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Session 2: "Biofuels: Continuing Shifts in the Industry and Long-Term Outlook"

Speakers:

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[Note: Recorders did not pick up introduction of panel (see biographies for details on the panelists) or introduction of session.]

Michael: To the EIA-SAIS 2010 Energy Conference. This is session 2, "Biofuels: Continuing Shifts in the Industry and Long-Term Outlook." And certainly, as we drill down into the individual energy sectors, it's clear that, for biofuels in particular, the future is changing. And it has been changing rather dramatically over the last 5 or even 10 years. And certainly, within the last couple of years this industry has grown … technology has been deployed, new technologies are being developed, and there have been consequences as a result of the growth of this particular industry.

As we were thinking about what some of the key biofuel questions would be in the short-term that may frame some of the longer term or medium-term outlooks, there are four basic questions that come up. First of all, what are the carbon emission impacts on biofuels? Are we correctly accounting for direct and indirect impacts of biofuels with regards to food, emissions and other environmental impacts? And as we consider those impacts, what is the implication, with regards to climate change legislation (such as Cap-and-Trade types of programs at state and national levels) of the formation of the low carbon fuel standard? And with that in mind, what does that imply for the present

and the future for renewable fuel standards and other policies that seek to grow this industry, and push it along to even higher levels.

Other questions, which our presenters will address at some point or *may* address at some point, are: What is the future for biofuel tax credits and import tariffs? What are the implications of the Blend Wall and the *[inaudible]* of blends above E10? How will those be deployed? In addition, what are the prospects for cellulosic biofuels technology development, and the deployment of that technology?

We have, for you, a distinguished panel of speakers to address these topics and these questions. We'll be starting with Dr. Peter Gross with the U.S. Energy Information Administration. He'll be followed by Dr. Steven Hamburg, who's Chief Scientist for the Environmental Defense Fund. Following Dr. Hamburg will be Brooke Coleman, who is Executive Director of New Fuels Alliance. And then rounding out our session will be Paul Argyropoulos, who is Senior Policy Advisor for the Environmental Protection Agency.

So, to begin with: Dr. Peter Gross, who is EIA's lead biofuels analyst in our office of Integrated Analysis and Forecasting. For the past three years, he has specialized in biofuels market and policy analysis, as well as biofuel supply projections. He has worked in the areas of: refinery, energy use, the potential impacts of climate legislation within the refining industry, and also, he has done quite a bit of our work in analyzing the prospects for hydrogen production in the context of a hydrogen economy. Peter received his doctorate from Princeton, and has a Master's degree in statistics from Brooke University. Dr. Gross.

Dr. Peter Gross: Am I live? All right. Thank you, Michael. I'm going to try to harp back on the points Michael made in my talk, which is going to focus on projections that we've done at EIA regarding biofuels. So, I start out with some projection highlights, and assumptions behind those projections. I'll give a brief overview of the Renewable Fuel Standard Two mandate, borne out of the Energy Independence and Security Act of

2007. I will then get into specific projection results that we've generated, regarding the Annual Energy Outlook of 2010 Reference Case to start out with. And then, looking at the effects of oil price … the various oil price cases on biofuels projections by looking at the Annual Energy Outlook 2009 price cases. I'll also look at the effect of climate legislation; in particular, runs that we did last year involving a Western marquee scenario climate case and looking at biofuels projections from that. And I'll also look at where the ethanol is going in terms of the E5 and E10, and discuss some future issues (again harping back to what Michael had been talking about).

In terms of the highlights of the projection cases for the AEO2010, we see that biofuels account for most of the projected growth in liquid fuels consumption. The renewable fuel standard is met at about 26 billion gallons in 2022 … met at 26 billion gallons, even though it's mandated to be 36 billion gallons by renewable fuel standard. The shortfall is due to our assumptions that the renewable fuel growth will be limited by the projected ramp rate of cellulosic biofuels, but we say "met at 26 billion gallons" because within the law, as a lot of you may know, the EPA has the authority to lower the mandate if it sees that biofuels supply is not adequate. And this especially pertains to cellulosic biofuels, which the EPA did this year with the Cellulosic Biofuels Mandate for 2010, lowering it from 100 million gallons to 6.5 million gallons.

However, in the long term in the reference case, biofuels *do* become competitive relative to petroleum-based fuels (on a cost-competitive basis in the long term). Also, take a look at oil price comparisons, and not surprisingly, you'll see that biofuels are more competitive in the high oil price case and they are also more competitive under watch from *[inaudible]* as well.

As with any projections, one has to state one's assumptions behind the projections. EIA goes by the mantra of existing rules and regulations behind our projections, even if it seems that these existing rules and regulations will likely be extended, as in the case of tax, credits and tariffs. So, following existing rules and

regulations, we assumed that the blender's tax credit for ethanol (45 cents per gallon) will expire at 2010, as well as the tariff of 54 cents per gallon. We assumed that this cellulosic biofuel tax credit will expire at the end of 2012. We assumed that the $1 per gallon biodiesel tax credit has already expired.

We do make some assumptions about the growth rate of cellulosic biofuels and technology, as well as the rate at which the production cost of these fuels will ramp down. We assumed that ethanol is only going into E10 and E85, even though there is an E15 mid-level blend waiver being considered as we speak by the EPA which will be decided upon this summer. We assumed that all biofuels are assumed to qualify (on a lifecycle basis) greenhouse gas emissions under the RFS2. And finally, we did not include the California low carb and fuel standard in the AEO2010 projection results, but we plan to include it in those for the AEO2011.

Just a quick overview of the renewable fuel standard. As most of you know, it ramps up to 36 billion gallons total by 2022. Of these, 21 billion gallons must be advanced biofuels. Advanced biofuels are those fuels coming from any renewable feedstock other than cornstarch, that meet a lifecycle 50% greenhouse gas reduction, as compared to their equivalent petroleum-based fuel which was measured on a 2005 baseline.

Of these 21 billion gallons of advanced biofuels, 16 billion gallons must be cellulosic biofuels (obviously coming from cellulosic biomass) and required to fulfill a 60% reduction in lifecycle greenhouse gas emissions. And of the 21 billion gallons, we also have a 1 billion gallon mandate for biomass-based diesel, which can either be the FAME-based biodiesel (which is the more traditional biodiesel), renewable or green diesel. And finally, there can also be the BTL or Biomass-to-Liquids, which we project to come online later in the forecast. And it's also a cellulosic biofuel.

The gap between the "Total" and the "Advanced," … this 15 billion gallon gap can be filled by corn ethanol. And corn ethanol, of course, has its limit up to 15 billion

gallons. On to the projection results; as I said, by 2022 in the AEO2010 reference case, we do not reach the legislated RFS mandate, but we do reach the modified mandate (again, with the assumption that the cellulosic biofuels do not ramp up insufficient supply).

However, because of the cost-competitive nature of the biofuels, as the production costs come down for the cellulosic biofuels, they become more competitive with their petroleum counterparts. And we do exceed the legislated mandate by 2035, later in the forecast.

