INTERMEDIATE BIOBASED PRODUCTS

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PUBLIC MEETING

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Thursday,
April 1, 2010

Iowa State University
Scheman Building
1810 Lincoln Way
Ames, IA 50011

8:30 a.m.

PRESENT:

KATE LEWIS, Deputy Program Manager, USDA, Moderator
JEFF GOODMAN, USDA
DEBRA DARBY, Director of Marketing Communications - Telles
DR. CARL MUSKA, Director of Regulatory Affairs DuPont Tate & Lyle BioProducts, LLC
DR. SHRI RAMASWAMY, Professor and Dept. Head, Department of BioProducts and BioSystems Engineering - University of Minnesota
DR. BRENT SHANKS, Professor, Department of Chemical and Biological Engineering Iowa State University
DR. RINA SINGY, Policy Director Biotechnology Industry Organization
DR. XIUZHI SUSAN SUN, Professor, Department of Grain Science and Industry Kansas State University
STEVE DEVLIN

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Adjourn

P-R-O-C-E-E-D-I-N-G-S

(8:30 a.m.)

MR. DEVLIN: I don't want to break up the big conversations, but we have reached about 8:29 now. If everybody could have a seat we're going to invite Kate Lewis up to emcee our program this morning. I'd like to thank everybody for coming to Iowa State this morning, or joining up online. My name is Steve Devlin and I'm happy to be working with USDA on the BioPreferred program. We appreciate your attendance and your participation this morning. Kate?

MS. LEWIS: Good morning everybody. We've got a small but enthusiastic crowd here in Central Iowa. I'm Kate Lewis. I'm Deputy Program Manager of the BioPreferred initiative at the U.S. Department of Agriculture. And just to kick things off this morning, I wanted to introduce myself, and there's one other representative here from the Department of Agriculture, and that's Jeffrey Goodman. And

he'll come up after me and sort of set up the context with regard to today's meeting for the issue of intermediate materials and feed stocks.

Aside from Jeff and I though, there's a whole team of people associated with BioPreferred that have worked to make today's public meeting the third of our public meetings that we're planning on holding this year possible. So I wanted to extend our appreciation to the staff of Iowa State University; Steve Devlin, Jessica Riedel, Rudy Pruszko. There's a whole host of other folks that you'll meet today. Some folks that you won't meet today and that aren't here because they've been working for the past six or eight weeks to really pull this event together. So thank you, Iowa State University for us being able to hold our public meeting here today on your Ames Campus.

In addition to those of you present in person and in our audience, we have more

than 100 other program stakeholders, individuals in the federal sector, some of the manufacturers we work with, other members of the biobased products industry value chain that could not make it out here to Ames today, that will be participating in this meeting online via the Webinar and via the internet. So as we move through our discussion this morning, I would ask that you remember those 100 or so individuals and I'll do my best as we move through the slides. And if there's some related discussion to keep those keep as engaged as possible given the medium they're using to participate in our meeting today.

A couple of housekeeping details before I turn it over to Jeff, I'm pulling up now for people online, hopefully you can see the agenda this morning. And we've got an aggressive agenda and a number of distinguished speakers that are going to speak specifically on their thoughts with regard to the integration of intermediate materials and

feed stocks into the BioPreferred program.

I've had a couple questions so far today from some of the attendees. Yes, at the end of this meeting it will be possible to get a list of attendees both in-person and online. We'll make that available after the meeting. As we will also make available a copy of all the presentations. If you attended our two previous public meetings, you'll take note that about two or three weeks after the meeting, we posted the presentations, the attendee list and the meeting transcription. We're also transcribing today's meeting on our website at BioPreferred.gov. So again, give us some time. It will take about two to three weeks to pull all those materials together and ready them in a format that's able to be easily downloaded. But that's where you could go after this meeting to obtain copies of all this information that we're going to be talking about today.

I mentioned there's 30 here and

more than 100 participating online. Thank you online folk. We're also going to take a break midway throughout the agenda and I'll be serving as sort of the mistress of ceremonies to kind of keep us on track. There may be some time after each individual speaker's presentation for a couple questions, but you'll see that we do have at the end of our agenda, a lengthy period of time really for, that's dedicated to open discussion and questions to any of the speakers. So if you have questions, I encourage you as we go through our agenda this morning to write them down and capture them. Because if we're not able to address them at the end of each speaker's presentation we will open the floor up and we will open the online up at the end part, period of this meeting to be able to engage in hopefully some pretty interactive discussion.

I guess the last two things, please turn off your cell phones. We do understand

that business goes on as usual, even though we're here in Ames. If you must take a call, not a problem, we just ask that you leave the auditorium. And restrooms are outside this auditorium, on this level, directly opposite the auditorium entrances.

If there are no other questions for me --

AUDIENCE MEMBER: Will you be accepting comments.

MS. LEWIS: Yes, as a part of the discussion we're having today, we're not only going to be accepting questions, but any comments that you might have, we've certainly got a process in place today to be able to track and respond to those as well. Do you just want to come up here and say that? I'm going to introduce my boss right now, Jeff Goodman, who obviously has more detail and information to share on the comment process. Jeff?

MR. GOODMAN: Good morning, I

wanted to echo the welcome and the thanks that Steve and Kate gave to the people who are here and participating via technology, by teleconference or by computer.

The piece that Kate meant to mention, but didn't, but was that one of the key purposes of these public meetings is for us to get some ideas on how to revise our program guidelines, which I'll talk about in just a minute. But we are anxious for suggestions and ideas and whatever thoughts and suggestions come up during the course of this meeting are good. But for a period of 60 days following the meeting we will be accepting any written comments that people have on ideas on how we should be revising our program guidelines. Let me take a couple of minutes and explain what our program guidelines are and why we want to revise them.

For those of you who follow our program and for those who don't, the program was created by Congress in 2002 in the farm

bill and Section 9002 of that statute is our legislative authority. And it creates a two-part program to promote the biobased product industry.

The first part of the program is a federal procurement preference program whereby USDA in consultation with some other organizations designates categories of biobased products. And once designated the federal government is obliged to procure those preferentially over similar kinds of products that are not biobased.

There's a second part of the program that's called a voluntary labeling program whereby manufacturers and vendors of biobased products can apply to USDA for the privilege of putting a USDA certified biobased product label on their products. And the notion is that the first part of the program, the federal procurement preference program, would stimulate the growth of the biobased product industry in the federal marketplace

and the voluntary labeling program would stimulate the growth of that industry in the commercial marketplace.

Now, following the pass of the 2002 farm bill, USDA put together some program guidelines that described how the federal procurement preference program would be run, how the whole process of designating categories of products for that preference program would occur, and we call those our program guidelines. And those were promulgated in the federal register as rules in 2005. And we've been operating under those program guidelines for coming on five years now. And during that period of time USDA has promulgated five rounds of regulations designating categories of biobased products for that federal procurement preference program. We now have 42 categories of such products and encompassing somewhere between four and 5,000 individual products, by our best estimate.

In 2008 Congress passed some amendments for the farm bill that cause us to have to revise our program guidelines. And in particular, the amendment that brings us here today states that USDA should designate intermediate materials and feed stocks, the building blocks of the biobased products that we've been designating for the last five years and that we should need to being those into our designation process.

The law further goes on to state that once we've designated those intermediates and feed stocks that downstream products, finished products that are made from those intermediates and feed stocks would automatically come under the federal procurement preference program, without an explicit designation, if they were made of at least 50 percent from the designated intermediates and feed stocks, or such other proportion as the Secretary of Agriculture might find appropriate.

So given that our current program guidelines don't provide for having finished products automatically coming into the program following designation of feed stocks and given that we haven't designated any intermediates and feed stocks to date, we're in the process of revising our program guidelines to accommodate that legislative amendment from 2008.

Given that we are forced to open the program guidelines to meet our legislative mandate, we're also trying to take a look, a broader look at our program guidelines. They're five years old. We've had a lot of operating experience. We've founds some glitches in them. We've also got some ideas on ways we might improve them. And this caused us to go about scheduling and holding three public meetings, because we felt like there were three major issues that we needed to address in the revision of our program guidelines as well as making some technical

fixes. And this is the third of those public meetings focused on how to bring intermediates and feed stocks into our designation program.

The other two areas that we've been focusing on in public meetings are how to bring complex assembly products into our program; things that have multiple components to them that we can't readily determine the biobased content of. And the whole question of how we evaluate environmental impacts of the products that we're designating.

Although this public meeting is not primarily about our labeling program, there is a relationship between the federal procurement preference program and the labeling program as regards intermediates and feed stocks. Right now our labeling program is not yet underway. We proposed rules on how the program would work last summer. We're in the process of finalizing those rules. One of the key components of the labeling program is that people who wish a label would have to evaluate

and test the biobased content of the product they want to have the label on.

As we being to revise the program guidelines to automatically include some finished products that are derived from intermediates and feed stocks, there may be a need to change our labeling program to be consistent with how we've brought finished products into the program that weren't designated as regards testing. And we're going to move forward with our labeling program and hopefully have a labeling rule and initiate the program later this year. We won't be putting our revised program guidelines into effect until next year if, base do the public meeting and based on the way we revise our program guidelines, we have a need to go back and fix our labeling program to be consistent, we will do that next year as well.

So that's kind of a brief overview of why we're here and what we hope to

accomplish. We're very anxious to hear from our speakers and hear from anyone in the audience; either present or via the internet or teleconference, on ideas they may have on how we might bring intermediates and feed stocks into our program.

Kate has just told me that I have a slide presentation that I didn't know about, so why don't we all see what they say. So I guess the slide presentation I didn't know about, I don't have. Okay.

MS. LEWIS: Jeff doesn't have a formal slide presentation, but our first speaker does, as do the five other speakers that we're going to have with us today. We're assembled a really distinguished list and I have their bios in front of me. But we're all been at conferences where the emcee just goes on and on about a particular speaker's bio. So I'm going to keep it very brief today in terms of the introduction of the six non-USDA speakers today.

And the first one that's going to be joining us this morning to provide us of an overview of the bioproducts market, specifically how the business of bioplastics is done. It's Debra Darby from Telles. And Debra has been with Metabolic since December, 2006. And she is responsible for directing and implementing the marketing communications and building the brand awareness for commercializing Mirel Bioplastics globally. So we're very happy to have Deb with us this morning and she's going to kick off as our first speaker. Deb?

MS. DARBY: Kate, thank you very much for the introduction. And good morning ladies and gentlemen. As Kate said, I'm Debra Darby and I'm the Director of Marketing Communications for Telles. And thank you so much for this opportunity to talk to you about the business of bioplastics. Before I launch into the presentation I just want to say what great weather Ames, Iowa is having. Coming

from New England and having weeks of rain, it's really a pleasure to see the sun shining. And I want also to say hello to everybody who's on the Webinar this morning.

Just to overview some of the key topics I'd like to deliver this morning, first of all, a quick review of some terminology and the definitions that I'll use were developed by the SPI Bioplastics Council of which Telles is a member. I'll also give an overview of the bioplastics market, some of the drivers for new material. And finally, an overview of Mirel Bioplastics.

So let's just start off with what's a degradable plastic? From the ASTM definition, it's a material that's designed to undergo a significant change in its chemical structure under specific environmental conditions. And I think just a great way to describe it, it's a breakdown of the polymer otherwise known as fragmenting or fragmentation.

And what's a biodegradable plastic? Well, biodegradable plastic, it undergoes biodegradation. It's a process which results from the action of naturally occurring microorganisms like bacteria, fungi and algae. But it's per industry accepted standards. And I think the specifics here is it's over a period of defined time. But also important to note is that the microbes that actually feed on the bioplastic use the material as food and as a life source. There's a source of energy that they gain from the material. And as of 2008 there are certain industry standards, specifications to ASTM D6400 EN 13432, D6868, D7081 and also 5988 for determining aerobic biodegradation in soil of plastics.

But one note I'd really like to add, when you're looking at new materials or considering a new material, you really want to ask yourself, you know, what's the story. You know, does it really biodegrade? Does it really compost at the end of its useful life?

So it's really good practice to ask for a third party certification and testing from well-known organizations like the BPI here in the U.S., Vincotte in Belgium and OWS, which is a lab.

And what is biobased material? An organize material in which carbon is derived from a renewable resource. And the focus here is on the raw material basis. And again, rather than using fossil carbon in the manufacturing of conventional plastics, biobased plastics use non-fossil carbon. So in general, it involved the use of renewable resources such as sugar, starch, vegetable oils or cellulose in the production process. And the proportion of non-fossil renewable carbon, use in the product can be determined by ASTM 6866.

So here's a great question, you know, biobased is not biodegradable, so are all bioplastics biodegradable? Unfortunately people do confuse the terms biobased and

biodegradable, so I'm hoping that with this slide we can kind of dispel some of the confusion.

So a product that contains 100 percent annually renewable raw material may or may not be biodegradable. It really depends on the molecular structure of the material itself.

So bioplastics, it's a term that can define two different types of plastics. Number one, a plastic that's based on renewable resources, which is the raw materials used. Number two, it's a biodegradable and compostable plastic according to EN 13432 or D6400 which is the compostability of the final product.

And bioplastics may be based on renewable resources that are in biodegradable. Could be based on renewable resources and not be biodegradable. And it could also be based on fossil carbon, fossil resources and be biodegradable. I hope I dispelled any

misunderstanding out of all of that. But there's a lot of misconception between biobased and biodegradable and I'm hoping that that clears it a little bit.

So I want to take a look at the bioplastics marketplace and this kind of reinforces what I was just trying to convey where on the slide here you've got as series of key market players where products are based on either a petroleum or renewable resource. And then you can see going up the slide that there is the scale being the products that are non-biodegradable leading up to compostable and biodegradable. So I just wanted to reinforce that you can have bioplastics that are made out of petroleum and you can also have bioplastics that are made out of renewable resources. And through the spectrum they have different compostability and biodegradability properties.

So here's another question. Are bioplastics really plastic? Well, of course

they are. Bioplastics are plastics. Bioplastic properties cover a broad range and they serve a wide variety of applications just like conventional plastics. In fact, if I can just kind of speak outside of my slide presentation for a moment, bioplastics are the next generation of plastics and the companies that were on the previous slide were all pioneering new materials and bringing new products to market that will really change the way that people think about plastics, being that they can be made from renewable resources.

And another statement that I'd like to add is that bioplastics are not considered substandard. Perhaps earlier when some of the new materials were coming to market there were some issues with heat, moisture, shelf stability. But that's changing. New properties are really coming out, new materials. And they're really designed to be functional for the job that they're meant to

be used for with similar performance to conventional plastics. But once more, the additions are the environmental benefits that bioplastics also bring to the market.

Bioplastics are produced through two different types of production processes. Bioplastics can be produced directly within the organism, which is a single process, and this is how Mirel Bioplastics are made, through a patented microbial fermentation process. But then there's also a secondary route where the process also uses a conventional polymerization process.

Now, I just would like to add, the image on this slide are actual microbes. Those are Mirel PHA, that's if you will kind of the fat or the PHA that's stored within the cell of the microbe.

And this table provides some information about the general characteristics of selected unmodified bioplastics; clarity, moisture barrier, oxygen barrier, temperature,

rigidity impact, resistance. These are functionality of conventional plastics and you can see that bioplastics can also serve a wide variety of applications and provide different properties. So just like there's a variety of conventional plastics out there, there's also a range of bioplastics that are suitable for a wide variety of applications.

And here, this is really just a quick look at some of the major market segments that bioplastics are penetrating. Compost bags and films, single use disposables including cutlery, containers, films and other packaging. Primary packaging for consumer products such as cosmetics and other personal care items, household. We're starting to see more activity in agricultural and the horticultural space and also with marine applications.

So what are drivers for new materials? I think we're all kind of familiar with how consumers' actions are changing.

Everybody is concerned with reducing reliance on petroleum, energy security and climate change, as well as reducing waste that's sent to landfills. And we're also looking to embrace alternative waste disposal options. And I think a lot of us now have a more personal commitment to the environment too.

In addition too, I think brand owners are responding more to what consumers are looking for and Walmart and other leading retailers are really interested in sustain ability measures in their corporate goals and taking a look at what the new resins in performance of materials are bringing to the market.

But where our challenges are, where we really need to work together as an industry, is really around consumer education. Helping consumers to understand key definitions, how they should embrace alternative waste disposal options and recovering, how to recover useful resources

from products and packaging that are no longer useful.

Labeling is also an area that we face. You know, working to harmonize the communication from the industry to consumers and concerns around recyclability and compostability of bioplastics. And really helping to build up the infrastructure for the collection and the disposal of bioplastics. Helping consumers to change their behavior. I mean, we've had years where curbside recycling is really now something that people really understand. But I think there could also be more work to help build the infrastructure for organic waste diversion and the collection of bioplastics for energy recovery and really being able to capture the useful material that's still available.

And the four, last but not least, we all face impending legislation that does impact the bioplastics market. And some of the legislation in North America, it stays in

local level. The city of San Francisco is a great example. They have a lot of programs in place that really serve as a model for other cities. You know, mandated zero waste program where they have a very nice organic waste pick up citywide. And they have other requirements that other cities are modeling after.

Another great example, of course, is the USDA BioPreferred program. That's why we're all here this morning and also online at the Webinar. And FTC green guides, I think a lot of us are familiar with the green guides. And the purpose for those green guides to help reduce or eliminate green washing. Marketing claims really need to be written and understood from a consumer's perspective. And anytime that a green marketing claim is used on any product or package or advertising, they can be scrutinized by the Federal Trade Commission. So it's very important that all expressed or implied marketing claims really are from a consumer's perspective, and that it

can be understood simply and right and immediately.

And then internationally too, there's a lot of development with Europe really leading the world, not only as in volume consumption but in a lot of their legislation. According to a BBC research report in '07, Europe, of course, is leading in volume consumption. But they also have a fantastic existing composting infrastructure that has helped to enhance bioplastics development in growth rate. And this is expected to grow over the next five years.

And Europe is also leading in other waste management solutions that include anaerobic digestion and other progressive legislation that involves extended producer responsibility. And I think this type of programs and legislation is something that we would want to look at here in the U.S.

And the market growth, bioplastics market represents less than one percent of

total plastics usage globally. And we've got a lot of market that we can penetrate. Demand continues to outpace production. And making ID roads into what was traditionally dominated by conventional plastics. There's so much opportunity for bioplastics.

This is a really great time to remind people about all the new production facilities that are coming online. Mirel Bioplastics, our new production facility in Clinton, Iowa, just came online so it's now ramping up our production. Nature Works extended their production line in Blair, Nebraska. So we really do expect significant growth of bioplastics over the next few years. And as the industry continues to innovate and bring new polymers to the market, we really expect to increase our market share.

And I'd like to now just go into a little bit about Telles and what we're doing. As a business Telles looks like most other plastic businesses. We have a range of

products for use in typical thermoplastic converting processes; extrusion, injection molding, thermal forming. And these products are formulated component products.

We also have a great team in place with significant industry experience in helping customers in their selection of the right material for the job and how to best process our materials.

