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I N D E X

I N D E X

P R O C E E D I N G S

8:40 a.m.

DR. JENKINS: We'll get started here. Thanks for coming again, and welcome on this bright winter day at the beginning of spring here. It's a little cool out there, so I hope you've brought your jackets.

Yesterday at the forum we dealt with the issues, many issues in policies in advanced technologies for bioenergy development from biomass. And today we're going to focus on issues surrounding biofuels and chemicals production from solid waste. So we're going to focus this in a little bit.

The forum today is sponsored primarily by the California Integrated Waste Management Board. And I do want to thank them for the sponsorship of this forum. This forum does have specific purpose in helping the Board formulate research and commercialization plans. And we're going to deal with that over the coming day to try to get your input directly into that process, and to help create some good ideas for how we're going to move forward in a sustainable way in the future.

I hope after our great reception last night that you all went home and did your homework assignment, which was to read the background paper. And I hope you were able to either download that from the web or to pick it up yesterday from the back table. There is a background paper, so if you've not seen this I think we have additional copies here, perhaps on the back table there.

So there is a background paper that discusses some of the issues associated with energy from solid waste. And some of the resource potentials. So I hope you were able to do that. And many thanks to Rob Williams, staff with the Collaborative and a development engineer at the University of California Davis, for organizing and putting that paper together for us today. With a lot of support and a lot of research that he's done and a lot of assistance from a number of other people. But Rob is really the driving force behind organizing that paper, and several of the other reports.

Also many thanks to Martha Gildart and Rob for helping to organize all of this activity. Also with support from Howard Levenson, Fernando

Berton and Alan Glabe of the Integrated Waste Management Board for their assistance and funding support so that we can sit here today and do what we're doing right now. And then this afternoon a little more active input from you for this planning process. So thanks very much for all that, and thanks for coming.

The look at solid waste in California today, we are still disposing something over 40 million tons of waste into landfills. The question is, is that the best thing to do with this material. And I think there's been an increasing concern and increasing attention to resource value of this material and we might be perhaps doing some better things.

And we will hear over the course of this morning both some discussion on policies, as well as technologies for biofuels, bioenergy production from these materials. So we will address, in both the presentations this morning and in the breakout sessions this afternoon, really how we should plan for the future use of this resource. And whether we should continue what we're doing today with these.

We just look at the resource content

here, this landfill stream. And we have a total of some 46 million tons, if you include the inorganic component, but paper and cardboard going into landfill now is close to 9 million tons. Food waste 6 million tons; construction demolition lumber 4 million tons; other organics close to 2 million tons; leaves and grass 2 million tons; prunings, branches and stumps and other green waste about a million tons there. And alternative daily cover, which actually is considered a part of diversion, but winds up in the landfill anyway, about 3 million tons.

And if you add all this biomass up we've got about 27 million tons of biomass that wind up in the landfill. And then beyond that we have plastics and textiles in the amount of about 6 million tons. And there's a resource value there.

And the, of course, we have a number of metals and glass and other inorganics that go into the landfill, as well, to make up this total, which is well over 40 million tons.

The dry matter content of the biomass is 18 million tons, and that's a substantial amount of energy value; constitutes something close to 47 million barrels of oil equivalent. And so a substantial heating value, a substantial energy content in this material. This is going into the landfill.

We are, of course, extracting energy from landfills in the form of landfill gas. We'll hear some discussion about advanced techniques for landfill gas applications and utilization today during the morning sessions. But there are other things that we can do with this resource.

And, of course, we have also resource simply being stored in landfills. We now have more than a billion tons of solid waste in existing landfills, which could serve as a source of resource were we to mine that material if we wish to do that.

Of course, there are also -- there's lots of carbon being sequestered in landfills. And we have also that issue to deal with.

So, when we look at the full lifecycle associated with our practices and the production of waste, then we need to consider all of these. And so in our planning for the future in looking at research that's needed to advance technologies, to improve the sustainability of the system, and how we're going to commercialize those technologies, we do need to consider these full effects.

With that I'm going to just briefly review for you the itinerary for today, the agenda. And we have one change on the schedule. Don Stevens, who was scheduled to talk during the second session of the morning, unfortunately has a family matter, urgent family matter to deal with, and will not be here.

So what we're going to do is to allow some discussion at the end of the second session for actually both presentation sessions. So if you have some questions as the speakers go through their materials, reserve those and we'll do some discussion before we break for lunch. And the, of course, you can come back to those during the afternoon breakout sessions.

So the first session this morning we'll discuss policies affecting the use of biomass in municipal wastes. The second session in the morning after the break will address biofuel production from municipal wastes.

We'll go to lunch and we'll come back; hear from Howard Levenson about the structure of the breakout sessions and the intent of the Board in soliciting your input for the research and commercialization planning.

And those breakout sessions, there are three concurrent sessions in two groups. So we will first look at pathways to commercialization. And the breakout sessions have been organized around products. You can discuss other things as you feel appropriate, of course. Those product sessions, the first session is alcohol fuels; the second is on biogasoline and renewable diesel fuels; and the third one is on biogas. So you can divide appropriately, and Martha will give you some more instruction on this; and then Howard will give you some more detail about, again, the intent of the Board on this.

The second set of breakout sessions, after the break in the afternoon, will be, again, on alcohol, biogasolines and renewable diesels and biogas, but in this case looking at specific research needs that we need to move forward in the future.

And we'll come back at the end of the afternoon; summarize the results from the breakout sessions. We're looking for some very good input from you to help us see how we're going to go forward and realize the objectives associated with the sustainable use of this resource.

So, that's the structure for today. And to get us started on all of this it's my pleasure to be able to introduce to you the Chair of the Integrated Waste Management Board, and this is Margo Reid Brown.

And Margo was appointed to the Board by the Governor on January 11, 2006, so she's been Chair of the Board since February of 2006, a little over a year.

And prior to joining the Board she was Director of Scheduling for the Governor. And she's also the Founder and President of Capital Ideas Development Corporation, which is a community relations and fund development consulting firm.

She also served as President of the Junior League of Sacramento from 1999 to 2000. And a lot of involvement in the community. Served as a Board Member on Prevent Child Abuse California. Also in the Sacramento Capital Club and the Putting Our Children First, a neighborhood alliance.

She first started out in working with

Senator Pete Wilson, and then continued with the Governor from 1991 to 1999.

And so with that, Margo, if you would, please. And tell us what we're to do here today.

(Applause.)

CHAIRPERSON BROWN: Thank you, Bryan, very much. And I have to say thank you to Fernando and Martha and Howard, who we've been working with on getting this prepared.

And my background really doesn't say a whole lot about what I've been doing in the last year, but as you can imagine, coming over to the Integrated Waste Management Board was a departure from my previous history.

And it's been a great learning experience over this year just to get up to speed on what the Board's priorities are and the great task before us here in California. Especially with Governor Schwarzenegger being announced as one of the greenest governors, or the greenest governor in the United States.

And his leadership in the passage of AB-32 and the launch of the Bioenergy Interagency Working Group has really guided this Board to where we are setting our policy direction for the future of landfills, landfill preservation, exploring alternative energy and fuel productions here in California.

I'm not going to take a whole lot of time with you this morning because, as all of you are, I'm anxious to hear the sessions that we have set up for the rest of the morning; and hope to participate in some of the breakout sessions this afternoon.

But let me tell you that Bryan hit on many of the issues, and core issues, that this Board is dealing with as we look to the next forefront of what is happening in solid waste. And we do have aggressive targets that have been set forth by the Governor to achieve three specific strategies for the Global Warming Solutions Act.

The first one is high recycling and 50 percent waste diversion from landfills. And I'm proud to announce that California did achieve that last year. In fact, we have a 52 percent waste diversion rate from our landfills, saving the costly resource extraction production materials by re-using, promoting recycling and diversion from the landfill.

But as Bryan mentioned, we still have 42 million tons of waste going to our landfills here in California. And there's a great potential there for what to do with those 42 million tons.

This Board has actively participated in the Bioenergy Interagency Working Group looking specifically at that biomass component of the waste stream which has a huge potential. And according to the Board's most recent waste characterization we have nearly 30 percent of the waste stream that is highly recyclable and biomass potential for both energy production and alternative fuels.

A speech here I'm not going to give. I'm just going to tell you that we are extremely pleased to have such a distinguished audience and group of speakers here with us this morning. Look forward to the success and information that we can gather; and appreciate all of your participation here.

Great potential; great opportunity. We certainly have a Governor who stands behind science and looks to the industry to advance bioenergy, alternative fuels, as well as, I think most of you probably have had your eye on what the

ARB is doing with the low carbon fuel standard.

So, really the pathway to commercialization for some of these technologies in California is what is of most interest to us. And we look forward to having you here, having a robust discussion and the future of what lies ahead here in California.

So, anyway, with that I'm going to turn the microphone back to Bryan a couple minutes early. Thank you all very much for being here; and look forward to individual discussions and the breakout sessions as we move forward. Thank you.

(Applause.)

DR. JENKINS: Thanks very much for those words, Margo. So, actually I'm going now to turn the microphone over to Martha Gildart, who's going to introduce our moderator for the first panel. Thanks, Martha. You should be used to this by now.

MS. GILDART: He works by surprise. The first session is going to be moderated by Fernando Berton who worked at the Waste Board sort of off and on now for several years. He had been at the Board for about ten years before he branched out on his own in a consulting firm. And then decided it was a little too erratic in the payment scheme of things, and came back to the Board.

And for the last seven years he has been with their advanced technologies biomass conversion group; pretty much the only such staff person at the Board. And he's going to be moderating this next panel. Fernando.

MR. BERTON: Good morning. And my role is to introduce everyone else. Actually I'm supposed to moderate a panel, and so what I would like is my panel members here next to my left. So, is Kit Strange in the audience somewhere?

MR. STRANGE: Yes.

(Pause.)

MR. BERTON: Well, again, good morning. And just real briefly, we do have a very good lineup of speakers this morning. Bryan talked about it a bit.

And one thing I would like for all you to do is the information that you hear today, this morning, use that information for fodder for the breakout sessions in the afternoon. It's very important to us. And not just the information that you hear from the speakers, but, as Bryan had mentioned, the background paper. It's a very good background paper that Rob put together. So all of that information put together is very important for us for the breakout sessions in the afternoon.

So, without any further ado, I'd like to introduce our first speaker, Luis Diaz, who is the President of Cal Recovery, Incorporated. Dr. Diaz has been involved in the field of waste management and nonconventional sources of energy for more than 30 years.

He has conducted waste management studies, technical and economic assessments of solid waste systems, environmental analyses of resource recovery systems, and marketing studies. Has participated in a large variety of projects including refuse processing for material and energy recovery.

He has experience in waste processing technologies including recycling, composting, co-composting, incineration, mechanical composting, anaerobic digestion and many other things that have multisyllables to it.

He has earned an international reputation as an expert in composting anaerobic digestion. And has prepared a number of feasibility studies and master plans in the U.S.

and in other countries.

In addition, Dr. Diaz has substantial experience assisting clients in strategic planning of their solid waste systems and procurement of processing capacity and services.

Dr. Diaz has more than 400 publications and has co-authored 17 books in the field of waste management and energy. He has also conducted training courses throughout the world, and is a visiting professor in universities in Europe, North America and Latin America.

He is also Editor-in-Chief of Waste Management, an international, peer-reviewed journal published by Elsevier Science. He's a member of the editorial board of several journals. He's the chair of a task force -- and he's telling me to stop, so he can start his presentation.

(Laughter.)

MR. BERTON: As you can see, he knows his stuff. So, Dr. Diaz.

DR. DIAZ: Thank you, thank you for that --

(Applause.)

DR. DIAZ: Now I'm thoroughly embarrassed. I didn't know that that was sent.

That's not the point. The point is that I've made a lot of mistakes in my life. I've been working with solid waste for 30-some-odd years. I've been burned; I've been dirty, cut, you name it. So, that's the kind of experience that I'd like to share with you.

Now, you're probably asking why is this guy with a Latin name going to talk about Europe. That's because we work there a lot. I've had a chance, I've been fortunate to work in Austria, Germany, Italy, England, Spain. So, I made more mistakes there, as well.

Very quickly, I have a lot of information because this is a very broad topic. And I'm going to try to do it as quickly as I can. I want to thank the organizers of the conference, especially the Waste Board, for inviting me here. It's a pleasure to be with all of you. And I see a lot of very old friends of mine around in the audience, garbage people --

(Laughter.)

DR. DIAZ: -- from back in the '70s. I was five years old when I started.

(Laughter.)

DR. DIAZ: I'm going to cover very

quickly introduction, the general types of technologies, an overview of what's going on in Europe and in the U.S. And then some concluding remarks.

One of the benefits of being an editor-in-chief is that I get to see a lot of papers, read a lot of -- two a day, we get manuscripts two a day. And as you may know, in the European Union, trying to harmonize the educational system, before you get your PhD you've got to have a published paper based on your dissertation. And it has to be published in a peer-reviewed journal. So there are a lot of very nervous kids waiting to get that paper published. So I learn a lot in reading the latest research.

The management of waste in general has undergone a lot of changes in the past 50 years. And now we're looking at biomass as a source of energy and fuel. So I was asked to talk about these two concepts.

I'm going to concentrate on energy production primarily. We spoke about biofuels yesterday ad nauseam, so let's just concentrate on energy recovery.

This is a very very broad subject.

Europe, U.S. But I'm going to try to just give you a glimpse, touch a few subjects and I'll talk about some issues that I would like to just gloss over.

And there's someone else also talking about anaerobic digestion, so I'm going to complement the information.

Just to give you a refresher course in case some of you have not covered these items before. There are three general types of technologies, thermal, physical-chemical and biological.

Now, in thermal processes I would like to emphasize these because there seems to be a misunderstanding that incineration, gasification and pyrolysis are the same. Or at least trying to classify them as such. In theory they are different. They are different processes. They can be carried out in different reactors. So I'm going to separate them.

And then there's also plasma that's emerging as another potential solution to waste management. Mind you, all of these technologies, I'm not trying to support any one of them in particular. I'm just trying to give you an overview.

The process of combustion, itself, we can subdivide it into stoichiometric, which means that you have the exact or close to the exact amount of oxygen that you need to carry out the combustion process, or excess air. You can also divide it by the degree of treatment, as mass fired. And there's also fluidized bed.

Gasification -- and then I'll show you some examples. I just want to get everybody on about the same level.

Gasification is a process where you don't have enough air to have a complete combustion process. So what you produce is a fuel, gaseous fuel. And I'll show you how. But it's also vertical fixed bed, horizontal fixed bed and fluidized bed gasification.

In terms of physical chemical processes, there's several unit processes that we've used. Size reduction, classification, screening, flat bed. We've produced refuse-derived fuel. In New York they call it solid refuse fuel, SRF. Same thing. Densified RDF, using densification. Liquid fuels, and it's also acid hydrolysis that can be used to produce alcohols.

Nonbiological processes, anaerobic digestion. That process takes place in landfills. The normal conditions would produce landfill gas. Someone else will be talking about that later on so I'm going to skip it.

You can also talk about anaerobic digestion connected in reactors. Now, there are two general types that are being used, have been demonstrated, used in Europe, as well. Wet digestion, and it's classified between 5 and 10 percent dry matter in this reactor. And the dry, in quotes, dry digestion when it's more than 30 percent dry matter. I'll show you some examples of these systems.

There's also enzymatic hydrolysis. We talked about that yesterday quite a bit. And biological production of hydrogen.

Now, going to the regional part, the EU. In 2004 it was EU-15; now we have more than that, 25, I think, EU0-25. But at that time producing about 200 million tons of municipal solid waste. And I'll only touch this very briefly, Kit.

The one very important, I think, in my mind, very important piece of legislation that was passed there was the landfill directive. Very

very critical. That has really pushed a lot of changes in the EU.

And this is one of them. It's a very brief summary. Essentially what it does is reduces -- requires a reduction in the amount of organic matter that is placed in the landfill. And in '06 75 percent; then 50; and eventually 35. There's some exceptions, but that's the general concept. Less and less organic matter into the landfill.

Now, there's some countries that have gone even further, and essentially they're banning because it's like 5 percent volatile solids, only 5 percent volatile solids going into the landfill. So, it's basically inert matter that can only be put in the landfill.

So, in my mind that's one of the drivers of all of the evolution of waste management going on in the EU.

They also have a EU framework directive; it's a hierarchy of processes. This establishment sustainable waste management; so it's really nice. Defines the waste types.

Now, in 2002 you can see the gradation, and I've tried to make it colorful. I don't know if you can see it. The red represents combustion. This is what some countries were using as their method of treatment and disposal.

And it goes from the left, it's Denmark on your left-hand side. You can see it is and was rely on incineration. And on the far right we have countries like Greece, Portugal and unfortunately at that time the United Kingdom was also relying on landfill disposal. So that's the gray areas on the bars. That was in 2002. And is still, the U.K. is still relying on a substantial amount of landfill disposal.

Now, in '04 -- and I've tried to use data that are kind of reliable, the most recent data I don't feel comfortable giving it to you, but this one is. So I combined here, the colors should not be like that, but that's the way it turned out.

Landfilling 44 percent EU-wide; thermal treatment 24; and the rest is some form of recycling. So recycling is increasing.

Waste-to-energy. That's a very -- I really like the architecture of that incinerator in Vienna. It is just something really nice to look at. That is an incinerator operating. It's wonderful. Costly.

Fifty million tons of MSW were treated in 420 plants and produced 20 million megawatt hours of electricity. And the other thing that we don't understand here very well is that in Europe you have district heating, so that allows you to use a lot of the heat; 50 million megawatt hours of heat are being used with those 50 million tons.

And then at the same time in '05 there were 13 countries that were using a lot of -- producing a lot of RDF SRF, as they call it, almost 13 million tons.

There's some issues about the marketability of the RDF, but I don't have time to cover all of that. If you have any questions, or you know about that, I'm not trying to skirt the issue. We can talk about it later.

Now, modern incineration. Controlled feeding, that's really important. Optimize combustion, value in reduction and inertization.

Then energy recovery. We talked about that. It's power recovery, generation of power, plus heat, CHP.

And then there's a lot of work being done on the segregation of pollutants from the ash, the different types of ash. And I get, apparently get like ten different manuscripts per week on some type of ash processing.

To use the ash, some countries that are using the bottom ash and also the recovered metals from the fly ash.

Lots of waste-to-energy facilities throughout the EU. You can see there that for instance Germany has 61 plants in '04 processing about 14 million tons per annum. So, lots of plants all over the EU. And I included most of the new countries that have been admitted.

Important things to remember. The way that the ash -- one of the concerns here in the United States is what happens to the ash. And this is a way that it's being managed there. Fusion, stabilization, filler in asphalt in the Netherlands is fairly common. Some countries are storing it for future use, in quotes, just like we do with some of our nuclear waste.

(Laughter.)

DR. DIAZ: Solid residues. This is a mass balance, an average mass balance for a typical modern waste-to-energy facility. You have 1000 kilograms of waste going in; produce about

200 kg of bottom ash. That's used, and quite a bit of research is being done on the impact of using the ash on roads and so on. And then 15 kg of fly ash and 12 kg of salts.

In the U.S. same thing. A lot of laws that we have passed. In '03 we produced about 240 million tons per year of MSW. And we spent say on the order of $40 billion to manage those wastes countrywide.

How are we managing the waste? According to the EPA is like that. Land disposal about 55 percent; combustion 14; and the rest is recycled. This is average countrywide.

We have 89 waste-to-energy facilities now. This is fairly new information. Processing the capacity is about 31 million tons per year.

How this number has changed since 1982. We had about 59 facilities and now we have 89. We peaked in 1993 with 136 facilities.

Now, what can we do to optimize thermal processes. We have to increase energy efficiency; reduce the flow of flue gas. Of course, minimize air pollution, dioxins, carbon monoxide, NOx. Corrosion is a problem. We have to reduce it. And then improve ash management.

How we do on that. On a worldwide basis we have water-cooled grates; we have recirculation of flue gas; we are enriching the amount of air going into the combustion unit with oxygen; and we're also cladding boiler tubes.

Gasification, very quickly. That's a very old process. You can see 240D there. I wish I had that one; that's really nice. All of these -- this process was used during the Second World War to fuel vehicles. So, we're not talking about something that's new. It's been around for a number of years, the process, itself.