The other thing I mentioned about this graph is that a large portion of our cellulosic biofuels are assumed to come from the BTL diesel substitute (Biomass-to-Liquids, which is a Fischer-Tropsch process creating a diesel fuel, much like Coal-to-Liquids, only using biomass feedstock).

This just re-emphasizes the point about the AEO2010 reference case: the growth of biofuels being the major component in the total growth of all liquid fuels for the AEO2010, going from 4% of the fuel pool in 2008, to about 12% in 2035.

As expected, biofuels do gain a greater market share more quickly under the “high oil price” case. “High oil price” case here being about $200 a barrel in 2000.. In the “low oil price” case, biofuels push up according to the mandate, but after 2022, you see that it flattens … the “biofuels” flatten out. This is because we assumed that, under the existing regulations (although this is yet to be, I think, decided by the EPA). We are assuming, for now, that the “biofuels mandate” levels out or is constant after 2022. Under the “low oil price” case, cellulosic biofuels are not competitive against their petroleum counterparts and hence, you have … and hence, the mandate essentially becomes the binder for the biofuels.

Under the Waxman-Markey case scenario published last year [in the AEO 2009], as would be expected under the assumption that biofuels are considered, the combustion of biofuel is considered to be carbon-neutral. You would have, compared to

petroleum fuels, a greater market share. And this is particularly important because the petroleum fuels obviously are taxed by their combustion. And, as we go along in the forecast, and as the Cap becomes tighter under Waxman-Markey (and therefore, as the allowance prices increases), obviously cellulosic biofuels (which are again carbon-neutral) or biofuels (which are in general carbon-neutral) compare more favorably as the forecast goes on with the reference case.

I said I would mention something about ethanol. Michael had referred to the impact of the Blend Wall. Again, under existing rules and regulations, we do not assume an E15 mid-level blend, no matter how imminent that may seem. And so what happens, as you can see with the red line, is that ethanol is blended most economically into E10, the standard gasoline ethanol blend (mostly with corn ethanol). When it hits the blend wall around 2012, you have a leveling off, obviously of the ethanol going into E10. Eventually though, the ethanol (the cellulosic ethanol in particular) supplies starts to grow. It has to go somewhere; must go into E85 and you'll see it peaks in 2022, dampens a little bit, but (as I explained on top here) that's largely due to the fact that BTL at that point starts to come in to supply pool and provides competition to the ethanol as the E85.

There are a lot of questions surrounding where biofuels are going to go. First and foremost, all those are probably often ignoring what's going to happen with the petroleum refinery industry. They are, after all, the obligated parties in all this. They are facing some anxiety, no doubt, and some questions. What will they do if the midlevel blends or if the waiver is granted for E15? What kind of blend stock are they going to start producing which would satisfy both the E10 and E15 blends? Are they going to try to seek to fulfill their mandates with other fuels, perhaps paralysis oils or biocrudes? I don't know. It depends on market conditions. It depends on what they see in terms of the supply forecast.

There are questions and issues surrounding the biofuel supply. Can the cellulosic biofuel producers achieve their production cost targets? This is especially pointed given the volatility of oil prices, as we've seen over the past few years. What about the development of a non-grain feed stock market, the biomass market? It's largely been assumed to be composed of switch grass, energy crops and agricultural residue, but questions still remain. Is that supply going to be available in the future? And at what price, probably more importantly?

The Brazilian supply. Will sugarcane ethanol become more valuable as the low-carbon fuel standards come into play (as we've seen in California) or perhaps in other states given the low carbon intensity of Brazilian ethanol? What about cellulosic ethanol coming from Brazil? Are the Brazilians in the mood to start investing in cellulosic ethanol for a single US market? Given our history with tariffs, I don't know. Or would they rather see their sugarcane bio-gas residue be put into their power generation needs in the future?

The viability of E85 as an outlet fuel market: this is an important point. Especially, I think, for the ethanol producers. The transition to E85 as a viable fuel, as a substantial fuel, will undoubtedly lead to energy parity pricing for ethanol. The effect that would have on the ethanol suppliers and producers remains to be seen … probably it won't be a very good one. And of course, how are we going to incentivize retail outlets to start pumping out the E85? What would be involved there from the obligator parties, the refineries themselves?

On the policy side, the low carbon fuel standard looms as another big potential future issue. California has already enacted its low-carbon fuel standard. Other states may follow in the northeast, especially in Minnesota, or Oregon perhaps. What will be the carbon intensities of the fuels that those states assign? Will they be similar to California's? Would Minnesota assign a similar corn intensity for corn ethanol that California does? Probably not. If there is a disparity in carbon intensities, what does that

mean for biofuel supply and distribution? Would a national LCFS be resurrected, possibly after restructuring of the first Waxman-Markey draft? I don't know.

Cap and Trade legislations. Michael had alluded to these. Biofuels are assumed to be largely carbon neutral, but will this change from the environmental point of view? Should this change?

And finally, technological improvements are coming around and will be incentivized by climate legislation. Refineries will improve their energy efficiency, and soon too will other biofuels (and especially the corn ethanol industry, if it sees value in that). A lot of questions; maybe not too many answers. Thank you.

Michael: Thank you, Peter. As you can see, in addition to publishing rather detailed projections about the future of liquid fuels, we also have a lot of questions about the *future* of liquid fuels. Next up is Steven Hamburg, who is the chief scientist for the Environmental Defense Fund, and is EDF's public voice for its commitment to science-based advocacy, and is responsible for the scientific integrity of EDF's positions and programs.

Dr. Hamburg has a lot of excellent academic research credentials, as well as having been a leader in the environmental movement. In reviewing his background, you can see that he understands the land as a living organism, and that apparently has directed a lot of his efforts. Dr Hamburg.

Steve Hamburg: Thanks. So, I'm going to take a little bit of a different tack, and I want to sort of examine this issue of carbon neutrality and trying to understand how we need to think about carbon flux as it relates to using bioenergy more broadly. And this becomes important because, if we can't be sure to understand the first principle, the basic biogeochemistry of carbon, we're not going to get policy right. And I'm going to push a notion that right now we have insufficient information to understand the carbon implication of most bioenergy policy as it currently exists, and in most cases as it's being contemplated.

So, I'm going to look at the forest: that's what I know best. But I think it's a lesson that we can do the same kind of scenarios for other sources of material, that can be used for bioenergy. But it's important to think about a couple of factors that have historically not been integrated into the policy framework of trying to understand the implication on greenhouse gas (net greenhouse gas) emissions and those are time … we need to understand time and space. Any biogeochemist who thinks about cycles has to think about time and space, and whether or not they're integrated into public policy or not. That reality exits.

So, if we look at this … and I don't think I've got … I just did the wrong thing. All right. So, we have a landscape, and we can think about it in two special scales. We initially think about as a plot; and we can think about harvesting a piece of landscape, generating biomass and burning it and emitting carbon to the atmosphere. And then, over time, that plot will regrow. These are metric tons, carbon per hectare or per year and we're going to start to reaccumulate that carbon. So there was a large increase initially, and then a slow rate of reaccumulation. And each year, there's going to be a slightly different rate … the function of the environmental conditions. And then, we can sum those over a period of time. And eventually those will equal, but that time period when they're equal will probably be longer than the full rotation link. So, how long does it take to regrow the full biomass, because we don't have a 100% efficiency because of moisture content. Okay, that's on a plot basis.