As a joint venture, Telles was formed by Metabolic and ADM to commercialize our Mirel technology globally. Metabolic brings the technology to manufacture the product and ADM has built and will run our production facility and they also supply the key raw materials for our production.

So let me zoom in a little bit on Mirel Bioplastics themselves. As the title of the slide states, you know, our story is simple. It starts with being biobased. We're made from corn sugar. And it ends with being biodegradable in the right conditions. It is

quickly decomposed through microbial action.

The production of the material, given that it's a new processing technology, although it's not different from thermoplastics, but in use Mirel performs like a thermoplastic in dry heat or moist conditions. Mirel is shelf stable and it's a durable thermoplastic. And we, of course, formulate compounds to meet the performance needs of specific converting technologies and applications. So Mirel really is applicable for a wide variety of market applications.

And this year, as our new production facility comes online, we will launch four commercial products for injection molding, cast sheet, thermoforming and blown and cast film. And of course, we are working on other products that we will be rolling out this year and over time.

And I'd just like to talk a little bit about this case study with Newell Rubbermaid. However, with the converting ease

and performance, these are really the minimum entry requirements of a new bioplastic. It's the innovation of the technologies around the biodegradable and the biobased natures of materials that brand owners and retailers are really taking interest in.

So it's the combination of new technical capabilities with good performance, good expected performance that really sets Mirel and other bioplastics apart. And this distinction is echoed here in the feedback from one of our customers, like Newell Rubbermaid, which is a very established global brand, in describing how they can look to a new material to really address their broader needs, corporate sustain ability goals and consumer demands.

Certifications, for us, this is really how we want to convey our transparency to customers. By taking the extra step to get our materials certified through third-party testing and then going and actually getting

the certifications from BPI and Vincotte. But this slide also is a really good opportunity to develop an awareness of the different disposal mechanisms for bioplastics.

And for reaching our consumer audience, we also work with our brand owners to help them develop effective communication and also to build transparency to offer a very authentic communication route. And this investment in consumer education is valuable for capturing the real value in the biobased and the biodegradation benefits since consumers who want to make a difference, make a difference in the environment, they really need to know what their role is. They really need to understand what they need to do.

They also need to know what infrastructure is out there. For example, taking advantage of home composting. And this example here is just a couple of web pages that we helped Newell Rubbermaid put together to educate consumers.

And Mirel Bioplastics is enabling alterative disposal options. This is where the true inherent value of biobased and biodegradable technologies will be found. This is done by establishing infrastructures to take advantage of the biodegradation capabilities. And as an industry we're working to support the growth of new business models that can justify the investment in the infrastructure needed along the value chain.

Bioplastics need these business models for recycling, to take advantage of the energy already invested in polymer by recovering intermediate raw materials that can be reused to make polymer molded parts. For anaerobic digestion, again, to take advantage of the energy invested in the polymer in the form of bioenergy. And also in composting, both at home and centralized locations where biodegradable waste can be productively turned into valuable resource rather than filling up passive landfills or collecting as debris in

our oceans.

So I just want to thank you very much for your time in listening to my presentation and this is my last slide on here. There's some useful links that might be some value for further reading. And also please visit MirelPlastics.com for further information. Again, thank you so much this morning.

(Applause.)

MS. LEWIS: Hi, this is Kate Lewis again, for those of you participating via Webinar. Before, I get to our next speaker, and I do want to try, as mistress of ceremonies today my job is to try to keep us on schedule.

I do just want to make one quick point. Mid presentation Debra pointed out some of the international developments that were occurring on bioplastics outside of North America. And we have the great pleasure today to be joined by Mr. Michael Telan. Michael is

here in Central Iowa all the way from Germany. He works for a company called Polymedia and he's the publisher of Bioplastics magazine.

So we don't have time now, and I don't want to put him on the spot right now, but I wanted everybody attending and participating in this meeting today to know that Michael was here. And if you have specific questions, either from those of us in the audience or participating over the internet, I encourage you to write those down and capture those and we can address those in the general discussion session occurring later this morning at 11:30 Central time, 12:30 Eastern time.

I'd like to introduce our next speaker. It's Carl Muska. Dr. Muska is the Safety, Health, Environment and Regulatory Affairs Manager for the DuPont Applied Biosciences business. And he's been working over the past several years specifically with fellow members of the ASTM committees to

develop international standards for the biobased products industry. And he's going to talk with us today about intermediates in the biobased products supply chain. Carl?

MR. MUSKA: Thank you, Kate. And I want to thank USDA and Steve and Glen and the folks here at Iowa State for giving me an opportunity to speak today. It's always great to get out and I echo the previous speaker about the weather. I was telling people I came from the East Coast and there was, I was telling Steve Devlin this that I came from the storm where I was actually the night before last, out helping state rangers take trees off of roads that were down blocking the roads and one o'clock in the morning. So it's been a journey to get here, but I appreciate the fact that I'm here.

MS. LEWIS: Stay will us online folks, we're making some connections here.

MR. MUSKA: Okay. We've got an advance problem on the slides. There we go.

That was a manual override, okay, thanks.

Okay, so today I'd like to talk about the role of intermediates in the biobased product supply chain and provide a case study. So why don't we go to the first slide. Thank you. Would you like a chair, you're going to get very tired there after a while.

So, here's an outline for my presentation. What is a biobased intermediate. I'll talk briefly about that. And from a supply chain perspective it's probably easier to define what a biobased intermediate is not than what it is. It's not the finished product and it's not the agricultural feed stock. It's everything in between. So there you go, Jeff, I hope that helps you.

I suspect that's probably not very helpful to USDA as they're faced with the task of implementing the biobased preferred program. And so as I was preparing for this

talk I remembered reading, as many of us in this room have read the 2004 DOE study on the top value added chemicals from Biomass. Could you go to the next slide please?

And for those of you that, it works now, all right, we're back in business.

So here's just the cover from that particular report, just to remind us all, and actually this time instead of just looking at the pictures, I actually read the report. So it formed kind of the basis for my presentation today. Let me go back to the actual presentation itself.

So I'm going to talk about this report very briefly, provide a little background, talk about the approach they used, and what I saw as some of the key learnings, at least key learnings for me, and share this with the group. And then to kind of illustrate those key learnings I'd like to use 13-Propanediol as kind of a case study. And in with some thoughts around the role of

intermediates and principles for labeling. So with that I'll go forward.

Okay, so anyway, this is the study I referred to earlier. And I'm on slide, I think about four now, titled top value added chemicals from Biomass. DOE requested their research organizations to identify the top ten value added chemicals from Biomass. They actually identified 12, but it's pretty close.

The team developed a screening tool and with it, the initial screening tool, they limited it down to about 300 candidates and they based it on the following criteria: cost of feed stock, estimated processing costs, current market and volume prices, current relationship to future/current biorefineries operations. So this was helpful, but it wasn't the goal. The goal was ten and they actually achieved 300.

So they concluded that the initial screening criteria really didn't provide sufficient differentiation for them to achieve

their goals. So how did they get there? Well, the answer is on the next slide. They utilized a flow chart approach from the petrol chemical industry. And after all, you know, we've been in the oil refining business for what, 80, 90, 100 years and it's really, I think we view it as kind of the historical model for a lot of the bio-refinery work that we're doing.

And at the end of the day, petrol chemical products are based on nine foundation chemicals. Let me just show that. So this is the chart that nobody can ever read and it's up here just strictly for effect. And I'm going to point to that second column under commodity chemicals for those of you online. And those are the, basically the nine, depending on how you count them. But these are the, basically the commodity chemicals that all downstream products are based on.

So, the DOE team, this is the team of working on the bio mass project developed a

screening tool based on concepts employed in the traditional chemical flow chart. They used what they defined as a value chain with a down selection process based on chemical and marketing data, based on estimates of material and performance properties and a lot of industry experience. And so that initial list of 300 candidates, these are again from bio mass, was reduced to 30 and ultimately to 12, sugar derived building blocks analogous to the petrochemical industry of flow chart.

And the authors, of course not all bio mass and bio mass agricultural feedstock is sugar based, but the authors recommended that a similar approach could be used to evaluate other value adding products from bio mass, aromatics, polysaccharides, oils, proteins, et cetera.

So here's their handiwork, this is the work of the bio mass -- I didn't do that right. Here we go. So this is the chart that was actually put together and is in the DOE

report, and this column I'm pointing to the, about the third column, and I'll talk about the Syn gas, but the C-3 to C-6, these are your building block chemicals based on sugar.

So what are the lessons learned? One, the petrochemical flow chart provided a useful model for how to organize and categorize intermediates from renewable source materials. I know that was one of the questions that was in the information supplied before the conference, or the forum. And so I think there's a lot that we can learn here in terms of how to address that.

A value change approach and a down selection mapping process were the key success factors. These people were kind of stuck at this 300 candidates, and this was kind of the break through that they were able to make to get it down to these top 12 sugar derived building block chemicals. And the DOE process I think illustrates the leveraging effect of identifying the key intermediates in the

product value chain. And of course the further you move up that chain the more leverage you obtain in this particular flow diagram.

Let me move on to an example, and I'll pick glycerol because it was one of the 12 building block chemicals that was identified in this study. And just for some background, this is a material that we're all pretty familiar with. Over 2 million pounds are produced annually in the United States and the EU, it's a large commodity chemical. About 75 percent of the US is supplied from natural sources. There are thousands of documented uses for glycerol. It's in a lot of the products that we use every day. It's found in countless products but most of them, and this is a lot of challenge in the bio based products market, but most markets are small and fragmented. And, but we're going to see a lot more glycerol in the future.

For example the biodiesel industry

will have a high impact on the availability and use of glycerol as it's a byproduct from that process. And for example a two percent displacement of petroleum base on diesel by biodiesel would produce about 800 million pounds of glycerol. So this is a, it's a readily available material and it's going to be more so.

So I'm choosing this again, as my case study. And we're looking at it from a value chain, glucose to glycerol to 1,3-propanediol. I won't force this to go back to that complicated picture in the report but you can actually connect the dots and follow this through on that diagram I showed you earlier.

Why did DuPont and Tate & Lyle who joined the joint venture in this area target 1,3-propanediol? And I've given you some reasons here. If you're a technology based company, you have to focus on transformative opportunities. You're not going to make it if it's not so. So, here's some of the

transformative opportunities that we saw in this material: You need to target areas of unique advantage. This is a building block chemical that was not really commercially available at the time, now you can make PDO, by a petrochemical route and it has been made and we've made it that way. But PDO is not a chemical that has been in commerce for many years. It's something that DuPont knew about 60 years ago as a building block chemical that would make a very good polymer, but it was not commercially available. And only more recently has it been made commercially available.

But you've got to target areas of unique advantage. The R&D costs are just too great to do otherwise. You need to be looking at things that can really shape the industry with what we call integrated knowledge, or knowledge intensity. And that's where the technology development comes in. It requires partnerships. And I think we all understand

that, it's been said at many of these types of meetings, to maximize the value capture.

This is a complex value chain and it requires an integrated approach and it requires partners. Partnerships also include the government as well. So that's why we're here today.

It is, you also need to develop a high performance product. In other words, Darcy was saying, you have to perform. If you don't have the performance then really all bets are off from the get-go.

So in 2006 DuPont and DuPont Tate & Lyle through our joint venture constructed and began operating our 1,3-propanediol facility in Loden, Tennessee. It's 100 million pound per year capacity and again been at it for about three years now. Basically this is demonstrating what we do. We take corn and through our partners convert that to starch and glucose. And then we use a biocatalyst and what we do is we actually take glucose PDO

in one step versus two. So, glycerol is still important intermediate, it's just that we don't isolate it. Our organism is converted directly from glycerol to PDO. And that's where the technology part comes in.

So let's look at PDO from a value chain perspective. You can think out of it right now currently that we have three major areas of application.

One is direct application. In previous meetings with this group and others we've talked about Sorona polymer and some about Cerenol, and I'll probably spend more of the time on the direct application. But we have two brand new products, Zemea and Susterra. I will talk a little bit about what those products are being used for.

Zemea is currently in over 200 personal care products. And the physical chemical characteristics are such that it makes it well adapted for that marketplace. So here you can see the various products.

It's not 19,000 yet over here, but this is starting to mushroom. And again I think this is why taking a supply chain approach is so important. As we talked about, how do you handle manage keep up with the product development that we're going to be seeing in this industry.

The other branded product is Susterra. And it is going into polymer applications; unsaturated polyester resins, thermoplastics, polyurethanes, as a monomer, similar to what Darcy was talking about earlier.

Okay, another part of our product line then is Sorona, which would be considered an intermediate. It's made with PDO and teraphthalic acid, so its part biobased. And it's going into carpets, textile fibers, resins, films et cetera. And while carpet is a pretty straight forward supply chain situation, apparel is anything but. Apparel is another example of a very complex and very

fragmented value chain and it's one of the things that makes the right-hand side of the supply chains very complicated.

Getting back to the performance issue, Sorona is a durable polymer. It's designed not to biodegrade and it goes in applications where you're looking for the various properties that are listed on this chart. And it is that structure that leads to these properties and these performances either equivalent or advantages in these uses. Again it's all about performance. That's the chart you were missing.

The last one I want to talk about will be Cerenol which is a new family of high performance PolyAlls that uses Susterra renewal resource PDO as a key building block. And these have specialty applications; elastomers, stretch fibers, that sort of thing.

But what I've been building here is this chart. And this should look very

familiar to you. With across the top we have building block chemicals, intermediates and ingredients and then markets. And this is all coming from one molecule bio PDO for all these various applications. And the markets I'm indicating here are market spaces, so there'll be many applications in automotive. There are already as I've shown any applications in personal care and cleaning products and that sort of thing, so this thing is going to mushroom very quickly. And my belief is is for USDA to help get a handle and keep a handle on it, you really need to focus on the intermediates.

So just to wind up, what is the role of the intermediate? There was a, in one of the program guides to this conference it was stated to promote the use of agricultural feedstocks, and produce value added products downstream for consumers. And intermediates are the vehicles. They connect the farm to the consumers. That's where it happens.

Why label intermediates, to accelerate awareness and conversion. The converter or manufacturer needs to be able to easily identify the potential intermediates. We need to simplify information transfer down the value chain to the consumer. Labeling intermediates will allow us to do that. It will reduce the potential for green-washing, there'll be greater transparency, greater traceability in terms of having an intermediate labeling program. And it's much more cost effective. Intermediates are the leverage points. For example an LCA on an intermediate on a biobased content measurement is all leverageable to all the downstream users of that material.

And I'm going to close with a few principles. This is a tough job that USDA has, and we want to support them in any way we can. But I understand the difficulty of it. But here are just some thoughts that we had as we were preparing for the presentation. One

is the label need to protect the integrity of the brand or the label itself. USDA brand is exceedingly valuable brand, so getting this right from the get-go is very important. Obviously it needs to be aligned with congressional intent, it needs to encourage transparency, it needs to have some consistency in its methodology. I believe and I heard Kate Lewis say this at an earlier meeting and she sold me, it needs to be simple. But at the same time it needs to recognize that we are talking about a complex supply chain here. It needs to provide useful information either directly or indirectly. What do I mean by that? Well, I think there's a lot of ways we can communicate information. If the label is maybe just to be based on one or two attributes but I think the USDA has a tremendous opportunity to make additional information of that product available through the website or other avenues. I think this is a place where consumers and converters could

go and get valuable information about biobased intermediates.

I do think that, I know life cycle assessment is a very important issue. Nowhere did I mention that. I wasn't going to wade into that discussion today, but I think, I remember Mark Duncan saying something at the DC forum that it's just as important to keep in front of us that just because a product is biobased doesn't mean that it is environmentally sustainable. So I think there's definitely a role, and I think we need to have some more discussion on what is that role for life cycle assessment in the labeling program.

So with that I think I'll end and see who have a few questions. I think I might be a little bit early. So thank you.

(Applause.)

FEMALE VOICE: I have a question from an online participant. The first one is can you please elaborate on the leveraging

effect point three of your key lessons learned?

MR. MUSKA: Yes, if you have a good information regarding the properties and the, for example, as I just mentioned, the life cycle characteristics, the performance characteristics of your building block materials, and that can be leveraged in a lot of your downstream uses and applications. So that's what I'm really referring to at that point.

FEMALE VOICE: Yes, I have another question. I have another question from online? Are Mirel and DuPont trying to make intermediate materials and feedstocks from cellulose also besides from starch?

MR. MUSKA: Darcy, do you want to respond to that? I can tell you right now that we have, this is not biobased products that DuPont is in joint ventures with Dynisco to make ethanol from cellulose. And we participated in a DOE sponsored project around

developing the bio-refinery concept. And in that bio-refinery concept you're not looking at just using the sugar from, in this case, corn, but you're also looking at using intermediates such as cellulose and other materials.

We lost the microphone. You can hear it okay? Okay.

Any other questions? Did that get to your --

FEMALE VOICE: We have a couple questions from the audience.

FEMALE VOICE; It's just a quick question, and based on your slides you mentioned about the raw materials through your PDO, the final product and from -- into the Sorona or those other things. And then in the medium there is glycerol and is that possible just to use the glycerol from the biodiesel production rather than derive it from corn?

MR. MUSKA: In this case, for us no, because one of the challenges I'm sure

will be overcome is that the glycerol that comes from the biodiesel is a dilute glycerol solution that does have byproducts and has to be cleaned up basically, has to be refined. So I'm very confident over time that will be done. There'll be useful markets for that. But our particular product, 1,3-propanediol to be able to be polymerized into a polymer has to be extremely high purity. And so that's where, we're allowing organisms to do that step for us, to achieve the purity that we need for our product. But I think it doesn't take much imagination to see that with the 800 pound gorilla in the room for the bio-product industry is biofuels. And there's going to be a lot of useful byproducts, co-products coming out of the biofuels industry, and I think you'll see more and more people taking advantage of that for biobased products.

Okay, thank you.

MS. LEWIS: Before our next speaker gives us his presentation, I just wanted to

check in with the technical booth and make sure there aren't any additional questions since we do have a little time. No? Okay, then I will introduce our next speaker.

You know, I just bought my nine year old daughter a pair of Converse high-tops, or Chuck Taylor's or Chuckies, as we all know them, and you may say why is this significant, or what does this have to do with intermediate materials and feedstocks. Because everything old is new again, suddenly. And our next speaker is going to take us back to the future, by providing us a presentation on traditional bioproducts in biobased materials, and that speaker is Dr. Ramaswamy. He is Professor and Head of the Department of Bioproducts and Biosystems Engineering at the University of Minnesota, and in that capacity he is also a graduate faculty member in the Department of Mechanical Engineering at the University of Minnesota there as well. So, please help me welcome Dr. Ramaswamy.

DR. RAMASWAMY: Thank you. Let me make sure that my microphone works. I'll carry this in my hand and let's see, yes.

All right. Good morning everybody. Thank you again very much for providing this opportunity to speak at this forum. And I'm been a big proponent of biobased products and using biological resources for, you know, for our everyday life. And this is an excellent opportunity for us to connect, you know, what we used to do, or the old biobased industry with the new biobased industry.

