A PATH TOWARD THE BROADER USE OF BIOFUELS: ENHANCING THE FEDERAL COMMITMENT TO RESEARCH AND DEVELOPMENT TO MEET THE GROWING NEED

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

FIRST SESSION

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A PATH TOWARD THE BROADER USE OF BIOFUELS: ENHANCING THE FEDERAL COMMITMENT TO RESEARCH AND DEVELOPMENT TO MEET THE GROWING NEED

THURSDAY, JUNE 14, 2007

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 2:30 p.m., in Room 2318 of the Rayburn House Office Building, Hon. Nick Lampson [Chairman of the Subcommittee] presiding.

BART GORDON, TENNESSEE
CHAIRMAN

RALPH M. HALL, TEXAS
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Subcommittee on Energy and Environment

Hearing on

"A path toward the broader use of Biofuels: Enhancing the federal commitment to research and development to meet the growing need"

Thursday, June 14, 2007
2:30 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

Witness List

Mr. Thomas Foust
Biofuels Research Director, National Renewable Energy Laboratory

Mr. John Berger
Chairman and CEO, Standard Renewable Energy and the CEO of BioSelect

Mr. Robert Dinneen
President, Renewable Fuels Association

Mr. David Waskow
International Policy Analyst Friends of the Earth, U.S

Mr. Michael J. McAdams
Executive Director, Advanced Biofuels Coalition

HEARING CHARTER

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

A Path Toward the Broader Use of Biofuels: Enhancing the Federal Commitment to Research and Development to Meet the Growing Need

THURSDAY, JUNE 14, 2007
2:30 P.M.—4:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

The House Committee on Science and Technology Subcommittee on Energy and Environment will hold a hearing entitled *"A Path Toward the Broader Use of Biofuels: Enhancing the Federal Commitment to Research and Development to Meet the Growing Need"* on June 14, 2007, at 2:30 p.m. in Room 2318, Rayburn House Office Building.

The purpose of this hearing is to examine the federal efforts on research, development and demonstration of technologies related to the production of biofuels, the development of biorefineries and demonstrations of those technologies. The hearing will further focus on legislative proposals to restructure and enhance the biofuels research and development programs of the Department of Energy and the Department of Agriculture under consideration in the House and Senate and how the provisions will help to enhance ongoing research in areas related to biofuels and promote a greater degree of coordination of research materials related to biofuels.

Background

High gasoline prices, a desire to reduce our dependence on foreign sources of energy, and concerns over climate change have greatly increased interest in bio-based fuels as an alternative to petroleum for transportation fuel. Over the last several years, in part as a result of the Renewable Fuel Standard included in the *Energy Policy Act of 2005,* the use of biofuels—most notably corn-based ethanol—has grown significantly. Ethanol is most commonly blended with gasoline at a level of 10 percent or less. And, this still only represents a small portion (less than five percent) of the total gasoline sold.

Recent proposals in Congress and by the Administration have called for significant increases in the use of biofuels over the next ten years. Currently biofuel supply relies almost exclusively on corn-based ethanol. Concerns have been raised about further expansion of corn-based ethanol to meet the targets set for biofuel production. Competition with food and feed supply, water and nutrient demand associated with corn production, and continued questions about the energy balance of corn-based ethanol production all suggest that biomass sources for biofuel production must be diversified The majority of this focus has been development of fuels from cellulosic materials including grasses, wood, and waste materials. However, current technologies for the development of fuel from these sources continue to be expensive and not cost-competitive with corn-based ethanol.

If we are going to move toward broader use of biofuels, technology will be necessary to create reasonably priced fuels from cellulosic materials. The *Agricultural Risk Protection Act of 2000* (Title III), the *Farm Security and Rural Investment Act of 2002,* and the *Energy Policy Act of 2005* created bioenergy research and development programs to focus federal research funding on the development of biofuels derived from cellulosic materials. This research is ongoing and operates under a Memorandum of Understanding between the Department of Energy and the Department of Agriculture.

Legislative Proposals/Discussion Draft

The Committee on Agriculture marked up a title on Energy at the end of May. Their proposal amends the Sections of the 2002 Farm Bill that authorize joint USDA and DOE research and development programs on biofuels and amends the *Biomass Research and Development Act of 2000,* the other primary authorization for joint DOE and USDA biomass research and development programs.

The Senate Energy and Natural Resources Committee reported energy legislation to amend and expand authorization for research and development programs on biofuels at the Department of Energy (S. 1419).

Earlier today, Subcommittee Chairman Lampson released a "Discussion Draft" of legislation entitled *The Biofuels Research and Development Enhancement Act.* The witnesses have been provided a copy of the draft and are being asked to include thoughts on the draft in their testimony. A copy of the draft and a section-by-section are attached. To quickly summarize, the draft would do the following:

- As it relates to Section 932 (Bioenergy Programs) of the *Energy Policy Act of 2005,* discussion draft does several things:
  1) Creates a new research component to focus on biofuels infrastructure.
  2) Creates a new research component to focus on energy efficiency in biorefinery facilities to reduce energy consumption in the development of biofuels.
  3) Increases the authorization levels for the Bioenergy program. Specifically:
     - FY08—$377 million
     - FY09—$398 million
     - FY10—$419 million
- Creates an "Information Center" at the Department of Energy to serve as a clearinghouse of information about biofuels research and development.
- Creates a grant program for states with low levels of biofuels production to work toward higher levels of production.
- The draft also conducts several studies:
  - Increasing consumption of mid-level (10–40 percent) ethanol-blended gasoline
  - Optimization of Flex Fuel Vehicles while running on E–85
  - Engine durability at differing blend levels of biodiesel.

Witnesses

Robert Dinneen, President, Renewable Fuels Association. RFA is a national trade association for the domestic ethanol industry. RFA's membership includes a broad cross-section of businesses, individuals and organizations dedicated to the expansion of the U.S. fuel ethanol industry. Mr. Dinneen has presented testimony before the Congress and federal agencies on numerous occasions, and represented the ethanol industry's interests at State, national and international forums.

Thomas Foust, Biofuels Research Director, National Renewable Energy Laboratory. The National Renewable Energy Laboratory is the Nation's primary laboratory for renewable energy research and development. The Biomass Program supports NREL R&D focused on biomass characterization, thermochemical and biochemical biomass conversion technologies, bio-based products development, and biomass process engineering and analysis. Dr. Foust manages these programs.

John Berger, Chairman and CEO, Standard Renewable Energy and the CEO of BioSelect. Standard Renewable Energy is a leader in renewable energy, serving commercial and residential customers with clean, renewable energy and energy efficiency technologies. BioSelect, a division of Standard Renewable Energy, is a developer and operator of biodiesel production facilities.

David Waskow, Friends of the Earth, U.S. Friends of the Earth, U.S. is part of a network of international groups in 70 countries. David Waskow is an international policy analyst and works on the environment, trade policy, and corporate accountability.

Michael J. McAdams, Executive Director, Advanced Biofuels Coalition. The Advanced Biofuels Coalition is a collection of companies who utilize advanced tech-

nologies or provide renewable-based feedstocks to produce renewable fuels—both biodiesel and gasoline compatible components.

Chairman LAMPSON. I would like to extend a warm welcome to all five of our witnesses. Thank you for being here today and for testifying before the Subcommittee on Energy and Environment on the subject of biofuels and more specifically on the status of our biofuels research and development, and what steps we can take to enhance the efforts toward better commercialization of new technologies. I still say our old technologies. We are just dusting them off and using them again.

I would like to make specific mention that we are joined today by Mr. John Berger, Chairman and CEO of Standard Renewable Energy. I recently joined Mr. Berger at the opening of his company's large scale biodiesel facility in Galveston, Texas, and I look forward to hearing more from him today about his experiences and continuing research and development challenges facing the industry.

For sometime now, it has been clear to me and many of my colleagues that our nation's energy needs can no longer be met with fossil fuels, fully met at least. Our reliance on fossil fuels, and more specifically foreign sources of energy, jeopardizes our economy, our foreign policy, our national security, and most importantly our environment.

The scale and complexity of addressing our energy and climate challenges cannot be overstated.

And though I believe that fossil fuels still remain an important part of any viable, balanced energy strategy, we must continue and in many cases enhance our efforts to develop alternative energy sources, namely biofuels.

All of the country ventures like Galveston Bay Biodiesel are emerging that demonstrate our country's strong commitment to producing reliable energy through the use of exciting and cutting-edge technologies. These projects are shining examples of the American innovative spirit.

Further, they demonstrate how a strong federal commitment to research and development can spur our economic growth and result in real solutions to our energy problems.

Though we have seen amazing growth in our country's biofuels development, mostly in the forms of corn-based ethanol and soy-based biodiesel, ethanol still represents only five percent of the total gasoline sold, and biodiesel is an even smaller portion of the total diesel market.

Currently, biofuel supply relies almost exclusively on corn-based ethanol. Surely, we wouldn't be where we are today without the efforts of those who pioneered the development of our ethanol industry. Recognition of these efforts to build the ethanol industry and make current supplies of ethanol available is well deserved.

However, concerns have been raised about further expansion of corn-based ethanol and its impact on food and feed supply and costs. And to meet some of the biofuels mandates that have been proposed, it would require nearly half of the current corn crop produced annually. Clearly this all suggests that biomass sources for biofuel production must be diversified.

The majority of this focus to diversify feedstocks has been on cellulosic materials including grasses, wood, and waste materials. However, current technologies for the development of fuel from

these sources continue to be expensive and not cost competitive with corn-based ethanol. If we are going to move toward broader use of biofuels, technology will be necessary to create reasonably-priced fuels from cellulosic materials.

To realize this needed "technological bump," we must increase our investment in research and development, focus our research on the most promising technologies, and ensure that the latest research information is readily available for those looking to either expand their biofuels production or embark upon the development of new facilities.

Earlier this week the Committee staff released a discussion draft of a bill that I will author and the Committee plans to consider in coming weeks. The draft attempts to better coordinate and compile information from federal biofuels research programs, focus some of the biofuels research on infrastructure needs and efficiency of biorefineries, study some of the continuing challenges facing broader use of biofuels, and increase the funding levels for biofuels research.

This draft will serve as a starting point to discuss what legislative efforts are needed to ensure that we maximize the federal funding spent on biofuels research and development. I am eager to hear from colleagues on the challenges that they see ahead and to, and I look forward to working with the Members of the Subcommittee as we move forward toward consideration of that bill.

It is my hope that our witnesses today will share with the Subcommittee their thoughts on the state of biofuels research and development, the technological challenges that we continue to face, the efforts underway to commercialize the new technologies for biofuels development, and what steps can be taken to ensure that there is strong continued federal support for biofuels research, development, and commercialization of technologies.

Their testimony will surely help guide us toward crafting sensible legislation that will help us realize the benefits of biofuels in years to come.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

I would like to extend a warm welcome to all five witnesses. Thank you for being here today and testifying before the Subcommittee on Energy and Environment on the subject of biofuels, and more specifically on the status of our biofuels research and development, and what steps we can take to enhance those efforts toward better commercialization of new technologies.

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It is my hope that our witnesses today will share with the Subcommittee their thoughts on the state of biofuels research and development, the technological challenges we continue to face, the efforts underway to commercialize new technologies for biofuels development, and what steps can be taken to ensure that there is strong continued federal support for biofuels research, development and commercialization of technologies.

Their testimony will surely help guide us toward crafting sensible legislation that will help us realize the benefits of biofuels in years to come.

Chairman LAMPSON. At this time I am pleased to recognize the distinguished Ranking Member from South Carolina, Mr. Bob Inglis, for his opening statement.

Mr. INGLIS. Thank you, Mr. Chairman. Appreciate the hearing this afternoon on how the Federal Government can encourage research and development of biofuels, a promising alternative energy source.

One of the great advantages of biofuels is the regional diversity of feedstocks. Different parts of the country can "customize" production based on their energy sources that make the most sense for their area. So while pines or sugar cane might make sense for ethanol production in South Carolina, the Chairman's State of Texas might benefit more from soybean or vegetable oils for biodiesel production. The advantage then is that every part of the Nation can

take part in developing biofuels that will make economic and agricultural sense and, in turn, will yield commercial benefits.

However, that versatility will also present a challenge when it comes to infrastructure development. While oil tankers and massive pipelines support our national gasoline industry and have the potential to support our biofuels industry, the regional availability of feedstocks may demand additional models for production and distribution. I hope that any biofuel legislation we discuss considers and accommodates this regional component.

We are only in the beginning phases of what I hope will be a very profitable biofuel energy economy, promoting energy security, protecting the environment, and creating jobs for American workers. It is important that we not only encourage current technologies and methods of production but also facilitate the development of next generation systems that will make biofuels even more efficient and affordable.

Thank you, again, Mr. Chairman, for holding this hearing. I look forward to hearing from our witnesses and welcome any suggestions they may have for how we can improve this proposed legislation.

[The prepared statement of Mr. Inglis follows:]

PREPARED STATEMENT OF REPRESENTATIVE BOB INGLIS

Good afternoon. Thank you, Mr. Chairman, for holding this hearing on how the Federal Government can encourage research and development of biofuels, a promising alternative energy source.

One of the great advantages of biofuels is the regional diversity of feedstocks. Different parts of the country can "customize" production based on the energy sources that make the most sense for their area. So, while pines or sugar cane might make sense for ethanol production in South Carolina, the Chairman's State of Texas might benefit more from soybean and vegetable oils for biodiesel production. The advantage then is that every part of the Nation can take part in developing biofuels that will make economic and agricultural sense, and, in turn, will yield commercial benefits.

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Thank you again, Mr. Chairman. I look forward to hearing from our witnesses, and welcome any suggestions they might have for how we can improve this proposed legislation.

Chairman LAMPSON. Thank you, Mr. Inglis. I ask unanimous consent that all additional opening statements submitted to the Subcommittee, submitted by Subcommittee Members be included in the record. Without objection it is so ordered.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Good afternoon. Mr. Chairman, thank you for calling today's hearing to receive testimony on the discussion draft of the *Biofuels Research and Development Act.*

I support expanded use of biofuels to diversify America's energy mix. With the passage of H.R. 6, the *Energy Policy Act of 2005,* a major milestone in the develop-

ment of a national market for renewable energy was achieved through a Renewable Fuels Standard (RFS). Further, the 2002 Farm bill has awarded $58.1 million in grants to 55 projects in 27 states and the District of Columbia under the Biomass Research and Development Initiative. Since the beginning of 2007, the Department of Energy (DOE) has announced nearly $1 billion in funding for biofuels R&D. On Tuesday, the U.S. Department of Agriculture (USDA) and the U.S. Department of Energy (DOE) announced a combined total of up to $18 million will be available for research and development of biomass-based products, biofuels, bioenergy and related processes. These grants will fund essential research leading to the creation of new, sustainable energy sources, in addition to creating new uses and markets for agricultural products. Through the passage of critical energy legislation, biofuels production has exploded and will jump from the roughly four billion gallons produced in 2005 to 12 billion gallons by the end of this year.

My home state of Illinois is already experiencing considerable growth in biofuels production. Currently in Illinois, there are 47 proposed ethanol plants, eight in my district alone. Of those 47 proposed plants, 19 have filed for air permits. Further, Illinois is operating four biodiesel facilities and three more are under construction. Illinois is perfectly located to build and operate ethanol and biodiesel facilities because of its access corn and soybean production and to transportation ranging from rail, barges, highways, and pipelines.

In addition to helping satisfy our nation's growing appetite for energy, biofuels can assist greatly in rural development. Each ethanol plant represents the investment of tens of millions of dollars into local economies, construction jobs and permanent employment opportunities, new markets for grain producers, and an expanded tax base for local governments.

While I support research into developing an efficient process for turning biomass into fuel, it is unclear why additional funding it is need to provide money to states with low rates of ethanol production, including low rates of production of cellulosic biomass ethanol, as stated in Section 6 of the discussion draft legislation.

I look forward to hearing from our witness panel on this issue.

Chairman LAMPSON. At this time I would like to introduce our distinguished panel of witnesses. Dr. Thomas Foust is the Biomass Technology Manager for the Department of Energy's National Renewable Energy Laboratory in Golden, Colorado. John Berger is the Founder of Contango Capital Management, a Venture Capital firm, focused on renewable energy and CEO of Standard Renewable Energy. Mr. Berger also served as an advisor to the Federal Energy Regulatory Commission in 2002 and 2003. Mr. Bob Dinneen is the President and CEO of the Renewable Fuels Association, the National Trade Association for the U.S. ethanol industry. Mr. David Waskow is an International Policy Analyst with Friends of the Earth, U.S., and works on environment trade and corporate accountability issues. And at this time I would yield to our distinguished Ranking Member of the Full Committee, Representative Hall, to introduce our final witness, Mr. Michael McAdams.

Mr. HALL. Thank you, Mr. Chairman, and I am honored to introduce Mike McAdams. He is presently Executive Director of Government Affairs of Hart Downstream Energy Services. He has been involved, he doesn't look old enough, I know, to say this, but he has been involved in every major federal energy and environmental initiative over the last 25 years.

I came here in 1981, and Mike, to the best of my recollection, was the very first employee that I had. I inherited him from Rayburn, Sam Rayburn's organization through Ray Roberts, who was the Congressman then at that time, and he actually took care of Ray Roberts' boat, and I had bought Ray Roberts' boat. It is a 52 footer. I was going to live on it until my wife told me that that wasn't going to happen. I asked him if he would stay on and work with me. I really wanted him to run the boat for me. He said, well, he did want to stay, but he believed he was worth more as an en-

ergy advisor, and I don't know, he was 19 or 20 years old then, something like that. He would be better as an energy advisor than he would as a boat boy, and he was a great energy advisor and has really done me great service since that time. In his current capacity he spearheads governmental advocacy efforts for Hart's clients including the Advanced Biofuels Coalition. Prior to joining the firm he spent 14 years with British Petroleum acting as Vice President of Federal Affairs and Environment and Associate Group Policy Advisor while there. Before joining BP, of course, Mr. McAdams served on staffs of several Members of Congress, and I was honored that he worked with me for a lot of years. He holds a B.A. in political science from Virginia Tech. I think he played quarterback for that football team. He has a J.D. from the Washington College of Law. His father was the first Governor's Rep as Texas was one of the early states to have a Washington office, and his father was the man for the Governor of Texas at that time and represented him here. He grew up on a Texas ranch, and was educated at Virginia Tech. He is a bright young man, good friend of mine. I am honored that he is going to testify before this committee.

I thank you, Mr. Chairman, my fellow Texan, for allowing me this long, extended introduction that Mike helped me write.

Chairman LAMPSON. I was going to ask. You didn't, I wasn't sure you knew all of that on your own.

Well, we are proud to have him and thank you for that introduction.

Mr. Inglis.

Mr. INGLIS. Mr. Chairman, speaking of Mr. McAdams, may I have unanimous consent to substitute two slides that were previously submitted that need to be replaced with two new slides in his presentation?

Chairman LAMPSON. Is there any objection? Seeing none, it is so ordered.

Okay. You will each have five minutes to present your spoken testimony. Your testimony, your written testimony will be included in the record for the hearing, and when all five of you have completed your testimony, we will begin with questions. Each Member will have five minutes to question the panel, and Dr. Foust, would you please begin?

STATEMENT OF DR. THOMAS D. FOUST, BIOMASS TECHNOLOGY MANAGER, NATIONAL RENEWABLE ENERGY LABORATORY

Dr. FOUST. Thank you, Mr. Chairman. Thank you for this opportunity to discuss important issues related to our nation's energy policies as we move to reduce our dependence on foreign oil, maintain a healthy environment, and fully meet the energy demands of the future.

I am the Biomass Research Director of the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL is the U.S. Department of Energy's primary laboratory for research and development of renewable energy as well as energy efficiency technologies.

Biomass, as you know, is very abundant in the U.S. and the production potential is quite large. One recent study estimated that

the U.S. has the potential to produce 1.3 billion tons of biomass annually without impacting food production. That amount of biomass converted to biofuels could potentially supply over 50 percent of our nation's fuel needs.

However, to use these and other resources we need to perfect new technologies that convert this material into fuels economically. Clearly this is an area that has great promise, but it must be done correctly.

Let me start with ethanol. To move the ethanol industry to where we need it to be we would have to move corn grain as a primary feedstock resource, and we have to move into biomass. Production of ethanol from corn grain is a well-established technology. It is a good technology, but corn grain is also an important food and feed commodity in the U.S., and most believe that we cannot produce more than about 12 to 15 billion gallons a year from corn without having significant impacts on the economics of other critical corn grain products.

Ethanol from plant biomass, or bioethanol as it is commonly referred to, promises to meet these ethanol capacity hurdles by utilizing feedstocks as biomass which are abundant and do not compete with other needs.

However, the technology is relatively immature and not yet competitive with corn ethanol or gasoline. At NREL our biofuels focus is almost entirely on advancing this bioethanol technology to enable competitively-priced ethanol from a variety of feedstocks. The current goal is to attain $1.31 production cost via 2012 via both a biochemical and a thermochemical route in order to make this bioethanol competitive with corn ethanol and, more importantly, gasoline.

Based on current and expected future progress we believe that there is significant growth potential for ethanol beyond the 2012, timeframe. Given the high-expected future demands for biofuels as a major component of our nation's fuel supply, we believe that bioethanol will not replace today's corn ethanol industry. Rather, it will evolve and grow from it, making the potential for ethanol encouraging from both an economic and large-volume perspective.

Now, let me switch gears and talk about diesel fuels, specifically biodiesel and renewable diesel, which can be made from either plant oils or animal fats, as well as biomass itself.

Biodiesel production is a currently commercial technology which takes oil or fatty feedstocks and converts them into a diesel fuel through a fairly straightforward process called transesterification.

Another process that shows a lot of promise for producing renewable diesel use is a process referred to, hydrogenation, to convert the same oil or fatty feedstock into a diesel fuel.

Although these processes are straightforward, the problem with these approaches is the general consensus that the production volumes can only ultimately reach two to four billion gallons a year because of the very limited ability to produce these feedstocks in the U.S. Approaches for producing renewable diesel at volumes capable of supplying a significant portion of our diesel demand will require technologies that can utilize more available feedstocks, specifically biomass.

Fortunately, two such approaches do exist. The first approach is biomass gasification, followed by a process called Fischer-Tropsch synthesis to produce a renewable diesel. Another longer-term approach is to develop an entirely new feedstock source for producing oils at large volumes. Algae shows considerable promise in this regard and is potentially capable of producing oils at rates up to 10,000 times soybeans.

Although this is very encouraging and should be pursued, this technology needs significant work before achieving commercial viability. Together these two approaches for producing renewable diesel, combined with the current biodiesel production show considerable promise for producing renewable diesel economically and large volumes, similar to ethanol.

Finally, let me address the need for biofuels infrastructure. Specifically the Department of Energy has sponsored studies on infrastructure needs for large-scale production and utilization of biofuels. These studies have specifically looked at two key components of infrastructure; distribution from the biorefinery to the refueling station, and then equally as important vehicle needs.

These results have shown that the current biofuel distribution infrastructure is inadequate to handle large volumes of biofuels. To reach our goals of producing these fuels at a significant scale of gasoline and diesel, these areas need to be addressed.

Additionally, the same issues hold for vehicles. Although current generation flex-fuel vehicles are capable of utilizing up to 85 percent ethanol, they suffer from significantly reduced fuel economy when utilizing the E–85 compared to conventional gasoline. Vehicles specifically developed to take advantage of the high octane and other desirable fuel properties of E–85 could potentially not suffer from this decreased fuel economy and allow us to utilize the ethanol more efficiently.

Thank you for the opportunity to address this committee on these important issues.

[The prepared statement of Dr. Foust follows:]

PREPARED STATEMENT OF THOMAS D. FOUST

Mr. Chairman, thank you for this opportunity to discuss important issues related to the Nation's energy policies as we move to reduce our dependence on foreign oil, maintain a healthy environment and fully meet the energy demands of the future. I am the Biomass Technology Manager of the National Renewable Energy Laboratory (NREL) in Golden, Colorado. NREL is the U.S. Department of Energy's primary laboratory for research and development of renewable energy and energy efficiency technologies. I am honored to be here, and to speak with you today.

We applaud the Committee for its examination of alternative transportation fuels to reduce our dependence on imported petroleum. Researchers at NREL have been working on biofuel technologies since our laboratory was founded in 1977. However, it only has been recently that public policy has looked to biofuels as a way to reduce our dependence on petroleum use in the near-term.

Recent studies have shown that there is sufficient biomass potential in the U.S., and worldwide, to produce significant amounts of transportation fuels without impacting food production—enough to displace a major portion of the petroleum we use today. Clearly, this is an area that has great promise; but it must be done correctly.

The Committee has asked what our nation's R&D focus should be in addressing the technical barriers to developing biofuels from diverse feedstocks. Let me address this question first.

Biomass: A Plentiful Resource

While much remains to be done, we as a nation start with some significant strength. The biomass resource in the country is huge, and the potential for it to grow is significant.

The Department of Agriculture and the Department of Energy looked at the question of whether the Nation's biomass resource could foster a biofuels industry large enough to meet a significant portion of our nation's future fuel needs. The report, now commonly referred to as "The Billion Ton Study," for the first time confirmed that the U.S. could yield more than a billion tons of biomass annually for energy needs. And, importantly, we could do this without negatively affecting the Nation's ongoing needs for food or fiber. This is significant because the 1.3 billion tons of biomass that was forecasted contains as much energy as 3.5 billion barrels of oil.

