AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

S. HRG. 111–794

# EXPANDING THE ROLE OF BIOFUELS FOR AMERICA

## FIELD HEARING

BEFORE THE

## COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY UNITED STATES SENATE

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

SEPTEMBER 1, 2009

Printed for the use of the
Committee on Agriculture, Nutrition, and Forestry

Available via the World Wide Web: http://www.agriculture.senate.gov

U.S. GOVERNMENT PRINTING OFFICE

62–714 PDF WASHINGTON : 2011

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2104 Mail: Stop IDCC, Washington, DC 20402–0001

COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY

TOM HARKIN, Iowa, *Chairman*

PATRICK J. LEAHY, Vermont
KENT CONRAD, North Dakota
MAX BAUCUS, Montana
BLANCHE L. LINCOLN, Arkansas
DEBBIE A. STABENOW, Michigan
E. BENJAMIN NELSON, Nebraska
SHERROD BROWN, Ohio
ROBERT P. CASEY, Jr., Pennsylvania
AMY KLOBUCHAR, Minnesota
KIRSTEN GILLIBRAND, New York
MICHAEL BENNET, Colorado

SAXBY CHAMBLISS, Georgia
RICHARD G. LUGAR, Indiana
THAD COCHRAN, Mississippi
MITCH McCONNELL, Kentucky
PAT ROBERTS, Kansas
MIKE JOHANNS, Nebraska
CHARLES E. GRASSLEY, Iowa
JOHN THUNE, South Dakota

MARK HALVERSON, *Majority Staff Director*
JESSICA L. WILLIAMS, *Chief Clerk*
MARTHA SCOTT POINDEXTER, *Minority Staff Director*
VERNIE HUBERT, *Minority Chief Counsel*

# CONTENTS


Page

FIELD HEARING(S):

Expanding the Role of Biofuels for America ..... 1


**Tuesday, September 1, 2009**

STATEMENTS PRESENTED BY SENATORS


Harkin, Hon. Tom, U.S. Senator from the State of Iowa, Chairman, Committee on Agriculture, Nutrition, and Forestry ..... 1

Thune, Hon. John, U.S. Senator from the State of South Dakota ..... 3


WITNESSES


Corcoran, Steve, Chief Executive Officer, KL Energy Corporation ..... 14

Couser, Bill, Couser Cattle Company ..... 8

Olthoff, Ed, Cedar Falls Utilities ..... 19

Rath, Anna, Director of Business Development, Ceres ..... 11

Sheehan, John, Scientific Program Coordinator for Biofuels and the Global Environment, Institute on the Environment, University of Minnesota ..... 16

Stowers, Mark, Vice President for Research and Development, POET ..... 6


APPENDIX


PREPARED STATEMENTS:

Corcoran, Steve ..... 42

Couser, Bill ..... 49

Olthoff, Ed (with attachments) ..... 53

Rath, Anna ..... 79

Sheehan, John ..... 85

Stowers, Mark ..... 94

QUESTION AND ANSWER:

Harkin, Hon. Tom:

Written questions for John Sheehan ..... 104

Stowers, Mark:

Written response to questions from Hon. Tom Harkin and Hon. John Thune ..... 105

# EXPANDING THE ROLE OF BIOFUELS FOR AMERICA

**Tuesday, September 1, 2009**

U.S. SENATE,
COMMITTEE ON AGRICULTURE, NUTRITION AND FORESTRY,
*Sioux City, Iowa*

The Committee met, pursuant to notice, at 1:10 p.m., at Western Iowa Tech Community College, Sioux City, Iowa, Hon. Tom Harkin, Chairman of the Committee, presiding.

Present: Senators Harkin and Thune.

## STATEMENT OF HON. TOM HARKIN, U.S. SENATOR FROM THE STATE OF IOWA, CHAIRMAN, COMMITTEE ON AGRICULTURE, NUTRITION, AND FORESTRY

Chairman HARKIN The Senate Committee on Agriculture, Nutrition and Forestry will come to order. Good afternoon and welcome everybody to this committee field hearing, and I want to thank Western Iowa Tech Community College for hosting us here today.

Senator Thune, I want to thank you for being here today and for your contributions to our 2008 farm bill, especially your work on the biofuels program and other energy provisions that we put in that bill. The 2002 Farm Bill is something that we have worked very closely together on. Senator Thune is a very valued member of our Senate Agriculture Committee and, as I said, one of our leaders on biofuels.