Before I get started, I would like to recognize some of my colleagues. Laura Babcock, who used to be formerly with Cargill, William C. Ricochurner and myself in essentially helping to put together this star today. Great.

As Kate was mentioning, connecting the old to the new is kind of the theme for my talk and we are indeed pretty old, okay? You can look at the centennial celebration for my

department. So, we actually trace our roots to agricultural natural resource industries of the past, and then positioning ourselves, you know, for the future.

Again, sustainable use of renewable resources, you know, has been the mainstay and the focus all over the place, but this is actually something that we in the United States and elsewhere, have been focusing for a long time. So the teaching research extension and outreach the people in our department, you know, focuses on sustainable use of resource, renewable resources and also enhancing the environment simultaneously.

So, if you look at the vision of the bio-economy that has been proposed a few years ago, that centered around translating from what we have been doing, using the petroleum as a feedstock, to actually, you know, so-called bio-refinery. So using biological resources of feedstock and converting them into various chemicals,

materials, you know, energy and other products.

And slowly and steadily we have been evolving into diverse range of products, and of course biofuels has been the focus of our attention over the last, you know, for a few years, to corn-based ethanol, cellulose-based ethanol, et cetera.

This is again from one of the technology roadmap from the USDA, and it was actually done in 1999, and you can kind of see to see where we are today and maybe ten years after that. And what was projected is the content of materials and chemicals they aren't from biological resources, but actually a small fraction back then, and it is projected to increase fivefold to 2020, which is only ten years from now. And it is further increased, or projected to increase another fivefold again.

And if you look at it in 2010, I think we have made significant progress and

even 2020, it is expected to be only ten percent of the total chemicals and materials demand coming from renewable resources. But there is a significant market indeed, about 400 billion dollars a year. And actually, if you look at the forest products in this year, which is one of the natural resources our biobased industry, and that is about 200 billion dollars per year in the U.S.

So, what are some of the plant made resources, okay, in the old industry that we were using and if you look at it, it is primarily wood products and pulp and paper, and they actually comprise about more than 90 percent of the plant-based resources for industrial and other products. And the pulp paper industry uses about a hundred million tons a year and the wood products industry about 160 tons per year. So, together, they actually comprise a pretty large industry, which is based on renewable resources and it is sustainable.

And here is another list of the, what I call the convention biobased industry and the emerging biobased industry and you see up on the top are the two convention biobased industry and then down below you see the emerging biobased industry, some of which were discussed in the previous speakers, and what I'm going to say is how does the conventional biobased industry, at least one of the roles it can play or you can connect to the future.

Just to give you a basic background on what is biomass on lignocellulose as we would like to call it, it is essentially comprised of the three major bio-polymers, cellulose, hemi-cellulose and lignin, and cellulose and hemi-cellulose, you know, from sugars and lignin being the binding agent, which is, you know, very useful, has a very useful purpose in nature. And actually if you look at the plant cell wall, it is very complex. It has the, is the matrix of cellulose and hemi-cellulose and lignin, they

are essentially all intertwined.

So, in the old or the conventional biobased industry, the focus has been primarily, how do you go about removing the lignin so you can retain the long fiber cellulose and at least part of the hemi-cellulose, because the focus has been for fiber or structural applications.

As we emerge into the future biobased industry, we don't quite restrict ourselves that way, but actually we can go to removing the sugars and converting the sugars into polymers and other products and using the lignin, can also be used for polymers and other products, even though up until now, it is mostly used for energy.

And here is another picture of a spectrum of what can be derived from biomass, and what I would like to point out is on the left and the right, you see the conventional bio-based industry and all around us are the emerging way of this industry and certainly

they are all interconnected.

So, the focus of my presentation is, what are some of the components of the conventional of this industry and what role can it play in the future. And one specific example I'm going to take is actually using bio-fiber as reinforcement for composites. And of course biobased composites would involve components of biobased polymers and other materials. And actually the bio-fibers can be a good root ingredient as part of the overall mixture, and still it is biobased from, you know, recent carbon.

So the four parts of this talk is composite market, you know, what is the market size and value and what are the major applications that we currently have been using and, you know, in the immediate future, and what are the advantages for bio-based approach, especially using the bio-fiber and applications for, of the reinforced bio-fiber in composites and future applications, future

directions.

So, glass fiber is something that is commonly used as a reinforcing fiber for plastics, and if you actually look at the market size in the U.S., it is very large. So, the reinforced plastic market is about 4.1 billion dollars in 2003, and it is projected to increase to 7.4 billion dollars. And out of the reinforced plastic demand and two major classes of polymers are being used, thermoset and thermoplastic. So, this is a huge market potential for bio-fiber as we move into the future to replace glass fiber.

And within the thermoset and the thermoplastic systems, obviously these are polymers that are widely known, and most of them are petroleum derived, and it is used in a variety of applications, and you can see structural composites in the right-hand column as well as construction and automotive composites, et cetera. And these represent a broad range of application targets for bio-

fiber replacing, you know, replacing currently reinforced, reinforcing fibers.

So, if you go on to the next part, essentially, you are talking about the bio-fiber, how does it compare as a reinforcing agent, and what are some of the advantages. And biobased fibers are actually very unique in the sense that they are very light, they have a very low density or specific gravity, and they also have a high strength.

And if you look at the first column, you can see the specific gravity of plant fibers being, you know, at least half or one-third of the other fibers, and the tensile strength is reasonably high and what is important is the strength to weight ratio being significantly large compared to some other synthetic in other alternatives.

And also the cost. If you look at the cost in the fifth column on the right-hand side, you can see plant-based fibers are actually literally cheap. And even the most

high quality cellulosic fiber that you can obtain in the marketplace today, it's about a thousand dollars a ton, okay, and that compares very favorably with other alternates.

So, both the strength, the strength to weight ratio as well as the cost are some significant components to consider for the future.

What are the other advantages of using bio-fiber as a reinforcement, you know, for the future bio-based products, is what is performance. As mentioned before, the strength to weight ratio and the cost, as well as it is biobased and they are biodegradable and compostable, and availability is very broad. Okay, all the way from the Midwest, the Northeast, South, Northwest throughout the world, okay, depending upon the region and the geographic area, the different types of bio-fibers and bio-resources are available.

Process performance, and they have some unique features in terms of being less

abrasive compared to glass, conversion energy as well as the ability to shrink or lack, you know, less shrinkage compared to other substitutes. And the composite performance itself, as we will see in biopolymers, as we move into the future, there are some product property characteristics that need to be overcome, either through modification or through reinforcements. And bio-fiber can actually contribute in addressing some of the composite performance characteristics.

So cost, if you look at the cost of bio-fiber, and of course it can vary, you know, throughout the world, and here is an example of a cost projection from Doug Stokey from Iowa State, and where you can see, if you just look at the residues, not the fiber that is currently used in conventional biobased industry, actually the residue which is unused, you can see it is a total of about 300 million tons and that is approximately the total amount of wood fiber that is currently

being used and that can actually be available at a reasonable cost of $55.00 per metric ton delivered, you know, to the local, to the local processing facilities.

If you look at the North American consumption for the fiber in general, the wood fiber component of the wood fiber composites, which is an established industry in the building materials case, it's about 300,000 tons. The nature fiber, meaning the agricultural residue based fiber that is used in composites, is actually a smaller component, which is only about ten percent. And this is the portion that can actually significantly grow in the future.

So, moving on to the next segment of this presentation, actually what are the applications where you can use bio-fiber, along with biobased polymers, you know, in composites and other applications. A wood polymer composite is actually the old, you know, the technology or, it's been around for

relatively, you know, the old, the last ten years and more. And where you can see 30 to 70 percent and approximately about 50 percent wood flour, wood particles, actually in some cases, it is reused wood that is used by weight, along with thermoplastic resins and this matrix essentially, you know, with the help of coupling agents and stabilizers and pigments, you can actually produce products which can meet the property demand as well as the performance characteristics.

It's a very simple process. You make use of the thermoplastic nature of the resins as well as the fiber or the wood flour. You combine it with the thermoplastic polymer such as polypropylene and you essentially extrude them and form them into different shapes. So if you look at some of the windows and doors, okay, some of them are made using this material, or the deck and other applications.

So, why is it, why has it become

more common or increasingly being used. Again, these products have to perform and compete well with other products that are being used in similar applications. So, if you look at the third band of columns called the flexural properties, if you look at the strength characteristics of polypropylene, it's about 38.3 mega Pascal and with additional wood flour, you can actually increase the property and further with the addition of fiber, which would be more expensive than a wood flour, you can actually increase it further.

So, as we move into the future in bioproducts, and if you look at PLA or any other biobased polymer and you want to use them for different applications, these other biobased fillers, or biobased reinforcement can actually help us in a significant way in delivering the product properties.

And similarly modulus on the other side and heat deflection, again become very important

when you have cycles of temperature and the heat, freezing and thawing cycles, et cetera, to consider.

So, you may have seen this in many places in WPC, or the wood plastic composites. It's used in a number of applications, and one of the interesting aspects of this is it used to be that being able to use, you know, nails and screws, et cetera, used to be an issue and this has been addressed of late, and also these, once it is used, it can also be reused.

So, if you look at automotive industry, it's actually one of the places where natural fiber reinforced composites have been used, other than building products, where you can see this is a slide showing five to 24 kilograms of renewable materials per car. Maybe the car itself may weigh tons, or maybe a few thousand kilograms, so it's a small fraction of the overall weight, but within that, you see that 50 to 70 percent of the

bio-fiber is used as a reinforcing material for various products within the automotive industry.

So, this is where the natural fiber comes in, wheat straw being one of the natural fibers, as opposed to the wood fiber. And wheat grows in, for example in the upper Midwest. Again in combination with the thermoplastic resin, it can be formed and molded into various products.

So, how is it actually made, say, for example, in the case of the automotive industry, very similar to the wood plastic composite that I showed you, the raw material can be flax, hemp, et cetera, and some of them actually have a very large fiber length and very unique characteristics to be especially suitable for these applications as opposed to, say, for example, making paper.

So, you go through a fiber preparation process, which could be very similar to what is currently done, and then in

concert with the plastics and biobased polymers, you can then form them and mold them into different products or applications.

So, what are the requirements in automotive applications and one is, for example, thermal performance as well as, you know, crash behavior or crash resistance, so that's one key component. Another one is physical properties, just like any other products, physical properties have to be met. And flex strength and impact strength being one of the key physical properties, as well as durability.

Okay, one thing that you note is biobased materials in general, since they are biobased, they actually interact with natural systems more easily. So, as a result, they absorb moisture, they change, they expand, you know, so this property cannot be a detriment when you are actually using biobased fibers as a reinforcement in many applications. So, this needs to be controlled as well as

improved in order to be able to use in different applications.

So, this is an example of an electronic application, which is relatively new and where you can see NEC computers and also some of the cell phone, where you can see N7O1I Eco brand apparently has 90 percent biobased content. Again, you see PLA being one of the biobased polymers and Kenaf, another long fiber that is used.

So, going to the last portion of this future direction scene, how can we connect the old to the future, of course there are some areas of research that still needs to be done, and especially as we get into more and more of the newer biopolymers, and one example being PLA and Cargill and Nature Works have been developing this polymer, and you can see here, bio-fiber composites and PLA, they are already in the marketplace and commercially being used.

And we heard from DuPont and the

polymers that are made from other than PLA can also be used in concert with bio-fiber for our composites. But these are areas of actually an increasing interest in research. Kenaf fiber, you can see here, is something that is grown in some parts of the world, and again PLA Kenaf fiber in a spare tire, car floor mats, which Toyota has used from 2003.

And here are some other examples of commercial biobased composites. Again, PLA, coupled with Kenaf fiber, and cellulose fiber from recycled biomass, this could be from wastepaper, for example, and it is produced from a melt, spinning process and also blend of PLA, mineral fillers and plant fibers.

So, what you see is bio-fibers offer a significant potential, and as you approach each and every one of these product applications, and you can evaluate and improve upon the different fibers that can be used.

Here is an example of how glass fiber and bio-fiber in the public domain in

the literature, how it is getting increasing attention. On the left, you can see the green columns or the bars, of the glass fiber citations, and then the orange is the natural fiber citation. You can see over the last 20, 30 years, the amount of natural fiber used in composites and other applications, has actually grown significantly.

And similarly, the natural fiber composite publications, okay, has also grown, even though the glass fiber still is pretty large. So, there is a lot of room for, you know, opportunities for replacing, for example, glass fiber with bio-fiber.

So, the future directions, of course, with any development of any industry, like in the petroleum industry that we have seen and petroleum-based plastics that we have seen, there are significant steps that needs to be taken, and one is the material sourcing. And here, the sourcing of the bio-fiber feed stocks, okay, again, they are very diverse and

they are available throughout the world. And process development, in terms of the fiber themselves, as well as the use of the fiber in different polymer matrices and applications. And how do you increase the biobased content, you know, with the resins and fibers.

And strength, performance and cost, okay, are key components and the bio-fibers can actually certainly help in trying to achieve some of those strength characteristics.

I'm going to show you one example of what an emerging bio-fiber application, you know, in this biobased composites can be. You know, thus far we have been using particles, fibers as reinforcing agents. Actually what you see and what we have not yet made use of is actually looking at the intrinsic, or the internal characteristics of natural fibers.

So, this is a picture of how a plant cell wall looks like, and you can see the big rectangles are the individual fibers

or the cells, and in between them they are connected to the middle lavila and the cellulose, hemi-cellulose and lignin that we talked about, is essentially built into the entire cell wall and in between.

And if you look at cellulose, it is a very unique, interesting polymer. It has both crystalline region as well as an amorphous region and one possibility would be for us to actually extract, you know, either smaller fragments of the cellulose fiber and use them because of their unique properties, for various applications. So, one possibility could be actually extracting the nanocrystalline, or the crystal portions in nano scale, and using that as a fiber reinforcement for products.

So, the nanocrystalline cellulose can be isolated from, you know, biologically-based resources, and of course, if you remove the amorphous cellulose through acid hydrolysis and ultrasonication, then you

essentially end up with the crystalline part and this can be used.

And one stage, if you don't go to the nanocrystalline, or the nano scale, if you actually go to a slightly higher length scale, you can product micro-fibrillated cellulose and fibrillation of cellulose has been used, you know, for a long time in different applications. You can actually increase the strength properties of cellulose by doing fibrillation. So, these micro-fibrils can be separated and then can be used as reinforcing agents of future bioproducts.

So, here's an example of polylactic acid, which again is, you know, is being explored for different applications. You can see the polylactic acid film and this can be reinforced with a small amount of micro-fibrillated cellulose and this can help address, you know, the properties without losing the biodegradability.

And one other possibility is

actually make a fully bio-based composite, and which uses the cellulose, the crystalline actually as an amorphous component and blend them together and possibly with even other biobased polymers, to produce the future composites.

And at last, I would like to again bring back to say the old materials, even though they were used for, you know, certainly useful purpose and continue to serve a useful purpose, can be used in very interesting and exciting new applications. And we talked about the composite market and also the biobased fiber advantages.

And the strength to weight ratio is actually something very unique, and there are also interest in looking at, for example, carbon fibers or carbon nano-fibers, you know, using biomass as a resource. And the applications can vary quite a bit, all the way from building to automotive electronics.

And the research interest, there is

a lot of interest that is increasing as you saw from the citations in publications, and this is an area which I think is going to be exciting for folks in academia and industry to participate to double up the market.

With that I would like to say thank you for the opportunity and if you have any questions, either now or later I'll be more than happy to answer. Thank you.

MS. LEWIS: Hi, this is Kate Lewis again for those of you participating online. Before we go to break I also neglected, earlier in the meeting I did point out that we have international representation this morning. In addition to Michael Pelin, we have a participant in this meeting from the great north, great up north, Maria Wellish is on the line from Natural Resources Canada, ARCAN, and we're very happy to have such a varied mix of meeting attendees today, because with regard to moving these key topics forward within the implementation of BioPreferred,

we're very interested in not doing this within a U.S. or even a North American vacuum. We'd like our international stakeholders to see what it is we're proposing and to both follow and contribute to the revision and the enhancements to BioPreferred, because we really do want to move this market forward in the most harmonized way as possible.

So I became aware that Maria Wellish has a question and we'll go ahead and take that now before we break.

FEMALE SPEAKER: Maria's question is what would you call the intermediate, the bio-fiber itself, for example flax fiber, or something else? Please elaborate.

DR. RAMASWAMY: The bio-fiber itself can be considered as an intermediate in this case, and not only intermediate but it can also be as a feedstock because you're going to take the emerging biobased polymers, such as PLA, and in order to double up them for market for various applications, now

you're essentially using a bio-fiber as a reinforcing agent. So that's how I would view it.

MS. LEWIS: We're going to go ahead and break now for ten minutes. I'm sorry, we have one other question before we break.

MALE SPEAKER: Yes, I believe you said something about the reinforced plastics being about $4 billion worth of industry.

DR. RAMASWAMY: Yes.

MALE SPEAKER: I guess my question was was that $4 billion related to the reinforced plastics or just the fibers that reinforce the plastics?

DR. RAMASWAMY: I believe it is the glass fiber reinforced plastics market.

MALE SPEAKER: So it's the combination of both?

DR. RAMASWAMY: Yes.

MALE SPEAKER: So if we replace a portion of the fibers it's some subset of that 4 billion. And then further you mentioned the

wood composites, the wood lumber, being approximately 50 to 60 percent on average, in general, of the reinforced plastics market. Is 50 to 60 percent a consistent average across all reinforced plastics or is that a high content application? I guess I kind of feel when we talk about reinforced plastics, most reinforced plastics, they have a high reinforcement content or a low reinforcement content.

DR. RAMASWAMY: Actually in the wood plastic composite case the reinforcement is about 50 percent, so the 50 to 60 percent is the fiber component.

MALE SPEAKER: But compared to other reinforced plastics, is that a high number or is that a low number? I mean, for the automotive industry, when they have a reinforced plastic, is it typically in the 50 to 60 percent content or is it somewhat lower?

DR. RAMASWAMY: I think it is lower. But I'll go back and check and confirm

it.

MALE SPEAKER: Okay, thank you.

MS. LEWIS: Thank you, Shri. We're going to go ahead and break now for just a brief ten minutes. Before we do, because I neglected to do this after each individual presenter's presentation, I wanted to thank Debra Darby, Carl Muska and Shri Ramaswamy for getting us off to such a good start this morning. Individuals participating online, we're about to take a ten minute break so please rejoin the public meeting via webinar at 10:15 Central, that's 11:15 Eastern and 8:15 in the Pacific time zone. Thank you.

(Off the record.)

MS. LEWIS: Good morning. Welcome back to our discussion on biobased intermediate materials and feedstocks. I'm going to ask that our in-person attendees reconvene here in the auditorium at Iowa State University. And I'm welcoming back online our 100 or so participants in the meeting that are

joining us via the webinar technology.

This now begins the second half of our public meeting. Our three additional presenters will be speaking and then we will follow up their presentations with a section on open discussion and questions, and that open discussion portion of our agenda will begin at 11:30 Central, that's 12:30 Eastern and 9:30 Pacific.