I should emphasize that such a transition to biofuels will not happen overnight. It will take a significant and sustained national effort to get us there. Still, "The Billion Ton Study" clearly demonstrates the biomass resource is real, and large enough to ultimately replace a large fraction of the petroleum-derived fuels we depend on today. DOE is in the midst of developing a vision for replacing 30 percent of current motor gasoline with ethanol by 2030 and this should help guide us in realizing the potential of biofuels.

Moreover, the resource is regionally diverse. We envision that every state in the Nation could produce biomass and could benefit economically from an expanding biofuels industry.

We also are encouraged by the fact that there already exists a strong and growing ethanol fuels industry in this country. The U.S. currently produces more than five billion gallons a year of ethanol, almost exclusively from corn grain, and the industry is growing 30 percent annually.

To understand where we are today and where we need to go, we need to see ethanol technology issues and biomass resource issues as interrelated. To move the ethanol industry to where we need it to be, we have to move beyond corn grain as the primary biomass resource. One of the most abundant potential resources we have is corn stover, the non-food parts of the corn plant, including the stalks, leaves and husks. Other resources are forest thinnings, hardy grasses like switchgrass, and fast growing trees.

To use these and other resources we need to perfect new technologies that convert the cellulosic materials of the plants into fuel.

Current and Future Biofuels

First, let's start with ethanol. Production of this alcohol fuel from the starches of corn grain is a well established technology, and accounts for almost all of the current 5.5 billion gallons per year (bgy) U.S. capacity. Additional plants that are planned or currently under construction are estimated to put our capacity close to 12 bgy within a couple years. The limiting factor is, of course, the feedstock itself—corn grain. It is an important food and feed commodity in the U.S., and most believe that we cannot produce more than 12–15 bgy of ethanol from corn grain without having significant, unacceptable impacts on the economics of the other critical corn grain products.

There are no other realistic starch or sugar-based crops in the U.S. from which to ferment alcohol in quantity. The Brazilians use sugar cane and in other parts of the world, sugar beets are used as a feedstock, but these sugar crops can probably never be widely grown in the U.S. because of climate differences. One or two bgy in the U.S. is possible from sugar crops in the next decade, but significant growth beyond this amount from this resource will likely never be a major factor for us.

Cellulosic ethanol promises to leap these ethanol capacity hurdles by utilizing feedstocks which are abundant and do not compete with other needs. However, the technology is relatively immature and we have little more than a few pilot plants on the ground. At the National Renewable Energy Laboratory, our biofuels focus is almost entirely on advancing the cellulosic ethanol technologies to enable competitively priced ethanol from a variety of feedstocks. The current goal is to attain a $1.31/gallon production cost by 2012 in order to make this ethanol pathway competitive with the corn grain pathway. However, to get the production ball rolling, DOE has recently awarded cost-shared contracts with industry to establish six cellulosic ethanol biorefineries which can each process approximately 700 tons/day of feedstock, each plant potentially producing 15–20 million gallons per year (mgy) of ethanol.

But, we still need to significantly improve the technology and reduce the costs for industry to begin major cellulosic biorefinery construction efforts. For that reason, our projections—even with significant incentives for the ethanol refiners and the feedstock growers—puts our national capacity at 2–5 bgy in 10 years. By 2022 or

2023, however, the cellulosic biorefinery construction rate will be on a steep upward slope, with a significant growth potential for cellulosic biofuels beyond 2017. This, then, is undoubtedly our most promising pathway to meet an aggressive national alternative fuels standard.

Integration of Biorefineries into Existing Industries: The R&D Role

Another exciting area of work is in the development of "biorefineries." Our scientists at NREL, together with those at other DOE national laboratories, universities and corporations, are leading the development of fully integrated refineries that use biomass, instead of petroleum, to produce fuels, chemicals, synthetic materials—virtually all of the products we use from a conventional oil refinery today. It is envisioned that biorefineries will utilize a complex array of processing technologies to break down, convert and recombine a wide range of biomass components into fuels and chemicals, in a manner similar to how petroleum refineries convert petroleum crude oil. We envision that future biorefineries will utilize a wealth of resources that we currently either underutilize or don't use at all today. That includes agricultural residues, forestry residues, dedicated energy crops, municipal solid waste, algae and byproducts of the food and grain industry.

A range of biorefinery R&D is underway in partnership with industry. DOE's biomass program is partnering with a number of the major ethanol technology providers and ethanol producers, including Abengoa, ADM, Broin and Cargill, to increase the yield of ethanol from existing corn ethanol facilities and expand the slate of feedstocks. In many ways, a cellulosic biorefinery can be viewed as an expansion of a corn ethanol facility. That's why we believe tomorrow's cellulosic ethanol industry will not replace today's corn grain ethanol industry, it will evolve from it.

At the same time, DOE is partnering with chemical industry leaders, such as DuPont, to develop new opportunities for producing both fuels and chemicals from biomass. DOE is partnering with the forest products industry to explore and develop biorefinery concepts that can integrate into existing forestry operations. And, most recently, NREL is partnering with oil industry technology developers to explore novel options for integrating biomass streams into existing petroleum refineries. These and other partnerships are speeding the progress of new technologies to the marketplace, and may uncover new options for producing fuels from biomass.

Thermal technologies such as gasification, pyrolysis and hydrothermal systems are all worthy of further research and development to determine how these technologies and the respective biofuel products impact the cost, efficiency and integration into existing fuels infrastructure.

Before we leave the alcohol fuels family, let me mention at least one other of these potential fuels—butanol. This higher alcohol has certain advantages over ethanol. In particular, its energy content is significantly higher than ethanol (but still not that of gasoline) and it is has fewer water miscibility challenges than ethanol. However, it is more difficult to ferment, and the economics and technology are well behind that of ethanol. You have probably heard that BP and DuPont are beginning a bio-butanol program in the United Kingdom. However, at least in the nearer-term in the U.S., butanol is not out of the starting gate and will assuredly be a minor contributor compared to ethanol. In addition, the challenges of establishing a fuel infrastructure for one new major fuel, and the vehicle and engine implications, are daunting enough. To throw a second alcohol fuel into that challenge, I would propose, is not a good decision or investment in terms of moving up the alternative fuel path as quickly as possible.

Biodiesel and Green Diesel Fuels

Diesel-like fuels—biodiesel and green (or renewable) diesel—can be made from plant oils or animal fats and greases as well as biomass itself. For biodiesel, the oil or fatty feedstock is chemically reacted with methanol in a process called transesterification, which splits the fuel portion of the feedstock from the non-fuel, glycerol co-product. This is a fairly straightforward process and the technology is proven and mature. Essentially this process is used to produce the entire non-petroleum diesel in the U.S. today. The problem is that our current capacity is only around 500 mgy, primarily due to feedstock limitations. If we would, for example, use every acre of the annual U.S. soybean crop to produce soy oil and then use that to make biodiesel, our capacity would be only around three bgy. Remember that on-road we burn 40 bgy in the U.S. today.

Green or renewable diesel is an emerging technology which uses the same oil or fats feedstock, but instead of the transesterification process, subjects the plant oils or fats to hydrotreating, as is done in the hydrocrackers of a petroleum refinery. The advantages are that we can potentially utilize existing refinery assets and not have to build new transesterification plants, and that the green diesel is essentially iden-

tical to petroleum diesel and does not require a unique or new fuel handling infrastructure, nor vehicle or engine modifications. Another process that shows considerable promise for producing renewable diesel is biomass gasification followed by Fischer tropsch synthesis to produce a renewable diesel. This process has considerable long-term promise since it utilizes biomass as a feedstock and is not subject to the feedstock limitations of plant oils or animal fats of the other processes. I will say that, from a technical standpoint, all of these pathways produce a diesel fuel which is not petroleum dependent and reduces CO_2 emissions.

Another longer-term approach for producing a renewable or green diesel that gets considerable press is to develop an entirely new feedstock source which has a higher gallons-of-oil-per-acre yield and can be produced on otherwise non-arable lands. Algae shows considerable promise in the long-term—beyond 2017. Whereas soybeans can only produce about 50 gallons of oil/acre, micro-algae might produce significantly higher yields on a per acre basis. Unfortunately, this technology needs significant work and will not contribute materially to the alternative fuels standards under discussion, but in the longer-term may be a dominant component of our alternative diesel and jet fuel markets.

Biofuels Infrastructure: Research Needs

The Committee has also asked the panel to address the need for research in the area of biofuels infrastructure.

DOE has sponsored studies that have examined infrastructure needs for large-scale production and utilization of biofuels (i.e., 20 bgy and greater). These studies have specifically looked at the two key components of the infrastructure; distribution of the biofuel from the biorefinery to the refueling station, and vehicle needs. The results have shown that the current biofuel distribution infrastructure is inadequate to handle large volumes of biofuels, thus an improved distribution infrastructure is needed.

Two options are available for accomplishing this; utilizing the existing gasoline and diesel distribution infrastructure for the distribution of biofuels, or developing a dedicated biofuels distribution infrastructure. Although utilization of the existing gasoline and diesel distribution infrastructure would theoretically facilitate a quicker, less costly approach toward addressing this issue, technical challenges exist—such as the miscibility of corrosiveness of ethanol. These challenges could be addressed by a dedicated infrastructure; however the triggering mechanism to drive investment in this dedicated infrastructure in not clear.

The vehicle issue is more easily addressed. Currently, all U.S. cars are capable of utilizing 10 percent ethanol and studies are underway to see if these vehicles can handle higher ethanol blends up to 20 percent. Flexible Fuel Vehicles (FFVs), in contrast, are capable of utilizing up to 85 percent ethanol. FFV sales are growing rapidly and this growth rate is expected to increase in the future. Current projections show that the vehicle infrastructure will be more than adequate to utilize all the ethanol being produced.

Fuel Fungibility

The Committee has asked whether standardization of biofuels, whether ethanol or biodiesel, is needed to ensure fuel fungibility, and whether the standard should focus on blended stock optimization.

When a fuel is produced, either fossil fuel or biofuel, it must meet standards established for its sale for it to be truly fungible. Ethanol and biodiesel already have fuel quality standards established through the American Society for Testing and Materials (ASTM). These standards have been created to partially match the current production methods from corn starch and vegetable oil respectively. They help to establish what will and will not be compatible with the gasoline to which they will be blended. If the predominant process for making ethanol changes (i.e., to lignocellulosic conversion from starch conversion), an ASTM committee will likely want to examine the "typical" fuel produced to determine if there are any minor components that could potentially be present that wouldn't be otherwise using today's technology, especially if they might be harmful to the engine performance.

The standard in question should also focus on gasoline blend stock optimization. For the example of E–10, the Reformulated Blendstock for Oxygenate Blending (RBOB) must have certain properties so that the blend does not exceed Reed Vapor Pressure (RVP) maximums. For E–85 there may be an opportunity for refiners to blend in low octane, high RVP gasoline materials and still comply with the overall specifications.

Workforce Requirements for Biofuels Technology Innovation

The Committee has asked the panel to comment on the need for trained personnel to form the biofuels workforce of the future. Others on the panel may comment on that, but let me address the topic from a research and development standpoint.

You are all aware that, in general, the U.S. is not producing the numbers of scientists and engineers that we need to stay at the forefront of global technology innovation. This is especially true in the energy field, as well as in the particular area of biofuels and bioenergy.

The National Renewable Energy Laboratory partners with many universities and colleges, and we bring their undergraduate and graduate students and their postdoctoral students to NREL to support our research and to influence them towards a career in this important field. But that is not enough. We need a concerted national effort to encourage and stimulate our young men and women to become energy scientists and engineers. Just as a national space goal dramatically grew the numbers of aeronautics and space scientists in the 1960's, we need to elevate our energy challenge to that level such that our young people acknowledge and respond to the call. There is, perhaps, no more important undertaking we face as we move into the 21st century—ensuring that we have skilled and motivated energy researchers to meet the Nation's challenges.

Making Biofuels Information Available to the Public

The Department of Energy's Office of Energy Efficiency and Renewable Energy is funding NREL in late FY07 to create an on-line Biomass Data Center, which will provide current, relevant data about ethanol and other biomass-derived fuels to support informed decisions by industry, policy-makers, researchers, and the public. The Data Center will be an extension of the widely recognized Alternative Fuels Data Center (*www.eere.energy.gov/afdc*) managed by NREL for DOE since 1991, which provides information about availability and utilization of biofuels and other alternative fuels.

The new Biomass Data Center will gather and provide centralized access to information on biofuels resources, production, and infrastructure issues, and will link to existing information from DOE and other agencies to minimize costs and duplication of effort. The project to develop the Biomass Data Center will begin in FY07, will proceed in phases, and will entail ongoing maintenance and enhancements in future years. The Data Center will provide easy access to information from both government and the private sector on feedstocks, production technologies and facilities, incentives and regulations, infrastructure and fuel retailing, and market opportunities.

Summary

Significant potential exists in the next decade and a half to reduce petroleum use in the transportation sector under an aggressive scenario for technology development and public policies to encourage deployment. The biofuels potential for a maximum petroleum reduction scenario in the next decade is large and, if fully realized, will position biofuels for accelerated growth beyond 2017, putting our nation on the path towards energy security with reduced CO_2 emissions.

BIOGRAPHY FOR THOMAS D. FOUST

Dr. Thomas Foust is the Research Director of the Biofuels Research Program at the National Renewable Energy Laboratory (NREL). In this role he guides and directs NREL's research efforts to develop biomass conversion technology to fuels via both biochemical and thermochemical conversion routes. This research is focused on developing the necessary science and technology for converting biomass to biofuels in an economical manner and covers the gamut of fundamental to applied. NREL is recognized as a world leader in developing biomass conversion technologies and has won many prestigious awards recognizing our accomplishments.

Dr. Foust recently led an effort as the lead author of a team of biomass experts to perform a detailed assessment of a scenario in which 30 percent of the United States demand for light vehicle transportation fuels are met by biofuels by 2030. This landmark study investigated all aspects of the supply chain from feedstock growth to vehicle needs and is in process of being published.

Dr. Foust's research has focused on complex fluid flow and heat and mass transfer processes it relates to fundamental biomass conversion issues for both biochemical and thermochemical processes. The focus of this research has been on identifying areas for process improvement that are heat and mass transfer limited. Prior to joining NREL, he spent seven years with the Idaho National Laboratory (INL) where he was the research lead for the biomass feedstocks program. His primary

area of research was in complex multi-phase flow analysis as it related to physical fractionation of biomass. Dr. Foust has over 20 years of research and research management experience specializing in biomass feedstocks and conversion research. He has over 100 publications in the biomass field covering all aspects of biofuels technology.

He has a Ph.D. in Mechanical Engineering from the University of Idaho, a M.S. in Mechanical Engineering from the Johns Hopkins University, and a B.S. in Mechanical Engineering from the Pennsylvania State University. He also is a licensed Professional Engineer.

Chairman LAMPSON. Thank you, Dr. Foust.

Mr. Berger.

STATEMENT OF MR. JOHN BERGER, PRESIDENT AND CEO, STANDARD RENEWABLE ENERGY; CEO OF BIOSELECT

Mr. BERGER. Chairman Lampson, Members of the Subcommittee, my name is John Berger, and I am President and CEO of Standard Renewable Energy. We are a global leader in renewable energy, serving commercial and residential customers with clean, renewable energy and energy efficiency technologies. Standard provides one-stop shopping for solar, wind, biofuels, hydrogen fuel cells, and energy conservation devices on a nationwide scale. We are headquartered in the global energy city of Houston, Texas.

BioSelect Fuels is a division of Standard Renewable Energy and is a developer and operator of biodiesel production facilities, offering the highest quality biodiesel fuel to the global marketplace. The initial BioSelect plant is located in Galveston, Texas, as the Chairman recently just pointed out in the introduction, and began operations the last few weeks in May of 2007. BioSelect Galveston currently produces over 20 million gallons annually; however, expansion is already underway to take the site to over 190 million gallons by the first quarter of 2009.

Mr. Chairman, I am pleased to be here to discuss the future of our nation's biodiesel industry and how the *Biofuels Research and Development Enhancement Act* can help our country achieve its energy security goals, protect our environment, and foster economic development through the expansion of renewable fuels.

America relies on imports for 60 percent of its petroleum needs. Rising crude oil prices and political uncertainties in strategically-sensitive regions of the world are focusing the public's attention on the need to enhance our nation's energy security. U.S. produced biodiesel expands domestic refining capacity. Every gallon of domestic, renewable biodiesel reduces the need for imported oil because it replaces diesel fuel refined from imported crude oil.

The biodiesel industry is made up of small businesses and has shown steady growth over the last 15 years. In 2006, the industry produced 250 million gallons of biodiesel. Today there are 142 plants in operation with more than 50 new plants under construction or expansion, which will add an estimated new capacity of 1.7 billion gallons. The industry is on track to create at least 40,000 new jobs and add 24 billion at least to the U.S. economy.

Biodiesel is and will continue to be a strong partner in the growth of the biofuels industry and can be a substantial tool in the Nation's overall move towards energy security as it: directly replaces crude oil that is imported to produce diesel fuel, opens up much needed U.S. refining capacity, decreased greenhouse gas

emissions, contributes to cleaner burning diesel fuel, and creates jobs and stimulates rural and urban economies.

Standard applauds the Subcommittee for its comprehensive approach to policies that will lead to increased education and exchange of information on research, development, and demonstration of technologies related to the production of biofuels, the development of biorefineries and the demonstration of these technologies. The Subcommittee's Discussion Draft emphasizes the importance of active research, communication, and development of a solid infrastructure towards building a strong biodiesel industry.

Our industry is witnessing a period of dramatic change in how Americans create and consume energy. The overlapping public concerns of national security, increased domestic energy independence, global climate change, and rural economic development have led to dramatically increased production of renewable fuels.

BioSelect believes it is imperative for the biodiesel industry to secure a targeted fuel standard that sets an ambitious, yet achievable goal for the future production of biodiesel in this country. Standards should be designed to support existing biodiesel capacity and be progressive to encourage continued capacity growth. A biodiesel standard will aid to ensure short-term growth and long-term development of a sustainable domestic biodiesel market. We are confident that a federal biodiesel fuel standard that seeks to displace five percent of current domestic diesel consumption within the decade should be a principle policy objective for current legislative action. Such a goal will stimulate the demand for soybean oil and other oils, will help spur the development of new domestically-produced feedstocks, will promote the development of production facilities in all regions of the country, and will encourage automakers to increase production of diesel-powered passenger cars for the U.S. car market.

BioSelect Fuels provides safe and superior renewable energy to consumers in a clean and efficient manner. We are led by a seasoned team and supported by strong partnerships with companies such as Chevron Corporation and highly-regarded academic institutions like Texas A&M University. The future of biofuels, however, and the means by which to create a viable source is highly dependent on the continuous innovation, research and development in both private and public sectors.

Support for longer-term clean energy goals will come by focusing on and funding a portfolio of research, development, and commercialization activities. Standard would like to see Congress focus on solving technical problems to overcome barriers to biofuels growth, including infrastructure, through forgoing or forging strategic cost-shared partnerships with private industry, collaboration among relevant federal agencies, and working with partnerships in the different regions of the country to bring the promise of biofuels to fruition. In addition, we believe that the next generation of feedstocks and production technologies should receive particular attention as they are the foundation of the future of the biofuel industry.

With feedstocks accounting for approximately 60 to 80 percent of the entire cost to produce biodiesel, BioSelect and our allied entities are focused on moving away from traditional edible oils and existing arable land currently used for the cultivation of food crops

such as corn and soybeans. Together, with the Engineering and Agricultural expertise of our partners at Texas A&M, we are actively pursuing the development of biofuel specific crops and lesser-known seeds that can be grown in arid lands that currently lie in idle in regions of West Texas. Specific areas of research that would benefit our industry include harvesting techniques for new feedstocks where manual labor costs are problematic and on longer-term feedstock envelopment projects such as oil-rich strain of algae and other new sources that have been long recognized as abundant possible feedstock sources for biodiesel.

Several barriers exist before existing biofuels can be realized from these diverse new feedstocks, but there is a lot of work enabled to be done including looking at how to, you know, form these arid lands.

I think I have—have I run out of time?

Chairman LAMPSON. You have.

Mr. BERGER. Okay.

[The prepared statement of Mr. Berger follows:]

PREPARED STATEMENT OF JOHN BERGER

Good morning, Chairman Lampson and Members of the Subcommittee. My name is John Berger and I am President and CEO of Standard Renewable Energy, ("Standard"). We are a global leader in renewable energy, serving commercial and residential customers with clean, renewable energy and energy efficiency technologies. Standard provides one-stop shopping for solar, wind, biofuels, hydrogen fuel cells and energy conservation devices on a nationwide scale. We are headquartered in Houston, Texas.

BioSelect Fuels is a division of Standard Renewable Energy and is a developer and operator of biodiesel production facilities, offering the highest quality biodiesel fuel to the global marketplace. The initial BioSelect plant is located on Galveston Island, Texas, and began operations in May 2007. BioSelect Galveston currently produces 20M gallons annually; however expansion is already underway to take the site to over 190M gallons by the first quarter of 2009.

Mr. Chairman, I am pleased to be here to discuss the future of our nation's biodiesel industry and how the "Biofuels Research and Development Enhancement Act" can help our country achieve its energy security goals, protect our environment and foster economic development through the expansion of renewable fuels.

Background

America relies on imports for 60 percent of its petroleum needs. Rising crude oil prices and political uncertainties in strategically sensitive regions of the world are focusing the public's attention on the need to enhance our nation's energy security. U.S. produced biodiesel expands domestic refining capacity. Every gallon of domestic, renewable biodiesel reduces the need for imported oil because it replaces diesel fuel refined from imported crude.

The biodiesel industry is made up of small businesses and has shown steady growth over the last 15 years. In 2006, the industry produced 250 million gallons of biodiesel. Today, there are 142 plants in operation with more than 50 new plants under construction or expansion, which will add an estimated new capacity of 1.7 billion gallons. The industry is on track to create at least 40,000 new jobs and add $24 billion to the U.S. economy.

Biodiesel is and will continue to be a strong partner in the growth of the biofuels industry and can be a substantial tool in the Nation's overall move toward energy security as it:

- Directly replaces crude oil that is imported to produce diesel fuel;
- Opens up much needed U.S. "refining" capacity;
- Decreases greenhouse gas emissions;
- Contributes to cleaner burning diesel fuel; and
- Creates jobs and stimulates rural and urban economies.

Standard applauds the Subcommittee for its comprehensive approach to policies that will lead to increased education and exchange of information on research, de-

velopment and demonstration of technologies related to the production of biofuels, the development of biorefineries and demonstrations of those technologies. The Subcommittee's Discussion Draft emphasizes the importance of active research, communication and development of a solid infrastructure toward building a strong biodiesel industry.

Our industry is witnessing a period of dramatic change in how Americans create and consume energy. The overlapping public concerns of national security, increased domestic energy independence, global climate change and rural economic development have led to the need to dramatically increase domestic production of renewable fuels.

BioSelect believes that it is imperative for the biodiesel industry to secure a targeted fuel standard that sets an ambitious, yet achievable, goal for the future production of biodiesel in this country. Standards should be designed to support existing biodiesel capacity and be progressive to encourage continued capacity growth. A biodiesel standard will aid to ensure short-term growth and long-term development of a sustainable domestic biodiesel market .We are confident that a federal Biodiesel Fuel Standard (BFS) that seeks to displace five percent of current domestic diesel consumption within the decade should be a principal policy objective for current legislative action. Such a goal will stimulate the demand for soybean oil and other oils, will help spur the development of new domestically produced feedstocks, will promote the development of production facilities in all regions of the country, and will encourage automakers to increase production of diesel-powered passenger cars for the U.S. market.

Biofuel feedstock research

BioSelect Fuels provides safe and superior renewable energy to consumers in a clean and efficient manner. We are led by a seasoned team and supported by strong partnerships with companies such as Chevron Corporation, and highly regarded academic institutions like Texas A&M University. The future of biofuels however, and the means by which to create a viable fuel source, is highly dependent on the continuous innovation, research and development in both private and public sectors.

Support for longer-term clean energy goals will come by focusing on and funding a portfolio of research, development, and commercialization activities. Standard would like to see Congress focus on solving technical problems to overcome barriers to biofuels growth, including infrastructure, through forging strategic cost-shared partnerships with private industry, collaboration among relevant federal agencies, and working with the different regions of our country to bring the promise of biofuels to fruition. In addition, we believe that next generation feedstocks and production technologies should receive particular attention as they are the foundation of the future of the biofuel industry.

With feedstocks accounting for approximately 60 to 80 percent of the entire cost to produce biodiesel, BioSelect and our allied entities are focused on moving away from traditional edible oil feedstocks and existing arable land currently used for the cultivation of food crops like corn and soybeans. Together with the Engineering and Agricultural expertise of our partners at Texas A&M, we are actively pursuing the development of biofuel specific crops and lesser known seeds that can be grown in arid lands that are currently idle in regions such as West Texas. Specific areas of research that would benefit our industry include harvesting techniques for new feedstocks where manual labor costs are problematic and on longer-term feedstock development projects such as oil-rich strains of algae which have long been recognized as a potentially abundant source of feedstock for biodiesel production.

Several barriers exist before realizing biofuels from diverse feedstocks, including but not limited to; access to more exotic seed crops, laboratory and equipment availability, open land and amenable farmers, length of time to conduct research and development and overall cost of implementation.

