of putting that together.

And we produced this results in terms of a tank-to-wheel processor; actually there is a tank-to-wheel report. And that tank-to-wheel processor is giving us results on what the vehicle and application emissions are in terms of a gram per mile. And we looked at that, as I said, both on an average fleet emissions, as well as new vehicle emissions.

ARB also gave us information on toxic speciation, which we used to track what was happening in some of the emission events throughout the fuel cycle analysis.

And then there is a well-to-tank processor which allows us to take the energy in terms of joules per joule of fuel, the greenhouse gas emissions criteria, and toxic emissions and convert them into a gram-per-mile number once we know what the vehicle application is and what its fuel economy is.

And then what comes out is everything in terms of energy, greenhouse gas emissions, criteria and toxics all on a gram-per-mile basis or a gram-per-hour, depending on what the application is.

So, there's 59 of these different pathways in here. Various vehicle applications. This starts to add up to a phonebook of results which anyone's happy to look at. Be happy to give it to you to look at.

This just kind of summarizes in words

some of the modifications that we did make. So transportation distances were one of the important thing that we wanted to make sure that we were accounting for in California versus what was in there on a national basis. So it needed to reflect our assumptions regarding the marginal analysis.

We did have three different scenarios in the GREET model to look at, whether you're in U.S., whether you're in California or whether the rest of the world.

The emission factors for delivery trucks and offroad equipment had to meet the California standards. Emission factors for natural gas, transmission equipment in California meet BACT requirements. Marine and rail emissions reflected in-port, and rail switcher activity with an adjustment factor for urban emissions. These are all the kind of things that were changed.

And then the natural gas transmission and distribution losses reflected data from the California utilities versus the national utilities.

Continuing on, urban emission shares reflected facility and transportation equipment in

California. So, again, as I explained before, CEQA requires things to be offset. You got BACT plus offsets, all those things in the case of a facility that was built, they would have to be offset.

The model was modified to calculate the urban emission shares based on the urban distance and total transportation distance. And then emissions from facilities requiring offsets, emissions basically go to zero. That includes SOx, NOx and VOC emissions. And then finally, the heating values and carbon contents were adjusted for Fischer Tropsch diesel, reformulated gasoline and hydrogen based on our best estimates of what those were compared to what was in GREET.

This gives you an idea of what you do with all this information and where it counts. So you're taking the local transportation distance, that's going into determining what the specific energy is on a joule-per-joule product basis by fuel.

You're looking at where the emissions are occurring, what their share is. You're looking at the emission factors for carbon, sulfur content. What's the technology in the fuel share;

what's the energy factor efficiency in fuel consumption. All those things count.

And then you're trying to figure this out, not only outside of California, but inside California nonattainment areas.

Let me spend a little bit of time of how we dealt with toxics. Again, there are many sources primarily from the hydrocarbon releases that you think about, but also fuel spills would cause toxic releases to occur. And that's sort of illustrated on the table that's shown here. Benzene, for example, can be from the fuel, but it also can be from the vehicle and also can be from the facilities, as well as spills at the facilities.

The calculation method here was to use speciation data that we got from ARB. And then to sum up, so the total toxics based on what their speciation was, plus what the source was. So, for example, what's shown on the bottom table here for hydrocarbon that's coming out of a running exhaust, the percent of that hydrocarbon that is benzene is 2.64 percent.

So we had different speciations for different sources of the hydrocarbons, and those were all put into the model so you could track that.

Now, the question is what do you do with that. And the analysis methodology was to weight those toxics air contaminants based on the state's inhalation unit cancer risk, which we then normalized to for formaldehyde.

All right. Now, one thing that'll be apparent, when we go through these results in a little bit, is that relative to particulate matter, only diesel particulate matter is on here. So, particulate matter coming from natural gas engines, for example, is not on this list. So it doesn't get counted. Is that right? Probably not. Does that need to be changed? Probably. That would be a refinement we'd have to do.

Water impacts, again from spills and fuel transport, as well as fuel production. Sources include tanker ships, pipelines, you can think of this. Underground tanks is probably one of the biggest ones. But other things like just leaking motor fuel from vehicles. That's an issue that affects our groundwater.

So we tried to track this, and I'll show you one example for the petroleum, and describe some of the benefits you get with some of the fuels. But, again, this was not as detailed as looking at the greenhouse gas emissions or the criteria pollutants.

So, let me give you some example pathways. Here is importing CARBOB from the Middle East to California to make reformulated gasoline. So, again, one of the assumptions here on a marginal basis is that we are going to import from a refinery offshore, either gasoline or gasoline-blend components that will meet the growing demand beyond what our refineries in California can supply.

So, obviously you have an overseas well; probably have some sort of crude pipeline that delivers that to a refinery, which is overseas. Then it refines the product. You put that into a tanker ship and you ship it to the California coast. Put it in storage tanks, probably in and around the refineries that are already in California. And then ship it via pipeline, existing gasoline pipelines in California, to mix it with ethanol to make California-based reformulated gasoline. That then is transported by truck to local fueling stations.

So you can think about what the big emission events are going to be here, right? From a NOx point of view, at least in California, it's going to be a NOx and particulate matter, it's going to be the tanker ship in and around our coast, sitting in the loading docks, generating NOx and particulate.

And then the next major part there is hauling the ethanol into California, which comes, as you'll see in a minute, mostly by rail from the midwest. Then by truck to the product terminal. And then finally the truck, itself, distributing the fuel from the product terminal to the local gas station.

So, the lower the emissions of the tanker ships, the lower the emissions of the tanker trucks, the lower the emissions of rail, the lower the upstream effect will be for criteria pollutants.

About midwest corn-based ethanol to E85, as an example. Well, again, in this case you are planting, growing, harvesting, fertilizing the corn. You've got to account for all that activity relative to energy use.

It then goes to, say, a dry mill

processing plant. Gasoline is added to it to denature it, somewhere between 2 and 4 percent. It then goes to a railhead. The railhead then transports it to California. That denatured ethanol then is probably stored at a rail receiving head here in California. Then trucked to the blending terminal and matched up with CARBOB. And then you would then distribute an E85 to the fueling stations.

Another example is imported natural gas, say, from a remote location. So you have the foreign natural gas well; you have a pipeline that probably goes to some liquefier. You liquify the natural gas. You put that on a LNG specially designed tanker. That would then come to an offshore facility -- an onshore facility to be vaporized. Then distributed through the California pipeline network. And then you might compress that and make compressed natural gas to be used as a vehicle fuel.

The last example I'm going to show is electric pathway where here, again, as I said, we're mostly talking about natural gas combined cycle plants. But also renewable energy including solar, wind, biomass, geothermal. All those would have to be considered in this part of it. It's then distributed via high voltages down to a transformer, to housing and buildings to be used as consumers want. Perhaps a plug-in hybrid vehicle, for example.

Okay. So what's the scope here? About 59 different pathways. We did two to three vehicle applications for analysis years, for criteria pollutants, well-to-tank energy, well-to-wheel greenhouse gas emission, toxics, water pollution. Gets pretty big. Like I said there's probably a phonebook that we could fill up now with all the results.

Six conventional fuel pathways, specific towards California reformulated gasoline, California ultralow sulfur diesel fuel, ten different blend pathways including E10, biodiesel, biodiesel 20, B20, BD20, as we refer to it, Fischer Tropsch diesel 30 percent blend, so it's FT30, with California ultralow sulfur diesel. And we've also included E-diesel. And then there's about 43 different fuel pathways, compressed natural gas, ethanol, DME, electricity, hydrogen, LNG, methanol and LPG.

And we've looked at light-duty vehicles, transit bus applications and other offroad. So, for today's presentation I'm going to show you mid-sized, light-duty vehicles; going to show you transit buses; and I'm going to show you a forklift application.

So, now we're ready to move to the results. And, again, this is 2012. Some things to keep in mind on 2012, especially relative to the upstream emission events is that the new heavy-duty standards that are going to control both NOx and particulate, particulate is being controlled in the '07 engines now, but the NOX will be controlled in 2010. So you're going to have ultralow, heavy-duty emissions; but they may not all roll in by the time you get to 2012.

So, some of the results you see here might be a little bit high in terms of criteria pollutants in the early years, but would be lower in the out years. So something just to keep in mind.

On the mid-size autos we needed to assume a fuel economy, as I showed on the methodology flow chart. And this shows what we used in terms of fuel economy. This has been bandied about a number of times. And you could argue, well, you know, we haven't quite got the right number here, this number should be higher, this number should be lower. But, this is probably pretty good.

Now, I'm going to go through these results, and what you're going to see for each fuel, for each example, there's going to be a well-to-wheels energy comparison. So how much energy does it take, milijoule, to go a mile for this particular application.

And then on the right-hand -- left-hand side there's going to be various options. And I'll walk through this one once, and then you'll have to sort of remember them. But you have a number of different fuels plus assumptions that go into this.

So, for example, you have at the bottom, it starts out with California reformulated gasoline. This is on the margin now. We're importing it from -- not producing it in California. And it's used in an internal combustion vehicle.

Next one up, same thing except it's used in a hybrid electric vehicle. Improved efficiency, use less energy.

Next one up is LPG used in an internal combustion engine vehicle. Slightly less energy than is required on the RFG.

Next one up is compressed natural gas. And now you can see that I'm starting to say, well, where did this energy come from. So there's a petroleum component; there's a natural gas component; there's a coal component; and there's a nonfossil component. So in this case, not surprising, natural gas comes from mostly natural gas.

When you get to the next one which is ethanol as E85, produced from corn, midwest. And sort of using the average, you can see you need some amount of petroleum to move the product around, to do the harvesting in the fields. You need some amount of natural gas, sort of an average, to do the processing. But there's also some amount of coal that is needed because it's using electricity and there's a mix of natural gas and coal to make that electricity. And then there is some nonfossil that is used.

And as you go up to the cellulosic or the sugar cane you can see the fossil components become very very small. And the nonfossil components are much larger. There's also some cogeneration that's going on here in these two cases. So there's actually a net, a gain of a bit of that.

And in the case of hydrogen we're only considering onsite locals steam reforming. So this is all natural gas. This is the assumptions on some of the electricity cases that we've looked at. So, there's both a battery electric vehicle and there's a plug-in electric vehicle. So, well-to-wheels energy is the first one.

The next one I'm going to show you is well-to-wheels greenhouse gas emissions. And this is broken up between the tank-to-wheel component and the well-to-tank component, or the upstream of the fuel cycle.

And what you see here is the baseline where the California RFG in a mid-sized auto slightly over 400 grams of GHG equivalent per mile. And then if you increase the efficiency obviously you reduce the impact in terms of GHG. And this is about a 30 percent drop here.

Next one shows LPG. Again, LPG has less carbon, about the same efficiency in the fuel. You get a benefit of about 20 percent or so.

Next one up is natural gas. With similar efficiency in the vehicle and the fact that it has less carbon, you get inherent benefit.

Corn ethanol is shown next. And although you have quite a bit of -- you have photosynthesis that can do some recycling here, corn-based ethanol is quite energy intensive, which takes away some of its benefit in the 20 percent range.

Cellulosic, here you can get the tremendous benefit of the CO_2 recycling as well as Brazil's sugar cane, you can see this is the credit that is from the recycling of the CO_2, and you get a net that is considerably less than some of these other sources. Same thing goes with Brazil sugar cane.

The case of hydrogen, obviously you don't have any tailpipe emissions of CO_2, so it's all an upstream event that's occurring and this is just one example of many production pathways for hydrogen.

And then the same for electricity, although for the plug-in you're going to use not only gasoline but also some electricity. So you get a little bit of both in that case.

Next up is criteria pollutants. And what's shown here for this set, again it's a mid-sized auto. The top one is NOx, so that's NOx. And we go to VOC; then we go to CO, which has been divided by ten to get it on the scale. And then we go to particulate matter which has been multiplied by ten just to give us a balance here on the scale so we would have --

What do you see on this? Well, there's a couple things you can draw conclusions on. One is that the LPG -- and I'll address this in a minute -- but if the refueling events are not controlled you do have some unreleased emissions that are going to be higher than what you would normally see for the gasoline RFG.

You also see that in the case of E85, ethanol being produced from poplar trees in California, that you'll have a higher particulate emission. And this is primarily the reason is that you're doing all the harvesting, you're doing all the work, so to speak, in California. For the corn, this is only California emissions of particulate.

If I put the total emissions on here, then it would probably be as high as this. So this is a boundary-condition problem.

The other thing that's noticeable here is when you get to some of these cleaner fuels, these numbers really start shrinking. Although you'll see that particulate here, here and here is still fairly high. And this primarily has to do with the emission factor that's coming out of these gas turbine facilities.

Now, the question is, is that the same as that. And that question is not answered in this presentation today, although what we've assumed is that only diesel particulate is included in the toxics. So when I go to the next chart this will be there, but that disappears.

And that's what's shown here. What we've shown is diesel PM, benzene, 1,3 butadiene, formaldehyde, acidaldehyde; mostly all these pathways are dominated by diesel exhaust. Either moving the fuel around or the shipping or the trucking emissions.

And, again, what you see is most of these fuels are about the same as reformulated gasoline except when you get into some of the fuels which require that you're either bringing the fuel in by rail or you're bringing it in by ship or you're actually doing all the work inside the state.

So, what are some of the observations that I get at looking at this. First, the energy impacts really depend on the pathway. That's not a surprise.

If you have electricity from renewables that's going to be fairly low in terms of a GHG impact. If you have electricity from coal it's going to be very high.

Ethanol from corn, sugar cane and cellulosic biomass are going to be different. And so ethanol is just not ethanol. You can make a distinction between where that ethanol, what the feedstock is and where it's coming from.

The differences are largest in the GHG emissions but the pathways also affect some of the criteria and toxic emissions as I've showed you.

This table here kind of gives you an indication of what the benefits were on a GHG basis. Corn ethanol is about, you know, could be anywhere from zero to 30. Cellulosic is in the 80 range. Natural gas is in the 27 range. LPG 18 to 23, depending on where that -- what the source is, what the feedstock is. Plug-in hybrids, battery

EVs in the 20 to 50 percent. And hydrogen, at least in this pathway, in the 40 to 50 percent.

Again, if I looked at this from a screening point of view, the alternative path -- the carious alternative fuel pathways are about the same in criteria pollutants. The one thing that I guess I would say on a toxics point of view you got to make sure we understand how to deal with that.

There is the LPG VOCs that are higher, and could be controlled. They can be controlled. They just need to be controlled. That would be a part of the 1007 plan, is how you do that if you're going to get LPG into the marketplace.

California's cellulosic ethanol increases the PM emissions slightly because you're doing all the work here in the state. Maybe that means you have to mitigate that some way, either by forcing newer emissions on those vehicles sooner, or some other mitigation.

The natural gas and hydrogen pathways seem -- and electric pathways seem to be much lower than the baseline gasolines.

And then finally, the air toxics are really dominated by the diesel exhaust. But, again, my caveat is a particulate -- is gasoline particulate as health-damaging as diesel particulate. Wasn't counted in here.

So, let's look at urban buses. This is slightly different. The urban buses use a lot more energy. You're not going to see as much spread on the results. But, again, we use diesel, California ultra-low sulfur as the bottom chart. You can see that's mostly petroleum, little bit of natural gas on an energy basis.

Then the next one is DME, assuming remote natural gas, also used in an internal combustion engine. And, again, most of that is natural gas. You got to ship the DME here so you're going to use a little bit of petroleum to do that.

Next one up is methanol, also remote natural gas. This would be used in a fuel cell vehicle which gives you a little better efficiency in the vehicle, which helps drive down, a little bit, the energy use compared to DME.

Then you have natural gas, followed by -- compressed natural gas, followed by -- from North America, followed by LNG from a remote location, it gets shipped here. And, as you can expect, the energy use is more because you're shipping it here. And then there is hydrogen with onsite steam reforming used in a fuel cell vehicle. And then battery electric with natural gas meeting the RPS requirement, too. So, the lowest here not surprisingly is electricity.

On a greenhouse gas basis, again what's shown is the split between tank-to-wheel, the blue; and in the lighter color, the well-to-tank, the upstream emissions.

And you'll see that diesel is on the bottom. DME is slightly higher than diesel on a well-to-wheel basis. Primarily because of having to ship it here and using it in internal combustion engine.

Methanol is a little bit better for a couple of reasons. One is that the carbon in the fuel is a little bit less than diesel. Plus you're using it in a fuel cell vehicle which has better efficiency.

You can see that natural gas is about the same as methanol from North America. And LNG is a little bit higher. And surprisingly, the hydrogen example here is about the same as the CNG, and then electric would be the best in this grouping.

You look at criteria emissions, the DME suffers the same sort of fate as LPG. You need to be able to control the refueling emissions. So that is why the VOCs are so high here. Everything else looks about the same relative to diesel. A little bit lower here, a little bit higher there, but roughly comparable.

Again, the issue of PM coming from the combined cycle plants is counted here, but it's not counted relative to a toxic.

And if you look at the toxics, I've emphasized that on this chart. We're only counting the diesel PM. So most of all, the other options, if you don't count them as a issue relative to toxics, they pretty much all go to zero.

So, what do I conclude out of these? Zero emission technologies obviously provide the lowest or the largest GHG benefit, depending on the fuel and fuel pathway.

CNG provides benefits comparable to hydrogen, at least through the pathway of local steam reforming.

And those methanol from remote natural

gas; and the table here shows what those are. The electrics being about 48 percent. And then the criteria, the toxic emissions are pretty much comparable.

So, again, looking at this from a screening point of view you wouldn't necessarily drop out any of these fuels, with the exception of potentially DME, which kind of goes backwards, but not hugely backwards relative to GHG emissions.

All right, probably about half-way done with all these examples. You're probably getting tired of these examples, but bear with me.

This shows now blending options. So what we're trying to do here is take reformulated gasoline and blend in various levels of, in this case, ethanol.

And we've done, on the bottom is reformulated gasoline, its baseline again. Then it goes to an E10 or a 10 percent ethanol, again from corn-based. Then I've shown a RFG California marginal with an FFV, because the top ones are comparing with a flexible fuel vehicle, so for apples-to-apples we did that. They're about the same anyway as the RFG marginal anyway.

Then next up is E85 corn. E85 locally

grown here in California, cellulosic, and then the Brazilian sugar cane. So, those are the energy requirements.

The GHG is shown here. So, again, the weighted greenhouse gas emissions for the RFG is shown on the bottom. Doesn't change much for E10, just slightly because you just put a little bit more ethanol into it. The corn doesn't give you that much bang for your buck anyway.

E85 corn does give you a reasonable benefit. And then, of course, if you're going to cellulosic or sugar cane, that gives you much more of a benefit from a GHG basis.

And, by the way, this is now the blend strategy is looking at blending it in the legacy fleet, all vehicles. So this is a much different comparison than what I showed you before, which we were talking about new vehicles. So, you'll notice that the baselines here are different for the RFG gasoline baseline.

If you look at criteria pollutants, hard to conclude anything different here. Either from looking at only the FFVs, which are catalytic equipped versus the legacy fleet which is a combination of catalyst-equipped and noncatalystequipped vehicles.

Either comparison says GHGs are about the same. So, I don't see any impact on blends affecting the criteria pollutants. Nor do I see much in terms of toxics.

So, conclude that blends, there are benefits with using blends, depending on the carbon intensity. And the blending component, not all are equal. E10 using corn maybe gives you something like a 2 percent GHG benefit compared to RFG at 5.7. Also using corn.

E85 blends with cellulosic or sugar cane can give you in the 80-plus percent reduction. Criteria pollutant emissions seem to be about the same. No red flags. And toxics emissions seem to be about the same.

Now, if we do the same thing for diesel, with diesel blends, here we started out as a comparison is diesel California ultra-low sulfur. Again used in an internal combustion engine. At the bottom. And there is FTD30, Fischer Tropsch diesel, with 30 percent added to California ULSD. The Fischer Tropsch is produced from remote natural gas in another part of the world. It's used in internal combustion engine. All these are internal combustion engines.

The next one up is a soybean-based biodiesel mixed at 20 percent in with California ultra-low sulfur diesel fuel.

And then finally is E-diesel, and there's really not much too surprising here, either. This sort of follows your thinking. For example, Fischer Tropsch, if you have to ship it here, is going to be more energy intensive than normal diesel.

On a global warming basis, GHG basis, things are roughly about the same. Looks like B20 is about the only thing that gives you something that is of a slight benefit. E-diesel is about the same. And we've seen this before, but Fischer Tropsch, because of the energy intensity, tends to increase -- the amount of energy needed to produce that fuel tends to -- and ship it here tends to increase the GHG emissions.

On criteria, everything looks pretty much the same. No issues. Toxics, you get some slight benefits, either the Fischer Tropsch or the biodiesel-20 on toxics, primarily just the difference in particulates emissions. But it's not great.

So, only B-20 in this set provides a benefit. And that benefit is about 10 percent.

Fischer Tropsch and E-diesel are sort of comparable on a GHG basis, the ultra-low. You could do things with Fischer Tropsch, especially with neat Fischer Tropsch to improve the efficiency. And therefore, you probably could get emission benefit with that fuel. But, in this blend that wasn't considered.

And just a -- I should be saying this all along, but land use is a real important part of any of these kind of analyses. And exactly how much energy you're using to do the harvesting, how much fertilizer you're using to do that harvesting, how much different herbicides have to be used. All that matters.

And, again, what we've done here is an average of that for these various pathways. If you're really going to credit some of this stuff, you would probably have to have people sign up saying this is how I'm going to -- this is how I'm going to do the land, this is how I'm going to harvest this particular crop. And there would be guidelines for them to say yes, I will do that.

All blends in this case were comparable

to the criteria emissions for ultra-low sulfur diesel and then toxics as shown there.

I might go through one last example for our friends in the electricity sector. And this is electric forklifts. This is an offroad application. There's many different types of offroad applications that we could have done.

This shows a comparison between reformulated gasoline, LPG, and electric forklifts. I suppose I could have put natural gas on there, too, but it's not.

This is the energy. And not surprising, the electric is more efficient than either the gasoline or the LPG internal combustion engines.

Similarly on a well-to-wheel basis, you see that the electric forklifts provide a fairly large benefit compared to either the gasoline or the LPG.

And on a criteria pollutant sense, ARB regs now -- this is in 2012 -- the ARB regs basically have said that the LPG and the gasoline have to be the same. They are.

And then, of course, for electricity criteria pollutants are pretty small.

And similarly the toxics emissions are

similar, but slightly different. The LPG is higher in terms of diesel particulate because you have to truck around that fuel, whereas you do not do that with gasoline.

So, electric drive technology substantially reduces GHG emissions, as well as the criteria, toxic emissions. Propane and gasoline technology is about the same. Propane toxics emissions dominated by the diesel PM events.

All right. Let me say a couple words about water pollution and water impacts. This is only for petroleum fuels I'm showing here, but you can think of the various steps where this may be important.

Starting on the left-hand side where we have marine in the open ocean, we have then marine terminals where things might happen, you have pipelines where spills might happen. You have railways, you have refineries, you have transport and fueling events. You have underground storage tanks and finally, you have engine oil.

The biggest events occur in and around transport fueling and have occurred in the past in underground storage tanks. Current regulations which require double-wall tanks, sensing and monitoring, is going to drop those emissions greatly in the future. But in the past, at least looking at the data, this is the kind of data that you see.

And what I'm showing here is average California discharges in thousands of gallons per year.