The industry rightfully would say, "Well, wait a minute. We don't manage plots. We manage landscapes." Correctly said. So we need to then think about this in a broader context. Before we do that, let's look at the carbon from a single plot. On the left-hand side is the carbon emissions over time, from burning that biomass energy versus a fossil fuel. And you'll actually see that the amount of carbon emitted to the atmosphere is greater (initially because of this moisture content and efficiency argument) than burning a fossil fuel. And at some point in time, they'll break even and at

some point in time, you'll shift from having less carbon emitted from the biomass than the fossil fuel. But time becomes important. The answer to what are the carbon implications of using this plot-based approach varies through time. It's not a single answer, which is critically important. And the key other variable and thinking about this is, if we're managing forests that have not been managed up 'til now, the process of managing them will reduce total standing stock of that forest because we're managing it. It's going from unmanaged to a managed state. The total amount of carbon on the landscape on that plot will go down, and the breakeven point will be pushed out in time. The majority of the biomass that we're likely to utilize in the future falls into this category. So we're going to have a carbon equivalency with fossil fuel at some point in time out in the future.

Right now, we do not have sufficient data to answer what that point will look like for the U.S. as a whole (let alone for regions). Individual land owners might, but we don't as a society know where that breakeven point is, and where it will be advantageous. So, there's no way to set good policy until we understand these relationships. But we need to also think about this on a landscape level. We know we have got a whole series of plots feeding that plant, because that plant isn't going to sit idle waiting for the full rotation. You're going to be burning. Let's say it's electric plant: you're going to be burning material at the steady rate.

So again, the question is what is the rest of that landscape doing? You could say it's fixing carbon every year because it's a managed landscape. But, when we add the biomass to the plant, we're either going to reduce the standing stock of that landscape (the carbon stock) or we're going to displace some other product. The problem doesn't fundamentally change, even though we're moving around the landscape and harvesting it.

So the theory that we've all been assuming about carbon neutrality is this one, that there's no net cumulative emissions. Almost in no cases will this be true. If you're

using waste product, it will be close to that line, but it will not *be* that line. That's a *theoretical* construct that empirically we will *not* have in most cases. So we need to get rid of that construct. It doesn't serve us because it gets us the wrong answer.

So, this is closer to what we're likely to see, that the biomass energy on a landscape basis will be emitting at some rate until we've gotten through the whole rotation, and the whole landscape is integrated into this bioenergy system. It's a system. It's not a single plant. It's "utilization plus a landscape" combined, and it's going to cross the fossil fuel line at some point in time. Okay. How long that will take is about public policy. Is that too long, too short? That's not … as a scientist, that's not the decision I should be making, but we need to figure out when that point is, depending on what our assumptions are of how we manage the landscape and we produce this fuel.

Coming up with single numbers about available fuel is not terribly useful. It provides very, very little information to answer these critical questions. Fundamentally, we've been doing the accounting for bioenergy wrong. We've had the simplistic notion of how it works, and the result is we're going to get the wrong answer. We're going to create far more emissions in the short term that we will be assuming don't exist. They will not have the net effect on the atmosphere we want. We will not see the decline in greenhouse gas concentrations. We have to start doing the accounting differently, and we have to start collecting data in different ways. We can, in some cases if we use forestation, actually have negative carbon emissions. So, it's not all one, that's the problem. We have to calculate what these areas are, what the probabilities are, and put them together and then, we can compare it to fossil fuels.

We also have to remember, it's a little more complicated. If we use fossil fuels and the landscape is taking up carbon (because we're not managing it), that's an offset against that fossil fuel. So, what we're seeing here on the bottom on the gray is the uptake of the landscape that's not being managed. And remember, much of the U.S. forest ecosystem is not being managed, currently. And the carbon emissions and the

red line is the net flux to the atmosphere of combining it as a system. What's happening in the landscape? What's happening in the energy production field? That's our net. If we combine those two, we get a different point in time.

So again, the critical thing here is how long does it take. I've left a unit list because I'm not trying to tell you what the answer is and I can calculate … I've done my own first approximation, and I won't even give it to you because I don't think at this point, that's the useful conversation. We can have arguments. I have them with and among colleagues as is, whatever number it is. Let's get the real data. Let's really get this kind of analysis. Where is the biomass? Where is the biomass pit stock coming from? What kind of landscapes are going to be used? Everyone is using different assumptions, and we're coming out with different numbers and it's a tractable problem.

Okay. So, we need more information. We need to know it by fuel type, by region and by sector. What's out there on the landscape? We could use transportation. We can use biomass sheds. We can do it by region, because we have different silviculture or agronomic regimes in different regions so the answers are not uniform across regions. And it matters with fuel type, because again efficiency and moisture content are all going to differ.

We need to understand the conditions under which the biomass was grown. Is it a waste material? Is it a slash from an existing harvest? Or is the material being harvested directly for biomass, for bioenergy? The type of material, we need to understand more about. We will tend to underestimate the greenhouse gas emissions over the next several decades in the current framework. We will be emitting far more carbon than we estimate given the current way we're doing the analysis and we got to change that because we're getting it wrong. It's simply not right, scientifically not correct.

There is no basis for comparing the relative merits under the existing data. We need better data comparing bioenergy, comparing fossil fuels. We need to do it

differently. And we will underestimate (in the current system) the value of the carbon stock that exists in the forest today and will increase. The U.S. is a net accumulator of carbon in the forest but we're not giving it the appropriate value of carbon compared to fossil fuels right now. And we are going to see a lot of leakage because we are going to be pushing that stock relative to paper and wood products, and we're going to be pushing things into other more energy intensive products unless we get this carbon accounting correct. With that, thank you very much.

Michael: Thank you, Dr. Hamburg. We're getting ready for the next presenter. I want to remind you that if you have questions, please write them down on the cards that are available. Our wonderful volunteers would be happy to provide you with cards and pick them up, bringing them up to me.

Next stop is Brooke Coleman, Executive Director of New Fuels Alliance. Brooke has been involved with transportation fuels at the regulatory and policy levels in California and other states since 1998. It's quite clear from Brooke's background and the number of accomplishments to his credit (including his involvement in the national campaign to ban the gasoline additive MTBE) that he is an agent of change. Mr. Coleman is a graduate of Westland University, the Northeastern University School of Law and member of the Massachusetts Bar. Mr. Coleman.

Brooke Coleman: Thank you, Michael. My name is Brooke Coleman. I'm the Executive Director of the New Fuels Alliance, and we're thinking about changing our name to biofuel defenders. I think we spend a lot of our time defending biofuels. I think we're supposed to play the role of the pugnacious *[inaudible]* here. I think we are disagreeing on something but perhaps agree on some others, but I don't want to focus too much on the stuff we agree on because we were told to disagree.