Information and data sharing

Although the public market is becoming more aware of biodiesel as a fuel, additional education is still necessary for business leaders to invest capital and advocate for future biodiesel production facilities and distribution infrastructure. A great deal of ambiguity exists in the renewable fuel marketplace today due to the fact that there is very little concrete factual data assigned to specific individual fuels; i.e., ethanol, biodiesel and renewable diesel.

Although we as an industry are diligently working towards uniform testing and standardized fuel criteria, federal monitoring could help avoid inconsistencies. To date, uncertainty in the industry, negatively impacted biodiesel sales and the integration of biodiesel fuel strategies in public and private fleets, and inhibited progress towards meeting national renewable fuel goals.

The EPA is currently developing a complete emissions profile for biodiesel. As leaders in the renewable energy sector however, we ask that the Federal Government do more with the creation of a centralized database benchmarking and comparing all renewable fuels independently to a baseline conventional diesel fuel. We as an industry will benefit tremendously from factual data which compares biodiesel to conventional diesel. In addition, we believe it would be useful to have a scientific and factual description of renewable diesel and a comparison of biodiesel to renewable diesel and a comparison of renewable diesel to conventional diesel.

Federal coordination and cataloging of information from federal research on biofuels development processes as well as other aspects of the industry and related industries will be essential to the longer-term goal of creating mainstream renewable fuel. Demystifying the fuels themselves will not only provide the general public with more information and confidence about utilizing renewables but also assist both federal and State bodies in defining credit structures, future industry incentives, and other programs to promote renewable fuels.

Research in Infrastructure

Standard Renewable Energy's mission is to make it easy to use renewable energy, and for BioSelect, infrastructure is essential. We have located our first facility in the refining center of the United States because we believe in the logistical and distribution advantages that come along with our regional location. Our vision for BioSelect fuel is that of a low concentration blend of quality biodiesel into conventional fuel to be distributed on a nationwide scale. In support of this goal, Standard would like to see a number of infrastructure activities pursued on a federal level, most likely through coordinated work from government agencies such as Department of Energy, the Department of Transportation, the Federal Regulatory Energy Commission, and the Environmental Protection Agency. Our primary focus at this time is the continued research and development of low blend biodiesel pipeline batch movements. Successful pipeline analysis testing has already been done, on several different pipelines, on several different occasions, yet we as an industry ought to be more involved in the process. BioSelect is eager to assist with this exciting project and offer assistance to the Committee and relevant federal agencies to advance this type of necessary testing. Additional specific research needs currently facing the industry include but are not limited to: feasibility studies on tankage, pipe and pump options, cold flow properties, water issues, stability testing of fuel samples and advanced vehicle technologies. In addition, we believe there is a clear need for an overall general economic study of capital requirements to bring biodiesel to local retail pumps nationwide.

The goal of this extensive research is to produce the data necessary to gain the acceptance and approval from environmental agencies, engine manufacturers, public and private sectors and most importantly develop consumer confidence from the refinery to the retail level where you and I buy our fuel each day.

Standardization

Standardization of all biofuels, is imperative to ensure fungibility into conventional fuel pool and towards longer-term acceptance as mainstream fuel. Biodiesel producers and marketers are primarily concerned with two American Society for Testing and Materials Standards (ASTM) International standards, ASTM D–975, which covers diesel fuels and may soon include biodiesel blends up to B5, and ASTM D–6751, which sets the minimum standards for B100.

Implementation of these standards and continued growth of the industry requires top engineers, the same individuals that we must compete against high paying large Oil and Gas companies to recruit. In our Galveston facility we have been fortunate to find strong talent that were instrumental in taking us from construction to start-up but we are already finding more difficulty in identifying qualified workers for our expansion. BioSelect views market stability, and targeted education and outreach about biodiesel as keys to attracting good talent.

As the biodiesel industry develops, the demand for highly skilled trained labor is on the rise. Industry professionals have observed that safety concerns have been raised when smaller start-up plants have shortcuts out of ignorance or to cut time and cost. In October 2006, the National Renewable Energy Laboratory (NREL) released a report showing that out of 32 biodiesel samples collected nationally, half failed to meet ASTM quality requirements. BioSelect believes that each and every U.S. biodiesel manufacturer is responsible for knowing what can go wrong in their manufacturing processes and how that can lead to impurities in the finished product. As a large-scale producer however, we at BioSelect know that compliance costs money, and we have focused substantial time, energy and a great deal of capital on the implementation of first-class safety and quality assurance on all aspects of

our facility, from the people all the way through the process. In addition to the training of operators and other industry personnel, BioSelect enforces compliance with our own codes and have an internal team that act as a forum for exchanging safety suggestions, violations, remediation and investigative reports, as exists in the chemical industry. With over 300 years of experience in the petrochemical and refining industries, BioSelect knows that a unified approach to train workers while also adopting best safety practices is nothing more than being on par with similar industries. This process has prepared both our facility and operators to meet the industry standards set forth by ASTM. BioSelect is currently in the process of obtaining our BQ9000 certification from the National Biodiesel Accreditation Commission (NBAC.)

According to the National Biodiesel Board, there are currently 17 accredited biodiesel producers and six certified biodiesel marketers, which account for 40 percent of the biodiesel production capacity in the United States. In addition, half of the states in the country have implemented the ASTM D–6751 specification as part of their fuel quality regulations, and an additional 13 states are either planning to accept the specification or studying it. Ten states now proactively test biodiesel or biodiesel-blended fuels.

Conclusion

Thank you for the opportunity to speak with you today and for your continued commitment to expand the use of renewable fuels. Promoting innovation and proactive leadership to create new energy sources, like the added domestic refining capacity at BioSelect Galveston, is critical to meet the growing energy demand of the future and in securing our nation's energy security. Standard Renewable Energy looks forward to working with you to further develop this important legislation.

BIOGRAPHY FOR JOHN BERGER

Four years ago, at a time of extremely low energy prices, Mr. Berger foresaw the looming global shortage of traditional energy sources and knew that the country would inevitably be forced to turn to renewable sources of energy to serve our vast energy needs. Given his background in the traditional energy sector, he recognized that the way to turn renewable energy into a successful enterprise was to build an integrated platform that could readily be built to scale. As a result, he created Standard Renewable Energy.

Prior to Standard, Mr. Berger founded Contango Capital Management, a venture capital firm focused on renewable energy. In addition to Standard, Berger is currently Chairman of Trulite Inc, a portable fuel cell company that is majority-owned by Standard. He has more than eleven years of experience in the energy industry.

In 2002 and 2003, Mr. Berger served as an advisor to the Federal Energy Regulatory Commission (FERC) on distributed generation, demand response, information gathering and application issues, investigations and trade clearing/credit issues in the North American energy markets.

Mr. Berger graduated *cum laude* from Texas A&M University with a BS in Civil Engineering and earned an MBA from Harvard Business School.

Chairman LAMPSON. And we will get back with you and you can put some more of that stuff in, and certainly you can submit all of your written testimony for the record.

Mr. BERGER. Thank you, Chairman Lampson.

Chairman LAMPSON. You are welcome, Mr. Berger, and Mr. Dinneen.

STATEMENT OF MR. ROBERT DINNEEN, PRESIDENT AND CEO, RENEWABLE FUELS ASSOCIATION

Mr. DINNEEN. Good afternoon, Mr. Chairman and Members of the Committee. Thank you for the privilege of being here again today.

I want to thank you for the opportunity to discuss the growth in the domestic ethanol industry, the increasingly important role of continued research and development for our nation's biofuels industry, and the Committee's Discussion Draft legislation, the Biofuels Research and Development Enhancement Act.

The ethanol industry today is on the cutting edge of technology, pursuing new processes, new energy sources, and new feedstocks that will make tomorrow's ethanol industry unrecognizable from today's. Ethanol companies are already utilizing cold start fermentation, corn fractionation, and corn oil extraction. Companies are pursuing more sustainable energy sources, including biomass gasification and methane digesters. And there is not an ethanol company that I represent that doesn't have a very aggressive cellulose-to-ethanol research program underway.

The Science and Technology Committee, the Energy and Environment Subcommittee in particular, can play an important role in accelerating these efforts by promoting and targeting research and development funds and resources appropriately. Support through research and development to promote the commercialization of cellulosic ethanol and to continue to build upon the existing industry's advancements in technologies will be critical to the future growth of the biofuels industry.

The Discussion Draft clearly reflects a concerted effort to identify the research needs that must be addressed to facilitate the rapid expansion of domestically-produced renewable fuels such as ethanol, bio-butanol, and biodiesel. It recognizes that challenges remain, not just in biofuel production, but in developing biofuel markets as well. The Committee is to be commended for its commitment to meeting the challenge of imported energy, recognizing the potential benefits of biofuels, and motivating the research community through this bill to provide a pathway that will provide a more stable and sustainable energy future for all Americans. The RFA supports this effort but would offer the following suggestions to enhance the bill's effectiveness, particularly given the unfortunate budgetary constraints this effort will likely face.

With respect to the Biofuels and Biorefinery Information Center, if the center is intended just to be a clearing house for technical and commercial information about biofuels development, I would suggest that there may already be federal and private resources for that mission. If you envision the Center's role to coordinate multiple, and at times conflicting, federal research efforts on renewable energy, it could well serve a very useful purpose in streamlining federal efforts.

Clearly, many of the concerns raised in the Discussion Draft as issues with the transportation and storage of biofuels do not apply to ethanol when used as a blend component in today's gasoline. Other biofuels that do not have the record of successful use and experience that ethanol enjoys will certainly want to evaluate their physical and chemical properties and how they will fare in the transportation network.

And as ethanol moves beyond just being a blend component in gasoline and into E–85 markets where far more than today's ethanol is being used, there will be other transportation issues that will likely arise as well.

These analyses should be focused on the physical transport of the products and provisions requiring an access of environmental impacts should rightfully be left to the U.S. Environmental Protection Agency.

The RFA supports the Draft Bill's Biofuels Grant Program, and we would recommend expanding funding in this area if at all possible. As Dr. Foust mentioned earlier, we need to move beyond grain and the production of ethanol. The industry is working hard to do so, but more work clearly needs to be done. Federal efforts to help that would be very, very useful.

The RFA also strongly supports amending Section 932 of the *Energy Policy Act of 2005,* to create a biorefinery energy efficiency program. This will be particularly important as State and federal fuel policy gravitates towards a carbon matrix for fuel policy.

With respect to higher levels of ethanol blends, EPA has already largely defined the scope of the analysis necessary to approve such new fuels for commercial use. EPA's testing needs are focused on the drivability, durability, materials compatibility, and emissions of these blends. The study envisioned in the draft bill goes beyond what EPA would require to approve new fuels, creating a new and higher standard for ethanol fuel blends than other fuels that may enter the market soon. The RFA would suggest, therefore, that the bill track EPA protocols for a review of higher ethanol blends and provide sufficient funding to expedite such a test.

Mr. Chairman, increasing America's energy and national security by reducing our dependence on foreign oil and continuing to expand domestic renewable fuels is among the most important challenges facing our country today. We at the RFA look forward to working with you and this Congress to develop the appropriate federal policies that will help us achieve those goals.

Thank you.

[The prepared statement of Mr. Dinneen follows:]

PREPARED STATEMENT OF ROBERT DINNEEN

Good afternoon, Mr. Chairman and Members of the Subcommittee. My name is Bob Dinneen and I am President of the Renewable Fuels Association (RFA), the national trade association representing the U.S. ethanol industry.

This is an important and timely hearing, and I am pleased to be here to discuss the growth in the domestic ethanol industry, the increasingly important role of continued research and development for our nation's biofuels industry, and the Committee's Discussion Draft legislation, the "Biofuels Research and Development Enhancement Act."

The ethanol industry today is on the cutting edge of technology, pursuing new processes, new energy sources and new feedstocks that will make tomorrow's ethanol industry unrecognizable from today's. Ethanol companies are already utilizing cold starch fermentation, corn fractionation, and corn oil extraction. Companies are pursuing more sustainable energy sources, including biomass gasification and methane digesters. And there is not an ethanol company represented by the RFA that does not have a cellulose-to-ethanol research program.

The Science and Technology Committee, the Energy and Environment Subcommittee in particular, can play an important role in accelerating these efforts by promoting and targeting research and development funds and resources appropriately. Support through research and development to promote the commercialization of cellulosic ethanol and to continue to build upon the existing industry's advancements in technologies will be critical to the future growth of the biofuels industry.

Background

Today's ethanol industry consists of 120 biorefineries located in 19 different states with the capacity to process 2.2 billion bushels of grain into 6.2 billion gallons of high octane, clean burning motor fuel, and more than 12 million metric tons of livestock and poultry feed. It is a dynamic and growing industry that is revitalizing rural America, reducing emissions in our nation's cities, and lowering our dependence on imported petroleum.

Ethanol has become an essential component of the U.S. motor fuel market. Today, ethanol is blended in 50 percent of the Nation's fuel, and is sold virtually from coast to coast and border to border. The almost five billion gallons of ethanol produced and sold in the U.S. last year contributed significantly to the Nation's economic, environmental and energy security. According to an analysis completed for the RFA[1], the approximately five billion gallons of ethanol produced in 2006 resulted in the following impacts:

- Added $41.9 billion to gross output;
- Created 163,034 jobs in all sectors of the economy;
- Increased economic activity and new jobs from ethanol increased household income by $6.7 billion, money that flows directly into consumers' pockets;
- Contributed $2.7 billion of tax revenue for the Federal Government and $2.2 billion for State and local governments; and,
- Reduced oil imports by 206 million barrels of oil, valued at $11.2 billion.

There are currently 77 biorefineries under construction. With eight existing biorefineries expanding, the industry expects more than 6.4 billion gallons of new production capacity to be in operation by the end of 2009.

Biofuels Research and Development Enhancement

The Discussion Draft clearly reflects a concerted effort to identify the research needs that must be addressed to facilitate the rapid expansion of domestically produced renewable fuels such as ethanol, bio-butanol and biodiesel. It recognizes that challenges remain, not just in biofuels production, but in developing biofuels markets as well. The Committee is to be commended for its commitment to meeting the challenge of imported energy, recognizing the potential of biofuels, and motivating the research community, through this bill, to provide a pathway that will provide a more stable and sustainable energy future for all Americans. The RFA supports this effort, but would offer the following suggestions to enhance the bill's effectiveness, particularly given the unfortunate budgetary constraints this effort will likely face.

Section 1—Biofuels and Biorefinery Information Center

While we certainly agree Biorefinery Information needs to be more widely available, we believe this function is more appropriately met by private industry, and that limited federal dollars can be better utilized in other areas. Trade associations and industry-led promotion councils have traditionally fulfilled the role of clearinghouses for information related to the research and development, and the commercialization and deployment of technologies. Certainly, with respect to ethanol, numerous organizations offer information related to the technology, financing, permitting and construction of ethanol plants.[2] In addition, careful consideration should be given as to how to best coordinate and consolidate the work already being done by various federal agencies on biofuels research and development before creating additional layers of bureaucracy. The RFA recommends a thorough review by the Secretary of Energy of the existing public and private resources before determining the need for a new information center.

Section 2—Biofuels and Advanced Biofuels Infrastructure

The U.S. transportation fuel market has been blending ethanol into our fuel supply for more than 30 years. Ethanol is now blended in 50 percent of gasoline nationwide. Indeed, over the past several years the ethanol industry has worked to expand a "Virtual Pipeline" through aggressive use of the rail system, barge and truck traffic. As a result, we can move product quickly to those areas where it is needed. Many ethanol plants have the capability to load unit trains of ethanol for shipment to ethanol terminals in key markets. Unit trains are quickly becoming the norm, not the exception, which was not the case just a few years ago. Railroad companies are working with our industry to develop infrastructure to meet future demand for ethanol. The biofuels industry is working closely with terminal operators and refiners to identify ethanol storage facilities and install blending equipment. We will continue to grow the necessary infrastructure to make sure that in any market we need

[1] *Contribution of the Ethanol Industry to the Economy of the United States,* Dr. John Urbanchuk, Director, LECG, LLC, December, 2006.

[2] For example, BBI International publishes an *"Ethanol Development Handbook"* that has proven to be an invaluable resource to companies and individuals looking to invest in ethanol production technology.

to ship ethanol there is rail access at gasoline terminals, and that those terminals are able to take unit trains.

Clearly, many of the concerns raised in the Discussion Draft as issues with the transportation and storage of biofuels do not apply to ethanol when used as a blend component in today's gasoline. Other biofuels that do not have the record of successful use and experience that ethanol enjoys will certainly want to evaluate their physical and chemical properties and how they will fair in the transportation network, however. These analyses should be focused on the physical transport of the products and provisions requiring an assessment of environmental impacts should rightfully be left to the U.S. Environmental Protection Agency if necessary and appropriate.

With respect to ethanol, the most significant infrastructure-related research and development need to advance cellulose and other bioenergy feedstocks for biofuels production is on improved collection, storage and handling systems for those feedstocks. The RFA would encourage the Committee to expand this provision to include research, development and demonstration of the transportation and distribution needs of the emerging cellulosic ethanol industry.

Section 4—Bioresearch Centers for Systems Biology Program

As mentioned previously, there is, and will be for the foreseeable future, limited available funding, so an increase in the number of Bioresearch Centers to 11 from the *Energy Policy Act of 2005*'s three is unnecessary. Perhaps five Bioresearch Centers—one for every Petroleum Administration for Defense Districts—would be more appropriate. There is already a great amount of regionally-focused research being conducted at universities, federal laboratories and other public and private institutions nationwide. Increasing the pool of research entities that would compete for limited funds may further dilute efforts to commercialize and deploy these new and emerging technologies.

Section 5—Grants for Biofuels Production Research and Development in Certain States

The RFA strongly supports the Draft bill's biofuels grant program, and we would recommend expanding funding in this area if at all possible. A wide variety of energy crops and agricultural waste products such as switchgrass, myscanthis, wood chips and corn stover from many regions of the country must all be researched, developed and commercialized as additional ethanol feedstocks to realize the annual production levels envisioned in the many proposals already introduced by this Congress. New biorefineries are being built in new regions of the country everyday—the East Coast, the Gulf Coast, the Pacific Northwest and even Hawaii. Grant programs that promote geographical dispersion, such as those included in the Discussion Draft, will help to commercialize cellulosic ethanol quickly and continue the trend just beginning to expand ethanol production beyond the traditional corn belt.

Section 6—Biorefinery Energy Efficiency

The RFA also strongly supports amending Section 932 of the *Energy Policy Act of 2005* to create a Biorefinery Energy Efficiency program. This will be particularly important as State and federal fuels policy gravitates toward a carbon matrix for compliance. Opportunities for both grain and cellulosic ethanol production will be enhanced by technologies that allow biorefineries to decrease energy costs by diversifying energy sources. Advances in research on the development of processes to produce alternative energy at biorefineries such as biomass co-generation and biomass gasification, and methane production through anaerobic digestors, will be critical to increase energy efficiency and reduce the energy consumption of biorefineries.

Section 7—Study of Higher Levels of Ethanol Blends

Ethanol today is largely a blend component with gasoline, adding octane, displacing toxics and helping refiners meet *Clean Air Act* specifications. But the time when ethanol will saturate the blend market is on the horizon, and the industry is looking forward to new market opportunities. As rapidly as ethanol production is expanding, it is possible the industry will saturate the existing blend market before a meaningful E–85 market develops. In such a case, it would be most beneficial to allow refiners to blend ethanol in greater volumes, e.g., 15 percent. The ethanol industry today is engaged in testing of higher blend levels of ethanol, beyond E–10. There is evidence to suggest that today's vehicle fleet could use higher blends. An initial round of testing is underway, but more test programs will be needed. It should be noted, however, that EPA has already largely defined the scope of the analysis necessary to approve such new fuels for commercial use. EPA's testing needs are focused on the drive-ability, durability, materials compatibility and emissions. The study envisioned in the Draft bill goes beyond what EPA would require

to approve new fuels, creating a new and higher standard for ethanol fuel blends than for other fuels that may soon enter the market. The RFA would suggest, therefore, that the bill track EPA protocols for a review of higher level ethanol blends and provide sufficient funding to expedite such a test.

Higher blend levels would have a significant positive impact on the U.S. ethanol market, without needing to install new fuel pumps and wait for a vehicle fleet to turn over in the next few decades. It would also allow for a smoother transition to E–85 by growing the infrastructure more steadily.

Section 8—Study of Optimization of Flexible Fuel Vehicles

As flexible fuel vehicle (FFV) production is ramped up, it is important to encourage the use of the most efficient technologies. Some FFVs today experience a reduction in mileage when ethanol is used because of the differences in BTU content compared to gasoline. But the debit can be easily addressed through continued research and development. For example, General Motors has introduced a turbo-charged SAAB that experiences no reduction in fuel efficiency when E–85 is used. There is also technology being developed that utilizes "variable compression ratio engines" that would adjust the compression ratio depending on the fuel used. Thus, if the car's computer system recognized E–85 was being used, it would adjust the compression ratio to take full advantage of ethanol's properties. The RFA supports the further study of how best to optimize technologies of alternative fueled vehicles to use E–85 fuel as included in the Discussion Draft. The study of new technologies could dramatically improve E–85 economics by eliminating or substantially reducing the mileage penalty associated with existing FFV technology.

Conclusion

Increasing America's energy and national security by reducing our dependence on foreign oil and continuing to expand our domestic renewable fuels industry is among the most important challenges facing our country. We look forward to working with you in the 110th Congress to develop the appropriate federal policies that will achieve those goals.

Thank you.

BIOGRAPH FOR ROBERT DINNEEN

Bob Dinneen is the President and CEO of the Renewable Fuels Association (RFA), the national trade association for the U.S. ethanol industry. As such, he is the ethanol industry's lead lobbyist before the Congress and Administration.

Mr. Dinneen joined the RFA in 1988 as Legislative Director, and became President in July of 2001. In this capacity he has led the Association's effort to build coalitions with the industry's petroleum customers as well as transportation and environmental groups in order to provide for marketplace growth for the industry. These coalitions have resulted in an historic Renewable Fuels Standard (RFS) fuels agreement and passage of the Volumetric Ethanol Excise Tax Credit (VEETC).

Mr. Dinneen has presented testimony before the Congress and federal agencies on numerous occasions, and represented the ethanol industry's interests at State, national and international forums.

Prior to joining the RFA, Mr. Dinneen worked on Capitol Hill for various Members of Congress and Congressional committees. Mr. Dinneen graduated from the Catholic University of America with a Bachelor's Degree in Political Science.

Chairman LAMPSON. Thank you, Dr. Dinneen, Mr. Dinneen.

Mr. McAdams.

STATEMENT OF MR. MICHAEL J. MCADAMS, EXECUTIVE DIRECTOR, ADVANCED BIOFUELS COALITION

Mr. MCADAMS. Thank you, Mr. Chairman. Chairman Lampson, Ranking Member Inglis, Members of the Committee, my name is Michael McAdams. I serve as Executive Director of Hart Energy Government Affairs Group. I am testifying on behalf of the Advanced Biofuels Coalition.

It is a great privilege and responsibility to appear before you today and to share how the members of the Advanced Biofuels Coalition are contributing to meeting our energy and environmental

goals. I am delighted to join such a distinguished panel, some of whom I have worked with for years in the area of fuels policy.

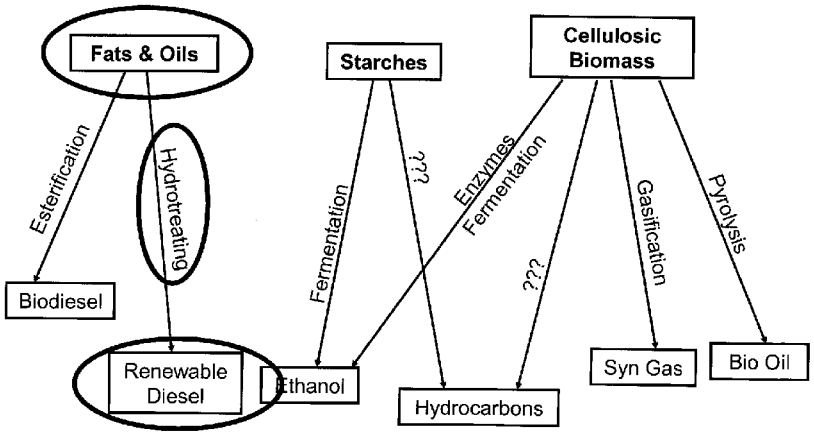
The Advanced Biofuels Coalition is a group of companies whose second and third generation technologies hold great promise. The companies, working with the Federal Government, have the potential to provide the American public with abundant values, volumes of high-quality, no-compromise renewable fuels. The fundamental objective of the coalition is to educate policy-makers on the ability of these technologies to deliver significant volumes of lower carbon fuels today and in the near future. For these companies to be able to achieve this goal they need your support in adopting policies at the federal level which are technology and feedstock neutral.

We applaud your efforts to provide a path to broaden the use of advanced biofuels. The legislation before us today we believe can make a significant contribution to America's fuels marketplace. Our members recognize the tremendous contribution and the path traveled which first generation fuels have already made and will play in the future of this effort. But we believe that the future of energy policy will require contributions from many sources. As one Governmental official recently suggested, this is a matter of "silver buckshot, not a silver bullet."

Members of the coalition have reviewed your legislation and agree that many of the provisions would be helpful in moving the marketplace forward. Specifically, we are most interested in your section regarding infrastructure and would encourage that you consider the benefits that second-generation fuels would have in terms of reducing the overall infrastructure costs to the country and to consumers.