Now, if this is a gaseous fuel, let's say like natural gas, that's used in North America, well, there is no marine open ocean, there's no marine terminals. There is a pipeline, of course, but it's not going to spill. The natural gas in that pipeline isn't going to go into the groundwater. There's no railways, there's no refineries, so to speak, that's going to spill any liquids. So a fuel like that, or a pathway like that is going to considerably reduce the amount or the impact of spills and how it will affect water.

Same thing goes with electricity. I'm not going to go through all that in this presentation today. But, be it said that the alternative fuels can eliminate many of those steps. And therefore will be a benefit compared to petroleum fuels.

And the other part of this is engine oil pollution. Looks like, to us, it's comparable to the kind of spills you see in other parts of the distribution system. And if you have technologies that don't use engine oil, well, that's going to reduce that impact, too.

So, finally, getting to the summary. All right, I want to walk through a couple of things here. First, on GHG emissions for mid-sized autos and buses, I think you can agree with me that there is substantial greenhouse gas benefits for a lot of these different pathways. At least on the auto side. On the bus side it's not as dramatic, but nevertheless, buses use a lot of energy, so 20 percent of a big number is still a lot of savings.

So, depending on the fuel pathway, alternative fuels like ethanol, natural gas, LPG, electricity, hydrogen can provide significant benefits.

Biofuels provide the largest reductions, 80-plus percent compared to gasoline. But you got to be careful of what the processing intensity is. And the benefit comes primarily from CO2 being recycled through plant photosynthesis.

Low carbon fuels also provide a reasonable benefit here. LPG and natural gas up to 27 percent compared to gasoline. And the zero carbon fuels and/or power are also quite good in terms of benefits for GHG emissions. But depends on how you produce that fuel and how you're going to distribute it. But typically in the 40 to 50 percent range.

We see similar reductions for urban buses with like a 20 percent reduction for natural gas; and for batteries type vehicles you see like about a 50 percent.

On criteria and toxics emissions, there are some little hot spots that sort of pop up. The LPG VOC, if it's not controlled during refueling it's an issue that has to be resolved. Boundary conditions are important here, so local biomass conversion is going to have increased emissions of PM, primarily because diesel is used in a lot of the operations in terms of harvesting and moving the feedstock and the fuel around.

Natural gas-based hydrogen, electric pathways, reduce the criteria pollutants. And, for the most part, toxics are really dominated by how you move the fuel around in distribution, and primarily from diesel trucks.

For the urban bus scenario the fuel pathways are very comparable.

On the blend side higher ethanol blends in gasoline can be pretty effective for reducing GHGs, as well as criteria and toxic emissions, compared to gasoline if the ethanol is produced from low GHG ethanol production pathways; cellulosic, sugar cane -- or sugar cane.

Only biodiesel in the cases that I've showed you here today is going to give you a GHG emission benefit compared to ultra-low sulfur diesel. And that BD-20 also is estimated to be able to reduce some of the criteria pollutants. But may have a small impact on NOx that we've got to keep track of.

So, what are the major take-aways for me in this? One, improved efficiency, be it at the production facility, be it at distribution, be it at end use, obviously is a way of reducing impact. Not only of global warming gases, but also of criteria and toxic emissions. A big lever.

Electricity provides the lowest overall impact on GHG criteria, toxic emissions and water pollution. And shouldn't be a surprise to any of us. The biggest issue is going to be do we have vehicles that meet all the attributes if you want to buy.

Biofuels are very effective at recycling carbon and therefore providing low GHG emissions. But we've got to be careful about how we deal with harvesting, collection, fertilizing and the whole fuel cycle associated with that. It's not going to do us any good, for example, on a global warming basis to plant more sugar cane if you're going to chop down the rain forests, for example. So all that's got to be considered in looking at this.

Neat fuel use, that is E-85, compressed natural gas, provides the greatest per-vehicle GHG benefits compared to a blend. But the blends also can give you a reasonable type benefit.

So, thanks for your attention. Hopefully you haven't fallen asleep with all those charts.

MR. ADDY: Thank you, Mike, for that presentation. I wonder if we can play a bit of musical chairs here and ask my peer reviewers to join the rest of the group at the table there.

Commissioners and Director Scheible, you don't need to move. So, Alan and Anthony, let's see here, Dave; is Alex Farrell here?

VICE CHAIRMAN BOYD: McKinley.

MR. ADDY: Yes.

VICE CHAIRMAN BOYD: While people are coming to the table could I ask Mike a couple of questions?

MR. ADDY: Oh, yes.

VICE CHAIRMAN BOYD: I know you want to do questions later, but while it's fresh in my mind and -- Mike, I just want to reaffirm for myself a couple of assumptions that I noted in reading this. And re-emphasize today that are kind of important to us in the energy business, anyway, in particular.

And that is you've got LNG as a player in the California natural gas picture, as providing supply to California's future, as, I guess, an affirmation.

Secondly, in the area of electricity and renewable electricity, you're basically assuming that we operate consistent with our RPS policies in the state, that is the 20 percent goal and the 33 percent goal. And, in particular, that we actually meet those targets on time.

Do I interpret that correctly?

MR. JACKSON: You do, Jim. And there is an issue. What we have assumed, at least in some of the near-term analysis, the 2012, 2017, that there's sort of a ramp-in of the renewables. But if you're going to meet the 20 or 30 percent goal, let's say the 20 percent, the 33 percent goal by 2020, you're going to have to have a heck of a lot more renewables in the near-term years than you are in the out-term years.

That subtlety has not been worked into this yet. And we are going to Commission Staff right now to see if we can look at the resource plans from the utilities to get a California average of how it might look in the near-term years in terms of ramping in the renewables.

VICE CHAIRMAN BOYD: I guess I pursue and push this point because, as documented by this agency, we're quite concerned that the state is on a path to not meet its RPS goals unless we really get on the ball, so to speak. So I just wanted to make that point, since what you're revealing here in a full fuel cycle analysis is really the first great deep dive, at least in California, to looking at the system.

And since energy is a giant system and interconnectivity of everything we do in the energy area begins to affect everything else, this agency is quite concerned about this RPS issue. And this just helps drive the point of if we don't meet our RPS goals the consequences ripple through the systems, so to speak; and affects even this arena.

Lastly, --

MR. JACKSON: Just as a reinforcement of that, Jim, if, in fact, the RPS, if there is more renewables than what we assumed in here, in this case 2012, what it's going to do is reduce the electric impacts. And if you go the other way, it'll increase it slightly.

But electric gives you such huge benefits to start with.

VICE CHAIRMAN BOYD: I'm just looking for another lever to pursue the issue of whether or not we meet our RPS goals.

Another point I want to bring up, and it could be a question or just an observation, is in our reviews of biomass in California for almost a decade now, leading up to the most recent studies and embodied in the most recent studies that resulted in our biofuels or bioenergy action plan, the Governor's executive orders and what-have-you, we've noted that California is either blessed with and/or awash in waste material, cellulosic waste, quite frankly.

Be it the ag waste from the fields or from food processing in California, the forest waste issue, and of course, the urban cellulose I'll call it, the huge amounts of urban wood waste, green waste, et cetera. I mean we have so much of this that we've often indicated that we don't need to grow energy crops in California, at least in some near term perhaps.

That if we could just get our hands on that waste stream, which really means we need those breakthroughs in technology to deal with cellulose. And although you said in your conclusions that bioenergy, biofuels and maybe almost a reference to waste, is important, the analyses don't dwell much, that I've seen, on using this waste stream versus growing an energy crop somewhere.

And this is kind of an observation and a concern of mine about where we're going with our energy future here in California. Something perhaps we'll have to deal with more. And I will commit that I didn't read every page of all those binders full of stuff. I read a lot, though, believe me.

Nonetheless, that is an issue that I think this agency needs to deal with, and perhaps all of us dealing in this arena needs to deal with more. And maybe puts a little more emphasis on the need in the state to address intercepting that waste stream and/or using that waste stream for energy purposes, if we can get the technology and the economics stream.

MR. JACKSON: I agree fully, Commissioner Boyd, that that probably needs to be one set of the analysis that needs to be expanded, in that biomass type area. I don't think there was as many pathways that went down there as some of these more conventional ones.

VICE CHAIRMAN BOYD: Thanks.

MR. ADDY: Thank you, again, Mike. I'd like to ask Barbara and Tim Olson to get back around the table again, just in case we have questions relating to things that our peer reviewers aren't able to deal with.

Alex Farrell, who is supposed to be one of our panelists up here is delayed in Davis, thanks to the efficiency of the Amtrak system. But I think we will be hearing from Alex in the next few hours or so.

What I'd like to ask at this time is to ask our peer reviewers to, you know, take a break. Well, no -- okay --

(Laughter.)

MR. ADDY: Because we have about an hour before lunch, so anyway. But get some comments from our peer reviewers and I'll give them some guidance here about some of the things I'd like to hear, that it might be good for them to share with you.

Before we get into questions from the audience, and then perhaps later on, if we have some additional time, I will take some of the formal comments that people have asked to make. Otherwise, I might reserve the privilege of keeping you here -- well, inviting you, after lunch, to hear some of those comments.

If you're interested in the background of our peer reviewers, in the workshop materials package that you have there are short bios for each of these people.

So, from the peer reviewers I'd like to s or solicit your comments on some of the broad assumptions, the methodology and the results to date, from your perspective.

And then perhaps you can give some additional broader feedback on the analysis to date and the work products to date.

Any one of you may begin. Please.

MR. RICE: I'm Dave Rice from Lawrence Livermore National Laboratory. I'm an environmental scientist, been in the business for about 30 years.

I really want to congratulate the Energy Commission and TIAX for taking a stab at doing a lifecycle approach. This is very very complicated. The issues of boundary conditions are really important and I think this is a good starting point.

In reading the recommendations one of the things that they recommended was that they maintain the model and keep updating it. This should be something living. As you get more information you feed it into the model and then you refine your outcome as you gather data.

One thing that I'm sure that TIAX struggled with that still is probably something that is a difficult is how do you deal with uncertainty in your estimations and your assumptions. What are the error bands on some of the big driving factors that give you the answers that you get.

And the way you deal with that really is I think that you take a start and you keep updating the information as you gather it. You always make decisions under uncertainty. And this is a really good example of that.

I caution again, and I think that it was brought out several times, this is a high-level view. This is not to specific fuels. There's a lot of averaging goes on in here. The devil is in the details for specific fuels.

And there is a process for what specific fuels are brought to market, if you will. And maybe, Barbara, you can comment on that when the time comes here.

So the public is protected in terms of a risk management point of view, in terms of getting to those devils that are in the details. By and large as you read the document I would caution people to realize a lot of times the word emissions refers to air emissions pretty much. And that emissions to other media are a bit thin. And that's not the fault of TIAX; just there isn't a lot of data out there. And that's one of the big areas of active research that I think is going to be required as you go forward, trying to do a multimedia assessment.

Land use issues are going to be really important. I had a friend that was invited to give a talk in Malaysia. As he was flying into Kuala Lumpur, heavy smoke. And he asked his host, what's going on? He said, oh, they're burning the jungles because we're going to plant oil palms. So, I mean we've seen a lot of that sort of stuff, particularly in corn and so on.

I'm a little curious about the -- in some cases we excluded emissions from outside of California. Like, for instance, the corn grown in Kansas. But in other cases we included emissions on a global scale, during transport and so on. And it makes comparisons maybe in some cases -- to my mind a little bit, maybe I don't understand fully -- a little bit difficult.

MR. ADDY: We could go on to somebody

else if you're still collecting your thoughts.

MR. RICE: Yeah, that pretty much covers mine. Maybe, Barbara, you could mention that business on the multimedia assessment. I think that's an important part of any emerging fuel.

MR. ADDY: Barbara, can I ask you to hold that yet, please? Thank you.

Alan or Anthony, your impressions based on what you've heard of the assumptions, the methodology and results today?

MR. EGGERT: Hello, everybody. My name is Anthony Eggert. I am a researcher at the Institute of Transportation Studies at University of California at Davis. Also working on a team, along with our colleagues at UC Berkeley for the low carbon fuel standard, which many of the outputs from this process will be potentially used in that process. So we're keenly looking at this report to come up with accurate, realistic and useful outputs that that can be used as potential policy for low carbon fuels.

I just want to sort of echo some of the comments, commend the team on an incredibly challenging undertaking. The progress that they've made to date has been quite impressive.

Having been involved with lifecycle analysis in the past, and in particular tank-to-wheel analysis for vehicles, I can appreciate some of the complexities of trying to come up with a number that is then used for full cycle analysis.

One, just adding to something that Dave had said about these boundary conditions and the ability to make cross-comparisons between different fuels, I do think it would be very useful, I assume, as part of the lifecycle analysis that the out-of-state, upstream emissions are tracked through the analysis.

And it might be useful in the reporting of the information to include that, perhaps, as a separate bar. Especially for things like upstream toxic air emissions and such. Just to show that, you know, somebody's going to be breathing these things. It may not be us here in California, but we can't ignore the fact that there are these health impacts that we may be exporting from the fuels production process.

We have been working with this team in looking at some of the more detailed assumptions. And we do have a lot of comments on various aspects of efficiency and such. And so I'm not going to go into the real detailed comments, but maybe a couple of sort of broader observations. And I'm actually going to leave the comments on the biofuels routes to Alex and the UC Berkeley team, because they're much more proficient and knowledgeable about that.

On the tank-to-wheel assumptions, and especially for energy efficiency ratios, this is an area that, again, having been involved with it, I know is highly contentious. There are many different ways of evaluating the tank-to-wheel efficiencies, depending on whether or not you're looking at drive cycles, real world versus theoretical modeling associated with vehicle parameters, and trying to come up with equivalent comparisons across these vehicles is a very challenging task.

Having said that, I do think that there may be some more room for improvement, especially in trying to understand some of these future technologies, such as fuel cell vehicles, both light-duty vehicles and heavy-duty buses. And the current energy efficiency ratios that are used for those appear to be more or less consistent with the data that's coming out of the DOE's demonstration program for vehicles that were built and produced a few years ago.

There is now some new information out of companies like Honda and others that might be more useful to show a direct comparison between these advanced technologies that are under development today versus comparable vehicles like hybrids and conventional vehicles.

So, both in terms of sort of today's analysis, as well as sort of projections out to 2012, I think that's going to be extremely important to try to either come up with more defendable numbers, or at a minimum, consider a range of values that would represent the best available technology.

One other methodological question, I guess, which is the electricity that is used throughout is assumed to be what I believe is natural gas, combined cycle, modified to account for the RPS, is that correct?

MR. ADDY: Yes.

MR. EGGERT: Okay. Now, is that electricity then -- is that assumption for electricity used consistently throughout all aspects of inputs into things like liquefaction of hydrogen, compression of gaseous fuels? Do you use sort of that same electricity mix assumption?

MR. JACKSON: It depends where the plant is, for example. So, if it's a processing plant in Nebraska, not going to use the California electricity mix. So, if it's in California, it does. But we'd use a national mix if it was in Nebraska, for example.

MR. EGGERT: Okay.

MR. JACKSON: So it's not consistent. Depends where the electricity is used.

MR. EGGERT: Okay, so on a specific question, then, for, say, for liquid hydrogen, what were the assumptions associated with that mode?

MR. JACKSON: For hydrogen, which was -- the cases that we showed you here was all steam reforming. So there would be some electricity used, that would be the California mix.

MR. EGGERT: Okay, in the full report where they do look at LH2 delivery, that's also instate electricity?

MR. JACKSON: So we're liquefying instate, is that right, Stefan?

MR. UNNASCH: Correct.

MR. JACKSON: Okay, so the answer's yes.

MR. EGGERT: Okay.

MR. JACKSON: If we were liquefying out of state and bringing it in, the answer would be no.

MR. EGGERT: And then with respect to something like LNG imports, the electricity or the energy associated with the liquefaction, the natural gas, --

MR. JACKSON: That would be done with a mix that's on the world scale.

MR. EGGERT: Okay.

MR. JACKSON: You bet.

MR. EGGERT: Okay. I think I have a few other certainly more specific questions, but I think I'll hold those till --

MR. ADDY: Thank you.

MR. EGGERT: Yeah.

MR. ADDY: And then, Alan, please? Again, along the lines of your sense of the assumptions, the methodology, the results to date, and then other broader comments that you might have.

MR. LAMONT: I'm Alan Lamont from

Lawrence Livermore Laboratory. I work primarily in the analysis of energy systems and energy economics.

One comment that we're always ask to make is that when we're presenting in this sort of a setting that we are giving our own personal opinions, we're not giving a Laboratory position on any of these issues.

I paid most attention to the overall framework of the electricity side. And I do want to say that I think the framework that they've developed is quite appropriate for the problem, and I felt pleased with that.

The report takes a lot of effort to delineate the boundary conditions that they use. And one might quibble about this boundary condition or that, but they are pretty clear. And a great deal of attention was obviously paid to that.

And, you know, having done that, one thing that is clear about the whole methodology developed is since the assumptions are pretty explicit, this methodology can be extended, it can be applied to other situations, and you can change assumptions and so forth. And going forward this will probably be quite valuable to us.

The other major assumption in here is the issue of the marginal production. And, you know, in my opinion that's quite appropriate. But one can from the questions asked here and questions in discussions we've had with TIAX prior to this meeting, that it's not always easy, and it's not always exactly clear how to do that.

I think that the assumptions that were made here are probably the most plausible that can be made. But other assumptions could be made and probably should be in future questions.

The other issue that we've all touched on here, Mike touched on it in his talk, and everybody's touched on it here, Commissioner Boyd touched on it, is that this was formulated with a particular view of how future events will unfold. And my concern is mostly how the electricity system would unfold. And it's a very plausible future. But there are others that could develop.

The assumption that the combined cycle combustion turbine is going to be the marginal generator is quite plausible over the next couple of decades. But it's perfectly possible that other things might become more marginal. It's possible that things like coal gasification and so forth might take up more of a marginal position.

And then Commissioner Boyd's questions about the actual development of the RPS standard and so forth, which is built in here, is also very pertinent to this.

So one of the things that we had talked about and hoped that eventually will be discussed is a broader discussion of the range of things that might be looked at and considered in future reports. This report, there's a substantial amount of effort here, but what other things would be plausible futures over the next 30 years and how might they affect the results. What sorts of things should we be thinking about; what sorts of things might possibly be considered for future studies. What sorts of things should we be mindful of as we go forward and try to develop these systems.

Let me just see here in my notes. I mean actually that basically covers my impressions and my comments about the report.

MR. ADDY: Thank you, Alan. Barbara, do you want to comment on the question that Dave asked?

MS. FRY: If I understood that question correctly I believe you wanted us to point out that when we develop fuel specifications we're required to do a multimedia impact assessments in California.

MR. RICE: That was the point that I kind of wanted to make is that there is a point in the overall development of fuel introduction into California where there has to be a peer-reviewed multimedia assessment which will go back and deal with a lot of the uncertainties that may remain with that particular fuel.

MR. ADDY: Thank you. Before I get into the questions and comments from the audience, I'd like to apply something that I learned in the working group at NREL, by asking the peer reviewers here about their comfort level with the results and the approach to date.

And comfort level means that if you can agree with 70 percent of what's being done, you're comfortable. If you disagree with 30 percent of what's being done, you can live with it.

(Laughter.)

MR. ADDY: So this was the same approach we used in the peer review conversations and that's what I'm putting out to you, do you have a sense of a comfort level with the approach that the agencies and the contractor, taking into account the inputs and contributions of the stakeholders to date is reasonable?

MR. EGGERT: I'm feeling quite generous today, so I'll say 72 percent comfortable.

(Laughter.)

MR. ADDY: Okay, well, that's good.

MR. EGGERT: No, actually, I mean seriously I do think, you know, this is, as I said previously this is an extremely challenging effort. It does require a lot of assumptions. And a lot of assumptions are debatable, and some of them heavily debatable. But I do think, at least at this point in the analysis, the authors and the team has done a pretty reasonable job in identifying which of those assumptions are debatable and have a lot of uncertainty associated with them. So I think that aspect makes me more comfortable with the analysis, itself.

MR. ADDY: Thank you, Anthony. Alan or Dave?

MR. RICE: I'm very comfortable with the analysis of the energy and the emissions, particularly the air emissions. I still twitch a little bit over some of the other environmental media. And I think it really goes back to the, maybe the lack of general knowledge that we have, in general; and the unavailability of a lot of the data. For instance, the old issues of what's the impact of the fertilizer of all the new corn growing might do in the midwest, for example, and things like that. Those are just really big questions that could swing things pretty importantly, but we just don't have enough knowledge about, and it's really kind of hard to put it in there if you don't know, in this type of analysis.

MR. ADDY: And your approach would be to then highlight those issues in your report as outstanding issues to be treated in the future?

MR. RICE: This is my personal, if I was writing a document like this I would highlight some of the how the document should be used, in terms of the broad scale. And that focus on some of the uncertainties. I think they've done a couple steps that way, particularly in the recommendations and so on.

But my preference would have been a

little more upfront about that. That's the only -
- that's just a personal preference.

MR. ADDY: Thank you. Alan, keeping my rule in mind?

MR. LAMONT: Well, without getting too numerical about it, I'm quite comfortable with the report, especially within the scope that it outlines for itself.

I just think that as -- view this as a first step in a larger effort. And what I would like to see is a bit more discussion about what is important from going here forward. And how that -- why it might be important.

MR. ADDY: Thank you. And now I will begin to take some questions from the audience. And I'd like you to please stay focused on the presentation to date. If there are incidental issues in your mind, I would encourage you to hold that until towards the end of the day.

But I have up on the screen a list, what I call a representative list of many of the issues that we identified in briefings with stakeholders, as well as some of the written comments that were submitted to us prior to the workshop.

I put up this list to let you, the

stakeholders, know that we were listening to you when we met with you. Some of the issues overlapped many of the briefings with the stakeholders.

And in the right column I show the status of our treatment of those issues. And so you can see some of them are resolved; some are being resolved; and some are still outstanding. For example, I think some people are very much interested in the issue of the electricity generation mix, RPS levels.

One commenter talked about the need to perhaps take a look at coal with carbon sequestration as a resource to meet some of the marginal electricity demand in California. There was also a comment on considering nuclear generation, as well. And then, of course, from our environmental coalition folks, interest in biomass resource as a generation item.

So, these are the issues. We're listening to you. Keeping that in mind, we will now take some questions. And what I'd like to do is those of you in the audience will have some very quick questions about the presentation, to ask them now -- oh, okay. I'll stop a little bit.

Professor Alex Farrell has arrived. And perhaps, Alex, I don't know if you're ready to make any comments, or you can wait --

(Laughter.)

MR. FARRELL: Thank you, McKinley. I apologize for being late. There was a accident on the Amtrak route I was on. So, my apologies to the folks here.

I can make a few comments, if you'd like.

MR. ADDY: Okay, let me just update you on what has happened so far. TIAX, our contractor, has given their summary presentation of the results to date covering the broad assumptions, the methodology and highlighting some of the results, focusing on ethanol, electricity, biodiesel, yes, and there's one more -- hydrogen, all right.

So those four areas. And then they drew some broad observations, or shared some broad observations with the audience.

What I've asked the panelists to do is to give us their sense of the analysis to date covering the assumptions, the methodology, and the results to date, as well as any other general comment.