So, I'm going to focus on one particular thing here which is actually ubiquitous through the entire carbon accounting (sort of what we think of biofuels and its land). So, to steal from Keith Kline at Oakridge National Laboratory, he actually pooled a whole

bunch of people in a room and he said tell me your concerns about biofuels and bioenergy. And everybody said what they are concerned about, and it came back “land, land, land” (whether it’s *food* or *starvation* or *rainforest* or *what have you* as land). There’s a whole community of people that would say you’re absolutely wrong. And as a boat owner, I can tell you that they are active and they believe that ethanol and things like that are ruining their boat and small engines. And we can talk about that another day, but we’re going to move forward here. So is the land-use critique valid? Let’s just get right to it.

We’ve basically, because of land, taken a totally different approach to how we understand biofuels and bioenergy. And what I will tell you is the answer is “of course.” There are valid claims about land use and there are completely misleading claims about land use; and so, I’ll start with the valid ones, to be positive.

Land intensification creates impacts in the world economy. There’s no question that that happens. If you use more land for energy, we’re going to create market-mediated effects. Land is a finite resource, no question. Land is not treated dynamically in lifecycle carbon accounting. So this speaks to Steven’s issue. There’s basically this presumption that, because plants absorb carbon, that the stuff that comes out of the stock is going to be absorbed by the plants and we’re going to call it even, right?

And so the principle might be sound, because you actually are recycling carbon in comparison to oil, where you’re pulling carbon out of the ground that’s been there for 10,000 years. But it obviously does not capture the reality that, if you convert a pasture to a bioenergy crop, that’s different than converting a rainforest to a bioenergy crop.

And here come the misleading claims about land use and (just to make sure that we don’t get too friendly here) I would say that some of Steven’s … Steven to a lesser degree … some of Steven’s colleagues are guilty of spreading these misleading claims about land use … Dan came, and Tim is searching … So when they did this initial assessment, they came out and they said all these things. So, using land for energy is a

zero-sum game. That basically means, if you step on a balloon over here, it's going to pop out over there. We don't have things like ending stocks, and oversupply, and things like that in agricultural space.

Second, land is uniquely finite. That rationalizes the focus so we need to do land use impacts for biofuels, but we don't need to do any other stuff on a margin for other fields because this is sort of a unique thing. *Indirect land use change* properly addresses the problem. What's lurking below Steven's recommendation for how to do this fix, is this indirect land use changes, and I'll talk a little bit about that.

An indirect land use change is traceable to one factor; so we can run all these models, and then we can say "biofuel" because of the tree felling in Brazil. I don't think that's the proper way to deal with the problem. It doesn't mean that biofuels should be held scot-free … but moving forward.

Quickly deconstructing the land use issue. First thing I want to do in my agenda here, above all else, is to define it. It's incredible to the degree that people sort of mix-up direct and indirect effect and all that stuff. It's important that we define it.

Quickly touch on some of the current … problems of the current debate, and then what is the right way to look at the issue. So, here is our indirect land use balloon. Pretty simple actually, and this is maybe over simplified. You basically … that yellow thing is the agriculture world, the agricultural footprint. You have existing biofuel use below, the green bubble at the bottom. That's actually out of scale; it's only about 1% of the oil bag.

Then, you have a great bubble of expansion because we want to use more bioenergy. And then you have the grey bubble at the top that expands outside of the margins of the agricultural economy. It all comes down to (and this is the top left) … the magnitude of effect depends largely on what type of new land is converted. It all comes down to whether that land is forest, or pasture, or grazing land. Because if it's pasture or grazing land, the impact is very small. If it's forest, the impact is huge.

And so, when you do these models, you really have to focus on how much excess capacity we have in this country. If you go outside of the country, that's where the big hit comes. Now, of course this is not unique, and this is my primary concern.

Natural gas expansion effect … same problem, totally out of scale. We're using a certain amount of natural gas in the green bubble for vehicles, right? We want to expand that for below carbon fuel standard in California. We're going to … that yellow circle could be the electric grid or the finite resource of natural gas. You're going to have to go outside of current natural gas and find something to produce the electrons or the natural gas that is going into these vehicles, right?

Well, if you do the analysis, you'll find that there's coal and natural gas, heavy oils, and what have you. And so, that's the impact on the margin. And not to leave out oil, this tops the list of "out of scale." Imagine that, the green is oil we've already used. The yellow is the remaining light, sweet crude. And it doesn't really matter if you use light, sweet crude, you're still … every galloon you use, you're still going to push. If I'm Shell and I use light, sweet crude, that piece of light, sweet crude is not available for Exxon. So they're going to have go get another gallon, and they're going to get on the margin. And that margin's heavy oil, thermally enhanced-oil recovery, tar sands, and oil sands. Okay.

So now, we've got … we know that here's the bottom-line with indirect effects, okay? Producing all forms of energy requires resource use. All resources (it doesn't matter if it's oil, natural, gas, coal, land) are finite and intensification will therefore produce impact on the margin. Okay, there's not an infinite amount of any one of these things. Impact on the margin is the product's indirect effect, so you know, variety of … indirect land use changes the theoretical impact on the margin using more land for bioenergy, but it's not unique.

And so, we have this huge policy decision and we're halfway through it and we sort of … EPA has done it well. California, relatively … well, California has done a

terrible job with this. They have a performance standard and it's sort of half-baked. But if you want to start importing marginal effects, you must do the same for all fuels.

And so moving forward, problems with the current debate. Well, this is step two on the list of deconstructing indirect effects in land. Indirect land use change advocates are consequentialists. So, one thing that happened is: let's say well, biofuels, we haven't really accounted for land. We've got this mistake, and it's just an easy fix. They're actually asking for a fundamental shift in how we look at carbon accounting. What I mean by "they are consequentialists," is I mean that there's basically two schools of thought.

The old school of thought is: you're an attributionalist and you say the way you carbon-score a fuel is, you add up all the carbon emissions that are attributable to the supply chain of producing and using that field, right? A consequentialist will ask a different question. He will say that we have to model this stuff in interaction with the whole world economy, because that's where it exists. And so, what I want to analyze if I am the consequentialist, is when you show this product into the marketplace, what happens? What's the response, right?

And so, indirect land use change is a consequential impact. So it's not really a simple solution if, all of a sudden, you shift the world to a consequential assessment. It's a pretty big one. It's being applied selectively, particularly in California, and it has all these issues with science. So, when someone says the science is *[inaudible]* people say "Oh God, he's a climate skeptic." Well, I'm from Boston, Massachusetts, which by definition is supposed to make me not a climate skeptic. So, I would tell you that it's not about that. It's about taking a real look in what this science does. And if anybody wants to ask questions, there's probably a PowerPoint on each one of those.

So, this is what selective applied indirect effects look like. This is one of my favorites. This is basically the final results of the California law carbon fuel standard. So,

you … based on the left, your gas … that's the base. Well, carbon fuel standard in California said you have to reduce your overall carbon intensity by 10% by 2022.

In the dark blue or purplish color, you have life before indirect effects. This is what all these fuels did. And I want to talk about electricity, and ask you on the right because that's not really a real number either. And so, you can understand why the biofuel guys are ticked off, right. Because they're the only guys that are bearing the burden of the light blue and it's a big number, the game changing number … that's an *investment* changing number.