If a picture is worth a thousand words, then with the remaining portion of my five minutes I want to present the Committee several slides that illustrate the potential of second and third-generation technologies which use existing biofuel feedstocks.

Biomass To Biofuels



Source: Advanced Biofuels Coalition

The first slide depicts various technology pathways and potential fuels which they can produce. This is the slide version of the oral version that Dr. Foust gave.

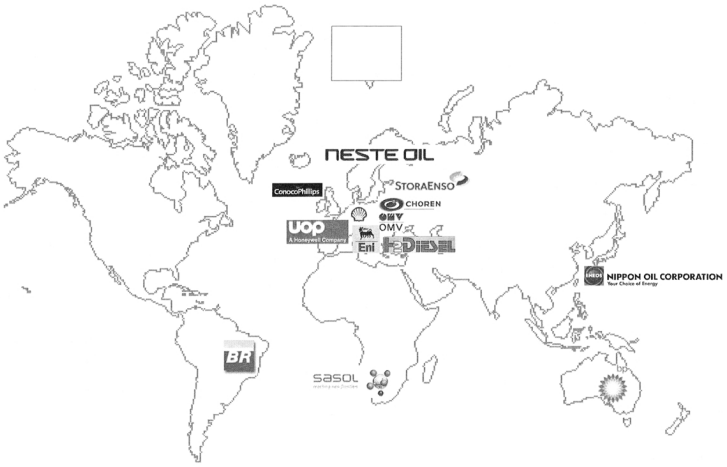
Source: Advanced Biofuels Coalition

Renewable Diesel Alternatives

Feedstock Preferred	Product	Application	Timeframe
■ Vegetable oil	Biodiesel (methyl-ester)	On-road diesel (splash blend, 2% blend)	Available Today
■ Animal fat	Renewable Diesel (uncatalyzed TDP)	Bunker fuel, heating oil	Available Today
■ Animal fat	Renewable Diesel (co-processed catalyzed TDP)	On-road premium (pipeline, 10% blend)	Available Today
■ Animal fat	Renewable Diesel (stand alone catalyzed TDP)	Jet fuel, DoD, on-road premium (pipeline, 100% bio)	Available Today
■ Sugar (corn, sugar cane, cellulose)	Renewable Diesel, Blending component (fermentation)	On Road High Cetane, Jet Fuel (pipeline)	2010
■ Animal fats and oils	Diesel Substitute (Emulsion)	Heating oil, distillate, and Marine diesel, (100%)	Available Today
■ Biomass (animal fat, vegetable oil, litter, wood chips, etc.)	Renewable Diesel (BTL)	Jet fuel, On-Road high cetane (pipeline)	2010

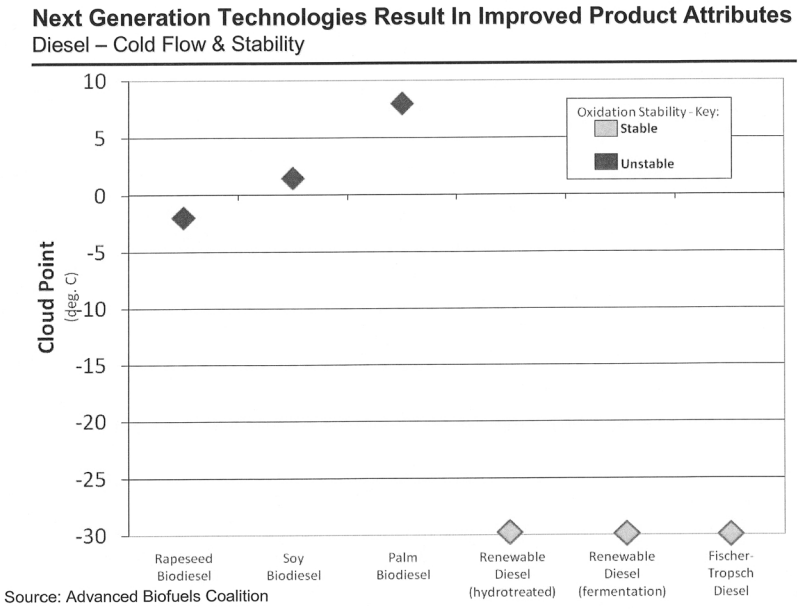
The second slide presents a suite of technologies currently available or under development. As you can see, there are a range of different technologies on the slide, all of which are renewable.

Geographic Introduction of Second Generation Biodiesels



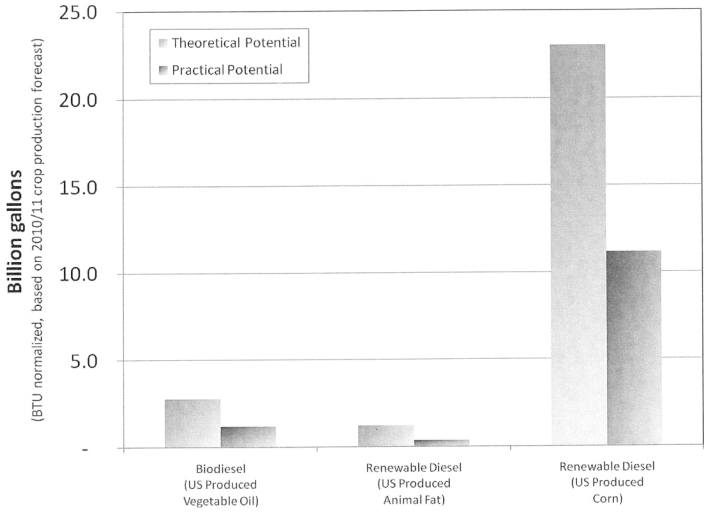
Source: Advanced Biofuels Coalition

The third slide briefly depicts where many of these technologies are currently being deployed around the world. To the extent we do not make technology-neutral policy choices in the current energy legislation, many of these technologies may never find their way to the United States.



The fourth slide is a comparison of biodiesel product quality as it compares to several different technologies. You can see from this slide that there are significant quality differences, not to mention fungibility benefits associated with second and third-generation technologies. The fact that the basic chemistry of these products is fundamentally different from first-generation biodiesel provides the opportunity that jet fuels may actually be produced from these new processes in the future.

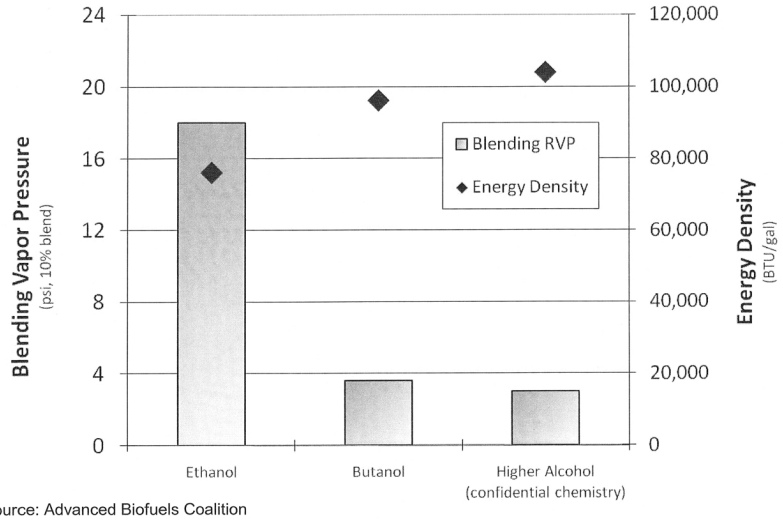
Next Generation Technologies Bring Increased Volume Potential



Source: Advanced Biofuels Coalition

The fifth slide attempts to show the potential of scalability of the various technologies. As you can see, the second-generation fuels which are sugar-based and biomass-based give the country significant opportunity for large volumes.

Next Generation Technologies Result In Improved Product Attributes
Gasoline – Volatility & Energy Density



Source: Advanced Biofuels Coalition

The last slide depicts several second-generation alcohol products as they compare on energy density, volatility, and octane with the current first-generation ethanol.

The last point I would wish to make to the Committee concerns the desire by many in Congress to develop a Low Carbon Fuel Standard. Depending on its specific process, feedstocks, and products, an individual biorefinery may have a wide range of life cycle carbon emissions. Should the Congress seek to mandate a specific biofuels target, it should provide sufficient flexibility to allow both the objective of hitting a renewable gallon target and the objective of having a low carbon fuel supply to both be achieved and not be in conflict with each other. To do so would put the consumer at risk.

In conclusion, we appreciate the opportunity to testify before you today, and we stand ready to work with the Committee on the legislation before us.

Thank you.

[The prepared tatement of Mr. McAdams follows:]

PREPARED STATEMENT OF MICHAEL J. MCADAMS

Mr. Chairman, Ranking Member, and Members of the Committee, my name is Michael McAdams, and I serve as Executive Director of Hart Energy's Government Affairs Group. I am testifying on behalf of the Advanced Biofuels Coalition.

It is a great privilege and responsibility to appear before you today to share how the members of the Advanced Biofuels Coalition are contributing to meeting our energy and environmental improvement goals. I am delighted to join such a distinguished panel, some of whom I have worked with for years in the area of fuels policy.

The Advanced Biofuels Coalition is a group of companies whose second and third generation technologies hold great promise. These companies, working with the Fed-

eral Government, have the potential to provide the American public with abundant volumes of high quality, no-compromise renewable fuels. The fundamental objective of the coalition is to educate policy-makers on the ability of these technologies to deliver significant volumes of lower carbon fuels today and in the near future. For these companies to be able to achieve this goal, they need your support in adopting policies at the federal level which are technology and feedstock neutral.

We applaud your efforts to provide a path to broaden the use of "advanced biofuels." The legislation before us today we believe can make a significant contribution to America's fuels market place. Our members recognize the tremendous contribution and the path traveled which first generation fuels have made already and will play in the future of this effort. But we believe that the future of energy policy will require contributions from many sources. As one Governmental official recently suggested this is a matter of "silver buckshot not a silver bullet."

Members of the Coalition have reviewed your legislation and agree that many of the provisions would be helpful in moving the market forward. Specifically, we are most interested in your section regarding infrastructure, and would encourage that you consider the benefits that second generation fuels would have in terms of reducing overall infrastructure cost to the county.

If a picture is worth a thousand words, then with the remaining portion of my five minutes I want to present to the Committee several slides that illustrate the potential of second and third generation technologies which use existing biofuel feedstocks. The first slide depicts various technology pathways and the potential fuels which they could produce.

The second slide presents the suite of technologies currently available or under development. As you can see, there are a range of different technologies on the slide, all of which are renewable.

The third slide briefly depicts where many of these technologies are currently being deployed around the world. To the extent we do not make technology neutral policy choices, many of these technologies may not find their way to the United States.

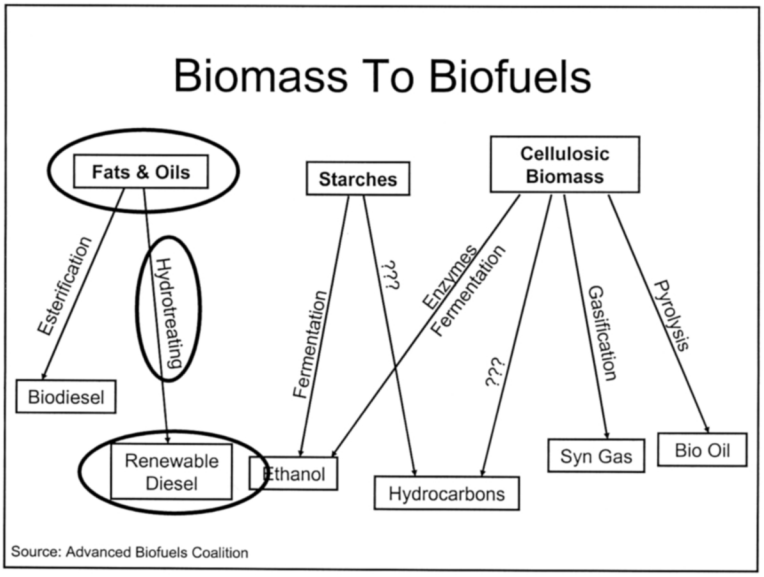
The fourth slide is a comparison of biodiesel product quality as it compares to several technologies. You can see from this slide that there are significant quality differences, not to mention the fungibility benefits, associated with the second and third generation technologies. The fact that the basic chemistry of these products is fundamentally different from first generation biodiesel provides the opportunity that jet fuels may be produced in the near future from some of these renewable based processes.

The fifth slide attempts to show the potential of scalability of the various technologies. As you can see, the second generation fuels which are sugar-based and biomass-based give the country significant opportunity for large volumes.

The last slide depicts several second generation alcohol products, as they compare on energy density, volatility and octane with ethanol.

The last point I would wish to make to the committee concerns the desire by many in this Congress to develop a Low Carbon Fuel Standard. Depending on its specific process, feedstocks, and products, an individual biorefinery may have a wide range of life cycle carbon emissions. Should the Congress seek to mandate a specified biofuels target, it should provide sufficient flexibility to allow both the objective of hitting a renewable gallon target and the objective of having a lower carbon fuel supply to both be achieved and not be in conflict.

In conclusion we appreciate the opportunity to testify before you today and stand ready to work with the Committee on the legislation before us.

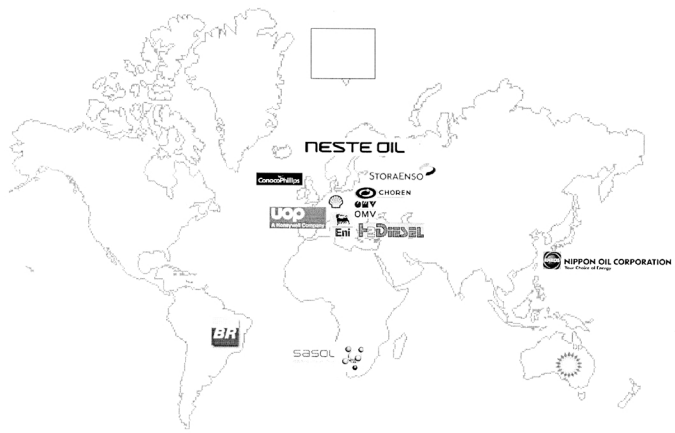


Source: Advanced Biofuels Coalition

Renewable Diesel Alternatives

Feedstock Preferred	Product	Application	Timeframe
■ Vegetable oil	Biodiesel (methyl-ester)	On-road diesel (splash blend, 2% blend)	Available Today
■ Animal fat	Renewable Diesel (uncatalyzed TDP)	Bunker fuel, heating oil	Available Today
■ Animal fat	Renewable Diesel (co-processed catalyzed TDP)	On-road premium (pipeline, 10% blend)	Available Today
■ Animal fat	Renewable Diesel (stand alone catalyzed TDP)	Jet fuel, DoD, on-road premium (pipeline, 100% bio)	Available Today
■ Sugar (corn, sugar cane, cellulose)	Renewable Diesel, Blending component (fermentation)	On Road High Cetane, Jet Fuel (pipeline)	2010
■ Animal fats and oils	Diesel Substitute (Emulsion)	Heating oil, distillate, and Marine diesel, (100%)	Available Today
■ Biomass (animal fat, vegetable oil, litter, wood chips, etc.)	Renewable Diesel (BTL)	Jet fuel, On-Road high cetane (pipeline)	2010

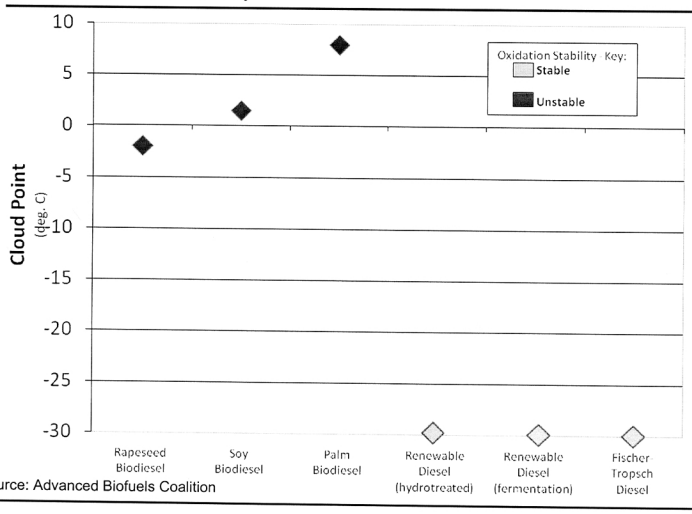
Geographic Introduction of Second Generation Biodiesels



Source: Advanced Biofuels Coalition

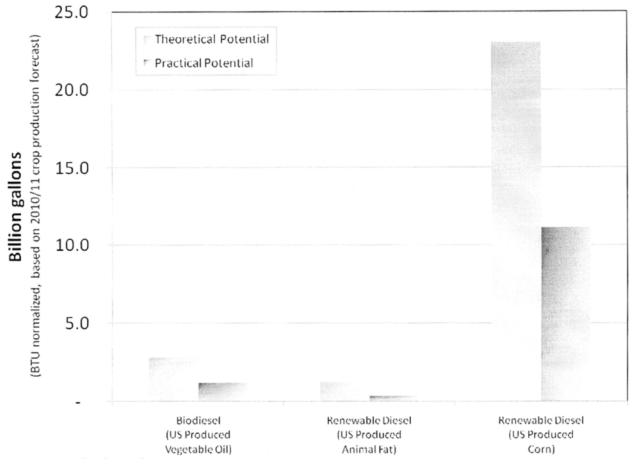
Next Generation Technologies Result In Improved Product Attributes

Diesel – Cold Flow & Stability



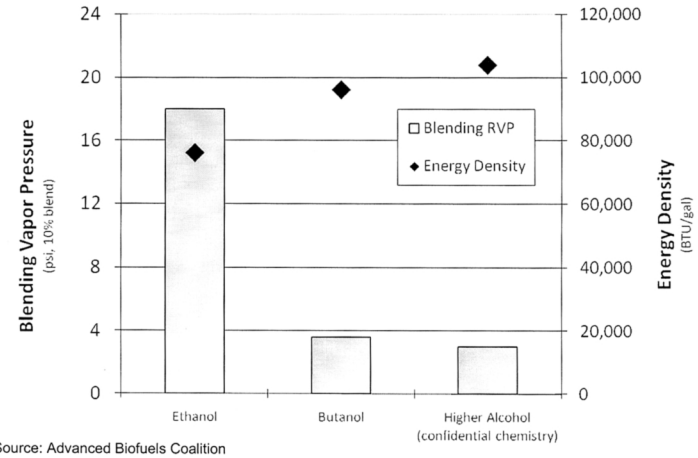
Source: Advanced Biofuels Coalition

Next Generation Technologies Bring Increased Volume Potential



Source: Advanced Biofuels Coalition

Next Generation Technologies Result In Improved Product Attributes
Gasoline – Volatility & Energy Density



Source: Advanced Biofuels Coalition

APPENDIX

Questions from the Committee:

1. *Is a greater federal investment needed in biofuels research? Are there specific areas that are in need of greater research focus? What feedstocks are presenting the greatest long-term potential for development of biofuels? What are the technical barriers to realizing biofuels from diverse feedstocks?*

Answer: Currently many of the new second and third generation technologies have begun in the laboratories from colleges and universities around the country. We would encourage the Committee to continue to encourage and foster public private-partnerships with industry and governments to make the new discoveries in this area.

The type of technology and choices of feedstocks utilized by a specific processes determine their specific interest in any given research focus. In addition, the types of process will have a direct bearing on the view of which feedstocks may hold the greatest long-term potential for the development of fuels. Clearly for a company like Amyris, which leverages sugar containing feedstocks to create hydrocarbon fuels, the ability to utilize forms of low cost sugars from cellulosic processes may hold great promise. As for a company such as Velocys, which is developing a Fischer-Tropsch process, woody biomass or slash from trees provides a great opportunity forward.

Your last question inquires as to the technical barriers to realizing biofuels from diverse feedstocks. In most cases, whether it is gasification or biotechnology, scaling up the technology is one of the primary challenges. The government's ability to provide support for the demonstration of technology and the assistance in the testing of fuels to meet the specification for different engines could be particularly helpful to the smaller companies involved in this space. Additionally, food oils have a distinct tendency to make different products from different process applications and have different quality aspects even within the same process. This creates technical barriers to transportation and engine use of various technological applications and feedstocks for biofuels.

2. *How will the business community benefit from better federal coordination and cataloging of information from federal research on the biofuels development process? Should databases and a centralized clearinghouse be created to make this information readily available?*

Answer: To the extent the Federal Government is conducting its own research and development, and it would catalogue and provide transparent access to a wide variety of stakeholders, this could potentially lead to partnerships and shared technology developments that might not otherwise be forthcoming. Putting this information into the marketplace at a time of high investment in these types of areas does provide for the potential that new technologies may be picked up, combined and moved forward in a more expeditious fashion.

3. *Can you comment on the need for research in the area of biofuels infrastructure? What should be included in such research?*

Answer: There are many new technologies that hold the promise to bring fungible high quality diesel and gasoline components to the market on a cost effective basis. The legislation should explore the timeframes for these alternatives and include these fuel options in the studies for infrastructure requirements. It might be in the Nation's best interest to sequence the requirements for certain volumes of renewable fuels until after the completion of these studies to afford the potential of significantly lowering any large investments which could be required to move massive volumes of first generation fuels.

4. *Is standardization of biofuels, whether ethanol or biodiesel, needed to ensure fuel fungibility? Should this standard focus on blend stock optimization?*

Answer: Various technologies make differing qualities of biofuels and as a result require different infrastructure. As a result of the biofuels' properties, the quantity of renewable fuel that can be added as a component to either diesel or gasoline also varies. This is further magnified by the warranty requirements of various engine manufacturers.

In the past we have seen certain technologies utilize standard requirements at state levels to attempt to block advanced biofuels with great potential from entering the marketplace.

The Committee should be very cautious to not preclude the development of newer higher quality options for consumers in the market place. We appreciate the interest to creating a standard to optimize blend stock for those fuels with highly variable

quality. However, depending on the technology and the product involved, the level and requirements needed to create a fluid system to deliver consistent finished product to an end point are extremely complicated and could have unintended consequences. For example, requiring U.S. refining in the system to make changes to their blends could require significant changes to the base stock and lower the optimization of the current refining system.

5. *Is the current workforce adequate to meet the growing needs for trained personnel to develop and operate biofuels facilities? Is a comprehensive workforce training program needed?*

Answer: Depending on the technology involved governs the type of workforce required. For most of our members, the existing personnel from either the ethanol or refining industries have provided adequate personnel requirements. However, support in working training programs is something we would welcome as a way to increase the supply of workers in the future with the knowledge to operate these new technologies.

BIOGRAPHY FOR MICHAEL J. MCADAMS

Michael McAdams, Executive Director, Government Affairs of Hart Downstream Energy Services, has been involved in every major federal energy and environmental initiative over the last 20 years. In his current capacity, he spearheads governmental advocacy efforts for Hart clients including the Advanced Biofuels Coalition. Prior to joining the firm, he spent 14 years with British Petroleum (BP), acting as Vice President, Federal Affairs and the Environment, and the Associate Group Policy Advisor while there. Before joining BP, Mr. McAdams served on the staffs of several Members of Congress, including the current Ranking Minority Member of the House Science and Technology Committee, the Honorable Ralph Hall. He holds a BA in political science from Virginia Tech and a JD from the Washington College of Law.

Chairman LAMPSON. Thank you very much, Mr. McAdams.

Mr. Waskow.

STATEMENT OF MR. DAVID WASKOW, INTERNATIONAL PROGRAM DIRECTOR, FRIENDS OF THE EARTH, U.S.

Mr. WASKOW. Chairman Lampson and Members of the Committee, thank you very much for the opportunity to appear today to discuss research and development priorities related to the environmental impacts of biofuels production. My name is David Waskow, and I am the International Program Director at Friends of the Earth, which is a national environmental advocacy organization and also the U.S. arm of an international federation, Friends of the Earth International, that has groups in 70 countries around the world.

In the U.S. and abroad, as you know, biofuels are often viewed as an essential solution to the linked challenges of global warming and our dependence on oil. If done right and at the appropriate scale, biofuels can indeed make an important contribution to reducing greenhouse gas emissions, while also improving agricultural sustainability, protecting natural resources, and strengthening rural economies. However, these results are by no means guaranteed, and we must be vigilant in ensuring that the potential of biofuels is, in fact, achieved. Without a serious consideration of environmental impacts, increased biomass production could have unintended consequences for water, air, and soil quality, water availability, and sensitive ecosystems and potentially could provide only minimal benefits or even negative outcomes in terms of greenhouse gas emissions.

As biofuel production and use rapidly increases, a robust research and development program addressing environmental im-

pacts is urgently needed. Perhaps the most important task for research in coming years is to more thoroughly understand the environmental impacts of biofuels production on a life cycle basis. Particularly, to determine the actual greenhouse gas emissions associated with production. Life cycle analyses should estimate the greenhouse gas emissions associated with the entire chain of production and end use of a fuel, including impacts associated with land use, feedstock production, fuel processing facilities, transport, consumer end use, and more. This research need is even more critical now given that pending legislative proposals create greenhouse gas performance standards for renewable and alternative fuels. Indeed, getting these analyses wrong could end up, upend the entire policy framework and fundamentally undermine greenhouse gas reduction goals.