MR. FARRELL: Okay, thank you. My comments are posted, and they've been posted for a couple days, on a website at UC Berkeley associated with the Center for -- or rather the Transportation Sustainability Research Center.

First, I want to thank the Energy Commission for the opportunity to make a few comments on this study, draft as it is.

My comments are largely confined to the energy and greenhouse gas aspects of the study. There are other aspects that are important. I am not commenting on those today.

I think, in general, it's worth noting that the work, as has been posted, is improved over the last couple of drafts, and has reflected the work by the contractor to listen to and take into consideration the number of comments that were made during the peer review process, including some comments that we made, as well as others.

Also, the current study is much more suited to thinking about California in particular because the GREET model has been adapted and parameterized much better towards thinking about

California than previous versions have been.

I also want to note that this study uses what's the currently accepted approach to lifecycle assessment embodied in the widely used GREET model which was developed by Argon National Lab and maintained by them.

However, like all models, the GREET model contains some simplifications and omissions. This is unavoidable in modeling. And these create uncertainty in the results. And it is certainly true that more research is needed to develop better lifecycle assessment tools and data. And I believe that the State of California, as well as other organizations, are supporting that sort of research.

I do have a couple more specific comments I'll make at this point. I also have included in my posted comments, comments by a PhD student at UC Berkeley, Richard Plevin. But let me just cover -- and also let me mention the relationship between the low carbon fuel study, which is a study that was called for in the Governor's executive order in January, that I'm co-directing with Professor Dan Sperling at UC Davis, and this study.

For the low carbon fuel study we will use the TIAX results as much as practical so that our study, the LCFS study, and the study that's being discussed today for AB-1007, will share a common technical basis as much as possible.

At some time in the near future, however, we will need to freeze, essentially, the well-to-wheels analysis and proceed with the rest of our analysis, because our report is due in the near future.

After that point, the analysis for the purposes of AB-1007 study is likely to evolve. I would expect that it would. And there may be some sensitivity analyses or other analyses that we feel are important to do that have not been covered at the time that we have to freeze the TIAX analysis.

And so for those two reasons our analysis may deviate slightly. But the fact that the GREET model has been updated for California provides for a lot of value in looking ahead.

Let me mention four things. The first is low-quality petroleum resources. The current draft reflects, to some degree, the ongoing transition in global oil production from high quality resources to lower quality resources, such as heavy oil and tar sands.

Specifically it's very helpful that the AB-1007 study includes technologies like tar sands-derived crude oil and natural gas and coal-derived synthetic fuels. However, some important pathways for the State of California are not included, and it would be helpful in our study. It may not, and I want to recognize these next several comments are things that would be helpful for the low carbon fuel standard study, may not be appropriate for the AB-1007 study, given the priorities and resources.

It would be helpful for our study if some of these low-quality resources were included, such as the production of heavy oil in California, which is produced through cogeneration of electricity and steam, powered by natural gas. I think this is rather important for us to look at.

And there are at least one or two others. Oh, the potential for the use of enhanced oil recovery with CO2 flood, which is both feasible -- now it's actually done in west Texas, but could be done even in California in the future. And this was also something that would be helpful for us to have.

Second, variations in near-term biofuel processing technologies. California currently includes approximately 5.7 percent by volume ethanol in gasoline. There's a little bit of biodiesel in the state.

One of the opportunities to lower the carbon content, or more correctly the global warming impact of the fuels in California is to improve, that is to decrease, the global warming impact of the biofuels that we already mix into the fuel blend.

And to do that we've suggested -- and I won't go through this table, except in a descriptive way, a table of several pathways that we would find it very convenient and helpful if the AB-1007 study would include. And so, in particular, this includes differentiating the types of energy that go into the biorefinery process for corn ethanol production which dominates in the U.S. today.

It also includes the potential to use residues, forest residues, even possibly municipal solid waste as a feedstock. And lastly, the potential even to use the prairie grass systems that have been suggested by Professor Tillman from University of Minnesota.

These are not currently in production but probably could be some time before 2020, and could represent an opportunity to, with very little infrastructure or maybe no infrastructure, distribution and vehicles, significantly improve the greenhouse gas impacts of California transportation fuels.

Number three, electric vehicles. The analysis of several different patterns of electric vehicle charging, including both nighttime and daytime, is commendable. However, the current draft assumes that marginal electricity generation will be natural gas, combined cycle combustion turbines, and renewable power that complies with California's renewable portfolio standard.

For a variety of reasons which I won't go into verbally right now, I think this is over-optimistic. And, in fact, in the sense of a study, so that we can understand the potential impacts, I think looking at a wide array of potential electricity generation sources for both pure battery and plug-in hybrid electric vehicles are useful.

And given the study has adopted a timeframe of 2030, it strikes me that technologies that are not available today would be interesting to know about, including pulverized coal, including coal with carbon-capturing sequestration, and including advanced nuclear. They all may be part of the mix at that point.

And the last is land use. The current draft acknowledges that land use is a significant issue for biofuels and suggests that potential land use impacts could be quantified and shown as a separate component of the well-to-wheels analysis.

The land use impacts are potentially significant, but highly uncertain at this point. And it would be useful to know if this issue was going to be taken up. And if so, where. I make a few other comments about the potential importance of this, especially in the near term.

And the point I'd like to make, if I might, is that if we want to make decisions about how to lower the carbon content of fuels in California, and we can avoid having land use implications, and this would mean using either fuels that did not require land, or new land in particular, for the production of biomass feedstocks, that could avoid some of these uncertainties while we actually were able to reduce the greenhouse gas impacts.

And so that concludes my comments. Thank you.

MR. ADDY: Thank you, Professor Farrell, for those important comments. Let me give you the opportunity that I gave the other peer reviewers, to give us your sense about the results of the analysis and the approach to date. And I'm defining your sense in these terms: If you agree with about 70 percent of what's been done so far, separating the application of results to the low carbon fuel standard framework, but disagree with about 30 percent of what has been done so far, what's your comfort level?

MR. FARRELL: That's a good question. I haven't thought about it in that framework.

VICE CHAIRMAN BOYD: Nor had any of the others.

(Laughter.)

MR. FARRELL: I guess agree and disagree, I'd rather use a slightly different terminology, and I'll --

MR. ADDY: Please.

MR. FARRELL: -- go back to my statement which is the well-to-wheel analysis, that parts that I looked at, use the best data that I know of, or close versions of it. And I appreciate that there may be changes that are appropriate as people bring data forward.

The GREET model is, as far as I know, the best available tool to study this problem. It has shortcomings, as I indicated and it's important to improve those.

So, I would think that -- one other thing, there are a few pathways that might otherwise be evaluated, but to answer your question I would be quite comfortable with the statement that at least 70 percent of the analysis I agree with.

MR. ADDY: Thank you very much. Now, questions from the audience. Again keeping in mind that we've talked about a number of these things with you. And if you could come up to the mike and ask your question, your very short question, related to the material presented, we would appreciate that.

I'd like to keep that part of our Q&A

period to about 15 minutes. And then I will take from my list here those people who requested to make a specific comment during the workshop, maybe two or three, observing the five-minute limit.

So, if there is somebody in the audience that has a question, can come up to -- I have blue cards, yes.

UNIDENTIFIED AUDIENCE SPEAKER: No, that were already handed in.

MR. ADDY: Before the workshop? I have the blue cards that I've had -- yes, I'm going to call those; they are on my list.

UNIDENTIFIED AUDIENCE SPEAKERS: So call them.

(Laughter.)

MR. ADDY: Call them, all right.

VICE CHAIRMAN BOYD: You got a hand out here, McKinley.

MR. ADDY: Oh, all right. Okay.

VICE CHAIRMAN BOYD: You have to come to a microphone or the people out there --

MR. JESSEL: I submitted my name before the workshop as wanting to make some points.

MR. ADDY: Okay.

MR. JESSEL: I've got a lot of -- Al

Jessel, --

MR. ADDY: Yes, you're here.

MR. JESSEL: I've got separate questions --

MR. ADDY: You're here.

MR. JESSEL: If I get up and ask a question now am I relinquishing my right to come back later --

(Laughter.)

MR. JESSEL: -- and use my whole five minutes?

MR. ADDY: No. If you ask one question or a short question related to the presentation, you still reserve your time later.

MR. JESSEL: Okay.

MR. ADDY: I have your name on the list.

MR. JESSEL: Okay, and I'd like to do that at the public comment period at the end of --

MR. ADDY: Sure.

MR. JESSEL: -- if that's okay. And I've got a whole list of questions, but you'll let me ask one?

MR. ADDY: Only one question.

MR. JESSEL: Okay, one question. Not necessarily the most important, but again, going to the methodology. There was an assumption made that all gasoline, incremental gasoline coming into the state would be imported.

Typically there's refinery capacity creep and there always has been historically. I'm wondering if the authors could tell me why refinery capacity creep is assumed, by implication, to completely stop in the future.

MR. ADDY: Thank you.

MR. JACKSON: I don't think that we assumed that creep is going to completely stop now. But, you're right. I mean we had to make some simplified assumptions, we made one.

And just like I said that I think that the petroleum sources are going to change in the future. We didn't consider that, either.

So there's lots of different things that have to be looked at. And we probably need to do some sensitivity around what's important and what's not important, too.

MR. ADDY: Another question from the audience?

MR. FULKS: Tom Fulks representing today Neste Oil. I also would like to reserve time during the public comment period. But I do have a really quick question on the alternative fuels that were analyzed.

And that is, it appears that most of the so-called alternative fuels are represented in the analysis with the exception of hydro-treated renewable diesel, which -- and I read somewhere in one of the deeper reports that the reason it wasn't looked at was because it didn't seem to be a commercially viable technology.

I would just like to ask you why that assumption was made. The reason is because Neste Oil is preparing to open a 75-million-gallon-a-year plant in Porvo, Finland, in about six weeks. And they plan to come to the United States, to California in particular, with at least one 75-million-gallon-a-year refinery as soon as they can.

And so I'd like to just ask the question why was this left out. And for perspective, 75 million gallons a year is just about all the biodiesel that was produced in the United States last year.

MR. ADDY: Before Mike gives an answer, I would like to point out that the inclusion of renewable diesel in the analysis was raised yesterday in our conversation with our WSPA friends. And we are going to be responding to that.

MR. JACKSON: The process like what Neste Oil is talking about should be included in the analysis. There just wasn't a lot of time to do everything that we possibly could want to do.

So, as McKinley said, I think that should be one that should be added.

MR. OLSON: McKinley, I'd like to add another comment. We are considering that, but we also need your input into it, too. So it's helpful to have detailed data. And to the extent you're willing to do that, it will help us out.

MR. FULKS: Well, we've already submitted a complete lifecycle analysis that was conducted in Europe on greenhouse gases with various feedstocks, and showing a 50 percent greenhouse gas benefit.

You have a very thick technical document right now, which is again why I asked the question.

MR. OLSON: That was submitted to us in our docket or do you --

MR. ADDY: No. I'll answer that

question. It was submitted to one of our colleagues. He did share it with us. And, as I said, we are taking that submittal into consideration.

Gina -- or before I recognize you, Gina, do you have a question you want to ask, or would you like to reserve your time to when I --

MS. GREY: The latter.

MR. ADDY: All right. A question from the audience?

MR. ALTSHULER: I'm Sam Altshuler; I'm an unpaid consultant, having recently retired from PG&E. And this is a question that gets into some minutiae, perhaps, but on slide 31 you showed the PM emissions from a combined cycle electric power plant.

And I guess the question is did you use AP-42 to derive those numbers? Okay.

A number of years ago I was looking at that in my work with PG&E on the AP-42. AP-42 is sort of the bible of emissions factors for air quality. And within that document there's a section for the combined cycle. And it lists two different types of particulate that are emitted from a combustion source. One is condensible and one is filterable, or noncondensible.

And classically the filterable PM is what you collect on a sample out of the exhaust on a filter, use a filter paper. And everybody's pretty familiar with that, and that's what you use for automobiles and engines and whatnot.

The other fraction, the condensible PM, is PM that's captured in a bubbler with water. And the water's evaporated and what's left is measured in weight and called condensible PM.

If you drill down into the AP-42 document that data looks pretty suspect to me. And there's been discussions at the AWMA meetings several years ago about what is this condensible PM that's coming out. It's not carbon.

And you really need to look at that and see if that's really an artifact of NOx and SOx, and whether those condensible PMs should be included in this analysis or not. Because I think you're introducing another form of PM that probably isn't included in the other half.

And this is being more of a comment, but it's a concern that we're not accurately addressing the PM when we compare electric with the engines that use the fuel.

MR. ADDY: Thank you. One last question and then I'll take from my list of people who wanted to make a comment. And then I'll also ask if there's somebody on the telephone who wants to ask a question, I'll take one question from the phone, as well.

Pat.

MS. MONAHAN: Mike, I have a question. My name is Patricia Monahan, by the way, with the Union of Concerned Scientists. It was very interesting to see the toxic emissions associated with E85, and particularly with E85 produced from California poplar. And I'm wondering if you can elaborate a little bit more on the assumptions that went into that analysis.

MR. JACKSON: As I tried to point out the toxics emissions are primarily driven by the diesel PM exhaust throughout the fuel cycle. And if you look at corn-based ethanol coming into California the sources of that particulate diesel emissions are the trains that are hauling it in and the trucks then that will haul not only from the railhead the ethanol to the product terminals, but from the product terminals to the local distribution systems.

And the fact that you have a little bit less energy means you have to do a little bit more work to haul that liquid around, which means you generate more, on the truck side you generate more emissions. So all that adds up in terms of particulate.

Now, on the California-based system you then start adding in -- this comes to this boundary condition where we're not, on the corn-based ethanol we're not accounting for all the diesel fuel used in production of that corn. Whereas in California, we are.

So I think there was a suggestion that we ought to show the total. And we have those numbers, and we can show those numbers. So, I suspect that it's not much different when you look at the total emissions whether it's corn is done or cellulosic is done in some other location outside the state, or it's done inside the state. You get the same kind of numbers.

I hope that helps.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Mike, when you look at 2020 or 2030, we hopefully turn the corner on diesel emissions control and gotten those emission rates down a lot, the trucks and the trains and other things, does the picture change? I mean it's still going to be larger, but the margin should be far more smaller.

MR. JACKSON: The margin should be a heck of a lot smaller, Mike. I mean the emission factor in 2012 is, you know, for a heavy-duty -- heavy, heavy duty truck is probably still in the 14, 15 gram per mile. Okay?

In 2030 that number is down to 1 gram per mile using EMFAC, the average fleet. So there's a fifteenfold reduction just in the emission factor. So, yes, it's going to decrease considerably.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Okay, and just from a public health perspective, you showed toxics, and because we said we labeled, included diesel as a toxic air contaminant that has a cancer effect, and it dominates that estimate.

But from a public health perspective I'm far more interested in the massive PM that comes out of all of the combustion sources because the effect on mortality, and PM as a particle, is actually almost an order of magnitude greater than its impact as a cancer-causing agent.

So, when we look at this information I think we will be paying far more attention to the criteria pollutant emissions of PM from combustion sources and looking at that.

MR. JACKSON: Yeah, I appreciate the comment. And the comment that Sam Altshuler made relative to is it really condensibles, or is it really particles that are coming out on the electric side is an important one, too.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Right. And emission from a stack that's effectively several hundred feet in the air --

MR. JACKSON: Yeah.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: -- is different from the emissions above the sidewalk where there's lots of people breathing it immediately.

Mike, I actually have one additional question I'd like to ask. I have lots of questions, but for one, I don't want to be precluded from being up here later --

(Laughter.)

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: I've watched over the last decade various efforts to identify the global warming and other impacts associated with traditional good old corn-based ethanol from the midwest. And there's a lot of controversy there and a lot of different ways to get to the final answer.

Yet, we're going ahead and we kind of have point estimates for these different things that I think are good for comparing corn to biodiesel to cellulosic to sugar ethanol.

So, the question I have is, is there just as much or more uncertainty when we try to figure out what the right value is to assign to these other biofuels? Obviously it's very important because if my agency is going to develop a regulation in the next year and a half for low carbon fuel standard, we've got to figure out how to do the math, and how to account -- and how to get people to account for it.

MR. JACKSON: I think the question was is there just as much uncertainty in the corn-based as the other potential pathways for ethanol today. Did I get that right? Whether it's cellulosic --

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Is there as much uncertainty in the others as there is in the corn? Because, you know, we've been trying to do corn for a decade now, and it's not like we have a full consensus.

MR. JACKSON: Right. And I suspect there is some uncertainty in the sugar cane, too. Although, you know, there's been a lot of study of what has happened in Brazil. Cellulosic, probably a lot more uncertainty since we just don't have a lot of those processes in play.

Alex, do you want to add something to this?

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: And biodiesel --

MR. FARRELL: If I might. So for those who are interested I actually have a talk I gave here -- actually not here, at the Air Resources Board in their chairman series, where the title was something like, separating the confusion from the uncertainties.

So some of this is confusion, some of this is different methodological approaches so you get different numbers. Not because there's uncertainty in the data, but because different methods are chosen. And the paper that I published with several colleagues in January last year discusses this to some degree.

Nonetheless, and we have what we think is the correct method, and once you get that resolved then what are the remaining uncertainties. There are certainly differences in the production, the implications of ethanol production or any fuel production at any different facility. So there's going to be some facility-to-facility differences. And whether you think of those as uncertainties for an average value, or just differences that need to be accounted for, those are two ways to think about it.

The real uncertainties are associated with biofuel feedstock production. And for corn ethanol -- for corn production, I should say, it appears to us that limestone application rates turn out to be very important because they have a very big influence on nitrous oxide emissions in the field level.

This is a very difficult problem to solve. There are folks in a number of universities and research institutions working on this. We are working on it, ourselves.

But incorporating uncertainties in a meaningful way and dealing with them, I think, is a primary concern going forward. And will require work both in the regulatory arena as well as the research arena.

MR. ADDY: Thank you. From my list, -- oh, yes, a question.

MS. HOLMES GEN: Thanks. Bonnie Holmes Gen with American Lung Association of California. I'm just wondering if you could comment on why you weren't able to include other emissions from outside of California, and what it would take to do that kind of analysis. Because that may be important as we move forward and get to the steps of looking at the policy the state wants to be promoting in this area. Thank you.

MR. JACKSON: The analysis actually accounts for all the emissions. We just didn't show them here. So, we can roll in the phone book and you can have a look.

MR. ADDY: Okay, I'd like to draw from my list. I want to get you out of here by noon, and leave maybe after this, one or two people speak, have the Commissioner and maybe Deputy Executive Officer say a closing remark for this session. And then let you out for lunch by noon.

So, Catherine, Dunwoody, you requested some time, here with the California Fuel Cell

Partnership.

MS. DUNWOODY: Thank you, McKinley. I'm Catherine Dunwoody with the California Fuel Cell Partnership. And I just want to open my comments by saying that I took a kind of a big-picture look at the report and, in particular, of course, focusing on fuel cell vehicles and hydrogen. And my comments are related to that part of the report.

The first comment I'll make actually may fall into the category of a question. I notice that in the pathway for centrally produced hydrogen and trucked-in liquid that the results were pretty dramatically different from other well-to-wheel studies that have been done. For example, the ANL/GM study as well as the UCAR study. So, curious as to what the difference in the assumptions are. They weren't readily apparent to me in reading the three volumes that covered that area.

On a more general basis I think that the reports need to more clearly distinguish between fuel cell vehicles using hydrogen and internal combustion engine vehicles using hydrogen, as these ar two very different vehicle technologies and they have different efficiencies.

Speaking of efficiency factors, from what I could tell the data that was used to arrive at the EER for fuel cell vehicles in this report was based on information that was probably based on pretty old technology vehicles. I know there was a reference to the hydrogen highway blueprint plan and the apparent consensus that came out of that process.

I would just suggest that there's some more recent information available, including EPA-certified efficiency numbers for at least one auto manufacturer. And that that should be considered when determining the EER for fuel cell vehicles.

As an example of this distinction between fuel cell vehicles and internal combustion engine vehicles using hydrogen, there's a table that compares the greenhouse gas impact and the reductions are listed as being the same for fuel cell vehicles and internal combustion engine vehicles, about 40 to 50 percent reduction from conventional gasoline vehicles.

But it seems to me that can't -- I wonder how that could be, given the efficiency differences between the two vehicles. So maybe

I'm not understanding something there, or maybe that needs to be looked at more closely.

Comments from sitting here and listening to the presentation I wanted to make. The Department of Energy, hopefully you're all very aware, has been looking at the data that's coming out of their fleet validation program. And there's reports that are available pretty much on an annual basis from NREL looking at that data. So that's pretty good current data. But, again, the technology that is being demonstrated in those programs is actually a number of years -- it's old technology, not the latest technology.

The scenario analysis, the DOE, as you're going forward in the next step of the process, be very important to factor that in. They're looking at different roll-out strategies for hydrogen vehicles in the future years like 2015, 2020, 2030 timeframe.

And then lastly I think the efficiency values for hydrogen fuel cell buses, it wasn't really clear to me, looking at the report, exactly how those were arrived at. There are some very current reports available through NREL on the hydrogen fuel cell buses that are being operated in daily service at AC Transit Sunline and Santa Clara VTA. And that's much more current data than what might be used in here from the KUTE (phonetic) project in Europe.

Lastly, I noticed that in the forklift analysis that there was no consideration of fuel cell forklifts. And that might be something that would be interesting to add.

I guess overall just looking at the difficulty, recognizing the difficulty of projecting in 2012, and certainly even farther out, these advanced technology vehicles, and to the point that Anthony made, I think that really is critical looking at a lot of the data that's available is based on vehicles that were actually new five years ago, and the latest information is, in some cases, dramatically different.

So, thank you for the opportunity to comment.

MR. ADDY: Thank you, Catherine. I'll take one more person from my list. Dave Modisette, Cal ETC. And I'm enforcing this five-minute rule.

MR. MODISETTE: Thank you, McKinley, Commissioner Boyd, Mike Scheible. I'm Dave

Modisette with the California Electric Transportation Coalition. I'm here today on behalf of our board of directors, which is Southern California Edison, Pacific Gas and Electric Company, San Diego Gas and Electric Company, Los Angeles Department of Water and Power and the Sacramento Municipal Utility District.

I have three quick comments. I guess the first is really a plea to look at this from the stakeholder perspective for a minute. You can see the tremendous amount of detail and work that went into this. It's really a herculean task on behalf of the contractor TIAX and the staff. My hat is off to them.

But I guess I want to make a plea for additional time for the stakeholders to take this information in and to make comments on it. We've had about ten days now to review the three documents, and then the model, which has been made available, and post-processor model. Tremendous amount of information, and frankly, we just have not had time to absorb it yet.

And it's taken on much greater importance now that, as Professor Farrell said, all this information, this methodology is going to roll into the low carbon fuel standard; it's going to roll into an ARB regulatory proceeding. And it's going to become, in some form, regulations on fuel providers. And it's going to affect other communities such as the utility community.

So it's going to have a direct impact on investment, you know, millions of dollars of investment that's going to be made by fuel providers and certainly by utilities, as well. So, we need the additional time, frankly, to look at this and to make comments on it.

We've asked for an additional 15 working days from today to be able to make complete and thorough comments. And as I said, because this is going to roll into a regulatory proceeding and affect investment, the final decisions on this are really going to be made by upper level utility management. It's going to directly affect our ratepayers and our shareholders.