Well, rural America is rapidly increasing the production of renewable energy, including biofuels, and that is one of the bright spots in our rural economy. Equally important, producing and using more biofuels is one of our major strategies for reducing dependence on foreign oil.

Congress recognizes this. Last year, our Country produced over nine billion gallons of ethanol. That reduced oil imports by 321 million barrels. This year, we will produce over 10 billion gallons of ethanol, and that is quite a success compared to just 30 years ago when we put out only 175 million gallons.

Under the Renewable Fuel Standard that we passed in 2007, our Nation is on exactly the kind of expansion trajectory I believe we need, growing to 36 billion gallons of renewable fuel used by the year 2022. The Food, Conservation and Energy Act, or what we call the Farm Bill, that we passed last year will boost and maintain that trajectory.

Building on our base of corn ethanol, the new Farm Bill has payments, grants and loan guarantees to help farmers and biorefineries develop advanced biofuels, grow biomass crops, process them

and market biofuels. It does so, as I said, with grants and loan guarantees, payments for biomass crops, payments to farmers to begin to grow energy crops, and payments for feedstock harvesting and delivery to user facilities.

There are two pieces of legislation that I introduced this year, aimed at improving distribution and marketing. The first authorizes loan guarantees for renewable biofuels pipelines to provide critical infrastructure for transporting our fuel from the Midwest to places of high population centers. And, Senator Thune, again, we have worked together on that, as co-sponsors of that legislation.

The second bill I introduced is one that I have had in previous Congresses, a bill that Senator Lugar and I have worked on. Actually, he started it I think when he was Chairman of the Agriculture Committee as a matter of fact. That bill requires that 90 percent of the vehicles manufactured in the U.S. are to be flex-fuel by 2013. I am convinced that we can do that if we just have the will to do it. Brazil does it right now. I do not know why we could not.

It would also require increasing the number of blender pumps, pumps that can dispense ethanol blends ranging from 0 to 85 percent, and would authorize grants to support their installation.

Another important action we have got to take is relief from the blend wall. John and I have discussed that a lot in the Senate. I want to thank Growth Energy and all of the biofuels firms that supported the application to the EPA for the waiver to allow E–15 to be used, and, hopefully, that is going to be done before the end of this year.

Actually, to tell you the truth, it could be higher than E–15. We know that. POET knows that. We all know that, but we will settle for E–15. It could be E–20. It could be even as high as that without any problems whatsoever, but we will take E–15.

Let me also mention that recently Senator Thune and I sent a letter to EPA Administrator Lisa Jackson, asking her to refrain from including international indirect land use changes in the rulemaking for the Renewable Fuel Standard. While I think we can all agree that we need to make sure our expansion of biofuels does not come at the expense of our environment or climate, we clearly do not have any data or analytic tools to link deforestation overseas to biofuels production here in the Midwest with any credibility whatsoever.

So, again, to fulfill the potential of biofuels, we have to understand the obstacles and challenges and devise practical solutions, and that is why we are here today, to explore the current situation, including prospects from promising research and trials, market barriers, opportunities, and finally, the impact on the farm level and what farmers are doing out there at that level.

So, again, this emerging industry, biofuels, is important to all of us in the Nation but really important to Iowa and South Dakota, and that is why you see us working very collaboratively here to move ahead in this whole area.

So, with that, I would yield to my good friend and colleague, Senator Thune.

**STATEMENT OF HON. JOHN THUNE, U.S. SENATOR FROM THE STATE OF SOUTH DAKOTA**

Senator THUNE. Thank you, Mr. Chairman. I want to thank you for holding today's hearing, and I want to thank our panelists too for joining us today.

This is an extremely timely subject, timely hearing. And, as the Chairman mentioned, we did work very closely in the last Farm Bill on a lot of these issues that relate to the future of the biofuels industry, and that is why I think we need to make sure that we continue the forward momentum and continue to put policies in place that will encourage greater expansion and growth in that industry.

I would say that I think today that our biofuels industry is at a crossroads. Traditional ethanol production has greatly expanded over the past few years, has already helped to reduce our dependence on foreign oil. However, existing ethanol plants are facing significant economic challenges, and the future widespread commercialization of advanced biofuels remains uncertain.

A lot of this uncertainty can be attributed to what I call the Dr. Jekyll and Mr. Hyde national biofuels policy. The Federal Government has made biofuel production the cornerstone of our energy policy. However, at the same time, we have erected barriers that are having a negative impact on the profitability of existing ethanol plants and private sector investment in future advanced biorefineries.