Unfortunately, however, the current generation of life cycle analyses including the well-known GREET model out of Argonne National Laboratory, contain important uncertainties and land use-related impacts in particular are poorly characterized in these life cycle analyses. The land use impacts of expanded biofuels production will include shifting marginal, unused, or ecologically-sensitive land into biofuels production. These impacts could change fundamental assumptions about greenhouse gas emissions for biofuels both domestically and internationally.

Indeed, the recent surge in corn ethanol production in the United States underscores the importance of examining these greenhouse gas issues closely. Based on estimates from the Argonne National Lab, the per acre greenhouse gas benefits from corn ethanol production compared to conventional gasoline amount to 0.6 metric tons of carbon dioxide equivalent.

By contrast, clearing an acre of grassland would produce 45 to 80 tons of carbon dioxide equivalent and converting an acre of forest will commonly release 200 to 300 metric tons. The implications are substantial. In essence, to make back all the greenhouse gas emissions from an acre of land converted from grasslands, one would have to grow corn on that acre for approximately 100 years.

Careful analysis of the greenhouse gas impacts of land conversion is also relevant for biofuels feedstocks other than corn, including biofuels production outside the United States, partly intended for export. In southeast Asia, for example, the palm oil industry which has devastated rainforests and wetlands, is increasingly shifting production to biofuels for export. Similarly, in Brazil rapidly-expanded production of biofuels is likely to increase land use pressures in ways that could influence the greenhouse gas profiles of those fuels.

In addition to the critical task of analyzing greenhouse gas emissions, life cycle analyses should also be expanded to address a full range of potential environment impacts, including some of the issues I described earlier, soil quality, water use, water quality, and so forth. Broader research on these issues is especially needed for feedstocks other than corn.

In addition, if we hope to continue the growth of a sustainable biofuels industry in the United States, we must also find ways to steer the sector in directions that will be more compatible with our environmental goals. Research into best practices for the cultiva-

tion and harvesting of feedstocks will be especially important, and the research agenda should permanently include issues involving crop diversification, including mixed perennial grasses.

Sustainable practices for biofuel processing facilities and research into the impacts of biofuel processing facilities, particularly involving energy use and water use, should be a priority. And research and development for production alternatives is also vital, especially for small-scale production and local and on-farm use of biofuels.

Let me conclude by saying that we appreciate this opportunity to address the Subcommittee and look forward to working with you to address the critical research and development agenda needed to deal with the environmental impacts of biofuels. An intensive research program can help insure that biofuels provide the benefits we want while also avoiding the environmental harm that would undermine our fundamental objectives.

Thank you.

[The prepared statement of Mr. Waskow follows:]

PREPARED STATEMENT OF DAVID WASKOW

Chairman Lampson and Congressman Inglis, thank you for the opportunity to appear today before the House Science and Technology Subcommittee on Energy and Environment to discuss research and development opportunities and priorities related to the environmental impacts of biofuels expansion. My name is David Waskow, and I am the International Program Director at Friends of the Earth. Friends of the Earth is a national advocacy organization in the United States founded in 1969 and the U.S. arm of Friends of the Earth International, the world's largest environmental federation, with groups in more than 70 countries worldwide.

In the United States and abroad, biofuels are often viewed as an essential solution to the linked challenges of global warming and our dependence on oil. If done right and at the appropriate scale, biofuels can indeed make an important contribution to reducing greenhouse gas emissions, improving agricultural sustainability and protection of natural resources, and strengthening rural economies. However, these results are by no means guaranteed, and we must be vigilant in ensuring that the potential of biofuels is in fact achieved. Without serious consideration of environmental impacts, increased biomass production could harm water, air and soil quality, decrease water availability, and increase loss of biodiversity, wildlife habitat, and sensitive ecosystems, while providing only minimal benefits or even negative outcomes in terms of greenhouse gas reductions.

Recent data regarding increases in the scale of biofuels production, as well as current policy proposals aimed at significantly increasing the levels of biofuels production, make the consideration of environmental benefits even more of a pressing concern. According to Department of Energy data, U.S. ethanol production increased from 3.4 billion gallons in 2004 to an annual rate of six billion gallons at the beginning of 2007, and annual biodiesel production expanded from 28 million gallons to approximately 287 million gallons from 2004 to 2006. Meanwhile, annual imports of biofuels have also steadily increased. More than 10 percent of fuel-grade ethanol came from abroad in 2006, despite the current 54-cent per gallon tariff on ethanol, and there has been an upswing in the construction of plants, such as a 100-million gallon per year facility in Washington State, designed to import palm oil for biodiesel. Legislative proposals to dramatically increase the use of biofuels in the United States to more than 30 billion gallons annually would accelerate these already existing trends both for domestic production and imports.

As biofuel production and use rapidly increases, a robust research and development program is urgently needed to ensure that we understand the full scope of the environmental implications of biofuel production and that investment in promising technologies results in significant greenhouse gas reductions and the best environmental outcomes possible. Greenhouse gas emissions and environmental impacts vary enormously by feedstock and the full life cycle of the production process. Moreover, the increased scale of biofuels production itself raises important questions of environmental sustainability, especially in terms of land use impacts. Research and development efforts should consider these impacts thoroughly and help steer future

biofuels production in a way that can maximize benefits and minimize environmental harm.

Life Cycle Analysis

Perhaps the most important task for research in coming years is to more thoroughly examine the environmental impacts of biofuels production on a life cycle basis, particularly to determine the actual greenhouse gas emissions associated with biofuel production. At their best, life cycle analyses for greenhouse gas emissions estimate the emissions associated with the entire chain of production and end-use of a particular biofuel, including impacts associated with land use, feedstock production, fuel processing facilities, transport, and consumer end-use. The greenhouse gas evaluation of renewable fuels on a life cycle basis can help provide the underlying technical foundation for policy options, particularly when the life cycle emissions are compared to the life cycle emissions from conventional fossil fuel-based fuel. Particularly given recent legislative proposals that would base renewable fuel mandates and other fuel policies on the greenhouse gas profile of specific fuels, it is imperative that life cycle analyses are comprehensive and accurate. Indeed, getting these analyses wrong could upend the entire policy framework.

The current generation of life cycle analyses, including the well-known GREET model developed at Argonne National Laboratory, examine a wide range of life cycle contributors to greenhouse gas emissions (including not only carbon emissions, but also gases such as methane and nitrous oxide). Unfortunately, however, even the GREET model, which is considered the pace-setter for greenhouse gas modeling, is inadequate and contains important uncertainties that must be addressed. Many in the scientific community have echoed our concern that life cycle analyses must be improved to address the full scope of greenhouse gas emissions related to biofuels production.

Land use-related impacts, in particular, are poorly characterized in current life cycle analyses, and broader and deeper research is needed to quantify the full range of parameters affecting greenhouse gas emissions. In their recent technical analysis of California's Low Carbon Fuel Standard for the California Air Resources Board, University of California professors Alexander Farrell and Daniel Sperling noted the limitations of the GREET model in terms of land use change. The land use impacts of expanded biofuels production will include shifting marginal, unused or ecologically sensitive land into biofuels production, potentially changing the underlying assumptions about greenhouse gas emissions for biofuels produced both domestically and internationally. The scale of land use conversion for biofuels production, the types of land being converted, and the land intensity of various biofuel feedstocks will likely have significant impacts on greenhouse gas outcomes in ways that current models do not fully account for.

The recent surge in corn ethanol production in the United States underscores the importance of examining these greenhouse gas issues closely. USDA estimated that corn acreage in the United States would increase by 15 percent, or 12 million acres, during the spring 2007 planting season. Legislative proposals currently under consideration would further increase pressure on land, expanding corn ethanol production to as much as 15 billion gallons annually, an amount that would require using land equivalent to half the current corn acreage in the country, or 45 million acres.

The greenhouse gas implications of this land use will depend on the types of land that are used for such biofuels production, including whether protected lands such as those in the Conservation Reserve Program are retired from that program and placed into ethanol production. Yet even if the land put into biofuels production is currently farmed with other crops, the use of that land is likely to displace some level of existing agricultural production, including to production on vulnerable lands outside the United States. Other, indirect impacts that might occur due to the use of corn for ethanol could also be considered in a comprehensive life cycle analysis. For example, when an acre of corn is diverted for ethanol, livestock operations around the world will replace most of the corn in some other way, which on a worldwide basis could result in the conversion of additional land to agricultural production.

The greenhouse gas emissions related to the increased use of land for corn ethanol production could be quite substantial. Based on estimates by the Argonne National Laboratory, the per-acre greenhouse gas benefits from corn ethanol production compared to conventional gasoline amount to 0.6 metric tons of carbon dioxide equivalent. By contrast, the Intergovernmental Panel on Climate Change estimates that clearing an acre of grassland would produce 45 to 80 tons of carbon dioxide equivalent greenhouse gases and converting an acre of forest will commonly release 200 to 300 metric tons of carbon dioxide equivalent greenhouse gases. The implications of these data are substantial. Even small increases in the use of land converted from

grasslands or forests would undo the greenhouse gas benefits from corn ethanol production on an acre of land. While it would be reasonable to amortize the greenhouse gas impacts from land conversion over a limited number of years, doing so would not limit the quite significant immediate impacts of the land conversion.

Careful analysis of the greenhouse gas impacts of land use conversion is also relevant for biofuel feedstocks other than corn, including for production outside the United States. In Southeast Asia, for example, palm oil production is increasingly shifting from a focus on food inputs to production as a biodiesel input. Unfortunately, despite palm oil's high energy content, the production of palm oil is a major source of destructive land use patterns, particularly due to deforestation and wetland conversion. Nearly 50 percent of currently productive palm oil plantations in Southeast Asian countries is planted on land that was recently converted from forest, releasing substantial quantities of greenhouse gases. Meanwhile, a quarter of all palm oil plantations in Indonesia are established over converted peatlands, which have been drained and often then burned to make way for palm production. Wetlands International estimates that peatland drainage and burning in Indonesia contribute two billion tons of carbon dioxide emissions annually, or eight percent of worldwide carbon emissions.

Similarly, in Brazil, rapidly expanded production of biofuels is likely to increase land use pressure in ways that could influence the greenhouse gas profiles of those fuels. In the case of sugar cane production for ethanol, which already occupies 13 million acres in Brazil, expanded sugar cane production could take place on the country's significant quantity of degraded and fallow land. However, many observers believe it is likely that expanded production will also increasingly move into the Brazilian *cerrado,* the biodiverse tropical savanna. In addition, sugar cane production in Brazil frequently encroaches on previously occupied lands, which often results in crop and livestock production relocating to land converted from savanna or rainforest. Meanwhile, although soybean cultivation for biodiesel production in Brazil is still relatively undeveloped, the potential for pressure on sensitive lands is significant. Soybean production currently occupies more than 22 million acres and frequently drives widespread deforestation.

In addition to conducting more comprehensive analysis of the greenhouse gas impacts of land use changes, other elements of greenhouse gas life cycle analyses should also be strengthened. For example, one of the most significant remaining uncertainties in life cycle analysis is the impact of nitrous oxide emissions, an important greenhouse gas related to agricultural production. Several potential sources of nitrous oxide emissions, including the use of crop residues, are not included in any major life cycle analysis. In addition, greenhouse gases emissions related to energy use for irrigation are not included in the GREET life cycle analysis.

Beyond the critical task of analyzing the greenhouse gas emissions associated with renewable fuels, life cycle analyses should also be expanded to address a full range of potential environmental impacts from biofuels production. This will be especially important in order to compare the impacts of various biofuels in terms of their relative impacts on soil quality, water use, water quality (including such critical issues as nitrogen and pesticide run-off), air quality, and protection of native ecosystems, habitats and biodiversity. As next-generation renewable fuels, such as cellulosic ethanol, become increasingly viable both technologically and commercially, it will be critically important to be able to compare the entire range of impacts of those fuels with conventional biofuels. In addition, analysis of the aggregate and cumulative environmental impacts related to the growth of the entire biofuels sector, both domestically and internationally, should be developed.

Finally, one of the most significant gaps in research on the environmental impacts of biofuels is the extremely limited set of feedstocks that have been analyzed in any detail. Broader research on environmental impacts and the development of comprehensive life cycle analyses are needed for a number of feedstocks other than corn—including soy, sugar cane, palm oil, canola, native grasses, various wood sources, straight vegetable oil (including waste vegetable oil), and crop residues. In some instances, greenhouse gas life cycle analyses have been conducted for those feedstocks, but broader and deeper analysis would add significantly to the understanding of the greenhouse gas and other environmental impacts from those fuel sources. In addition, most studies of biofuel production use broad averages for analyzing impacts and land-use intensity, rather than geographically-specific data. Variability across regions of the United States and the world can be significant and should be included in these analyses.

Research and Development for Best Practices and Advanced Biofuels

It is increasingly clear that our domestic demand for biofuels far exceeds our supply of corn for conversion to corn-based ethanol, currently our major source of biofuels in the United States.

Meanwhile, the recent rapid expansion of corn-based ethanol production has helped stir increased concern about the environmental sustainability of biofuels production more broadly. If we hope to continue the growth of a sustainable biofuels industry in the United States, we must find ways to steer the sector in directions that will be most compatible with our fundamental environmental goals. Research and development must tackle the challenge of promoting best practices for biofuel production and facilitating the development of improved, advanced biofuels sources.

Research into best practices for the cultivation and harvesting of feedstocks will be especially critical to the environmental sustainability of biofuels production. Examples of the issues that research need to address include harvest timing and quantities; crop rotations; fertilizer requirements; use of appropriate and safe chemicals for cellulosic crops; impacts of crop residue utilization; potential integration of no-till and organic farming to provide the greatest possible greenhouse gas and soil benefits; use of single-pass harvesting; and feedstock processing and handling methods for woody biomass and perennial grasses. The research agenda for best practices should also prominently include issues involving crop diversification and appropriate mixes (including cultivation techniques for mixed perennial crops). A recent University of Minnesota study showed that diverse perennial grass mixes are more beneficial in reducing greenhouse gas emissions and other environmental impacts than is the case with other approaches, including monocropping of switchgrass.

In addition, a research and development program for conventional plant breeding of cellulosic and other feedstocks could help develop biofuels that are less land-intensive and promote environmental sustainability in other ways. Pursuing conventional breeding, rather than using an approach involving transgenic engineering, would avoid significant controversy and trade-related disputes and would avoid contamination of the food supply from genetically engineered biofuel feedstocks.

Sustainable practices for biofuel processing facilities, particularly for energy and water use, should also be a research and development priority. Research on the most effective ways to use biomass for powering biofuel processing facilities could be particularly important to creating greenhouse gas and air quality benefits. In addition, research on minimizing water use by ethanol processing plants, which currently use more than four gallons of water to every gallon of ethanol produced, will be critical to limiting the potentially intense pressure that biofuels production could place on water resources.

Research and development for improved fuel types is also critical. Potential alternative biofuel sources such as straight vegetable oil and algae have received too little attention and should be made more central to a research and development strategy. Straight vegetable oil (including waste vegetable oil) can be used in modified diesel engines without processing into biodiesel, thereby reducing the life cycle greenhouse gas emissions that would otherwise come from a biodiesel production process. However, in order to make straight vegetable oil technologically and commercially viable, research and development will be needed for vehicle engine modifications. Another promising fuel source is algae, which can likely be produced in substantial quantities for biodiesel with significant greenhouse gas reduction benefits and limited environmental impacts. It would be valuable to support a research and development program to facilitate production of environmentally-sound and commercially viable algae biodiesel.

Finally, it will be vital to support a research and development agenda for small-scale production and local and on-farm use of biofuels. Distributed technologies that can be used to provide local co-generation of electricity and heat and to produce biofuels, particularly biodiesel, for on-farm use, should be priorities of this research and development program. Small-scale gasification technologies for conversion of cellulosic biomass also offer significant opportunities that should be explored. These approaches are important not only in the United States, but can also be developed for use in developing countries so that local communities in those countries can produce biofuels for their own consumption and economic benefit.

DISCUSSION

Chairman LAMPSON. Thank you, Mr. Waskow. I will now move into our first round of questions, and the Chairman will recognize himself for five minutes.

BIOFUELS INFRASTRUCTURE

Mr. Dinneen, surely the ethanol industry should be commended for insuring adequate supply of ethanol available to all parts of the country. The virtual pipeline through multiple modes of transport has done an exceptional job in quickly moving product.

However, the discussion of significant growth in the use of biofuels generally, I am concerned that we will reach a point when the virtual pipeline will meet capacity. With the introduction of larger quantities of biofuels wouldn't it be more economical for the producers, the blenders, and consumers to move the product through pipelines if we know it is safe and effective?

Mr. DINNEEN. Potentially. Let me first say that I think analyses have been done by CSX Railroad as to how much additional rail traffic it would take to move as much as 35 billion gallons of ethanol, and their assessment is that that is 14,000 unit trains a year that would be necessary. That certainly looks like a really big number until you put it in some context. It is actually less than four percent of the total number of trains in this country. So if moving more biofuels into the motor fuel market is going to be a national priority, I think finding four additional percent, you know, rail traffic is certainly feasible.

But your question was more on the economics than on, you know, the logistics. And certainly it could potentially be far more economic to move product by pipeline. The question will be how is the ethanol industry going to develop. Is it going to develop as the oil industry has been, where much of the production is highly centralized in one region? Because now the pipeline system has been built to accommodate gasoline production in the Gulf Coast, and the pipelines flow from there out to the population centers. Well, already you have seen the ethanol industry expanding beyond just the traditional Midwest. We have got plants today that are being built in California. They are actually in operation, four plants in operation in California. There are more plants under construction in Texas today than are under construction in Illinois, and as our industry develops, you will see, I think, expanding production capacity in all regions of the country. So you might not have a concentration of production that would make pipeline shipments, you know, feasible or more economic. I think you are just going to have to see.

Chairman LAMPSON. If we are ultimately planning to displace a large amount of petroleum-based products with biobased products, shouldn't we explore using some of that petroleum infrastructure that becomes less utilized in order to move ethanol?

Mr. DINNEEN. Absolutely, Mr. Chairman. We should explore that and indeed, it is feasible to do. It has been a marketplace issue thus far. There may be some technical issues that need to be addressed, and this bill I think will help to identify those.

Chairman LAMPSON. You were nodding your head, Mr. McAdams. Do you want to make a comment about it, and then I would like for Dr. Foust to comment on it.

Mr. MCADAMS. Yes, Mr. Chairman. I think it is a very intuitive question, because as you move forward and you look at the bills in both the House and the Senate that are currently proposed, the

Congress is trying to change the fundamental balance of where the energy comes from in the future, and so we are looking at 36 billion gallons of renewable fuels in the Senate, somewhere around 30 billion, 35 billion in the House. And those bills sequence the time in which the renewable fuels come into the marketplace. If you look at the second slide that I laid down on the right hand of the slide you would have seen all the timeframes that these second and third-generation technologies could come into play. They are totally fungible in the existing pipeline system. They are totally fungible with existing fuels. Some of the fuels, the gasoline slide I showed, some of those fuels could actually work in conjunction with ethanol and be blended with ethanol.

So I think it is a very intuitive question, and I think your legislation and the section in your legislation that talks about how you would blend these fuels and what the properties are and what the benefits of those properties are, is particularly on target and timed to show the benefits of those fuels being merged.

Chairman LAMPSON. These aren't cost competitive yet just because they are available?

Mr. MCADAMS. Some of them if, some of them would be very cost competitive. Yes, sir.

Chairman LAMPSON. Dr. Foust.

Dr. FOUST. I would highly agree with what my colleagues say. I think it depends on if the ethanol industry develops more decentralized than the petroleum industry, it does complicate the petroleum model for ethanol. However, with that said, I think there, clearly economic studies show it is a fraction of the cost to move fuel via pipeline than it is by rail or truck, and that is significant, and I think it needs to be investigated.

As Mr. Dinneen said, there are technical challenges with putting ethanol in existing pipelines, but those are predominantly due to practices. Currently hydrocarbon fuels are separated by a water slug within the pipelines, which works well for hydrocarbon fuels, gasoline, diesel, jet fuel, et cetera, but ethanol has a high affinity for water, so it will absorb the water, so that doesn't work. That would have to be investigated. Corrosivity would have to be investigated, but I think those issues are solved and the economics do justify it.

As far as the vehicles go, I commend the section in the bill for looking at optimizing vehicles on E–85. I think really to, that there is one vehicle out there made by Saab, it is marketed in Europe, it is not available in the United States, but actually gives higher performance on ethanol. And there is a lot of data that shows——

Chairman LAMPSON. Ethanol blend?

Dr. FOUST. E–85. Actually, E–85. So predominantly ethanol. And there is a lot of data out there that shows that we would not have to pay the one-third penalty on current gas mileage penalties on fuel-flexible vehicles that are optimized to run on gasoline octane in the high 80s, if we did specifically look at these vehicles and how to develop them and what the public incentive, policy incentives would be to automobile manufacturers to make these vehicles.

Chairman LAMPSON. Thank you very much. The Chairman's time has expired, and at the request of the Subcommittee Ranking

Member, I will recognize the Full Committee Ranking Member for five minutes. Mr. Hall.

BIOREFINERY TECHNOLOGIES

Mr. HALL. Thank you, Mr. Chairman. That is me, isn't it?

Mr. McAdams, your slide, I was fascinated, I guess, with your first slide, and we all look for production dates and facts about them and time and what is the time certain, and of course, you may not be able to give that, but could you give me a couple of examples of actual companies and the timeframes which they are going to be able to produce these new higher-quality fuels?

Mr. MCADAMS. Yes, Mr. Hall. And coming back to Chairman Lampson's point, let me name two companies that are very fascinating. The first company would be Amyris Biotechnologies, which was a company originally founded by Bill Gates, a grant, to try to solve the world malaria problem. They created a yeast molecule that has made a quantum collapse in the price of making artemisinin, which is the drug that kills malaria in eight hours. They took it from a price of about $2.50 a pill down to 24 cents. Well, the technology they developed is the same technology that is, frankly, used in my colleague's, Mr. Dinneen's, ethanol plants every day. And so instead of using a yeast molecule that he would use today, you would simply plug and play, pardon the phrase, like a new software in a computer. You would simply put their new and improved yeast molecule in one of Mr. Dinneen's plants, and it will make a diesel fuel with all of the characteristics of the second-generation fuels down to 30 degrees below. It will make a jet fuel, or it will make a gasoline additive.

It would, therefore, give all of Mr. Dinneen's clients an opportunity to have a complete product slate rather than just one product slate going forward. And they believe that they will be able to bring it fully to market in three years.

Real quickly, one other company, Neste, out of Finland, on May 31 introduced a 60 million gallon stand-alone hydro-processing summarization plant that is, that can take 100 percent tallow and turn it into 99 cetane, no sulfur diesel, high-quality diesel. They are doing it today. They are looking in the United States to see whether there might be a place, Texas, Louisiana, or a place where it might fit with the products.

MANAGING BIOFUEL FEEDSTOCKS

Mr. HALL. Thank you. And I go to Dr. Foust at this time. Doctor, in your testimony you mentioned the forest products industry, and I have a lot of that in the northeast part of the State of Texas and my district. I understand that they have a concern with sustainability. If, when a biomass is extradited from forests that are not sustainably managed, they feel that it is not carbon neutral, it adds to the atmospheric carbon and it is, therefore, not renewable energy. So I guess I would have to ask you, would you agree that forest lands should be managed in a sustainable way to ensure forestry replacement, forest health, and adequate supply for existing and future generations and uses in order to be considered renewable?

Dr. FOUST. I would absolutely agree with that statement. I think Mr. Waskow summed up that very well, that that, for this whole, I would extend your comment even beyond forestry into agriculture and all sources of biomass. In order for this to be sustainable, the feedstock has to be managed in a sustainable manner. Carbon, storage, the health of the soils, the health of the forest, that all has to be considered.

I think on the positive side as many studies have shown, that can be done, and we can have sustainable biofuels with carbon neutrality, but it is a challenge, and public policy, I think, has to guide that towards carbon neutrality.

THE RENEWABLE FUELS STANDARD

Mr. HALL. Thank you. My last question is to Mr. Berger. I noticed in your testimony that you suggest a mandatory biodiesel standard of five percent be instituted so as to insure a sustainable domestic biodiesel market. Is the type of biodiesel BioSelect Fuels produces not eligible under the current renewable fuel standards as included in the *Energy Policy Act* we passed in 2005?

Mr. BERGER. Mr. Hall, no, it is not. Most of the renewable fuel that is being standardized under that Act is ethanol, and biodiesel or at least the market participants who sell the petroleum products, whether they would be unleaded or diesel, are not forced to blend or do not blend biodiesel by mandate into the petroleum diesel currently.

Mr. HALL. Then can you tell me how much biodiesel has contributed to meeting the required volumes under the renewable fuel standard?

Mr. BERGER. I can't give you that exact number, but you can see through the small amount of consumption that is actually consumed in the United States and reported by the National Biodiesel Board, that it is quite a small amount of the petroleum diesel consumed in the United States, which is about 60 billion gallons.

Mr. HALL. I may have follow-up questions, but I see the red light on, and I am, Mr. Chairman, will be allowed to submit questions with some expectation of getting back——

Chairman LAMPSON. Well, and if you have——

Mr. HALL.—in a reasonable time?

Chairman LAMPSON. Yes, and if you have time to hang on, we are, I am sure, going to have more than one round.

Mr. HALL. Thank you, sir.