VICE CHAIRMAN BOYD: Dave, don't use all your time up on that question because apparently before you got here a March 16th date was established as the deadline for comment. So that's been acknowledged already.

MR. MODISETTE: And I appreciate that.

I'm just not sure, though, that giving us an additional ten working days is going to be sufficient to go through the literally thousands of pages of documents that have been produced.

VICE CHAIRMAN BOYD: Do you have any influence in changing the deadline date of the submission of this document to the Governor and Legislature? I mean we are facing a brick wall, ourselves, so we tried to accommodate you all.

Check Mike Jackson's red eyes.

(Laughter.)

MR. MODISETTE: My second comment, which has already been alluded to, is the assumption on the renewable portfolio standard. Again, this is a marginal analysis, but the numbers that have been factored into the analysis are really the statewide average number.

So the assumption, for example, in the 20 percent renewable portfolio standard is for every megawatt of renewables that the utilities are installing we're also installing four megawatts of nonrenewable power.

And I would submit to you that in order to meet the renewable portfolio standard, both the 20 percent and the 30 percent goal, that cannot be. Utilities are not going to be able to make those kinds of installations and meet that standard.

The percentage of renewables on a marginal basis is going to have to be much higher. It's probably going to be more like, you know, four parts renewable to one part nonrenewable.

So if we're going to do marginal analysis we should really reflect the much higher levels of renewable power which are going to be built in this timeframe from now till 2030 in this analysis.

And lastly, we were very pleased to see that there's at least one or two non-row technologies in the analysis. We would simply ask that there be inclusion of two others which are very very large, have very large impacts in California.

First of all, use of electricity at marine ports. This has been included in the goods movement action plan. There's an ARB regulation in this area which appears that it's going to require the use of electricity at marine ports. And we think that that should be included in the analysis.

And then lastly, the use of electricity to reduce diesel idling and idling of auxiliary power units used in truck stop and refrigerated container usage.

Thank you very much.

MR. ADDY: Thanks, Dave. So, Commissioner and Deputy Executive Officer, you have any closing comments before we let the folks out for lunch?

VICE CHAIRMAN BOYD: Well, since we're not done I don't have any closing comments.

MR. ADDY: For this session, anyway.

VICE CHAIRMAN BOYD: Kind of an observation that keeps going through my mind, and that is as I said in the introduction, you know, this 1007, as has been recognized by other speakers here today, is an alternative fuels plan predicated upon questions about the need, or issues about the need to diversify our state's fuel portfolio in consideration of a large number of questions.

And the dilemma we mutually face here, the ARB and the CEC, is, as has been pointed out, now the low carbon fuel standard becomes heavily dependent upon what we develop here in this whole fuel cycle analysis. And they are facing a deadline even more stringent than we are facing with regard to submitting the 1007 report.

It's been pointed out, and I'm very gratified that there's consensus amongst the peer reviewers that 70 percent plus, that this is good enough to proceed with based on what we know at this point in time. I said it before, and I try not to say it too much, you know, this is the first real deep dive that's been taken on this subject. And there will have to be a lot more.

And that's probably unnerving to a lot of folks who recognize the world could change based upon these analyses in the future. But decisions will be made in the short term based on what we know today. And those decisions may change over time as we develop more information.

But the alternative fuels plan is just that. It's fuels alternative to petroleum. And when the low carbon fuel standard folks issue their scorecard, so to speak, I'm sure there'll be a lot of debate about what do we do in the near term to provide fuels adequate to address the issue of price volatility, i.e., to supplement our fuel pool with other fuels to meet the economic demands of the businesses and citizens of the state with an adequate fuel pool that provides equitable prices, equitable to be defined.

Versus the mutual desire of all of us to have the least possible environmental impact, or to minimize environmental impact, and to certainly address the low carbon fuel question that AB-32 certainly brings to the table.

So, we are traveling multiple paths all at the same time. And, one, I'm pleased, as I said, with how we feel about where we're going. And I also fear the difficulty we're all going to mutually going to have in making our choices in the short term as we proceed towards this longer term future.

And I'm sorry that -- I guess I can't blame Amtrak anymore, I've blamed Amtrak before, but if you had an accident on the rails, why lord knows. I'm sorry the Professor missed so much of our discussion and we'll talk to him some more, I'm sure, about use of our cellulosic waste stream in this state as a primary source of cellulosic fuels instead of maybe having to grow many energy crops, et cetera.

But, we're halfway there in terms of

this workshop. And we have a long way to go.

One last quick observation. I was in Brazil recently with Michael Wang of Argon. And we both came to the conclusion that the analyses of the full fuel cycle with regard to sugar cane ethanol lacks a lot, as well. And there are a lot of externalities that those folks don't seem to take into account.

So, we're all on equal footing of learning and needing to do a lot more.

MR. ADDY: Mike, anything?

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Nothing other than thank you very much to Mike Jackson and his team for what, I think, was a very good -- it was a long presentation, but I paid attention to it all the way through. I think you did a good job of laying out what you've done. and I think what you've done is really great in terms of given where we're at and what we know.

You've laid it out, you've given us all the material we need to start from, and hopefully all the stakeholders material that they can respond to so that they can help us make it better.

MR. ADDY: Thanks to the panelists for

this first session. And thank you, the audience, for helping us start on time and end this first session on time.

There are food eateries around the place. LaBou is just up the track. There's one upstairs, the cafeteria, and you can ask us where other options.

Thank you.

(Whereupon, at 12:00 noon, the workshop was adjourned, to reconvene at 1:00 p.m., this same day.)

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AFTERNOON SESSION

1:05 p.m.

MR. ADDY: Welcome to the second part of the workshop on the AB-1007 proceedings focusing on the full fuel cycle analysis. This part of the workshop will cover the fuel-by-fuel full fuel cycle assessment. It's not going to be an exhaustive presentation of all of the fuels, so take heart. Otherwise we'd be here until midnight.

But I'd like to welcome Stefan Unnasch up to the podium so he can begin his presentation. We're going to have copies of the presentation for you in a few minutes, but let's get underway and have Stefan begin.

MR. UNNASCH: Thanks, McKinley. So, I was asked to talk about some of the key factors affecting the analysis and some of the dominant assumptions. And to that extent I'm going to cover the major uncertainties, especially some of the ones that have been pointed out to me by stakeholders, what some of the unique assumptions are for California.

And in doing this I'm just going to

highlight one pathway for a fuel to illustrate some of the key points. And many of these key assumptions are common amongst different fuels and different pathways. So something I say about electricity certainly would apply to CNG or any other fuel. And look at what some of the significant findings and surprises are.

Most of the assumptions have to do with production inputs, how much feedstock you're using; what the efficiency is; where the electricity comes from; how you move the fuel around, especially for California that affects the local criteria pollutant emissions; and also what's the vehicle doing in terms of its fuel consumption.

These inputs on the well-to-tank side, we dealt with this in the GREET model. And the primary things we changed were the efficiency as an input to the model; the resource mix; how far travels; the urban shares feature. I won't get into all the detail of the GREET model or the phone book we could have produced.

But these results are grouped and categorized according to energy, greenhouse gas emissions, total criteria pollutants.

So, what we did was we took the feature in the GREET model that takes the total criteria pollutants and we applied that to the global criteria pollutant emissions.

And then there's another feature in the GREET model which they call urban emissions. And we adapted that to represent the emissions in California. So the assumptions that were consistent with fuel delivery in California, we set to the urban emissions assumption.

So, for example, if there was a marine vessel operating in California waters we set that up as the GREET input assumption.

So, let's just get into some of these results and see how the assumptions affect the outcome.

First, you're not going to see many tables like this fortunately, but gasoline was terribly complicated and there's lots of assumptions that drive both the energy inputs and the emissions.

We analyzed, as Mike pointed out, the marginal production of gasoline in California. And that's looking at importing finished product to California. An important assumption is how efficient is operating the refinery. And we based that on analysis done for the CEC by a firm called MathPro, where they looked at linear programming analysis for refineries and tried to identify the inputs to the refineries and the product slate, and develop an allocation.

There's also a certain amount of hydrogen that's used in the refinery. And that all goes into estimating the refinery efficiency.

For this marginal case the fuel comes from, we estimated, 9800 miles away. And a very significant assumption for the local criteria pollutants is how far do you count those emissions if you want to look at them in the California urban area.

For a marine vessel going 9000 miles you figure some of the time it's going to get rained on. And I'm not sure quite how to deal with the fate of particulates that's out in the open ocean. But we certainly know that as it gets closer to California eventually you count it in the emission inventory.

This 115-mile distance corresponds to 100 knots, which is in some ARB and CEC documentation. It's in a CEC petroleum performance report, and we used that number.

Another important number is the cargo capacity of tanker ships. You can imagine crude oil tankers that are as big as a million dead weight tons. And it's our understanding that the biggest crude oil tanker in the world is being used as a product storage barge because it's too big to go anywhere.

California has limitations on its tanker ships. And you might see 200-plus-thousand dead weight ton tankers, but in California they're limited more to 150,000, especially for petroleum products.

I'm not going to go into the other fuels, but ethanol from Brazil, for example, has to go through the Panama Canal, and you're talking more about 60,000 dead weight tons there.

Another important assumption is how much of the tanker truck do you count. How far does the truck drive. And Mike Jackson did some great digging there, and we like our 50-mile-delivery-distance number. So these are some of the key parameters. I promise I won't go into this kind of detail again. And let's just start looking at how this affects the results.

So, as I pointed out, for gasoline the key input is how much fuel is the refinery using. From a criteria -- refinery creep was a question. You know, we're aware of refinery creep, and this was vetted quite a bit when we've done fuel cycle analyses in the past.

The idea is that the -- what we're analyzing here is the marginal gallon coming from overseas. And you could say that some of it will come from refinery creep, but what about the criteria pollutant emissions. And one of the things that was brought up in the past is that the refineries are subject to reclaim in the South Coast air basin, subject to CEQA, and they have declining criteria pollutant emissions over time.

So even if some of the incremental gasoline does come from refinery creep, I think the analysis we're applying here to the criteria pollutant emissions is still relevant. Maybe the mix of crude oils might change.

Another thing to consider is what's the energy intensity of producing the gasoline. We're looking at heavier crudes, more hydro-treating. What's the impact of the transportation distance and ethanol blending. Let's see if I got this right here.

So, it's interesting to reflect upon the detail in the well-to-tank numbers. And these are the gram per megajoule values that you can get by inspecting the intermediate GREET results or digging through the well-to-tank report.

And you can see that transportation is really a fairly small sliver, even with 9000 miles of distance for the product to be hauled. And about a third of that transportation is the local delivery truck.

The refinery, of course, reflects how much hydrotreating and the refinery efficiency. Another comment about refineries is that another, like in the EU car well-to-wheel study they look at European refineries and point out that those are very diesel intensive refineries and producing an extra gallon of gasoline is actually a relief to that refinery because it's so heavily configured to making diesel. They're looking at refinery efficiencies more in the order of 90 percent, as opposed to the 85 percent we had in this study.

So there's a range of numbers to be considered. And that was on McKinley's list of items that we should try to investigate further.

And finally, oil production. These numbers haven't gotten a great deal of inspection. The baseline GREET values are pretty well been there for years and not a lot of inspection.

I know in California we're looking at a lot of steam enhanced oil recovery, so oil production component might be bigger.

So, having said all that, the uncertainty for California-based or for conventional sources of crude for gasoline is reflected by the little bar shown there.

You can also look at more carbon-intense options like tar sands and maybe experience a 20 or 30 percent increase in the greenhouse gas intensity of the fuel. So that's the key factor driving greenhouse gas emissions for gasoline.

You can see not a lot of variability with conventional gasoline, but looking at other sources you would increase the carbon intensity.

Another, now what about criteria pollutant emissions. There's a lot of interesting nuance to this. One factor is that the lion's share of the particulate from the vehicle is the tire and brake wear. Another topic that comes up is how much of it is coming from the tanker ship versus the delivery truck. And how much are we not thinking about when we look at only the marginal analysis.

So this chart here shows these parameters broken out on a well-to-tank basis. So just for hydrocarbons. So this is just the VOC emissions on a gram per gigajoule basis.

And the biggest component in the fuel cycle is how much gasoline is spilled when you're fueling your vehicle. That's the green bar on the chart there. For VOCs, the tanker ship VOC and the truck are just a small sliver there.

Now, I also showed the vehicle on a gram per gigajoule basis just by multiplying out the vehicle emissions times the energy consumption, just to put this into perspective.

So those, the first, the green and the blue bar with the small slivers in between reflect the California marginal VOC emissions for conventional gasoline car.

And what we haven't shown a lot in the study is what about the refinery. We're basically not counting the refinery emissions that are shown here due to the marginal analysis. So these numbers in the purple-dashed area reflect the California refinery emissions, or presumably the emissions from a refinery outside of California that would also be subject to stringent emission controls. Let's say it's in Norway.

And then finally, the other fuel cycle emissions associated with producing crude oil as well as the tanker ship emissions which must be a fairly large part of those total emissions.

So we do have the total emissions in the report. And I think -- we've got a lot of comments about how to present the marginal analysis. And I think this is a good way to do it, where we could show strictly, you know, if you use a gallon here's what you've got to emit, because you can't get around that tanker truck trip.

Whereas you can understand the notion for assigning the refinery emissions to something that's been offsetted or not counted in the analysis, but you could still take it into account in your thinking.

Another one of these charts applies for ethanol from corn. I'm just going to go through some of the key processing energy inputs here.

So, for a corn-to-ethanol plant one of the key things that drives the energy inputs is how much energy does the corn-to-ethanol plant use.

And in the GREET model they're looking at dry mill plants. So basically when you make corn to ethanol, there's two kinds of plants you build, a wet mill or a dry mill. You build a wet mill if you want to make corn syrup, corn oil and other yummy byproducts. Whereas a dry mill grinds up the material and then the byproduct is used as animal feed. It doesn't survive the process to become stuff that's going to hit the grocery shelf.

So dry mills are also more efficient and that's the way we're looking at the incremental gallon of ethanol.

In the report, as Mike showed, we were also looking at other pathways. Coal as the energy source; maybe corn stover digester gas from manure. We also analyzed looking at taking the protein byproduct of the distilled dry grains, distilled grains insolubles and pumping them into a truck and feeding them to cattle as a wet feed. And that has about a 10,000 Btu-per-gallon impact.

So the bar shown here for the corn-to-ethanol case just reflects what might be a range of uncertainty due to just conventional dry milling plant maybe with changes in agriculture, also taking into account variations in corn yield, maybe no till farming practices and variations in nitrogen inputs.

All of the analysis shown in this report is based on using existing farmland. So we don't show the impact of tilling the prairie to grow corn. And I don't think that's a likely scenario, either. But if it were, that would need to be added separately.

And to that extent, though, we do include the impact of displaced products, at least for corn and some of the other biomass products.

So what Argon National Lab did, working with the Department of Agriculture, was they analyzed the economic supply and demand of agricultural crops at the 3- to 5-billion gallon of ethanol per year level. And looked at what agricultural products were displaced. And that analysis can go pretty far. It's a whole lifecycle analysis in and of itself.

So let's say corn displaces some wheat. Now, if that's exported wheat, you know, the analysis certainly doesn't look into the impact of growing wheat in other parts of the world. So this is really a tricky problem on how to deal with the displaced agricultural products.

Now, the factor that's used in the GREET model is quite small. And to the extent they have it right, hopefully some of these other displaced agricultural impacts don't have a big impact.

In some of them it seems like a pretty good story. If you're displacing cotton, which isn't really grown on the land where corn is grown, you might cause cotton to be grown overseas where there would be less transportation energy. But this is certainly one of the tricky areas that needs to be investigated further.

Now, ethanol from biomass. There are lots of good questions about that. One had to do with how sure are we about the greenhouse gas intensity. And one thing is clear about the biomass pathways for growing ethanol is that they primarily use biomass. The ethanol plants, at least as they've been analyzed, run on the basis of collecting wood waste and treating it with acid, and then taking the lignin that's not converted to ethanol and burning that in the ethanol plant.

So there's really very low amount of fossil energy in the fuel cycle. So your well-to-wheel greenhouse gas results are always going to show fairly significant numbers for these biomass pathways, unless you have to use fossil fuel as an energy resource, which brings up another question of what byproduct credit do you assign to the electricity that you could have displaced.

If you follow some of the thinking that's gone on in this room, the electricity that would be generated from an ethanol plant would just displace wind power, so, we shouldn't give it any credit. Or maybe it should displace natural gas, combined cycle power, which was the assumption that we used.

These plants use a little bit more energy than a corn-based ethanol plant. And, you know, realistically speaking, everyone talks about the yields being 90 gallons for a bone dry ton. And the plant hasn't been really built yet. So maybe in the near term we're more in the 40s and 50s for these plants. That doesn't have a big impact on the net greenhouse gas emissions, because the lower you go in efficiency the more leftover stuff you have, the more excess electric power you have. Which brings up the question of what about the emissions from running these ethanol plants.

So, here I'm going to look at one of the interesting points on the biomass-based pathway. People picked up on the fact that the PM emissions were higher and some of the fuel cycle emissions were higher when you just count them in California.

And you can see on the chart there California poplar versus conventional gasoline, it's almost double the PM if you exclude the tire and brake. And this is due to the agricultural equipment that's used to harvest the ethanol and also the ethanol plant, itself.

And what I was doing diligently, as Mike was speaking, was looking at the case for the year 2020 when the newer vehicle engine technologies are going to kick in based on the EMFAC model and the offroad model. And the emissions from that equipment are going to drop significantly.

So that puts you to the point where you're almost -- you are essentially at a break-even on PM emissions with gasoline if all of those new technologies, low-emission technologies do kick in for the agricultural equipment and the diesel trucks.

Another thing to consider is the ethanol plants, themselves. Burning biomass is not as easy as burning natural gas to achieve the same emission levels. Probably some of the early biomass plants are going to try to be configured with an existing biomass power plant. But as you start building greenfield plants they're going to be looking for emission offsets, and maybe even having to employ advanced technologies for emission reductions like biomass gasification.

Another thing -- so again, this PM weighting here, as Mike pointed out, is just the diesel PM. And it also illustrates the relative importance of benzene and 1,3 butadiene in gasoline relative to diesel PM in terms of the weighted toxics.

We looked at a variety of biodiesel vegetable-oil based pathways. And there's a lot of -- we just cover some of the broad issues first -- there's a lot different well-to-wheel results you see for biodiesel, for example. And it turns out that some of the results that we show, like no improvement in greenhouse gas emissions for biodiesel. Those have to do with including land use impacts.

And I think the way to treat the land use impacts is to add them as a separate bar because otherwise the reader never knows what's going on. Because first of all, the word land use impacts sounds kind of academic and no one really knows what that means. And it's not clear that -- it's also sort of case-by-case. It would depend on where you grow it and the agricultural practices. So I would suggest that the land use, if there is an impact or if someone thinks that we should know what the impact is, whether or not there is one, ought to be treated as a separate item.

So, having said that, we looked at some other soybean -- soybean oil is, of course, the biggest biodiesel source in the U.S. One of the reasons it's so popular is it produces the soybean protein byproducts, tofu, all the good stuff you get from soybeans, which helps its economic viability.

But we also wanted to look at some things that you can grow in California. And one example is mustard seed. Mustard seed, when you look at mustard seed it looks just like canola. But the crop yield is lower. And it can be grown as a cover crop. So in between rowing of other crops, when you're trying to keep the weeds from growing, or maybe do a little bit for the soil health, mustard seed can be grown and doesn't require any pesticides or fertilizer or herbicides. So this is an example of a crop with very low energy input. It's not going to have a very high yield per acre, and I'm not sure if it's economical or not, but it would have a fairly favorable well-to-wheel greenhouse gas result.

Now one thing else I wanted to comment on the report, and we got comments from reviewers, the report shows all of these results on a blended fuel basis. So here we're showing the result for BD20. And the reason we did that was we wanted to get the criteria pollutants just right, taking into account the combined transportation logistics. And some of these fuels have a double-truck step in them.

So if you're looking at E85 we wanted to make sure that we counted all that correctly, which caused us to show all of these fuels on a blended fuel basis.

So, if you're looking at just pure BD20, which, by the way, I'm sorry, I just made this chart today, the well-to-tank and well-to-wheel there is for the pure vegetable oil, of course, because it's showing almost no net greenhouse gas emissions.

So, that's one thing we've been asked to look at, is how, you know, looking at these as a pure fuel. So, of course, if you have low fossil fuel energy inputs you're going to have low greenhouse gas emissions, as we've shown here.

Another fuel that's been talked a lot about is palm oil. And I've heard so many comments about burning forests. And we've also, you know, to me, I think the question is, you know, how can you -- you know, what measures are in place to assure that you can have a economically environmentally sustainable source of palm oil. I think the industry needs to, and I understand they're working on that, needs to be able to assure that maybe some mitigation takes place. Or at least, at a minimum, that there's proper attribution to the sourcing of the different types of vegetable oil.

All right, natural gas. We did a lot with natural gas. We got a lot of comments from the stakeholders, and we changed a few things in the GREET model.

One of the things we looked at a lot was the compression energy for natural gas. All of the compressors for CNG stations are powered by electricity. And the amount of energy that's required depends on how high the pressure is that's going into the compressor.

And also there's a little bit of subtle nuance to how you run the station, because some of these are cascade systems and some of them are filling up big transit buses. So it's not completely obvious, even if you did all of the modeling, which we and others have done, you should get a number in the range of .6 to .8 kilowatt hours per gasoline equivalent gallon.

And we've got some work we're doing with the NGV folks where we're going to try to get them to actually collect the meter data on the natural gas stations. I did that about ten years ago for a very small station that had low pressure input, and you get the results that you would expect for that type of a facility.

Another important factor in the natural gas fuel cycle that affects all the fuels is how much does the methane -- how much does the pipeline leak. And this is a key factor; it's an input to the GREET model.

And a lot of this was based on studies of unaccounted-for fuel, UAF. And there's several places where the natural gas can go. A leading one is metering uncertainty. Another one is theft, believe it or not, in the U.S. And there's also losses.

And prior assessments of the methane losses assumed that a much higher fraction of the unaccounted-for fuel was methane leaks. And the best information we have now is it's more like 7 percent rather than 70 percent. So the methane loss factor that we used was, I believe, .07 percent, rather than .35 percent of all -- or .49 percent of all of the gas that's going through the pipeline.

That had a big effect on the CNG pathway. And it also has a secondary effect on anything else that uses natural gas, like electricity. And the impact of that assumption is shown in the error bar there. The well-to-tank factor is, with those losses, would be about 28 grams per megajoule. And I believe it's about 14 grams per megajoule if you use the lower methane losses shown here.

Another factor that's important is the mix for the compression energy. And there's so much interest in that factor by other folks that I won't cover it here.

Oh, yeah, let me just -- yeah, so this shows here the breakdown. You can see that processing is about half of your fuel cycle. This is the natural gas sweetening plant. And then the compressor is a relatively small amount of the total fuel cycle. And how much goes into those losses, and this is, again, with the .07 percent of the pipeline losses, but I think there's still about .35 percent is lost from the production and processing plants. And I'm not sure if we're going to get any more input on whether those numbers are -- what the range in those numbers might be.

All right, hydrogen. We looked at a lot of hydrogen pathways and I just want to examine some of the key factors that we found in this study. We looked at -- we did set up the analysis to look at both fuel cell vehicles and hydrogen IC engine vehicles. And we didn't necessarily put every one of those in the report. And there is a typo, obviously, in the well-to-wheel report that shows them having the same greenhouse gas emission benefit.