But what we have to keep in mind is that was for a very homogeneous fuel, in this case coal. When we introduce wastes or a mixture of wastes, say RDF, densified RDF, or biomass, mixtures of biomass, different types of trees, then the process gets a little bit complicated.

I've given you some equations there for you scientists. It's nothing extraordinary, reducing carbon monoxide and hydrogen. The key here is to clean it up, clean up the gas so that you can use that gas in some form. In a combustion agent, to recover the hydrogen, or to make chemicals.

And as I said, I make mistakes. We've had this thing running in the 1980s in our lab at the University of California at Berkeley. And you have a very sexy looking reactor there on the right. It's a 55-gallon, very inexpensive reactor on a scale.

We fed the gas into an IC engine. We evaluated what happened to the pistons, the valves, all of that, the impact of not cleaning the gas properly. Corrosion.

I also had the pleasure of working in the Philippines. The Philippines in the 1980s. I think I was talking to Val earlier yesterday. There was a nonconventional source of -- resource center. We were building these things in the 1980s. Gasifying all kinds of biomass. And putting these units in their jitneys, in their vehicles. But very homogeneous biomass.

And now when we're talking about municipal solid waste, I'll give you just one example. There's several; this is by no means an endorsement on the corporation. I've been trying to get to this facility in Tokyo. I know that Fernando will be going there, so I'm looking -- may be going there, so I'm looking forward to getting some data.

They have installed these plants. Allegedly they're working, and they have been working for quite awhile. The one in Tokyo-Chiba processing about 100,000 tons per annum.

Now, one possibility, and I think it's very viable, one of my colleagues in Germany, Bern Bilitewski, suggest to use gasification as a free process and feed the gas into combustion chamber, as well as with coal, to use syngas.

Pyrolysis. Endothermic reaction, which means that you have to add heat to this reactor, you add heat. Heat it to different temperatures, different pressures. You form a gas, a liquid and char from the organic matter. This is basically what happens in the reaction. And you can play with the temperature and the pressure to adjust the amount of gas, liquid and/or char.

Issues that come, as I talked to you earlier, that the liquid may be corrosive, depending upon what kind of biomass you're processing. If you've tried to burn eucalyptus here in California, for instance, in your fireplace you know what can happen to your flue. So these are the analogies of what can happen to the gas when you're gasifying that.

Quickly, an application. I snuck this one; it's from my colleagues in Japan. Pyrolysis and gasification is being widely used in Japan for the treatment of the ash from incineration, for melting it. And the slag is processed and made into these pellets that you see on the right-hand side. They have about 150 melting facilities throughout the country. And they're heavily subsidized by the government.

FT, we talked about this process. It's also been around for a long time, since the early 1920s, to produce synthetic fuels. So the process, itself, is nothing new. It's how you apply it, what kind of gas you're going to put into it. The key is to have a gas that would be clean enough so that the process can be carried out.

But FT -- plasma, how am I doing -- I'm going to go over, I'm sorry, but I would like to go to biogasification, because that's really interesting. It can be applied to wastes here in California and in other parts of the country.

I talked about the two general types of anaerobic digestion, wet and dry. There's several plants, many many plants in the EU. Five thousand onfarm digestion plants now in Germany and Austria.

Also, as I said, some countries require very low organic matter content be going to the landfills, so it's called mechanical biological treatment plants. And ask me about those later on.

Many AD plants throughout Europe. In '04 there were many of them treating many thousands of tons per year. We were doing this in Berkeley in the 1980s, food waste digestion. Again, nothing new. But there are some -- what's driving anaerobic digestion in Europe, it's the subsidies, financial subsidies given by some countries.

And this is one that I just visited last month in Germany. Dry fermentation. It's a very nice looking building. The reactors look like garages. Here's a schematic diagram; it's a batch process. Put it in with a front-end loader. You let it degrade; collect the gas; open it up; put in a new batch. They also have -- flow feeding, continuous dry fermentation. Many designs now of biogas facilities. I think there there'll be somebody else talking about one particular type, but there are many. The shapes, different sizes.

In Germany they have more than -- almost 3000 facilities. But what's driving that is the financial incentives. In Germany, this is an example, they get a compensation for producing electricity; compensation if you're using an energy crop. You get an additional bonus for extent of heat use. And then if you have a different technology you get even more. So there are bonuses on top of bonuses. A lot of incentives.

You can produce hydrogen biologically through enzymes. There are three that have been identified. A lot of work being done on fermentation to produce biohydrogen.

Enzymatic hydrolysis. We talked about that a lot yesterday, to make glucose, and then eventually make alcohol.

Just a couple more minutes, please, Mr. Chairman, because these are the critical things about all of this. Some of the issues that I see.

Operations and maintenance. We really don't know how much things are costing in some of these relatively new technologies, and we don't get the proper amount of data, quality of data. Not enough independent objective estimates.

When you work with waste everything clogs. Waste is very abrasive. You can see that valve there that was clogged when we were producing pulp. Everything clogs. Things get dirty; it's corrosive.

Reliability, availability. Very low. So we have to improve systems. We have to design better preprocessing systems, conversion technologies.

We talked about agricultural wastes yesterday quite a bit, but collection of these wastes is fairly expensive. These wastes are dispersed all over the countryside. So we have to consider that if we're going to be able to use them.

We need R&D to improve the efficiency of waste-to-energy facilities. And consequently reduce the cost of energy generation.

I emphasize and re-emphasize legislation and financial incentives are driving things in the EU. It's promoting anaerobic digestion, for sure, and in fact, some farmers are introducing maize into the digesters, mixed with -- corn mixed with manures.

But we don't seem to have enough good reliable information to make sound judgments. So we need to do that, collect data, good data. Even on the quantity and composition of the wastes. We can produce hydrogen biologically, but right now it's at the lag scale.

And last, a little commercial for our Sardinia Conference coming up in October in Italy. Anyone that's interested, we attract about 1000 people every two years. We cover a lot of topics over five days. This is like garbage camp, if you've gone to five days of nonstop garbage talk.

So, please, if you're interested, go and let me know. Thank you so much.

(Applause.)

MR. BERTON: Thank you, Luis, that's a lot of information and appreciate you sharing that. And, again, any information you got from that use it for the afternoon sessions.

Now I'd like to introduce Kit Strange. Since 1998 Kit Strange has been Director of the Resource Recovery Forum, a not-for-profit international association of more than 300 members worldwide. He also owns, publishes and edits a journal on sustainable waste management, Warmer Bulletin.

Kit Strange is Secretary General to the European Association of Cities and Regions for Recycling and Sustainable Resource Management, based in Brussels, Belgium. He is retained as Head of Strategy by the Edinburgh -- and you can correct my pronunciation -- International Resources and Recycling Institute.

He's written the text for two books, "Future Perfect" and "The Mass Balance Movement," both dealing with materials flow and mass balance studies in the U.K. environmental economy.

So, with that I'd like to introduce Kit Strange.

(Applause.)

MR. STRANGE: Thank you very much indeed. Good morning, ladies and gentlemen. I'll take another one at the end and then we can digitally measure how many of you are asleep at the beginning and the end. It's a helpful indicator.

(Laughter.)

MR. STRANGE: It's really nice to be here; thank you very much indeed, both to the

Integrated Waste Management Board and also UC Davis. It's very very kind of you to allow me to come over here again.

It's also the first time I have ever spoken in a facility where they provided an internet cafe. If it gets a little bit dull I can see we've got a couple of guys checking the weather and the emailers down here. So, that's good news.

The process, we do this, you know, we provide a written paper. And there's quite a long paper that has come that I sent with this, 8000 or 10,000 words with lots and lots of information in. And after that, about a week later, you send in your PowerPoint slides. And then after that you start to think about what it is you really want to say. And then after that you turn up and you listen to the first day; and you then think how can you change what it was you'd planned. So everything I want to say is written in my paper.

But I do want to react to the way in which the first day took things forward, and other things. And actually, on the plane over I was reading last week's Economist magazine, which is here. And I'd quite like to just read a paragraph, because it's very pertinent. It's an editorial piece in the Economist, and it's called, "What Price Carbon?" It's just a paragraph, but it's relevant.

It says: Governments can try to reduce emissions in three ways: subsidize alternatives; impose standards on products and processes; and price the greenhouse gases that cause the damage. The first is almost always about idea; the second should generally be avoided; the third is the way to go." And that's from the Economist, obviously.

Europeans do all three. America does the first and the second; it stays in federal levels. California has decided to do the third and it looks as though a federal system priced carbon will follow. Green energy is fat with subsidies. America's ethanol subsidy, which has led to a huge rise in production. Rocketing maize prices and rioting in Mexico is the sharpest example of why the government should not pick winners. Once the fertilizer and fuel used in corn production are taken into account ethanol may not be much greener than petrol, or gasoline."

So, I found that's an interesting way of setting up the opportunity that I'd like to take to run through some slides and some views on the way in which we're handling things differently, and in some ways the same on the other side of the Atlantic.

So I've got some slides. They don't necessarily follow in the right order, because I've slightly changed the emphasis of what I want to say. But I set out a number of slides.

And what I want to cover are the drivers for change that we're seeing in place. And what are the best practices that we have to offer in Europe, both in terms of policy and practice. And also the role of energy recovery, as Luis has explained, is an important element. Not just in the old-fashioned paradigm of waste management, but also in the greater demands that we now have as a policy tool for sustainable development and for climate change.

And certainly energy recovery is now seen not simply as a way of dealing with waste, which is the way we certainly in many European countries; for decades we've approached that option. We're now using it much more heavily as a means of compliance with our landfill diversion obligations. It's the landfill directive that

Luis had mentioned.

It's a contributor to our compliance with the Kyoto targets. It is actually seen now as a means of cutting waste disposal costs; reducing the public sector costs for waste management, as well, involving the private sector, as it does very often. And also allows us to achieve higher other material recovery targets for a number of reasons.

The way in which policies go in Europe is quite clearly the last ten years have seen a fundamental change, and a very exciting one. Obviously policy tends to go first, and practice catches up afterwards. So we're still looking at exciting prospects for the future.

But very much the emphasis has been on assigning financial responsibility for waste streams, primarily to producers. That's been the biggest change, is trying to tack the costs of end-of-life management processes and activities on the sectors that produce those in the first place.

And this is basically taking a decision in society as to whether we -- it's all of us that pays for these things -- to whether we should be paying, as consumers, in proportion to the amount we consume, or whether we pay as taxpayers through the sort of common public purse.

And the policy in Europe has also looked primarily at diverting organic material from landfill. It's not seen, I believe, essentially as a policy tool in the way that it appears to me to be in America, where there's as much an element of energy security. In fact, President Bush, I think, was on television last night applauding one of the renewable initiatives here, and claiming that really in the name of energy security, as the first objective. In Europe it's more seen to do with management of a resource.

And, of course, in Europe we want to -- we say we want to look at waste prevention as one of the highest levels of the hierarchy. And, indeed, there is more evidence now that some of the countries that Luis has been working in, Austria and Germany and Switzerland, particularly, but some of the northern European countries where waste prevention is actually moving forward now, providing you can measure it, you can actually make a lot of progress.

So I ought to move into some of my slides. Seems a long way away. But these are for illustrative purposes only.

The policy tools in Europe now have broadened to embrace the issues of sustainable development and climate change. But fundamentally we're still looking at consumption issues. And this is just a measure from the OECD last year looking at the amount of waste we produce as individuals. And that's measured there in kilograms per capita.

It's not particularly material to quite which ones are which, but certainly the three highest, Iceland, Ireland and the USA. So it's very difficult to draw broad assumptions as to why that might be. I would suggest it's largely to do with the definition of what's in municipal solid waste. And if you weigh things like vehicles in there, as well, then it obviously skews the figures.

There's a big study published a couple of years ago now by the European Environment Agency, looking at the factors for change in the next 30 years in Europe.

And we can see clearly population is set to continue to grow. The number of households will grow. This is very important, because not only are we seeing a significant growth in the number of homes, but also a significant decrease in the size of those households. The average population of a house falling from about three in the 1990s to nearer, or less than 2.5 in 2030.

Of course, we know that the smaller the household the less efficient we are on resources. This was a study of three or four years ago, which shows the number of products per person we would buy in a year, 3400 if we live alone, 1400 if we live in a three-person household. And the same applies to the mass of products and the mass of packaging. And so these trends of population are not encouraging.

Gross domestic product, well for affluence, is also set -- this is across Europe -- to increase substantially. And there's been little we can do historically to break the link between GDP and waste arisings. That's the biggest single battle that we have, is to decouple those two.

There's some evidence in some countries that that's been achieved. It's difficult to be certain at the moment, but Germany claims to have done it. And there's some evidence in parts of

Belgium that whole regions have broken this link. But normally if you see a waste arising's decline it's because the economy has suffered; more people are out of work.

Energy consumption in Europe also set to grow. This means inevitably the predictions are that a number of waste streams will grow substantially, some by more than 50 percent, over the next 20 years.

And we heard yesterday that the difficulty in conceiving of a 50 percent growth in energy consumption, well, you can't see the energy particularly, but you got a 50 percent growth in European solid waste arisings over the same period. And that's material that you can see, and it all tends to pile up and needs processing.

So I don't want to dwell too much on the behavior aspects, because that's not really what we're here for. But it is important, because it's what we consume and what we buy, and how we behave with the waste materials that dictate how much waste there is to deal with, and what's in it, and the cost of it.

And a study that we ran four or five years ago now concluded the factors at work here are really population density and affluence. And I'll come on to those. There are some other factors, such as whether you have a garden and how big that garden is, that also play an important role.

But we took a look at the best performers across Europe, and what they were doing in the wa of recovering and recycling and composting materials. And these are a number of towns, municipalities; and they indicate recycling rates of up to 55 or even 60 percent.

The top left is the Belgian region of Flanders, which is perhaps the best place to go in Europe if you want an example of how policy and practice have come together to give you really the ideal opportunity to make the most of the resources. They are the top performers, in my view. And if you want to visit anywhere, that's the place to go.

But clearly it's not just how much you recycle, it's how much waste you've got in the first place that's important. And these are the same towns, showing you the red dots, how much was recovered; but the blue diamonds, how much was there in the first place. Because the most important element, of course, is what's left over at the end.

And this -- by the way, these are measured in kilograms per person per year, up the side; running from 25 at the bottom to 475 at the top. This shows actually how much residual waste there was in the bin after they'd finished playing about with it and getting back what they could.

The top left there is the English average, which we were leaving more than 450 kilos per person in our bin. It's a bit better now.

But the point is how to make the best of that. And, of course, recycling and composting were seen -- are seen as the ways in which to get the public going; produce effective products back into the market.

And we found that you can get upper limits, probably 60 percent or so, of recycling and composting in areas which are rural, 250 people per square kilometer or less. And Europe, that's hard to do.

This graph simply shows you what an enormous contribution you get to recovery levels from the organics. Without the organics recovery, either for composting or for a fuel or for energy or anaerobic digestion, we would be performing disastrously across Europe.

But it's really when you start looking at adding on the organic system -- this was a local authority in the U.K. in the late 1990s which started out 80, 100 kilos per inhabitant -- or per household per year. And they added green waste collection for composting. And you can see over the subsequent years, the amazing development in terms of resource recovery. And that's important because that was previously going into landfill.

As the population density increases the recycling and the recovery rate potential goes down. And there's that familiar incinerator again in Vienna. But, again, in Vienna 3000 people per square kilometer; it's very difficult for them to recycle much more than a third of the waste.

So the point here is that recycling and composting will not do it all. They just can't. Best practice in Europe will allow us to pull about 120 kilos per person out of the bin containing dry recyclables. Perhaps 100 kilos per person per year of green waste.

But there's still a lot more left that

needs to be dealt with. On this slide, which one can make out there, it's just a very quick illustration of the fact that if you've got a system in your waste stream and you target a certain amount of materials as being recyclable, you give the service to a certain proportion of your homes. Some of those participate and some of those don't. And the ones that participate capture all or less than all of the material.

If you put in optimistic assumptions in each of those links in the chain, you can only get to about 60 percent recovery. And, of course, you don't need to make very pessimistic assumptions in one or two of those links by multiplying all these numbers together, each less than one, you quickly come down to very low levels of recovery.

So, back to Flanders with its waste prevention, its energy recovery, it's achieving the best in Europe.

But I wanted to move on to the tools. Luis has covered thee amount of energy recovery in Europe. Okay, the key tools we're playing with in Europe: Variable rate charging, which we're not allowed to do in Britain. The mandatory collection of recyclables, which also applies to biowaste in some countries.

Banning material from landfill or restricting it and taxing materials are the key clues to move effective use of resources.

Well, okay, that was quite an interesting one. That was showing you the --

(Laughter.)

MR. STRANGE: -- different tools that were available to be used in different countries. And I just wanted to mention a few of those because they are being used in quite adventurous ways. Somewhere here, my little table.

But it's to do with many countries now are using a blend of tools, carrots and sticks. So if you looked at my little table here you would see the most of the most successful countries are using a blend of landfill taxes and bans, statutory recycling targets, effective producer responsibility in a number of streams, voluntary agreements with different sectors, public and private, and different waste streams and product streams, separate collection and variable rate charging. But I wanted to show you which countries were using it and what that led to.

But in terms of the biggest tool before

I just move on to the conclusions, is the landfill directive in Europe. It affects all of the countries in Europe. And just as an update, there are 27 now. We had Romania and Bulgaria joined in January. It won't get a lot bigger, but it's big now. And we're about 300 million people across Europe.

But the directive affects us all with these targets that Luis has shown that we need to divert. But it's very interesting because the targets are fixed on the amount of organic material that was in the municipal waste in 1995. Apologies, I told you 1998 yesterday, but it was '95.

So that fixed a certain number of tons that would be allowed to be landfilled in Europe. And, of course, since 1995 the waste arisings have gone up for all the reasons I've shown you. And that's meant more and more challenging. And in countries they've tackled this in different ways.

But there are really severe penalties that will attach to countries that fail to meet these targets. $1 million a day will be a quite normal fine to come from Europe on countries that don't manage to get these diversion rates in place. And they bite because they get worse over time, and of course the waste arisings are increasing over time, so we get more and more squeezed.

I just wanted to spend a moment telling you that in England, that's not the whole of the U.K., but in England we've introduced in 2005 something called the landfill allowance trading scheme, which is a very interesting innovative concept.

Which basically gives an obligation, an allowance to every local authority based on the amount of organic material they were disposing of back in the '90s. And it's permission to landfill biodegradable municipal waste.

And those allowances they can trade, they can bank, they can buy and sell them. And depending on what they have in place, in terms of their waste management system, they can make money or they can lose money. And they can opt to invest in infrastructure to avoid the charges that will inevitably come.

And is often the case with these permit trading systems, it's very easy. Last year, the first year it was measured, everybody complied.

But a report from our audit office came out at the end of 2006 and it showed quite conclusively that Britain will face a real problem complying with targets in 2010, 2013.

And when you look at how many millions of tons of biodegradable material have to be removed from landfill by then, even with optimistic assumptions about how much more waste is likely to be, you can see we, in Britain, will need something like 200 new waste management facilities. And those might be incinerators, composting plants. It's a remarkable burden on communities, but it's going to have to be developed.

So the next question is how you can get through a planning system which makes it very difficult to put those kind of infrastructures in places.

So, very briefly, on to my conclusions. I've got really a final set of observations. Clearly in Europe we are worried about landfill diversion. It's a very crowded place and some countries really just don't have the land anyway.

We are focusing on waste prevention and there are some really neat examples which I could talk to you about; national strategies of embedded prevention in and local strategies that are really delivering schemes.

The priority remains organics and the curbside collection of recyclables. And the more we can charge householders will provide an instrument that would effectively change their behavior.

And I think that's probably where I'd like to conclude. So, thank you very much.

(Applause.)

MR. STRANGE: I think the clapping might have woken up the ones that were asleep.

(Laughter.)

MR. STRANGE: Thank you very much.

MR. BERTON: Thank you very much. Okay, our next speaker is Chuck White with Waste Management, Incorporated. I don't have a bio for him, but he really needs no introduction, so --

(Laughter.)

MR. WHITE: Didn't I send a bio over? Well, thank you very much. I feel a little bit out of place with this august group and this panel. But I'll try to do my best to catch up.