But jumping back in I'd like to introduce our next speaker, Dr. Brent Shanks. Brent is a Professor in the Department of Chemical and Biological Engineering right here at Iowa State University, and he is also the Director of the National Science Foundation, Engineering Research Center for Biorenewable Chemicals. And Brent is going to spend some time right now talking to us about the relationship between platform chemicals and biobased chemicals. Welcome Brent.

DR. SHANKS: Is this mike working? If not, I'll just go to use the one on the,

is it working? I can't tell. Well, I go ahead and use this.

So again, I would like to echo from earlier this morning the thanks to the organizers of this meeting and echo what my view is of the importance of this discussion. I was struck when I was sitting here listening to the first few talks that intermediate chemicals or intermediates mean many different things to many different people. And in fact, I think that's one of the challenges when we go forward in terms of a BioPreferred program, what do we mean by intermediates. I think a definition becomes pretty important.

I come from a petrochemical background actually. I worked for Shell Chemical Company, so for me intermediates do not mean plastics or polymers. That's the end product for us, or when I was in that capacity. So when I think of intermediates, I think of the chemicals, the monomers that go

into those products. But clearly in the context of where we're at in this program where it's consumer products, intermediates must necessarily encompass not only the polymers but then also the monomers that go in. And I think that's an important consideration and I think Carl spoke, 1,3-Propanediols essentially, one of those intermediates leading to a polymer. Debra had talked about really more the polymer piece and so I'm going to be listing more towards the monomer piece in my discussion.

And I think what's important to that is, what I hope to, well, I don't know if it's the next slide yet, but I think, what I would like to think as our objective in general is it's really an issue of carbon and how do we track where the carbon comes from. We're currently, fossil carbon is our main source through the processing industry to fuels and chemicals, and we'd like to shift to renewable carbon. And when we think of how we

can do that, there's really, in my view from a chemical perspective, two modes in which you can do that.

Those two modes are we can either do a direct replacement of the petrochemical or we can do a functional replacement of the petrochemicals. And there's a great temptation to do functional replacement, and in fact, quite candidly that's a lot of what we were talking about this morning so far as function replacement.

And there's a good reason why we start at function replacement is because we can start with a molecule that's easier to get to from a biological feedstock, then that has great advantage because it cuts our manufacturing costs down. And what you would like is potentially with this functional replacement, that you might even get enhanced functionality from that and that's what we see with some of the polymers that we saw presented earlier today is those are, I mean,

in some level the polymers market is static. And so when you bring a new polymer in, it replaces one that's already there. There is some growth potential but it's limited, so really its inter-polymer competition.

And so what you're challenged with there is are you going to functionally be able to place that molecule, and there's ways, and you can do that in terms of performance, but then it's the whole price issue and that's what dictates its entrance into the polymer market.

The other approach is direct replacement. The infrastructure is already there to use those products, so can we directly replace the monomers that go into those polymers. And that creates two very different issues in terms of tracking. In one level the intermediate you're tracking is this unique polymer with its unique functionality. And the other if you do a direct replacement, the challenge is you're trying to track a very

fungible molecule. And so the question becomes how best to do that and I would argue that in anything that we talk about intermediates and BioPreferred, we have to find a way to deal with those fungible products.

If we really want biorenewable chemicals, biobased chemicals to make an enormous impact on the chemicals we use, we must have some aspect of direct replacement. It's not going to be good enough just to target functional replacement is my personal opinion. And why is that? Well, actually, this is a somewhat negative slide, actually, because this is all the challenges associated with doing either of those two things, but we can see for direct replacement, of course, the big challenge you're competing with mature technology and that's very efficient technology. The petrochemical system is a remarkably efficient system. However, if we don't compete against that we're going to

never be anything other than a niche player in the chemical market.

Of course, the big challenge for direct replacement is we've got too much oxygen. Carl mentioned this nice study from DOE, but one of the things you'll note of those 10/12 compounds is they're still very highly oxygenated compounds. Well, in fact, most of our chemical industry is predicated on low functionality in the molecule, little oxygen, so the big challenge is how to get that out.

The other thing that you frequently have with biorenewables is you can have these in dilute streams particularly if you're talking fermentation type products, how do you deal with those dilute streams. And one that I don't think is mentioned enough if you're particularly talking about bringing in a monomer to replace the exact monomer is the industry that does the polymerization, they're used to the impurities that are present,

albeit you can't have very many of them, but if you have 99.5 percent purity in the monomer, that 0.5 percent is frequently not well understood what it is, but the folks that do the polymerization know how to handle it.

And so to get it from a petrochemical route, it has 0.5 percent impurity in the monomer, they've been able to adjust their polymerization to deal with that. Now, if I introduce a biorenewable molecule, exact same molecule, exact same purity, that 0.5 percent of it comes from a different type of process, which it will inevitably, we'll have different impurities and therefore have different impact on the person doing the polymerization.

Important challenges for direct replacement, functional replacement, as I mentioned, the big challenge here is you're competing with entrenched chemicals that are there at a very low price. We have a very efficient system and so you're having to tap

into, and not only you're having to displace with a new molecule, but you have to ask the consumer or the customer of that product to absorb two risks, the technology risk associated with a new molecule and the market risk with any slight changes in performance associated with that. So this is the problem with functional replacement is you have two levels of complexity that you're asking the consumer, or two levels of risk that you're taking on.

Also, and I think we can't diminish this and I know those folks that have talked earlier today in Nature Works could speak to this as well. If your aspiration is a large scale commodity polymer, which again, if we're going to have a significant impact in moving to renewable products, we are talking large scale products, it's very expensive to introduce a brand new polymer. These are not cheap things to do. And so that's a real challenge with functional replacement is

having that whole infrastructure to, in fact, I think in Chemical Engineering News it was estimated that it was about $1 billion to bring a new commodity chemical to market. That's a significant commercial investment on top of the technology risk.

So what I'm going to talk about more in this talk is actually what I call, the one step back, the monomers. And so how do we go about the monomers and right now I would say there's two approaches. I think inevitably when you're looking at a new technology, the right thing to do is go after the low hanging fruit. I think DuPont did a wonderful job with the 1,3-Propanediol. As Carl mentioned it was a wonderful molecule but no one could produce it in a cost effective way, so they went after it. It was a great target to go after, however there's some challenges with that. That's a lot of investment for a single molecule and it also is a very sequential process. You kind of

pick up each low hanging fruit as you go.

So one of the things that I'm going to talk about today and I think ties into this whole sort of understanding how we get BioPreferred to potentially fungible molecules is the question of can we create a more generalized framework for making these monomers where we have some shared development cost over multiple products. In fact, you could already see some of that going on with the talks earlier that that first chemical they're making, they're looking to put it in many different things.

1,3-Propanediol was a good example. They're going into many different products so that helps share the development cost among different products. And whatever that generalized framework has, it has to provide some synergy. So in other words, if I make that investment I don't have to go back and make the whole investment over again for the next chemical.

So I guess maybe I'm a little more simpleton that Carl's nice one that he showed where all the petrochemicals went. Here's my view of petrochemicals. It's blacked out because it's fossil, but I think it is a nice illustration of kind of what the petrochemical industry looks like.

Coming from fossil carbon we have this tree of compounds, and each of the major limbs is a platform chemical, methanol, propylene, ethylene, benzene, xylene, these are the major branches and all those other things after that in the tree are the leaves and smaller branches that come off those main ones. And so the challenge is if we want to have a significant impact on this, if we try to pluck off one leaf at a time, that's going to be very challenging for us.

And so here is just written out a little more is kind of one step down from ethylene, the tree and kind of the amount of ethylene that goes into each of those areas,

whether it be alpha olefins, you see a big uptake is polyethylene in it, but a lot of these you're essentially taking ethylene and adding functionalization to them.

And so what we would propose with the biorenewables, what we would like to do is come in and find a way to start to replace this tree, but not to make, all the way back to ethylene, is to replace the leaves with a different branch, with a different trunk that we come up through is what we're talking about now with a generalized framework.

And so I'm going to give kind of at least our vision at CBiRC for what could be a generalized framework that could potentially do this. And so our idea is now could these major limbs be compounds such as ethers and esters, fatty acids, Ring Pyrones. This is not dissimilar to the DOE report where in that case their major trunks would have been things like glycerol, succinic acid and some other compounds like that, but the one difference

between what we're proposing is these are still major limbs but they're not the trunk. In some level the DOE report, each one is still a tree and from this you have to go a different route to succinic. It's a different route to glycerol.

What we would say is could we go to a generalized framework in terms of the fact that we have a unifying principle in which to make the trunk that we can take the major limbs from, and that's what I'll show you if we back up and do a little bit of biology.

As I mentioned, I was at Shell Chemical so it's always a little bit dangerous when I start meandering into the biology realm, so if I butcher this, please be kind to me. If we look at organisms and they take carbohydrates, they do glycolysis to go to the sugars, well, or a sugar precursor, I should say. They do glycolysis when they metabolize that and there's a key branch point in organisms, a Pyruvate. And this Pyruvate then

has a number of different branches in which organisms go from that Pyruvate.

One of the important ones is through acetyl-CoA and over to ethanol. That's a big one in our world right now. You can also go another one that goes to lactase, which is the under pinnings for lactic acid which, of course, is what Nature Works has done very nicely. Another one in Pyruvate, you can go through the citric acid metabolic cycle and go to succinate, this is where the succinic acid one, and I think we almost have in the audience folks, companies that play in each of these branches.

There's also for more specialized products, there's an amino acid metabolism that we can go keto acids. But we think there's this other very interesting one through acetyl- CoA again, which is the fatty acid metabolism. And fatty acid metabolism is quite nice because it's a metabolism that, the way the molecules are built in the cell is

there's an elongation. They start with C2 molecules. They add them together to make C4 molecules, C6, C8, C10, C12, and not only that, you can diversify off those molecules to make a range of different.

So our trunk of our tree that we're proposing is the fatty acid metabolism, and the branches from that are diversifications of that fatty acid metabolism because of this way that you can reiteratively make molecules through the elongation. So one of the first questions as a Chemical Engineer that came to my mind when biological people come and talk to me is what's the practicality of that, fatty acid metabolism, actually we see fatty acids lead into triglycerides. They typically show up in seeds of plants is where, and in fact, a lot of the knowledge of fatty acid, polyketide metabolism resides in the plant community. But there are examples in microbial systems, which are probably better workhorses, to make chemicals on large scales

to get high levels of these.

And in fact Debra had really kind of spoken to this with PHA's or along that same pathway that make the fatty acid metabolism, they show up to 80 percent of these things in the organisms. You can also get other lipids in these kinds of oleaginous yeasts where these are stained red and you can get up to 60 percent of these things within the organism, so you can get high levels of these compounds made in these materials.

So what we're looking at now then is from this trunk we have this central fermentation where we can go to this fatty acid, polyketide synthesis pathway, and if we interrupt it at various places we can go to this whole range of different compounds at that first level, fatty acids, eneone complexes, keto fatty acids, ring pyrone structures, et cetera, et cetera.

And then in the context of a vision of our Center, we can take those intermediates

and convert them further with chemical catalysts to products that are direct replacements now for petrochemicals that can then go into the polymer products. And the beauty is now this tree that we formed is based on a central metabolism and all the major limbs come off that, so in principle one would hope is that investment in the technology now multiplies itself dramatically.

And we think then an important aspect of this, and I'm going to zip through these fairly fast because these are an academic, they can't help themselves, what the Center does is bring together biocatalysis folks and chemical catalysis folks with the idea that they're each going to optimize their part in that tree. And the key is then in the bottom part is the handoff between the biocatalyst and the chemical catalyst and where that handoff should take place. And those two communities have to be talking to each other to understand that, and remarkably

enough in this world there's very little of that going on. Those two communities are totally separate and so we think that's an important aspect of what we're trying to do in the Center.

And this shows an example. One of the things we're looking at is through that fatty acid is actually taking glucose, going to fatty acids but now it's going to shorter chain fatty acids that we can then selectively decarboxylate to make alpha olefins. Alpha olefins is a very desirable product. You'd like to be able to make C6, C10's, or C6, C8, C10, C12 alpha olefins, so if we can go to that fatty acid metabolism, truncate the fatty acid at, we can give various chain length alpha olefins. And there in fact is precedent in nature to make shorter chain fatty acids, so there's some voracity behind that.

As I mentioned, I'll go through the next slide fairly quickly. We have folks from across the country that are involved with the

Center in three areas discovering the enzymes in that metabolic pathway, put them in an either E. coli or yeast hosts and then chemical catalyst design group.

Okay, real, real quickly because I just can't help myself. This is fatty acid metabolism. It's an elongation process. You can see starting from the yellow, it condenses out to the C4, runs around the ring, condenses out to the C6 and it just keeps reiterating up to C16's and C18's is where it wants to go. But in principle you can intercept any of these molecules in their synthesis within the fatty acid metabolism which would allow you then to make this whole landscape of chemicals is the concept.

And as I mentioned, the beauty is this goes off one central metabolism, so if you can get high carbon flux into this elongation pathway, in principle then if I pluck off this one, this one or this one, I've at least got the right carbon flowing into the

metabolic pathway that I need. And then as I mentioned, the chemical catalyst piece as well.

So the idea then is can we then through this pathway create a range of, these would be different chained fatty acids. We can make eneone complexes where we can then do chemistry to make other molecules, but we can do this now in a way that we can make all different R groups in these things so we can make a whole range of different leaves from the same trunk.

I was very glad to hear the comments on the international participants because I think the membership of our Center kind of demonstrates an important part in the BioPreferred program that when we're thinking of these molecules, we need to be thinking globally because there's multinational corporations that cross, that are members of this that are looking at the regulations. They would love to have some uniformity of

regulations wherever they operate in the world so that there isn't differences in each place that they're at. And so I think this membership demonstrates that multi-national interest of these companies and I think we need to consider that.

Our Center also has a number of, and it does show the enthusiasm in the investment community around biorenewables, a number of innovation partners that are major venture capital companies as well.

And I'd like to end with just a thanks to the National Science Foundation for funding for the Engineering Research Center and I'd be happy to take any questions.

MS. LEWIS: Brent, thank you. Much like you truncate fatty acids, I apologize to have to truncate your presentation a little bit. It's fatty acid humor. I know, you've heard it. I think they're laughing online.

If you do have questions for Brent, again, apologies, you had to, just because of

time Brent, run through those past couple of slides a little bit quickly. If anybody in the audience or over the webinar has questions, please hold them so that Brent can adequately address them in the open forum part of our meeting.

I'd like to introduce our next speaker. Prior to joining the Biotechnology Industry Organization, BIO, Dr. Singh had long tenures at key companies in the bioproducts industry, most recently at Ashland, Incorporated. She was asked by the President and CEO of Ashland to serve as a key member of a committee that determines the new strategic direction for the company, and it's this big picture thinking that Dr. Singh continues to bring to her new role at BIO, the Biotechnology Industry Organization, as Director of Policy and Biotechnology.

Rina is going to share with us BIO's perspective on growing and strengthening the biobased chemicals industry this morning.

Rina?

DR. SINGH: Thank you so much, Kate. So I'd like to thank Glen and USDA for the invitation, very appreciative. And I would like to take the opportunity to talk about growing and strengthening the biobased chemicals industry, and one of the ways to do it is through these government programs, specifically the BioPreferred program which establishes itself in providing guidance and growth in the biorenewable biochemicals space.

So I am, as Kate said, Rina Singh. I'm the Director of Policy at Biotechnology Industry Organization situated out in D.C., and I'm looking around the room here, a lot of familiar faces and just wanted to give you a background on who some of the key members in this business unit or what we call some of the industrial companies that are part of the environmental section in our organization. It is one of the fastest growing sectors in BIO, and I apologize for those of you online and

some of you folks in this room if your company logo is not showing up there, it's because it would have been a terribly eye chart.

So having said that, all of these folks are members, participants in the bio industry. So I wanted to bring to point here, you've seen some facet of this slide from a lot of my colleagues in this panel, but some added color to it, so biorefining is almost like talking about the petrochemical refining processes. It's not just about bioethanol. As you can see, it basically starts from an agricultural feedstock and the processes that typically are used, conversion chemistries that are used in the biorefining have been known for the past 100 years or so, such as grinding, crushing seeds, extracting, so there's nothing novel or new in these processes. But you get into monomers that go into polymers and then all of the end applications, so it basically targets commodity chemicals, specialty chemicals, fine

chemicals, what may you have in the chemical industry.

An example of the typical biorefinery is shown here, and this is a wet mill where you're actually looking at starch, corn, taking, extracting the structures, the carbohydrates out of them, and using some conversion chemistry in making a lot of the, what we call the high value chemicals that go into a lot of the applications shown at the bottom, pharmaceutical intermediates, deicer solvents, resins, surfactants, citric acid, gets into food applications and what may you have in the 3-Hydroxypropionic acid, which makes acrylic acid. It's just a commodity chemical, gets into making water soluble polymers for water treatment technologies. So it gives you a good flavor of what a typical biorefinery looks like, not very different as I mentioned, from the petrochemical refining.

So here are some examples of, this is not meant to be a totally exhaustive list,

it is an exclusive list of chemicals that are getting a lot of attention today and not necessarily in the fuels. So biobutanol, there's -- working and try to make not only fuels, but they are working in what they're making -- out of it for typical chemistries that go into chemicals that are a commodity, engineering thermal plastics, and the list goes on.

You've got polyvinyl chloride, unsaturated polyester resins, PLA, polyhydroxy -- that you heard about this morning, PDO monomer from Carl, and polyethylene terephthalates. Unknown to a lot of people Coca-Cola is working on PET where they've actually used ethanol to make the component that is bio, and it is a good example where you're looking at all of a sudden bioethanol that is not only going for biofuels application, but you're actually looking at making polyethylene terephthalate in a lot of the packaging industry.

And so terephthalic acid, which is the other component in PET, is also getting attention now. There's work right now with Soybean Council that's looking at soybean molasses trying to make terephthalic acid. But in all of these examples, they're areas that I'll focus in with all the companies that are working on. LG for example, you've heard a lot in LG biofuels, but LG making chemicals. And if LG chemicals is not new. It's in the food industry already.

So here are some examples of what we consider the first wave on bio-derived plastics. We've got Carl who spoke about sorona polymers from 1,3-PDO, and this is a very good example of what Brent was talking about, what do we consider as intermediate chemicals. And this slide is a really good one because you're really looking at PDO and the polymers that come from it. And the same goes for, if you look at Nature Works PLA, for example, lactic acid and then making PLA out

of it, some of the processes that go into these polymers are biotechnology. They come from fermentation processes and are very unique from a cost and also from a process perspective.

And so the other one at the very last column that's showing here where you're looking at the Dow and Crystalev JV, they're looking at converting ethanol, another example of not necessary biofuels making ethylene out of it. And a traditional chemical such as polyethylene and various other monomers that come out of ethylene.