Chairman LAMPSON. Thank you. The gentlelady from California, Ms. Woolsey.

ENVIRONMENTAL AND FOOD SUPPLY CONCERNS

Ms. WOOLSEY. Thank you, Mr. Chairman. As we are here, I am here listening, I can't help but comment that as we get started on this really huge, huge endeavor to become independent of petroleum-based products, products in an economy that we are learning has been disastered for our national security, and for our environment, while we address this and going to biodiesels and all the other alternatives we have for generating energy in this country, I have to ask a question. Is carbon neutral enough? I mean, don't

we want to make improvements? Because the measurements we are comparing with have not been very healthy. So I think we should be addressing that because the tradeoffs are big here, and as long as this effort is going to be so gigantic, and it is going to be. Let us not leave out some very important steps and some standards and measurements that we are going to need to be addressing down the line anyway, so we might as well do it up front.

So my first question is to Mr. Waskow. Thank you for being here, and I am particularly concerned when we talk about ethanol and corn ethanol about the land use issues. I have, you see, everything becomes personal when we start talking about anything around here. It starts being part of what does it mean to our districts. But what does, this is going to mean, is meaning already? We are subsidizing corn on all these acres all over the Nation for ethanol, and my dairy farmers can't afford to feed the cows, and we know that the Mexicans can't afford to make their tortillas.

Well, would you comment on that? I mean, are we finding alternatives? Is this a tradeoff that is even worth it? The corn part of it.

Mr. WASKOW. Let me first take the question about carbon neutrality, and my answer would be that absolutely we have to do better than carbon neutrality. If we are, in fact, going to tackle the very serious challenge of global warming, we have to do much better than carbon neutrality. I think that low carbon fuel standard that California has adopted, in fact, points in the direction of tackling that challenge in a serious way in terms of moving past carbon neutrality.

I would just, with apologies for referring to the other chamber, I would just note that the bill that is on the Senate Floor this week has some helpful language on this question. It requires that renewable fuels would have to reduce greenhouse gas emissions compared to conventional fuels by 20 percent. We have been pushing for an even higher target for the fuels referred to in the Senate Energy Bill as advanced biofuels. We think that those should have to meet a target of 50 percent greenhouse gas reductions.

So in sum, yes, we need to push the envelope on this question, especially given that renewable fuels will only be limited percentage of the overall fuel supply. If we are going to make good on their promise, they need to have substantial reductions.

On the land use question I think it is going to continue to be a growing dilemma, and I would just note that in addition to the kinds of dynamics you have pointed to and that I mentioned earlier, we are concerned about some of the indirect effects, some of the ripple effects. For instance, if corn continues to be used for biofuels, the world supply of corn for feed will diminish as you noted. It is likely that that will stimulate soybean production in Brazil, and soybean plantations in Brazil have been closely linked to rainforest destruction. They have put incredible pressure on the rainforest in Brazil, and so although obviously there are some uncertainties about whether this dynamic that I just described would play out, I think we do need to keep our eyes very closely on these questions. And I think it points to the need to think about biofuels options that, in fact, are less land intensive. I think perennial grasses, for example, are an important example of that and also I

think sources such as algae could be particularly useful in this regard.

Ms. WOOLSEY. Thank you. I have, yes, Mr. Dinneen.

Mr. DINNEEN. As a representative of the existing corn ethanol industry, let me assure you that I agree that carbon neutrality is not adequate, and indeed, I would suggest to you that the renewable fuel standard that was passed in the 2005 Energy Bill created, in effect, a surrogate low carbon program, because according to the GREET model that Mr. Waskow referred to earlier, the ethanol industry that is producing today realizes about a 20 to 25 percent reduction in carbon. And I would suggest that probably underestimates the carbon benefits of the existing industry because it was based off of an energy survey that was done on the industry in 2002. The industry's getting better all the time, but I think absolutely we need to do a lot more, and we are.

With respect to the land use issues, again, those are critical issues. The industry itself recognizes there are limits to what we are going to be able to do from grain, which is why we are pursuing a cellulosic industry as hard. Corn is, indeed, being driven up today because of the expanded market opportunities for ethanol, and markets are, indeed, having to adjust. The fact that farmers responded to the marketplace and planted 90 million acres of corn this year suggests we are going to see the largest corn crop in history. And I believe that there is certainly going to be adequate supplies of grain to satisfy the demand in this country for feed, for fiber, and for fuel.

Ms. WOOLSEY. Thank you.

Chairman LAMPSON. Thank you, Ms. Woolsey. I now recognize for five minutes the Ranking Member, Mr. Inglis.

BIOENERGY RESEARCH CENTERS

Mr. INGLIS. Thank you, Mr. Chairman. Perhaps Dr. Foust or Mr. Dinneen could answer this and others if they want to take a shot. As I understand it we have three bioenergy research centers established under EPACT. The Draft Bill contemplates the addition of 11 centers as I understand it. I am wondering what would be the focus of those centers, or what would they add to the mix of the three. And do they at some point get too many, or is it the more the merrier? From three to 11 makes more the merrier or we start losing, becoming then, creating then a coordination challenge between three to, actually, I guess it would be 14.

Mr. DINNEEN. Congressman, I sort of wish Dr. Foust would take this, but I will jump into it, what the heck. I noted in my testimony that, you know, there is value to these facilities. I do sort of agree with the premise of your question that 11 may be a bit overkill, and I think our testimony suggests that one in each petroleum district might satisfy the needs. There are going to be different feedstocks in different parts of the country. The northeast, northwest is largely going to be a woody biomass opportunity. There would be other feedstocks perhaps for other fuels as Mr. Berger had referenced with respect to some biodiesel feedstocks that might be available in Texas. So there are benefits to some regional centers like that, but 11 might be more than what the current budget situation would suggest might be feasible.

Dr. FOUST. I think Mr. Dinneen summed it up quite well. I also agree that three going to 14 does seem excessive. I think Mr. Dinneen's point is well taken that there is all, as the old saying goes, all biomass is regional but expandable to national, or whatever the statement is. I forget. But as far as different feedstocks in different regions and different technologies are suitable for different feedstocks and enzymes have to be tailored to different feedstocks, there is, market conditions are different. I would agree with Mr. Dinneen's point that geographically locating these per petroleum district makes sense or geographical region. Fourteen does seem excessive.

Mr. INGLIS. How many petroleum districts are there?

Mr. DINNEEN. Five.

Mr. INGLIS. What is a petroleum district? I don't know.

Mr. DINNEEN. Now there is a good question. It was determined by the Department of Energy many years ago. It was just typically the way that motor fuels travel in a given region, and it is a term that is used an awful lot by the refining industry because each petroleum district will have perhaps separate and distinct fuel quality standards. Mike is probably actually a better person——

Mr. INGLIS. And I guess it has to do with pipelines, too.

Mr. MCADAMS. Within a specific region.

Mr. INGLIS. All right. So what would the centers do? Somebody want to tackle that? Are they into commercialization, are they into the scientific breakthroughs needed for, say cellulosic ethanol development? What is their focus? Is it basic research, or is it more applied?

Dr. FOUST. I will take a stab at that, answering that. I think it is more applied. I think the existing national laboratories, universities that are focused on the basic research, understanding the fundamental challenges to economical production of cellulosic biofuels, whether that be ethanol, biodiesel, or these higher alcohols, is done in, currently done, probably more resources are needed, but currently done better in a focused effort where there is a group of consolidated scientists. But as far as the applied, applying, understanding the market factors, understanding the feedstock diversity, understanding the regional issues, citing issues, the density and the logistics, those issues could appropriately be addressed by these regional centers. And that would be a good usage of those centers to take the macro technology and apply it regionally.

CELLULOSIC ETHANOL

Mr. INGLIS. And my time is almost up, but I wonder we are going to have the breakthroughs in cellulosic ethanol. Is that what we are, we got a high degree of confidence in that?

Mr. DINNEEN. Congressman, absolutely. I had the privilege of visiting a cellulosic ethanol plant that is currently under construction just a few weeks ago. It is being built in Spain, but the company operates four ethanol facilities here in the United States today and is building a similar facility here in Nebraska as well that is likely going to be open before the end of the year. I can report to you that commercial cellulosic ethanol production is closer than conventional wisdom would suggest. There are a lot of companies that are looking at this. As our industry has grown and as

new capital has come into the industry, new intellectual capital has come into the industry as well, and there are more companies that are looking at this today from a different point of view than ever before. And there are a range of technologies, whether it is enzymatic conversion, which is what we are most familiar with, or gasification, which is what they have been doing a lot of in Europe, and we are just starting to get behind now, or some other technology. I can assure you that cellulosic ethanol production is very close.

Chairman LAMPSON. You are welcome. And Dr. Bartlett, five minutes.

ENVIRONMENTAL CONCERNS

Mr. BARTLETT. Thank you very much. I bought the first Prius car in Maryland. I bought the first Prius car in the Congress. I have an off-the-grid home. Its only energy comes from solar and wind. So please accept what I am going to say in that light. I am an enormous fan of renewables. But having said that I think that unrealistic expectations are really hurting us, and they are permitting those who don't believe what we believe to relegate us to the lunatic fringe.

Let me, for example, talk just for a moment about corn ethanol. I am sure you all saw the article in the *Washington Post* about three weeks ago. I had done those back of the envelope calculations a long time ago, and I didn't sign onto a single corn ethanol bill, because it was, I was afraid going to be a cruel hoax as it turned out to be. If we used all of our corn for ethanol, all of it, and discounted it for fossil fuel input, it would displace 2.4 percent of our gasoline. And they noted correctly, if you tuned up your car and put air in the tires you would save that much. So we have made essentially no contribution to relieving our dependence on fossil fuels.

And I would submit that maybe we have gone backwards environmentally, because what we are going to do is to take land out of agriculture reserves that shouldn't be farmed, and we are going to put it into farming because there is a potential profit to be made by growing corn. Remember, there is an 80 percent of all the energy you get out of corn is represented by fossil fuels you put into growing the corn. So we may have gone backwards environmentally while we are making essentially no contribution to displacing our reliance on fossil fuels.

And I am concerned that we are going to be in this same place on biomass. And our first testimony was said that we could do this, that is get this more than a billion tons without negatively affecting the Nation's ongoing needs for food or fiber. I would like to see those analyses.

Our top soils are not increasing in quantity and quality, and there is such a thing as tilth and the need for organic material in soil, because it doesn't have that, it isn't top soil, it won't hold water, it won't hold nutrients. And I am very concerned that that switchgrass that we salivate over is growing this year because last year it died. Now, maybe switchgrass is kind of unique, because I think most of the nutrients are transported back into the roots, but most other crops are not that way. And this year's crop that is

growing, of weeds is growing because last year's crop of weeds died and is fertilizing it. So I think that what we are going to get out of biomass is going to be considerably less than we anticipate.

And I am just concerned that these exaggerated expectations make us look silly, and I don't want to go there.

Our first presenter noted that if we took all of our soybeans and converted it into biodiesel, it would displace less then eight percent, and I am sure that is gross and net, maybe that shrinks to four percent. Am I right? So if we took all of our soybeans and made biodiesel out it, we would displace four percent of the diesel fuel that our across-the-road trucks use.

I am just, am I wrong, Mr. Waskow, that we may, in fact, be going backwards environmentally? You know, we are very much like the pioneer in our country who worried about the worm eating the tassels on his corn, while the wolf was eating all of his cows. There is nothing you shouldn't worry about, about fertilizing his corn, but he really should worry about that wolf eating the cows, shouldn't he? And I just think that we are focusing on the wrong thing here. We need to do it, but it is just have you done enough to have left the other undone. Am I wrong?

Mr. WASKOW. Well, I think we certainly have the potential to go backwards. I think we are at a critical moment where we have to decide, in fact, how we are going to pursue the biofuels sector and industry, and I think we do have an opportunity now to place environmental safeguards on the sector in such a way that it can propel us forward. But I think our concern is that some of the legislative mandates may be running out ahead right now of some of the science and also almost all of the safeguards that we are going to need to insure that this does bring us to the potential we are hoping it will.

I would just add that establishing targets like a five percent of all diesel requirements, one of the concerns we have actually has to do with imports. If you establish targets that can't be met with productive inside the United States, the likelihood is that we will start importing significant quantities of feedstock and biofuels themselves, and in many cases the ways in which those feedstocks are produced is quite damaging. Indonesia and Malaysia with palm oil is the most extreme example, but I think other instances are going to be problematic as well. And so I think when setting very high targets for use we need to think about not only where it is going to come from in the United States but where it may come from on a global level.

Mr. BARTLETT. Thank you. I yield back, Mr. Chairman.

Chairman LAMPSON. Thank you, Dr. Bartlett. I will now yield five minutes to Ms. Biggert.

Ms. BIGGERT. Thank you, Mr. Chairman, and I am sorry I missed the testimony, but I do have a couple of questions.

DOES RESEARCH NEED TO BE FEEDSTOCK SPECIFIC?

First of all, does our research on the efficient production of ethanol from the cellulosic material need to be feedstock specific?

Dr. FOUST. Yes, that is true to a degree, however, you can, you don't have to go through feedstock by feedstock. You can group them. For the enzymatic conversion fermentation, yes, the enzymes

themselves are feedstock specific. However, agriculture grasses, corn, wheat, switchgrass tend to behave very similarly, as do the wood. So it is not as onerous as it might sound that you have to develop the technology feedstock by feedstock. And once those enzymes are developed, they are fairly easily tailored. For the gasification approaches, no. Those are not feedstock specific. Those are general technologies that work across the feedstock resource base.

Ms. BIGGERT. Well, once we figure that out then will it take a markedly different or marginal, different process to make the cellulosic ethanol from other feedstocks? I mean, will it be so necessary that we would have to have a different center do that?

Dr. FOUST. I don't think, I would say as far as tailoring the enzymes to the specific feedstock and the mix of those enzymes, that would be the companies' proprietary advantage that deployed that technology. So as far as centers developing that and under government funding, no, I don't think that would be necessary.

MORE ON BIOENERGY RESEARCH CENTERS

Ms. BIGGERT. Well, the DOE is currently evaluating proposals to spend 250 million over five years to establish and operate two new bioenergy research centers to accelerate the basic research of, and development of cellulosic materials and ethanol and other biofuels.

So if the cellulosic ethanol is really feedstock neutral, do we really, and I know it was discussed about whether five should be or 11 was too many, couldn't we just do it in those two research centers that the Department of Energy is developing?

Dr. FOUST. Those research centers are actually looking at very fundamental biological breakthroughs, what they refer to as systems biology, where you take the current three-step process that we are talking about that Mr. Dinneen talked about as near-term commercially ready to a single-step process that produces the ethanol at rates two to three times what current processes are, about half the cost. And what they are really looking at is advanced technologies to get down to processes as simple as corn or even sugar-based ethanol.

So they are really far-reaching basic research, which I think is good. They are not specifically looking at tailoring specific enzymes to regional feedstocks. They are not near that applied type of research.

Ms. BIGGERT. Well, it sounds like you are saying that the research that Mr. Dinneen was talking about is more advanced in, as long as it is specific feedstock, but the, what the DOE is looking at is making feedstock neutral but more advanced basic research which will lead to be able to do probably the same thing at different centers? Am I simplifying that too much, or is that——

Dr. FOUST. I think in general that is a true statement. I mean, there is, I guess the best way to put that in context is what Mr. Dinneen and what I were, what I was talking about in my testimony is this cellulosic ethanol technology, the first generation is competitive with crude oil prices at about gasoline, crude oil prices about $55 a barrel. If you look at projections, Department of Energy's as well as the National Petroleum Refinery's projection, crude oil prices are expected to drop into, if you truly believe those projections, into the $40 range. And what that, those advanced tech-

nologies really enable the cellulosic ethanol not to go uncompetitive as crude oil prices would drop into that range, as well as higher yields, higher efficiencies with reduced environmental impacts.

I think that is a long-winded answer to your question, but I guess what I was trying to differentiate is there is a near-termness and long-termness to those different——

BIOREFINERY ENERGY EFFICIENCY

Ms. BIGGERT. Then my other question would be does it make sense to create the stand alone biorefinery energy efficiency program rather than to incorporate it into the research, this research into the integrated biorefinery demonstration projects that were authorized in EPACT? It seems like we are trying to do the same thing when we have already authorized this in 2005.

Dr. FOUST. The way I understood it is the EPACT 2005, especially the Section 932 provisions.

Ms. BIGGERT. 932D.

Dr. FOUST. Okay. We're to incentivize near-term deployment to address the risk of capital and investor ease and cellulosic ethanol. However, those plants that are being, that were selected by DOE, although they are good technologies as past peer review, they are really, you know, sub-optimal as far as competing long-term competitiveness with gasoline.

So all sections of the EPACT, the 932 and all sections address both issues; the commercialization, the need to development to risk, to overcome the risk hurdle for financial, as well as the research needed to make the technology competitive in the long run. So I would think based on the economic analysis that my lab has done and others, that both aspects are necessary to really move this industry to long-term potential.

Ms. BIGGERT. Thank you, Mr. Chairman.

BIOFUEL FEEDSTOCKS: RESEARCH, DEVELOPMENT, AND ESTABLISHING STANDARDS

Chairman LAMPSON. You are welcome, Ms. Biggert. I now recognize myself for five minutes as we start our second round of questioning.

For Dr. Foust, there has been a great deal of discussion both in Congress and in the research community about other possible feedstocks with a growing focus on algae biomass. You noted that algae shows considerable promise long-term, but the technology still needs considerable work, and I was hoping that you would elaborate on this point to help give the Committee a better idea of what technological barrier exists and where research should be focused to see the greatest improvement in the algae-related technologies.

Dr. FOUST. Thank you, Mr. Chairman. That was actually a good question. I look forward to answering that.

I think the real challenge is developing these algae strains. The strains that have been developed are native strains, and they are biological organisms, which to get them to express oils, which is basically fats, you have to starve them. They will only express oils when they are starved, and they will only grow when they have plenty of nutrients. And the challenge to get this to be economically

viable is to get them to do both. So you have to get them to express oils, fats, while they are also growing. And that is a significant biological challenge. The scientific, the microbiology community of which a lot of those people are at my laboratory, believe that can be done and believe that we can get these yields, 1,000, 10,000 times of the soybeans or other oilseed crops.

However, they realistically put that at about a five to ten-year effort, and then once that is done, then they are grown in these shallow-water ponds, and you have to develop, it is an easier challenge but it is an engineering challenge—ways to harvest them and crush them so you can get the oil out at pennies per gallon to compete with diesel fuels at the $1, $1.50 gallon range.

Chairman LAMPSON. You noted that there are already fuel quality standards in place for ethanol and biodiesel and these standards have been created to match the current production methods. Once we get past the technological hurdles to the broad use of cellulosic ethanol, surely we will be producing ethanol from a variety of feedstocks. How will we insure that fuels derived from diversed feedstocks are fungible? Will we need a better system for establishing standards since we will no longer be able to rely on production methods of one item, corn starch, and how will we be able to insure conformance with the standard, when multiple feedstocks are use for fuel development?

Mr. DINNEEN. Dr. Foust may want to jump in.

Chairman LAMPSON. Okay.

Mr. DINNEEN. But just with respect to ethanol, ethanol is ethanol no matter what the feedstock is. There may be some feedstock-related issues with some of the other renewable fuels, but you can produce ethanol from corn. It is the same product as if it is produced from sugar or from cellulosic material or from, you know, whatever. And the specifications that has been developed have been developed for its performance characteristics along, you know, through a process with the refineries and the automakers through the American Society for Testing and Materials (ASTM). So there really aren't standards issues with respect to ethanol, but Dr. Foust or Mr. McAdams may want to comment on some of the other renewables.

Mr. MCADAMS. I would say, Mr. Chairman, that if you look at the second and third generation, particularly renewable diesel technologies, that the standard they hit is D975, which is the standard currently for diesel. It is one of the real confusing nomenclature problems we have in this debate between a biodiesel which is a coined term that comes out of the tax law, and now you have a new term renewable diesel, which is another coined term coming out of the tax law, and then their third term is green diesel.

But most of the second, third, and fourth-generation processes that make diesel whether it is Fischer-Tropsch or whether it is the Amyris technology or whether it is Neste, they make a D975 diesel spec, which is through the tier one process of EPA, and they are very comfortable with going through that process.

Dr. FOUST. I would agree with what my colleagues said. Mr. Dinneen is right. One of the beauties of ethanol is that it is a single molecule fuel, so whether you make it from corn, sugar, or cellulose, it will be the same. However, there will be trace contami-

nants that when it is distilled and standards to control the contaminant levels, the water levels, pipeline issues would be desirable, especially for blending as one section of the Bill specifically addresses, the lower ethanol blends greater than E–10 but less than E–40. As those blends come into play, the gasoline standards and the ethanol standards for those various different blends will need to be controlled. It will be more of an issue.

Chairman LAMPSON. Thank you very much. I now call on Mr. Inglis for his five, extra five minutes.

Mr. INGLIS. Thank you, Mr. Chairman. Dr. Foust, it is very exciting what you were just talking about, about an organism that may create or express oils at a faster rate. That is pretty exciting. What is the best thing government can do to help facilitate that, or is it going to happen because the marketplace is pushing us to that? Which would be a fine answer. We are from the government. We are here to help, but if, you know, if we can help by not helping so much, maybe that is what we need to do.

Dr. FOUST. No. Thank you. That was a good question. I think because that is far from being a commercially-viable technology unlike corn ethanol or biodiesel where there really isn't a rule for the government beyond standards, it is commercially viable so it is appropriate rule for industry to develop and deploy those technologies as they are currently doing. Right now it clearly would be economically unfeasible to deploy this algae technology without these improved strains.

So I think the government's role would be kind of, again, as was accentuated in this bill, to increase the funding for the field of biofuels in general of a significant portion of this to go in these high-potential, high-risk, high-payoff, but not near commercially viable type technologies.

Mr. INGLIS. Mr. Berger.

Mr. BERGER. I would echo those sentiments, and I think, you know, one thing to really sit back and kind of think about here is that you got to start someplace, and I think you have heard that consistently across the panel. And moving, just speaking from a for-profit company such as Standard Renewable, we are starting in what is economically feasible right now, at least, you know, with the existing tax credits, and then we are more than happy to invest our profits in these new technologies and be able to move them into the marketplace. Nothing would please us more and our shareholders to have the kind of numbers that Dr. Foust spoke about. Those are the kind of numbers where, you know, people in the oil business would get a little bit nervous to say the least.

But at the end of the day what is that really going to require from companies like ours to the government? We want consistent policy. We want to know that over the next few years that biodiesel in whatever form it is or ethanol, whatever form it comes in, is going to have a place here to stay so that we can go in and take those profits and put them into these new technologies and deploy those new technologies.

Mr. INGLIS. I suppose that the fluctuation in the price of gas, is that a larger determinant of that question than what we are talking about there, that research or, I mean, in other words, if gas is $3 a gallon, you have got a business. Right? If gas is $1.80 a gallon,

I guess you don't have a business. Right? I mean, don't answer that question. It might upset your shareholders but——

Mr. BERGER. No, no. I am very happy to answer that. Actually, you know, from, speaking from the biodiesel business, and I will let the other, Mr. McAdams and others talk about their respective battlefields, it really depends upon just as it does in the crude oil business. You know, what is the profitability from taking a barrel of oil, whether it is vegetable oil, whether it is crude oil, and converting that into a product, and what is that product trading for. So as soybean oil, for instance, is a very-well traded commodity, and I would also like to point out that the U.S. is one of the largest exporters and in some cases the largest exporter in the world for soybean oil. The world. And so what we are talking about here is we are going to keep more of our bean oil here at home. We are not the importation of oils back into this country in a massive way. At least we don't anticipate that to be the case any time soon. So from our standpoint as long as it is fluctuating with that bean oil price and in looking at the product price, it doesn't necessarily mean that crude oil has to be, you know, or crude oil-based products have to be $3, a buck 80, two bucks, four bucks, whatever it is. It is really more of a market-based approach to profitability.

Mr. MCADAMS. I would say across the whole fleet of the technologies I represent whether it is Fischer-Tropsch or Invomatic, these people are trying to, they look at the price of crude, and they are trying to develop a range of technologies that can compete across $40, $50, $60 crude ranges. And a $60 crude solves a lot of technology problems because it gives them some headroom.

In terms of your specific question about what not to do if the Congress chooses a standard and says, okay. To hit the RFS target, you have got to be ASTM D–6751, then that means all those companies that make a D–975 fuel don't count against that standard, and you remove the certainty and the investment that all those companies want to put in the marketplace to develop these fuels. And that is why my coalition was formed to just try to request technology neutrality across all of these frames, either the RFS and others.

Mr. INGLIS. Thank you, Mr. Chairman.

Chairman LAMPSON. Ms. Woolsey.

MORE ON ENVIRONMENTAL AND FOOD SUPPLY CONCERNS

Ms. WOOLSEY. Thank you for the second round, Mr. Chairman.

Mr. Waskow, in your testimony you point out that we need to improve the model for evaluating the impact of biofuels on the environment. How much funding do you think Congress would need to dedicate to improve this model and get the results, get good results? I mean, real results. And do you know if there is any work being done anywhere? I am creating a new model.

Mr. WASKOW. That is an excellent question. I don't know what would be required in terms of funding to address those needs. There are a number of researchers around the country, not only at Argonne but at other institutions and I am sure with federal funding backing many of them doing some of this work. But it is clear that we have to step up the pace. We need to be able to do this work not only for corn, which has been analyzed in some detail now

but also for a number of other feedstocks to be able to make adequate comparisons, and we need to be able to look better, as I was saying, at sections such as land use changes.