All the other fuels there were never tested for economically-mediated effect. So, if you're going to do indirect effects, you have to run these fuels through economic models. None of these fuels were even run through economic models, according to public record.

And on the far right, you actually have a situation where electricity and hydrogen have policy-induced reduced numbers. So, those numbers are actually up above gasoline if you based it on today's grid. But they say, well, because of all these policies that are infused in a place, we think that they're going to produce these fuels cleaner and that's how they get a low score. So, you actually have selective application of indirect effects, and on top of that, your selective application of policy-induced effects. So basically you've got a system boundary in a scientific process. It's completely out of luck.

So probably, people are saying "okay, well maybe these indirect effects aren't big. Maybe he's making much ado about nothing." Well, here's a study that came out in December 2009 from UC Davis, and they were largely responsible for a lot of the analysis within the LCFS. And this just gives you a sense; it's definitive, but it gives you a sense of what happens when you take a whole bunch of electric vehicles and hydrogen vehicles and shelve them into the California economy.

Now, the number they used for the most part was 100%, but they wanted to see what would happen. What happened was the grid basic...there's… the grid basically can't handle that type of influx, and so it reaches out for the marginal electron. And it doesn't reach out and say "okay windmill, spin faster." It doesn't. It goes out and gets a natural gas. And as we heard earlier this morning, there are certain electric productions that can ramp up quickly in our peaking units, and certain there that can not.

What I want you to take from this slide is that it fundamentally changes the carbon scores of these fuels, so you have today's vehicles on the left, and the lighter gray is the natural gas in the marginal electricity. It basically takes *electrolysis* hydrogen and punches it way above hydrogen. You'll notice it takes plugged-in hybrid electric vehicle (it's that PHEV40 at the bottom) depending on when you hit them with the marginal impact. It makes them basically comfortable with today's hybrid Prius. So, all of a sudden, this game change impacts, and that's just from saying "well, we're going to hit you with what's on the margin of your resource use." That's the same thing they're doing for indirect land use change. So as a biofuels guy, I can tell you I'm not really surprised that it changes again.

So let's now focus very quickly on "search engine approach." Now, as case in point for this mindframe, it came on in 2008. Steven was not on that paper, in his defense, I don't think. The biggest problem is it compares biofuels of indirect effects to oil without them. So that's a violation of basic LCA systems. It basically said, if you use indirect effect data: corn ethanol is now terrible, and terrible relative to gasoline, and I didn't do that exercise for gasoline. It has no indirect effects, so we can march into the hydrocarbon future without any indirect effects in the marketplace. I don't believe it. They use a large initial model shock and backcast results, so it doubles the amount of corn ethanol required by the RFS. Get the model to spit and hum and sweat, and it then jumps back and applies those impacts to get the incremental gallons. Well guess what, I mean that's basically a useful inquiry to see what happens in the worst case scenario.

You can do it; we just did it. I showed you a slide where you take all the cars and smash them in, and say we're going to just switch over all these cars. That's fine, but let's not pretend that's reality.

So, when he goes to the New York Times, and he says this is *definitive proof* that corn ethanol is not … is worse than gasoline … that's the misleading part. So there is a value to this paper. It stirred the pot. And probably one of the reasons I'm standing here talking about indirect land use change and studying all this stuff. So there are leakage effects that are real, but the last bullet point there is: the whole game is, if you're trying to make biofuels look bad and I'm not saying that, but if you are, is to make sure that the impacts occur outside of the United States. The obvious way you do that is you limit the amount of agriculture capacity in the United States. And I would tell you that that paper hit virtually every single spot to make that happen. It assumed that our farms are basically operating at capacity. There's not … there is supply and demand balance, which if you talk to agricultural people, they'll say that's ridiculous.

We have more corn idle access capacity than actually is going to go into the corn ethanol industry to make ethanol. Okay, so there's always oversupply featuring *[inaudible]* I'm going to shoot through this, because I'm going to get hung up. So there's a recent essay that Steven did write and I actually agree with the problem assessment, and it alludes to it in his presentation. He basically says, "Look, there is … we have this presumption, and the presumption is that the CO_2 coming out of a … burning biomass is going to equate through the CO_2 that pops out of the ground when you grow the bioenergy." It's too simple. It's true. And the essay basically says so.

What we disagree is on the solution. They say that the solution should be to have land-based credit. So, count it at the stock, and then give biofuel guys credits if they actually absorb carbon upstream with their land use. The problem is, what's the reference case? How do you know … what's additional carbon? And that's not well-defined, and what I see is not good.

On the one hand, it says they should pay for leakage emissions resulting from changes in land use activities to replace crops or timber *[inaudible]* that's indirect land use change, okay?. So imagine this situation, the basic difference here is: say you have a cotton field in California and you show up, and I'm a bioenergy guy and I decide we're going to go *[inaudible]* something for biofuel.

The theory behind indirect land use changes is that this cotton guy is going to have to go somewhere else. He's going to tear down rainforest. He's going to tear up pastures and do something, right. The indirect land use change guys want biofuels to pay for sending that other guy there. They don't want them to pay for actually converting cotton. And then, the actual forecasting of that gets extremely difficult when you consider the fact that California's cotton production has gone down 60% to 75% because China has been so effective at it. The GMOs, now you have the marginal land issue. What is the reference case?

And so, you have this strange principle at work where you're saying bioenergy is escaping its true land impact. Bioenergy is escaping its true land impact and that's bad, and we agree on that. But is the solution to hold bioenergy accountable for someone else's land impact? How do you sell that? And so we're in the situation where agriculture is rejecting indirect land use change. And I want to sit there and shake both sides and say "you know, of course you are, because when agriculture sees this, it's part of a solution to what real problem?" It just pits the two sides together and we sit around pompously, and we say, "God, they're not getting *[inaudible]* yet." There's no...we'll never going to have the change we want.

So, I don't think that solving an accountability problem by nailing someone for economically-derived land impacts is in certain models, but at the end of the day, there is someone else's impact. Someone else's direct impact is a real solution to the problem.

So another thing they say in their paper is that biofuels need to account for leakage. Now, the one thing that's good about that that is the proper terminology. All impacts are direct. A corn cob can only be in one place at one time. It can't be in two places, okay? So, all impacts … and this is leakage. Indirect land use changes leakage. It's an effect outside of the primary system, under that we need to worry about. But they want bioenergy to pay for that effect, right?

The problem is to look at it as a principal. There's great potential for complications. If you add them, it's carbon shifting as we've discussed. So, in a carbon accounting world, how do you deal with that? NRDC, which is a huge advocate environmental group, a huge advocate for indirect land usage and defender of the concept, has admitted that in the ideal world, everybody pays for the direct but this is a good solution in the interim. How is it possibly a good solution in the interim to abandon supply chain accountability, and have cotton guys tearing down forest to produce cotton or food guys tearing down for food in another country, and they'll import it and nail bioenergy for that because they're the new interim. That just means as a principal, you're basically saying to the world, don't be a new interim, we're going to nail you for the change.