And so one of the things that comes to mind with PDO, and Carl has spoken about this already in regards to how it's made from glucose and glycol intermediate, glycerol, excuse me, intermediate into the bio PDO, and then Tennessee where it's been actually produced and how it's made from corn. And wanted to go to the next slide with this PDO in mind.

This slide is very near and dear to my heart. As Kate indicated my former employer was Ashland, Incorporated, and Ashland is well recognized for being one of the first producers of a thermoset resin that is bio-derived. And the chemicals that go in it, it's a patented technology, is maleic hydride you're looking at, which is not bio-derived but bioethanol, soybean oil, and this was one of the first resins that was made. It was initiated by the United Soybean Board and John Deere making a lot of these farm equipments where the panels are made from sheet molding composites.

And glycol, and it goes back to my previous slide, could be anything from PDO, 1,3-PDO or propylene glycol or what may you have, but the first product that has gone to commercialization is Envirez 1807. Ashland continues to invest in the research and development of green resins. There's a lot of classes of Envirez available to date and these

products are for sheet molding composites, BMC bulk molding, protrusion casting, infusion and typical general laminating resins.

And here are some of the companies that have already listed their products. These are customers for this particular resin to date. These are hard surfaces Bendura and Bradley and -- and hard surfaces that have already listed themselves. So we're looking at now the intermediate chemicals, so we're looking at the PDO and unsaturated polyester resins that would like to be in the BioPreferred program.

Some of the other applications that have reached commercialization are in the boat hulls and decks, and these are pleasure boats. It was announced in generally 2010 in the Bradley instance, Ashland actually won the 2009 ACMA Green Award and are very well recognized in this space. So it would be a shame not to put polylactic acid up here.

One of the things as you folks

know, they are the world's leader in biopolymer, so polylactic acid in the BioPreferred program, there's a lot of effort going on downstream for all of the customers that are in the packaging industry, but PLA itself needs to be recognized. It is recognized as Indigo, which is the trade name. It's got some superior environmental characteristics, similar if not close to that of PHA. And it's got a very significant manufacturing in IP position for itself. It's got about 100 million pounds in annual sales and some of the customers happen to be Wal-Mart, Frito Lay and Coca-Cola, which it's basically competing against PET.

With that, here's some of the packaging of products that you're probably familiar with, and also in the textile industry, not necessarily packaging, and so also in the durables. The third column that was shown previously in some of the first wave is also the Dow Crystalev JV making

polyethylene from sugar cane, and they are coming right along with ethylene from ethanol to make this engineering thermal plastic polyethylene a commodity polymer. Ethylene oxide vinyl chloride monomer, vinyl acetate monomer and one of the key chemicals that go into a lot of the UPR resins as a diluents is styrene. So as you can see, there's a lot of opportunity for intermediate chemicals and also polymers, so there are actually biomonomers and biopolymers.

And another organization, a start-up company Z-Chem has a hybrid biotech thermal chemical process where they're actually making bioethanol and also ethyl acetate and they're using fermentation in concert with a thermal chemical process. In fact, what's really unique about their process is they're able to use the CO2, which is typically liberated in a fermentation process, and they're able to use it to make acetic acid. So it is a 100 percent carbon efficiency process.

And Solvay is looking at sugar cane in making another commodity thermal plastic, polyvinyl chloride, so that too would be something we would look at as a BioPreferred in the BioPreferred program.

Second wave of bioproducts, we spoke about some of the engineering thermal plastic, the commodity monomers and polymers. Now, we're looking at some of the companies that are involved in a lot of the monomer space, some of which Brent had mentioned. And also some of these companies are right now looking aggressively at this particular platform and it is one of the top ten in the DOE.

And succinic acid, as you can see, has a lot of other monomers that the branching of the trees and leaves that come off it, and this is a classical slide that appears in the DOE and also the USDA. But what's missing on this slide are all the polymers that come out of this too, and so again restating it, it's

not only about monomers, its monomers and polymers as intermediates.

And so the production of succinic acid, one of the players in this field aggressively pursuing it is Myriant and they've got sample quantities of succinic acid available. They use metabolic engineering and basically it's an organism that makes the succinic acid. It is supposedly a softer, cheaper, cleaner process, and this is a quote from them, that "they're very competitive with today's oil prices," and pretty much down to less than $45 per barrel of oil of crude.

Another player in the field of succinic acid happens to be a partnership that's out there with Roquette and DSM. Now, just before I go down that partnership route, I just wanted to point out that DSM has a huge history in white biotechnologies, so some of the intermediates, the pharmaceutical intermediates that they have that go in a lot of these products over the years, hopefully

could qualify also and that could be some discussion that we may want to have, though, with the USDA.

But they are traditionally very engaged in a lot of the areas and they are also in the petrochemical space with succinic, so it's not anything novel from a business perspective, but it's a great partnership where they're considering looking at synthetic biology as the technology and making this particular monomer. You're looking at a lot of the technologies, from thermal plastics to thermosets to some of the monomers that I'd shown that could result, so it's a host of monomers and polymers that come from succinic.

And I'd be amissed here if I didn't mention a couple of the other players, but unfortunately this is only a 25 minute presentation. And one of the other companies that has gone commercial is DNP in this space in Europe, so succinic acid is available. And the other partnership that's out there is BASF

and Curac that are working in this space also. So there's a lot of you might say activity with a lot of companies out there.

Okay, the third wave is plant expression, and it's basically using synthetic biology technology and what that just means is looking at microbes where you're actually looking at synthetic DNA, putting the synthetic DNA's in the microbes and generating the desired chemical or polymer for that matter. And it uses systems biology and the contributions from synthetic biology today, it is not a well recognized or it's basically starting with a lot of voluntary regulations out there on synthetic biology, but it is impacting itself in contributing to not only fuels but renewable chemicals, specialty chemicals and bioproducts.

And here's a case example for Modular Genetics who's working on surfactants and they are on the verge of going commercial in this space. Typically, these are made from

renewable chemicals and also from crude oil. It's a $24 billion market and annual global production, about 13 million metric tons, and some of the end applications with surfactants, it's like foaming agents, emulsifiers, dispersants. And in the surfactants as a platform in the biorenewed or in the BioPreferred space that we'd like it introduced, would encompass now replacing some of the petrochemicals and looking at feedstock that it would be synthesized from, such as glycerin which is a waste byproduct from biodiesel.

So palm and coconut plantation expansion threatens the rainforest so that is a negative, and there's about 32 billion kilograms of CO2 in burning that's given off. It's equal to burning about 3.6 billion gallons, so surfactants does get into a lot of commodity products and formulated products for that matter.

Another piece of chemistry that

gets kind of ignored a little, and Allylix is one of the leaders in this space, is terpenoids, terpene chemistry, where historically they've been very expensive, but using biotechnology they have managed to show that it can be done in a cost effective manner. It's sustainable and it's a stable supply. So Allylix actually opens the use of terpenoids and some of the market spaces that they play in, in the industry is shown in the column that, the first column which is flavor and fragrances, insect repellants in crop, natural sweeteners, biofuels, pharmaceuticals and some of the products listed on that space.

So moving on to another organization, Genencor, Genencor is a division of Dynisco division and they have historically had an impact in this whole biotechnology space. Some of the products that they have gone commercial with is shown on top. They have impacted what Carl, my colleague here on this panel, spoke about, PDO. Genencor was

behind the micro organism that DuPont Tate & Lyle worked on. So they're very engaged in this whole synthetic biology space.

Right now they are looking at Bioisoprene. Bioisoprene is a monomer, isoprene, they've trademarked the word Bioisoprene. It goes into replacing natural rubber and we would be looking at then being self-sufficient and not dependent on the Asian continent where the rubber tree is actually grown. So it is not out there totally commercial, but they're paired, Genencor is paired up with Goodyear in moving forward in this space. And they had in a climate change, in the U.N. Climate Summit in December, there was a big announcement at that time in this space.

So other companies, start-up companies, Itaconix, is using itaconic acid. And as you know, Cargill is one of the world's largest producers for itaconic acid. Itaconic acid can be use to polymerize it to

polyitaconic acid and some of the end applications are dispersants and coatings and biocides, and some of those which are listed here at the bottom. And one of the nice things about this polymer is that it's a water soluble polymer. It would compete directly with some of the other water soluble polymers, such as polyacrylamide, polyacrylic acid, and it is almost 100 biobased. So this would be another polymer. It's not a commodity polymer, but would compete against those that are out there in the commodity space that are water soluble.

Here we've got Genomatica working on the 1,4-PDO space. As you saw in my succinic acid platform, 1,4-PDO is also, is a chemical that can be produced from succinic acid. What these folks are doing is they're taking sugars and doing some of the synthetic biology to make the 1,4-PDO. It would go into some of these commodity engineering thermal plastics, such as PBT, which is polybutyl

terephthalate, urethanes, co-polyesters, unlike the unsaturated polyesters, you're looking at a lot of the saturated polymers here. So the end applications for PDO with these uses in these polymers, so there's a host of these that would go into then possibly in the BioPreferred program.

OPX is focused on making bioacrylics. They are looking at the 3-HPA platform, again, one of the top ten from the DOE. And here they're basically looking at going into a scaled up production by next year, so hopefully samples will be available for the bioacrylic monomer. And typically this is, like I said, a commodity chemical. It's about a $10 billion market space, growth of four percent. End use markets are shown here for bioacrylic and synthetic biology from feedstock such as the sugars, fermentation process, making 3-Hydroxypropionic acid, dehydration that, hydroxy functionality into the bioacrylic monomer. And so bioacrylic

monomer itself, the monomer before it gets into the polymer, could be in the BioPreferred program too.

And then Microalgae is a feedstock and it is now being, it's commercial by Solazyme and for the use of jet fuels, but they have another effort that is focused in looking at industrial chemicals and some of which are listed at the bottom here on the last bullet, they're looking at replacing petroleum chemicals that go into making plant oils, diverse range of products from oleochemicals to cosmetics and food. It is an indirect photosynthesis where typically direct photosynthesis is giving algae some light and CO2. Indirect is actually though using the sugars and feeding the algae here, so thus it is indirect. And it is a process that fits very well in a typical standard fermentation process that's out there. But this is a platform on its own for biochemicals and biopolymers.

So to summarize, BIO, as you folks probably already know but worth mentioning, was one of the first organizations to endorse the Farm Bill's energy, which is the title 2001 and 2002. We supported the expansion of BioPreferred bill in 2008 that was out there in 2008, which proposed the voluntary labeling program which offered potential to expand biobased markets. It was a very market facing approach which was excellent for a lot of our industrial chemical companies out there. It is based on the USDA certified biobased product label.

One of the things that as a bio organization, we do definitely recognize the role of the entire value chain from feedstocks to intermediates where we're at this point on the intermediate side of things. Biomonomers and biopolymers to final products needs to be recognized to achieve maximum potential in this whole BioPreferred program from the USDA.

And finally, the last bullet, BIO strongly supports the inclusion of biobased intermediates and any which way we can help make that happen along with all the support from all of our chemical companies and start-up companies and medium sized companies, to make this space eligible to receive the label under current rule making.

So with that I just wanted to finish that there is a world conference coming up in June. It's already got 200 speakers. It's got a very good program, so if you haven't had a chance to go on the website, do go on the website and have a look at the website shown on the bottom. One of the first times this year we're going to have an investor session where some very well recognized CEO's will be presenting the latest and greatest technologies. It is an open forum where all of you are invited to attend.

With that, I'd like to thank you for your attention.

MS. LEWIS: Dr. Singh, thank you. You not only, as I mentioned, when I intro'ed your presentation, you not only gave us BIO's perspective on growing and strengthening the biobased chemicals industry, that presentation was basically a run through of the heavy lifting some of BIO's member companies are doing to really commercialize these innovative biochemicals, so thank you for that.

I'd like to introduce our next speaker. This is Dr. Susan Sun. She's a Professor of Grain Science and Industry at Kansas State University. She's also the co-director of the Center for Biobased Polymers by Design at KSU. Just one of Dr. Sun's many research interests include plant proteins extraction and modification. She's going to share a little bit more about that research interest in her presentation where she's going to talk with us about the potential applications for soy polymers. Dr. Sun?

DR. SUN: I will try if this one

works, which one works? This one works. Okay, so I will turn this one away. I heard some complaints about a kind of echo, so I'll just use the one.

It's a great pleasure to be here and biobased products is my favorite topic through my career, and so I think in the morning and all of the speakers talk about the biobased plastics and monomers derived from the biobased materials and for plastics, and also the fibers and also fatty acids. And so then this talk will talk about protein polymers.

And so I give you this graph and I just listed all of the three major monomers, and that's the building blocks of plants. And the plants are the only producers on the earth, I think everybody knows, and converting the solar energy through into amino acids and the sugars and the fatty acids, and then those are the monomers and the building blocks and for all types of products and possibly like

the adhesives and the resins and the inks in pens and the coatings, surfactants, detergents, and the tires, rubbers, that we listed, all of the above from our today speakers.

And biodegradable polymers and the pharmaceuticals, the cosmetics and composites and the bio-nano materials, and more. I can't list any more. And besides food and animal feeds, and so, and the fuels, did I list the fuels, and the transportation fuels, yes, that's only one of the products. So although fuel is a very hot topic in large volumes, but the biofuels is only one of the products. And so from the list you can we have all diverse products.

And so then we have other energy sources like nuclear energy and wind energy and also solar energy itself cannot be converted directly through those products. You have to go through the plants and biosynthesis, and those nuclear energy and

other energy sources cannot be converted into the biobased products, the monomers and the polymers that we talked about this morning.

And then the true base of the polymer and the true base of resources, and I have a question mark there and even though if we have enough resources and we don't want to use the petroleum based feedstocks forever because of the environment issues and the climate change issues. And so then besides the food and animal feed and then we have to produce enough then to meet our future customer needs on biobased products.

And so the biomass and we list it and we have carbohydrates, that the family name of a carbohydrates they have zero grains and the -- and the straws and the grasses and the sugar canes and the trees, all of those belongs to carbohydrates. And then proteins like oil seeds and algae and cereal grains also contain proteins. And oils and fatty acids, for example there's oil seeds in the

algae and the corn and phenolics, and like lignocellulosic biomass and contain a lot of phenolics. And so then for carbohydrates, just for example, I didn't list all of those, like starch, cellulose, lignin, xylose, and more, and then all of those has their own applications for each different type of intermediate polymers and the biomonomers in the products.

And so here is just kind of a little bit of the monomer structure and as a building block for all type of polymers. And for example, glucose, and glucose is the building monomers for like starch and xylose, xylose and the like polysaccharides and then we have all type of products on the market already and mainly for food uses, and also cosmetic and pharmaceutical uses. And then in the past decades and we use the glucose as monomers and it converted, fermented into different monomers like a lactic acid, succinic acids, all type of chemicals, and

then further on for a plasticizers in plastics and so on and so forth.

And fatty acids and Brent mentioned about, I think, their Center focused on fatty acids, and I have a question for him on what type of oil seeds and plants that you use to synthesize those fatty acids. And so those fatty acids, it's the monomers of the fats and the oils and it has triglycerides and then you can use the fatty acids directly and into all type of chemicals and for different monomers and polymers.

And then amino acids, I think we haven't talked about proteins and this is one of the topics today. And protein as the kind of on the representative group is forgotten and I see Rina didn't list protein as a polymer, and this is kind of a minority but I think this is a huge minority. You can't think of protein as a minority and protein is the majority. And the protein and we have the amino acids, this is the monomer, and on the

earth we have about 20 amino acids and then we have all type of protein based materials, and I always compare this to the English letters in my class when I teach and we have 26 English letters and then how many words or sentences were derived from that 26 English letters. Huge, so it you consider that and then protein has huge potential and the amino acids, you can make them into different sequences and different combinations of that 20 amino acids and then you can have all type of monomers and polymers.

And so it's kind of a similar route to the fatty acids, but then the fatty acids is a little bit easier compared to the protein. And the protein is so complicated, so that's why nobody wants to touch it. It's very difficult and the chemistry of a protein is huge in the molecules. And so small molecules is easier to deal with, like peptides, and most of those materials are suited for medical uses, tissue engineering

and drug delivery.

And then for industrial materials and peptides probably is kind of expensive, and depending on future fermentation technology, you can make it affordable. And so that would be the third wave like Rina mentioned this morning, third wave monomers, polymers.

Okay, so then they can make it into structured materials and then different alpha helix and beta structures and they can make it functional polymers very much. So today I will focus on the protein polymers. So the main protein polymers from the oil seeds and I have a table for the starch based crops, like corn and wheat and sorghum and those protein contents is about 12 to 14 percent. Mainly it's the starch resources for corn and sorghum so then the huge protein polymers is from the oil seeds. For example, the soybean and then the, yes, this is the protein. This is oil. I forgot, this is the continuous table.

Before this there is another table I cut it off because this is a short, 25 minutes talk. And so the protein contents and ripe seeds and then sunflower seeds and peanuts and canola and caster bean, cottenseeds, so you can look at it if you utilize and fatty acids and oils of those oil seeds and then simultaneously you generate a lot of protein products.

And so based on biological nature and then no plants can only produce oil or can only produce carbohydrates. You have to have the three things. You have a carbohydrate, you have a fatty acid and then you have a protein to make the plants become functional.

And another example, for example, the trees and people thought we produced more cellulose and to convert it in because the monomer cellulose is a sugar and then you can convert it into many different products. And then don't forget that the trees, you need the

lignin and other adhesive to hold all of the cellulose together and make the tree grow straight up, otherwise if you don't have a lignin and then the trees will just grow on the ground as a kind of a spread everywhere. We don't have that much space for the trees to grow on the ground and spread everywhere. We have to use the space and so if we utilize the cellulose fibers or sugars and then you have to consider lignin as a polymers.

And so the protein polymers, why it's difficult and why it's complicated and the proteins are, sorry. Yes, the proteins are major polymeric materials and for food, pharmaceutical, medical, tissue engineering and industrial products, so on and so forth. And protein has two major components, like hydrophobic and hydrophilic and also has the charge and non-charge. And the 20 amino acids that I mentioned, each of the amino acids has its own functional group. It's not like afilin for example or lactic acid, they have

the same structure and then if you polymerize the lactic acid become a polylactic acid and then you have the same monomer.

And then if you use the protein amino acids and then if you polylysine for example, this is the monomers uniform, but then if you have peptides and then consist of several amino acids, if that one is a functional monomer, if you polymerize that and then you have different functional groups and each of those has different functional groups like hydroxyl, carboxyl and amino and thio so that makes the protein complicated. And the hydrophobic interaction has been considered the most important factor dominating the protein surface properties and for folding and aggregation and the gelling and the self-assembly, the adhesion and the cohesion and so on and so forth.

And so the protein amino acid, the composition, I just use a soy protein as an example. It has glutamic acids and acetic

amino acids and basic amino acids and hydrophobic and sulfur containing, all of those dominate the protein's properties. And a protein is a mixture of polypeptides and if we consider about the monomer of the amino acid that's easier, but then if you consider about the protein derived from the oil seeds, for example soybean, you extract the oil out and then you have the soy meal. And then soy meal contains soy protein and the fibers, and then if you get the protein out, that protein is the mixture of the polypeptides. That protein is very difficult to be used directly as polymers or functional products by industry. You have to modify it and you have to separate it.