I've had a series of epiphanies in my

lifetime that have kind of brought me to this point in time. One of the first ones when I was about four years old and I saw these big garbage trucks. And I thought, boy, this is pretty impressive; I want to do that.

The second one was actually Earth Day in 1970 when I was in college and the founder of Earth Day, we know, he was at the University of Michigan, and I met, kind of woke me up. I said, well, maybe I don't want to be a mechanical engineer learning how to build automobiles; maybe I want to become an environmental engineer. So I kind of did that.

But when I was still working with Oldsmobile as a student trainee, I had this very in-depth conversation with the engineer that I was working for. You've all seen the movie "The Graduate" perhaps, where it's "plastics, young man, plastics"? Well, the Oldsmobile engineer said, it's waste, young man, it's waste. We need to figure out what we're going to do with all this waste we're generating. So that was kind of my third epiphany.

My fourth epiphany, I think, is greenhouse gases. And this last year has kind of taken over my life with respect to this issue.

I've been asked to talk about feedstock quality, separation of markets. I'm kind of a regulatory affairs guy. I spend more time in this room and this building trying to figure out what the regulatory agencies are up to, than I do necessarily worrying about feedstock quality and separation.

But I'll try to do my best with respect to this issue that is really emerging this last year with respect to climate change.

People think of Waste Management as a big landfill company and a garbage company, $13.5 billion company. We've got 350 landfills throughout the United States and all this kind of thing. But more and more I'm beginning to think of Waste Management as a recycle energy company. And why is that?

Well, truly we have a lot of landfills, but we generate 470 megawatts of power from the landfill gas that we collect. And we're certainly not collecting all the landfill gas that we need to be doing. There's a lot more we can do, and I'll touch on that as I go through.

And we have 17 waste-to-energy plants.

So we own Wheelabrator, which is one of the largest companies in the United States, that converts waste to energy, primarily in the east and Florida. But we also have a plant here in California that does biomass, wood waste to energy.

But by far the largest energy, and by indirect result, on greenhouse gas emissions is our recycling operations. We're one of the largest collector of recyclable materials, processor of recyclable, marketer of recycled materials, in the United States. We have 138 recycling facilities. And the amount of energy that's saved as a result of recycling rather than using virgin materials dwarfs the other two categories.

And so when we talk about how we're going to be moving to the future of waste management, and I mean the little "w", little "m", in California and the United States, these are important factors to keep in mind.

Was 2006 the year of greenhouse gases? Well, it certainly was here in California. But I can tell you, just wait for 2007 and 2008 and 2009 and 2010 and so on. It's just going to keep on ratcheting up. And I really think this is going to be one of the biggest drivers, not only of the solid waste industry, but through our society, as a whole. And I don't think any of us really fully recognize what the consequences of this are going to be, but I think it's pretty exciting. And that's why I kind of think that's one of the biggest epiphanies in my life, is trying to get a better handle on what climate change will do, not only to society as a whole, but also to our industry.

With respect to emerging programs, and believe me, they are just emerging. We don't know where the mandatory greenhouse gas reporting and inventorying is going to go. The enforceable greenhouse gas emission caps. What kind of offset or credit trading program is going to evolve. What role is the waste operations, both landfills, our collection fleet, going to play in this new developing scheme.

Potential carbon taxes could have a huge impact on our operations. New fuel engine mandates; we see those go on all the time. And transition to low carbon fuels; that's going to hurt our truck fleet, but at the same time may provide an opportunity if we can provide that fuel from some of the biomass that we own and operate, including landfill gas and including the biomass we receive. And what kind of new technology incentives are out there to really move the ball forward.

Now Citigroup is a big investment group; and they look at investing in solutions to climate change. And they had a number of findings recently this last year. The U.S. will likely follow the global trend. We'll be behind, but we won't be that far behind I don't think. There's a lot of legislative activity, certainly in California.

But just take a look at the number of bills in the U.S. Congress right now. And some of those are very aggressive bills, although the most aggressive ones are modeled pretty closely after AB-32 that we have here in California.

There's a lot of investment opportunities. In fact, that's one of the center points of Governor Schwarzenegger's efforts is that this is really going to help the economy grow because it's going to bring new businesses, new opportunities. But there's clearly going to be a transition.

Oh, and by the way, the Citigroup mentioned the clean dozen companies that they thought were best suited to respond to this, and I'll just mention one. Oh, yeah, it's Waste Management.

(Laughter.)

MR. WHITE: Anyways, well, what is the solid waste greenhouse gas sources and sinks? There's a whole bunch of them, but really the four biggest ones are, number one, our collection and transportation fleet and its net source of emissions.

But we need to figure out ways we can lower those emissions through more efficient collection, more efficient routing. We're even looking at hybrid refuse trucks that we think has a potential of reducing fossil fuel consumption by as much as 40 percent.

So there is clearly a source of emissions we've got to take responsibility for. We've joined the California Climate Action Registry this year. And we're going to be reporting our entitywide California emissions for the first time anyway in the United States. And we're going to be rolling that out for the rest of the country. And it's really going to be interesting to see what Waste Management's net footprint is with respect to sources, and other sources and sinks.

Well, now landfills. They're clearly a source of greenhouse gases, fugitive emissions of methane. But we've been regulated for methane capture in California more stringently than anyplace else in the country for a long time, over 16 years. And so we think that a majority of our landfill gas has been captured.

Now there are some landfills that don't have gas collection systems. None of ours, typically smaller ones. But there's probably more we can do to really make sure we're doing everything we can to capture the landfill gas and turn it into a beneficial use, into energy.

Right now only about 50 percent of the landfill gas in California that is being captured is being used to generated power. It's just being flared. Now, it turns it back into carbon dioxide, which is a biogenic form of carbon dioxide that comes from biomass. But nonetheless, there's more we can do.

And also landfills are a sink. About 50 percent of the carbon of the potentially biodegradable carbon, biogenic carbon, is sequestered. Landfills form an anaerobic environment; as long as that anaerobic environment is maintained, lignins and other kinds of materials in the waste are essentially stored. And maybe provide an opportunity for recovery.

In fact I was down at the California Climate Action Registry conference last week in Santa Barbara and one of the big editorials in the local Santa Barbara paper is how they wanted to go back in and mine the waste out of the local landfill down there and use it for energy recovery.

Why is that energy recovery a potential possibility? Because there's carbon stored in that landfill.

Waste-to-energy. I mentioned Wheelabrator. We have a lot of mass burn facilities. They're not particularly popular here in California. We wish that we could change that. We think they're a pretty clean technology. But there's a lot of environmental opposition to high-temperature technologies, certainly mass burn, but others as well.

It's clearly a source of emissions to the extent that a portion of the waste stream is derived from fossil fuels like plastics. Those are a net anthropogenic source of greenhouse gas emissions. But to the extent you actually generate power from the biomass it's a net sink as a displacement for fossil fuels.

And then finally, and one we can't ever forget, is recycling and composting. And it's a net sink. Every recycle material you collect has a net benefit of reducing greenhouse gases as a replacement for virgin materials. One of the big factors, though, is transportation. How far do you have to transport that using fossil fuels to get it to a point of use.

The history of solid waste management in the United States has really undergone tremendous changes. Prior to the '70s there were -- sanitary landfills were rare. Wastes were dumped and burned to reduce volume. Waste incinerators had no pollution control. There was very little recycling. And that, by the way, is based on a paper that I've got a reference in the back. It's on there by Weitz and Thorneloe.

Major changes have included source reduction, recycling, composting yard waste, integrated regional waste solutions, waste-to-energy facilities with minimal environmental burden, and the adoption of sanitary landfilling practice that has controlled landfill gas and leachate recirculation and addition of other liquids and so-called bioreactors to enhance the biogenic.

And here's the kind of summary this paper comes up with of where we've been over the last 30 years in waste management in the United States. If we had followed the 1974 technology path we would be basically generating far more greenhouse gases today than we were back in 1974.

But instead, the actual technology path of transitioning to more recycling, more source reduction, more energy recovery and most importantly, we've controlled our landfill gas to a high degree; and we certainly look for further room for improvement.

But there's been a net 50 million metric tons of carbon equivalence in the United States avoided because of the practices. There's very few industries in the United States that can point over the last 38 to 40 years a net decline in greenhouse gas emissions. If you look at the automobile, petroleum refinery, cement, they're all going up. The waste industry, we believe, and this study certainly supports that, has gone way down. There's still room for improvement.

One of the great documents I urge people to familiarize themselves, if you're not already, is this latest publication of solid waste management and greenhouse gases by USEPA. And it really does a complete lifecycle analysis. It points out some of the limitations of their evaluation, the need for more data. It's available on EPA's website for downloading.

And it really comes up with a kind of an interesting conclusion. It says source reduction makes the most sense for greenhouse gases. Recycling is second. Energy recovery is next. And composting and landfilling are actually pretty close to each other. I kind of put composting up ahead of landfilling because I thought that was the right thing to do.

(Laughter.)

MR. WHITE: And here's the kind of thing they go through in a lifecycle analysis. Now, I hate people that give presentations with slides like this, because you can't possibly decipher what it says.

But suffice it to say that it's a description of the overall lifecycle starting from virgin materials through the manufacturing of products, the generated and greenhouse gas emissions from the manufacturing process; to the recycling, and sinks of greenhouse gases. Then the transportation of waste products to landfills, to composting; and to waste-to-energy facilities. And the net emissions and net sinks of greenhouse gases that come through this overall train. It's a very excellent summary of the state of evaluation of greenhouse gases.

Let's take a look at landfills. Carbon inputs to landfills, basically 50 percent of the waste that goes into a landfill is sequestered. There's carbon storage for a long term due to the anaerobic environment.

About one quarter of the carbon comes up as methane. That's the bad stuff. We get penalized for that; everybody hates to think of the methane, and that landfills generate methane. But we put in landfill gas collection systems that are very effective at reducing that. The question is how much of the reducing of that, and that's a big unknown.

We can measure how much landfill gas we collect, but we can't measure the landfill gas that is fugitively emitted. And you have to use a number of assumptions and calculations to derive an estimate of the fugitive emissions. And there's a wide variety of opinion.

In fact, EPA currently uses a factor of 75 percent capture of landfill gas. Where did that 75 percent come from? They did a survey of the various managers at landfills around the country and asked them what they thought the estimate was. And it ranged from about 50 percent to 100 percent. So guess what number they chose.

(Laughter.)

MR. WHITE: That's where the numbers come from for methane emissions from landfills.

So, you know, the question is how well are you operating your landfill gas system and how finely tuned is it.

The other quarter is upping the CO2, which, again, I pointed out is biogenic. It really doesn't really contribute as CO2, but as good CO_2 in the sense it doesn't come from fossil fuels.

Sorry to do this to you folks, but I'm sure you can't read it. But I'll try to summarize it for you. There are various types of carbon biomass that goes into landfills. My number's about 52 percent; it was off the Waste Board's work. And there's probably some -- probably missed some numbers there, but it's generally over 50 percent.

And take a look at the total tons disposed, of how much comes up as estimated to come up as methane, how much is carbon storage, how much you can get derived from recycling, the Btus, and the avoided, the CO_2 that could be from energy recovery of all these wastes.

And down at the bottom you see the kind of comparison of landfill versus carbon storage, and there's about twice as much bad carbon going up in methane as in carbon storage. But that assumes only 75 percent capture of methane. If we could improve that and show we're capturing more, landfills could be a net-neutral contribution.

Now, does that mean that's all we can do? When I give this presentation people say, oh, that's, there goes Chuck, again, he's talking about how landfills are the solution to global warming. And that's not what I'm saying at all. I'm just simply saying the landfills need to be evaluated for what they are.

Take a look at recycling and composting. The highest numbers are for various papers and cardboard and you get more energy and greenhouse gas savings out of recycling that cardboard and paper into new cardboard and paper rather than trying to do any kind of energy recovery.

The low number is from composting of food, lumber materials, leaves, grass, prunings, trimmings and so on and so forth. Doesn't make a whole lot of sense to do composting of all those based upon as compared to paper and cardboard.

Take a look at the total Btus. If you have energy recovery from those Btus of only 20 percent, and there's many technologies that can push that number higher, you really want to be focusing on your, you know, potentially it's better for paper, for example, to recycle it than it is to burn it, because you get more greenhouse gas reduction from that.

It's kind of a wash with respect to

food, so maybe it makes sense to do food composting. With respect to lumber we get far more energy value than recycling it, so it's better to generate the power from lumber. And cardboard, it makes more sense to recycle rather than burn it, so it makes more sense to pull that cardboard out before you send it to your energy recovery facility. Leaves and grass may make more sense to compost rather than burn it because you get very low return on heat. And then prunings and trimmings and branches all make sense to do energy recovery.

And here's just a chart showing the benefits of recycling. The biggest question is who's going to get the credit for this. Landfill's getting penalized for emissions, but who -- you talk about, this is a huge amount of greenhouse gas reductions from recycling, the collection and reuse of recycled materials in terms of avoided emissions from virgin materials, but who's going to get the credit. Is it going to be the State of California for passing the 50 percent diversion requirement; or is it going to be the city or county for establishing the program; or is going to be Waste Management for collecting it and doing it? Or is it going to be ultimately the manufacturer that makes use of these materials?

There's an interesting study that was done talking about materials management in the United States in the average community. A whole series of different scenarios that were done talking about 10 percent recycling, 90 percent landfilling; to 20 percent recycling to 80 percent landfilling; 30 percent recycling, 70 percent landfilling. And then about where California is now, 30 to 50 percent diversion, and with 70 percent landfilling, as an example. And then more energy recovery and other types of long haul to large regional landfills.

And what's the net greenhouse gas reductions? Well, California's somewhere around between 4 and 5. We think the overall greenhouse gas emissions from the current system of the way our waste is managed is probably -- but we're probably getting close to a neutral because of all the recycling that's going on.

But if you take a look at number 7, the best option is biomass-to-energy in terms of net greenhouse gas reductions. That's number 7 there.

Number 8 and 9 are just simply long haul to large distant landfills. Because of transportation costs of greenhouse gases and energy, begin to go back again.

So, overall, from the greenhouse gas standpoint it makes sense to separate those things to generate power. The problem is the net annualized cost. For 20 percent energy recovery the costs of, again number 7, is energy recovery, is very expensive. And it is a huge detriment.

We went through a process in Coachella Valley, Palm Desert to try to figure out if we could put in a waste-to-energy project. We chose anaerobic digestion as being -- the local government that was at the table with us wanted to find one that had the most experience, and it seemed to be anaerobic digestion in large part because of all the effort in Europe.

The problem was it was going to increase the tip fee about $10 a ton. And that was a cost that they were really concerned about paying, plus the fact they weren't certain they would get the diversion credit for it. So that project is kind of stalled.

I guess the point is we need to work

together as private enterprise with local governments to come up with the solutions even though they may, in fact, cost more money.

Waste Management's number one priority right now is to cork our flares. We want to get off of just simply flaring the gas and we want to convert it to energy.

Here's kind of Waste Management's priority. Number one, we want to make sure we're collecting all the gas we can. About 95 percent of it in California of waste in place has gas collection system; 95 percent has flaring and methane destruction. But we want to move to more internal combustion engines only about less than 50 percent used in internal combustion engines; another 10 percent use turbines or boilers. And we can improve upon that.

The problem is we're running into NOx emission problems, criteria pollutant problems that are forcing us to perhaps go back to flaring, and I'll talk about that if I have time in a second.

The next step would be refining the landfill gas to make a natural gas. That's much more expensive. We're going to try to do a demonstration project in one of our landfills later this year, or the next couple years. But there's no one doing that right now.

But then the next step beyond that is to prevent the organic material from going into landfill in the first place. And then use alternative methods of management such as compost conversion technologies to fuel.

We got some real challenges to landfill methane recovery and use because of variability of contaminants. I know Pat Sullivan will talk about that later. The expense of equipment and operations. And the criteria pollutant emissions standards. Everybody says you don't want to have any backtracking on criteria pollution emission standards like NOx.

But the problem is the regulatory agencies, the air districts, are lowering these standards more and more and more. It's just not holding to current standards, which you might be able to meet; but the new standards they're coming up with have the potential of shutting down landfill gas-to-energy recovery systems because of the problems of meeting the criteria pollutants, primarily NOx.

Then to go into the final step of going to cellulosic ethanol converting, that's one of the things we're looking at. Look at working with BlueFire; you'll hear more from the BlueFire project. To see if we can actually divert waste.

And I love this chart because it compares corn ethanol today with corn ethanol using coal for power, as compared to cellulosic ethanol.

One of the big challenges we're facing through is diversion credit. Right now we can take biomass and put it onto a landfill as alternative daily cover and get diversion credit for that. But if we take that same biomass and put it into an energy recovery like cellulosic ethanol plant it's considered to be disposal. That's got to change because that's going to be a net lock to prevent the development of these technologies.

Positive message for the waste industry. Waste-related emissions are small in total. You take a look at all of our collection. Landfill gas, our recycling, our waste-to-energy. Progress has been significant; huge reduction in the past years. We've increased recycling rates. We're moving landfill gas controls from 15 years to zero percent to more than 90 percent captured today. Increased diversion to energy and alternative fuel vehicles, which Waste Management's taking a lead in.

The big issue is going to be further landfill gas control and carbon storage and how do you make accurate estimates of what's really going on there. And, of course, the opportunities for further waste-to-energy are ever so important.

I've listed some references. A lot of this information is available. I'd be happy to provide these references or access to them if anybody is more interested.

Thank you very much.

(Applause.)

MR. BERTON: Thank you, Chuck.

MR. WHITE: Fernando kept that going, you know, one minute, one minute, one minute.

MR. BERTON: It's a very long one minute.

(Laughter.)

MR. BERTON: Thank you very much. Just as a reminder, there will be a chance for questions and answers after the next session; and all these PowerPoint presentations will be posted on the Biomass Collaborative's website.

It's break time now. If you can come back at 10:25 for the next session. So, thank you very much.

(Brief recess.)

MS. GILDART: We're going to start our sixth session. It is on biofuel production from municipal wastes. I think we've got a very interesting panel of speakers here. At the end of this session we should have time for some questions and answers before we break for lunch. Lunch will be in the Sierra Room where you just had your break.

The moderator for this session is Rob Williams. And he is the Research Engineer for the California Biomass Collaborative at UC Davis. And he has been with the Collaborative since its inception over four years ago. Rob.

MR. WILLIAMS: Thanks, Martha. And welcome back to session number six. Our first speaker in this session is Necy Sumait. She's a Senior Vice President of BlueFire Ethanol with responsibilities for business development and regulatory affairs.

Necy has been a long-time proponent of cellulose-to-ethanol processes and systems. Originally under the Arkenol name, or the Arkenol Company, which is the technology licensor for the BlueFire system.

Necy's also a member of the California Biomass Collaborative Executive Board. Prior to Arkenol, Necy was Vice President of Project Development for Luz, where she led the efforts to gain regulatory approvals from the Energy Commission and others for either solar thermal power plants of which seven were built in an under-five-year period.

Necy looks forward to an even more rapid deployment of BlueFire Ethanol opportunities starting in California. So, Necy.

(Applause.)

MS. SUMAIT: Good morning. I want to thank the Integrated Waste Management Board for focusing on the issue of MSW-to-ethanol; and actually it's a great opportunity. We had two other Board Members here, at least for, you know, part of the time to listen to the opportunities of doing something more with NSW.

Yesterday we heard phrases like, the

stars are aligning. We heard about convergence of interests forming creative innovative partnerships. We heard an oil company spokesman say biofuels are here and now. We heard GM committing to produce more flexible fuel vehicles in the future. So, indeed, I think the time is now.

Biofuels, in our estimation, will be the most significant achievement in the 21st century. And I'm personally happy to have survived a long trek to get here, and excited about the opportunity that lies before us, not only as BlueFire, but for California, as well.

I think it's important to remind ourselves, you all know what this slide contains. You know, why we're all here. It's important to take a few minutes to do that.

We need to reduce our foreign oil import dependency. Sixty-five percent of our U.S. oil consumption is imported. Oil imports are the largest single element of our U.S. trade deficit. California only produces 37 percent of its oil supplies here in the state. And we heard California relies on petroleum fuels for 96 percent of our transportation needs.

As our urban communities grow, as we continue to find alternative disposal for agricultural residues and for creating more health for our forests, we need to look forward and get a solid waste management strategy that works. And of late there's a lot of awareness about global climate change. And, of course, the preservation of natural resources.