But our analysis showed that you have about a 40 to 50 percent reduction in greenhouse gas emissions for fuel cell vehicles with the natural gas based pathway, either with a pipeline based central plant, or with a onsite steam reformer. And, of course, you give back a lot of that benefit if you have to run with a hydrogen IC engine vehicle, unless the vehicle is dramatically different and wouldn't necessarily represent a comparable comparison to the gasoline vehicle.

Here, again, with hydrogen the generation mix comes into play, again. I'll talk about that later.

Another thing that we found that was really fascinating, and I think a lot of you in this room have been exposed to this, is what's the well-to-wheel comparison of gasoline vehicles compared with hydrogen vehicles.

And by the time you get this far into a

presentation and you see the energy inputs, you see the greenhouse gas emissions, by the time you see the PM you're pretty tired and you don't really think about it.

Well, if you apply the analysis that's in the GREET model that's been applied in a lot of studies, it shows quite a significant increase in PM from hydrogen. And the reason for that is that they're assuming the AP42 emission factor that's 3 grams per million Btu. And that's being applied to the hydrogen steam reformers.

Now, the only way you can make particulate from a steam reformer is one, ingested air; so it could come with the air. But the only other way you can make particulate, see, what's happening is you're taking natural gas, reforming it, converting it to carbon monoxide and hydrogen, and there's a little bit of trace methane. So, particulate can come from the trace methane or it can come from two carbon monoxide molecules bumping into themselves in a rich condition. So it's pretty rare that you would make particulate.

Well, it turns out that, I believe, that most of the hydrogen plants that have gotten permits and there's been a basis for emission inventories, they have to do a source test for NOx, because it's a source of NOx from the hydrogen plant. And then when it gets down to doing particulate, they're faced with either paying for source test for the particulate, or just assuming the AP42 emission factor, which will get them their permit.

So it's either you can write in the AP42 emission factor, or you can pay for a source test. So it turns out that everyone just goes with the base emission factor.

And we studied the PM emissions from one hydrogen plant over time. And it turned out that as a condition for an upgrade to the facility the local AQMD said you need to do a source test. So we got their source test data. And it's actually .32 grams per million Btu rather than 3. So it's off -- the factor that everyone's using is off by a factor of 10.

Sorry I didn't have a chart to show here, but basically PM emissions from hydrogen are lower than they are from gasoline vehicles on a fuel cycle basis. And, you know, it's only a couple of data set sources we've been looking at, but you really have to be careful when you're looking at the inventory of emissions and thinking that represents the summation of people filling out inventory forms. It doesn't necessarily represent the emissions data from every particular plant. And that was, I thought, a significant finding we had with regard to hydrogen.

There was lots of questions we got about the relative comparison with other studies, and I don't want to get into those now. I just -- touch on those topics.

The GTL. We looked at a variety of GTL pathways. The one that's most interesting because it's so close to diesel is taking overseas natural gas and converting it to synthetic diesel. And the leading process there is the Shell SMDS process. The plants that are built today -- and there's a picture of one -- they operate at about a 63 percent thermal efficiency.

What you need to look at with the GTL process is how much of the fuel -- how much of the carbon in the fuel is converted into fuel, and how much goes up as CO_2 emissions. And if you look at that, in the perfect situation if your plant was 100 percent efficient, for every joule of methane -- no, for every pound of carbon you would get .78 pounds of GTL. So that's the most perfect, that's the 100 percent efficient case.

So if your plant's at 63 percent efficient, pretty good guess can be factored into what the carbon conversion efficiency would be for your plants.

Now, we talked a lot with Shell and looked at some other modeling studies. And the plants that are 63 percent efficient today, by the time they get to 2020 they might be building them at more 68 or 69 percent efficiency.

The improvements that they're looking at would be reducing the amount of energy used to recycle the synthesis gas and the synthesis reactor, and better thermal integration. So that has -- what happened to the result -- oh, I didn't show that.

So, if you look at GTL compared to diesel, and this here is for FTD30 or 30 percent GTL, you have a small increase in greenhouse gas emissions. And if you change that to a 69 percent efficient plant you end up being about dead-even with diesel fuel. And there are maybe other opportunities; maybe you could look at pure GTL, although the impact on the efficiency would be somewhat subtle.

Okay, here's the one everyone likes to talk about, electric transportation. The interesting question with electric transportation is where does the marginal power come from. And indeed, we have a renewable portfolio standard in California, and that affects what the future generation resources might be.

So on the top chart there is a resource mix from the California ISO for a nonpeak day in California. We also looked at it for a peak day. That's showing the conventional intermediate natural gas power plants, new renewables, hydropower, coal and nuclear.

And just to be clear, the RPS applies to new renewables which would mean wind, biomass, solar and not large hydro, and geothermal. And the RPS is based on the total gigawatt hours that are sold.

So, in order to meet the RPS requirements you would need to move from this fairly about 8 percent new renewables to 33 percent in the year 2030.

So the question is, what happens if you have some additional load growth due to electric transportation or ethanol plants or CNG compressors or anything that adds to that load.

So, here's one way to look at it. In the year 2010 there's a target for 20 percent new renewables. And the chart down there shows one projection of the amount of new renewable power that would be needed to meet the RPS.

So, basically you would have to produce almost all new renewable power, and you hardly have any room for fossil power, in order to comply with the RPS.

So let's say you're in the year 2010 and you want to comply with the 20 percent RPS target, how much new renewable power do you need? Well, it's this number right here. Okay. So, now let's say you have some load growth, -- let's say you have some additional load represented by the checkers here. So now you've met your RPS requirement right here, you've produced all new renewables.

And now you have new load. Well, I would think that the utility is free to do whatever they want. And the constraints are the RPS. So, this is just simple calculus. We couldn't have landed on the moon without it.

There's a change in demand, and I'm attributing it to the load.

So, I think the analysis that we did that applies the RPS constraint to a fossil mix is still a good way to look at it. You go out here in the year 2030; again, you've met your 33 percent RPS requirement. You had to do it with 100 percent renewables. And where does the additional load growth come from. And, again, the utilities are free to pick whatever generation resources they want, subject, of course, to the RPS. so, this, again, you'd think it could be 33 percent renewables and it's 67 fossil. At least that's the way my high school math works for me.

Now, we've also gotten comments that this doesn't -- the mix doesn't necessarily have to be all natural gas, combined cycle. There's advanced technologies, maybe coal with sequestration.

Another thing we looked at was biomass, and it's clear that if you look at the existing emission factors from biomass plants, they're going to be challenged to be permitted. And we didn't do an analysis of the criteria pollutants based on the existing emission factors, because we didn't think that there could be that kind of growth in biomass power with the old emission factors. They're going to have to do something with gasification or advanced cleanup technologies. So that's our take on how to treat the generation mix.

Now, another key assumption on electric transportation that we took a good look at was the efficiency of the electric vehicles. We got data from the Electric Vehicle Association, which is in the tank-to-wheel report, where they looked at the electric consumption for the vehicles. They also did some analysis projecting what the impact of lithium ion batteries are.

And the short answer is that we're assuming that the electric vehicles have a 3.6x improvement in fuel consumption over a gasoline vehicle. And that's with a gasoline vehicle that's improving over time.

So, we factored into this analysis the AB-1493 improvements in vehicle fuel consumption. So arguably you could have electric vehicles doing better. They're up against also an improving gasoline vehicle mix.

Another comment is that my electric car

does better than this, better than 80 miles per equivalent gallon. And we did the analysis for comparable mid-sized cars. And what's happening here is that some of the electric cars aren't quite mid-sized cars. So maybe you're buying a smaller electric car when you would have bought a mid-size car, but that's not the analysis we've been asked to do.

We could have done this entire analysis for subcompact cars, but we thought it was better to do it for mid-sized cars because it reflects kind of the average car. So, we think this is a good way to represent electric vehicles.

And while we have the hydrogen vehicles up here, we also looked at a lot of data on hydrogen vehicles. And we used a 2x improvement in fuel economy for the hydrogen vehicles. And that was based on modeling data which will tell you it can be 2.6x, and it was based on looking at a lot of onroad test data which generally is sub 2x in performance, except for the Honda car, which is hard to find exactly a comparable vehicle to compare it to. And, you know, you might say that the Honda car does achieve a 2.5x improvement in fuel economy.

But again, we're using this number in comparison with gasoline vehicles that are also improving in fuel economy. And in the tank-to-wheel report we show GM's projection for how good gasoline vehicles could do over time based on their modeling studies.

So, there's a lot of variability in the vehicle fuel economy. And maybe, indeed, the best way to deal with that is in the sensitivity analysis. But one thing you want to consider is don't give away the store here. You don't want to, a priori, assign some kind of a efficiency when maybe it will all be given back in improved acceleration, although I don't see that for electric vehicles.

All right, so what does this do for the GHG emissions. We assumed that for electric transportation that it was a mix of natural gas combined with the RPS constraint. And one thing to recognize when you look at these energy charts, by definition for renewable power, to get 1 kilowatt hour of renewable power, in the GREET model at least, the definition is that it takes 1 kilowatt hour to make that. Transmission losses are ignored.

So, this is just the 1 kilowatt hour represented here, whereas, of course, for the natural gas based power that takes into account all the losses on a well-to-wheel basis.

So, the results for the assumptions we have here show for electric cars, over 50 percent of -- almost looks here like almost 60 percent reduction in greenhouse gas emissions compared with a conventional gasoline vehicle. And that's in the year 2012 where we assumed 7300 Btus higher heating value per kilowatt hour. And we see that improving somewhat over time into the future.

Now, there can be combined cycle power plants that are more efficient, but there's still going to be a mix of plants out there. And we think that these are good numbers for attribution to the electric transportation.

Then, so we've covered the marginal source of electricity. And another option to consider for electric transportation is there is always the option to buy a renewable energy credit for both electric vehicles, as well as all sorts of fuel production facilities. A liquid hydrogen plant could buy electric power to meet its electrical load, and that would also impact its greenhouse gas score.

So, again, the point to bring home, does electric transportation force an acceleration of the RPS schedule. If this little kink in the curve means compliance with the RPS at that particular load, does a small epsilon in load mean that you're also at 100 percent renewables, or that you're back to the regular RPS constraint.

Another thing to think about with the renewable component for electric transportation, if you do think it all comes from renewables, what about hydrogen IC engine cars running on electrolyzers where you might have, you know, quite a bit more energy and greenhouse gases if they were running on natural gas. Does that mean that that pathway should also be treated as 100 percent renewable.

So, I think we've treated it appropriately in the report and we've got some comments on how to address the uncertainties.

Another thing that was already brought up today, and we've been aware of this for a long time. In fact, in our 2001 fuel cycle report we recommended that the emission factors for particulate from natural gas plants be examined in greater detail, and maybe their attribution studied more closely. It could be due to secondary particulates due to NOx, or maybe it's simply air ingestion of particulate in the air. Because a lot of the power plants that were tested a long time ago were in southern California.

We also looked at offsetting NOx emissions; it's a requirement in the South Coast air basin, that there's no net increase in SOx. And, by the way, in the rest of the GREET model we did zero out the SO2 emissions because there's also a cap on sulfur emissions from power plants in the U.S. So these results for offsetted emissions can also be treated the same way that I dealt with refinery emissions.

So, finally, just to go over some thoughts on our scenario selection. We've looked at California-specific delivery options and pathways. And we've tried to apply assumptions on emission control that are in the bag. So we didn't assume that there was an emission control that could happen unless the rules were already there.

So, a lot of the pollution sources that are in the report might be subject to future emission control, but we didn't assume them if it wasn't already required. An example might be marine vessels might come under more emission controls, or maybe something could be done with LPG venting.

We looked at -- we had a lot of requests to look at zero fossil fuel sources, do a fuel cycle analysis on those. The results are somewhat predictable, however the analysis may still be worthwhile doing in terms of the low carbon fuel standard. For example, let's say you looked at CNG from landfill gas, which would have no fossil fuel involved, but you might still have electricity for compression. So that's still worth doing.

And there's also a question about displaced resources. If you think it's tricky with what agricultural products are displaced with corn, what about using digester gas for electric power or to run an ethanol plant. Digester gas is perfectly usable to generate electricity and process heat for sewage treatment plants. So there's a significant displacement issue there. I don't see the same issue for landfill gas where most landfills will continue to flare their gas because there's no good opportunity for using the energy resource.

Vehicle emissions, we took into account future ARB requirements. Oh, yeah, we got a lot of comments about the analysis of the benefits of emissions from different fuel options like biodiesel and FT diesel. And this is very difficult because you have new engines that are being built with new emission control technologies and a lot of data in the past on what the impact of these fuels were on older engines.

And the guidance we got from the sponsors here was that ARB has ongoing programs to both test and assess the emissions from alternative fueled engines. And we didn't try to analyze in great detail what the emission impacts were from ethanol or biodiesel or FTD, so they might have better emission impacts. The guidance in AB-1007 was to look at places where there could be increases in emissions. So we didn't place a lot of effort into trying to understand what future engines might be doing.

Finally, there is a phonebook of information that can be generated here, all of the ARB different vehicle classes. But they generally would result in comparable greenhouse gas emissions. If you look at a LGT2 versus a gasoline car, the impact on greenhouse gas emissions from different fuel options, at least on a percentage basis, would be comparable. But we have provided the tool to produce over 2000 different sets of charts. And I like the phonebook analogy.

So, what are some of the key drivers. I think it's clear we have energy inputs, power generation mix, feedstocks. Methane losses are a big impact. We analyzed them for natural gas, CNG vehicles. They seemed to be under control for LNG, but there aren't necessarily rules that control that. The practices for fueling LNG vehicles seem to control the methane losses.

Land use impacts can be huge. We didn't show the land use impact on the charts, but if you have to cut down a forest to make your biofuel, better to leave the forest there.

Criteria pollutants, California emission facilities, offsets, we looked at all those requirements.

Water impacts, clearly if you don't have petroleum you don't have much of a petroleum impact. A lot of the water impacts are regulated by both federal and state agencies, so there's already regulations for agricultural applications. It's very difficult to attribute this on a gram-per-mile basis.

And finally, fuel economy. There's lots of opinion on this. And it is clear that no one will agree on what the right comparison is. And you do need to take into account maybe what car the customer is going to buy. So if a customer wants to buy a smaller car that's electric, maybe the policy could take advantage of that. But we tried to do the analysis for a more comparable car.

So, that's the extent of my comments on the nuance to the analysis.

MR. ADDY: Thank you, Stefan. I want to give an appreciation for the difficulty in getting this point. When we asked him to put together a presentation that would highlight, on a fuel-by-fuel basis, some of the unique assumptions, and then uncertainties related to those unique assumptions and how they would affect the results for the particular fuel, the first try, I think I said, we didn't want that.

So, I think about two or three days ago I sort of shared with him a sample of what we're looking for. And, Stefan, I want to tell you that I think this comes close to it.

From our point of view as the FFCA team, I think it was important first for TIAX to highlight the unique issues affecting the analysis on a fuel-by-fuel basis. We don't point these out to generate a debate, but only to bring to your attention that as a result of our interactions with you, we were aware of many of these issues, and how we treated them with the constraints of data adequacy and availability that we face in analysis. Also keep in mind that we looked at representative vehicles.

With that, I'd like to -- Commissioner Boyd or Mike Scheible, if you have any upfront questions before I get to the peer reviewers?

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: No.

VICE CHAIRMAN BOYD: None for me.

MR. ADDY: Okay, good. So I'd like to invite our peer reviewers to come back up, those of you who are not at the table.

And what we are looking for from you, one, is based on what you've seen so far, what your reactions are to the unique issues that were highlighted in the fuel-by-fuel treatment. You don't necessarily have to comment if you don't have a comment, but we'd like to get some impressions from you. Hopefully you were taking some notes. Anthony.

MR. EGGERT: I guess I'll kick it off here. Perhaps first a comment. And initially I was going to address this specifically to the energy efficiency ratio issue, and in particular with respect to the things like electric vehicles and hydrogen fuel cell vehicles. But then I realized that it's potentially applicable to a lot of the new technologies, including on the fuel generation side.

And that is the idea that when you're talking about new product development and you're working on a new product like a fuel cell vehicle or a plug-in hybrid electric vehicle, or a cellulosic biomass production facility, biofuel facility, one of the first things that you do is you try to make the thing work. That's sort of step number one.

And so having previously been involved with vehicle product development at Ford Motor

Company, working on the fuel cell vehicle, the first two years of the product development portion of that program was just getting a car that could actually, you know, when you turn the key the thing came on and you could actually drive down the road.

The second step in product development is getting it to work for longer than a day. And then, you know, as you sort of move through the product development process, you start to pay more attention to things like performance and et cetera.

And it's really really down towards the tail end of the product development cycle that you really start paying attention to things such as efficiency. And you start to identify where your parasitic losses are. You try to reduce those. You try to integrate the rest of the system with more sophistication.

And so, I think, again I'm just going to sort of repeat a previous comment, which is I want to commend the reviewers for addressing this issue of the changing nature of technology. And I'm also very happy to see that they are considering to deal to update these numbers as more information becomes available. Especially on items such as efficiency.

I do actually just have one sort of question or curiosity in relation to some of the results that were presented. And it has to do specifically with the liquid hydrogen production.

Do you have -- this wasn't included in the documentation but -- the efficiency that was used for that process?

MR. UNNASCH: Yeah, we, I believe we're assuming it's 11 or 12 kilowatt hours of electricity per kilogram of hydrogen. And with the appropriate input to the GREET model. And I know that some projections of the energy required have gotten a bit on the aggressive, and we're not using like the 8 or 7 kilowatt hour number anywhere in our analysis.

MR. EGGERT: And I think actually, at least as far as the general comments, I'll hold there and maybe come back to some more detail if we have the time.

MR. ADDY: Another peer review.

MR. RICE: See, a lot of this still deals with the overall energy balance of a lot of these fuels and how you compare which fuels are beneficial from an energy point of view. There was some evaluation, again pretty much looking at the issues of particulate emissions and things like that.

But in looking at some of the fuels that have gone through the recent multimedia assessment process, again it's some of the things that cause a little bit of heartburn are things that are unique to that individual fuel.

For example, there was a fuel that was recently evaluated that combined water, 20 percent by volume water. It was a diesel/water emulsion. And water's a wonderful oxygenate, so it really reduces the particulate emissions. But in order to get your water to stay in the fuel you had to do some fancy chemistry with it. These additives. Well, it turns out if you're putting this stuff in the tank and it gets out, now we're not so much worried about diesel, diesel's pretty biodegradable.

It's these interesting additives now that you put into the subsurface. And that may be the same thing that goes on with biodiesel. I think the French regard biodiesel almost as a food, it's a food product. It's derived from food oils.

But in order to make a fungible product you have to put additives, because biodiesel is very biodegradable. You put it in your tank it has a short half-life, a short tank life.

So in order to quench the biodegradation in your tank you put biocides in the biodiesel. Now, if you're counting on a risk management strategy that says, you know, if I get a tank that leaks I'm relying on the bugs in the ground to chew it up. But yet you're putting a biocide in your fuel. What's that doing for your risk management strategy?

So, it's these ugly little details that come back and are worthy of some consideration.

MR. ADDY: Another reviewer?

MR. FARRELL: Since I missed the beginning part of the day and I didn't memorize all of the introductory material to the studies, it's not clear to me in what way to prioritize the un-do-able amount of work that could be done.

But I suggest that, you know, this kind of goes to the question of what's the study for. And I believe the study is to devise a plan that the state might implement. And there are some things that the state can control and some things the state isn't likely to be able to control. But that doesn't mean that they can't know about them.

And so some issues, as you pointed out, are about drawing boundaries. Some issues are about the regulations or the practices in other jurisdictions. And so my only suggestion actually is that given all these things that we could look at, that the effort to complete this study be focused on those aspects that will provide the most information for the actual decisions that might be made either by the state, or by private interests in the state. And not get too distracted by what could be very important issues, but are for others that really aren't at hand with the folks who are looking to complete the study or ask for it in the Legislature and so forth.

That's the -- prioritization, in one word, prioritization.

MR. ADDY: Alan?

MR. LAMONT: I just had one comment about the electricity assumptions that these go well beyond probably the scope of what would be expected here, but when we look ahead to high penetrations of renewables and, you know, the optimistic view of how the RPS is going to work out, you know, we take the way it's represented here, the renewable generation is shown as a nice even band of generation during the day.

And, in fact, to the extent that we rely upon wind or solar as major components of that, you'll see a much more irregular generation.

And that could affect the conclusions of a report like this in the sense of when either electric vehicle charging would take place, or when electrolysis would take place. And somewhere in the report they did mention the notion that there might some day be time-of-day pricing or real-time pricing that would affect how these things are done.

But it also would tend to affect the mix of generation technologies that we would want to use in conjunction with the renewables.

However, you know, even looking at some of the scenarios that we've looked at, it still leads you to the kind of conclusion that they are relying upon here, that combined cycles would possibly be the marginal generators. So it doesn't really contradict that. But it would give you a different picture and a different picture of how these things would actually operate.

MR. ADDY: Let me, as a point of inquiry, Commissioner Boyd, the issue of electricity generation mix and marginality keeps coming up. And as was pointed out in the first part of the discussion, some of our stakeholders might want to look at that incremental generation coming from resources like coal, taking into account carbon sequestration, or perhaps some advanced nuclear. I wonder what your reaction might be to some of those.

(Laughter.)

VICE CHAIRMAN BOYD: Coal and nuclear aren't in my vocabulary.

(Laughter.)

VICE CHAIRMAN BOYD: I don't want to touch the nuclear question until a lot of higher level policy people wrestle that one. And I don't see it -- well, I'd better not express my personal opinions too much here, but I don't see it in the near term, mid-term.

The coal question is an interesting dilemma, or an interesting question. It is a dilemma in this country since it's talked about so much, and there's such a huge resource, and such interest in using that resource.

I'm guided by the policy principles that we developed in developing our 2005 Integrated Energy Report which kind of established a baseline for what we think should be the greenhouse gas effect of imported electricity, which the PUC has taken to heart and is following through on.

Therefore, coal, you know, will have quite a struggle in recognizing that a former want-to-be chairman of this organization didn't survive over the question of pursuing coal too diligently. I'm not sure how this agency is going to stray beyond its current stated policy.

By the same token we expressed extreme interest in IGCC and carbon sequestration. We held two days of workshops on the subject and we came away, quite frankly, very disappointed in finding that while everybody really likes it, there's not a good idea when it's going to be delivered. And it really hadn't turned the technologically feasible corner.

So I kind of put that along with the study that we're directing, as an agency, WESCARB, on CO2 sequestration, along with the technology needed to turn the corner on cellulosic material.

All in that we need technologies; we don't know when the breakthrough's going to come. And as a believer in the ever-accelerating technological development I still can't quite see when it's going to come.

So I think for those who are going to look at the question way out at the end of the spectrum, you probably need to assume that they're going to conquer the sequestration and IGCC technological issues.

But for the middle term and short term, and the length of my term, you know, --

(Laughter.)

VICE CHAIRMAN BOYD: -- I'm not real optimistic about it. So, I mean that's just a point of view. I don't know if my peers on the Commission would see it the same way, although I kind of think it's reflected in our IEPR findings, to follow along those lines so far.

Maybe it's pessimism, I don't know.