And so for example, the protein for example from the soybean, they have storage of proteins and like conglycinin and glycinin and also some other subunits, the proteins. And then if we just have one example like a conglycinin, is only, also is a mixture of

polypeptides. And this is the glycinin, for example, and the glycinin protein is a major protein of soybean. It consists of about 50 percent, and then glycinin itself and it contains like acetic and basic polypeptides, and then those acetic and basic polypeptides and then they link it together and then stuck together and based on the biological functions during synthesis and so then for industry uses. And then you have to break down those into polypeptides and then to study their functional properties and then to see if there's any potential uses.

And so this is the structure of the glycinin just for example, and then most of the hydrophilic components is on the outside and then the hydrophobic components inside and then if you want to utilize this approach for adhesive, for example, and then for water resistant adhesives. And then you have to open this up and then turn the hydrophobic functions outside and then also the

hydrophobic functional groups, it contains a lot of functional reactive groups with other polymers and to make use for materials.

And so maybe this is the more technical, and I apologize but like Brent, I can't help, I want to talk about this. And those are the polypeptides -- polypeptides – beta and acetic and the basic, each of those has a different hydrophobic/hydrophilic properties, and also charge, a positive and negative charge. And then during processing and you can make them into uniform mixture and or you can make them like hydrophobic components in -- lab and make kind of a continuous networks, and then, or you can make them into aggregated polymers and then for different applications. Each of those has different uses and for different products.

And so another complication of a protein polymer is the protein polymer has the denaturation behaviors, and then the thermal behaviors is very complicated depending on the

protein structure. And for example, this one is the soy protein and then the curing temperature, for example, if you are not familiar with their thermal behaviors and then you don't know how to deal with the polymers.

For example, the thermal behaviors of this protein has been its raised temperature for 7S at 140 and 160 11S and then if you're curing temperature is choosen 100 degrees C and then you don't see any cross link or straw materials and then if you cure the protein at 150 degrees C and then you have a stronger composite materials, it's like a plastic. For example here has the strength about 35 mega Pascal and then if you cure temperatures, this is the, yes, molding temperature, the curing temperature as a lower and then your strength is very low.

So then if you deal with a protein polymer you have to study their thermal properties and behaviors in order to better utilize this polymers. And so this is just

another, probably I run out of time. Just let me know if, five minutes, yes, I just escape some of the slides.

This is another interesting morphology. This is a negative protein and then after if you know, if you understand their structure better, if you understand their thermal behaviors better and then you can turn them into kind of a, turn them into network chain and then has the morphology similar as formaldehyde and I will have another morphology I will show you later on. And those are the potential application of protein polymers like gelling and thickeners in emulsification, surfactants and coatings, adhesives, fiber spinning in plastics in protein films, and protein biobased composites and also drug delivery and tissue engineering. And those are the potential uses.

And then the next few slides, I have four minutes, yes, which just give you example of potential uses. And like for

plywood and wood veneer and particle board and fiber board and labeling and packaging and paper coating and textile sizing, and also this is the soy latex adhesives from soybean protein developed from K State. And this one also compatible with many synthetic latex polymers like polyamino acetate or polyamino alcohol based and phenyl formaldehyde, urethane formaldehyde, vinyl acetate base, et cetera, and those proteins and they make them into stronger functional products and adhesives and coatings and paints and surfactants.

And also compatible with color pigments and paints and so this one the protein can be used as the large micro molecules surfactants to hold the pigments. And also compatible with functionalized plant oil based resins and so, and one example, like for children arts, and those soy protein packs is compatible with food color. And so none of the true based latex compatible with the food

color. Like the Elmer's Glue, the children glue used and if you mix with food color it decomposed and it becomes aggregate -- and then the protein latex includes and compatible with the food color, so you can develop for like children's artwork for the kindergarten and so it's edible and it's non-toxic. And for the glues -- and this one is cure faster than the Elmer's Glue in just a few seconds and then bond together.

Another potential applications for glass bottle labeling, and for particle boards and compare with your urea formaldehyde and those are the tensile strengths and the compressive strengths and modulus of rupture and modulus of elasticity. And this is the soy based and this is the formaldehyde based and so if you compare those, it's very comparable, very comparable. And for the sealants of the box for Navy, and the Navy usually used the 3M produced. 3M, if we have audience from 3M don't be offended, and the

glue gun use as a sealants for the paper box and then the Navy looking for biobased that they were in for adhesives as sealants so they can dump those box into the ocean without pollution to the ocean animals. And also the paper itself and most of those are solid fiberboards made of formaldehyde based or some PBA based vinyl acetate based adhesives.

And then we can use soy protein and paper pulp fibers and make it a biodegradable, 100 percent biodegradable fiberboard and with 40 percent less weight, and then the tensile strength is about a 70 mega Pascal and so the I-bar MOE is higher than the commercial fiberboard.

And also the protein in adhesive has the potential for foundry, and the glue the sand together even though foundry is the molding, the iron and line molding, casting industries and we have a lot of applications -- and also this is the morphology of a protein polymer mixed with oil, functionalized oil and

so then you see a lot of the oils and they mix very well and then those is the oils in the seal hydrophilic gaps doing the hydrophobic/hydrophilic separation and mix nice coating films for with a potentials and for plywood veneer and compare with, this is blended with commercial monomer, adhesives, I'm sorry, and then you see this is the commercial, pure commercial, this is the pure soy and then if you blend it, it will have benefits and better properties.

And this is just escape those, and blended with many other commercial like PBA and vinyl acetate based. Yes, here is the morphology comparison. This is soy and this is the formaldehyde based and they have a similar morphology and so there's huge potential for polymers. And the challenges, I want to mention those. Give me one more minute. And the challenges is the performance durability is a big issue, and the raw material supplies and the costs and

variability in the chemical composition of raw materials is depending on the climate change and the environment.

And like in Brent's presentation about the fatty acid synthesize use the, eventually you will also face the variability from the climates and the environment of soil and those type of things and so how to control that variability from the plants and synthesize and during synthesis is also a challenge.

And compatibility and the processing methods with existing facilities, industrial expectations and public expectations and EPA regulations and limited funding, and the research needs and the fundamental studies of biobased intermediate polymers, especially proteins I mentioned is needed, and to study their structure and the functional properties to make them into a very functional easy process, easy deal with polymers and because we have a huge protein

derived from the biodiesel and also the fatty acids chemical platforms. And estimated is about 90 billion pounds available besides food and the feed in the nation.

And so the structure functional properties, the important, structure modifications chemical reaction pathways and targeted and functional properties like curing kinetics, we need to study and the morphology and rheology, crosslink density, mechanical strengths and cohesion, et cetera. And acknowledgment and my research has been supported by USDA and DOE and NSF, the industry and United Soybean Board, KS soybean commission and all of my graduate students.

And I have a biomaterial technology lab and here is the website and the www.grans.ksu.edu/btl and also Center for Biobased Polymers by Design is www.ksu.edu/cbpd, and you can find some information there. And also there's a book of biobased polymers and the composites and that

book contains protein polymers and fatty acids, triglyceride polymers and also polylactic acids.

And with that, I thank you for your attention.

MS. LEWIS: Thank you, Dr. Sun. Did you mention you'd be after the meeting in the lobby area signing copies of that book? Thank you very much. It was a really incremental look at the protein chemistry behind those potential applications. Thank you, Dr. Sun.

At this point in the meeting we'd like to commence with the open forum, the public discussion, and I'd like to ask all of the speakers that joined us this morning to come on up to the table in the front here and I will also request that the audio and video technical staff at Iowa State University, I'm sure they, if they've not already they'll make sure that we're well calibrated here in terms of capturing this by audio and video. So the

six speakers come on up, just take a seat at the table.

Now, the online participants, there's a process that those individuals have been following to submit questions and comments and that process will still be in place. For those of you in person who have questions, we have a couple of mikes in the aisles between the seats, so those microphones will be live, as well as the table microphones will be live as well.

And I'm going to turn over the moderation of this part of the discussion to a gentleman from Iowa State University who you met this morning, but he neglected to talk a little bit about himself so I'll do that. Steven Devlin is going to moderate this part of our open forum discussion. Steve is an Industrial Specialist here at Iowa State University's CIRAS group, and CIRAS is the Center for Industrial Research and Service. Steve works with, as I mentioned, this

morning, a host of individual staff, professional staff, as well as graduate students here at Iowa State. And in his role as Industrial Specialist for BioPreferred, he leads our programmatic effort and activity along many of these technical veins, so Steve, kick it off for us, will you?

MR. DEVLIN: Thank you, Kate. Again, thanks everyone for coming in today. I really appreciate having all these high quality speakers. I'd like to just give a couple thank you's to the folks that work with us on this as well, ISU faculty and staff as well as some of our partners within the BioPreferred program, a number of individuals that aren't here today.

I've written down a number of questions myself but I don't really want to dominate the conversation. I'm going to go ahead and throw it up to Jessica back in the booth if we have any online questions at this point. Jessica, do you want to, okay, one

second.

FEMALE SPEAKER: Charles Patrick McShane asks, ASTM standards exist for the determination of the degree and the rate of biodegradation of bioplastic materials in an accelerated test environment. Are the determinations classified other than pass, fail, biodegradable? For example, some EPA biodegration test methods use classifications biodegradable, readily biodegradable, ultimate biodegradable.

MR. DEVLIN: Would anybody on the panel like to talk about ASTM biodegradability standards? Carl, do you want to say anything?

DR. MUSKA: Yes, I don't know exactly the answer to that question but the person that you do need to talk to is Dr. Ramani Narayan who heads that particular committee and he's a constant participant here, so I think we can make his address available to the questioner.

MR. DEVLIN: Yes, I know he did

make some presentations on that in our meeting in January in D.C. related to the biodegradability. Debra, did you have anything you wanted to say about it?

MS. DARBY: I think that Dr. Ramani Narayan is the expert and is the go to person for that question.

DR. MUSKA: Yes, the only thing I would say is that typically the tests that are done for, like the OECD tests are done for ready biodegradability, ultimate biodegradability, those are intended for a slightly different purpose in the studies that are done looking at the biodegradable properties of certain materials, so I don't think you want to mix and match those necessarily.

MR. DEVLIN: Okay, any other questions from there, Jess?

FEMALE SPEAKER: One person earlier asked about the toxicity of biobased plastics versus petroleum based plastics, and I wanted

to know if anybody would address that, how they compared in toxicity.

MR. DEVLIN: So the toxicity of biobased based plastics versus traditional plastics. Steve Davies, sure, from Nature Works. For the folks in the audience, this is an open forum so we want to, it's not just questions of our panel. It's also let's have an open discussion, so if you have comments, please.

MR. DAVIES: Steve Davies, Nature Works. I'm just commenting only from the perspective of what we make Ingeo polylactide completely safe in its intended use, so various grades designed for food contact have, are food contact qualified, so no issue there.

MS. DARBY: And Steve, thank you, this is Debra Darby with Mirel Bioplastics. It's the same with our bioplastic material. We go through standard testing and certifications for ecotoxicity and there is nothing harmful in any residue for either food

contact, soil or marine biodegradability in our material.

DR. MUSKA: Carl Muska, DuPont. I am a toxicologist it so happens. It's my background so I can actually speak with a little bit of authority over this. Toxicity is an inherent property of the material itself, so whether or not a polymer is biobased or petroleum based really should not be the question. It's really what is the toxicity associated with that particular material and the source there should not really come into play.

MR. DEVLIN: Okay, well, I have a question kind of once again for our commercial side folks. For the materials that you produce, what's the potential or what's the outlook for blended or compounded polymers? You hear some discussions about compounding biobased polymers with traditional polymers for improved performance or for different characteristics, I don't want to say improved

performance, but for different characteristics. Do you see that as a relatively large or a significant area that you're concerned with?

And then I've got some follow-ups depending on what you think about that in terms of how we as BioPreferred are supposed to evaluate those downstream products. Debra?

MS. DARBY: Well, Steve, as you said the term concern, and that's an interesting word to use, when you start to mix biobased with petroleum materials, you lose the biodegradability property and then also reduces the biobased content of the material.

MR. DEVLIN: Steve?

MR. DAVIES: Yes, Steve Davies with Nature Works again. So to your question, Steve, yes, we see huge potential outlook for blends of biobased and specifically our own Ingeo -- applications. Rina showed a nice slide, I don't know if the folks online could see it, but we saw a slew of applications like

Samsung cell phone, things like that, that are basically the biobased material is going after say an ABS polycarbonate application pretty demanding application. And I think the bottom line for us is the material has to work well and that type of durable application it's pretty irrelevant at the end of life. You don't want it to biodegrade. You want it to last for years and what people like Samsung are interested in is biobased content, where it comes from not where it goes, and that's why I think the BioPreferred is going to be a great fit in boosting that market.

MR. DEVLIN: Okay, Carl any thoughts?

DR. SUN: I have, yes I have thoughts

MR. DEVLIN: Okay, sorry Doctor.

DR. SUN: Yes, may I comment on that also?

MR. DEVLIN: Sure.

DR. SUN: I think the challenge

between the traditional petro based plastics and biobased plastics during compounding, and one thing is the thermal properties of the biobased plastics. They're different from the traditional. For example, polylactic acid has a melting temperature of about 170 degrees C, and then the sorona has a melting temperature about 210 degrees C. And also the viscosity at melt also is different depending on their structure.

And so then if you compare with polyethylene and from the traditional feedstock and polyethylene is like the viscosity is easier then the injection molding is easier. And so when the industry pick up a biobased plastics versus replace to there, and then they have to have a better idea about maybe dealing with thermal properties and also the viscosity issues and also their facility maybe need to be modified, and those type of things.

And also the biobased plastic

depending on their structure and they also have some challenges about the plasticizers to see if there is biobased plasticizers available rather than using the traditional plasticizers for the petro based plastics. And also the plasticizers other additives and also what about emission and doing thermal like microwave. If you have a product from a POA or PHA and you have a plasticizer there and then doing microwave heating or what is the emission or migration and during storage maybe those, the plastics also become emission and then the plastic itself lose its flexibility sometimes.

MR. DEVLIN: Dr. Shanks?

DR. SHANKS: Yes, I guess my concern a little bit with the discussion is that I think there's a false paradigm set up between bioplastics and plastics. I think there's an important role for new functionality that comes with polymers that are derived from biological sources that have

unique functionality and that's wonderful. But there's a tremendous market out there for existing polymers that can still be, biobased materials can still play a role in. And so I worry a little bit that there's a little bit of a false dichotomy set up that bioplastics means a completely unique material that is somehow competing against the existing one where there are clearly other materials where what you do is replace a portion of the polymer with a biological sourced material.

And so I think it would be very detrimental to the overall objective of trying to enhance the amount of biorenewable material in the chemical space, in the polymer space if we only look at materials that are uniquely functional with biomaterials. They have any important role, make no doubt, and it's great that they're coming, but I think we shouldn't just create this differentiation. I don't think that's simply, I think it's an oversimplification.

MR. DEVLIN: Okay, other thoughts? Okay, I'm going to kind of go down that line a little bit further from a standpoint of, oh Jeff, did you want to, Jeff Goodman has a comment or question.

MR. GOODMAN: Thank you, a question for any of the panel members. One of the things that I mentioned at the kick off to the meeting was that when we struggle with revising our program guidelines to include intermediates and feedstocks and the bringing into our program of the downstream products made from those, the Farm Bill language says that we should automatically include those downstream products if they have 50 percent content from intermediates and feedstocks are designated, or such other amount as our Secretary might deem appropriate. I'm sure some of you meant to talk about that, but neglected to in your presentations.

I was just wondering if the panelists have any thoughts about what that

number is. Is 50 percent a good number? Is there a better number? Should we consider a scheme where we had a sliding scale for different applications or classes of applications? I'd be very interested in the panelist's thoughts on that topic.

DR. SHANKS: I guess one thing I would throw out there as a possibility, we see a number of materials that are co-monomers between two different polymeric materials that aren't necessarily there at equal weight. One could envision another classification where it's more based on the moles of the material that goes in. So for example, if one of the monomers was biorenewable but the other wasn't, that would still potentially qualify. I think, I would like hear that one that would be at least considered, but I think that might be more appropriate than a simple weight basis if you're looking at the polymer.

DR. SUN: I think, yes, that's very good question about how much percentage is

considered as a biobased. I think we are still in the transition stage from petro based to biobased and it probably is kind of hard to make the petro based disappear because the functional performance issues. I think at this time we probably -- 50 percent is called biobased or ten percent is called biobased or 100 percent. It probably is kind of a diverse. I think some of the products on the market now can be used as 100 percent biobased and then some of those probably blended with the traditional products like 50 percent, 40 percent, replacement, that would be very good for now, or even for some of the functional polymers from biobased and it can be used as a ten percent or 20 percent, and so that's my comment on that.

DR. SINGH: So let me take a stab at it too, Jeff. I think when you're looking at bioproducts you'd look at, for example, a formulated product that goes into water treatment chemicals. It's a formulated

product. You're looking at the bio content in the finished formulation and there I could understand where the 50 percent bio content from the sources is coming from.

But when you start going down the intermediate pathway, I think the rules of the game, it's a game change where now you're kind of looking at, for example, if in a formulated product surfactants is used less than one weight percent it wouldn't qualify in the bioproducts. However, the surfactant made from 100 percent renewable stand alone in the intermediate space are to qualify. So there's going to be those qualifiers that need to be put in the language as we move forward if we're going down the intermediate chemicals space.

And I believe Brent just mentioned, when you look at a polymer in the intermediate space, for example classical UPR in saturated polyester resins, you can say, well, there's four or five different components that go in

making that resin and not all of those components are going to be biobased, but there's going to be an appreciable amount from a range of 20 to 50 weight percent. And the higher you can go obviously the better the, from a bioprogram it becomes. But that's one of the drivers in industry that people are moving forward.

So I think it's kind of a tricky question. It depends what you're kind of looking at from an intermediate space or end application, end user.

DR. SUN: Then one more thing we probably need to keep in mind is if you just use ten percent like from a biobased as a functional properties and then the product cannot be claimed as a biobased, because when you say biobased it means the percentage has to be higher enough than your, for example, ten percent is from biobased and then 90 percent is from petro based and then that new product is still labeled as a petro based and

then you have a biobased strengthening or functional polymers.

MR. DEVLIN: Dr. Ramaswamy?

DR. RAMASWAMY: Don't you think the problem will become simpler if you were to define the biobased based on the final product? Say for example the use of surfactant, the surfactant can be sold as a product and if it is purely biobased, then that will be a biobased product. If the surfactant is used in some other process where the product generated, or it is part of some other product where it is not fully biobased or meeting the minimum threshold then it should not be biobased.

So I'm wondering why do we need to, if the intermediate is sold as a product, then it can be classified as a biobased product. If the intermediate is used as an intermediate to derive something else, then the final definition of the final product is what should matter.