The transportation sector, alone, accounts for 40 percent of California's annual greenhouse gas emissions. So focusing on that sector, I think, will create the most significant impact on reduction of greenhouse gas.

Another statement of fact. We all know that ethanol is produced in the midwest from corn. But yet our markets for ethanol are in the coastal areas. So we need to create geographic diversity in ethanol production. And we think cellulose could do that. Cellulose is the future of ethanol. Corn will always have a place on the table, and there's plenty of demand for all of that. But we need to be able to use our biomass so we can gain significant progress in meeting our energy security goals.

The Department of Energy's experts have

estimated that greenhouse gas emission reductions, and you saw it from Chuck's slide earlier, provides 90 percent reduction over petroleum. And if we put these biorefineries within landfills they're even greater greenhouse gas benefits.

We will create the geographic diversity by bringing ethanol production closer to the transportation fuel markets. We will contribute to our waste management goals of diverting cellulosic materials from landfill and creating more beneficial uses for agriculture and forest residues.

If we do all that right we would have established a new industry that creates economic development for our rural and our urban communities.

So one statement that I hope you all come away with today is that landfills, we need to look at them as our new energy source. The landfill wastes will continue to be there with or without us. Instead of burying it in the ground, it's useful to convert those to more useable products.

To the extent that landfill gas is also available it could be used to generate the power and the steam requirements for the ethanol biorefinery. And theoretically, since existing landfills already have regulatory oversight, it might simplify permitting for ethanol biorefineries. And we're hopeful for that.

And lastly, it would generate the greenhouse gas credits for ethanol production in addition to what's already benefitting us, as Chuck had said earlier, in landfills.

Of course, you know, BlueFire is very excited about receiving a DOE grant. But I think that DOE grant is a California victory. We now have an opportunity to show the rest of the nation that California can do cellulose-to-ethanol. We have a reputation to set trends; we have a large transportation market; we have significant biomass resources.

I just pulled this from the Integrated Waste Management Board's website. And I guess this number is even understated. If you had 15 million tons of materials going to landfill, conservatively that's a billion gallons per year of ethanol. That's our current demand for ethanol. We could fill that just with landfill waste.

Technology is already available to convert biomass renewable fuels. There's several ways to produce ethanol from biomass, you know, thermochemical, hydrolysis. At some level all the technologies work. And there's plenty of market for all to play.

The key would be to make them economic, to be sustainable in the marketplace, and to be competitive on a long-term basis. So I'll just focus on our technology, which is the concentrated acid hydrolysis process.

Our process does not require additional pretreatment. We don't use enzymes. And it's a concept that has been proven since the mid-1900s. War times when they didn't really -- well, they could disregard the commercial viability of a process, they produced ethanol just during war times as fuel.

That proven concept we took, and the significant improvements that we have patented make that process more economical for the marketplace. The feedstocks that could be used for the process range from urban waste to ag waste to forest waste. The acid does not discriminate as to the source of cellulose. It has a tolerance for a mixed waste stream to produce ethanol, lignin and gypsum.

Just a little bit about BlueFire Ethanol. July '06 we were traded on the pink sheets as BFRE. As Rob said, we are the exclusive licensee of Arkenol's concentrated acid hydrolysis for North America. We're headquartered in California. But the staff and the majority shareholders of BlueFire has been with the technology development under Arkenol since 1992.

We're an experienced developer of energy projects. Actually we began this journey as ArkEnergy. We were power plant developers; financed over $1 billion worth of energy projects. In the PURPA days, if any of you are familiar with it, in order to be an independent power producer you needed to have a cogeneration thermal host.

So we looked at what thermal host we could put in that would use the steam for power plants, to make us more competitive in the PURPA. We looked at different opportunities and settled on ethanol. And we looked at different technologies that are already available.

And we picked concentrated acid hydrolysis because the information shows that it's been demonstrated and proven. And that with just minimum proprietary improvements we could make that process economical and be ready to commercialize the technology. That was in 1992.

In the mid 1990s we piloted the facility in the City of Orange in southern California. In that facility we tested various equipment; we tested various feedstock, all the way from Holland to Minnesota, a lot of straws here in Sacramento, wheat straw, all kinds of biomass.

We also, in 1990, if any of you remember the Sepco project, to produce ethanol from rice straw. We went through the process with, at that time, the California Energy Commission because we were building it next to a power plant.

We took that process through a permitting over a two-year period, scrubbed clean and obtained all the permits in hand ready to begin construction of a 12-million gallon per year ethanol plant. Unfortunately, it was probably a decade and a half too early for the market. We weren't able to finance it. And I'll talk about the slides that are -- about the constraints to commercialization of the technology a little bit later, and put the Sepco project in that context.

So, I mention that to say that we know that the process can be permitted. It's a benign process. And we met the regulatory review of the various federal, state and local agencies, and got our authorizations to begin construction for that project.

In about 2000, 2002, JGC, which is a Japanese company, we licensed the technology to them and they built a pilot facility in Izumi, Japan. After four or five years of operating experience they validated our results from the City of Orange experience.

I'm not the Chief Technology Officer, so I get to use block diagrams to go over the process. But basically it is a concentrated acid hydrolysis. We use the acid to break down the cellulosic polymer. Cellulose is just a polymer of glucose molecules. Lignin is the glue that holds them together.

The lignin is used for power production. And the acid and the sugar goes to an acid/sugar separation. This acid/sugar separation is one of the keys to our process. In the old technology they weren't able to effectively separate the acid from the sugar, so there's a lot of waste.

We are able to recycle the acid. In fact, our makeup is less than 5 percent. So after the acid/sugar separation the sugars go on to just traditional fermentation to produce products like ethanol. And the acid is recycled to be used back in the process.

There's some pictures of the facility in Izumi, Japan. It is about 6 tons per day. A lot of the existing equipment are used in other industries. You know, we always get the question of scale-up. Actually some of the pieces of equipment that was used at Izumi had to be scaled down so that it could be used in a pilot facility.

So our research is done. Our pilot plant experience is done not once, but twice. Most recently with a third party that owned the plant, validated the plant. That provides us with that third-party validation. It's not just us saying it works. JGC is also saying that it works. And we're ready for the commercial facility.

This is the slide I was going to talk about, the constraint to commercialization. Why hasn't a cellulose-to-ethanol plant been built? And basically it comes from most of the technology providers are small companies needing outside capital. So, for us it's never been the technology; it's the structure under which we needed to finance the technology.

In the ArkEnergy days we were able, like I said earlier, finance $1 billion worth of energy projects. So we went to those same people and they said, great, we know you guys, you're credible, we like it, come back to us for a second plant.

So the risk profile of private capital for that first plant is difficult for a small company unless you have a significant balance sheet.

They really focus on three areas with regards to feedstock. In the Sacramento project we obtained growers of contracts for rice straw for over 100 percent of what we needed. These are growers that have grown rice straw forever. But, at the end of the day, project finance folks didn't see it to be creditworthy. It's not viable. There's no guarantee that Grower Smith will continue to be there and provide the spec and the backup, liquidated damages, et cetera, in the event it doesn't provide the feedstock.

So now with regards to the product it's becoming less of an issue now because the ethanol market is really pretty significant and pretty deep enough. So I think Wall Street's beginning to feel more comfortable about the product.

With regards to the conversion technology, the issue there is the process guarantee, the first one. A small company won't have the balance sheet to put that together. But with the JGC validation, with having JGC work with the U.S. company, in our case it's MECS, which is formerly Monsanto, we could do a failure mode effects analysis and start to box the risk; quantify those risks; estimate those risks; and perhaps we, you know, -- so I think we have the response for conversion technology.

But Chuck touched on this before. As we move forward, we need to look at the regulatory constraints to commercialization. We always get asked, great idea in municipalities, but does it count. That needs to be changed. Municipalities are faced with compliance requirements under AB-939. And they need to get full credit for conversion facilities.

Also we need to be careful about not

having redundant permitting processes. There's already a regulatory framework that works. We went through it. It's viable. And so we need to avoid redundancy.

The new environment for ethanol and for renewable fuels is changing. We see federal and California policies that begin to create a renewable fuels market. Federal standards, I won't go through all of that. You know about the RFS, you know that Bush wants to increase that to 35 billion gallons from the 7.5. He has calls for reduction in foreign imports, 75 percent by 2025.

And, of course, our own Governor. Twenty percent renewable fuels production by 2010 and the low carbon fuel standard.

BlueFire, going forwards, you know, over the years, we've got to go look at the lowest hanging fruit. Our business model is based on a sustainable production platform. We're going to access the most reliable material that's already there, widely available and inexpensive.

We need to locate these facilities where it makes sense with strategic partners; where there are resources that's already there we can maximize the environmental benefits and reduce incremental environmental impacts.

Landfill diversion facilities. We looked at residuals that come off of MRFs; that's excellent feedstock, like 80 percent cellulose, at least in the samples that we've seen.

We're also looking at co-locating with biomass power plants in which the infrastructure is already there. And we've been approached with being the anchor tenant in ecoindustrial parks, which is probably longer term.

So, we're looking for projects that have expansion potentials and replicable in the North American market.

These are just the milestones we've accomplished just since July of 2006. I don't include there the 15 years before as Arkenol. So it's been a long journey to get here. And we're excited about the promise of being there.

And you've all heard, I'll just cover the more recent progress, our U.S. Department of Energy grant. And then funding from the California Energy Commission.

The DOE grant is for the development of southern California biorefinery. We got $40 million, which is the 40 percent cost-share of the total project costs. And it's going to produce approximately 18 million gallons per year of ethanol. We're trying to be very conservative. Using 700 dry tons of green and wood waste. We take advantage of the co-location advantages of being in a landfill. We can use the natural gas; to the extent electricity is there, infrastructure is there.

You know, we would then preclude additional environmental impacts by disturbing other locations.

We've got engineering and permitting efforts started. Barring the timeframe for regulatory approvals, we have to be in construction first or second quarter of 2008; in operation by 2009.

The participants of the project are, as you've heard, Waste Management, Inc., PetroDiamond for the offtake of the ethanol. They're a Mitsubishi subsidiary. JGC Corporation, which is like an equivalent to RFlor here in the U.S. And ECS, which is formerly Monsanto will do the EPC. Colmac Energy will take our lignin to burn at the facility in Riverside.

So, in summary I just wanted to

reiterate ethanol is a viable and immediate renewable fuel solution. It's here. Cellulose ethanol, I think, you know, together we've decided it's the future of ethanol.

Everyone knows when you mention cellulose, even people off the street, yeah, I know about cellulose. Ten years ago when I'm talking to regulators they're looking at me like yeah, right. So, we've come a long way.

But, as a nation, we must really make a commitment to commercialize cellulose-to-ethanol. And make that an imperative strategy. There needs to be an increased production of cellulosic ethanol, increased flexibility to blend higher levels of ethanol. Be nice to begin that in California in our reformulated gasoline.

Need to expand the E-85 refueling infrastructure. Increasing our flexible fuel vehicles production. And at the end we all win. Consumers would then gain fuel flexibility. Just like in Brazil. Brazilians can decide whether or not they want to put ethanol or gasoline in their flex-fuel vehicles.

Then pricing becomes related to demand. We are no longer addicted to oil, and without being dependent on ethanol markets. So I encourage you to look at the possibility of this new paradigm and what California can do, as a state. You know, we've all worked this issue for a long time. And so I think hopefully now is the time that we can work together to make it a reality for our state.

Thank you.

(Applause.)

MR. WILLIAMS: Thank you, Necy. So our next speaker is Dr. Bin Yang. He's an Associate Research Engineer at UC Riverside. And he has 20 years of experience in biotechnology and renewable energy from biomass.

He's authored more than 45 peer-reviewed papers and book chapters. He's been invited to many conferences to give presentations. And he has two patents.

His research interests are in bioprocessing for sustainable production of biofuels and materials and other value-added products from cellulosic biomass. He has a masters of science in chemical engineering from Northwestern University in China; and a PhD in food engineering from South China University.

Before coming to Riverside he was a research scientist at the Thayer School of Engineering at Dartmouth. So, please welcome Bin Yang, who will speak on cellulosic ethanol from MSW.

(Applause.)

DR. YANG: Thanks for the introduction. And the first off let me, I want to thank California Biomass Collaborative and California Integrated Waste Management Board, gave me opportunity to present our latest status about bioprocess production cellulosic ethanol.

Status for cellulosic ethanol right now is everybody talking about it, cellulosic ethanol all ready to go for commercialize and signal come from the government, come from the capitals, come from research group, all one voice. And we have to push the first commercialized plant come as soon as possible. Then we can work on the second generation in order to reduce the cost.

The option cost is low and clearly feedstock's low, as well, because based on $42 or $40 per barrel of oil, equals to $13 per dry ton of a biomass. Clearly biomass is very cheap feedstock we can use.

The capital cost is high because specific for new technology. And we near commercialize experience, so we have lots of equipment that could be required, lots of different technology require different facility. You cannot just simplified use currently a facility to use it.

And ethanol have a very low return. In other words, to have lots of higher investment risk. That's why the private many not really come that quick.

I think biologically Necy just talk about how biologically work, kind of like typical biologically. Biological process have a couple very good ventures we want to take.

Number one, biological can get (inaudible) but as a come early products you have to be high yield -- to reduce its cost.

Number two, biological process could be do the continuous process; continuous process significantly reduces capital cost.

And right now lots of fundings, you know, are on the way like 500 million bp we know has already took the by Berkeleys; 250 million, you know, coming soon. And 384 announced by DOE;

and DOE also announce by project. So everything seems ready, at least fundamental angle.

Today I want talk about the pretreatment and enzymatic hydrolysis. The pretreatment is very tricky. Most of pretreatment method right now still use some mechanical method. The pretreatment method is not easy to make. The reason pretty simple because not only you have to concern about how much sugar release and how much solid you have to input in your pretreatment reactors, but also you have to entire your bioprocess for example, what kind of enzyme you want use, what kind of microorganism you want.

So that's kind of pattern you have to, you know, work.

And also the feedstock is different. Feedstock could be get different response by certain type of treatment which I will talk a little more about this.

These are the costs, which is done lots of work by NREL and our group, as well; and in Dartmouth, I think. And the stages I want to focus on is pretreatment enzymatic hydrolysis and fermentation. And we know the feedstock roughly 30 percent, 33 percent. And like 18 percent cost us for pretreatment. And 12 percent cost of fermentation. And 9 percent cost for the enzymatic hydrolysis. So total, this box, will be around 40 percent cost. If you want to reduce this process cost, that's okay to do that.

And if we blend out whole process during bi-process, we can lease out this things, which is important factor on the yield, also associated with the cost. So the high means the higher factors, medium factor or low factors. And if we highlight this will be, except that we don't want (inaudible) for the biomass production and harvesting and collection. I think that's a big topic. That's not my research area. And focus on pretreatment and the production enzymatic hydrolysis, and the hydrolysis condition.

The lignin part of residue is also big factors for reducing cost. And also if we found a new market for lignin probably we can dramatically change the patterns.

And if you highlight -- the pretreatment enzymatic hydrolysis and fermentation is okay in order to reduce those costs.

So what we can do for reducing pretreatment cost, so the things we can do now is we have to get high yield with a low cost of chemicals and energy cost. And we also would have to reducing units cost. And we want to compare with different, or currently different pretreatment measures, seeing what's happened there.

And for this, same thing, also is pretreatment also require to reducing enzyme cost. If you get open structure as feedstock you probably require very low enzyme loading which is not okay for bioprocess.

The lab we set up in UCR now is focus on standing biomass (inaudible) pretreatment and solid hydrolysis, which is so we think that's okay point if we want to get low-cost technologies.

And currently funding we have is DOE CAFI as in lead by Dr. Jerry Wyman. And that's co-work with Auburn, Michigan State, NREL, Purdue, Texas A&M, British Columbia from Canada and Genencor, of course, supplies the enzymes.

And in my project right now, also have USDA which use a blocking technique to reduce costs. And NST many for continuous fermentation SSF. And then we also have many support to use CFD work with effluents. We don't have really --

reactor to simulate it. We can use a software to simulate it how, if you scale up, how what's the factors to impact on your economic number.

And also have one NSD money to support, to extract the proteins before and during the pretreatment. And as you know, there's lots of feedstock, like switchgrass, lots of proteins and others, new crops. If we can get proteins put in animal feed, but that's another critical we can take.

That's our equipment. And we basically view the pretreatment, use tube, be in the right side, because smart tube we use syn -- smart tube is a 4-inch or 6-inch tube with half-inch diameter. We can put it in -- heat it up. And with one minutes we can heat up certain temperature that -- into the cool water, we can cool down the temperature within one minutes. That's allow us to really monitor the whole connected change, minimize the heat trans, in effect your hydrolysis connects.

And also use tubes that -- explosion steam come, because once you use a steam gun you probably lose lots of, you know, one gas go to the atmosphere and other one in the receiver. Hard to collect them in my work experience. So smart tubes get very good mass balance, allow us really know what's happen during the pretreatment.

And this one is a -- reactor, use the same strategies for heating and cooling. And we have -- use a continuous fermentation. This one with separation (inaudible) our steam gas.

And for CAFI I think is where I'll know around this area. For CAFI I, the project report already published in the Bioresource Biotechnology Journal last year. Probably you can take a look at the report.

The CAFI basically come up with ammonia recycle pretreatment, Y.Y. Lee from Auburn University, water only (inaudible) pretreatment with a flow slow, and Dartmouth College, which I was there for a number of years.

Ammonia fiber extension come from Bruce Dale, Michigan State. And (inaudible) come from Mike Ledisch, Purdue. And (inaudible) come from Mark Holtzapple, Texas A&M. And we have Tim Eggerman do the modeling and Rick Elander from NREL supply the feedstock.

And the CAFI basically have (inaudible) different manufacturers, different public agencies, different companies. They're on the board; they can check the status. If you are a member you get the report; simultaneously we get a stage report.

And the CAFI I basically use the corn stover as its composition of corn stover. And CAFI I is a pretreatment condition for each (inaudible) based on the acid pH distribution. So, from land to -- acid, have temperature and have a concentration of acid of chemicals, what's a solid concentration. Probably hard to get this but I think most of concentrated is acid 25 percent.

As Genencor enzyme, so Genencor supply different enzyme. Two of them is cellulase, one is xylenase, another one is pectinase. And that's the result from CAFI I, basically that shows your during hydrolysis first stage the hydrolysis, that's monoxylose. That's plus oligoxylose because not for every technology come up (inaudible) most of it monoxylose. That's monoglucose in the hydrolysis, and that's oligoxylose glucose in hydrolysis.

Then we go second stage, that's enzymatic hydrolysis. That's loading 15 FU program. And that's the hydrolysis results. And that's oligoxylose, that's plus oligoxylose count in your hydrolysis. I think that's oligoxylose.

If you now catch up a couple slides, this is comparison, (inaudible) total sugar U; and you can come up with the idea very close for corn stover, I think. Different pretreatment can reach over 85 percent yield, some of it reaches 90 percent.

And Tim Eggerman did use NREL modeling and did a economic calculation. They could become different numbers based on different things, different assumptions. This assumption they made; and this is come up with setting price for ethanol, around the $1.30. And (inaudible) pretty much same range. Another one seems a little different. The reason pretty simple because this was only concern about -- it only concern mono and oligomers.

And if we concern about only monos, currently technology, the box convert only monos to ethanol. The black bar is the -- no, the black bar is, that's a price, supposed to be. And if we concern about future oligomer -- can be used for fermentation ethanol, the black bar shows up this.

So it's very much we can see, the very similar price comes up.

CAFI II I think start two years ago, and there is switched feedstock from corn stover to poplar. And right now is CAFE II still undergoing and lots of things there. And the key finding right now that's initial data showed if you use the same condition or close condition to do the pretreatment of the yellow poplar, there response differently.

Different technology, based on the, you know, enzymatic hydrolysis poplar pretreatments, so you got different patterns. And that's a xylose release during hydrolysis.

If I give the picture compares three different technology, -- get better and ammonia recycle you have to increase certain amount of enzyme loading. And -- pH responds pretty badly.

But I have to mention here that's not really optimized condition. Optimized condition we'll present in Denver, I think, after -- something. We are collect the data and someone still work on the optimized conditions.

That's -- I want, how different response if you change the feedstock. That's feedstock sensitivity.