Is that what we're trying to do? It's no wonder that Exxon Mobile and some of the biggest oil companies are funding indirect land use change research and using it politically. It's a market defending mechanism. It's an important inquiry, but it's also a market defending mechanism. So, how would these new lands impact other policies? Well obviously, you have to look at all land conservation programs as having an eye-lock effect. So, conversation reserve program, national parks, state land programs. You're now basically saying you know we don't want to take that. We don't want to use land to produce energy. But it's okay to take it out of agricultural production because it's … we should conserve it.

Well, if you're for conserving pasture and then, running this model and saying well, every acre of pasture that we conserve is actually knocking down rainforest … that pasture may not be a good climate idea. And then, of course of you have a situation where you have to look at hybrids and things like Prius, right? You take Prius and you run them into the marketplace; what's going to happen? Electric vehicles, hydrogen vehicles, you're going to basically massively reduce the demand for oil. So, is there a going to be a market-mediated fact where the price of gasoline drops to 70 cents, 80 cents, $1.20, $1.80 and all of a sudden people say I don't need that Prius. They're expensive. I'm going to buy an SUV. Are we going to actually move that response to the carbon score of a Prius? I'm not for that. Because I think Prius make sense. My mom drives one.

So the principal is moving forward, and this is my last slide. The goal should be supply chain accountability. I don't know when we abandoned it, but that's what it should be and I think that's what, at the end of the day, Steven wants and his colleagues want. And it means all the effects are direct and it must be dynamically treated. We can't sit around and presumably treat all land use the same.

This is going to require better reporting. But that's true for the alternative as well. You can't import land impacts across country lines and not have good reporting. We need a consistent approach to resource utilization. We can't be flip-flopping between average and marginal, and fiddling around with all the different numbers because at the end of the day, all we're going to get is a totally rigged carbon system that's not going to be durable.

And we need to stop calling leakage … and this is my last point. We need to stop calling leakage something else and address it directly. Moving forward with change is going to have leakage impacts. Land is a serious one. We can't just fly ahead with bioenergy and tear down all of our rainforest. But there are certain things that carbon accounting can't solve. *[inaudible]* cellulose grass. It absorbs crazy amounts of carbon.

If we just base it on the carbon, you should probably tear down all of our old forest that aren't absorbing much carbon anymore because they are all old-growth and kind of the end of their life and *[inaudible]*, but I don't think that makes sense.

In some analysis, there's a paper by John DeChico who used to be at EDF. I'm sure Steve knows who started this process of calling it a leakage, and looking for ways to actually treat leakage directly and solve the problem. Thank you very much and I appreciate the one minute of difference.

Michael: Thank you, Brooke. Well, next stop is someone who is probably going to remain involved in attempting to reconcile some of these issues. Paul Argyropoulos is a Senior Policy Advisor in EPA's Office of Transportation and Air Quality. They are responsible for providing advice and analysis to the Office Director on a broad range of transportation program issues, with the focus on fuels. Paul previously chaired EPA's interagency work group for the national renewable fuels standard programs implemented under both the Energy Policy Act of 2005, and the Energy Independence and Security Act of 2007.

Paul began his career with the EPA, but *did* stray to work with Hart Downstream Energy Services and had a number of positions, including being their Executive Director of the International Fuel Quality Center. He also spend some time with the American Petroleum Institute. Paul.

Paul Argyropoulos: Thank you. I appreciate the opportunity to be here. I appreciate the remarks of all the previous gentlemen on the panel as well. It's always interesting to hear all these different perspectives. Somebody else's mic is still on.

Anyway, it's interesting for … pardon me. Okay. Is that better? Testing, 1-2-3. I've always want to do that. Okay. All right, we'll keep going here. I'm going to need this back though. Thanks.

My time here today is really going to be spent on explaining exactly what we did. Obviously, I'm going to give a little bit of history about what was required; and I know

Peter talked about some of the requirements that he used to put forth, before us. I'm going to talk a little bit about what we did with those requirements, and how we're moving forward with implementing them. That's going to be factually based. With regard to some of the nuances of the program, I'm also going to give somewhat of an upfront disclaimer. Obviously, the information I'm going to give you is based on what we've done in the regulatory construct.

At the same time, it's going to be abbreviated, for anybody looking to really understand what the rule is and how it needs to be implemented. And ultimately, if you are a party that is regulated under the rule, you really need to look at the regulations themselves, and see how they ultimately affect you in what those particular requirements are.

So, I am going to talk a little bit again about some of what is changed from EPAC and then, ultimately, talk a little bit about some of the highlights of what we did with the regulatory program. I will give some details on the 2010 standards and how we're moving forward from the RFS1 program to the RFS2 program.

And then, I'm also going to provide some illustrative examples of the work that we did to understand, when this program is fully implemented, what some of the possible scenarios are with the makeup of the fuels in the market at that particular time. And obviously, there are lots of assumptions behind those as well. And there are some waiver provisions in there (and I know Peter had touched on that as well). EIA is not necessarily projecting it. In 2022, we'll have full volume implementation. They are the ones that are projecting that. We're the ones that are going to be looking at, and evaluating, and setting the standards on a yearly basis. So that's generally what we're going to do.

And I will, at the end of that time, also talk about some of the other ongoing work that we have going on. Well, not … for the less than two years really after EPAC and when we implemented the RFS1 program, we had a new legislative requirement for us

to implement the RFS2 program and it did change a lot of things. It went from basically having one standard, and obviously increased the volume from 7.5 billion in 2012 to 36 billion gallons in 2022. It also covered the pool more broadly. Not just gasoline, but it also included diesel, and it also included both on- and off-road transportation fuels; and they also have some other new ones, such as allowing for renewables going into the jet (and into the home heating) on the market. It also accounts for using compliance in the programs.

But of significant interest (and one of the biggest changes that we had) was in going from one renewable fuels standard to actually having four different standards. And again, Peter had talked about what some of those are in the advance cellulosic biomass-based diesel and total renewable fuel standard.

Additionally, it's set beyond just being made from a renewable source. It also set specific definitions of what type of feedstocks are required by definition, and then ultimately, how you could use those feedstocks for the various categories in order to comply with the standards. And then, what these gentlemen have also been talking about, the greenhouse gas emissions requirements that were set forth for these fuels to basically demonstrate (in order to be able to comply) that they meet a certain emission reductions over the baseline fuel.

With that, now … here are some of the highlights, stealing a little bit of the thunder, so to speak, before we get to all the details. EISA has volume standards that were set forth and I'll show these (especially in the next chart) by year and by category.

This year's standard is 12.95 billion gallons, and that's what the Act required. And we believe that that's what we needed to do, to actually set what Congress intended to be 12.95 billion gallons this year.

Now, since we are not implementing the program effectively, the regulations are: if its regulations don't go in effect in July 1, we figure out how to transition from RFS1 to RFS2, and still use the fuels in the RFS1 program to demonstrate compliance with the

RF2 standard. So that's the transitional issue, and again, there's lots of ways that we have devised to do that and the regulations contain those as well.

And as mentioned before, we have four specific volume standards, and I'm going to show those in a chart. They're not only volume standards, but we are required to convert those into a percentage basis for each of the obligated parties.