MR. DEVLIN: I think that is what the language is referring to is the percentage in the final product. Right now the language talks about 51 percent in the final product of the designated intermediate. But the question, I think was, that we wanted to focus on was is 51 percent a viable number or is there going to be some lower number or some different number. Jeff?

MR. GOODMAN: Trying to derive the intent of Congress is sometimes a challenging task and I'm not sure I want to be pinned down on it. But my opinion of the Congressional intent behind this provision in the 2008 Farm Bill is that, and Carl talked earlier about leveraging and I believe that this is the Congressional intent, that by designating some intermediates and feedstocks we would leverage the inclusion of finished products made from those intermediates and feedstocks in our federal procurement preference program. And so we would save the government the time and

effort of having to do a lot more one off end product designations, and so clearly when we designate the intermediates and feedstocks in and of themselves we're done with the intermediates and feedstocks.

But the fact of the matter is that the federal government is not a big purchaser of intermediates and feedstocks. It's a purchaser of finished products, and it's not even a big purchaser directly of finished products. It's more a purchaser of services involving those finished products like construction services or janitorial services or operations and maintenance services. So the question then is much more focused on the set point for the biobased content of the finished product rather than of the intermediate and feedstock itself.

I think, we'll go through an exercise, and I think one of the great benefits of the meeting this morning is I think the panelists have shined a light on

some of the complexities that we face in thinking about intermediates or classes of intermediates and should be rethinking about those as chemicals or fibers or different classes and different, and how we break these all out is going to be some very interesting work for us. And I think the panelists have shown some of the dimensions of that, but I was just focusing on that little particular part of the Farm Bill that talks about how we bring in the finished products sort of in a leveraged way.

MR. DEVLIN: Okay, we have a question from the audience. If you would, let us know who you are.

MS. CULKIN: Hi, Darcy Culkin with Ashland. I guess I have kind of a comment and then would appreciate the feedback of the panel or anyone else in the room. I recognize the difficulty and I think there needs to be some minimum for the intermediate feedstock, but 51 percent to me seems pretty high and I

just kind of want to describe my experience, or my company's experience and then just kind of get your feedback.

We make resins that go into composite parts. Rina gave some good examples of some of the things we make, so we make a partially biobased resin and we have, and it goes into, as an example, it goes into solid surface counter tops. And so Vendura has listed their product using our resin in the biobased database. But our resins are really only 20 to 30 percent biocontent and so we're still at that lower level. So actually even as an intermediate feedstock, I would say that we're an intermediate feedstock. We should be, we would like to be recognized as you expand this program but under the current proposed at 51 percent, we wouldn't qualify for that.

But then to go a step back further, and maybe Carl can comment on this as well, we incorporate DuPont's biobased Propanediol and

so that is 100 percent biobased, but we put it in at a level that maybe we can only achieve 20 percent. And so to me, I think the 51 percent is too low but I don't know how do you, and so we're going from like a monomer to an oligomer and then it goes to our customer who makes a counter top that's already qualified for your program. So at the levels that we're at we wouldn't qualify as an intermediate feedstock, but when we're, but as when we're put into a product somehow we've already qualified.

So I guess, how do you have different levels in your end use final program where you're designating products, and in that case you have a range but now in the intermediate feedstocks it seems like we want to set some set number which that number is higher than many of the, than the minimums for the categories that already exist. Does that make sense?

DR. MUSKA: It's perfectly clear.

MR. DEVLIN: Carl?

DR. MUSKA: No, I think we all struggle with that same question and I think you said it well. For me, I have to go back before you get into is it 50, is it 51, is it 20, is it whatever, I've got to go back to kind of thinking about what is Congressional intent here. The Congressional intent for me, and I wouldn't be so bold as to, like Jeff said, is to say what they had in mind, but it would seem to me as I remember there were three major tenets. One was decreasing dependency on petroleum, another one was rural development and I think the third was higher valid uses for agricultural products or something along those lines.

And so for me it's, the test is in bringing this material to the market, am I moving the bar relative to those objectives, okay. And so from my perspective I would, in terms of moving the bar I would much rather be putting a lower biobased content into a high

volume product where the pull through is magnified tremendously and that's part of the leveraging too, I think, Jeff, in looking at it a different way, versus having something that's a high biobased content but the market space is relatively small because it's all about moving agricultural product and feedstock. So the challenge is what guidelines and process do we need to put in place to achieve those objectives.

And then the other way of looking at it is if we put something in place and it's not achieving those objectives then we ought to be questioning whether or not that's the right way of going.

On the 51 percent question, Jeff, I think you're right. I think that's what the Congressional intent was. I think you could do that by certain classes of materials where the biobased material is like an ingredient in a formulation where there might not be as much range on performance, but at the end of the

day we have to have products that perform. So for those that are both based on stoichiometric determinations, well, 51 percent doesn't make any sense to me because it's not, that's not within the realm of the performance.

There is a provision in there that the Secretary can make changes, so there may be a group of products where if it has a certain amount of a biobased material that has already been designated biobased material, 51 percent or whatever, that may make sense. For others, it probably doesn't make sense and you're in the category of getting approval by the Secretary, I guess, is the other way of going. I think it almost has to be done by class of final product. Does that make sense?

And on the front end of it for us, you get the question of what is the right percentage for a biobased intermediate or material and I think the rule said 50 percent, is that what we, the proposed rule had 50

percent on the label, excuse me, on the label at 50 percent. And I clearly think that's too high. I really think that needs to be lower, again, for the reasons I mentioned which is to create the pull. My answer was probably no better than your question, but I tried.

MS. CULKIN: It’s a great point and that we're really trying to grow the market. You need to have good performance and you need to have -- if you have 20 percent of a big market or if you have material that's 20 percent you can then address a big market. Isn't that better than something that's 51 percent and really is only a small, is going to be a small market because I think you touched on it that the intent of the program for those things like energy independence and increasing procurement of that the pull through has got to be in a bigger market.

And so the composites market is three billion pounds a year or something like that. Do you want to for us that we would be

less inclined part of the program but we're kind of cut out of the program. We're a big market versus some smaller niche application that it might be you're able to achieve a 51 percent or higher biocontent but a smaller market.

DR. MUSKA: There is a kind of trade off, there volume tradeoffs. Are there some numbers that you can share with us or share with the BioPreferred program to kind of share with some of those examples of lower content but high volume --

MR. DEVLIN: Other comments along those questions?

DR. RAMASWAMY: One way to, I guess, approach this problem could be very difficult depending on which product what is right amount biobased to use promote the use, actually I was just thinking about ethanol in gasoline we have different standards for E10, E20, E85 etcetera, maybe there should be a B10, B20, B85 type designation for biobased so

that what is important maybe in a large volume market like such as gasoline, maybe B10 and B15 will make a big impact as it does. Maybe a B10, B15 in a large market might be a better way to go than it should be fully biobased. I know it's probably totally different than where the law is written the way it is right now. Maybe this is one way to drive the market so you use more bioresources. I think that's, the ultimate aim is not using a small product such as this -- water using small, large amount of biobased versus the whole world is using biobased resources.

MR. DEVLIN: Steve Davies?

MR. DAVIES: Yes, just a comment there. I like that idea and I think you know it as well, Steve, but that's exactly what Vincotte did in Europe. They've got a one, two, three, four star system which matches 20, 40, 60, 80 percent biobased, so it's not binary that you're biobased or you're not. There's no judgement call. You just say

what's in there like the ethanol example.

MR. DEVLIN: Okay, so maybe a combination of content level and market size, kind of a variable scale based on that.

DR. SINGH: No, just designate the product as B10, B15, B20, et cetera, so from the labeling of the product one can then market it and say this is a B50. Then the consumers would know, hey, this is majority biobased.

MR. DEVLIN: Dr. Shanks? Oh, sorry.

DR. SINGH: I was just going to comment, another analogy is the Leeds program where they have the gold star where you're a platinum, depending on what the percent content, your biocontent is, comes down to. So just building on that. I mean, those things do exist.

MR. DEVLIN: Dr. Shanks, do you have --

DR. SHANKS: Well, no I just

thought it was a very good idea because the challenge is this intent question, right, because certainly, and you have a group of different folks here and they have very different desires as to how that program works, right? For some, the identification of 100 percent bio is a tremendously important part of their marketing. If you then say that that's not an opportunity anymore because the market isn't large enough or your competitor gets to do ten percent because it's part of a larger market, that's going to inhibit some so this content really I think addresses that and allows for both the pull through intent of the amount, but then also for some differentiation on the amount that's biocontent

MR. DEVLIN: Okay, Jeff?

MR. GOODMAN: I wanted to just put this in a little bit of perspective because I don't want people to be thinking that this set point is kind of a onetime be-all end-all decision. This is a decision just for

bringing downstream products automatically into our program. It doesn't necessarily preclude or prohibit the USDA continuing to designate individual categories of end products.

And if you look at what we've done so far, we've adopted a range that runs, I think from, Steve help me, from seven percent up to virtually 100 percent. And so I think as we've done this category by category, I think we've made pretty good recognition of the fact that different uses, different volumes, different applications in order to preserve performance and other market factors would make for a wide range of those designations. And again, not wanting to guess what Congress necessarily meant, they may have picked that 50 percent point as a relatively high amount for this automatic consideration.

MR. DEVLIN: Okay. All right, I'm going to try to take us in a little bit of a different discussion. Nobody really touched

too much on it, but I'm wondering as we think about the designation of intermediate materials and feedstocks, should we be at all concerned or should we do any kind of an analysis or evaluation on the whole food versus, usually it's called food versus fuel but in our situation we're talking about food versus bioproducts.

Is there any responsibility on our part at BioPreferred in including that in our designation process or is that something that is going to wash out on its own?

DR. SINGH: So Steve, if I'm understanding your question are we saying that we'd open to enzymes that go into food? I guess I'm struggling with your --

MR. DEVLIN: I guess I'm looking at it more from a standpoint of there's a lot of negative press out there on the whole food versus fuel discussion and so when we talk about making plastics from corn starch or using proteins, we're in essence impacting the

food starvation quotient. And so is that something that we need to incorporate in our designation of intermediate materials?

In the past when we looked at end use products we did a life cycle analysis of that end use product. We can't really do a life cycle analysis on each of the end use products that the intermediate materials goes into. I'm just trying to get your feel on that.

DR. SINGH: Well, let me put an example out there for you. Citric acid, right, 100 percent biobased and it's basically washed out of the petrochemical processes to make it. So citric acid goes into food products and also goes into industrial applications so how would we rule on that? Is it in the BioPreferred or isn't it in the BioPreferred or is it in the end applications?

MR. DEVLIN: I guess you're saying it's coming out of the petroleum industry.

DR. SINGH: No, all citric now is

made from renewable.

MR. DEVLIN: My personal opinion is that we would consider citric acid as an intermediate material.

DR. SINGH: So end application independent of what the end application is for food versus --

MR. DEVLIN: That's my opinion. I'm just saying there are people out there that say how can you be using this corn kernel and making ethanol when there's somebody starving around the world. Again, I'm just trying to get a sense from you folks is this something that USDA should be considering when they talk about designation of these products or is it something that really doesn't impact that. Carl?

DR. MUSKA: Well, the food and fuel in biomaterials is a huge issue and it's currently under discussion. I certainly think that it's appropriate to acknowledge the issue, but I would not put that within the

BioPreferred program itself for a couple reasons. One is that right now the biobased products, because your particular program excludes food as an end use and fuel as an end use, and the actual amount of biobased food type materials going into biobased products is really very, very small at this present time. And so I would not suggest you get into that.

I certainly would not, at the same time I would suggest that you acknowledge that we are part of that industry and we are part of that debate. But I wouldn't make it part of your program. You really open up a can of worms.

I think as a side issue, there's another issue that
Rina was talking about which I had not thought about, and that is one of the questions for intermediates. And so you have something like citric acid which can go into food, but it can also go into biobased end products. And obviously if it's going in, well, I would

assume that if it's going into biobased, I mean if it's going into food that would be outside of your program. If it's going into a biobased product then it would be in your program, but that's an interesting way, that's administrative --

DR. SINGH: Yes, how do you police that, though, at the end of the day?

DR. MUSKA: That's an interesting question.

DR. SINGH: Lose sleep on that

MR. DEVLIN: Dr. Sun, did you have something?

DR. SUN: Yes, I think food versus fuel is a huge challenge because the fuel volume is huge and even if we use all of the plants and the food materials and convert it into fuels, that can only make up about 20 percent of the fuel consumption today. And so then the biobased, the polymers in the products and that is a small part of the fuels and based on the statistics I know it is the

plastics itself, I mean the monomer, polymer and the end products, composites, that is about eight percent of the petro based feedstocks. And so compared to fuel and biobased products is a small, yes, it's small. It's a high value.

So for energy per se and then DOE has their responsibility and utilizes some of the residuals from food chains and the processing for biofuels, and we can only consider the liquid fuels when we need it and I don't recommend use, burn all of the good polymers for fuels, for energies. So we can utilize the sun energies, the nuclear energies, the wind energies for many other energy uses and then it would save those good polymers for biobased products. And because all of the sun energy or solar energy, wind energy, nuclear energy, cannot be converted into polymers that we're talking about today.

MR. DEVLIN: Okay.

DR. RAMASWAMY: I'll agree with

Carl, and like even the food versus fuel is a huge debate. These do not include anything related to this in there, in the BioPreferred as it is for the designation. But certainly the federal government and local governments can encourage all manufacturers to comprehensively look at the environmental sustainability impacts. And I think that is upon all of us to try to do the best we can in trying to estimate what are the over arching impacts especially if they are large volume products.

DR. SUN: Yes, I think -- is not just for the resource limitations. We also have environment issues. That is, I mean people consider about food versus biobased products and you also need to think about, you have food but then 1,000 years later with the earth was buried by the plastics or something and so the environment and air qualities like -- emissions -- driving forces in the environment issues and resources both and so I

think we have plenty on the earth for food and animal feed and then we have enough left over for the biobased products.

MR. DEVLIN: Dr. Shanks?

DR. SHANKS: Actually, on the surface I want to answer this question like everyone else has is that this market is sufficiently small that it doesn't introduce that same problem that you have, food versus fuel. The unfortunate reality is if you take that extension then and say the intent of the Congressional mandate for the BioPreferred, you'd have to say, well, if that's the case, if it's so small then how does it impact the amount of crude oil that's imported and the amount of rural development.

So it's a bit of a sticky wicket actually because on one hand to argue that it doesn't really impact this food versus fuel debate, but then on the other hand it's supposed to diminish our reliance on oil, you end up arguing two mutually exclusive

positions. And so I think it's important to take a very careful look at how you want to enter into that debate. I think it's tremendously important.

DR. MUSKA: And that's, maybe I didn't do a very good job. Thank you for bringing that up. This is Carl Muska. I think that's why it's important that USDA acknowledge that that debate exists and it is an important debate. My concern was just within the implementation of the BioPreferred program that if you tried to somehow include that it would be another hurdle but you can't ignore that issue and as more and more, as this BioPreferred program is successful and we hope wildly successful, then it is going to become more and more part of the issue to your point. So I understand what you're saying.

MR. DEVLIN: Okay, I'm going to kick it back up to the booth and we have a couple questions coming in from online.

FEMALE SPEAKER: First question is

from Mark Savo corn is a very energy intensive crop. What efforts are being made to use more sustainable crops to derive IMS?

MR. DEVLIN: Oh, intermediate feed stocks. So what other alternative crops to the traditional corn crop, anybody want to have a statement on that? Go ahead, Debra. Oh, I'm sorry.

DR. SINGH: Well, the whole cellulosic, the whole feedstock on cellulose is extracting the sugars and the whole lignin from sorghum to different types of weeds that are out there, that there are other feedstock sources, that the technology is advancing or rather the acid extraction type is being replaced with enzymatic and so just like in biofuels where they're looking at second and third generation, we'd be looking, it's very fitting to look at those kinds of sources as opposed to corn.

MS. DARBY: This is Debra Darby. I'm with Metabolics. Our first product that

we're bringing to market, Mirel bioplastics, is made from corn sugar and we get that raw material, as I mentioned earlier, from our partnership with ADM. We're doing a lot with creating jobs in rural areas so this is a really great first product to bring to market.

Metabolics is also working on a second platform and that's creating our polymer in the leaves of non-food crops. So there is a lot more technology that will be coming out and this is just the start and there is an abundance of corn and corn sugar in this country and that's our initial feedstock for now.

DR. SUN: And I want to comment on that now. This is Susan Sun from Kansas State University. And like I said -- the monomers is the glucose and so the reason that we use the corn because it utilize the starch. And the starch is the -- of the glucose. It is easier to be digested and is fermentable into sugars and so I think at this transition stage

and then still use the corn.

And then for the cellulose, like the perennial grasses, the switch grasses or the corn stover or trees, those types of things, they're also made of sugars but then the sugars and so it's difficult to be fermented and so the sugar conversion efficiency is still low. And so once the technology is available in the converted cellulosic based sugars is more efficient or similar as converting the starch and so then all of those feedstock can be shifted into those feedstocks and I think USDA, NIFA, National Institute of Food and Agriculture just announced a program cooperative original project divided in seven regions and one is Central and focus on grasses and perennial grasses and like North Central oil seeds and South Central is sorghum or whatever and the trees in the East and the West and different things.

And so then they are looking for,

DOE, both DOE and USDA are looking for alternative non-food crops and don't use the food crops -- take care of the sustainability issues, I think.

MR. DEVLIN: Dr. Ramaswamy first.

DR. RAMASWAMY: Yes, just like biofuels. We were on the first generation biofuels. I think there ought to be effort on second generation bioproducts and third generation bioproducts to essentially to steer the focus towards non-food as a starting point.

MR. DEVLIN: Okay.

DR. SINGH: This is Rina Singh from BIO, and to not only looking at cellulosics but there are waste products out there, municipal waste. There are byproducts like glycerin. You've heard glycerin brought up and so all of those could also serve, and especially using synthetic biology and some technologies are being developed beyond just corn or food sources as feedstock.

MR. DEVLIN: Okay. Do we have any other questions from the, oh, hold on, Steve Davies.

MR. DAVIES: Yes, just I have one more comment. To the extent to which on the bioplastics front, whether it's Nature Works Metabolics or DuPont, to the extent to which we do rely on corn today, I think we're all, as you guys have said, actively working on next generation. This is simply step one in a journey for us.

But to, I think it was Ron on the phone making the point about energy intensity of corn, that point notwithstanding, I think looking to Carl and Debra to nod here, but we've all done ecoprofiles on a polymer that do take exactly that energy efficiency of the crop growing into account. And that notwithstanding, we do show a significantly reduced carbon footprint for the bioplastics we produced, so that energy used to grow the corn is indeed quantitatively taken into

effect when we do our calculation of LCA, so to speak, from field to factory gate. And so that is accurately reflected.

I make that point strongly because there's a lot of misperception in the market that we don't take into account what's going on with fertilizer, fuel to run the tractor and so on.

DR. MUSKA: This is Carl. Thanks, Steve, for making that point.

MR. DEVLIN: Okay, online question?