Over the past several years, we have invested billions of taxpayer dollars in growing our ethanol industry. We have enacted a per gallon volume metric excise tax credit. We have put in place a tariff that protects that American taxpayers from subsidizing foreign biofuel. We have incentivized the installation of E–85 pumps, and we have invested hundreds of millions in research and development of traditional and cellulosic ethanol production.

In 2007, Congress took the boldest step toward energy independence by expanding the Renewable Fuel Standard to 36 billion gallons by the year 2022. If this goal is achieved, almost one of every four gallons of motor fuel sold in the United States will come from clean, renewable biofuels. However, the Federal Government simultaneously hamstringed the future growth of biofuels in the United States. Perhaps the most prominent example of these barriers is the issue of indirect land use that the Chairman mentioned and the carbon footprint of renewable fuel.

We all know that homegrown renewable fuel made from corn and other renewable sources is better for our environment than petroleum-based gasoline. However, the Environmental Protection Agency recently released draft regulations that would penalize domestic ethanol producers for land use decisions that are made around the world. Final analysis actually shows that corn-based ethanol production would unbelievably result in more carbon emissions relative to petroleum-based gasoline. If finalized, these regulations would prohibit soy-based biodiesel and efficient corn-based ethanol production methods from counting toward the new Renewable Fuel Standard.

Another significant barrier is the overly narrow definition of renewable biomass. The new Renewable Fuel Standard requires the

production of 21 billion gallons of cellulosic ethanol by 2022. This is a tremendous vote of confidence in the ingenuity of our biofuels industry. However, a significant amount of this fuel is expected to come from woody biomass.

Although woody biomass is abundant throughout the United States, the expanded RFS places all Federal lands and most of the private forestlands off limits. If we do not change this definition in the very near future, meeting the 2010, 2011, 2012 goals of the new RFS will be difficult, if not impossible.

We also have a 90 percent petroleum mandate within our fuel supply due to regulations in the Clear Air Act, only a blend of 10 percent of ethanol can be used in non flex-fuel vehicles. Approval of E–13 or E–15 or, as the Chairman said, we could go much higher than that, but at a minimum we need to increase the blend wall to E–15 in the near future. That will increase the market for ethanol by up to 50 percent virtually overnight. In the long run, it will create thousands of jobs in rural America and greatly displace imported foreign oil.

Recently, a group of 54 ethanol producers submitted a waiver to the EPA, requesting approval of up to E–15 for use in non flex-fuel vehicles. I would like to thank Dr. Stowers and POET for their leadership in this waiver. I am hopeful that EPA will follow the science that supports this waiver and approve an intermediate blend in the near future.

In essence, Mr. Chairman, we are asking our biofuels industry to run a long marathon while hopping on one leg. And, breaking a century-old oil monopoly is enough of a challenge. We do not need the government adding additional roadblocks.

Beyond removing the artificial barriers of the ethanol industry, Congress must keep moving forward effective and targeted biofuels policies. We must invest in the infrastructure that will break oil's monopoly on our fuel supply.

We must continue to incentivize the installation of E-85 and blender pumps. We currently have a little over 1,900 I–85 pumps in the United States. That is simply not enough. If consumers are going to have a real choice for their fuel source, we must greatly expand access to E–85 and blender pumps across the Nation.

Additionally, we must encourage our automakers to ramp up production of flex-fuel vehicles. Six million flex-fuel vehicles may seem like a high number but only until it is compared to the over two hundred and forty million vehicles that are on the road today.

Intermediate blends of ethanol will provide much needed short-term relief, but the long-term growth of our biofuels industry depends on access to more flex-fuel vehicles and greater access to E–85.

In addition to more access at the retail level, the government should work with ethanol producers and pipeline companies to construct a network of ethanol-dedicated pipelines that will reduce the cost of shipping ethanol from the Midwest to the East and West Coast. I am proud to be a co-sponsor of Senator Harkin's legislation that will expand the existing loan guarantee program with the Department of Energy to include loan guarantees for ethanol-dedicated pipelines.

Finally, we must fully implement the energy title of the 2008 Farm Bill. I want to thank Chairman Harkin and our Ranking Member, Senator Chambliss from Georgia, for their leadership and dedication to strong energy titles in the 2008 Farm Bill. I am particularly pleased to have worked with the leadership of the Ag Committee to include and create the Biomass Crop Assistance Program which the Chairman mentioned, which provides per ton and per acre incentives for collecting biomass and growing energy-dedicated crops for cellulosic ethanol production. As of July of 2009, the first half of this program is now available to our ethanol plants and agriculture producers.