MR. ADDY: Thank you. All right. Any other comment from peer reviewers before I get into questions? Okay.

Now, back to the audience and following the previously established principles, if you have a short question on the materials that have been presented I'll take those questions first. And then I'll get to my list.

Yes, please state your name. I think that is available now.

MR. CAMPBELL: Todd Campbell. Actually I'm not going to be before you as the person I actually came up here for, but actually as Mayor of the City of Burbank. Because the question relates right to what you've just stated, Commissioner Boyd, about IGCC and the likelihood of us figuring out how to do carbon sequestration.

And I'm speaking as a SCPPA member who just did renew a contract in hopes that IGCC, or IGCC and sequestration would work, and then we could rebuild IPP, or actually scrap IPP and do a project correct. But also do probably the largest windfarm that we could possibly build up there to make it a good project.

But given the fact that most of the cities in SCPPA rely 60 percent on this power source, if we fail what does this mean for the electrical market. Especially when we're trying to not only meet existing load but also expand into the transportation market.

VICE CHAIRMAN BOYD: Are you looking at me, or all these experts?

(Laughter.)

MR. CAMPBELL: I'm looking for anybody.

VICE CHAIRMAN BOYD: Todd, you were looking at me, but -- I'd like to hear from some of the other folks.

MR. ADDY: Does anybody at the table have a comment on that question?

MR. LAMONT: I'll offer a few comments, but IGCC and carbon sequestration are, as I understand it, physically possible. The DOE is starting several large demonstration projects, and people have high hopes that they will work.

And if they somehow don't work, I mean, we're all going to be in kind of a pickle. Because we are counting on it pretty heavily for the next century.

But I think it raises another issue in California which we're beginning to talk to some of the folks at ITS in Davis about. But, you know, California has an interesting geology, and the real opportunities for carbon sequestration lie in the Central Valley, and not on the coast where there's a fair amount of population. And as

I understand it, the opportunities in the L.A. basin are iffy. Perhaps you can do it, perhaps you can't. Perhaps you can do a little bit.

So, it does raise some questions about if you're producing hydrogen and so forth, where are you going to produce it, how are you going to move it around the state. It's, you know, awkward to move hydrogen long distances unlike natural gas.

So, you know, some of the questions that we would have that have come down sort of the more micro-questions here, is if you did move to a hydrogen infrastructure and you were using hydrogen fuels, would you produce it in the Central Valley so that you can sequester there, and then ship the hydrogen around the rest of the state or over to the coast and so forth.

So some of these questions come in. I hope they're somewhat relevant to your question. And none of these are particularly well addressed at this point. And they certainly aren't addressed in this analysis here.

MR. ADDY: All right. Alex.

MR. FARRELL: I'm not sure how much time ought to be devoted to a question essentially about electricity in this particular forum, but let me say a few words, if I could, about particularly this problem.

There are a number of different technologies for which we would really like to have the first couple of demonstration plants at full scale delta. You know, in a week or so my team's going to release a study that will talk about this.

It is possible, and probable in my view, that the amount of investment in these sorts of large-scale technologies, to demonstrate them as efficient. It's also probable that government is not well suited to make such investments.

There's a proposal that I heard about the other day by the electric power industry to actually place a wattage charge nationwide or something similar where they would then have a large amount of capital in order to do some of these large-scale demos.

I think we need several -- with the idea, several demos and with the idea that one or two of them are likely not to be economical, though technically they might work. Just will be expensive.

The real challenge is that the alternatives renewables are quite feasible, as well, on a technical scale. They have two challenges; one is cost; and the second is most renewable energy is diffuse, not located where most of the people are, and sometimes intermittent. Which means, almost by definition, the collection systems for them have to be physically very large, and also delivered.

I don't think there's -- and so there's no real easy answer there. And so this is probably not a lot of news to add, other than, yes, we need demonstration projects; yes, we need more R&D. But I don't think that this means that we are necessarily going to be able to find a satisfactory answer in any particular place.

And looking across a wide array of opportunities, you mentioned the large windfarm, for instance, that seems like the right strategy for now.

MR. EGGERT: Just one more quick comment. CCS is certainly potentially a game-changer for electricity production; potentially also for hydrogen production, as well. And not specifically necessarily just with coal. To the extent that you could capture and sequester carbon from natural gas reformation or even biomass gasification that actually potentially achieve negative carbon emissions, basically extracting carbon from the atmosphere.

But I do think that this is something that is sort of much further into the future, especially for the hydrogen portion of that.

But that was actually one comment that we had with respect to this report, was that in sort of the broad array of potential futures, this is one that we think should be evaluated in some detail.

VICE CHAIRMAN BOYD: The only comment I'll make is were that to be the future I think we'd have to mine efficiency even more deeply than we have so far to turn the corner for you, Todd.

MR. ADDY: Thank you. From the audience, again, and, people on the telephone, if you're there, if you have any questions related to the immediate presentation that Stefan gave, you're welcome to ask that question.

Rich, please come up to the mike.

MR. PLEVIN: Rich Plevin from UC Berkeley. About the charts, I recognize that there are an enormous number of parameters that need to be chosen to do these things. There's many pathways for many of these fuels. You could drown in the dimensionality of looking at all of these things and comparing them.

But I think when looking at the charts, or when producing these charts, it's really important to make sure that we're comparing things that are actually comparable and commensurate.

Specifically, the individual pathways could be averages of the way things are done now. They could be today's practices or projections into the future. They can be a specific pathway that we've chosen as the model for what we're going to represent this could be the best possible pathway or the worst possible pathway.

And it's really important that the charts, when we're looking at these, that we compare the same style of analysis for each fuel pathway, otherwise there's the possibility of getting these false comparisons.

And along those lines with the error bars that are shown on each of these, there's two different types of uncertainty associated with those. One is the statistical uncertainty based on kind of propagated uncertainty due to the choices of parameters that went into the analysis of a specific pathway.

But then there's the choice of pathway, itself. You could have chosen the best pathway or the worst pathway. And the difference in the results from that choice is probably larger than the statistical uncertainty associated with the parameters on any single pathway. And I don't think that comes out in these charts.

So, in the end I guess what I'm saying is when we look at these there's a risk that somebody's just going to see the chart and say, oh, that's natural gas, that's the number for ethanol, that's the number for gasoline. And, in fact, it's way more complicated than that.

Thanks.

MR. ADDY: Thank you, Rich. The issue of, you know, uncertainty treatment and expressing some of the results by ranges is very much an issue that we are kind of grappling with.

Any other comment? And then I'll begin to call from my list.

MR. SWEENEY: My name is Mark Sweeney and I'm here as a consultant representing the

California National Gas Vehicle Coalition.

MR. ADDY: Mark, forgive me, before you go on, I want the comment to focus specifically on the full fuel cycle analysis and the results that have been presented. So, if it's going to stray I will kind of try to bring you back to that.

MR. SWEENEY: Yeah, it's not going to stray. Your prophecy, I think, is misplaced.

MR. ADDY: All right.

Stefan, I've got a --

(Laughter.)

MR. SWEENEY: -- question for you regarding the information on slide 15. And as I recall, you mentioned that the well-to-tank emissions associated with pipeline gas were mostly coming out of natural gas processing plants.

And I would think at the margin natural gas production, pipeline gas supply is going to come from dry gas fields and not from associated gas fields because of the declining domestic oil production. And associated gas is produced in association with oil.

But if it's dry gas, which essentially is pipeline quality gas, I don't see how there would be processing plant emissions for marginal sources of pipeline natural gas.

So I just have a question about what the assumption is about the mix of associated dissolved versus dry gas is in your kind of marginal supply for natural gas.

MR. UNNASCH: Yeah, all of the processing, gas processing emissions, I think they're based on U.S. aggregate statistics. And I think they, by and large, reflect dry gas.

And, you know, on the margin the pipeline doesn't leak. So, if we don't need to build a new pipeline, you know, maybe there are no leaks in the pipeline. And these upstream losses haven't been investigated in a whole lot of detail.

I haven't looked at, you know, what the gas processing plant would look like, but you would think that the leaks aren't going to get any bigger or worse with a little bit more through-put.

MR. SWEENEY: Is that an assumption, though, you can look at again to see whether or not, in fact, you're assuming dry gas production as a marginal source of supply, in which case it would be running through gas processing plants?

MR. UNNASCH: Yeah, I think we should look -- we could look at that more.

MR. ADDY: Thank you. All right, my list. Kate Horner with Friends of the Earth.

MS. HORNER: Again, Kate Horner from BlueWater Network, Friends of the Earth. Thank you for the opportunity to comment on the fuel cycle assessment. We appreciate, like everyone else, the amount of work that has gone into this effort. And do feel that the product is strong. We also appreciate the effort staff has made to invite the public to comment.

We'd like to comment on the issue of sustainability and the importance of including a quantitative sustainability metrics into both the lifecycle assessment and the state's planning process.

Biofuel production, in particular, implicates many new environmental concerns, many of which have been mentioned already. But to reiterate, land use conversions, fertilizer rates, chemical pollution, deforestation and the associated release of greenhouse gases from those carbon. I also appreciated Alex Farrell's addition of Albedo and evapotranspiration.

So, as a leader in this area we think that it's incumbent upon us to lead the way in insuring that there's not unintended or unforeseen consequences, or simply shift California's transportation impacts elsewhere.

I think we're all familiar with the rather notorious example of the Netherlands and their use of palm oil production and the deforestation that it has resulted in.

So, we appreciate that the CEC and TIAX has qualitatively recognized a number of these sustainability issues arising from the increased use of alternative fuels. But to avoid the unintended and unrecognized costs we ask that you actually go further and quantify some of these land use changes associated with biofuels.

And we also ask that these sustainability metrics be taken into consideration when creating the policies that promote alternative fuels. And really, in particular, in the short term, developing quantification for the land use changes and long-term, looking at some of the other impacts of competition with foodstocks that's been mentioned already.

And we do look forward to working with

the CEC and the Air Board and TIAX to get the data that you need to be able to incorporate that into your assessment.

Another issue that we were concerned about is that the fact that the lifecycle assessment limits the review of some pollution impacts, including air quality impacts, to those occurring within California. And we don't believe that California should out-source pollution; rather that we ask that these impacts be included in the lifecycle assessment so that California not only recognizes the impacts amongst the public, but can create policies to avoid those alternative fuels that produce impacts outside of California.

Thank you for your time. And, again, thanks for the work that's gone into this.

MR. ADDY: Thank you, Kate. Al Jessel.

MR. JESSEL: Thank you very much. I'm Al Jessel from Chevron. This is my four to five minutes, is that right?

MR. ADDY: Did you say 45 or four to five?

MR. JESSEL: My four to five. I'm not doing 45.

MR. ADDY: Yes, four to five minutes.

(Laughter.)

MR. JESSEL: Okay. Very briefly, again I want to congratulate TIAX and the Energy Commission for pulling all this work together. This is an enormous effort.

Our focus on it, though, has changed a little bit since the low carbon fuel standard was proposed. And I suspect most everybody's has. And I don't suspect that it was designed from the outset to really serve that particular purpose. So, I recognize, and I think the TIAX people shouldn't be too upset if part of it goes off in a slightly different direction, as we've heard is likely to happen. I think the basis that was laid by this work is going to be enormously helpful in putting the low carbon fuel standard together.

Having said all that, my executive management has told the state in no uncertain terms that we support the low carbon fuel standard. I'm speaking for Chevron. And we were actually at the signing of the Governor's executive order. So we're in it for the long haul. We're going to participate in every step along the way, and that's the reason that I'm here today.

Now, the TIAX report is fairly long and has a lot in it; the GREET model has a lot of different entries in it, all of which need to be reviewed. I don't know how much we're going to be able to do that, but we're going to do the best we can.

We've done a fair amount of review of the report so far, but we're not completely done with it. We do intend to file a fair number of detailed comments in several different areas. I'm not going to try to do any of that today, but I will describe some of the broad categories that we found, areas that we think do deserve some comment.

One is in the area of refinery efficiency and some of the inputs that go into modeling petroleum refineries. The report that was used by TIAX, as I understand, was a -- report which dates back to 1999. A lot has changed inside refineries.

In our WSPA briefing yesterday I think some of that came out. I know that TIAX is looking for some information on the way that refineries run right now, and we're more than happy to help supply that so they can get the report up to date.

One of the things that I was talking to Mike McCormick out in the hall about a little while ago is why those inputs aren't as accurate as they ought to be right now, and I think one of the reasons was just a process issue. And that is there was no real refinery work group; there were work groups for ten other activities, but no real refinery work groups. So there wasn't the give-and-take in the process that we have for some of the other fuels such as ethanol, a work group that I participated on personally.

So I think there's some room for getting more accurate refinery information in it. Particularly hydrogen consumption was mentioned yesterday; and our people picked up immediately on some of the TIAX assumptions, and we think we can do better.

Chevron has experience in hydrogen. We've built two hydrogen stations here in the state. So we have some interest and some new numbers, I think, for some of the assumptions that were made in the hydrogen analysis, as well. And we'll bring those forward.

We have same concerns about the

electricity mix. But let me put that in a slightly different perspective. The low carbon fuel standard is going to depend on a carbon-per-Btu standard, which is going to be adjusted -- tell me if I'm wrong, folks -- by the greenhouse gas benefit or detriment of a particular fuel.

And it's going to be used to drive behavior; to have obligated parties put alternative fuels out into the environment which reduce carbon content.

So one has to be very clear about how you use the lifecycle analysis. And just assigning the best power to electric vehicles, if that were to go into a compliance standard and compliance calculation, might drive behaviors the wrong way. Because the electric vehicles, when they plug into the wall, they're going to get the mix. They're not going to get just the clean power. And you don't want to over-stimulate a technology which might then rule out some other technology that could do better.

And that just goes to the difference in working with a marginal analysis and with the regulatory standard that's been proposed so far. It's a different structure that I think we all need to keep any eye on.

Biofuels. I guess what I want to say about biofuels is that as somebody who has been subject to three depositions in the MTBE lawsuits, I think it's really important for the state and for the people, looking at the different possibilities for different fuels out in the environment, to understand that we've had this experience. That any kind of fuel additive -- and I applaud Dave Rice's comments here; he's sort of alluded to it several different times, I'll go right at it -- anything, any kind of fuel additive that dissolves in water, moves with water, is going to have to get an awful lot of scrutiny from the state before it's allowed.

And we already know in the ARB's regulations for gasoline that all oxygenates except ethanol are, in effect, prohibited; and have to go through a special process before they can be allowed into gasoline. And that's for environmental purposes.

So, when we do lifecycle analyses on DME and methanol, which are included in this report, somehow in that lifecycle analysis has got to come up the concern which drove MTBE out of gasoline.

I don't really see that in the TIAX report.

MR. ADDY: Here's the one-minute warning.

MR. JESSEL: Okay. Storage and distribution. We think we need some updates on that. And I'm sure ARB can supply the TIAX people with some updates on what's happened in the storage and distribution emissions.

E85. We commented through the ethanol work group not too long ago that there's one complication with E85 that doesn't seem to have gotten into the TIAX report, and that is the fact to meet the standard, to meet the vapor pressure standard for E85, one has to pump the vapor pressure up. There's a third component which must be brought to the terminal before you can actually make E85. And that is our experience here in California in the demonstration program that we're now cooperating with Caltrans, CARB, GM, Pacific Ethanol, that demonstration program has proven that that's absolutely necessary. That energy cost and the distribution, the logistics train is not accounted for in the TIAX report at this point.

Last, but not least, we talk about the

70/30 aspect of this report and all the consultants have sort of agreed that 70/30 is where we are. I just have to ask Mike Scheible, 70/30 good enough for regulation?

(Laughter.)

MR. JESSEL: And you can call that a rhetorical question --

(Laughter.)

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Well, probably at times it probably ends up being good enough.

MR. JESSEL: No.

(Laughter.)

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: I didn't say this time, but --

(Laughter.)

MR. JESSEL: I'm not going there.

MR. ADDY: Thank you, Al.

MR. JESSEL: Thank you.

MR. ADDY: Just a comment on the issue of the vapor pressure and the effect on supplies for E85 in California.

Al, is that a fuel cycle analysis issue or is that something that affects supply and movement of that, and the availability of that fuel? As I recall, from the conversation --

MR. JESSEL: Well, I think anything that affects the supply and movement of a fuel is going to affect the greenhouse gas emissions from it. So, I think it does need to be included. You've just got transportation emissions, but you also have a new refinery product that's got to be transferred and blended, so, yeah, --

MR. ADDY: Okay, I just wanted to clarify it.

MR. JESSEL: Yeah, okay.

MR. ADDY: Thank you. Mike Eaves of the California National Gas Vehicle Coalition. And, please, my five-minute rule.

MR. EAVES: Five-minute rule will be fine for me. I'm Mike Eaves with the California NGV Coalition. I'd really like to commend the Commission and TIAX, the contractor, for doing a yeoman's job, and actually doing some original work in modifying the GREET model for California.

I have to admit that there's probably one-half of one chapter in the well-to-tank deal that I failed to read, but I've been consumed over the last couple of weeks looking at it. Not only from the perspective of natural gas, but I wanted to see how -- what kind of detail we were going in for the other fuels so I could appreciate some of the issues with natural gas.

One of the things that, after going through those 450-something pages, you always look for the bottom line. I looked in the well-to-wheels, the final report in section 3, where they talked about the benefits for each of the fuels. And there's some figures in there for each fuel that tries to capture a summary of what they're trying to say, what the greenhouse gas impacts, what the energy requirements are.

And one of the things that I noted for natural gas was that in the summary table there are two ranges of efficiency for light-duty vehicles, two ranges of efficiency for heavy-duty vehicles and greenhouse gases. There are tables of values in the appendices that don't give any of those numbers that are in the summary. Even Mike Jackson today, in his presentation on slide number 33, his numbers were different than the numbers that were in the summary.

But I think that everybody has a tendency to want to distill this down to one number, one page, one figure, one chart. And we couldn't trace all the precedents on how that number was generated. So I think a little bit more needs to go into it.

And I really do, after listening to the presentation today, recognize that we're talking about averages of averages of averages, and lots of assumptions. But the stakes are pretty high. I mean we've been engaged with the low carbon fuel standard, trying to look at the potential of generating greenhouse gas credits on the heavy-duty side, which is our primary market in California.

Mike has, one of his final slides said that the alternate fuels had moderate or no benefits in urban buses, you know, somewhere up to maybe 20 percent. Twenty percent's pretty significant when you're talking about vehicles that consume 30 to 40 times what an average, you know, passenger car does in terms of a year.

And so 20 percent in terms of tons per year on what it can provide to meet goals for California is really substantial. And I hope that's not lost in the final assessment.

But, like I say, we are -- one other comment was in natural gas there's North American supply of natural gas and there's offshore supply of natural gas. I'd like to see it -- it's considered as two different paths -- I'd like to see that considered like the blend fuel analysis that talks about additional ethanol content going up to 10 percent or whatever.

Because the reality is it's not an either/or situation for natural gas. Natural gas in California, even if there are LNG imports, will only be impacted on offshore greenhouse gases by the blend split of LNG to domestic sources.

So, that leads you to a different number and a different conclusion, especially seeing how LNG might be, you know, 15 to 20 percent to the mix in the next, you know, 15, 20 years. So we'd appreciate that being considered into it.

But we will work and meet your deadline to provide additional comments, and work with staff. But we appreciate the efforts here. Thank you.

MR. ADDY: Thank you, Mike. And I want to acknowledge again, like many of the stakeholder groups, you and your team and people from clean energy, PG&E, Sempra, SCE have been very responsive to our need for additional information.

And you've been supplying that, so we appreciate that.

Mike Jackson, did you want to comment at all on -- a lot of Mikes -- Mike's observation that there's a difference in the numbers that you showed on slide 3 of the presentation this morning and numbers that might be in section 3 of the report? Is there an explanation, or do you want to skip that?

(Laughter.)

MR. ADDY: Sorry, Mike.

MR. JACKSON: I think that falls under the category that it was probably done late one night.

MR. ADDY: Okay.

(Laughter.)

MR. ADDY: We'll give you that pass. All right, Gina Grey. Is she here? Is Gina here? Oh, good. And, again, I want to just acknowledge Gina bringing together over, what, 20 people from your industry, or close to 20 people from your industry yesterday?

MS. GREY: Was it that number? I wasn't aware.

MR. ADDY: Well, it was quite a

representation. Again, we appreciate the opportunity to dialogue with that industry.

MS. GREY: No problem, thanks.

MR. ADDY: Five minutes.

MS. GREY: Good afternoon, everyone. My name is Gina Grey and I'm here representing the Western States Petroleum Association.

We do appreciate the opportunity today that you, both the CEC and ARB, has provided to brief both public and industry on TIAX's work, and allow us to ask some questions.

And I think I'd like to echo, I think it was Mr. Modisette's comments, in the sense that the TIAX analysis is potentially extremely important to both future legislative as well as regulatory development in the state.

Therefore, the entire set of documents, as well as the GREET model, which we've heard today has been modified, really needs very thorough analysis and review.

As you know, it's difficult to review several hundred pages, a very complex work, that's taken, I guess, the agency about a year or so at this point to produce, in a very short period of time. We are in the process of trying to hire some help to help us critique the documents. And actually we're affectionately calling all the documents the stack at this point.

And we sincerely hope that the process will be amenable to accepting our future input. And that revisions and corrections will have a chance to be incorporated.

And I guess to that point, I think, Jim, you mentioned March 16th as the date that's on the books right now. Unfortunately, that is not going to be sufficient. And we mentioned this yesterday. I think at least till the end of March is what we're looking at for our input.

And I guess respectfully I would just say that since it's taken approximately a year at this point to produce these documents, and you still have until the end of June, as I understand it, to adopt them or go before hearing. If we were given to the end of March I think that still provides you folks with about three months of internal further work and whatever else needs to take place. So I think a month, or just over a month, for public review is pretty minimal, at best.

We have six brief comments, and then a

couple of questions. And I think I'd like to preface our comments by saying, as I think, Al, you said as well, we note that the AB-1007 process, it did have several alternative fuel work groups that have been working over the past year, but there was no work group on conventional petroleum fuels convened. So much of what we are seeing as an industry in these documents is brand new to us, which also explains a little bit as to why we need a little bit of additional time.

Okay, comment one. One strong recommendation that WSPA has made, and I hate to say how many times at this point, but, me, personally, I made it, I know, during our testimony in the bioenergy action plan; also, I think I also made testimony in October before this group on AB-1007, was that the list of fuels that are being considered, it needs to include renewable diesel. And I think one of the other people also mentioned this today.

And I know people get very tied up with definitions and what is renewable diesel, et cetera. But I think in our minds it is a diesel that's produced from hydrotreating renewable vegetable oils or animal fats. So that's how we're defining it. I hate to use a term like nasty oil, but I think a lot of people can relate to that, so I'll just use that again.

You know, it does have a lot of promise and probably much moreso than some of the fuels that were studied in this report, such as DME, such as methanol, perhaps. You heard some comments earlier today about the commercial status of it.

So, you know, the Commission did initially expand the list of fuels beyond what was included in AB-1007. I think we would just like fair treatment of renewable diesel in the report.

Number two. We understand the GREET model was developed for general scenario evaluation and does not appear in this particular TIAX report to have been treated that way. So, I think that's just a general comment on our part. And when we get a little bit more input by our contractor, I think we'll be able to give you more details on that.