Now, recognizing that there is … there has been lots of controversy over the assessments for the various fuels. We did do a lot of work since the proposal came out last year. Ultimately, a lot of that work led to changes and what our assessments were for the various fuels. And, at the end of the day really, the fuels that we have assessed, they do comply with meeting the standards. I'll give you some details on that as well.

The fuels that have not been assessed at this point...(and there's other feed stocks or technologies that obviously are out there that either we didn't have time to do and some we've committed to do in a relatively quick time frame this year and others that have maybe not even yet been envisioned in some point) … We have a process, which we put forth so that we can move forward with efficiently and effectively evaluating those fuels (so that they can be used for compliance with whatever category they ultimately end up complying with).

The four standards (and again, this is critical for the obligated parties because they have to meet or comply with all of the standards on an individual basis). The biomass-based diesel, a minimum of 1 billion gallons by 2012 and that of course goes out into the future. The sale standard of 16 billion gallons, and Peter also outlined what the advanced category contains. It contains both cellulosic other advance and biomass-based diesel for a total of 21 billion gallons in that category. And these standards are nested, and then … actually I'll show you what that means in the next chart. And then, all the rest of the renewable fuel that make up "conventional." It could be ethanol from corn; It could be ethanol or biodiesel from other products as well. So there really isn't a

specific standard for a specific feedstock or specific type of renewable fuel. It's just a general total renewable fuel requirement.

The little thing down there, that it's teetering, is really important for people to understand. There have been assessments that have made in this (or are going to be used) for determining compliance by the obligated parties with the various fuels. So basically, the producers can generate a type of fuel and (based on whatever standard or category it can meet), that can be used to at the end of the day for compliance in those categories by the obligated parties.

However, those facilities that are already out there … basically, we used the term "they're grandfathered." They need facilities that had been constructed or were already in production prior to enactment of EISA; those facilities can continue to operate, as they had already been operating prior to enactment. So, any of the volumes (up to their capacity, again there are bells and whistles and specific limitations and allowances within the regulations) … but those facilities can continue to produce a compliant product, even if the product doesn't meet a greenhouse gas percent reduction. So, I think that's an important part.

And again: RFS1, this is really just showing the increase is coming out of the advanced category, and the lion's share of that is going to be coming out of the cellulosic. So today really we are at 12.5 billion gallons for 2010. And then of course, that continues to ramp up. And as Peter also indicated, we have the authority to make adjustments. And I'll talk a little bit about that as well.

Now, this table *here* is really the table *that* came out of. And it's been expanded, really, for clarity purposes out of EISA. So, well … these are the standards, as set forth in EISA. Again, we set the standards at the Agency in consultation with the IA and many of other federal partners, as well as doing market analysis (particularly with regard to the development of the cellulosic market). I'll talk a little bit more about that later on.

However, the importance of this here is, if you look at the … in the center section, under the advanced … just basically the green bar there … all of those products need to meet certain greenhouse gas emission reductions, but they are consider to be advanced fuels. And if you total the biomass-based diesel, the non-cellulosic and the cellulosic, that's what gives you the total advanced number. And then, if you go all the way to the left — what I'm terming conventional renewable fuel there — if you add that column to the total advanced column, that's how you come up with the total renewable fuel number.

Now, these fuels can be used for various categories. If you meet cellulosic's 60% reduction requirement, and also for instance, if you are a diesel-based fuel, you can use that for the cellulosic biofuel category (obviously a high value category). You could also use it for a non-cellulosic, for biomass-based diesel if it's a diesel product, and then for the conventional renewable fuel category.

So, that's how this is nested so you have allowances. There are limitations again cornstarch-based ethanol; currently in the Act, it's limited to 15 billion gallons. However, these other products have the ability to be used across categories.

These are the specific standards, and I'm actually just going to skip to the next slide because this shows you in table format what the requirements are. We have taken the volumetric requirements, and we have a formula which we use also, and establish that in the RFS1 program. You take that; you turn it into a percentage and then, at the end of the year with the compliance period, the obligated parties must show that they have either blended or obtained enough credits (which we called RINs) to demonstrate that they've met this percentage for that compliance period.

So, for this year, cellulosic biofuel (also as Peter indicated), the standard was 100 million in EISA. We have the authority and the discretion to reduce that standard, and we did so this year, because we looked at EIA's information (and also our own market assessment) and we made the adjustment accordingly. So it's 6.5 million

gallons, and of course, that's a very small percentage of what the obligation is. Biomass-based diesel, we did something, in order to again try and satisfy the intent of EISA. We didn't have regulatory programs in place last year, so we're combining the 2009 and 2010 biomass-based diesel EISA numbers, for a total of 1.15 billion gallons standard this year.

However, there are also allowances for being able to use last year's RINs (or credits) for those parties that blended last year, and to be able to combine those. So it's kind of a one-time only opportunity. And then the total advance is another thing. We can, since we lowered the cellulosic standard, we can lower the advanced standard and the total renewable standard by the same amount. We did not do that this year. We have the authority and discretion to do that. In the future, it may be necessary if the volumes are ultimately not being realized in the market. But not this year, because we expect that the biomass-based diesel market is going to ultimately supply those particular products into the market. There is the energy value of these particular products also, which gives a higher in-value. So, instead of a value of "1" such as you would have for ethanol, if it's a biomass-based diesel product (from soy in this case) it's "1.5." So, if you add those RINs up, ultimately you will achieve the total advanced standard this year.

The products that qualify for this are just really based on a life cycle analysis. It sums up where we are, in terms of cellulosic ethanol and cellulosic diesels from these particular pathways that we analyzed, if they have demonstrated matter reduction requirements for that category. Also biodiesel from soy, waste oils and also algae from … diesel from algae, meets the "Advanced" category. Ethanol from sugar cane meets the "Advanced" and then of course, corn ethanol from new plants with various technology assessments that we have done. You have to look at the table … the look up table to really understand what those are. Also, we will demonstrate that they meet the particular life cycle standards.

This is the … from the AEO 2007, and we use this as a reference case. When we did our evaluations (our impact assessment), we needed to know, "Well, what was the world going to look like prior to EISA?" *This* is prior to enactment of EISA, and *this* is what the EIA projections were at that time. So you'll see, by 2022 they have projected 13.5 billion gallons over renewable fuels. So it's well beyond what the RFS1 required; so the market was going to already command or demand these products on their own.

This next chart, here, is the primary control case that we did. And this really looked at what the mix of the various fuels would be in 2022. And there's lots of assumptions behind this, which I won't get into detail about, as well. But if you look at in 2022 (the far lower right hand corner) it's just 30.5 billion gallons. Well, people would say, well that's less than 36 billion gallons. Well again, if you look at an accounting for the extra energy value of some of these products, and you would look at the total volume of diesel or other distillate type products that are in the market, that of a higher value (RIN value), then you actually don't have to get the 36 billion gallons, and so that's just one assessment. We have a high ethanol case, a low ethanol case, and a number of other cases as well.