So this is the feedstock come from CAFI II and original composition and the location, USDA-supplied. And it have found that the lignin content is 21 percent. And later then we get a second shipping come from different area, and it use (inaudible); they found a higher lignin popular and high lignin and the low lignin poplar respond different. And the low lignin poplar we can get better yield.

So, -- based on the different feedstock is very very sensitive. And also we take a look at different species. Basically there's a poplar come from (inaudible), and just grow in the different area and (inaudible). And responds so different. The clear information tells you we cannot say before, we said, hey, we've grew up tree in my backyard and when they're ready to process them just cut it off and process it. Probably have to take a certain time, certain fill and certain content and certain time to harvest the tree or whatever, to go into your process.

So I think right now I come to the finalize my slides, so biological provide power for lower cost of fuel and chemicals, you can get better conversion. At least based on the corn stover results.

And the biological system require pretreatment if you -- in other words, we also joking each other, Charlie White, Charlie has said the most expensive pretreatment is no pretreatment. Basically the result pretreatment only have 20 percent you can get from directly hydrolysis.

And I come from the Washington, D.C. USDA EP meeting right now, some work on reducing the lignin content in the new energy crops; probably can reduce 50 percent in the laboratory scale. But even reducing 15 percent, they said the maximum they can do. And they can do like 20 to 30, maximum of 40 percent result pretreatment. So pretreatment is very important if you want do the hydrolysis and fermentation process.

And the pretreatment does not really factor the whole different -- that's I was (inaudible). So we have to focus on -- if we focus on the biological plants, we have to focus on the pretreatment which is a (inaudible) to pretreat the different feedstock in order to get a lower enzyme loading and a lower conversion cost and a high yield.

And finally I would thanks USDA, DOE give funding and the Natural Resource of Canada funded our partner in UBC. And CAFI team, students. The main thing in the CAFI team, I was join the CAFI team up to now. And we have set up same protocol; same screen, same everything. And we cross each other, send samples to each other; check the result.

I think that's really make more sense to do the very serious research and the CAFI result seems to make more sense to come, as people accept it. Because that's not really repeat one time, it repeat at least a number of times by different universities.

I also thanks Riverside, UC Riverside; give us facilities to do the work. Finally, I will use, as in the model, to show here. And then I would like to take your questions. Thank you.

(Applause.)

MR. WILLIAMS: Thank you, Bin. We'll have questions at the end of the session here.

Okay, as mentioned earlier Don Stevens will not be able to be here to talk today, so we'll move on to the next presentation, which is Peter Knecht.

He's from Zurich, Switzerland. And he represents Kompogas. And he'll be talking about that process. He's responsible for business development and licensing. He's been three years with Kompogas. He has a masters in economics. Peter.

MR. KNECHT: Welcome, everybody. Thank you very much for being here, and to present what we're doing over in Europe. We already heard today that the main drivers in Europe is legislation, banning from landfill, all that kind of stuff that are the main drivers, incentives, to deal with the organic waste.

We just heard this morning that 27 billion tons just in California are still going to be landfilled. That's really a huge amount. And you will see, I brought an example from an existing facility in Europe how much energy will be in that organic waste.

To start with, it's quite simple. The better the input -- it's like everything in life, the better the input, the better the output. You want to cook a meal, good ingredients, hopefully good outcome. The same with the waste. If the waste is a clean good source, you will have a good clean product.

So what kind of wastes are we going to treat or are we able to treat. Basically quite everything. We always say a good mix of everything is very fine for us because the digesters need to have a well-balanced diet, as we do, as well. So if you eat chocolate from morning till evening, you will feel very sick. The same is going to happen to your bacterias in the fermentery. If you feed them not the way they want to be fed, they will feel very sick and they just stop working for you.

Basically we can treat woodwaste. We're not really that excited about the woodwaste, as its lignin, lignin is not really degrading into the biological process, so we're happy to hand the wood over to Pacific Ethanol.

The yard waste, biogenic waste, as we know in Europe, the green bin system, so separate collection for organic waste. Kitchen catering waste, which is here a lot of times still landfilled. And in Europe, in Switzerland is going to incineration which is a pity because the really power is in the food waste.

Market wastes, it can be anything. I will touch on this later.

There have to say, these are clean sources of input material. So clean sources will lead to good quality end product, so compost and liquid fertilizer. It's also possible that's the good news, to process municipal solid waste, but mixed municipal solid waste needs pretreatment. So there we're talking about the NBT process. So needs mechanical pretreatment there.

I have to say out of our experience, and this was also said yesterday, the pretreatment is key. So, if you have a bad pretreatment everybody behind you, all recycling companies that will take care of the different fractions coming from the mechanical treatment, will have big problems to do their processes in a proper way.

And also, the good news is you can extract the energy; the bad news is mostly the compost quality that comes out at the end is not meeting any standards. So, it's again, go to landfill, which should not be the ultimate goal. The ultimate goal should be to close natural loops, natural cycles to come from a, let's say, waste to a product.

We're often asked does it work, in our country, AD. And basically we have to say yes because it's just the materials have to be fed in a certain way. They like a special environment where they work, so basically it's keeping bacterias happy.

They do not know where they are, in which country, so it's dark in the fermenter, so they have no idea where they are. So they just work.

The bacterias, if you treat them in a good way, they're your best workers. They have no union; they don't complain; they work 24/7; no breaks. So they do basically what you want to have them to do if you treat them well.

I brought some comparisons about the waste streams. In Switzerland we have source-separated organic municipal solid waste. So we call it simply the green bin system. So the households separate the green waste. Including yard waste, food waste, everything that's organic. And just put it in the green bin. It's separately collected.

We have quite lot of structural

material, so garden, tree clippings and stuff like that. That's why the gas yield per ton of input is around 100 to 110 cubic meters. I will stick to the metric because I'm not really familiar with the imperial, but I translated it to the imperial.

The German waste looks a little bit different, as they have more food waste going into the green bin. So they will have also a higher gas yield, 110 to 125 -- cubic meters per ton of input.

Then the Spanish waste is organic fraction of municipal solid waste. So this is a facility really treating, let's say, to black bag. So everything together; mechanical pretreatment. And then the different fractions go to different recyclers and the organic fraction is treated bios.

The gas yield, this is a little bit difference to what I read in the script. We're achieving quite high yields, as well, because also the food waste content is very high. But also it's hard to get all the contamination out. In Spain we're in a vine region, in the Rioja, it's probably similar to Napa Valley. Big vine producers. We have there the problem they're just throwing all their glass into the black bag, and glass will end up, or at least parts of it, in our compost.

A little bit about the process. So the process flow, everything that's pretreatment comes before, so all mechanical sorting would be at this end. So we come to an intermediate storage which is then constantly feeding our process.

So it goes to the fermenter. I will talk a little bit how this is working afterwards. From the fermenter the end product is going to be dewatered. I have to say, we're working in a dry fermentation so that means up higher 30 percent of dry solids. I will not touch on the topic of wet digestion today. The end product is dewatered, so we just -- it will be compost and liquid fertilizer.

From the fermenter the biogas is captured, and then brought to CHP units where it produce heat and power. The heat can be used, or in our case, part, a little part of the heat is used to heat the fermenter. The rest can be given to industries or district heating or whatever.

You can also take the biogas and scrub it to come to natural gas standard. And we're introducing in Switzerland into that natural gas create as renewable natural gas, which is also then used to power CNG vehicles.

All the air from the buildings is taken and brought over, biofed through to be released to the atmosphere.

As I said, we're in the dry fermentation, so higher, or at about 30 percent dry solids. Our specialty is we're a horizontal system, so we're moving like a plug through the fermenter. So it takes the material from this end to the other, two weeks.

We're achieving a so-called hygienization, as hygiene is also a question of temperature and time. So, the plug is insuring our time, 14 days. And the temperature to thermophilic range is -- temperature. So like this, we have a hygienic end product. So salmonella and E.coli and that kind of stuff will be eliminated.

An easy understandable mass balance. I always say the rule of thumb is you put in one ton of material, organic material, you'll have mass reduction which is disappearing in biogas, of about 10 to 15 percent. The rest is basically split up 50 percent liquid, 50 percent solid.

And as I said earlier, the gas yield will be, depending on your waste mix, about 110 to 130 normed cubic meters of biogas, which is about the equivalent of 70 to 80 liters or about 20 U.S. gallons of petrol.

This will be a mass balance. Of course, you cannot read it. This is just to show what the mass balance would look like. So, if we follow the project we will analyze the waste. So we'll know what's the input material; and just if we know what the input material looks like and how much organic matter is inside, that it's organically degradable, we will know what your mass and energy balance will look like. So, as you can see, mass balance in the project looks quite complex.

This will be a very, let's say, simple plant layout. We always call it the core module because we do not come to a site very often where we can place a plant on a greenfield. So there is always existing infrastructure. So we have to take that in consideration.

So the elements we'll have here, the intermediate storage, which is constantly feeding the fermenter. We have continuous system because continuous feed insures consistent gas quality and quantity.

So we will feed the fermenter. The fermenter over here. We have fermenters in steel, the small ones; and the big ones is concrete/steel construction.

So the material is basically flowing through the fermenter. It is two weeks. We take it out at the other end, bring it on the press. The compost is falling down; the liquid effluence, or the liquid fertilizer is flowing to this storage tanks, which are going to be reduced to bring it to the process.

There is an emergency flare, as you have CHP. You can see it over here, where we are transferring the biogas into electricity and heat.

There is a control container so there all the control systems will be inside and also the distribution back to the process and to neighbors and industries, whatever district heating you are connected with.

This is a plant layout from a plant in Germany we built about three years ago. This was a former composting plant. It was a former composting plant treating 20,000 tons of compost. Going to AD, they had the chance of basically with the same footprint to treat now 40, or over 40,000 tons.

Because what is AD doing? It's basically speeding up your front-end process of composting. So they are now treating double on about the same footprint as they had before. They became from a net energy consumer for a composting process, they became a net energy producer.

So this is what the plant looks like. I'll just point out a few things. You have here the entrance. The trucks will drive here on a weight bridge. They will come down here to the reception area where they basically dump the waste.

The waste is then treated into the fractions, so all the contaminants like plastics, you'll always have, even if you have source separation, you'll always have contaminants. But our system is quite forgiving about that.

The contaminants are removed. Then the waste is going to intermediate storages, what you see over here, which are constantly feeding the fermenter. They here have a double module and a single one.

The biogas going to CHP units, powering the generators and feeding the grid.

Before we installed the AD, the AD part is basically just this small part. So existing was already the pretreatment, so their old process was going into the whole separation and then basically do conventional composting, and the finished product. So, we've added the AD part, which is very complementary. So now they have much more possibilities to acquire all the waste streams like food waste, industrial waste and so on.

So basically they now go this way, pretreatment, then do the loop over the fermentation and go back into the composting. Here they sell the end product; here you will see the storage of the liquid which is taken to again bring it back to the process. If we have effluent, so liquid fertilizer, it's going to be picked up by farmers and they will spread it over agricultural land, which has a high fertilizer value.

Over here this is not belonging to the composting plant. Here is a recycling center where they recycle all different materials like metals, aluminum, plastics and that kind of stuff.

As I said, the goal is to close natural loops, so if you have good quality input materials you will end up with good quality output materials. So you will have liquid fertilizer which can substitute artificial fertilizer, which is again substituting fossil fuels.

You have fresh compost which is basically coming out of the digesters, which can be spread over land almost immediately. And you can make a cured compost which can go up to grade five. So that's really quality. That's what they are doing in Passau, they're really strong in composting business because they came from the composting business, so they're producing both lands, let's say, directly to agricultural land. And they're also going into retake.

I would like to talk a little bit on compost. It was mentioned yesterday that with the different scenarios, so if you take compost instead of artificial fertilizer, compost will basically improve your soil quality, which will be even more important probably in the future because you will probably have less rain. So the soil quality, if the soil quality's improving it can hold more water. Because we will probably have less rainfall this will be an important issue.

And you always have exhausted soils; I saw that when I was visiting the plant in Spain. They have really exhausted soils. But I don't know the farms they're just not using compost. They're still sticking to the artificial fertilizer.

Here we see the Passau plant, so we're treating about 40,000 tons of waste a year. As I said, they're producing heat and power with CHP units.

This is the different fermenters. You can see how the gas yield is. So we are in a quite good range of biogas yield and biogas quality.

One possibility is also to upgrade the biogas, to scrub it to natural gas standard, which is then CNG. So basically biogas is consisting of about 55 to 65 percent methane, -- 58, so the rest is basically carbon dioxide and hydrogen sulfate. So the cleaning process, after that you're having the same specification as natural gas, which can also then be called renewable natural gas. So we have to bring up to meet that content to about 97 percent.

How does the operating process work? Roughly you feed in the raw gas, which has a high CH_4 content. You go with pressure of about 160 psi to these adsorbent beds, which allow just the CH_4 molecules to pass. You will always have a little bit of other things that pass through, but basically that you shut off the valves. And you will clean the beds again. And you will have the exhaust gases which consists also a little bit still of CH_4 because it's never possible to extract everything.

These exhaust gases will then go on a burner because if you release the CH_4 it's counted according to Kyoto 20, 21 times worse than CO_2. So it's brought over a burner to really burn it off to CO_2. And the heat you're producing there can also be taken to the fermenter and to process.

I will not bother you with the figures. The presentation will be on the website, so you will see how much gas we're producing. This is just an example from the Passau plant. I took it as example. They're producing about 500 normed cubic meters an hour if you operate that to CNG.

You will see in all the figures the loss is about 5 percent.

Which brings me to the next slide. Not bothering you with the figures I'll show you how much energy is inside of let's say compared to North American standards, quite probably a small plant, if I look at the potential that's over here.

So if we take that energy, produce CNG, it will give us about a range of 40 million kilometers, which is 25 million miles, which is quite easy. Will give us a journey in a car 1000 times around the earth.

There's different applications. If you have CNG, we're having in Switzerland public transport. I was very delighted to see here also the CNG buses, because CNG is quite a good source, very clean source of energy to power buses. There is shuttle buses for hotels in Switzerland that work with CNG. I will talk about Migros which is the biggest retail trade in Switzerland, and you certainly know this one.

So we're having corporations with McDonalds and Migros. It works that way, so they bring all the organic waste they produce in their restaurants, catering services, stores and so on to us. We digest it, operate to biogas. And feed the biogas into the natural gas grid. The natural gas grid takes care of the distribution. So these companies are able to power their trucks on the CNG.

And just to make an example, Migros is delivering today about 10,000 tons to us. So we produce the equivalent of 600,000 liters of diesel. So they are powering parts of their truck fleet, which are all waste. This is in CO2; that's about 2000 tons of CO2 they're substituting like this.

So here are some references, most in Europe, as the legislation and drivers are set the right way. So, we see Weissenfels, which started with one digester, so they operated it for different years. So they started off in 2003. So now they are ready for extension because they acquired much more waste.

The plant in Spain that is processing MSW. Then prestigious one in Kyoto, according to the Kyoto Protocol. And there is one built also on MSW in France, which is processing 100,000 tons.

This is quite an interesting one because it's possible with the modular system, they have for the 100,000 tons of material they will -- they have four double modules, so they will run three of the four with the organic fraction of MSW. And they have already a little waste stream of source-separated. So they're running one module of source-separated.

So they're producing different qualities. And nobody knows how the waste streams are going to change through legislation, whatever. They will decide probably, and that's a limited right now to source-separate in Europe. So they'll be able to react to that and feed more and more fermenters with clean sources as they come in.

So, conclusions. I'm happy that all the speakers before came to the same conclusions. Setting the right incentives for renewable will force investment into the industry. The 3-R process we're following in Europe, reduce, reuse, recycle.

Just source separation keeps the most value to the waste; then it's seen as a resource. And this is true for everybody. This not just for the organic waste. This is true for every recycler.

It's the goal to complete natural cycles. And you don't know what future's going to bring, try to rely on modular systems, which keeps most flexibility.

So this reminds me to sentence I once read on my travels, I don't know where. But it keeps sticking in my mind. Which says that we didn't inherit the land from our grandparents, we borrow it from our children. That's probably a little bit how we should act in the future.

Thank you.

(Applause.)

MR. WILLIAMS: Thank you, Peter. That was very interesting.

Okay, to finish out this session we have Patrick Sullivan from SCS Engineers. Patrick's had over 17 years of experience in the area of environmental engineering specializing in landfill gas issues and air quality permitting and compliance, all this time with SCS Engineers.

Patrick is the Vice President and primary air quality technical expert for SCS, for the California offices as well as the national operations. He's the leader for SCS' solid waste consulting practice in California.

He's one of the experts, the company's leading experts, on landfill gas-to-energy project development and greenhouse gas issues. He's also a member of technical experts for permitting issues for the USEPA landfill methane outreach program. Patrick.

MR. SULLIVAN: Morning, everyone. This morning I'm going to talk about landfill gas-to-energy. The focus will be on vehicle fuels, landfill gas-to-LNG, landfill gas-to-CNG. But I'll talk briefly about where we're at overall with relative to landfill gas to recovery.

These are the three ways that we deal with landfill gas in terms of recovering the energy. The electric power generation is the number one use. But the fastest growing is actually what we cal the medium Btu projects.

And then the focus today will actually be on the third bullet there, the high Btu gas production in vehicle fuel.

Here are a number of projects that are currently in existence in the U.S. of the different types. That equates to about 1200 megawatts of online electricity and about 250 million cubic feet per day of gas that's utilized in either medium or high Btu projects.

In the electric power side of the reciprocating engines are really the workhorse, though here in California we have seen an emergence of the small microturbines, basically because of the cost of retail power here in California. People wanting to go off the grid and be able to generate their own power with the microturbines.

But why are we seeing such a growth in the medium Btu projects, and why are we seeing some renewed interest in the high Btu projects? Well, one of the big drivers, of course, is cost of natural gas and the cost of vehicle fuels, driving some to look at landfill gas resource in that way.

Also, there's other drivers, as we've heard today, politics, regulation. Here in California, of course, we have our diesel requirements and restrictions on diesel fuel vehicles. And the designation of diesel as a carcinogenic air contaminant.

So, with a lot of those things coming

together, and then, of course, the greenhouse gas legislation coming on top of it, there seems to be more of an interest in these uses of landfill gas beyond power production.

What is medium Btu gas? Really, this is a minimum cleanup of the gas, usually just dewatering, refrigeration, filtration and then piping it offsite to an industrial end user. The primary use is industrial boilers creating process heat, or building heat. But there's a lot of other creative uses, greenhouses, furnaces, kilns, et cetera, that are fired on landfill gas.

Why is it the fastest growing? Well, it's the cheapest relatively speaking on capital, and probably the simplest project to put together, assuming you can find that industrial end user.

Certainly the best situation is when that user is very close to the landfill. But we now have landfill gas pipeline that's as long as 20 miles moving landfill gas from a landfill to an offsite industrial plant.

High Btu. We're either talking about pipeline quality or vehicle fuel, LNG or CNG. A variety of processes and use for the treatment of that gas. And we'll go into that in a little more detail of what you have to do to create these high Btu gases.

And clearly the reason we haven't seen a lot of these projects is both the capital and the operating costs are much higher than either power production or the medium Btu because of the extensive gas cleanup that's necessary to get it here.

We all know, and here in California we certainly see it, that LNG and CNG are viable alternatives to diesel and gasoline. Every time we see a truck or a bus driving powered on CNG or LNG we realize that it can be done.

One thing to remember, though, that the primary source of the LNG and CNG in those vehicles is generated from natural gas. So it's still dependent no the natural gas market. And there is the natural gas market over the last several decades. And as you can see, particularly in the last five years, we've seen a dramatic increase on natural gas prices. And, again, probably a big reason we see a renewed interest in uses of landfill gas that would displace natural gas.

Clearly there are some benefits to LNG

or CNG versus diesel or gasoline, whether it's air emissions, greenhouse gas reductions, but there are some clear disadvantages, as well. The expense and the engines, themselves, the infrastructure issues relative to the availability and location of fueling sources make it such that these fuels are not quite direct competitors to diesel or gasoline.