Number three. There needs to be more transparency in the TIAX report, including clarity and data presentation. More detail on greenhouse gas emissions associated with the pathways. And then there also needs to be better documentation, discussion and grouping of assumptions. And then key sensitivities and uncertainties. And I think we heard from several other presenters on this same point.

And I was surprised, actually, to hear from three, I think, -- I may have counted incorrectly -- but three peer reviewers that actually said the same thing, talking about the range of numbers, more work on error bands, et cetera.

And this is something we feel pretty strongly about; and I think we commented in May when we were doing the scoping on this document, that this was something we felt was pretty critical. That, again, the policy people out there were going to be looking for a number or a chart with definitive numbers, saying 48 percent on this, 23 percent on that, without any understanding whatsoever of what the range might be. Of course, they won't know all the assumptions are, et cetera.

So that not only do we recommend that there be much more documentation on what those ranges may be, but that those be put into the front end of this document, or whatever the executive summary is, so that the table that appears in that executive summary that will say the 48 percent, or whatever the ranges, will also have a lot of other words that describe what the sensitivities are, that people don't just focus on those particular numbers.

Comment four. How am I doing on time? Some assumptions --

MR. ADDY: You got one minute.

MS. GREY: Okay. Some assumptions within the GREET model appear surprising, like the assumed refinery efficiencies. I think Al mentioned this. Also the energy allocation for the production of various fuel types within the refinery seems unrealistic. And we're going to review those. And as Al mentioned, we will be getting back to you on that.

Comment five. Several key years, such as 2012, are in the analysis. And we aren't sure that all of the work is consistent in terms of deriving information for these particular key years. And, again, we're going to be trying to check on that.

I think we also heard from the peer

review team that land use issues, and we've heard this from some other people, are not fully addressed. And we think this is a critical gap in this. Even though it may be very difficult to gather more information at this time, hopefully people start to try to address this a little bit more.

And overall, we find the multimedia evaluation discussion in the TIAX document to be very lacking in completeness with respect to alternative fuels.

Two questions at this point. And I know, Professor Farrell, you attempted to describe this to the group, but I think we are still a little bit unclear how the state sees the AB-1007 response to legislation effort and the Governor's low carbon fuel standard effort, and the ongoing regulatory process.

How are those merging or not merging? We assume it's a goal that they're going to merge. And we'd like sort of a clear answer, if possible today, on the record, for how these two efforts are going to be integrated.

And, again, I think you mentioned earlier that the general sense is that the TIAX analysis is really meant to sort of screen alternative fuels. And then it would be provided as an input to the low carbon fuel standard work. But we're not too sure if that's exactly the case. Or is the TIAX work being viewed as sort of the discrete element?

And I think another element of this is the low carbon fuel standard in our members' minds is needed to be done on an average basis. This was done on a marginal basis. So, you know, those types of questions are swirling around. So if anyone can provide a little more clarity on that, we'd love it.

And last question. The AB-1007 document required the plan to address how to increase alternative transportation fuels while insuring no net material increase. And I noticed on Kingsley's chart earlier that that said it was being reviewed. But if anyone here would like to take that one head on and tell us what no net material increase in environmental impact is, we'd love to hear it.

Again, appreciate the opportunity, and we are going to be offering more specific comments as soon as possible. But, as you know, if you already read them, and Jim indicated he'd actually almost read them all -- I'm impressed -- the work that's in these documents is very complex, very lengthy, and we do need additional time.

Thank you.

MR. ADDY: Thank you. Let me provide some guidance on how I'd like to treat the questions and maybe the comments. If it is okay with the group, I would like for us to put the question about how the AB-1007 full fuel cycle analysis interacts with the LCFS perhaps towards the end, if that's okay? Is that okay? Okay. So, we'll address that particular question.

But if anyone at the table wants to comment about some of the other issues directly related to the full fuel cycle analysis and AB-1007, I'd like to get those thoughts.

And then I'll make a comment about the list up here.

VICE CHAIRMAN BOYD: I only want to make the comment that I sure as heck haven't had a year to deal with this stuff. I've had a few weeks. I don't know if the rest of the staff may feel that way. The contractor has been working very diligently, like crazy, for months, I'm not sure a year, to do their piece of the work and we're all sitting here today having perhaps just barely read it and review. And this is a workshop.

The only other comment I want to make is you said we have till June to finalize this. I mean that was the -- that's what I inferred from the statement. We have till the end of June to prepare the entire alternative fuels plan, of which this is just one component.

The significance of this component is significant. And although McKinley deferred the issue to later in the day to have a greater discussion on, I tried to acknowledge in my opening remarks that the AB-1007 plan is what we're dealing with today. And as you said -- recognize the work that was being done on this full fuel cycle analysis obviously becomes a major piece of work that the low carbon fuel standard folks can use. But they can discuss at the end of the day a little more how that is going to work.

But they are severable, but to coin a phrase I've used before today, they are obviously joined at the hip in some way.

But, you know, we will use it differently than they will use it with regard to just giving the Legislature and the Governor the alternative fuels plan that they want. Which, as I said at the beginning, was really to address the major issue of diversifying our fuel portfolio for transportation, reducing our dependence on petroleum, and trying to begin to bring alternative fuels, therefore other fuels is the definition of alternative here, into the California mix of fuels, in as benign a way as possible with regard to the economy, the environment, and what-have-you.

MS. GREY: Thank you, Jim. And just to clarify my comment on the year, I think what I was referring to is the fact that I think the scoping document came out perhaps in April and I think there was maybe a May, I'm trying to remember, there was an IEPR thing that came about the same time. But, anyway, basically --

VICE CHAIRMAN BOYD: But that's in relation to the entire plan of which this is but a small component.

MS. GREY: Well, correct. But it's just been almost a year in terms of actual work in the two agencies to develop up to this point. And I was just putting it in context that since you've had almost a year of developing this, and there's, certainly I think everyone would agree, a large stack, again, of documentation, that to allow the public and the affected industries a couple of weeks or so is just, it's really inadequate.

So we were just requesting if, at all possible, to extend it to the end of March which hopefully will still allow sufficient time on your side to do whatever needs to be done.

MR. ADDY: Commissioner Boyd, if I may? I'd like to just say that perhaps we'll take your request into consideration, Gina, at this time. But leave the date that we've set out there. And we will work with the industry as much as we can to see how we can incorporate your future comments as we move forward. Is that okay?

MS. GREY: Fair enough.

MR. ADDY: Good.

MS. GREY: We'll be in touch.

MR. ADDY: Thank you.

MR. OLSON: McKinley, I'd like to add one other thing.

MR. ADDY: Yes.

MR. OLSON: We also need to look at your request on the renewable diesel. I think that would be a priority in our mind. We do have the -- we had planned in advance that we would be open to doing additional analytical work, and I think that's going to be a priority.

MS. GREY: Okay, I really appreciate that.

MR. ADDY: I also wanted to -- Gina, also for your information, I think as part of the biodiesel and the x fuels working group that my colleague, Gary Yowells, is heading up, renewable diesel is a part of the option. Perhaps we just didn't look at that in the full fuel cycle analysis. But as part of the AB-1007 portfolio fuels being considered, renewable diesel is in there.

MS. GREY: Thank you. And I think just the fact that the fuel cycle analysis will probably be utilized in many different venues, including LCFS, it's important in our minds that that be included as an element.

So, again, very happy to help, provide you with information.

MR. ADDY: Okay, thank you.

VICE CHAIRMAN BOYD: I want to agree with the staff on that point of renewable diesel, that that is a good point. And I know, for one, this agency, and I know for one, this Commissioner, has done battle with folks over the definition of biodiesel, diesel and in the Legislature last year we got into it pretty deep on what constitutes biodiesel. I thought it was a generic term; it's almost a copyrighted term.

MS. GREY: It is a copyrighted term.

VICE CHAIRMAN BOYD: And there are different kinds of synthetic diesels. And the point is a good one. We have been very supportive of the whole gamut of biodiesels, even what we might call synthetic diesel. And we may have to scurry on this one, because it is going to be debated, I'm sure.

MS. GREY: Thank you very much.

MR. ADDY: Thanks, Gina. Okay, let's see here. Gary Herwick has a short presentation.

MR. HERWICK: May I use that since I've got --

MR. ADDY: Surely.

(Pause.)

MR. HERWICK: Thank you, McKinley. First I want to -- I'm Gary Herwick with Transportation Fuels Consulting, and I'm here on behalf of the Renewable Fuels Association and the National Ethanol Vehicle Coalition today.

I want to compliment TIAX, the contractor, Mike Jackson and his team, and the Energy Commission and their team for this huge undertaking, for this amount of work. And, you know, I say that from the perspective of one who participated in the GM and Argon National Laboratories well-to-wheels study starting in 1999 and going through 2005. And so that's a personal compliment, as well.

I don't think we need to go through that; I'm going to skip through this quickly. The key elements of the contractor report, those are obvious. The marginal analysis is something I want to talk about a little bit. And something with respect to the new and existing propulsion technologies applied to mid-size and urban bus.

So, let's get right to it. I guess, you know, I want to lay out some qualifiers here on these comments before I actually go through them. I can see everybody's reading them already, but I want to say that first of all, since I've only had a brief time to look at this -- we've only had a brief time to look at this, you know, just a couple of weeks, these I would call concerns rather than criticisms, please. So they're not criticisms at this point, you know, they're just laid out as concerns.

And they're also examples of things that kind of caught my eye going through to kind of, you know, to talk about a couple of issues. And I've already heard several of them raised by the peer review group.

First of all, the marginal analysis, you know, is a concern that I've heard raised before, and certainly is one of mine, as well. To me, from my perspective, it's highly dependent upon the supply contribution of each of the alternative fuels. And that wasn't clear to me going through the report, what the contribution of each of the alternative fuels would be to the 30 percent petroleum displacement to the overall supply growth.

And also with respect to technologies such as PEVs, plug-in hybrids and electric vehicles, you know, marginal analysis could result in the distortion of the advantages, disadvantages of some of those technologies. Coming out with the wrong answer, if you will.

And, again, concerns rather than, you know, rather than criticisms here. There could be things that I don't understand because I haven't had an opportunity to get through this entirely.

You know, it appeared, and I already heard raised, that there was inconsistent application of the boundaries to fossil fuels and non-fossil fuels, and to petroleum fuels. That's a concern to me that these fuels -- it may make it difficult to make direct comparisons between the fuels.

And some of the assumptions which caught my eye, particularly after having been a part of the GM well-to-wheels thing that I participated in several years ago, the new petroleum fuel supply, the marginal petroleum fuel supply was assumed to produce no additional refinery emissions. And yet ethanol plants, if they were going to be located in California, as an example, would have to offset their VOC and NOx emissions.

Now, you know, I heard something in the earlier presentation today that indicates perhaps that's equal. But I'm not sure of that, and that was not clear to me to start with.

Blended fuels were also applied to the

entire existing fleet, which is older technology; whereas the new fuels were applied only to newer technologies. It seems to me that that sort of makes an apples-and-oranges comparison there, you know, between the different fuels.

It wasn't clear to me, either, in looking at the report whether all the new, that is the marginal corn and cellulose-derived ethanol was assumed to be produced in California, or if there was some of that imported. That was not clear to me; I couldn't figure that out from the report. Perhaps, again, that's because I didn't spend enough time with it. But I intend to try to do that.

And the electricity generation issue has already been discussed. I just want to point it out with respect to, you know, as an example, just having gone through the GM well-to-wheels process, and I don't mean to pick on natural gas here at all, but you know, looking at the greenhouse gas emissions, as an example of a natural gas fueled vehicle, it was just critical the electricity assumptions. I'm speaking of ranges and sensitivity analysis and so forth.

But using the combined cycle with the

renewable portfolio standard on the top of it would show quite a substantial greenhouse gas reduction from a reformulated gasoline fueled vehicle comparison; whereas, if you look at the GM well-to-wheel study that used a 50 percent, you know, 50 percent coal, 50 percent natural gas U.S. mix. It was about the same as a gasoline-fueled vehicle.

Just a couple of additional comments to kind of point this out here. The source of emission, fuel economy and engine mapping data for the various propulsion technologies was not clear to me. And if there were multiple sources of that data, that was another thing that became clear to us within the GM well-to-wheels study, that you had to have consistently derived data, if you will, in order to have a direct comparison. So that's a concern.

Another example, again not to be picking on hybrids here, but they were credited with lower criteria pollutant emissions that were in proportion to their fuel economy improvements. I, as an auto manufacturer, would not think that that's the case because, you know, it ought to be dependent upon the standard to which the vehicle is certified, rather than, you know, arbitrarily dropping the emission contribution.

And just to kind of point out, even if there were an inherent emission advantage from shutting the engine down, the restart emissions could add and take away that gain. So, something to be considered.

But these are only examples of some of the things that I've been through.

So, summary and recommendation. You know, our compliments to all of the people on this; and also, I think, taking the right approach, that is a full fuel cycle analysis, to evaluate the alternatives.

It's obviously a complex, highly dependent analysis upon assumptions, boundary conditions, fuel economy, emissions and fuel production data for which there is very little data available in, you know, in some cases.

So, it's difficult. And I think what this points to is that there should be adequate time allowed to take full consideration of this report. Fifteen days, as I understand it, to March 16th doesn't seem adequate to me. I would go along with Gina's recommendation hopefully that we could go to the end of the month and allow adequate time to fully review this.

Thank you very much.

MR. ADDY: Thanks, Gary, for taking the time to share these thoughts with us. I'm going to say something that's not targeted at you, but I've encouraged all of our stakeholders to take the time and read all 476 pages of the report. Because what I've found is many of the comments that we've heard are, in some ways, addressed in the report. But we'll take these into account, and then talk with you again after some additional review of the report, of the documents that are out there.

I also want to comment on the issue of adequate time. We are going to take your requests and concerns into serious consideration. But I'd like to share with you the tank-to-wheels report has been out on the street since about the end of January. The well-to-tank report has been out there since about February 22nd, I believe. And then -- I think before that, even; before that.

And then the well-to-wheels report was released February 22nd.

Where I'm going with all of this is if

you take into account the dates that the reports were released, through March 16th, and since the well-to-wheels report is really a summary of the combination of results in the well-to-tank report and the tank-to-wheel report, stakeholders should, I think, have had a good amount of time to be able to look at what we've done. And then be able to work with us on the schedule. I'd just like to leave that as a thought for you.

Anybody at the table wanting to say something about that? Okay.

MR. OLSON: Not about that, McKinley, but I'd like to also remind everybody that the Air Resources Board was a significant player in this, providing money and lots of staff time. And I think we need to reflect that in our cover of the report, too, so that their name is on that.

MR. ADDY: Oh, yes, yes. Okay, Luke Tonachel from the NRDC.

MR. TONACHEL: Thank you, McKinley. Good afternoon; my name's Luke Tonachel with the Natural Resources Defense Council. I had an encouraging feeling on the way here, and that started with my Amtrak ride up here. Fortunately I was on the train before you, so I didn't get stuck.

(Laughter.)

MR. TONACHEL: But, as we were cruising along the Carquinez Straits I looked out the window and there was a large ship. I don't know if it was a tanker, but it looked like a tanker. But what was encouraging about it was not that it was a tanker, but on top of it were these wind turbine blades that were like a third of the length of the ship. And I thought, okay, that's the right direction.

Also what I'm encouraged by is transparency in this process. So, from the very beginning, meeting with the Energy Commission, the environmental coalition has been saying, you know, we needed to have transparency. And I don't think this is just a point of the environmental coalition, but all the groups have been saying we need this transparency.

And I think with what's been presented here and the use of the GREET model, we have an understanding of the methodology, we have an understanding of what the assumptions are. We may not agree with all the assumptions, and there's always room for improvement. And I know, for example, Richard Plevin provided some comments in the attachment with Dr. Farrell's comments on ways that the transparency can be improved. And I certainly encourage that.

But what this shows to me is also that the CEC is building a capacity to do this analysis beyond this one report. And I wanted to point to that and point a little bit to the future, in that I think what this capacity, and I know that there's an RFP out there to sort of get the training within the CEC, you know, we're going to have to consider more feedstocks. Some that we don't even know about today. We'll have to consider more efficient processes.

As we develop the low carbon fuel standard we'll have to get more precise quantification of all this information. And we also need, in the future, to tie in more sustainability criteria.

So now that the capacity is being developed at the state level, I would encourage us to -- or encourage you to put forth sort of a methodology for the public and the stakeholders to continue to put into that process and make sure that this doesn't end with the 1007 report.

And that we continue to have a peer review function, as well. I think that that's been a vital part of this, for the credibility, and for catching any errors within it.

Finally, the next step being the story line development. I thought that Mike Jackson and Stefan Unnasch's presentations where they sort of bundled up some of the information, and also pointed out some of the key concerns in each of the different areas, having that upfront in the report is going to be very helpful in developing the story lines. Because that's, you know, we have to have that sort of big picture so we can get into how do these things all come together.

Because if you look at 49 or 59 different scenarios with all the different iterations within those, it's very difficult to see how these things can all come together. So, I would encourage that up-front material to be there.

And also, within the report, to identify the actions that need to be taken by other state agencies to help move the process forward. So, if there's things like what was talked about today, as VOCs from LPG, local biomass conversion and harvesting and the emissions that come from that, NOx from biodiesel, prices for food issues, shifting ag land, dealing with these and making sure that we have the environmental protections in place so that we don't make any problems worse as we pursue these alternative fuels. It will be coordination beyond just the CEC and ARB. It will involve other stakeholders and other agencies.

And so I encourage, like it was in the bioenergy action plan, there was a list of things there that other agencies needed to act on to make sure that we could move forward in a sustainable way. Thanks.

MR. ADDY: Thank you, Luke. Ed Harte from SoCalGas.

MR. HARTE: Good afternoon. I want to thank you for the opportunity to comment on this report; and want to thank TIAX and all the various stakeholders in their efforts in producing this.

Had one basic comment and that had to do with the full fuel cycle assessment report, which is basically the summarizing document that I believe most people will be referencing when they're comparing the various fuels.

And echoing Mike Eaves' statement

earlier, we're particularly concerned about table 3-11 which summarizes the greenhouse gas impacts from natural gas vehicles.

When we first reviewed the report we took a look at the tabular data and attempted to replicate those impacts. And we were unable to do that. A portion of it we were, a portion we were not. And what we concluded is that there must be some sort of an error somewhere. And we believe that the table 3-11, there was simply some sort of an error. So we would request that particular table be reviewed; and if the information is incorrect, that it be corrected.

I believe in Mike Jackson's earlier presentation he reflected numbers similar to what we came up with. I won't go through all the numbers right now. They are included in the comments that we submitted earlier today. I would simply ask that those comments be reviewed and integrated into the final version of the report.

Thank you very much.

MR. ADDY: Thanks, Ed. Before I call the next person on our list I want to just acknowledge again the efforts of Jamie Knapp and the entire environmental coalition for making themselves available and meeting with us, I think about three or so times. They have shown a great deal of interest in this work, and whenever we convene a meeting with them the whole entourage of them showed up.

Nalu from Lawrence Livermore National Lab. Before Nalu talks, I want to also mention two people from LNL that were helpful in putting together the peer review team, Jeffery Stewart and Annett McIntyre. They are leads at that government lab, and they were helpful in drawing together the staff at the lab to help us with the peer review.

Nalu, are you here? Oh, he left. Okay.

Comments from the table before I ask Professor Farrell to address Gina's question about the interaction of the 1007 report and the low carbon fuel standard.

Okay.

MR. FARRELL: Okay. Unfortunately, Mike Scheible just stepped out and I'd like to now procrastinate for awhile until he gets back.

But let me first say I can say a few things about the study we will do, which is not the same as the regulatory process and the regulations. So, all of the things I will say will be prefaced with this kind of comment.

I guess one thing that I'd like to say is that we have a self-imposed deadline in order to be helpful to the process that is underway by statute, by which the agencies required to act to identify early actions under AB-32. And so that sets the framework for the timing.

And in order to be helpful and useful in the process of the various agencies, including the Energy Commission and the Air Resources Board and others, we have the following timeline, ourselves.

We hope to produce two reports. The first one will make a simplifying set of assumptions and does not address policy issues very substantially. What it will do is it will evaluate the feasibility of achieving a reduction in the global warming impact, commonly called a low carbon fuel standard.

And there's an important difference in character with what we'll do with what folks here have been thinking about. We will not be particularly focused on a table that compares different fuel pathways -- Mike's back -- because, if, in fact, we turn out to be right I will be vastly disappointed. If we are right that means that we have not enabled, or that innovation has not developed over the next 12 or so years.

And so in the study our focus will really be to understand what is the right percentage; what is a reasonable way to think about the global warming impact decreases that the state might achieve.

I have no faith that anyone can predict what will actually happen. But we will talk about what kind of scenarios might result in a 5 percent reduction, a 10 percent reduction, a 15 percent reduction, and so forth. In order to allow the readers to understand what is or what could be, given what we were able to put together in the timeframe we have, a proposed piece of legislation. Which I'll let the agencies talk about.

So, that's our focus in the first part; and we hope to have that study done by the end of April.

By the end of May we hope to have a second study, we're obviously working on both of them at the same time, which will illuminate what issues will tend to be strong in determining the answers to the questions that we just -- what policy issues will tend to be strong in determining the answers to what a low carbon fuel standard might look like.

So, for instance, one of the slides that Stefan put up showed, for instance, that the transport emissions of -- frankly, I've lost track, but the transport of the fuels, themselves, in ships and so forth is a pretty small contributor when all things are considered.

Pointing this out and suggesting that in the time and resources that are available focusing on that as an important issue may not be the best use of time or resources. But the big things, most of the big things for greenhouse gases are the amount of fossil carbon that's in the fuel, as well as for fuels that don't have fossil carbon in them. Usually there's a set of, a relatively small set of activities or processes that really strongly contribute to the global warming impact. And so focusing, you know, understanding what those are, where to focus our attention.

And with that in mind, what I think here, the sorts of comments and thoughts that are helpful for our study, rather than necessarily the

1007, is not this is the right number or that's the right number. But these are important factors to consider when you want to calculate this number. We do want to get the right numbers, of course. And finding things like the error in a table, that's obviously something we want to fix.

But for our study we hope, in part two i particular, to identify the policy issues that are going to matter, and the implementation issues. Because we really do want to have something that's quite practicable to suggest at the end; something that can be developed into an accurate type of approach.

And in particular I want to use a phrase that's a little bit of a cliche, but it's quite important in the way we are thinking about the study, we're certainly not going to pick winners in the study. My understanding of the executive order, the comments by people in the Administration, is that not picking winners is an important part of the way the standards are likely to work. It will allow consumers to choose among different fuels if they would like to. But importantly, it allows the suppliers to innovate and compete.

And I think it's those two words, innovation and competition, that are the key words in thinking about what is it about a potential low carbon fuel standard that's going to encourage innovation and competition among fuels to reduce greenhouse gas emissions -- or the greenhouse gas intensity of those.

I think maybe now I'll turn it over to you, Mike, to maybe, if you choose to, to finish up the -- this is responding to the question from Western States Petroleum Association about the relationship.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Thank you. I guess we need to go back and look at what's the AB-1007 report, and then what happens after that's adopted by the Commission and the Board and we start on the development of a low carbon fuel standard are part of our AB-32 implementation, assuming it comes out as an early action measure, which is a pretty -- odds are that that will happen.