In closing, the combination of removing artificial regulatory barriers and enacting innovative policies that invest in infrastructure and advance biofuel production will lead to a consistent long-term biofuel policy. The result will be a growing and sustainable biofuels industry that will create jobs in rural communities, expand markets for agriculture and forestry biomass and reduce the dangerous dependence that we have on foreign oil.

I also want to thank Chairman Harkin for holding this hearing over the August recess, and I want to thank the witnesses for joining us today. I look forward to your testimony.

I look forward to working with you, Mr. Chairman, as we pursue these policies that are so important to the growth of this industry that is critical not only to the Midwest but to our entire Country.

Thank you.

Chairman HARKIN. Thank you very much, Senator Thune.

Before we start with the panel, I want to thank Bob Rasmus who is the Chairman of our Board out here at Western Iowa Tech and also our President, Dr. Bob Dunker, who is the President of Western Iowa Tech Community College, for hosting us today.

I always like to introduce our elected people who are here. The only one I see is State Representative Roger Wendt who is in the State Legislature. Is there anyone I have missed?

Is there anyone in the South Dakota Legislature here? I do not know. Anybody want to run for office?

[Laughter.]

Senator THUNE. I think Dr. Bob should run for office, do you not? Rasmus needs another job.

Chairman HARKIN. All right. Well, thank you again for being here.

We have all your statements. I read them over last night. They are very good statements. They will be made a part of the record in their entirety.

We will just start at our left with Mr. Stowers, and we will just go down the aisle. I would like to ask if you could sum it up.

Do you have these timers in front of you or do you not? You have one there.

Well, maybe five to 8 minutes, somewhere in there, if you could just sum it up, I would sure appreciate it, and then we can kind of get into a good exchange that way. So, with that then, we will start with you, Dr. Stowers, Vice President for Research and Development, POET, Sioux Falls, South Dakota.

Mr. Stowers, welcome and please proceed.

**STATEMENT OF MARK STOWERS, VICE PRESIDENT FOR RESEARCH AND DEVELOPMENT, POET**

Mr. STOWERS. Chairman Harkin and Senator Thune, thank you very much for the opportunity to be here with you. I would like to talk to you about our company's efforts in cellulosic ethanol, the opportunities and challenges that presents.

POET, headquartered in Sioux Falls, South Dakota, is the largest ethanol producer in the world. Our 21–year-old company has built and manages 26 ethanol plants principally in the Corn Belt while marketing 1.5 billion gallons and 4 million tons of distillers' grains, returning protein back into the animal feed diet and to human consumption.

Our one-time capital investment since 2000 exceeds over a billion dollars to the farm economy. And, through its corn purchases, corporate and plant operations, we contribute over $3 billion annually to rural America. In addition, POET has encouraged farmer investment in its operations and now has over 11,000 farmer investors.

As a way of some background, according to a recent U.S. Department of Commerce International Trade Administration study, there is enough cellulosic ethanol available in the United States to produce nearly 50 billion gallons. There are other studies that even show that a greater amount of cellulosic ethanol could be produced.

At 50 billion gallons, over 1.2 million barrels per day of crude oil could be displaced, creating over 54,000 jobs in U.S. agriculture. In practical terms, at this level, ethanol production in the United States could eliminate all oil purchases from OPEC in the Middle East, eliminating $840 million per day in oil export of dollars to overseas producers. That is on a $72 per barrel price.

Notwithstanding the economic benefit of cellulosic ethanol, there are also significant environmental benefits. Gasoline produces about two pounds of carbon dioxide equivalent in greenhouse gases. By comparison, cellulosic ethanol reduces greenhouse gases by a little more than 21 pounds. That is an 85 percent reduction in the amount of greenhouse gas.

The impact of ethanol in relieving our dependence on foreign oil is profound. I would like to share with you some work done by Adam Liska and Richard Perrin at the University of Nebraska where they published a well-reasoned study that showed the costs associated with foreign oil and the impact on the environment.

In 1997, it was estimated that the U.S. military spent between 5 and 15 percent of all U.S. materials consumed and used up to 40 percent of the greenhouse gas equivalent materials. That resulted in, if you look at the overall military impact of greenhouse gas, about 10 percent of all the greenhouse emissions could be attributed to the military.