I am happy after this to explore with colleagues and others what the cost would be. I am sure it is not extravagant.

Ms. WOOLSEY. You know, I had a thought for any and all of you if you wanted to. As we talk about the different forms of biofuels, what happens when a farmer invests in say, I will use corn because that is where I am today, and all of the sudden there is a much better way to make ethanol, and this, what happens to that corn production? I mean, it is a real gamble, isn't it?

Mr. DINNEEN. Well, the marketplace is going to do what the marketplace is going to do, and if, indeed, farmers can make more money producing miscanthus grass than corn, I mean, that is what the, you know, they will do. It is a risk certainly but, you know, I think the marketplace hasn't yet figured out what the next generation of renewable fuels is going to be. There is a lot of talk about bio-butanol and bio-butanol could be produced from agricultural feedstocks as well, and that might be something that farmers would grow their feedstocks for.

Ms. WOOLSEY. But, I mean, we cut down forests, we put berries out of business, we make it impossible for the Mexicans to have corn tortillas, and then we decide corn is not it or one of these other feedstocks you had talked about. Risks?

Mr. DINNEEN. You mentioned the tortilla issue a couple of times, and I appreciate that that has——

Ms. WOOLSEY. I worry about that obviously.

Mr. DINNEEN.—been one of those things that has been in the media, but it is, there is a lot of analysis out there that would suggest a three-cent per pound increase in the price of yellow corn is not responsible for an 80-cent increase in the price of white corn in Mexico. There are lots of reasons why the Mexican market is doing the things that it is doing and the relationship to the increased demand for ethanol from corn production is not a really strong relationship. But I understand your point that, you know, we are putting a lot of stock right now in ethanol from grain, but I would say to you and to Congressman Bartlett as well that corn ethanol, the existing ethanol industry is not the end of this road. It is the beginning. This industry is providing the foundation upon which we can grow a more sustainable and more economic renewable industry in the future.

And I appreciate that there are concerns with the existing industry today, but don't lose sight of the fact that it is just the beginning, and it is not a cruel hoax. It is the foundation upon which this nation is going to become more energy secure.

Ms. WOOLSEY. Mr. Berger.

Mr. BERGER. I would like to echo. Here are some numbers to think about, and they are quite scary. If you look at the energy issues that we face, they are more grave than the potential issues, and I think than anything that can come about in the agricultural space at this point in time. There are about a million and a half barrels per day of biofuels produced in the world, and there is about two and a half million barrels a day of crude oil spare capacity estimated because the people who love us so dearly produce

much of the oil in this world, and I mean that sarcastically, do not give us data on that. But that is probably pretty close to that. If you were to basically eradicate biofuel usage and the U.S. is a big producer of those biofuels, you would take about a million and a half barrels of capacity off the market. Even if you did it over a slow few month's period of time.

Crude oil, I don't know where it is going to trade, but it is not going to trade $66 a barrel. It is going to trade north of 100 and quite a bit north, and the reason is is that commodities are priced on the margin, and when you take that kind of, what may even seem to be four percent or five percent, it is just small, I can tell you from experience you will see exponential moves in commodity prices such as crude oil, natural gas, et cetera.

So the energy problem is very dire, and what we are representing here today is, it is not the silver bullet. It is not the end all, be all. It certainly has problems. But it is a start, and it is an American start to solve this problem.

Ms. WOOLSEY. Well, thank you. You are preaching to the choir with this one. Don't think for a minute I am sitting here trying to defend the fossil fuel abusers of the world. Believe me. But I want to do it right. I mean, we have a chance. This is new. We don't have to, you know, shortcut and then later say, oh, it is going to cost 100 times more because we didn't do it right in the first place. That is my point.

Thank you, Mr. Chairman.

Chairman LAMPSON. You are welcome. Mr. Bartlett.

Mr. BARTLETT. Thank you. You mentioned our biofuels contribution. You need to discount that by the fossil fuel contribution to the production of those biofuels, and if we hadn't turned the corn into ethanol, we would have four-fifths as much fossil fuel. So the real biofuels contribution is fairly trifling.

You are exactly right that we are on the verge of not having enough oil. One of you mentioned that the Energy Information Agency is suggesting crude oil prices will drop to $40 a barrel. I think you are far, far more likely to see $100 a barrel oil than you are $40 a barrel oil.

I would take the prognostications of the Energy Information Agency with a lot of caution. They are basing their prognostications on a series of computer simulations that USGS has run. They did these in about 2000. They have been tracking since then, and the actual data points don't begin to follow what they said was the main, there is a very strange transition from F, which is frequency in the USGS slides, to P, which I guess is probability. I have no idea what has happened in those two agencies. And I have talked with the chief statistician from the Congressional Research Service because I thought I was losing my mind, and he assured me that I wasn't, but there is just another rational explanation of the way statistics are used or misused by these two agencies. So I would be very jaundiced as to how much reliance I placed on, by the way, EIA does a really credible job of tracking what has happened. They have a bunch of economists who do a very poor job of predicting, in my view, what will happen.

And, you know, they are, they believe like many of my colleagues, I am a very conservative Member of the Congress, but I

try not to behave so that I might be considered an idiot. And many of my colleagues worship the market. They believe that it is both omniscient and omnipotent, that it will take care of everything. Where are resources infinite? I might tend to agree with them.

I talked to you on this analogy, worrying about the worm that ate the silks on your corn while ignoring the wolf that was eating your cows, and I need to explain who the wolf and the cows are. We use 21 million barrels of oil a day. All of these biofuels you are talking, and I am a huge proponent of these things. I am the greenest guy in the Congress probably. But, you know, we use 21 million barrels of oil a day, 70 percent of that in transportation. We are making really quite insignificant contributions with these biofuels, and if you are wildly optimistic about the productivity from these are going to, in the future, make trifling contributions. What we really need to be focused on is a lot of conservation and a lot of efficiency. I wish I could show you a slide that shows our oil consumption up through the Carter years. Every decade we use as much oil as had been used in all of previous history. Boy, have we changed that since then. Have that exponential occurred when extrapolated, we would be through the—what that means, of course, is that when you are half out, when you have used half the world's oil, you have ten years remaining at the current use rates.

Now, we were about halfway through the age of oil. We have been 150 years in the age of oil. We got about another 150 years to go. We are not running out. We are running out of our ability to get oil as quickly as we would like it, and it is going to be more expensive and harder to get in the future.

When I said we were nibbling at the margins, what I meant was we have an enormous problem, and we need to begin with an aggressive conservation program.

I led a group of nine people to China over the Christmas holidays. I spent New Year's Eve in Shanghai, and they begin their discussion of energy by talking about post-oil. Wow. I wish our guys got it. They are talking about post-oil with a great five-point program. Conservation is where it begins. Diversify. Do as much of that at home as you can. Be kind to the environment. That may shock you. That is the number four point. They recognize they have a problem, and the fifth one is international cooperation. I don't see us reaching out.

I want to thank you all very much for what you are doing, but I think we need a huge wake-up call in America, and if you are counting on $40 oil, you are probably counting on winning the lottery to solve your personal economic problems. I think the odds are about the same.

Thank you.

Chairman LAMPSON. Wow. Thank you, Roscoe. Interesting thoughts and I have to agree with some of what you said.

I am not sure we have got time to go——

Mr. BARTLETT. Some of it? What don't you agree with?

PURE ETHANOL

Chairman LAMPSON. I am not sure I can repeat it all.

I am curious about one thing, and I am not sure, unless Mr. Inglis wants to go for another round of questioning, but would any of

you or all of you, however you want to do it, comment on when, if we will, when will we reach the point of not blending fuels, but actually using 100 percent of a biofuel for either transportation or the generation of electricity?

Mr. DINNEEN. Well, it is going to take some time. I mean, we have a fleet of vehicles on the road today that will take a fair amount of time to turn over. Ford, General Motors, Chrysler have already committed to producing 50 percent of their vehicle fleet that they will produce as flex-fuel vehicles in 2012.

So, I mean, we have about 17 million vehicles a year that we purchase, about 45 percent of those are from the domestic market. That suggests about four and a half to five million in flexible-fuel vehicles coming on the road——

Chairman LAMPSON. It is flex-fuel. That is a blend.

Mr. DINNEEN.—by 2012.

Chairman LAMPSON. What is it going to take to get past that?

Mr. DINNEEN. It is a blend of 85 percent ethanol. So, I mean, it is a good amount of petroleum displacement.

Mr. MCADAMS. Price.

Chairman LAMPSON. Price?

Mr. MCADAMS. Price. And the reason I say that, if you just take the current economic model, there are a number of technologies that could make, let us take the diesel fuel. That could make 100 percent diesel fuel that could run in and existing engine so you don't have to have a new infrastructure, go through the current pipelines. They could make that kind of fuel 100 percent renewable, but it wouldn't be at today's current price.

Chairman LAMPSON. I was just curious. Anybody else wanted to make the comment. I believe that has got to be one of our goals as well.

Does anyone want to—Roscoe, you want to make——

Mr. BARTLETT. Mr. Chairman, I would like to note that a day will come when we are not blending. Geology will assure that. We are going to transition from fossil fuels to renewables. My concern is it is not going to be on our terms but on the terms of geology, and I think that is going to be a really rough ride.

Chairman LAMPSON. Thank you very much. I have more questions, and I am sure some of you do as well, so if you all will allow us to, we will submit these questions in writing and get them over to you, and if you wouldn't mind getting back to us, we would appreciate it.

I want to thank all of you for appearing before our subcommittee this afternoon. Your testimony has been very helpful. I believe that the legislation we have discussed today moves us forward in our effort to develop a more diverse supply of energy.

And under the rules of the Committee the record will be held open for two weeks for Members to submit additional statements and any questions, additional questions that they might have for the witnesses, and this hearing is now adjourned. Thank you very much.

[Whereupon, at 4:16 p.m., the Subcommittee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Thomas D. Foust, Biomass Technology Manager, National Renewable Energy Laboratory

Questions submitted by Chairman Nick Lampson

Q1. You mentioned that the technology for the development of cellulosic ethanol is "relatively immature." You went on to say that the goal for the production cost price point on a gallon of cellulosic ethanol is $1.31. If the price of corn continues to rise, how will this affect this target price point? And more importantly, what are the major technological barriers to realizing a cellulosic based fuel that is competitive with corn-based ethanol?

A1. The $1.31 production cost price point on a gallon of ethanol is based on competitiveness with corn ethanol at historical corn prices of $2.50/bushel. Since corn costs represent almost 50 percent of the total costs for corn ethanol production, corn ethanol production costs will increase significantly with the rising costs of corn. Equally, if not more important for long-term economic viability of ethanol as a transportation fuel, the $1.31/gal production cost price point is also based on competitiveness with gasoline on an energy adjusted basis at a crude oil price of $55/barrel. Therefore, both corn prices and crude oil prices will directly affect the economic viability of cellulosic ethanol at the production price point of $1.31/gal. As corn prices and/or crude oil prices increase above historical levels, the competitiveness of cellulosic ethanol will increase and accelerate its deployment in the marketplace.

The National Renewable Energy Laboratory (NREL), DOE, and the biofuels research community at large have had numerous discussions about whether we should periodically adjust our cellulosic ethanol price point targets based on current market realities. The collective decision was to update on an annual basis the $1.31/gal production cost price point target to reflect the latest inputs such as cost of steel, feedstock costs, and labor costs. NREL has spent considerable effort in developing rigorous technical and economic models that allow us to directly relate technical and scientific targets to production cost targets. This allows us to give our scientists and engineers technical targets to achieve and allows us to track and report progress and research spending towards the targets accurately to DOE.

Q2. There seems to be universal recognition that the current distribution system and infrastructure for biofuels is inadequate to handle large volumes of fuel. Noting that you mentioned two options—either using the existing petroleum infrastructure or developing an alternative infrastructure—I wanted to focus on the existing infrastructure. What research is still needed to determine if this is a viable option? What changes, modifications, treatments or even cleansing would be needed to use this infrastructure to carry biofuels? Do you believe it would be possible to use some of the pipelines for multiple uses, carrying both biofuels and petroleum based products at different times?

A2. Distribution of fuels is accomplished by several methods, including barge, tanker truck, rail, and especially pipeline. Infrastructure refers to the larger set of equipment and processes, including storage capacity necessary to utilize the fuel, tanks, pumps at filling stations, etc.

Research is needed to determine if utilization of the existing distribution system is a viable option. The issues of concern for ethanol in pipelines are 1) corrosion, 2) water miscibility and phase separation, and 3) solvency of ethanol. Ethanol-related corrosion problems can result from the particular attributes of the fuel and how it behaves in pipelines. There is evidence that ethanol in high concentrations can lead to various forms of corrosion including internal stress corrosion cracking that is difficult to detect. Fuels in pipelines tends to pick up water along the way, and ethanol accentuates that problem because it is hydrophilic and low-concentration ethanol blends have a tendency to phase separate with gasoline in the presence of a small amount of water. Because ethanol acts as a solvent, it will tend to clean out the existing pipelines of tars, gums, and other impurities that can degrade the quality of the fuel product. Although some research is currently being conducted to find solutions to these issues and to help determine what changes need to take place in order to leverage the existing systems, it is minimally supported. To truly address this important issue critically important to the ultimate success of the biofuels industry, a comprehensive research and testing program to address these issues need to be initiated. This research program needs to involve pipeline owners and current users to ensure that rigorous testing programs are put into place to address these issues so that this area moves forward. We understand that in Brazil ethanol

is shipped via pipelines and we need to better understand how the technical issues have been resolved there.

Q3. Addressing issues related to readily available information on biofuels technologies, you noted that the Department plans to fund the creation of a Biomass Data Center later this fiscal year. I have several questions related to this effort:

Q3a. When was the announcement made that the Department would pursue this effort?

A3a. An announcement has not yet been made because the Biomass Data Center (BDC) concept was just recently developed. DOE decided to initiate and fund the BDC following a February 2007 visit to NREL, during which we reviewed the existing information on the use of biofuels already contained in DOE's Alternative Fuels Data Center (AFDC) (*www.eere.energy.gov/afdc*), which is produced and maintained by NREL. The AFDC is one of the most extensive alternative fuel databases and a widely-used website by stakeholders across the country. It currently contains extensive information on fuel availability, retailing, nationwide station locations, federal and State incentives and laws, and available vehicles with information from across government and industry. The new BDC is envisioned as an extension of the AFDC that will capture similar information related to feedstocks, fuel production, distribution infrastructure, and relevant federal and State programs. The focus will be on supporting the decisions within the private sector and State and local governments that are required to accelerate the production and use of biofuels in the near-term. The R&D-related data sets which are proposed in Section 2 of the Committee's bill would be of significant value to the BDC and could readily be included in the current planning.

Q3b. You stated this would be done in phases. Can you give us more detail about time period for development of the Center and when the information will begin to be available?

A3b. We expect the site to be available with links to existing information in the fall of 2007. Initial activities will focus on a comprehensive inventory of available data and information from government and industry sources, and providing a central clearinghouse for these resources. Gaps identified during the inventory will be the focus of the next stage over the remainder of FY08 with targeted data-gathering activities where appropriate. Maintenance and updating of the data, along with development of data mining and analytical tools, will be the focus of subsequent years.

Q3c. What will be the process of getting information from the private sector?

A3c. Existing methods of working with industry representatives and associations for the AFDC will be replicated and expanded. NREL has a long and successful history in forming and capitalizing on these interfaces. The focus will be on publicly available data and information, and information provided voluntarily by the private sector. We put significant effort into gathering accurate information and updating it regularly. We verify data independently so that the data center contains unbiased, factual information that can provide the basis for sound decisions by individuals and businesses in the private sector. The biofuels R&D information that the Committee proposes could readily be included because NREL is the home of the National Bioenergy Center and the focal point for significant biofuels R&D; knowledge of other laboratory, industry, and academia progress; and technology transfer to the marketplace.

Questions submitted by Representative Ralph M. Hall

Q1. In regard to the six cellulosic ethanol biorefineries,

a. Where are they to be located?

b. When will they be operational?

*c. **Do we need the technology before the biorefinery or is the biorefinery part of the research?*

d. What feedstock will they be using? Will it be different at each one?

A1. Below is the list of the awardees from the EPACT 2005 Section 932 solicitation, there location, the feedstock they will be using and when they will be operational. **In all cases additional research is needed as part of the overall effort. Each of these companies is using its existing technology in order to demonstrate, at this point in time, the viability of their approach and to advance the overall understanding of the opportunities and issues in terms of cellulosic ethanol. Much work

still needs to be done to advance the overall technology available to the Nation in order to improve efficiencies, lower costs, and accommodate a wide range of feedstocks.

BlueFire Ethanol

a. Southern California
b. Construction start: 2008. Completion: End of CY 2009
d. Sorted green waste and wood waste from landfills

Poet (Broin)

a. Emmetsburg, Iowa
b. Construction start: CY 2007. Completion: 30 month timeline.
d. Wheat straw, barley, corn stover, rice straw, switchgrass

Iogen

a. Shelley, Idaho
b. Construction start: 2008. Completion: End of CY 2010
d. Wheat straw, barley, corn stover, rice straw, switchgrass

RangeFuels

a. Treulten County, Georgia
b. Construction start: CY 2007. Completion: CY 2011
d. Wood residue and wood energy crops

Abengoa Bioenergy

a. Colwich, Kansas
b. Construction start: Late 2008. Completion Late CY 2011
d. Corn stover, wheat straw, milo (sorghum)

Alico Inc.

a. LaBelle, Florida
b. Construction start: CY2008. Completion Late CY 2010
d. Wood, ag residues

Q2. In talking about infrastructure, you say that "the current biofuel distribution infrastructure is inadequate to handle large volumes of biofuels." Please explain the inadequacies.

A2. Ethanol is currently distributed by rail, tanker truck, and barge. Several studies have shown the inadequacies of the existing distribution system to handle larger volumes of biofuels. For example, at issue with barge transportation is inter-coastal waterways traffic. Locks along the major rivers are advanced in age and undersized for even current transportation load. This already causes long delays during peak months.

Regarding rail transport, equipment capacity has been tight for several years, and additional rail cars and rail lines are necessary to handle the increased biofuels production. Tanker trucks for gasoline and diesel are only typically used for short leg distribution, typically from pipeline terminal to local refueling station. For ethanol tanker trucks are commonly used for longer leg distributions. Although the additional truck traffic on highways is not necessarily problematic for the current ~5 billion gallons per year of ethanol shipped, the additional tanker truck traffic for large ethanol volumes (> 20 billion gallons per year) would put significantly higher truck traffic on highways.

Additionally, pipelines are a much more energy efficient and cost effective way to ship fuels so hence significantly less energy is used and cost added in transport as opposed to the current ethanol method of barge, rail and truck.

Q3. You mention the NREL is creating an on-line Biomass Data Center. Based on this and the function of the Data Center, do you feel that Sec. 2 of the discussion draft, "Biofuels and Biorefinery Information Center," is needed? Do you have any other thoughts or suggestions about the discussion draft?

A3. The Biofuels and Biorefinery Information Center section is still needed. This section puts a focus on the inclusion of biofuels R&D and technology transfer information into the center, which is an important and value-added concept. This needs to be fully integrated with the Biomass Data Center (BDC) that we discussed, although the exact architecture is still being planned. In addition, this section of the

bill would ensure that the Congressional appropriators recognize the importance of this provision and provide funding to enable its full development and maintenance.

The Biofuels and Biorefinery Information Center will allow DOE and NREL to present accurate and up-to-date information about the status of various biorefinery and biofuels production technologies. Providing credible, unbiased information on these technologies will enable informed analysis by technology companies as well as energy and environmental policy-makers. The focus of the BDC and the Biofuels and Biorefinery Information Center will be complementary, and together will provide reliable information about the present and future biofuels industry.

In addition, the toll-free telephone assistance included in the bill will complement the on-line resources. NREL has extensive experience providing this sort of assistance. We operated the National Alternative Fuels Hotline for a decade with consistently outstanding customer feedback. For the last two years, this service has taken a more narrow focus as the Technical Response Service, which fields the more detailed technical questions on alternative fuels and advanced vehicles that enter through the central DOE/EERE Information Center. With additional funding associated with the Biofuels and Biorefinery Information Center, this existing Technical Response Service could be extended to biofuels and biorefinery topics. Past experience has shown that this sort of personal assistance can be extremely valuable to key stakeholders and technology implementers in the private sector.

Questions submitted by Representative Bob Inglis

Q1. Section 3 of the draft legislation seems to limit infrastructure research, development, and demonstration to existing fuel distribution infrastructure. Since biofuels will vary by region, should we also be promoting research, development and demonstration in alternative infrastructure solutions that could prove to be cheaper and more efficient?

A1. Yes, biofuels production will be regionally specific primarily due to the regional nature of biomass and local fuel needs. For example due to the large feedstock production potential of the Midwest, it is likely that this region could be a net ethanol exporter beyond what could be used locally. Whereas for the east and west coasts it is unlikely that they would have enough biomass production potential to supply their high fuel demand needs. Hence dedicated pipelines or rail lines from the Midwest to the coasts might prove to be a feasible cost effective approach.

This would contrast to areas such as the Southeast where the biomass production potential aligns well with fuel demand needs. Hence in this case more localized distribution infrastructures might be a better option.

Q2. Does this draft legislation encourage a departure from food related feedstocks and toward high-yielding non-food related feedstocks?

A2. Yes this legislation by supporting the rapid and focused development of cellulosic ethanol that is price competitive with corn ethanol does support departure from food related feedstocks towards high-yielding non-food related feedstocks. The market will naturally favor the lower cost production route and currently that is corn ethanol. Unfortunately corn ethanol is inherently limited in potential with most experts estimating that the ultimate potential for corn ethanol being 12–15 billion gallons before serious impacts on other uses of corn for food and feed occur. Cellulosic ethanol and other biomass derived fuels can leapfrog this limitation by significantly increasing the ultimate potential by utilizing the much more plentiful biomass feedstock. Cellulosic ethanol technology has the long-term potential to be significantly lower in cost than corn ethanol because it can utilize the much lower cost biomass than corn for its feedstock.

However, because of its immature state it is currently higher cost than corn ethanol and not proven at the commercial scale. This legislation, by supporting ongoing DOE supported research at NREL and other institutions to develop and demonstrate cost competitive cellulosic ethanol by 2012 will facilitate the market place switch form corn to cellulosic ethanol. This transition will stop if not greatly slow the growth of corn based ethanol and reduce the upward pressure on corn and food prices while still affording our nation the opportunity to increase our energy security via domestic production of ethanol.

Question submitted by Representative Jerry F. Costello

Q1. On Tuesday, the U.S. Department of Agriculture (USDA) and the U.S. Department of Energy (DOE) announced a combined total of up to $18 million will be available for research and development of biomass-based products, biofuels, bio-

energy and related processes. They will fund essential research that not only will lead to the creation of new, sustainable energy sources, but also will create new uses and markets for agricultural products. Clearly money is being allocated to look at R&D of biomass. What will this legislation accomplish from an R&D prospective that is not already being done?

A1. The combined USDA and DOE program for the research and development of biomass-based products, biofuels, bioenergy and related processes has been a very successful program since its inception in FY02. Many good projects over the years have been awarded to universities, national laboratories and industrial companies that have addressed many aspects of biofuels and bioproducts technology development. With the many significant challenges that still face the biofuels and bioproducts industry, this funding can be wisely administered by the USDA and DOE to fund meritorious projects to develop needed technology and to address important issues as well as educate scientists and engineers in the biomass area.

Although this is a good cross agency program, it is by no means adequate by itself to address the daunting challenges that face the biofuels industry. The projects awarded by this program tend to be small and limited in duration to three years. Hence, these projects tend to address very specific regional challenges or small individual aspects of the feedstock or environmental issue. These projects are also good at building local support and interest in biofuels but do not address national biomass issues.

The legislation in this bill expands upon this existing individual project effort by supporting comprehensive research and analysis in many areas critical to the ultimate success of biofuels. For example this legislation will accomplish the following key aspects that need support: facilitate a critical investigation of the infrastructure issues associated with large-scale deployment of biofuels; support core research programs at NREL, Oak Ridge National Laboratory (ORNL), Argonne National Laboratory (ANL), Pacific Northwest National Laboratory (PNNL) and Idaho National Laboratory (INL), industry, and universities to develop all aspects of cellulosic ethanol technology from feedstocks through biochemical and thermochemical conversion; and allow comprehensive analysis of critical biofuels issues such as sustainability, greenhouse gas emissions, water use impacts and food price impacts. Additionally this legislation will stimulate the development of a much needed biofuels information clearing house that will be invaluable in delivering the latest accurate information on biofuels technology and other critical issues.

ANSWERS TO POST-HEARING QUESTIONS

Responses by John Berger, President and CEO, Standard Renewable Energy; CEO of BioSelect

Questions submitted by Chairman Nick Lampson

Q1. In your testimony, you noted that there is "A great deal of ambiguity. . .in the renewable fuel marketplace" because "there is very little concrete factual data assigned to specific individual fuels." Do you have a solution to this problem? Is there a need for better coordination of information and materials about the fuels and the process for developing fuels? Would a central federal clearinghouse help remedy this problem?