And again, getting into EIA's point: if by chance, the market doesn't develop, there are waiver provisions (both general in nature) for across the total renewable fuels program. And there are some specific waiver allowances in the Act as well, both for biomass-based diesel and most certainly for the cellulosic biofuel standard. This is the one of significant importance. Again, we already lowered the standard here. We see lots of opportunity in the market; but every year, we have to set the standards, and we will be going through a "notice and comment and rule making" process to set the standards (which is different than what we did under RFS1). So what you'll actually be seeing, in not too distant a future, are first proposals with some ranges of assessments of what we expect the cellulosic market would be in 2011. And then, we will be taking comment on those. And again, we're going to continue to be doing assessments of that.

And, with that very quick overview of RFS2, I want to leave people. Though if you … again, there are always … with regulatory programs, there are either: typographical errors, or there's a need for expanded clarity on interpretation of some of the provisions, and things like that. We have a pretty good process in place, where you could email questions to us, and then … we actually, we'll go through (in a team format, internally including our legal counsel) and prepare a response to these questions. We'll post them on our web, and then generally, if it's a question from somebody, there would also usually be an individual response back. But we try and do this on a weekly or biweekly basis. So, for people who do have questions where there's uncertainty, that's a process that we have in place. So there is actually a lot of new information since the rule came out, that is already posted on the website. So maybe even before you ask me any questions, you may want to go look there. It's just my way of deflecting. So, thank you very much.

Michael: Thank you, Paul. And again, if you have any questions, please bring them up. And we'll post them to our distinguished panel as we have time.

Our first question is for Dr. Hamburg, and this question is: "How is EDF involved currently in designs behind the development of some of these policies that we've been discussing: the whole carbon fuel standard, the RFS2 and issues regarding climate change?"

Steven Hamburg: Well, I'm not … since my responsibility really is in the science realm, I won't get into the specific policy, but the key thing we've been working on is trying to understand these carbon accounting issues. We are working with the stakeholder group (from across the spectrum of bioenergy) to try and come to a common understanding of carbon accounting so that, from that can emerge a set of policy options that we think will better reflect a common understanding of the underlying science, which I think is one of the things that plays. Our current framework is that we

have a lot of conflicting policies that simply aren't addressing the science in the same way. And that's difficult.

Michael: Okay. Actually, I'm going with another question. "If the science is uncertain," — and this is for Dr. Hamburg and Brooke here — "if the science is uncertain, about in particular the indirect land use effects, what should be done now with regards to encouraging biofuels and biomass power policies?"

Steven Hamburg: I'll start, and then hand it over. So, I think what we need to do (and where I would disagree with my colleague), is the 2009 paper tries to clarify some of what was raised in the 2008 paper, which I was not a co-author on. And if you do the carbon accounting right, the indirect … what we would agree on is the *indirect land use* issue, largely goes away. And basically, what you need to do is get the data that's necessary to do the carbon accounting in a way that's consistent with the basic biogeochemistry. And if you do that, that largely takes care of the problem and in most issues indirect land use will not be a concern. So, I don't think the science is nearly … is contested as we have … we do not have a common understanding, because most people have simply not worked through the basic underlying science. So, I think it actually, if we do the accounting right, it largely takes care of the problem.

Brooke Coleman: So, our solution is going through the process in California, you basically have … you have two different policies that are starkly different. One is a biofuels mandate at the Federal level, and one is a performance standard. And you have to understand the differences between the two to understand the solution to the problem. Indirect land use change is sort of an "adder" as a consideration. It makes a lot more sense in a mandated environment, because think about what you're … as a consequence of the policy, you're forcing biofuels into the space. It's reasonable to say, "What are the leakage effects of biofuels alone?" because that's the fuel you're forcing on this space. I don't think it's reasonable to say, "Okay, now that we know what they are, we're just going to add them on to the incremental gallons of biofuel carbon score"

because now you're mixing apples and oranges. But I do think you can say, "Well, here are the supply chain emissions for biofuels, and here are the leakage emissions, and here's the result with regards to whether or not this policy with these fuels meets the standard." Low carbon fuel standards are much different. They basically say we're going to hit every … this is a performance standard, so we're not mandating anything. We're saying, "Go get your carbon score and compete for the attention of the oil industry. And the lower the carbon, the better. Because you're going to be, you know, the sexiest fuel in the market." Well, in that situation, when you start adding leakage effects to one fuel and not another, you have a major problem because you're tilting the competitive marketplace. As we all said to California, and we stick by this: go and do supply chain emissions for everybody. You should spend more time forcing the bioenergy firms to report their feedstocks upstream, so we diversify our knowledge of what they're actually using. And then put incentives in place based on that process, so that you know: our cover crop, winter crop, gets a better score and alleviates indirect land use change from someone that just goes and tears down forest. Deal with it from a framework of supply chain emissions and direct effects, and then go assess the leakage effects for all these different fuels and come back in a couple of years because this thing is not going to drive change in two years. What we do have to do in two years is to go and say, "What are the leakage effects of all these different fuels?" We've got that solution completely out of the room. We're still saying it.

Michael: Okay. Our next question is for Paul. Paul, what's EPA's involvement in this assessment of climate change impacts, and will EPA be working with California and others to develop a … to reconcile some of these differences?

Paul Argyropoulos: Well, broadly with regard to climate change, I mean: yes, most certainly EPA is involved in all of these issues, both in informing from the technical basis any potential legislative policies in the future, and then of course doing assessments internally. My particular office is the office that's responsible for dealing

with doing the assessments for the biofuels program. And they were the team who put together understanding both: utilization of the various models that were necessary, and ultimately to continue to work on the assessments. Obviously, we have assessments that already been done. There will be a future need for additional assessments, and actually the Act requires that we do (at least every five years, I believe) kind of do a review of that. And we're going to have NAS do a review of the work that we did do, and we also will have other ongoing work that will help inform the evolution of our particular process that we have for the fuels. So, I mean, it's obviously … we had to draw a line in the sand, but as we move forward, we're going to continue to work with the various stakeholders in understanding these interactions more thoroughly.

Michael: Okay. Next Dr. Hamburg, this question asks for you to comment on the recent UN report that found that, over the last decade the rate of deforestation declined through the 1990s. And he wants to know, how do you explain that decline of deforestation with this growth in biofuels?

Steven Hamburg: Well, let me back up a second. Remember the kind of accounting I'm talking about is not about indirect land use.

Michael: Okay.

Steven Hamburg: So, what I'm talking about is not about indirect land use. It is not related to deforestation and the global numbers about deforestation have no relationship to the issue I talked about. That's forest management, domestic forest management and it's how we account for that carbon. And so, we have to be careful to not muddle up those issues because they are fundamentally different issues. With respect to global deforestation rates, I believe it's a reference and I have to be clarified if that's not true. On the net carbon emissions, relative percentage of carbon emissions coming from deforestation (and that is related to both the numerator and denominator problem) is that it has to do … it's a relative number to total carbon...*[inaudible]* carbon. And as we view more fossil fuels, the relative role of deforestation drops, not the

absolute rate of deforestation. And also it’s a conversion from carbon to total greenhouse gas emissions. But again, I’ve relied on the question to make sure that that’s in fact what they were asking, so we have to be careful. That’s a relative term that’s now correctly done on greenhouse gases, not just on carbon. But the actual size, the absolute size of the problem has not diminished.