CNG versus LNG, what are the differences? The big difference is the density of LNG. And because of that it is less expensive to store it or transport it. And the debate of CNG versus LNG is kind of like the old Miller Lite debate of tastes great or less filling. There's people on both sides of the argument that feel one is better than the other. But clearly LNG has an advantage on the density issue, but CNG probably has some advantage relative to the cost of the engines, themselves, and the cost to product LNG, because there's an extra step that we'll see here in a minute.

Landfill gas. Landfill gas can be turned into both LNG or CNG. Primary where we have seen this happen, the driver has been the desire to fuel the refuse vehicles or the equipment at the landfill on this. To a lesser degree on any sort of commercial sale of LNG or CNG into the clean fuels market.

Here's a typical landfill gas. Big issues here are the methane content; the air intrusion, the oxygen and nitrogen; and then, of course, the impurities which are the last three items, the hydrogen sulfide and the other sulfur compounds, the organics and siloxanes.

This is what we need to turn it into if we want to, in this case, create CNG. And really the key is how do we get from that to that. Removing the impurities, removing the CO2 and, of course, increasing the methane content.

In terms of landfill gas-to-CNG, I mean the big issue is the removal of the carbon dioxide. You saw a little example of that from our previous speaker. the two technologies that are in use are the membrane separation and the molecular sieve, which is also known as a PSA, or pressure swing adsorption.

In terms of pipeline quality gas, the existing landfill gas projects, both technologies have been used, but to date in terms of operating projects to date, the membrane separation seems to be what's been used for the very limited number of landfill gas to vehicle fuel projects.

And clearly, and you'll see this both with LNG and CNG, the amount of air intrusion in the gas is a big issue, because if there's too much air that is just yet another element of the gas treatment that has to be further separated, adding to that treatment cost.

Here's a little bit of a schematic of a treatment system. Again, we saw it with the previous speaker, a little bit of how that works. There is the material that's used in terms of the filter media, and then there's some schematics of essentially what's happening on a molecular level to separate out the methane and the other gases from the CO2, and moving the CO2 out of the gas stream.

Projects. The one very successful story we have to tell on landfill gas-to-CNG is the courtesy of the L.A. County Sanitation Districts. They do a small sized project, about 250 cfm of landfill gas, which is converted to about 100 cfm of CNG. That's about equivalent of about 1000 gallons of gasoline per day.

Their process at the Puente Hills

Landfill, the San District's; compression and moisture removal of the gas; they use activated carbon to remove the organics as well as the siloxanes. They happen to have pretty low sulfur content to begin with, so they didn't have to do extensive sulfur treatment. They use membranes for the carbon dioxide removal. And then they compress the gas to the 3600 psi.

They have storage facilities onsite and they dispense at about 3000 psi. Some pictures. That's the treatment facility at the Puente Hills Landfill. Here's their fueling station; and here's a couple of examples of pieces of equipment that they actually are fueling on CNG. So it's not only the hauling vehicle, it's actually some of the landfill equipment that they have retrofitted.

This is a relatively small scale project, but it is a successful longer term project. And really, frankly, one of the only success stories we have to date that has gone into full, and we would consider, commercial production.

Another CNG project that's currently actually in startup mode, which is Sonoma County at their Sonoma County central landfill. Currently the project is just a pilot scale project with about 100 cfm landfill gas, with a scale-up proposed to about 860 cfm.

The transit district in Sonoma County has a clean fuel bus fleet, and that's the goal of this project, is to ultimately fuel that bus fleet.

The process on the pilot scale project is 100 cfm will create about 40 cfm of CNG. Membranes again for the CO2 removal; activated carbon compression and chilling. Production cost, you can see at the bottom, that's for the pilot scale project, which is certainly higher than we would want it to be. And would probably not make this project economic commercially, but obviously the hope is the scale up will show much lower costs in terms of the economies of scale.

The scale up really will be the same process scaled up. And we hope to get the production cost down to about $7 per million Btu.

So, a few photos of the pilot project being installed. It was basically fabricated in the southern California area; put onto truck/trailer and transported up to northern

California. There it is in place. Here's some of the treatment equipment of the small scale project. A little bit of a closeup.

And as I said, the Sonoma County is in startup right now. It is producing CNG. However, the CNG has not yet been used in any of the fleet. What the plan is to test it in several of their CNG buses that the transit district has.

Let's talk about landfill gas-to-LNG. Really it's a similar process and similar issues exist. Is removing the impurities, removing the CO2. But has the extra step of the liquefaction of the methane to produce the LNG.

There are some projects. Montauk, in collaboration with Prometheus Energy, has actually just commenced operation on a project at the Bowerman landfill in Orange County. That project is currently sized to take about 850 cfm of landfill gas and produce about 7000 gallons of LNG. Ultimately they want to scale it up by about eight times is the plan. They started up in January, and going through their startup process right now.

Everybody's waiting with, I guess, bated breath to see the success of that project.

Because we really want to see a successful landfill gas-to-LNG project. There's been some stops and starts on projects in southern California and in the Bay Area that never came to fruition.

And here in Sacramento the County here has committed to a landfill gas-to-LNG project, as well, at the Kiefer landfill. Prometheus will also be involved with that project. However, just like everybody else, Sacramento County is also waiting to see the ultimate, hopefully the ultimate success of the Bowerman project.

Typical landfill gas-to-LNG project that one might consider, you know, if you want to produce about 5000 gallons per day of LNG you probably need about 900 cfm landfill gas. Obviously that varies based on methane content.

The process is somewhat power intensive, so alongside the LNG production is also power production to create onsite power. Right now we really do not have a good sense of what the production cost is for landfill gas-to-LNG. And that's really one of the biggest things I think the industry wants to get out of the major project in Orange County is, what will it ultimately cost to produce LNG from landfill gas.

What are the issues with LNG coming from landfill gas? And frankly, these are no different, I guess, for the CNG, which is the fuel. Fuel specification is very intolerant to nitrogen and oxygen in the gas, or would have to have additional treatment to remove it.

So that's really a grave concern, because it is very difficult to draw a vacuum on a landfill to remove the landfill gas without pulling in some amount of air.

And, in fact, the success of landfill gas collection and control systems as a means of air emission control sometimes is dependent upon your ability to extract enough so that you are ultimately pulling in some atmospheric air that gives you the best sense that you're pulling as much as you can. So there is a fine line that has to be walked between the gas quality and the ability to produce CNG or LNG.

And there are frankly some sites out there that simply are not going to be able to -- that would not be reasonable feedstocks for an LNG or CNG project because the gas quality is poor.

In conclusion, where are we at with

landfill gas as a precursor to vehicle fuel. Our experience, frankly, is limited. We have a lot more experience with landfill gas-to-electricity, or the medium Btu projects.

We do have one long term, and it's successful, but small landfill gas-to-CNG project, which is the L.A. San District project. We have a pilot scale project that's now in startup. There's been one demonstration project on landfill gas-to-LNG that actually was done by a predecessor to Prometheus, Cyrol Fuels Systems. And they are now, of course, in startup on a major commercial size project in Orange County. And again the success of that will hopefully tell us a lot.

But I think the bottomline is conversion can be done. We have the technology to do it. It has been done. And the big question is going to be what's going to drive us towards doing landfill gas-to-vehicle fuel.

One big driver is the natural gas prices. And that, in terms of economics, is where we'll be competitive.

Beyond that, what are the other drivers? Well, certainly politics. We have seen several CEQA processes for landfill expansions, whereas one of the mitigation measures they were obligated to put in clean fuel vehicles and consider, you know, conversion of landfill gas to CNG or LNG. So there is some push there. Whether the push comes from legislation or regulation, whether it's greenhouse gas, whether it's diesel fuel related issues, that may be the driver.

But there's always going to be competition for the gas. And the competition is going to be with our other technologies for energy recovery. We're going to be competing against electricity generation for that same gas. And we're going to be competing against the medium Btu projects, both of which have a lower capital cost than the landfill gas to vehicle fuel.

So that's really going to be the key; you know, what is going to push landfill gas to vehicle fuel ahead of some of those other ways to utilize landfill gas; and where is that push going to come from. Is it going to come from politics; is it going to come from legislation regulation; or is it simply going to come from some market drivers such as the cost of natural gas.

And like the rest of the renewable energy options that are here, we're always looking for handouts. So subsidies and tax credits are yet another way to make some of these projects happen that wouldn't otherwise.

Thanks.

(Applause.)

MR. WILLIAMS: Thank you, Patrick. Well, it's noon and that's scheduled for lunch. But we did promise to take some questions, so I hope we have a few minutes -- and Martha says yes -- we'll take a few minutes of questions for this panel, as well as the first panel this morning.

So, let's get the microphones out.

(Pause.)

MR. WILLIAMS: And please give your name and affiliation, please.

DR. NAND: Krisha Nand; I'm an independent consultant. I have a question for Necy. You said the byproduct when you are making ethanol is liquid. And you could use it in the power plant. What kind of this byproduct is, and which kind of power plant you can use it? This first question.

Second question, is if you can tell us some characteristics of the criteria pollutant and hazardous air pollutant emissions from your pilot plant which you ran in the City of Orange, because that's very key, critical thing for -- for a real power plant, you know, as probably you're aware, I'm also in the South Coast region, you know, so you know the problem.

MS. SUMAIT: The byproduct -- lignin is the byproduct. It's the glue that holds the cellulose and polymers together. And consistent with doing the simplest business model to deploy the technology, that lignin will be shipped in existing biomass power plant for this first project. We will send it over to Colmac. They are already committed to, you know, burn solid fuel. And so we're just going to simplify the process, which is going to take that lignin and ship it over to Colmac.

In future projects then we will tackle the possibility to put boilers onsite, and if the lignin can really produce over 70 percent of the -- needs of the biorefinery, so that helps to bring down the cost.

With regards to emissions sources, the emission source will come from the source of the steam and the electricity for the biorefinery. If we're using natural gas, then that would be a boiler that would be fired by either landfill gas, supplemented by natural gas. And so it would go through the back process, go through the new source review for the air emissions.

To the extent we, for VOCs, vapor recovery systems will be in place where there are VOC emissions. Fugitive emissions will be controlled in either through dust suppression or enclosures or bag houses.

So, in the Sacramento project we did go through the Sacramento Metropolitan Air Pollution Control District. Got our authority to construct. And so we're fully aware.

But most of the sources will come from the combustion source that provides the steam and the electricity for the biorefinery.

MR. WILLIAMS: Thank you. In the interest of time let's have all the questioners line up here. The line has already started. There's two people, and Don is our next question.

MR. AUGENSTEIN: Hi. This is for Peter Knecht. I was curious; you showed digestate or process digestate being spread on agricultural fields. And I just wondered what the cut was that you were digesting. Was it the waste that you saw entering the whole flow scheme, the material balance scheme where about 15 percent of it was converted? Or was it MBT, or was it some selection fraction of the waste that was being digested there and subsequently, after digestion, being applied to agricultural fields? I'm just interested in --

MR. KNECHT: Okay, so the digestate and the liquid fertilizer, you saw the pictures, that's from clean source input material. So we'll receive a high quality end product. This is even certified in Switzerland for organic agriculture. But this is just possible if you have good input source. Out of MSW will never achieve that sort of --

MR. AUGENSTEIN: Right, --

MR. KNECHT: -- that sort of --

MR. AUGENSTEIN: -- right, -- yeah, that's what I was curious about. Is it the entirety of the stream that would be diverted from landfills, or it's a selected cut then.

In other words, you have selected that to be an extremely fraction.

MR. KNECHT: No, actually it's source-separated. I mean, --

MR. AUGENSTEIN: Okay, so it's pretty -- yeah --

MR. KNECHT: Yes, if you start to source-separate you will always have -- then you will have very clean source of input material which means a good quality end product.

MR. AUGENSTEIN: Right.

MR. KNECHT: Once you start to mix everything together, you will increase complexity by factors --

MR. AUGENSTEIN: Yes, I understand. So you don't have the entirely -- the source-separated waste, then, is a clean fraction of the organics that you want to divert, in other words.

MR. KNECHT: Yes.

MR. AUGENSTEIN: Okay.

MR. CALDWELL: My name is Jim Caldwell from E3 Regenesis Solutions. This is a very -- I don't want to get into a single-factor analysis, but just to isolate one factor, you talked about compost. There are two questions for those dealing with compost. One is input cycle, you divert to compost, and we've already heard that a lot of it ends up as alternative daily cover on the landfill anyway.

But whether it ends up that way or is recycled as to fertilizer, when you do composting through windrowing and so forth, doesn't that put a lot of methane into the atmosphere?

MR. KNECHT: It does put what in the atmosphere?

MR. CALDWELL: Methane.

MR. KNECHT: If you compost --

MR. CALDWELL: Yes, right.

MR. KNECHT: -- basically if into the process will be perfect, then no. But in windrows you will always have parts of the windrow which are not in a perfect, let's say, environment. So they will go anaerobic. That's basically what's happening in the landfill, as well, it's going anaerobic and it's more or less uncontrolled.

That's why we put it into a reactor to have it under control and really push the methane to release.

MR. CALDWELL: Okay, thank you.

MR. KNECHT: So that's the difference between AD controlled and basically.

DR. DIAZ: I composted a little bit. I think that the generally the process, in fact, in

Europe, by definition, has to be anaerobic. If you have an anaerobic process whereby you're producing methane it shouldn't be called compost, number one.

So, that, in itself, negates what you're talking about. However, you produce CO2. You should not produce methane in the decomposition, by theory, by definition, legal definition. And we've gotten some little bit of emissions and odor, of course, ammonia. But no methane.

MR. CALDWELL: Yeah, oh, good. Thank you, thank you. And I just wanted to follow up with the other end of the composting question. When you -- after you digest it and then you take out some of the energy, your fertilizer that goes back to the fields, is that -- how do you balance that for the soil and crops that it's going to be used on?

MR. KNECHT: There is testing on the liquid fertilizers of how much nutrient is inside, so the farmers, they have to place balance sheets, so how much they bring out per hectare. So this is taken in consideration. So they're substituting artificial fertilizer for that.

MR. CALDWELL: Very good, thank you.

DR. LARSON: Eric Larson from Princeton University. I had a question for the first panel, particularly Kit Strange, and maybe Professor Diaz.

You both mentioned how policy and regulation drives the MSW utilization in Europe. I'm interested specifically in what kinds of incentives there are for the households at the household level for reducing the generation of the material to begin with; and then the next step being with recycling and separating.

MR. STRANGE: Thanks. Are you talking there about organics or across the household waste spectrum?

DR. LARSON: I suppose across the spectrum.

MR. STRANGE: Okay, because I mean it does vary. One of the most interesting examples I've seen recently is in Belgium where a region has introduced the idea of household chickens; and even in reasonably large cities they've encouraged homes to have two or three chickens which have been provided pretty well free of charge. Because chickens eat most of the kitchen waste that's being left over. And they produce eggs. And then you can eat them at the end.

(Laughter.)

MR. STRANGE: And that's actually been very successful. And I can supply more information on that, including photographs of chickens.

But another useful innovation in a number of countries where the regional or local authorities have acted to help encourage householders on prevention has been to empower them, you know, the junk mail that the postman brings, and they just drop everything through the letterbox. The local authorities have produced stickers you can put on your door, which in many parts of the world that happens.

But they've gone the extra mile and they've passed legislation which has made it an offense for a junk mailer to put anything through the letterbox which carries such a sticker and has a penalty of a fine.

And certainly in a city the size of Brussels, which isn't that large a city, they've saved several tens of thousands of newspapers. And they've been able to measure the impact on the waste flows of material, which hasn't been printed, distributed and stuffed through households.

But there are lots of examples, particularly the idea of just empowering people through information. So Vienna runs a very good observatory website which tells the householders in Austria what are the environmental consequences of their purchases, different types of packaging material. Maybe if you buy a concentrated laundry chemical in the rather bigger boxes, get the concentrate, you can save so much energy on transport and on packaging waste disposal.

And the idea is that householders will come and they'll wish to make an informed decision.

DR. LARSON: But there aren't policies that require payment by weight, for example, of material that the households --

DR. DIAZ: It's gaining a lot of interest in Europe. And a few cities are putting it into place. But it's just a beginning.

MR. KNECHT: May I make a comment to this. The big -- wave in Switzerland is when we introduced that you pay per bag, so the more ways you produce the more you're going to pay. And recycling is basically for free. So there is recycling centers where you can bring your recyclables, so now you have the choice. You put it in black bag you pay, and it's quite much. Or you recycle for free; that had the biggest impact on our waste streams.

MR. STRANGE: Even is going a little bit further, just one addition to that. In some places now they're starting to say, well, maybe the householder should even pay for recycling. But pay much less than for disposal. So it really does internalize all the costs.

MR. SUBIN: Hi, my name is Zack Subin; I'm a grad student at Berkeley. And my question is for BlueFire Ethanol.

Traditionally the decomposition from cellulose into sugars has been the hardest step and sort of the reason why we haven't seen cellulosic ethanol commercial yet. So I was wondering if you could talk more about your acid hydrolysis process, and what you've done that makes this more viable now.

MS. SUMAIT: I did talk about the pilot demonstration both what we did in California as well as what the Izumi facility did in Japan as a third-party validation.

The process has been validated not only there, but it's been a proven process that's been there since the 1900s.

In our website, if you want to view the process based on the equipment that is there at Izumi, I welcome you to do that. It is www.bluefireethanol. We've loaded it with the video of the Izumi facility and we go through the process with the equipment there, so you can see it working.

In addition, we try to load our website with as much information about our technology. And I'd be glad to introduce you to John Cousins, who if you ask him a question you'll get a five-page report.

So, you know, we'll spend the time if you want more information about it. But in the interest of time, I think I would refer you to the website.

MR. WILLIAMS: Okay, last question before lunch.

MR. MACLAY: This is Dick Maclay with Advanced Energy Strategies. Question for Peter.

I believe you said that you were running

MSW 100,000 tons per year in Montpelier. And I'm gathering from your reply to the previous question that that's not black bag MSW, that's source-separated?

MR. KNECHT: No, Montpelier will be the same as in Spain; it will be black bag MSW. So the good news on that side is yes, you can extract the energy. The bad news is the compost will be not of good quality. So it will go into landfill.

MR. MACLAY: Okay, that's what I was wondering.

MR. KNECHT: We would not even talk about the compost when we see the end product.

MR. MACLAY: Okay.

MS. GILDART: Okay, just one or two announcements before lunch.

One is I've had a cellphone turned in to me. If someone has missed their cellphone, please come and describe it.

We will have lunch in the same room, the Sierra Room. We are starting a little late, but I think there'll be enough time that we can come back to this room at 1:30 as scheduled.

So, please enjoy your lunch and be back

here at 1:30. It's going to be very important to hear the description of how the breakout sessions are going. So, 1:30.

(Whereupon, at 12:16 p.m., the forum was adjourned, to reconvene at 1:30 p.m., this same day.)

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AFTERNOON SESSION

1:37 p.m.

DR. JENKINS: We're going to start with the breakout sessions here, but before we do a couple of items.

First of all you should have received in your package that you got at registration -- and if you didn't get one I'm not sure we have any extras floating around, but we'll try to find them -- a survey form. We would like your opinion on the quality of the forum, both yesterday and today.

And so if you would please make sure to fill that form out. There's a box on the back table there. Please drop it in there. If we could get everybody's form today that'd be great. If you find that you don't have time to fill it out or something, and can mail it to us, you can just mail it to us at the Collaborative, care of the Department of Bio and Ag Engineering, UC Davis. That'd be great. But we'd like to get as many as we could today, so please get the survey form in. Thanks.

And then there's been some question about whether you might be able to drive independently on the tours tomorrow. The bus is full; we're a little bit over-subscribed for the bus, but we have some way to accommodate that. So if you are registered, we'll make sure that you get on the tours.

If you want to drive independently what we'd like you to do is to come to the first stop, which will be the UC Davis Anaerobic Phase Solid Pilot Digester System, Biogas System, which is located at the wastewater treatment plant on the campus.

And to get there you can, from Sacramento, you just head west on highway 80. You can take the UCDavis exit. And then head south on Old Davis Road. Don't go into the main campus, which is on the north side of the freeway, but go to the south on Old Davis Road.

Cross the railroad tracks about a half a mile down, and make a left turn into the wastewater treatment plant. And on the north side of that plant you'll see there's some big stainless steel tanks and it'll be quite obvious where the pilot plant is.

You can park in there. I would encourage you to find ways to carpool. So if you can do that ahead of time that'd be great. If you want to meet at the wastewater treatment plant and carpool from there, that'd be fine, too.