The estimated expenditures related to Middle East oil security alone was about $138 billion annually out of $526 billion spent on U.S. defense. That did not include the Iraq or Afghanistan operations.

So, if you kind of go through the math, 10 percent of the total U.S. greenhouse emissions were due to the regular ongoing military activity in the Middle East and only 26 percent of those operations were for the protection of oil supplies. The total indirect

military emissions would be somewhere in the neighborhood of 187 teragrams of CO2 equivalent per year.

What that translates into is about two times the amount of what California and EPA estimate as the impact of gasoline on CO2 emissions. Put that in comparison, cellulosic ethanol will be fivefold less. So we are spending a lot of money as well as carbon dioxide equivalents or greenhouse gases to maintain our oil supply when we have a domestic source of renewable fuels to meet that demand.

We believe that at this stage the value of cellulosic ethanol is profound at the economic, environmental and national security level.

The technology is available for cellulosic ethanol. We have developed a strategy to bolt on cellulosic ethanol production into our 26 ethanol plants. Actually, our first plant is here in Iowa at Emmetsburg. It is currently a 50 million gallon corn-to-ethanol plant which will double in capacity to 100 million and then bolt on 25 million gallons of cellulosic ethanol produced from corncobs. In addition, that will produce 80,000 tons of Dakota Gold corn germ as well as over 100,000 tons of Dakota Gold HP animal feed product.

What I would like to do in closing here is walk you through three of the key elements that are going to be necessary to meeting the cellulosic ethanol challenge.

The first is with the feedstock. POET has selected corncobs as its first cellulosic feedstock. Corncobs offer a significant advantage over other feedstocks based on technical, environmental and economic reasons. Corncobs are typically left on the field as corn stover after the harvest of corn grain. Corncobs are rich in carbohydrates, sugars that we can use in fermentation. They are heavier than the cornstalks, so we can separate them, and they can be removed from the field with little environmental impact as they contain little fertilizer value. And, last, they could be collected by the same farmers that provide grain to our plants in a similar kind of format.

In 2007 and 2008, POET harvested nearly 13,000 acres of corn to supply over 7,000 tons of corncobs in Iowa, South Dakota and Texas. We worked with 13 different equipment companies, using 2 different cob harvest concepts: a corncob mix with the grain and the cobs are collected simultaneously, then separated at farm edge, and a towable corn stover separator that could be attached to a combine. The stover that would be jettisoned out of the combine could be collected and separated into corncobs.

As we move into 2009, we have just completed our planning process. As we move into the harvest season, we will be harvesting over 25,000 acres of corn in Iowa and South Dakota with 15 equipment manufacturers, and we will evaluate 4 different cob harvest methods.

This really tees us up for 2012 where we will be harvesting over 250,000 tons of cobs, over across approximately 300,000 acres involving 400 farmers.

I would like to thank the Chairman and the Committee and Senator Thune for their efforts to promote biomass collection. These are critically important as we move forward.

Our investment in cellulosic ethanol technology is another critical factor in the success of bringing this technology to market. POET has invested over $25 million in the past 2 years in cellulosic ethanol technology including an additional $10 million of capital for a pilot plant that is operating in Scotland, South Dakota, where we process 1 to 2 tons lignocellulosic biomass per day.

Some of the highlights that I can share with you is we have achieved lab-scale performance in our pilot plant within 30 days of operating the facility. We have launched 24–7 operation of that facility 2 months after commissioning. The process was completely debugged in 3 months, and then we began a process of optimization that led us to a place where we are about $2.50 per gallon for the production of cellulosic ethanol.

I would like to just conclude with one additional supporting statement to the remarks made earlier about the blend wall. E–15 is a critical factor in the success of cellulosic ethanol. The addition of six billion additional gallons that would be afforded by moving from E–10 to E–15 is critical to our success.

There is absolutely no critical scientific or technical information that would show that E–15 or, for that matter, E–20 would harm engines. This is a real reasonable request, and we are hoping that EPA acts on this request very, very quickly.

One final statement I would just like to share with the Committee is that cellulosic ethanol is not a magical solution. It is not another shiny silver ball to detract or distract our attention from the critical issue of clean domestic fuel for today.

The technology to achieve cellulosic ethanol is here. It is real. We are making it every day as we speak.

We need market access to ensure that cellulosic ethanol becomes a reality. It is time to break big oil's monopoly on gasoline as our only liquid transportation fuel.