A1. The EPA is currently working closely with the National Biodiesel Board as well as many government agencies such as the Department of Energy's National Renewable Energy Lab, to create a complete emissions profile for biodiesel. As leaders in the renewable energy sector however, we ask that the Federal Government do more with the creation of a centralized database benchmarking all renewable fuels independently to a baseline conventional diesel fuel. We as an industry will benefit tremendously from factual data outlining what is biodiesel and why is it superior to conventional diesel? In addition, we would like to see information explaining what is renewable diesel and how does it compare to biodiesel and separately how does it compare to conventional diesel? These are the types of questions that need to be researched.

Federal coordination and cataloging of information from federal research on biofuels development processes as well as other aspects of the industry and related industries will be essential to the longer-term goal of creating mainstream renewable fuel. Demystifying the fuels themselves will not only provide the general public with more information and confidence about utilizing renewables but also assist both federal and State bodies in defining credit structures, future industry incentives, etc.

Q2. You mentioned the need for federal coordination of information and cataloging of research as essential to the long-term goal of creating mainstream biofuels. Without such efforts, do you envision a climate where the industry can consistently grow and develop a fungible biofuel supply?

A2. In order for the industry to grow and develop, the marketplace will need to focus and work together towards creating a fungible and quality biodiesel supply. In addition, federal coordination is key in order to foster such an effort, create standards, assist with phase by phase implementation, and lastly to support with necessary funding. Specifically, Standard would like to see a number of infrastructure activities pursued on a federal level, most likely through coordinated work from government agencies such as Department of Energy, the Department of Transportation and the Environmental Protection Agency. Our primary focus at this time is the continued research and development of low blend biodiesel pipeline batch movements. Successful pipeline analysis testing has already been done, on several different pipelines, on several different occasions, yet we as an industry have been removed from the progress. BioSelect is eager to assist with this exciting project and offer assistance to your committee and/or all government agencies interested in working on moving the testing forward. Additional specific research needs currently facing the industry include but are not limited to; feasibility studies on tankage, pipe and pump options, cold flow properties, water issues, stability testing of fuel samples and advanced vehicle technologies. In addition, we believe there is a clear need for an overall general economic study of capital requirements to bring biodiesel to local retail pumps nationwide.

Q3. In your testimony, you mentioned that one of the barriers to realizing biofuels from diverse feedstocks was laboratory and equipment availability. I was hoping that you would clarify a bit. Is the problem better collaboration among corporate entities with research capability, better access to federal research facilities, better access to university research facilities, or the need for a better understanding of where research is taking place and on what specific subject matters?

A3. The issues you have outlined are all contributors to the research and development of the biofuel industry. There are very few private laboratories available that are deemed acceptable by both federal and State environmental agencies which have already caused our industry a great deal of backlogging for new testing. Universities

nationwide have extensive capability but are either understaffed or under funded, which causes research and development with great promise to be defeated.

Q4. Currently, what are your fuel transport plans? What is the cost of transport and how does it impact the price of your products? Is this the most efficient and economical way to transport your fuel? If there is a significant increase the in the use of biofuels, what will be the impact on the cost of transporting the fuel if we continue to use the same mode of transport we are currently using? Is it important that we find other ways, including the use of pipelines, to transport biofuels?

A4. Given the reality of constrained railroads and high cost truck movements, Bio-Select will be moving the majority of both inbound and outbound movements via barge transport. Accessibility to water is an advantage we possess over the interior U.S. facilities, however barges and ships are increasingly in high demand themselves and corresponding costs are also on the rise. As broad biofuels use increases, these already existent issues will escalate. Finding other modes of transportation, i.e., national pipelines, is imperative in order for biofuels to become mainstream fuel.

Q5. You mentioned that standardization of all biofuels is imperative to ensure fungibility. If we do not have clear standards that provide for homogeneous fuel that is fungible, what do you believe will be the impact on our long-term biofuel supply?

A5. Without clear standards the result would be off-spec, low quality fuel entering the marketplace. Bad fuel could cause damage to engines in all sectors and would seriously hinder customer confidence.

Q6. You briefly mention that as the biodiesel industry develops, the demand for highly skilled trained labor will rise. Are you already finding that there is a shortage of trained skilled workers to meet your needs? And, do we need a specialized workforce training program geared to biofuels production?

A6. Education is key. Training and instruction focused on biofuels must find its way into academic curriculum for America's youth nationwide. Offering a tailored chemical engineering skill set to young potential operators would help create a specialized workforce and make the transition into biofuels a streamlined process universally.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Robert Dinneen, President and CEO, Renewable Fuels Association

Questions submitted by Chairman Nick Lampson

Q1. Clearly, there is agreement from many stakeholders that there is a need for better coordination and centralization of biofuels research materials. In your testimony, you noted that it would be more appropriate for industry to serve as a clearinghouse of this information than the Federal Government. And though I understand the value in having industry very involved in this process, with so much research going on with the Federal Government, it seems only logical that the government would coordinate a centralize systems for organizing all these materials. And, a reasonable use of federal funds. So, would an industry advisory group be a good part of an information center to ensure strong industry participation?

A1. An industry advisory group to assist in the coordination of research activities is a good idea and would certainly help to ensure there is as little redundancy in research and development efforts of both the public and private sectors as possible.

Q2. As you noted in your testimony, the discussion draft creates a new Biorefinery Energy Efficiency program. With significant resources already being dedicated to general research, we thought it appropriate to enhance the existing programs with some more focused mission specific efforts. With that in mind, are there other focused research areas that the Committee should consider as we move toward consideration of the bill?

A2. As I stated in my testimony, advances in research on the development of processes to produce alternative energy at biorefineries such as biomass co-generation and biomass gasification, and methane production through anaerobic digestors and waste gasifiers, will be critical to increase energy efficiency and reduce the energy consumption of biorefineries. Encouraging alternative energy sources is an important step toward enacting policies for a more diverse, domestic energy resource portfolio. Other areas where additional research could prove quite helpful would be in co-products, enhancing the feed value of distiller's dried grains and identifying new uses for the proteins, minerals and oils that remain after the starch is converted into fuel at ethanol plants. Finally, research into future market opportunities for ethanol, such as fuel cells, will be important to continued growth.

Questions submitted by Representative Ralph M. Hall

Q1. I am curious about a statement in your testimony. You state, "And there is not an ethanol company represented by RFA that does not have a cellulose to ethanol research program." Are these research programs supported with federal dollars? Are these research programs done independently by the companies? If every ethanol company you represent has a program how many programs are there? If every ethanol company you represent has a program, whether it be privately or publicly funded, do we need more?

A1. It is certainly true that virtually every ethanol company in the country is looking into the possibilities of producing ethanol from cellulosic feedstocks. First, all of these plants already have cellulosic feedstocks coming into the plant in the form of corn fiber. But, more importantly, every company recognizes that the future of ethanol lies in the ability to convert non-grain feedstocks into fuel. Certainly, some of these research efforts have received government support. Recently, the U.S. Department of Energy awarded six grants totaling $385 million to six different companies spread across the country and using a variety of feedstocks and technologies. Federal efforts such as this are invaluable to moving the commercialization of cellulosic ethanol technology further as quickly as possible. Other research is clearly occurring without Federal Government support, and is supported by state grants, foundations, academic institutions or private funds. It all will help. We ought not limit any of these important efforts.

Q2. It is my understanding that, as you mention in your testimony one of the challenges of using more ethanol is a lack of storage capacity. Is the same true if we are to use cellulosic ethanol as a feedstock? If the cellulosic ethanol is not transportable via pipeline, what storage challenges do you foresee? Is it tankage? What are the challenges to collection, storage, and handling of feedstocks other than corn ethanol?

A2. Actually, I do not believe storage capacity will be a major barrier to expanded ethanol production and use. I believe the market will respond with expanded infrastructure as needed, including potentially shipping ethanol via pipeline if the marketplace demand supports it. There will be new challenges as ethanol is produced from new feedstocks, however; none are insurmountable. Because there will be new feedstocks needed for many of these new cellulosic ethanol facilities, growers will need an opportunity to experiment with what will likely be new crops for many of them. Programs to familiarize growers with all aspects of new cellulosic crops will be essential. These programs should include research and development, management, harvest, transport, and storage techniques, and collection of data relevant to new cellulosic feedstocks. Such programs will allow growers to experiment with other crops, and incentivize farmers to plant cellulose crops, and continue U.S. agriculture's investment in our domestic biofuels industry.

Q3. Mr. Dinneen, you mention in your testimony that the ethanol industry has worked to expand a virtual pipeline. That virtual pipeline consists of rail, barge and truck traffic. Are you saying the ethanol industry does not believe there is a need to study the impact of ethanol on pipeline infrastructure? Are you not supportive of research and development that would enable ethanol, or for that matter the finished motor fuel containing ethanol, to be shipped via pipeline?

Q3. As I stated in my testimony, the ethanol industry has worked to expand a "Virtual Pipeline" through aggressive use of the rail system, barge and truck traffic. As a result, we can move product quickly to those areas where it is needed. Many ethanol plants have the capability to load unit trains of ethanol for shipment to ethanol terminals in key markets. Unit trains are quickly becoming the norm, not the exception, which was not the case just a few years ago. Railroad companies are working with our industry to develop infrastructure to meet future demand for ethanol. We are also working closely with terminal operators and refiners to identify ethanol storage facilities and install blending equipment. We will continue to grow the necessary infrastructure to make sure that in any market we need to ship ethanol there is rail access at gasoline terminals, and that those terminals are able to take unit trains.

That said, many stakeholders in the biofuels industry are beginning to look at the practical issues involved with shipping ethanol via a dedicated pipeline. Shipping ethanol in pipelines is done today in Brazil, and it has been done at times in the U.S., as well, in dedicated pipelines. If the marketplace demands it, as it does in Brazil, and there is enough ethanol demand to warrant the investment in the infrastructure for dedicated pipelines, such a system will develop in the U.S. Studying the feasibility of transporting ethanol by pipeline from the Midwest to the East and West coasts will be very helpful.

Questions submitted by Representative Bob Inglis

Q1. Section 3 of the draft legislation seems to limit infrastructure research, development and demonstration to existing fuel distribution infrastructure. Since biofuels will vary by region, should we also be promoting research, development, and demonstration in alternative infrastructure solutions that could prove to be cheaper and more efficient?

A1. In my testimony, I noted that programs that promote geographical dispersion will help to commercialize cellulosic ethanol quickly and continue the trend just beginning to expand ethanol production beyond the traditional corn belt. A wide variety of energy crops and agricultural waste products such as switchgrass, myscanthis, wood chips and corn stover from many regions of the country must all be researched, developed and commercialized as additional ethanol feedstocks to realize the annual production levels envisioned by Congress.

Q2. Does this draft legislation encourage a departure from food related feedstocks and toward high-yielding non-food related feedstocks?

A2. To date, the U.S. ethanol industry has grown almost exclusively from grain processing. As a result of steadily increasing yields and improving technology, the National Corn Growers Association (NCGA) projects that by 2015, corn growers will produce 15 billion bushels of grain. According to the NCGA analysis, this will allow a portion of that crop to be processed into 15 billion gallons of ethanol without significantly disrupting other markets for corn. Ethanol also represents a growing market for other grains, such as grain sorghum. Ethanol production consumed approximately 26 percent of the Nation's sorghum crop in 2006 (domestic use). Research is also underway on the use of sweet and forage sorghum for ethanol production.

In fact, the National Sorghum Producers believe that as new generation ethanol processes are studied and improved, sorghum's role will continue to expand.

In the future, however, ethanol will be produced from other feedstocks, such as cellulose. Ethanol from cellulose will dramatically expand the types and amount of available material for ethanol production, and ultimately dramatically expand ethanol supplies. Further, biotechnology will play a significant role in meeting our nation's future ethanol needs. Average yield per acre is not static and will increase incrementally, especially with the introduction of new biotech hybrid varieties. According to NCGA, corn yields have consistently increased an average of about 3.5 bushels per year over the last decade. Based on the 10-year historical trend, corn yield per acre could reach 180 bushels by 2015. For comparison, the average yield in 1970 was about 72 bushels per acre. Agricultural companies like Monsanto believe we can achieve corn yields of up to 300 bushels per acre by 2030. It is not necessary to limit the potential of any feedstock—existing or prospective.

Ultimately, the marketplace will determine which feedstocks are the most economically and environmentally feasible. While there are indeed limits to what we will be able to produce from grain, cellulose ethanol production will augment, not replace, grain-based ethanol. The conversion of feedstocks like corn stover, corn fiber and corn cobs will be the "bridge technology" that leads the industry to the conversion of other cellulosic feedstocks and energy crops such as wheat straw, switchgrass, and fast-growing trees. Even the garbage, or municipal solid waste, Americans throw away today will be a future source of ethanol.

To continue this technological revolution in cellulosic ethanol, the biomass, bioresearch, and biorefinery research and development programs included in H.R. 2773 will be essential to developing these new technologies and bringing them to commercialization.

Appendix 2:

Material for the Record

SECTION-BY-SECTION ANALYSIS OF

Biofuels Research and Development Enhancement Act "Discussion Draft"

JUNE 12, 2007

Section 2—Biofuels and Biorefinery Information Center

Directs the Secretary of Energy, in cooperation with the Secretary of Agriculture, to establish an information center to serve as a clearinghouse of information related to the research, development, and commercial applications of technologies related to biofuels and biorefinery technologies. This section will help make readily available to interested parties the latest information on methods for biofuels development to help support the rapid growth and deployment of biofuels.

Section 3—Biofuels and Advanced Biofuels Infrastructure

Recognizing the inherent problems with transporting and storing biofuels in the existing petroleum fuels infrastructure, this section establishes and program of research, development, and demonstration for modifications and treatments to existing infrastructure and development of new infrastructure.

Section 4—Biodiesel

The Secretary is directed to submit a report to Congress on any research and development challenges in increasing to five percent the amount of biodiesel, as compared to the current level, the amount of all diesels sold nationally.

Section 5—Bioresearch Centers for Systems Biology Program

The Bioresearch Center program created in the *Energy Policy Act of 2005* is amended to establish at least 11 regionally located centers.

Section 6—Grants for Biofuels Production Research and Development in Certain States

Establishes a research and development grant program in states with low rates of Biofuels production, as is determined by the Secretary of Energy.

Section 7—Biorefinery Energy Efficiency

Adds a new subsection the Section 932 of the *Energy Policy Act of 2005* (Bioenergy Program) to establish a program of research, development, demonstration and commercial application of technologies to increase the energy efficiency and reduce the energy consumption of biorefinery facilities.

Section 8—Study of Increase Consumption of Ethanol-Blended Gasoline with Higher Levels

Directs the Secretary of Energy to conduct a study, in cooperation with the Secretaries of Agriculture and Transportation and EPA, on the feasibility of increasing the consumption of ethanol-blended gasoline at blend levels between 10 and 40 percent.

Section 9—Study of Optimization of Flexible Fueled Vehicles to Use E–85

Directs the Secretary of Energy to conduct a study to determine if optimizing flexible fuel vehicles to operate using E–85 would increase the fuel efficiency while using E–85.

Section 10—Study of Engine Durability Associated with the Use of Biodiesel

Directs the Secretary of Energy to conduct a study on the effects of the use of biodiesel, at varying blend levels, on engine durability.

Section 11—Authorization for Appropriation

This section makes the following authorizing changes:

- Extends the authorization of Section 931 (Renewable Energy) *Energy Policy Act of 2005* through 2010 (currently expires in 2009) and funds the programs at $963 million.
- Increases the authorization levels for Section 932 (Bioenergy Programs) of the *Energy Policy Act of 2005* to:
  - FY08—$377 million
  - FY09—$398 million
  - FY10—$419 million

[DISCUSSION DRAFT]

JUNE 11, 2007

110TH CONGRESS
1ST SESSION

H. R. _____

To enhance research, development, demonstration, and commercial application of biofuels related technologies and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

Mr. LAMPSON introduced the following bill; which was referred to the Committee on

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A BILL

To enhance research, development, demonstration, and commercial application of biofuels related technologies and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Biofuels Research and Development Enhancement Act".

1 **SEC. 2. BIOFUELS AND BIOREFINERY INFORMATION CEN-**
2 **TER.**

3 (a) IN GENERAL.—The Secretary of Energy (in this
4 Act referred to as the "Secretary"), in cooperation with
5 the Secretary of Agriculture, shall establish an informa-
6 tion center to make available to interested parties informa-
7 tion on research, development, and commercial application
8 of technologies related to biofuels and biorefineries, includ-
9 ing—

10 (1) biochemical and thermochemical conversion
11 technologies capable of making fuels from
12 lignocellulosic feedstocks;

13 (2) biotechnology processes capable of making
14 biofuels with an emphasis on development of bio-
15 refinery technologies using enzyme-based processing
16 systems; and

17 (3) other advanced processes and technologies
18 that will enable the development of biofuels.

19 (b) ADMINISTRATION.—In administering the biofuels
20 and biorefinery information center, the Secretary shall—

21 (1) continually update information provided by
22 the center;

23 (2) make information available to interested
24 parties on the process for establishing a biorefinery;
25 and

1 (3) make information and assistance provided
2 by the center available through a toll-free telephone
3 number and website.

4 **SEC. 3. BIOFUELS AND ADVANCED BIOFUELS INFRASTRUC-**
5 **TURE.**

6 Section 932 of the Energy Policy Act of 2005 (42
7 U.S.C. 16232) is amendment by adding at the end the
8 following new subsection:

9 "(f) BIOFUELS AND ADVANCED BIOFUELS INFRA-
10 STRUCTURE.—

11 "(1) IN GENERAL.—The Secretary shall carry
12 out a program of research, development, and dem-
13 onstration as it relates existing transportation fuel
14 distribution infrastructure and new alternative dis-
15 tribution infrastructure. The program shall focus on
16 the physical and chemical properties of biofuels and
17 efforts to prevent or mitigate against adverse im-
18 pacts of those properties in the following areas:

19 "(A) Corrosion of metal, plastic, rubber,
20 cork, fiberglass, glues, or any other material
21 used in pipes and storage tanks.

22 "(B) Dissolving of storage tank sediments.

23 "(C) Clogging of filters.

24 "(D) Contamination from water or other
25 adulterants or pollutants.

1 "(E) Poor flow properties related to low
2 temperatures.
3 "(F) Oxidative and thermal instability in
4 long-term storage and use.
5 "(G) Increased volatile emissions.
6 "(H) Microbial contamination.
7 "(I) Problems associated with electrical
8 conductivity.
9 "(J) Increased nitrogen oxide emissions.".

10 **SEC. 4. BIODIESEL.**

11 Not later than 180 days after the date of enactment
12 of this Act, the Secretary shall submit to Congress a re-
13 port on any research and development challenges inherent
14 in increasing to 5 percent the proportion of diesel fuel sold
15 in the United States that is biodiesel (as defined in section
16 757 of the Energy Policy Act of 2005 (42 U.S.C. 16105)).

17 **SEC. 5. BIORESEARCH CENTERS FOR SYSTEMS BIOLOGY**
18 **PROGRAM.**

19 Section 977(a)(1) of the Energy Policy Act of 2005
20 (42 U.S.C. 16317(a)(1)) is amended by inserting before
21 the period at the end the following: ", including the estab-
22 lishment of at least 11 bioresearch centers of varying
23 sizes, as appropriate, that focus on biofuels, of which at
24 least 2 centers shall be located in each of the 4 Petroleum
25 Administration for Defense Districts with no subdistricts

1 and at least 1 center shall be located in each of the subdis-
2 tricts of the Petroleum Administration for Defense Dis-
3 trict with subdistricts''.

4 **SEC. 6. GRANTS FOR BIOFUEL PRODUCTION RESEARCH**
5 **AND DEVELOPMENT IN CERTAIN STATES.**

6 (a) IN GENERAL.—The Secretary shall provide
7 grants to eligible entities to for research, development,
8 demonstration, and commercial application of biofuel pro-
9 duction technologies in States with low rates of ethanol
10 production, including low rates of production of cellulosic
11 biomass ethanol, as determined by the Secretary.

12 (b) ELIGIBILITY.—To be eligible to receive a grant
13 under this section, an entity shall—

14 (1)(A) be an institution of higher education (as
15 defined in section 2 of the Energy Policy Act of
16 2005 (42 U.S.C. 15801)) located in a State de-
17 scribed in subsection (a); or

18 (B) be a consortium including at least 1 such
19 institution of higher education, and industry, State
20 agencies, Indian tribal agencies, or local government
21 agencies located in the State; and

22 (2) have proven experience and capabilities with
23 relevant technologies.

24 (c) AUTHORIZATION OF APPROPRIATIONS.—There
25 are authorized to be appropriated to the Secretary to carry

1 out this section $25,000,000 for each of fiscal years 2008
2 through 2010.

3 **SEC. 7. BIOREFINERY ENERGY EFFICIENCY.**

4 Section 932 of Energy Policy Act of 2005 (42 U.S.C.
5 16232), is amended by adding at the end the following
6 new subsection:

7 ''(g) BIOREFINERY ENERGY EFFICIENCY.—The Sec-
8 retary shall establish a program of research, development,
9 demonstration, and commercial application for increasing
10 energy efficiency and reducing energy consumption in the
11 operation of biorefinery facilities.''.

12 **SEC. 8. STUDY OF INCREASED CONSUMPTION OF ETHANOL-**
13 **BLENDED GASOLINE WITH HIGHER LEVELS**
14 **OF ETHANOL.**

15 (a) IN GENERAL.—The Secretary, in cooperation
16 with the Secretary of Agriculture, the Administrator of the
17 Environmental Protection Agency, and the Secretary of
18 Transportation, and after providing notice and an oppor-
19 tunity for public comment, shall conduct a study of the
20 feasibility of increasing consumption in the United States
21 of ethanol-blended gasoline with levels of ethanol that are
22 not less than 10 percent and not more than 40 percent.

23 (b) STUDY.—The study under subsection (a) shall in-
24 clude—

1 (1) a review of production and infrastructure
2 constraints on increasing consumption of ethanol;
3 (2) an evaluation of the economic, market, and
4 energy-related impacts of State and regional dif-
5 ferences in ethanol blends;
6 (3) an evaluation of the economic, market, and
7 energy-related impacts on gasoline retailers and con-
8 sumers of separate and distinctly labeled fuel stor-
9 age facilities and dispensers;
10 (4) an evaluation of the environmental impacts
11 of the ethanol blends described in subsection (a) on
12 evaporative and exhaust emissions from on-road, off-
13 road, and marine vehicle engines;
14 (5) an evaluation of the impacts of the ethanol
15 blends described in subsection (a) on the operation,
16 durability, and performance of on-road, off-road, and
17 marine vehicle engines; and
18 (6) an evaluation of the safety impacts of the
19 ethanol blends described in subsection (a) on con-
20 sumers that own and operate off-road and marine
21 vehicle engines.
22 (c) REPORT.—Not later than 1 year after the date
23 of enactment of this Act, the Secretary shall submit to
24 Congress a report describing the results of the study con-
25 ducted under this section.

SEC. 9. STUDY OF OPTIMIZATION OF FLEXIBLE FUELED VEHICLES TO USE E-85 FUEL.

(a) IN GENERAL.—The Secretary shall conduct a study of whether optimizing flexible fueled vehicles to operate using E-85 fuel would increase the fuel efficiency of flexible fueled vehicles, and shall include recommendations for how manufacturers can best optimize such vehicles to increase fuel efficiency.

(b) REPORT.—Not later than 180 days after the date of enactment of this Act, the Secretary shall submit to the Committee on Science and Technology of the House of Representatives the Committee on Energy and Natural Resources of the Senate a report that describes the results of the study under this section, including any recommendations of the Secretary.

SEC. 10. STUDY OF ENGINE DURABILITY ASSOCIATED WITH THE USE OF BIODIESEL.

(a) IN GENERAL.—Not later than 30 days after the date of enactment of this Act, the Secretary shall initiate a study on the effects of the use of biodiesel on engine durability.

(b) COMPONENTS.—The study under this section shall include—

(1) an assessment of whether the use of biodiesel in conventional diesel engines lessens engine durability; and

(2) an assessment of the effects referred to in subsection (a) with respect to biodiesel blends at varying concentrations, including the following percentage concentrations of biodiesel:

(A) 5 percent biodiesel.

(B) 10 percent biodiesel.

(C) 20 percent biodiesel.

(D) 30 percent biodiesel.

(E) 100 percent biodiesel.

(c) REPORT.—Not later than 1 year after the date of enactment of this Act, the Secretary shall submit to the Committee on Science and Technology of the House of Representatives the Committee on Energy and Natural Resources of the Senate a report that describes the results of the study under this section, including any recommendations of the Secretary.

SEC. 11. BIOENERGY RESEARCH AND DEVELOPMENT, AUTHORIZATION OF APPROPRIATION.

(a) Section 931 of the Energy Policy Act of 2005 (42 U.S.C. 16231) is amended—

(1) in subsection (b)—

(A) at the end of paragraph (2) by striking "and";

(B) at the end of paragraph (3) by striking the period and inserting "; and"; and

1 (C) by adding at the end the following new
2 paragraph:
3 "(4) $963,000,000 for fiscal year 2010."; and
4 (2) in subsection (c)—
5 (A) in paragraph (2), by striking
6 "$251,000,000" and inserting "$377,000,000";
7 (B) in paragraph (3), by striking
8 "$274,000,000" and inserting "$398,000,000";
9 and
10 (C) by adding at the end the following new
11 paragraph:
12 "(4) $419,000,000 for fiscal year 2010, of
13 which $150,000,00 shall be for section 932(d).".