We'll have more directions for you at the first stop tomorrow at the wastewater treatment plant for the rest of the tour. But if you'd like to do that, please feel free. But do try to carpool. We're probably a bit limited on parking in some of the places we're going to go. So if we have 50 vehicles show up, that might be a bit of a concern for some of the facilities we're going to visit.

But I hope you can come on the tours. We're certainly happy to have you come. And so if there are any questions check with me or with Rob Williams. Rob has been -- Rob and Pete have been responsible for setting most of it up.

Oh, yeah, I'm reminded about lunch. Sorry, you're out of lunch if you drive independently and have not preregistered. So, if you've registered and you want to drive independently, that's fine, you'll get your lunch. But if you're not registered, unfortunately we have not been able to reserve enough lunches for beyond what was registered. We might try to go out and get some sandwiches or something if things get desperate.

But, in general, if you want to drive yourself, I hope that doesn't stop you from coming on the tours, but somehow -- but we just don't have lunches associated with those who have not been able to register so far.

And I apologize for the constraints on the tours. If you tried to register and you really want to come on the tour and you weren't able to because we were full, I apologize for that. But we've been a bit constrained in transportation.

So, anyway, again, if there are any questions about the tours track me down at the end of today and I'll be happy to fill you in on some more details with that. Also if you see Robert around he can fill you in on that, as well. And thanks to Rob and Pete for getting those tours organized.

All right, we're going to begin the afternoon session here, which as I mentioned, is very important for you to provide input to us. And the person who's going to tell you about your responsibilities today, and how to do this exercise is Dr. Howard Levenson with the Integrated Waste Management Board.

And Howard is currently a Deputy Director of the Permitting and Enforcement Division at the Board. And he plays a coordinating role in the Board's bioenergy and biofuels work. He served as an Advisor to our Board Member Relis from 1991 to 1998. Then he was Supervisor of the Board's organic materials management section until May of 2003.

Prior to coming to the Board he worked as a Senior Associate in the environment program of the Office of Technology Assessment. Many of you probably know that. It's a supporting agency for the U.S,. Congress, or was, anyway.

While there he worked on a range of environmental issues including marine pollution, groundwater pollution, climate change, municipal and industrial solid waste management. So he comes very well informed and with a lot of expertise to this position.

He was primary author of the Office of Technology Assessments' 1989 assessment on facing America's Trash, What Next for Municipal Solid Waste. And with that, I'll let Howard tell us what we're going to do here. Thanks, Howard.

DR. LEVENSON: Thanks, Bryan, and welcome back, everybody. God, 1989, long time ago; that's when the Mobrowe garbage barge was floating around and people were looking at what to do with the solid waste.

So, we've come a long ways since then. And, you know, today's forum I think is kind of a great opportunity for us to take even another step forward.

What I'd like to do this afternoon is make a few opening remarks, kind of set the stage for why the Integrated Waste Management Board has been interested in this; what we intend to do with the results from this forum. And then give you some sort of marching orders on the breakout sessions and what we hope to achieve from that.

I'm not going to talk for too long. I know it's right after lunch. You know, it's great that everybody has come back. We've got over 100 people coming back for the last session. You've sat through a day and a half of what I think are some very excellent presentations, a lot of information that's been put out.

This is going to be your chance to tell

all of us, the Waste Board and our various colleagues, what you think needs to be done to further this whole effort in terms of biomass to biofuels, or biorenewable energy.

The Waste Board has multiple interests in having a day like this devoted to this topic of biofuels and solid waste. And as our Chair, Margo Reid Brown, indicated this morning, we're an active participant in the interagency bioenergy working group. We also have formally adopted strategic directives that encourage biofuels and bioenergy production.

So this forum is just part and parcel of that process of trying to gather more information relative to those topics; and try to get some analysis back to our Board in terms of what are feasible solutions. Whether they be research solutions, legislative, regulatory solutions or funding.

The Board has done a lot of work over the years on this kind of broad topic. Starting back as far as 2001 when Mr. Fernando Berton and I put on the Board's conversion technology forum. And I see some people here who were at that forum, and some of the issues that I know you're going to slam us on today in terms of regulations and legislation were on the table at that forum. But, you know, maybe things are starting to change and there's some chances to resolve some of those issues.

At that forum we were crazy enough to have, I think, 12 or 15 simultaneous breakout sessions, each one with a laptop, compiling notes. And then we provided all that information back to the audience before you left that day. We're not going to be that ambitious today. We're going to keep it a little looser, a little more informal. But we really are trying to get your input on where to go next.

But, as I said, the Waste Board has done quite a bit. We've had the conversion technology forum. We had, as a result of some legislation a few years ago, we did a lifecycle analysis of conversion technologies that resulted in a report to the Legislature.

Over the last couple years we've funded some research at UC Davis, several different projects including the phase solid anaerobic digester; some of the research that you're going to hear about tomorrow on the tour.

We've also worked with UC Davis on looking at the feasibility of taking landfill gas to hydrogen. We heard about LNG and CNG today. We've also been trying to get a handle on how feasible is hydrogen from landfill gas. That's further off, but we want to know what all our options are in that area.

We've just funded in the last year, the contract was just signed, another project at the Yolo County landfill, which is near the University of California at Davis, which will be looking at anaerobic digestion of source-separate green material in a landfill cell. But it will not be disposable, we'll just be using the landfill cell as a kind of vessel, if you will, for anaerobic digestion.

And we have an RFP out on the streets. I think it's actually closed now, but for a landfill gas-to-LNG demonstration project.

So those are things that the Board has been able to fund over the last few years. Those are typically one-time fund availability projects. When we have some discretionary dollars that we're able to squeeze out of our budget we can get some of these projects going, we try to. But there's no systematic funding for biofuels research in general, or for demonstration projects or pilot projects. So that may be something you want to discuss.

It's certainly clear that we need to do a lot more. I think various folks have mentioned today that out of this 27 million tons of biodegradable material going into landfills, out of that 42, 43 million tons a year, that's got a huge potential for electricity generation, 1750 megawatts. You know, 50 million barrels of oil equivalent. Certainly a lot of potential for development into biofuels.

But we, as a state agency, interested in promoting that, need to have a lot better information base about the status of different technologies, the kinds of technologies you've heard about today, and the projects that can use solid waste-to-biofuels.

So that was really the impetus behind the Waste Board co-sponsoring this day at the Collaborative Forum. And we feel very fortunate to be able to piggyback onto the annual Collaborative, you know, conference that's held. This is the fourth one. And to try and get some input on this issue from you folks who are much more intimately knowledgeable about these technologies and some of the barriers that you've come up across.

And before I go on, I do want to thank Bryan Jenkins and Martha Gildart and Rob Williams for all the work that they've done in putting this together. I think they deserve a round of applause. They've worked hard and long on this.

(Applause.)

DR. LEVENSON: And then I also want to thank my colleague, Fernando Berton, and Alan Glabe, wherever he is, for working with the Collaborative to put this together.

And then for last night's reception, to thank Waste Management and BlueFire and RealEnergy and PG&E. I think a lot of folks had a chance to talk and exchange information and ideas last night. And so that was really well worth it, and I want to thank those sponsors.

So, so far yesterday and today we've heard a lot of good information, exciting projects in the pipeline being developed. We've heard what's happening in Europe; we've heard a few projects that are happening in California, or about to happen.

And we want to go a step further now, and get your input on areas where two things, really: One is where is additional research needed on biogas or biogasoline, or any of the other fuels that we might be interested in.

And then, so as a research feedback we want it from you. And then feedback on what are pathways, barriers and pathways to commercialization. We want your input on where you see opportunities or barriers. And then solutions to those identified issues.

Because we know, the reason we've kind of split it up like that, we know that any given project can take years and years to come to fruition. Some projects need or processes need more basic research. And we heard from Dr. Yang this morning about enzymatic hydrolysis and kind of the status of some of the research that's going on in there.

We know that other projects may be ready for commercialization but they're not able to get the financing for the first plant. And we heard from BlueFire this morning about that. They got the DOE grant and they're able to get now, hopefully going on a first plant that will make it easier to finance, you know, second and third plants.

And so I think we're all familiar with those kinds of issues, but to hear it firsthand from some of the folks who are directly involved is great information for us. It's one thing for me to go to my Board and say, I think that financing's an issue. But when we hear it from the folks who are involved, that counts a lot more.

So, we've designed the breakout sessions to get your input on research needs and pathways to commercialization. And what we're going to do is have two sequential sessions, about 50 minutes to an hour each, with a break in between.

The first session will be on pathways to commercialization. And we're going to ask you to break up into three groups.

And then the second one will be on research needs.

Ultimately what, before I tell you kind of a little few more marching orders, what we will do, as Waste Board Staff, is work with the Collaborative to try and synthesize some of the key technical findings and information that's been presented so far at the conference. And then to synthesize the results of these breakout sessions in terms of research and commercialization needs.

And then put that together in what will be a public agenda item that is taken to probably our policy committee, and maybe ultimately to our full Board in a couple of months. I don't have a specific date. It will depend on when, you know, we can get that work done.

But that will be an open public item. All the Board meetings and committee meetings are webcast if you just want to listen in. The information's always posted well beforehand, and you can provide additional comments in writing or via email or in personal testimony when the Board does hear this.

So, what we hope to be able to do is get the Board's direction on where we should go next. Should we be pursuing legislative, specific legislative proposals. Are there regulatory changes that are needed. Are there funding opportunities for research that can be prioritized so that when the Board does have contract dollars we can kind of identify those and say, okay, this one makes sense to go provide some funding for. Or at least to have a competitive process for providing funding.

Are there policy incentives or subsidies that the Board should be considering in terms of its interactions with the Legislature. You heard this morning from Luis Diaz on the EU; all the directives that are driving things in Europe. That there's subsidies on anaerobic digestion. He also talked about R&D needs for optimization of bioreactor processes.

You heard from Kit Strange, again on the same kinds of things, the drivers in Europe; also he mentioned the cost of end-of-life management and the idea of moving those costs upstream to be placed more on the producers as opposed to the consumers and taxpayers.

Necy Sumait from BlueFire talked about the financing issues, the difficulty of getting financing for that first commercial plant. She also mentioned the issue of diversion credit, and whether, and for those of you who are familiar with the world of AB-939 whether a facility that takes in solid waste will get credit for diversion from the landfill or not.

Bin Yang talked about research on pretreatment. We had Peter also talked about the European mandates. And Pat Sullivan talked about like the politics of CEQA and whether mitigation measures might be warranted. And he also talked about subsidies and tax credits. And then Chuck White talked about landfills as a CO2 sink and other issues associated with landfills.

So there are a lot of, I think, different issues that were brought out in the various talks that are related to research; they're related to policy; they're related to barriers. And that's the kind of stuff that we want you to think about in these sessions and give us your feed back on.

So, what we will ask you to do is in each hour, the first hour will be on pathways to commercialization, is to spend about 20 to 25 minutes with kind of an open discussion. You'll have a moderator and a notetaker. Try to have an open discussion about what the primary path barriers or opportunities are for commercialization for that particular fuel area.

And then we'll have the moderator try to sum up what they've heard; post them on flip charts. And validate with you, here are the three or four things that I heard that were most, seemed to be most important.

And, you know, if we have a chance we can do a straw poll within each of the groups, as to, you know, here's the number one issue; here's the number two issue. So we have some sense from you of priorities for moving forward.

And then in that session we'll go on, the commercialization session, and identify solutions. We'll do the same thing, kind of open discussion for whoever's in the room in that particular breakout. Take notes. Then try and summarize at the end which are the three, four, five most important things that can be done to solve those issues.

So that we go back to the Board or to the Legislature, we can speak at least somewhat systematically or represent a broader spectrum of stakeholders, say here's what these folks identified as being most important.

So we want you to talk about siting issues, financing issues, regulatory issues, research needs. We want you to talk about should there be limits on the types of landfill, materials being landfilled. Should there be some changes in regulatory framework for permitting or streamlined approach. How do you balance that with health and safety issues that are associated with permitting.

Should there be incentives for research and demonstration. What should those be and how would you fund them. Should there be grants. Should there be subsidies. You know, those kinds of questions.

So we're open to hearing any and all ideas. We're going to take notes on, we're not going to lose anything. We'll try to in some way summarize those and have those available to everybody, certainly as part of our agenda item back to our Board. But also probably -- I don't want to speak totally for you guys -- but we'll probably be posting some information back on the website for the Collaborative in terms of what we found. But we won't tell you exactly how we're going to do that or when we're going to do that. No timeframe.

So, that's really all I want to do today is provide that kind of context and guidance. What we're going to do is split you up into three groups. And then when you're in the group the moderator will ask you to pick -- for a volunteer. Otherwise, they'll just pick somebody, to be a spokesperson for that group.

So, when we come back around a quarter to five, that spokesperson will be able to report out to the whole group that for biogas, you know, our top three research issues were A, B, C. And our top three commercialization issues were A, B, C. And here's the three solutions we came up with. Whatever you guys come up with.

And then we can have a little bit of an open discussion, depending on how much time is left at that last when we all reconvene.

So, before I break you up into groups I'll ask if there's any questions about the intent here or any confusion about what we're trying to get. We really want your input.

Everybody's napping from lunch, so start waking up. We're going to make you move as to get into the rooms. And, again, what we'll do is we'll go for about 50 minutes on pathways to commercialization. We'll take about a ten-minute break and then you'll go back into the same room and we'll follow up with discussion about research needs.

Whenever we finish, I'll be kind of wandering around and trying to monitor, if we finish a little early, we'll take another break. We'll kind of try and make it synchronous that we take the break.

Everybody will reconvene in here and then we will have the presentations by the spokespersons for each group, to run down what they found. We'll see where there's commonalities and where there's some differences of opinions, or at least different ideas.

And that'll probably be about it. Bryan will wrap up and, you know, we'll start processing all this. Sir, you had a question?

AUDIENCE SPEAKER: If you're dividing it by products, biogas includes syngas.

MR. WILLIAMS: No.

DR. LEVENSON: Biogas will be in the anaerobic digestion. And then we'll have the alcohols will be one group. And then biogasoline and renewable diesel would be the third group.

Sir?

AUDIENCE SPEAKER: So where is the syngas (inaudible)--

MR. WILLIAMS: Well, if syngas is going to be --

(Laughter.)

MR. WILLIAMS: Sorry. The intent was that syngas is not really going to be a vehicle fuel, I believe. So what fuel would syngas be made into, one of those three fuels.

DR. JENKINS: Let me --

MR. WILLIAMS: Would it be biogas?

DR. JENKINS: Let me comment. I think for the syngas why don't we simply arbitrarily assign it because it can be associated with biogasolines and renewable diesels. Syngas will meet in that session.

Also, if you're a thermochemical hydrogen, please meet in that session. If you are biological hydrogen meet in the biogas group. Does that make sense?

DR. LEVENSON: Okay, we have two large rooms and one small room. So what I would like to do is get a show of hands for each of the three groups so we can know which group's going to end up in the small crowded room.

So, Luis says the alcoholics go to the treatment room. No, that's not what you said.

(Laughter.)

DR. LEVENSON: Okay, let's try biogasoline and renewable diesel. Okay, that's a lot, that's a pretty big group.

Okay, what about biogas? Okay. And alcohols? Okay. I think we got a break there.

Okay, now who's the alcohol moderator? Fernando, okay. The alcohol group is going to go with Fernando into the small room, room 240, which is just around the corner here. So, if you all could go ahead and we'll just kind of do this in an orderly fashion.

(Whereupon, at 2:00 p.m., adjournment to the breakout sessions.)

--o0o--

P R O C E E D I N G S

4:26 p.m.

DR. LEVENSON: Please be seated so that we can get on with our last part of the day.

Okay, what we'd like to do now, first of all, thank you, all, again for sticking around to the very end, and for participating in the breakout sessions. I was floating around to all three and there was a lot of stimulating discussion.

Some people were saying, well, we've heard this before. Yes, we have heard some of this before, but those very things have not been solved. So, it's appropriate to keep bringing them up and keep trying to work on them in one way or another.

So what we would like to do now is have a report out from each group. And I'd like the spokesperson for each group to go ahead and try and summarize in five minutes, maybe a few more minutes than that, what your key points were in terms of pathways to commercialization, and then research. And then we'll go on to the next group and hear them.

And then we can have a little bit of

open dialogue in terms of was anything missed; is there some clarifications that somebody wants to seek. Have a little bit of discussion. But we're going to try and wrap up.

I will, after those three presentations and a little bit of discussion, I'll come back and just wrap up in terms of what we're going to do next. And then Bryan will call it a day with some instructions probably for the tours tomorrow or whatever you need to do.

So, we have Ruth, Mike and Tim are the spokespersons. Anybody want to volunteer to go first? Ruth is going to go first. Yeah, if you can come up here, Ruth, and if we need to hold --

MS. MACDOUGALL: Shall we do that here or there?

DR. LEVENSON: Whichever you're comfortable.

MS. MACDOUGALL: Somebody time me.

DR. LEVENSON: I will say this, although we don't have an exact timeframe, what we're going to have is the moderators will go ahead and they're going to type up their notes, the flip chart notes, so that they make some sense.

And then we will send those over to the

Collaborative; they'll compile them all into one file that will become part of the report that they're putting out as a result of this forum.

So, Bryan, I don't know if you have a timeframe that you might want to talk about later on, but certainly that material will be publicly available at some point. And certainly in terms of any presentations to our committee.

Yes, John.

AUDIENCE SPEAKER: Can I ask that the presentations be put on the website --

DR. LEVENSON: You certainly can ask.

(Laughter.)

DR. JENKINS: Martha's going to overrule me here, but go ahead.

MS. GILDART: We do plan to get them up as quickly as we can, but one of the requirements that we are working under is that we get signed releases from all of the presenters for those materials to be put on the web. And so far I'm only about two-thirds of the way through getting those forms. There may be a little delay on a couple of the presentations.

DR. JENKINS: But we can post those that we have.

MS. GILDART: Yeah, --
DR. JENKINS: So we'll post the ones that we have signed forms for probably within a week, probably before that actually. So look for that on the Collaborative website.
MS. MACDOUGALL: So, our topic was biogas; and we first established that that's biogas from landfills, anaerobic digesters and manure digesters.
So we found four barriers. And the first one was permitting. And that includes air permits, water permits and solid waste permits. So that's definitely everybody had consensus on that one, there's problems there.
The next was the cost gap between anaerobic digestion and business-as-usual. So in other words, either on TIP fees have to be higher, or the electricity -- there's a cost gap with electricity rates, as well, what is paid for it.
The third barrier is the multiple feedstocks that we're dealing with. And I think I might also add, you know, the complexity of the feedstocks.
And the fourth was the way that diversion credits are applied. It's not

consistent. They're not currently applied to conversion technologies. Anaerobic digestion, it's confusing right now whether they would apply to that. And then also there's the issue of ADC getting diversion credits even when they're going back to landfills. So there's issues with that.

And we came up with several solutions, and I'll do these in order, as well. Permitting, there's a few solutions on permitting. One is that we need to resolve some of the permitting ambiguity that exists.

And, for instance, one suggestion was there's a task -- that a task force be developed for one-stop permitting. It's encouraged that the board of directors, I mean the Waste Board, and then the Waste Board Staff and the LEAs all get on the same page as far as permitting.

The idea that we could bring multiple projects through, as kind of a pilot project through the permitting process, both public projects and private projects. And in order to develop and demonstrate the permitting pathway. We think that that would help us all.

Also, on permitting, we should look at the net benefits of projects. For instance, the way the greenhouse gas reduction against the NOx emissions, for instance, on combusting a landfill gas or biogas.

And secondly, the cost, to solve the cost issue. One is to provide incentives on the products of anaerobic digestion or biogas products, either the electricity, the use of the biogas, or the compost that comes out of digesters. And that might help bridge that gap.

For the multiple feedstocks, we could adopt the European Union has a spec on animal byproducts, on food waste. I think they call it biowaste. And we could just outright adopt that. That was a suggestion.

And let's see, the last thing, oh, diversion credits. There was a suggestion to phase out organics from landfills. Do it, again, as the European Union has done.

The next session was on research needs. And again we have pretty clear consensus on what those needs are. One of them is to research or establish the salt loading limits and nutrient loading limits for digestate or for liquid, you know, land application.