AB-1007 report will, at least now, as one element have recommendations about whether the -- strategy link to the low carbon fuel standard. It may have many other policies about what the state should be doing in the area of alternative fuels and how to develop it and promote it.

It will provide a great deal of technical information that carries forth, and hopefully it reaches a conclusion that 10 percent or something better is do-able by 2020. And as we go about doing that, whether or not a little, some or much of that can be achieved early, and what the different routes are.

And also I would hope would give us a great deal of insight and advice in terms of as the Air Resources Board goes about preparing this regulation, here are the additional work that needs to be done, here's the refinements, here's the policies that need to be pursued, and here are the landmines that are out there waiting for you to step on unless you're really careful. So, we'll get all of those things.

I envision and we envision that this, once 1007 is done it will take us most of the rest of this year and most of the next year to get to the Board with a proposal that has all of the analysis and the regulation and the other things worked out. And we have developed a workable format, one that is highly likely, better than

70/30, much better than 70/30, to achieve the goals and the policies put forth by the Governor in his executive order.

And what I see that as doing is setting a standard, setting the rules for measurement how different fuels provided to the transportation sector count in terms of their global warming emissions, carbon impacts and other impacts. Setting any conditions that we think are necessary to insure that other aspects of the environment are protected as we do that.

And setting out how we're going to enforce that, and how people affected by the regulation can comply. And then our job is largely to get out of the way and enforce it, and do corollary things that hopefully the state will be doing to make it successful.

For example, we may well conclude that finding a route to cellulosic ethanol would be very helpful to the fuel providers that want to comply with the standard. And as part of doing that, the state ought to be promoting that in some way, and maybe so that at least a policy's coming out.

I also see it as it doesn't really

matter for a fuel to play in the low carbon fuel standard whether or not it's mentioned in the AB-1007 report. If something comes along that has the right attributes in terms of being a viable fuel, will gain, you know, reduce greenhouse gas emissions and not have other, you know, would be acceptable from the other environmental impacts, then it could come in play.

Obviously those fuels that are mentioned will get, you know, put in the analysis. But we're not there trying to figure out that the way to a low carbon fuel standard is x amount of a certain type of ethanol in E10, y amount of E85, so much natural gas, so much electricity and battery electrics are so much and plug-in hybrids.

We're really there to say we see enough routes optimism so that achieving the standard on this schedule seems to us to be a pretty good bet and do-able. And we don't have to figure out all the details so long as we can say we figured out a way to implement it, insure that the rules are technically correct enough so that we get the result that we all want, which is the environmental performance out of the fuels.

And then let the various actors in the

world of energy supply that can provide transportation fuels use their efforts and innovation to hopefully build more business for themselves.

So that's my answer. And it's not Board policy yet, but since I'm kind of directing much of the program, hopefully I'll make it Board policy by the time we get to the finish line.

And it's going to be a hard job, but I think there's a lot to gain and I'm very heartened by the fact that I think almost all of the industry that's impacted by it, even those that weren't enamored when they first heard about it, will take the attitude of this is something that we got to make work right; and is going to happen; so, let's get together and figure our way through it.

Jim, you have any perspective on any --

VICE CHAIRMAN BOYD: I've said my piece, thank you.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: And our partnership with UC and the Energy Commission won't end with the adoption of the 1007 report, I'm sure. This is going to be a team effort all the way to the end. It's just that the lead forum probably changes a little bit.

MR. ADDY: Okay. Any last questions? Anybody on the telephone? Anybody in the room want -- a short question, please. Or comment.

MR. HUNT: I have a question on the phone.

MR. ADDY: All right, please state your name and your affiliation and your short question.

MR. HUNT: My name is Tim Hunt; I'm with the Community Environmental Council down in Santa Barbara. And I'd like to echo everyone's comments, great job on the report, and also a great job in terms of access to staff of the Energy Commission and at TIAX.

In talking to staff at TIAX and hearing the comments today I want to say I completely agree that the comments made regarding electricity and ethanol, and the need to distinguish the various fuel pathways to get to that fuel when it's used in transportation are very important.

By the same token, the same analysis should be done for natural gas versus CNG versus LNG. And especially for natural gas because natural gas forms the basis for a lot of the fuel pathways for electricity and hydrogen, also. And so when you don't distinguish every time you mention natural gas whether it's natural gas from domestic sources versus LNG versus CNG from LNG or domestic sources, then you tend to compound the effect of increased emissions.

Because, of course, LNG from say Qatar is a lot more impactful in terms of greenhouse gas emissions than natural gas produced in California or elsewhere in the U.S.

So, I'd like to ask, is there the intent to clarify throughout the report, when talking about natural gas, whether it's natural gas from domestic sources, or is it natural gas from LNG or CNG, or from LNG or natural gas, et cetera.

MR. ADDY: Mike or Stefan, are you -- answer that question?

MR. UNNASCH: Yeah, Tim. The analysis in the report, as you point out, is based on North American natural gas as the feedstock for all of the other fuels. So, you know, it's pretty clear we can do it in the case of CNG. If you think LNG is part of the mix, you just average the two numbers at the ratio you like.

But to the extent that natural gas provides the fuel for an ethanol plant or hydrogen, you know, that could form the basis for the sensitivity analysis, but we could address that. So that's a pretty big carbon impact, as you can see in how Mike portrayed the LNG to CNG comparison.

MR. HUNT: Great; thank you.

MR. ADDY: Thanks. Oh, yes, Sam, please.

VICE CHAIRMAN BOYD: McKinley, I think there are a few people you promised more time out there.

MR. ADDY: Okay, let me get Same here first, and then I'll see if there's anybody else.

MR. ALTSHULER: I guess the mechanical engineer in me has to -- is trying to say some things here.

And early on Mike spoke about the work of the analyzing the fuels, and made reference to the efficiency of the engines. And I think that this field work that we have in front of us is very important. But I think it's only about a third of the issue.

I think one third of the other third of the issue is the efficiency of the engine. If you have an ideal fuel but you can only run it in an engine that is half as efficient as what you're using, it doesn't do you any good.

And the other third would be the efficiency of the size of the vehicle, how big a vehicle you're pushing down the road.

So what I would propose is what Mike stated, what TIAX has stated here about fuels and all the attributes, which is an excellent framework, is we start plugging that into the different fuel cycle efficiencies.

And he did that a little bit when he spoke about the plug-in hybrids and the regular hybrids and the fuel cells. Those are all different engine efficiencies. But maybe we should be taking the step a little bit further and taking the optimum fuel and the optimum engine cycle and a few other add-ons.

And to be a little more specific, we have the comparisons of natural gas in heavy duty vehicles versus diesel. We didn't see the hybrid diesel in the analysis, but it's out there on the roads. And it's favorable for greenhouse gases.

If you were to run natural gas in a hybrid configuration and put it in a bus, it would be better yet than natural gas alone or a diesel or a diesel hybrid.

If you take the next step and go to a plug-in natural gas hybrid, you're going to get incrementally better. If you were to take, instead of using a spark ignition natural gas engine and maybe go to a dual fuel engine, and there are those available from Westport that use natural gas and diesel, you'll kick up the efficiency a step further. You could even put in biodiesel into the diesel portion of the pilot fuel.

You know, there's so many things you could do to improve the efficiency starting off with the data from the fuels as input.

And just to go forth, only focusing on the fuel is somewhat analogous to the old childbook story, "The Emperor's New Clothes." You're not telling the full picture to the policymakers.

And that's the engineer in me coming out, that it's more than just the fuels. You got to match it with the cycle. And it's not going to be a one-size-fits-all from buses to passenger cars to longhaul trucks or whatnot. But there's got to be a optimization of the fuels and the engine cycles to get the optimum result.

Beyond that, questions come up in my mind is we talk about ethanol and we talk about woodwaste. Are we better off to make energy, electricity out of woodwaste rather than to make it into ethanol from a total energy perspective. And then maybe use the electricity in the vehicles. I don't know the answer to that question.

The other thing that comes to mind is when we talk about electricity and the future emissions, the electric grid continually gets cleaner as older plants get decommissioned and replaced. And it's a steady ramp down over time we're seeing now and you'll see into the future.

So those are my thoughts as a mechanical engineer traveling up to Sacramento for the day. Thank you.

MR. ADDY: Thank you.

VICE CHAIRMAN BOYD: Sam, I'm just going to say that I agree with you on everything you said.

MR. ALTSHULER: You're a mechanical engineer, aren't you?

VICE CHAIRMAN BOYD: Only partially.

But it's the policy guy in me that overrides all the rest of that.

I mean your point of optimization is good. It has been recognized here in Sacramento, I know, by the Air Board for years. And it's recognized in this agency particularly in the Integrated Energy Policy Reports. We have made those very points.

The trouble is the nation-state of California has a much greater ability to influence the fuel component than it does the efficiency component. I mean in the transportation chapters of the Integrated Energy Policy Report, and Mike can talk ad nauseam, I'm sure, about all the reports of the ARB down through the years, but in the IEPR, as we call it, in transportation we've talked about the three components that affect energy.

And that is the technology of the vehicles, the fuels, and alternative fuels in particular, and the never-talked-about land use in transportation planning integration. And we're trying to address all of those.

We have very little ability to affect the efficiency component as it relates to motor vehicles. We raised that as an issue that needs to be addressed at the national level, since we don't have that authority. Some have tried to distort the intent of the 1493 regulation into an efficiency regulation and have the ARB in court on that point.

And I notice the Legislature and other agencies have now taken an interest in land use and transportation. We may see something going here.

To the extent that maybe we can highlight what you bring out in this report or other reports, maybe that's a good point. But right now we're trying to meet the requirements of a piece of legislation that asks specifically for an alternative fuels plan. And we'll do the best we can there.

On the biomass use question the Governor had asked us for a biofuels plan. We asked him, and explain how you need to talk about bioenergy so you can talk about biopower and biofuels. That is what was agreed to; that is what the bioenergy plan tries to do. And we will try to address the question of what's the best use of biomass. That's a tough thing to dice that out.

So we recognize those issues. They're just tough to deal with from a policy perspective; easy to deal with from a mechanical engineering perspective.

Mike, I don't know if you wanted to --

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Well, we have to address all of that when we look at how do we achieve the AB-32 goals of getting us back to 1990 levels by 2020 in addressing the transportation sector. So, we'll be looking at our 1493 standards and seeing what needs to go on.

Next we'll be looking at the area of how much we travel and how we travel and trips not taken, or trips taken more efficiently are, I think, going to be an important component of the eventual success of that effort.

So, I think we're doing all that; I just don't see how we can expand this particular effort to do it. But we surely should at least put some context in the report that the other things are going on. That this is just one element of a multifaceted approach to transportation.

MR. ADDY: Yes, Pat.

MS. MONAHAN: Good afternoon. I appreciate your attention after quite a long day.

I wasn't going to make comments because Friends of the Earth, BlueWater Network and NRDC made, I think, a pretty cogent set of comments that I agree with.

But since we've been expanding to the low carbon fuel standard, I wanted to make one point about the boundary of this analysis, which really focused on full fuel cycle emissions from light-duty vehicles, from heavy-duty vehicles, but not actually from offroad vehicles.

Mike is well aware of this issue of the low blend ethanol permeation emissions from offroad equipment; and some pretty significant air quality concerns around the use of low blend ethanol in offroad equipment.

And this analysis, I can understand why this analysis didn't address it, but it may be appropriate to have some sort of commentary around the fact that there could be significant air quality impacts from sectors that aren't part of this analysis, and are critical when it comes to developing a low carbon fuel standard.

So, Mike, if you want to respond to that or --

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE:

Well, the impact of ethanol blends on the increase in permeation emission, onroad we're addressing in our coming rulemaking on the predictive model. I think some of the fuel changes are going to benefit and reduce, to some extent, the offroad impacts.

And that's a basecase thing. So long as we have ethanol in low blends we're going to have the permeation issue. And we need to, under state law, address it and somehow mitigate it.

So we're going to carry that forth, and we hope -- we delayed our consideration of the item. We'd hoped to have it in April, and now it's probably going to be in June. And one of the issues was that we wanted to have a better approach to, one, defining how big that problem was, and second, showing all the interested parties what we thought we would be doing about it over the next year or two.

MS. MONAHAN: That's great, thank you.

MR. ADDY: Bob.

MR. FULKS: I stood up anyway.

MR. ADDY: Please introduce yourself.

MR. FULKS: Thank you very much. Commissioner Boyd, Panel Members, my name is Tom

Fulks; I'm here representing to this portion of my comments Neste Oil. And if there were a horse that were laying down on the floor I would be kicking it a couple of times because it's already dead. We've beaten this point into the ground.

But I did want to thank you and staff for your response with regard to the hydro-treated renewable diesel issue. It's very important, not just to Neste, but also to the other client I represent today, which is the Diesel Technology Forum, which is the trade association for the diesel industry. Heavy duty, light duty, components manufacturers and everything else.

And the reason this is important is because it is integrated with the renewable -- excuse me, with the low carbon fuel standard which eventually gets into the AB-32. And if we ever end up with any sort of a cap-and-trade system at all, it is one very potent potential form of currency that sort of binds together the refining industry and the diesel industry to create a market for this biofuel.

Anyway, it goes on down the line. But we're very concerned about the very beginning of the process and making sure that everything is included now because, as I think the fellow from UC Berkeley said, this is the document people are going to be looking at. And they're going to be going, well, this is it.

We've got apples, we've got oranges, we've got pears, bananas and peaches. We've got a bowl of fruit. And this is the official policy on fruit. And that's what it's going to be down the road, is okay, well, you've got your policy on fruit and you're not in it. You're not part of that. And so we wanted to make sure that we were clear on that.

Now, getting into some of the other content, we will be submitting, on behalf of the Diesel Technology Forum, comments by your deadline on March 16th, we won't complain about the timeline. Since we're not that deep of thinkers, we'll just give you very shallow remarks.

(Laughter.)

MR. FULKS: But I did want to pick up on a remark that Mike Scheible, you made about the sort of the call-out in some of these slides on the toxic issue with regard to diesel particulate matter, PM.

Our response to that naturally is going

to be, look, the '07 EPA regs for -- the emissions regulations for the '07 model year and the '010 model year require the PM and all criteria pollutants to be basically the same level as all fuels in all powertrains, so that the PM will be equal.

To call out the toxic issue, it sort of, without that greater context of what the actual emissions regulations are, tends to cause a reader to stop in his tracks or her tracks and say, wow, diesel is a killer. We can't go to that. When, in fact, it is regulated. The industry has been dealing with it. And the PM levels will be comparable to gasoline engines after the '010 model year.

So we would like to really ask the consultants or staff to take a look at the necessity to bring that toxic issue in, when I think you addressed it clearly, Mike, that the ARB isn't necessarily zeroing on that.

And, again, not being a mechanical engineer or an air quality specialist, we'll keep those remarks as shallow as we can until we get our experts involved in it.

The fellow who just spoke about diesel

electric hybrid buses, one of the main points we wanted to make as well is that this isn't some sort of maybe we're going to have a technology down the road and we ought to study it. We ought to study, you know, the squirrel-in-the-cage syndrome, too, you know, spinning the wheel. That's a potential.

But the diesel hybrid buses, in particular, are in service now at Muni in San Francisco, they're in service all over the country. And in terms of a baseline for your transit analysis, it seems to me that you would want to include vehicles that are already on the road, in service. So you've got CNG, you've got straight diesel, but you don't have the hybrid diesels. So you don't end up with any greenhouse gas analysis; you don't end up with any energy content analysis. And you don't end up with the layering on of the potential of using bio in a hybrid electric diesel bus.

And then, again, we'll give you these comments in writing, but I would like to take issue with one of the tables in there. And forgive me, I can't recall what slide it's on. But it is the comparison of fuel economy across the board in a 2012 model year, mid-sized vehicle.

And then you've got basically the fuel economy in a hybrid mid-size being superior to the fuel economy of a light-duty diesel mid-size. This is an emissions compliant, tier two, bin 5, California LEV to emissions compliant diesel.

We would challenge the assumption or the guess, at least that we're seeing in the table, that a hybrid electric mid-size would get better fuel economy than a light-duty diesel. We just don't think that's the case at all.

For lighter vehicles, absolutely the hybrid powertrain is absolutely the right way to go. But for the heavier vehicles, you're going to see a diminution in fuel economy performance the heavier you go.

So, for example, an Audi A6, which I'm driving right now, which is a diesel, gets 43 miles per gallon.

MR. ADDY: One minute.

MR. FULKS: Fine, thank you. I would just like you to go back in and look at the data and challenge some of the assumptions that are being made. And we are more than happy to provide data from the industry to prove the point on the fuel economy stuff and on the baseline stuff.

So, thank you for my time to present my shallow comments and we'll try to get a little bit deeper with our written comments.

VICE CHAIRMAN BOYD: Give us the date. Give us the data.

MR. FULKS: We'll get it, we'll exchange business cards before I leave. Thank you.

MR. ADDY: That's good. But, I just wonder, Stefan or Mike, would you like to comment on why we didn't show the hybrid diesel or even the natural gas hybrid in the medium- or heavy-duty vehicle application in the analysis? As well as the issue of the fuel economy comparisons of the hybrid electric vehicle, mid-size vehicle, to the diesel. And if that fuel economy comparison isn't a well-to-wheel basis.

MR. JACKSON: I'll comment on the heavy-duty side. Stefan, you comment on the light-duty side.

But we probably should include some of the newer transit technologies in that comparison; and I think that's a good suggestion.

So, I don't have anything else to say on that, but, Stefan, why don't you talk a little bit about, you know, your data --

MR. UNNASCH: The light-duty vehicle --

MR. JACKSON: Yeah, the mid-size, light-duty data of an HEV compared to light-duty diesel.

MR. UNNASCH: And, by the way, we do have these cases queued up. It's just a matter of using a pull-down menu; the heavy-duty diesel hybrid is in there. So, the inclusion of cases has nothing to do with our motivation but more the prioritization of the workload.

So, for the light-duty vehicles, and this addresses another commenter's comment, we've looked at the comparison of paired vehicles, that's what we try to do the most often. So, if you look at, for example, the VW diesel compared with the gasoline diesel, it's outrageously good in fuel economy compared to the gasoline pair.

But there's other cases and other modeling studies that show more of about a 30 percent energy economy improvement.

Now, when you look at the charts on the comparison of energy consumption, it's not miles per gallon, it's miles per gallon gasoline equivalent. So, you know, part of the difference between diesel and gasoline miles per gallon is its heating value. So you pick up an extra 10 percent on heating value.

Also, with these hybrid vehicles, for the gasoline hybrid vehicles, there's a huge range, all the way from the light hybrids, which just have a starter motor, to a full hybrid where you might expect maybe a 40 percent -- fuel consumption.

So, I think in the tank-to-wheels report we tried to cite the references including GM's own modeling for these fuel economy improvements. But do recognize that the gasoline hybrids have a pretty big range, and that some of these improvements, you know, you might expect them even through a larger car. And I think there is overlap with the diesels.

So, that's mine.

MR. ADDY: Thank you. Okay. One last round. Peer reviewers, you have anything else to say, final, before I summarize here?

Oh, yes, Alex.

MR. FARRELL: One comment. Those of you who are interested in providing input to the low carbon fuel standard, please feel free to contact either me, directly, or to look up -- there's a website at UC Berkeley, the Center that I direct. And you can send an email. I think there's a way to send an email to that, as well.

We are certainly looking for input, and will be happy to talk with you. Thanks.

MR. ADDY: Okay. Barbara, anything to say? No. Tim? No. Gabe? No.

VICE CHAIRMAN BOYD: Are you talking about closing down the hearing --

MR. ADDY: Yes, I'm talking about closing down now. Before I make my summary thoughts.

VICE CHAIRMAN BOYD: If I made a motion it would be to adjourn to the nearest brew pub, but I don't think that can go on the record. And I know Gabe wants to say something for Jeff. But, let me just say again that I thank everybody for their participation in this process.

Based on the complexity of this issue and the relative -- well, this is not a new issue, but I don't know if anybody's dug this deep in a long, long time. I'm very pleased with the participation, the amount of information, the amount of knowledge we've gained.

I mean there's the age-old problem of too much data and not enough time, and we'll try to address that.

I particularly want to thank the peer reviewers here for their participation in this process. I think this has definitely added to the body of work, and frankly, to the credibility of some of us sitting here, to have you participate in this process the way you have. It certainly helps us with our job and with the product.

And I just look forward to, otherwise I would read up, to the continued work in this area of fuels and vehicle technology that this is just a small example of. AB-32 will force more, the low carbon fuel standard component thereof will force even more.

I mean there's just going to be so much interesting, but complex and difficult, work in this arena that it's fascinating and challenging. And I do, indeed, hope at the Energy Commission that we are building a new body of expertise, as Luke said some time ago, in providing us an ability to deal with this 21st century world of looking at the entire system with regard to the fuel, the vehicle and even its effect on society and sustainability and the ability of us to meld these into our lifestyles.

So, this should prove to be really interesting, and has proven to be that so far. So, thank you all for your participation.

Gabe.

MR. TAYLOR: Jeff did ask me to get on the record his compliment to staff for doing an extraordinary job obviously on a very compressed schedule. And I certainly can't outdo those comments that Commissioner Boyd just said, so I'll leave it at that.

VICE CHAIRMAN BOYD: And let me, by definition, staff means the ARB as well as the -- just because the meeting is here doesn't mean it's been that we've done all the heavy lifting. This has been an extremely well done collaborative cooperative effort. So, thank you, Mike.

DEPUTY EXECUTIVE DIRECTOR SCHEIBLE: Thank you, Jim, and just thanks to everyone to participate. Remember, this is a marathon, not a sprint. Even though we're going to have to sprint to get the technical work done.

Once we get the easy part, the technical work, then we've got to develop good policies and make sure we understand them. And then the real easy part comes, we've got to turn it into regulations that works and is cost effective.

So, keep at it. We'll be seeing a lot of you folks.

MR. ADDY: So, let me close with these. Ashesh Gutam (phonetic) is a colleague of mine at the Energy Commission. I don't know if we could have convened all of the stakeholder meetings without Ashesh's help, and I want to acknowledge him.

We got together today to talk about and present the draft work products from the full fuel cycle analysis required under AB-1007. We shared with you assumptions, methodology; we highlights some of the results. And using the 70/30 framework got a sense from the peer reviewers about their comfort level with the full fuel cycle analysis products to date.

We discussed many issues to show that we were listening to the stakeholders. And we talked about ways we can improve the report and the analysis, given its importance.

The next steps would be to continue interacting with the stakeholders to address the issues you've raised. We will be relying upon you for your continued contributions of data and other resources to achieve the objective that all of us want on this process.

Then we will release the report, at least review the report internally by the two agencies. And then release the report.

I want to thank again everybody for coming and participating. And let's see here, I was looking for my list of stakeholders, but anyway, you know who you are. We appreciate your coming here today and all your contributions.

Thank you. This closes the workshop.

(Whereupon, at 4:00 p.m., the workshop was adjourned.)

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CERTIFICATE OF REPORTER

I, PETER PETTY, an Electronic Reporter, do hereby certify that I am a disinterested person herein; that I recorded the foregoing California Energy Commission/California Air Resources Board Joint Workshop; that it was thereafter transcribed into typewriting.

I further certify that I am not of counsel or attorney for any of the parties to said workshop, nor in any way interested in outcome of said workshop.

IN WITNESS WHEREOF, I have hereunto set my hand this 20th day of March, 2007.