FEMALE SPEAKER: Yes, we have five more questions from online participants. The first one is from Debbie Davis. It was indicated that polyethylene was available from biosources. What is the relative availability of these resins in the market and are they functionally similar to petro based polyethylene in most applications and construction in particular?

MR. SHANKS: The answers are identical. Polyethylene is polyethylene. It

doesn't matter where the ethylene comes from. The challenge with polyethylene, and quite candidly the reason Dow made the joint venture, is it works economically in Brazil and only in Brazil currently, and there's a number of reasons.

First of all, it's sugar cane. Ethanol is much cheaper than corn ethanol. And on top of that because of the infrastructure that exists in Brazil, they don't have a lot of ethylene crackers there and so there's a unique combination of events that make polyethylene from ethanol in the current economic environment economically viable. But in the current economics there is no other place in the world where that economics work for that process currently, but it's the same polyethylene.

MR. DEVLIN: Okay, next question.

FEMALE SPEAKER: This question is from Sam Carchinko. How do we effectively communicate a value of having either a greener

resin or filler, et cetera, in our product to an end customer when that product may be virtually identical in terms of its overall performance, and when the greener portion of our product may not even be readily apparent to a customer for its verification to one manufacturer using a conventional process involving oil based materials especially when our customers ask to pay a premium?

MR. DEVLIN: So that kind of sounds like how do you sell the biopolyethylene when they can't tell the difference.

DR. RAMASWAMY: I think that's why either biolabeling or green labeling or sustainable labeling is the means by which the businesses can promote their products and why they are better.

MR. DEVLIN: Okay.

DR. SINGH: Rina Singh from BIO. One of the things you may want to also look at from a business perspective is look at the customer and what sort of sustainability

programs they have in place in order to, it becomes easier to sell than which you've got to do some homework as to what your customer is all about.

MR. DEVLIN: Okay, next online question?

FEMALE SPEAKER: Next question is from Alex Schroff. Would use of biobased sources and products get carbon offsets to producers?

MR. DEVLIN: Could you restate that question?

FEMALE SPEAKER: Would use of biobased sources and products get carbon offsets to producers?

MR. DEVLIN: I'm going to refer that question to Jeff.

MR. GOODMAN: I think the answer to that question depends on legislation that is yet to be passed. And if you thought I was reluctant to guess what Congress meant after they acted, you can perhaps infer how

reluctant I would be to guess how Congress is going to act before they've acted.

MR. DEVLIN: Yes, okay, next question.

FEMALE SPEAKER: This question is from someone named Ed. Ed asks, we use high density polyethylene for large -- blow molding. Polyethylenes are not the same between injected and blow injection grade and they will be very soupy if used on blow molding. Please confirm there is a blow molded grade of high density polyethylene.

MR. DEVLIN: Dr. Shanks?

MR. SHANKS: There's actually a whole range of polyethylenes and a lot of it has to do with there's some small amount of -- in it, so there's high density polyethylene, there's low density polyethylene and there's many, many different classes of polyethylene. So one has to get the right polyethylene for the right application, and there are slight modifications to that polymer that make those

small modifications.

But back to the biobased one, it's the monomer that's going in and the ethylene and so that doesn't impact the properties at all. It's irrelevant. The final polymer doesn't know. It's what you compound with the polyethylene, how you make the polyethylene that impacts the properties, not the source of the ethylene.

MR. DEVLIN: Okay, another online question?

FEMALE SPEAKER: We have one from John Giovanni. In your labeling program will the labels on biobased cleaning products require disclosing the name or source of plant materials they are made from? Our experience at Earth Well Tech, Incorporated is that the ingredients we use in our formulas only tell us that they are made with plant materials, but often the manufacturers of these biobased ingredients don't disclose the source materials because of proprietary reasons.

MR. DEVLIN: Okay. Jeff, I'm going to defer again.

MR. GOODMAN: Our proposed labeling rule does not require the identification of the source materials. I'm at this point uncertain of what our final program is going to involve. I'm relatively confident that it would not appear on label. Whether or not it might be, we talked earlier on about indirect information, whether it might appear on the website or not. I don't know. I tend to think not because as the questioner correctly notes in many cases the information is not available.

MR. DEVLIN: Okay, Kate Lewis?

MS. LEWIS: I'd request that the gentleman that asked the question follow-up with either Jeff or I personally because there are some processes in place, not at USDA but at the Environmental Protection Agency, regarding labeling and disclosure labeling initiatives for cleaners that are specifically

marketed as disinfectants. So long story short, I'd be very interested in providing a more sound and lengthy answer to John's question maybe at a later date.

MR. DEVLIN: Okay. Jess, next question.

FEMALE SPEAKER: I have one final one which is more of a comment. Mark -- says the bottom line is the ecological condition, not the financial bottom line that must be the future driver.

MR. DEVLIN: Okay, so that's a comment about ecology versus economy. Any questions or any comments from the panel?

DR. SUN: I want to comment on that. I think that is very good question. I think ecology is the more important than economy and like some of the biobased products available and then their performance may be good but then, I just give you one example.

For example, biobased adhesive and a cure needs four minutes to meet the

performance and then the formaldehyde based adhesive takes three minutes to cure, and then if you compare the final products and cured by four minutes and three minutes and then they are similar and in the biobased they may be superior, better than the formaldehyde based. And the industry won't pick the biobased because that's one minute longer the process time. That will reduce their productivity.

And so that is, I don't know how we're going to address on those type of things.

MR. DEVLIN: Okay.

MS. DARBY: I just have one last comment on that. It's great to have the environmental story and I'm a big proponent of that, but to have companies survive who are producing environmentally responsible products, they need to make a profit, they need to create jobs, so it is again that three legged stool of people profit for the planet. There needs to be an equilibrium.

MR. DEVLIN: Okay. I'm going to go ahead and move us along because I'm sure if we wanted to we could take the rest of the day with that conversation. I'm going to take it back to something that's a little bit closer to my interests just because of some of the work that we do for USDA.

When we talk about designation of end use products, we try to identify what are some relative or what are some common industry standards for performance of those products. So if we're talking about a biobased lubricant, we try to identify what are the industry standards that those lubricants are required to perform to. How are we going to evaluate intermediate materials for performance because I kind of see this, I see that as an opportunity where we might get into a situation where somebody sneaks an intermediate material in on us that doesn't perform and it may taint the overall program, the reputation of the overall program if we go

ahead and designate an intermediate material and somebody goes around promoting it.

So I guess what are your thoughts in terms of how can we establish industry standards performance-wise? Carl?

DR. MUSKA: Thanks, Steve. Well, I understand that there are probably more performance standards for some of the end products than there are the intermediates, but I would say you need to handle them both the same. I mean, you need, I think you're making the performance data available through your website, making it available to the procurement community. I think we need to do the same thing as an industry and partnership with the government, make that available to the downstream customers, if you will, of the intermediates.

You can get performance specs on PLA. You can get performance specs on Sorona and that type of information is available and certainly your organization can play a role in

helping us make it more available.

MR. DEVLIN: Okay, other thoughts? All right, then I'm going to kind of build off of Carl talking there.

In Carl's presentation he talked about the BioPreferred program focusing on building blocks versus the, what you might consider intermediates from the DOE study. And I'm just kind of interested in what are some of the thoughts from the rest of the panel about should we be focusing on where in that product chain, in that product development chain should we be focusing our designations? Should it be the product, the building block or should it be closer to the plant? When I say the plant, I mean the growing plant. Any thoughts on that?

DR. MUSKA: This is Carl Muska. From my perspective it probably depends on the particular supply chain you're talking about. I'm not sure there's one best vertical slice place for your concentration. I think, one of

the points I was trying to make is that there's a mapping process that happens when you're looking at those supply chains, and I think going through that mapping process it was going to be able to give you clues as to where is the key place where you can have the most influence from a labeling perspective. So it may not be exactly the same vertical slice for all supply chains.

MR. DEVLIN: Okay, Jeff?

MR. GOODMAN: One of the insights that I got from Carl's presentation is that if we think about that whole diagram that maybe we don't when we're all said and done, it may be that we'll have to go through several rounds of designations of intermediates and feedstocks in the same way that we did with final products. And it may be that in one round we'll think about that column closer towards the plant that we think of as the building blocks, the analogy to the petrochemical feedstocks. And maybe in

subsequent rounds we would go more towards the right hand side of the chart towards the intermediates.

Going out on a limb here with respect to Congressional intent when they said intermediates and feedstocks, I think I know what they meant with the, and so I think that we need not restrict ourselves to an either/or choice there. And I think we also need to think beyond just chemicals into the whole fibers area as some of the other presentations talked about.

So from my perspective this has been a very useful session in terms of broadening the horizons I'm thinking about with respect to the whole designation process.

MR. DEVLIN: Okay, Kate Lewis?

MS. LEWIS: Hi, yes, I just want to say I particularly appreciated that question, Steve, because that's really the fundamental reason or one of maybe two or three fundamental reasons why we're doing this

public meeting today. Jeff and I and the Program Manager, Ron Buckhalt are going to have to get back to the office and lay a plan and lay down a map for how to address this issue.

And again, I would just be really interested, I appreciated your answer, Carl, I would be really interested across the panel, at this stage there are no right or wrong answers. I would like to hear from each of you given your specific involvement in the industry, where do you think we should start? Where do we draw the line, how far upstream or downstream? And again, just really interested in your individual opinions on that.

DR. SINGH: This is Rina Singh from BIO, maybe I'll start. The last slide I had was, in order for this program to be all encompassing or all inclusive, the feedstock source, intermediates and end bioproducts should all be included. So from a labeling

perspective I strongly believe that whatever the percentages are or whatever the designation is, it needs to, it will be all one, all inclusive.

MR. DEVLIN: Carl, your thoughts?

DR. MUSKA: I'm going to give an administrative type answer instead of a technical one. As I remember the, and again, this is just off the cuff, but the label is a volunteer program, correct? So you will have people approaching you with wanting to qualify for the USDA label. Is that a fair assumption?

So in that regard I guess what I would be suggesting is that it might be useful for USDA to have some type of mapping process so as you get those requests in your tracking where those particular requests are in the value chain and collecting those and building your map, versus trying to sit down yourself and say where am I going to cut the slice and all that kind of stuff. It might be

administratively easier to do it that way, but if you set up a system at the beginning that allowed you to categorize and characterize those as they came in and sort of understanding that value chain, that could be a real useful tool for you and a lot of other people.

MR. DEVLIN: Debra, your thoughts?

MS. DARBY: Well, when it comes to the labeling, whether it be on the finished product that a consumer might be seeing in a retail environment or a federal procurement officer might be purchasing something, I think it's important to understand the amount of biobased contents. And then as Steve mentioned Vincotte has different classes of biobased labeling. Class 4 is anywhere from, don't quote me on this, but it might be from 80 percent up, and then I don't know what the other grades or I should say what the classes are. That's really important.

I think brand owners and consumers

would want to reach for biobased content and to make a conscience decision to buy higher biobased content than not. And to clearly have that choice is an important buying decision.

MR. DEVLIN: Dr. Ramaswamy?

DR. RAMASWAMY: I think the final product classification probably are the most important one because it gets in the hands of the customers who are buying the product, and that's going to drive how much the market is going to be, I guess, sought after. But classifying them with intermediate products, if it helps to promote the use of the resource I think it would be valuable to do so.

As I was preparing for this talk I looked at the intermediates and feedstocks and I was wondering, okay, in this old versus new biofiber used, how does this fit in. If I were to take a glass fiber reinforced composite and I'm going to substitute glass fiber with biofiber, I think that should be

considered for the BioPreferred because it is a biobased source which is substituting a petroleum based resource. So in that sense, I don't think we should distinguish between old versus new. It should be what are the biobased content and whether it is old or new. I think that way you're going to promote the use of bioresource altogether.

MR. DEVLIN: Okay, Dr. Sun, any thoughts?

DR. SUN: I think for the final product labeling like biobased, if you label as biobased then it has to be 50 percent and above. And then if you have 50 percent below, like ten or 20, and then probably say bio-containing and then give the number and how much percentage. So we probably still encourage the industry to use like lower than 50 percent because due to the performance issues and the cost issues, the processing facility limitation, and so at this stage they probably can only use ten or 20 percent. But

in the other way we encourage them and then in the other way we can leverage the biobased intermediate product's processing.

MR. DEVLIN: Okay, Dr. Shanks?

MR. SHANKS: Yes, well, I'm a little further removed than some up here, but I'll go back to the percentage. I think that's an important way because it strikes me one value of having intermediate qualified is for those that are going out to sell it, if it's prequalified then that simplifies that next user's use of that material, then that should help. So like if someone is making succinic acid, if they can already have the succinic preapproved and certified essentially, that could streamline the process for then the user of that intermediate to get qualified. It seems like to me that would be a valuable thing to do, but to do that I think you'd have to go to something like this percentage content for an intermediate.

But it strikes me if you want to

streamline the process that it's valuable to go after those intermediates and get them essentially preapproved to simply that rather than go to the myriads of thousands of end use products is the only way to do it.

MR. DEVLIN: Okay.

DR. SUN: I have another question about BioPreferred. For example, if you have a bottle of beer and then the glass and the beer its self as biobased and then the glass is not biobased, but then you have the label and the label is glued onto the glass that's biobased. So then the final product is just the beer and then how are you going to classify that? If the government preferred -- beer. I have no idea. It's multi components. And so the multi component put together as a final product.

MR. DEVLIN: That's a good question. Kate Lewis?

MS. LEWIS: As we finalize our label, Dr. Sun, we are paying particular

attention to the amount of clarity that is on the label as to if the label pertains to the product, the package, or both.

MR. DEVLIN: Okay, Jessica?

FEMALE SPEAKER: I really just have another comment. This is from John Baldis from the state of Wisconsin. He says the idea of labeling B10, B20, while still being able to utilize the BioPreferred label is a great way to reach next users.

MR. DEVLIN: Okay. Thank you, John, for that comment.

I've got a question I came up with thinking about in terms of looking at the development of these intermediate chemicals, intermediate materials and feedstocks, what's your vision or how do you see the industry developing? Is it going to be primarily the large established players that lead the way in terms of this industry development or is it going to be smaller ones?

You alluded a little bit earlier

about the domestic versus international. Obviously there's some questions about how the program works with materials coming from either from the United States or other countries around the world. What are your thoughts along those lines? Yes, Dr. Ramaswamy?

DR. RAMASWAMY: I think like the biofuels industry, it's going to depend on where the research is being conducted and how the companies can come off of the research. So when the research funding is available to a broad spectrum of folks, then I think it can actually generate from small companies because there is still a significant amount of research that needs to be done.

If the big companies are the ones who can afford to do research and take a long term look or view of this, then it will drive towards the bigger companies. So if the government can, I guess, facilitate providing research like the biofuels sector, this would

actually come out from small to medium companies as well.

MR. DEVLIN: Other thoughts?

DR. SINGH: Okay, so from BIO's perspective a lot of the companies that continue to have invested interests are all the start-up companies, and every time we turn around there are a handful of start-up companies. So I think more start-up companies are taking the lead here in the U.S. than the bigger ones. But at the same time you've got well established bigger companies helping the smaller ones.

One case example is Genencor just reached out to help Stratus so a lot of those partnerships are happening to drive the industry. And basically in the biotechnology industry the U.S. still has the leadership role in it, so a lot of the start-ups are taking full advantage of that.

MR. DEVLIN: Okay, any other thoughts?

DR. SUN: I also have some comment about the labeling. For example, not all of the biobased products is biodegradable or have an environmental impact. And so like for example ethylene if we produce polyethylene, that is a similar structure as the petro based polyethylene so that, so for that product it only free us, it reduce our dependency on the petroleum resources. And so then when we label that and we could probably label say this as the, derived from biobased or reduce or reliance on the petroleum based products.

And then for some, the POA and the PHA is biodegradable and we probably label as environmental or biodegradable or something. I don't know, we need to mention those or not.

MR. DEVLIN: Okay, any other thoughts from the panel today?

DR. SUN: Since that one is just confuse customers, I'm sorry, and if you don't label that and just say this is a bioderived polymers and then the public immediately think

about, oh, this is biodegradable or something with the environment. Is the polyethylene derived from a biobased ethanol and still not degradable and still stay on the earth and I don't know, and so we need to label those.

MR. DEVLIN: Okay, we have a question here from the audience.

MR. SHAW: Yes, my name is Bob Shaw. I'm with a company up in Minnesota called Bioplastic Solutions. We've been working for the last five years on developing a durable extruded profiles from PLA and we have reached a success point where we're now introducing two products into the market that are from basically Nature Works' PLA.

One comment about the big company versus small company, I think you're right. There's a lot of smaller companies that are doing application work whereas the bigger companies are doing research, the basic research and so forth, because a company like ours certainly doesn't have the money to play

around in that game.

My other question and sort of comment and not to put any of the folks from USDA or BioPreferred on the spot, my concern is that we're not going to try to solve all the world's social problems in a BioPreferred labeling program that will hold it up, because that label can be really important to us, to a smaller company that's trying to sell a product to a bigger company. Without going through all the problems of lead certification and all that stuff, some of those things are so difficult to meet that a lot of people just give up.

So one of the things that was mentioned earlier in one of these things is keep it simple, make it easy. I like the idea of European. Our products will qualify whether it's 51 percent, 30 percent or even a little higher because right now we're at carbon based content on a couple of them that are around 82 percent. So I think that that's

really what I'd like to see is move the labeling program along. Let's get it done.

MR. DEVLIN: Okay, thank you.

MR. GOODMAN: In response to that, I think if you look at our proposed regulation it is, I guess it would be arguable to what extent it's simple, but it is clear that it focuses just on biobased content, and that's what we're certifying. And while I don't know exactly what the final rule and the final program will look like, I do not believe that it will change radically from that concept of being focused on biobased content and I don't think we're going to be getting into issues of biodegradability or overall environmental impact either on the label or elsewhere as a criterion for issuing a label.

MR. DEVLIN: I'm going to go ahead and ask Kate Lewis to come up and give us our closing now.

MS. LEWIS: I just wanted to say thank you so very much for your travels and

your intelligence and your years of work and research in this space. Thank you for sharing that with USDA today and with our community of stakeholders that we've gathered here in person in Ames as well as online. We so very much appreciate your interest in both following the developments of the BioPreferred program to make sure that it's implemented as successfully and as logically as possible, but also more importantly contributing to those developments. So thank you very much to our six speakers that are here.

Just a couple of closing comments. I believe we got to all of the questions and comments that were submitted by our attendees. If we haven't there is an opportunity for you for at least, I believe, 30 or 60 days after this public meeting to get those on record. Again, where you can go to do that is our website, www.biopreferred.gov, and again, copies of all of the presentations today will be posted there, as will a list of attendees

both in person and online, as will the meeting transcript should you wish to follow and experience additional multi-hours of joy in the weeks and months to come by reviewing word for word of the meeting this morning.

With that, we'll close the public meeting for BioPreferred intermediate materials and feedstocks and I thank you all for your comments and presentation and attendance. Thank you.

(Whereupon, the meeting was adjourned at 1:02 p.m.)

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