And to understand the characteristics of the digestate as far as pathogens and chemical constituents.

And second is to solve the emission problem from combustion. We need to develop low NOx technology, emission technology; and especially work on gas cleanup which might make that easier or do away with that problem. Gas cleanup technologies.

And third is there's a lot of research that's been done on the various feedstocks, constituents, biogas potential, et cetera; and to get that research together and develop a database of what's understood about it, and maybe perhaps further that.

And fourth is to -- we need demonstration projects. So we need to be able to kick the tires on projects.

And I hope I'm collecting everybody's comments accurately.

So, the fourth thing is okay, how do we pay -- we have a lot of research needs. Actually there's a huge long list of research needs. But, so how do we pay for this.

And there's a lot of suggestions on this. One is a carbon tax; you know, use that to fund research. Another is to increase the electricity tariff that's paid for biogas projects. You can cap the carbon for large emitters and fine those who are in excess on a per-ton basis.

You can put a public goods charge on transportation fuels, which is what we already have on natural gas or electricity. A windfall profits tax. Increase the landfill tipping fee. Private equity; venture capital. Lots of ideas for where to get funding to pay for these.

So, any corrections? Omissions?

DR. LEVENSON: Any questions or clarifications, just to make sure? Okay.

All right, we'll start looking for commonalities now between the groups. Tim, you're standing up; if you want to go. And then Mike.

MR. JUDGE: You'll have to excuse me if I have to look with a pair of binoculars over to what this is. My gray hairs prevent me from remembering at all.

Basically there seems to be some overlap relative to some of the issues, particularly on permitting and AB-939.

We basically talked about how the

existing laws and regulations need to be updated. That the process is somewhat outdated at this point for how facilities and projects get permitted.

We also need to look at some of the contradictory points in the regulatory scheme where in one instance it's pushing forward on alternatives and renewable fuels, and looking at conversion technologies. And in the other direction it's inhibiting the implementation of those projects.

Part of that comes into interagency and intergovernmental coordination. So that we avoid situations where, let's say the air resources folks are saying one thing and not paying attention to what comes out the drainpipe, and vice versa. That we need to coordinate and have better coordination between agencies within governmental levels and between governmental levels. That coordination needs to occur.

Lifecycle and net emissions was something we also talked about, looking at the benefits. This was also, by the way, since I don't think I identified it, it's primarily on the alcohol fuels. I just realized a lot of people are going, what the hell is he talking about. So, in dealing with the waste-to-ethanol issues, which is one of the conversion technologies.

And we need to define that new regulatory process that we tried to identify as being one of the barriers.

Another barrier dealt with financing. And looking at those issues, specifically some of the things were state loan guarantees and supplemental loan guarantees to help get new and emerging technologies into the marketplace.

Another thing that we think that the state can provide is risk validation so that the technology and the process is validated such that those companies that are putting forth those technologies can go to private capital markets. That those capital markets will be satisfied that somebody else has taken a look at this.

Because all too often individual companies seeking those kinds of help from those markets, that investment, don't have necessarily the depth and credibility that some of the larger players do. Especially smaller emerging companies.

State support for demonstration

projects. And that's somewhat tied into our area on research, and I'll get to that in a moment.

And then another thing was a large education and public outreach to get the public to understand what happens with waste; taking a look at the benefits and costs associated with different methodologies to get rid of wastes, how we handle it.

On the R&D side, or the research needs side, we didn't identify particular research needs in terms of areas of research, but instead kind of focused on the process of getting research done. And what are the mechanisms that we can use to go ahead and get research going, specifically on conversion technologies.

One of them is to create a stable funding source, or a stable funding platform which we could all draw upon and use. And part of that may be an enhanced tip fee or something, a portion of the tip fee that's allocated for a particular state fund to get demonstration projects up and going.

We may be looking at green waste. We talked about a couple of different components to that. Another, which was discussed earlier in the presentations during this, it was brought up that somebody was looking at the landfill allowance system that they're using in Europe in terms of trading on those credits.

We also looked at -- if I can read from here -- we had the risk reduction is something that we think research can play a role in. We also looked at the validation, like a third-party validation. And that could come through research efforts, especially on the academic level and not just on the commercial side.

I'm trying to see if I've left anything out. Oh, request for proposal. How would the mechanism work. And one of the things we had talked about -- thank you, Fernando -- is, you know, send out a request for proposal or request for information on various technologies.

And get those in and then take a look at the promising field. Narrow that down for a competitive process to get research dollars from the state. And then take that and allow those folks to go forward and provide some benefit back. And some of those benefits may be such as NYSERDA's model in New York State, which is the New York State Energy Research and Development

Authority.

When they give money to a demonstration project, that project then acts as a platform for other individuals to come in and use that facility to do some research and to demonstrate other technologies.

So, you know, if we give you the money to build your plant, part of the agreement is that you allow the state to come in and open that up for other research needs. So that we can fund the true demonstration projects on the pilot scale rather than necessarily having to go to the commercial size demonstration facilities. Though both of those need to exist in the marketplace. And we think the state should support those.

I think that basically covered it. And if any of my fellow people in our group want to throw slings and arrows, here I am. So, I think I got everything. Thanks.

DR. LEVENSON: Okay, Mike.

MR. HART: I'm Mike Hart with Sierra Energy. I think it's safe to say that the range of political opinion in our group went anywhere from that we should use regulation in the state agencies to come up with the perfect solution, to other people who might believe that giving regulators authority is like giving whiskey and car keys to teenage boys. So I think it's safe to say that we covered the full spectrum in our group.

We figured out that the top five barriers, and we're talking about biogas and syngas production, the top five barriers that we came up with was, one, 939.

The credit limits are basically giving, when feedstock is basically diverted from the landfill, instead of giving credit to the community that created it for recycling benefit, that's a major problem. And that needs to be addressed.

There is an incredible lack of education at the various agencies, as far as specific technology. They tend to regulate first and figure it out later. And so there is a benefit in the agencies becoming more educated and more informed about the technologies prior to passing regulations governing them.

There are also, there was an issue raised that the project proponents lack a general understanding of the permitting process. And the need to give better data to those regulating agencies that are trying to deal with the permits. And that actually was one of the central points that we come up with later, is about the issue about permitting and dealing with the agencies involved.

There is a significant issue, as the other groups have pointed out, a lack of funding available for addressing risk. There is a real problem with this. And the state could definitely address it. The state could also work on developing data and tests that could support new technologies with alternative energy.

Finally, one of the other barriers that we came up with was out-of-date legislative definitions. They don't reflect the current state of technology. And, again, that goes back to 939. But there is a need to redefine a lot of these specific definitions. And that's a real opportunity. It's not talking about changing the legislation, it's talking about redefining some of the specific terms.

The top five solutions which we came up with as a group. The first was addressing the issue of ownership of the feedstock. Right now the waste basically belongs to the waste haulers once it's diverted away. And there needs to be a way for the communities to take control of that waste stream and divert it to some of the renewable projects, some of the projects that takes waste-to-energy and waste-to-fuels.

And also, again, to address that issue about getting credit for those diversions and recycled to renewable energy and such through the 939 program. So those are issues that have to be addressed.

Next is education. Again, perhaps educating the agencies, the consumer and the project proponents. So education came through loud and clear; something that people need to spend more time talking to each other and communicating.

We came back very strongly on the issue about a one-stop shop for permits. We came up with sort of the definition of an ombudsman. Somebody that basically, through a developer fee, where you would come in, pay one agency, one entity within the state. And that person would be your project proponent that could trump all of the other agencies. Because god knows there's a lot of them. But could basically help guide you through the path of sometimes very conflicting regulations when you're talking about a new project.

There also was a discussion about, for research and development or pilot projects, specific waivers of some regulations. Basically step back and see how it works. Try it. And then decide how you're going to regulate it after-the-fact.

Risk mitigation again came up. One of the solutions we talked about was loan guarantees and seed funding for pilot projects. And we actually addressed that more on the next page, so I'm just going to cover that briefly.

And finally, using the Waste Board to actually lobby for change. Rather than them simply being a regulatory entity, actually having them be an advocate for the waste conversion community, because that's the role, I believe, they should take.

I've covered the next one as far as the research.

The research area, one of the things was a better understanding of the lifecycle impacts of waste management. Just a full understanding of the entire cycle of waste. And actually providing real numbers through lifecycle cost analysis; and to quantify that system against the status quo.

In other words, when you have a new technology you can lay it across in an apples-to-apples comparison against the current status quo.

Next was a need to look at the rules and regulations that impede the industry. Such as air quality standards and diversion credits. Again, this issue keeps coming up. I heard it in al three groups. These issues need to be addressed.

There is a need for an independent evaluation of the recycling markets, the costs, the environmental issues, and the understanding of the materials flow. Basically research just providing sort of a primer that any developer of a new project could look to and have a standard set of numbers to work from, addressing all these numbers.

Finally, I think the issue that, one idea that came up as a research idea was similar to an x-prise And that is that the state, the Integrated Waste Management Board should be able to put up some real money. We're talking about

$50 million, $100 million, to back projects that are interesting, but are in the valley of death.

And the valley of death is between a small little demonstrator, a university lab or in somebody's garage, where they've got an interesting idea. And having five commercial projects up and running that GE is willing now to finance another 50 of them, there's a gap between those two, those two positions. And there's a lot of research thrown in there, there's a lot of development thrown in there. It's not commercial yet, it's in that gap in between.

The state should be able to put together a set of guidelines saying we're looking for innovative technologies that are not commercial, they're not out there, they're not being stamped out someplace else. But they're innovative and they have real potential.

The state could then take a position where they would actually replace the typical venture capital community which is amazingly risk averse. And actually come in and say, we'll invest in this because it's our problem, it's our waste. And the state could take that position and they could actually make either a reasonable rate of return or actually take an equity position, depending on what guidelines that are developed.

But it's actually using this approach to look at a broad variety of ways of dealing with the waste stream in California. It gives the state the opportunity to basically lead in this area, rather than simply be impeding progress. So that was one of the suggestions we came up with.

Is there any questions? Okay, thank you.

DR. LEVENSON: Okay, thanks to all three of you; that was very coherent and concise descriptions of what we're -- as you all know, you were in the groups, the conversations that I heard were going all over the place. So I think you did a great job of trying to pull them into some semblance of coherence. And we'll keep working on that.

I mean I just was trying to jot down some commonalities. And I'm sure I'm going to miss some, but clearly some of the things that came up in all the groups were the issues of AB-939, the diversion credits and the definitional issues.

Then kind of the permitting issues where they're related to the definitions so there's consistencies, or the need for some sort of one-stop shop, ombudsman or other ideas like the waiver ideas.

Education. The regulatory agencies for, you know, in terms of technology status or development of the public in general about benefits and impacts. And the proponents about things that they need to know in terms of permitting processes and also kind of an overall education.

In a lot of different ways the issue of the cross-media benefits and costs that, you know, decisions are made on the basis of one particular parameter, and they don't take into account some of the costs or benefits associated with other -- in other media, like the greenhouse gas reductions versus NOx was one example.

And then the general issue of the valley of death and risk mitigation, the need for funding of some sort for demonstration projects, or a state role in technology evaluation of some sort. Or some investment function in terms of getting, you know, projects that are looking good, but can't quite get over the hump in the valley of death. Some role in that.

I probably missed a few, but those are five or six things that I heard. Virtually all the groups kind of talk about in terms of the presentations, gleaning from the presentations that I head.

What I'd like to do now is, you know, open it up for general comments if anyone wants to make them. Or if you're all tired and you want to just kind of wrap it up, that's fine, too. But, there's a chance to add onto any of those ideas, let us know that you think some of them are important.

Clearly, there are many different perspectives here on the role of government and the needs for these technologies. And we appreciate and recognize that.

So, you know, our role -- next steps right now will be for the Collaborative and the Waste Board Staff to take this; and the Collaborative will be prepping a report.

We will, as I mentioned earlier, you know, bring this information back to our Board. In a few months we will do further analysis of some of these issues. Many of these things have come up before. We've done analyses of some of them. Others are brand new, or at least we haven't done any, you know, detailed work on them. Some of them require legislation; some of them don't. You all know what the field looks like here.

So, we'll try to put that together in a way that makes some sense for our Board, and get some further direction on where they want to go. A lot of these things are being discussed at the Legislature, as we speak. Some of those discussions have gone on for years, some of them are new.

So, I think there's a chance now that some things can happen. There's a different alignment of the stars. Whether that's going to result in anything, I don't know, but it's certainly, I think, a better atmosphere right now for talking about these kinds of issues than it was a few years ago.

So, I'll shut up. And we have the gentleman in front, and then Mike, and then we'll --

MR. TAYLOR: (inaudible) --

DR. LEVENSON: Yeah, I think we'll need

to have you -- do we have a -- okay.

MR. TAYLOR: Well, I wasn't thinking of being that formal, but --

DR. LEVENSON: Well, just so everybody can --

MR. TAYLOR: Yeah. My name is Taylor, Donald Taylor with Taylor Energy. I noticed that even though we had a lot of diverse comments in our groups, when they came back together again I noticed an awful lot of commonalities in what we were looking. I was so surprised. I thought, okay, somebody copied our group, you know.

Anyway, so I think I felt we gave you a pretty good consensus from three different groups. And you could have changed the name from methanol to syngas biofuel, and a lot of us. I thought we did good.

DR. LEVENSON: Thank you. Yeah, I think obviously could have cut the groups different ways, but, you know, we needed to split you up in some way. And the fact that there were these commonalities, I'm sure there were a lot of differences, too. When we get into the details of things there'll be differences.

But that was striking that there were

four, five, six things that came through in all.

MR. THEROUX: When you pick this stuff apart with the Collaborative, one of the things that we've done in the past that might work -- pardon? One of the things that might help -- Michael Theroux. I thought he said put the mike down a little bit.

I probably don't need the mike very much in the first place. But, as you find specific items in this mix that could use a little further discussion, one of the things we've done in past systems is you call a roundtable, maybe at a call-in conference or something.

And say, hey, anybody, you know, with your list serve, we're going to pick at this topic a little bit more and unravel it here. Anybody interested in a call-in conference. And that was pretty handy in the past, and it seemed to be pertinent on some of these very specific issues that had come out of this discussion in this last day.

DR. LEVENSON: Thanks, Mike. Anybody else want to make any comments? Everybody's ready to call it a day. Oh, Tim. Sorry.

MR. JUDGE: I was just going to say

thanks to all of you, to the staff of the Integrated Waste Management Board --

(Applause.)

DR. LEVENSON: Okay. Well, thank you, all, again. I think it was great to have these discussions and hopefully you all learned something. I certainly did. And we will continue to work to get this material, you know, available in a public manner and have further discussions on this. And when you see things in the Legislature you need to be involved.

DR. JENKINS: All right, you thought you were going to get out of here, but you're wrong. Okay, you can't get out of here until I've got my say, so --

(Laughter.)

DR. JENKINS: That's my privilege, I guess; my pleasure, actually. Thank you, Howard, for excellent comments there.

I just want to comment a couple of things. First, on this issue of commonality, also was impressed by commonality. I was specifically impressed by the commonality with the Biomass Collaborative roadmap. So if you've not read that document, please go back to it and read it, and pull some of those things out.

Now, there were some new things that we heard, and we'll probably work those into the roadmap, as well. So, thanks for that. But we'll be working this up and get a report out to the Board and to you, of course.

We had talked briefly before the sessions about whether we wanted to pull specific issues out and have something like a follow-on. Michael referred to a roundtable or follow-on session, so we'll be looking for something along those lines, if we can see something there that needs to be addressed.

So, if you don't mind, and you haven't seen the roadmap, please go there and take a look at it. We are still anxious for comment.

Anyway, tomorrow for the tour, just to point out that the time for the gathering point, somebody reminded me, and I'd actually thought about it after I copied it off, but if you can be at the gathering point about 8:30. The bus will probably wind up there at about 8:30, and we'll begin with the tours.

We're loading up here about 8:00 so it will be a few minutes before we actually get out of here. So, 8:30, somewhere around there.

However, I would encourage you to be on the bus if you're scheduled to be on the bus. Because we're going to be pretty tight for parking, and a lot of vehicles moving around is not the most sustainable thing anyway. So if you're going to be on the bus, please be on the bus instead of driving. If you have to drive, that's fine.

Anyway, you know, if you didn't get it, there probably are a few more of these maps in the back. So you can do that.

And I do want to thank a lot of individuals and groups of people here. I made some comments yesterday about this, but I do want to say thanks to the California Energy Commission and the California Integrated Waste Management Board, in particular, for their support of the forums.

Now there were other agencies and institutions and organizations that supported that. And, you know, a number of them are represented here. SMUD, for example, has supported us in the past; and CDF and CDFA agencies, California Department of Forestry and

California Department of Food and Agriculture. I'm going to miss a whole bunch of people here, so I'm going to just stop. But we do appreciate the support to the Collaborative over these four years from a number of people.

Certainly for the reception we also want to thank our industry sponsors for that reception, which include BlueFire Ethanol, PG&E and RealEnergy and who else did I forget, Martha, is that -- oh, Waste Management, yes. They're going to fund everything else on this, I understand. So they'll be looking for a few billions into the biofuel industry here shortly.

Of course, also the agency staff have been very helpful in arranging, of course, this forum today. Howard Levenson, Fernando Berton and Alan Glabe, I want to express particular thanks to them for all that they've done in helping to assemble this.

Also, of course, the Collaborative Staff. I've mentioned these people, and I can't mention them enough times for all the effort that they've put into this. I sort of stand here and don't do a whole lot otherwise.

But, Arthur Gilder, Rob Williams; we

have with us Dae Hyun Kim and Seonggu Hong, still. Cora Monce's been participating with this. Pete Dempster, who's wandering around with the camera you may have noticed. Except this morning Rob had to do that, I guess.

Lime Yan is a programmer with the Collaborative. Lian Duan has done a lot of programming. She's now back with CDF. But we've had excellent staff support with the Collaborative. And this is sort of the one time during the year that I get to publicly announce thanks very much.

Also thanks, of course, to the speakers. Excellent presentations over the last two days. I really learned quite a bit and I'm very impressed with the quality of the presentations. And we'll get those proceedings up as soon as we can. We'll get at least some of them up within a week or so. So be looking on the Collaborative website for that.

Also for the moderators for doing a pretty good job on keeping us on time and getting us done. I see I'm running over my two minutes -- no, I've got till 5:30, that's right.

(Laughter.)

DR. JENKINS: Also thanks to Peters Reporting for sitting here and doing an excellent job keeping track of things. So we'll look forward to the transcript coming. That transcript should be up on the website, as well, when we get that available.

We can post -- well, if we don't have any objections to it, we'll post the list of attendees; we can do that, yeah. Well, I don't know, we didn't get signatures, so we'll post it, I guess. And then if people complain we'll take it down.

(Laughter.)

DR. JENKINS: Also thanks to the Conferences and Event Services out at UC Davis. A couple people sitting downstairs when you came in, I think where you got your registration, sitting in the cold down there this morning I noticed. The thing was fairly chilly yesterday, as well. So good service there provided on the registration.

Also, I'll thank in advance the various folks who are working with us on the tours, the facility operators and the like. And, of course, the various academic personnel associated with the various activities you'll see tomorrow over at UC Davis. I do want to thank them for taking their time and making these available to us for the tour.

And I think I've probably forgotten many other people here. But, certainly Jim Boyd and Margo Reid Brown for coming down and giving us the keynotes for the two days. I'd like to acknowledge them, as well as staff from Congresswoman Matsui's Office.

And then as I started out yesterday thanking you, I will thank you again for remaining here and being through all this and providing all the comment this afternoon, and helping to keep us on track. So I really do appreciate the input that you've made here. It's excellent.

And, of course, with that thanks you will receive an assignment. And that is, of course, to get your survey form in if you have not already done so. So please get that in before you leave today.

And with that, again, thank you very much. We'll look forward to this in another year, somewhere around the same time, probably. And if you have any comments ever at anytime or suggestions, just send me an email or call me up. I can't guarantee I'll respond instantaneously, but I will try to respond at some point.

So, thank you very much.

(Whereupon, at 5:05 p.m., the forum 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 Biomass Collaborative Fourth Annual Forum; 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 forum, nor in any way interested in outcome of said forum.

IN WITNESS WHEREOF, I have hereunto set my hand this 18th day of April, 2007.