We can make a difference in the economy, the environment and national security by supporting ready to go right now domestic, clean-burning, agriculture-based ethanol.

Thank you very much for the opportunity to be here today.

[The prepared statement of Mr. Stowers can be found on page 94 in the appendix.]

Chairman HARKIN. Thank you very much, Dr. Stowers.

Now we will go to Mr. Bill Couser, Couser Cattle Company in Nevada—not Nevada—Nevada, Iowa.

Bill, welcome to the Committee.

**STATEMENT OF BILL COUSER, COUSER CATTLE COMPANY**

Mr. COUSER. Well, thank you, Mr. Chairman Harkin and Senator Thune. It is a real privilege for a farmer and a cattle feeder, I guess, to sit in a group like this and be able to discuss some of the issues that present us today.

A little bit of my background, we do live in Nevada. My wife and I have a feedlot there. We finish about 5,000 head of cattle a year, and we are very involved in the biomasses that come off of some of these fields just for the simple fact that we have need them for bedding and feed. When you look at the rest of our operation, we are very involved in seed corn with Monsanto, commercial corn and

all the other seed crops that go on with some hay—so, a little bit of that background.

When we first started this, started farming, the fellow who had my farm before was an open door policy, Elmer Paul, to Iowa State students come out and practice and learn real knowledge and hands-on experience. So we have left that policy on right now, and today we have about 15 different projects going on with different kids. Whether it is the feedlot, whether it is the ethanol side of it, whether it is the environmental side or whether it is the farming practices, it is open door. If they want to try a project, we try to assist them any way possible.

So, through that, we have been very involved with the collection of biomasses that have happened over the last few years. And, working with John Deere and Vermeer and a few of those companies, we are trying to figure out as a farmer-feeder, how can we utilize those crops the best.

The transportation issues, the gathering issues, the time window that we have to collect those products in the last few years has been very narrow. We have had two to 3 weeks to gather them in a timely fashion to where they will actually keep for the rest of the season.

I think one of the issues there we have is storage. I know when we look at 300–bushel corn in the future. You know I started farming in 1977. I think I had a 125–bushel to the acre—well, in 1978. I had a drought in 1977, but in 1978 we had about a 125–bushel to the acre average. This year, our farms are going to make 250 plus.

Chairman HARKIN. That is amazing.

Mr. COUSER. What are we going to do with 300–bushel corn in the future? And, I know this is going to happen because working very closely with Monsanto in seed production we have got it all here. When we look at what has happened there, just the increase in bushels that we need to grind, they are already there. We have already manufactured them. So this food to fuel issue really is a no-brainer to us that are out in the country.

When you address the biomasses or the cellulose that comes off of these acres, last year, we went from actually a project pilot with Monsanto. We went from 30–inch corn to 20–inch corn and raised the populations. We have seen an increase in stover that we take off of those farms from 20 to 40 percent in volume that we can get off of these fields.

I guess I am a little disappointed when an individual in the White House mentioned switchgrass 1 day. We can do it all as Iowa corn farmers here. It is all right here. We can have the starch ethanol, and we can have the cellulose ethanol together.

I see some interesting challenges in the future when it comes to the stover that we collect and just the education and the mindset of the farmer. Right now today, when we go to the field, you do not want to let that grain buggy get in front of anything because we have to get the corn out. So we have got an education process.

I understand the importance of the products that are left in the field for food and bedding and the importance of them. But the question I go back to ask the consumer of tomorrow is in what form do you want that product? Do you want it in a pellet? Do you want

it in a cube? Do you want it in a corncob or do you want it in a corn stock? Because I really feel that if we can figure out the most efficient way to get this out of the field, in a timely fashion, it is going to be imperative to new business that is coming down the road.

I think we will be working with Green Products out of Green Mountain, Iowa. We had them come down last fall when we were doing some experiment with John Deere, and they made a comment to me that you know if we can figure out what the end consumer needs as far as what it looks like, the new business to come around the corner is incredible.

Cellulose ethanol is just a part of it, but we look at what can happen in the future. And, when you look at job creation through that, it is just amazing. So I am very excited, working with these different companies, so is POET, when you look at what it can do for the livestock industry, the ethanol industry and the new industries to come down the road.

Three-hundred bushel corn is not a challenge to us as farmers. We are very good at what we do, and I am bragging as an American farmer her, not as Couser Cattle Company. We are very good at what we do. We are environmentally sound when we look at some of those issues coming down the road.

Senator Harkin, I would like to thank you for sending out one of your staffers 2 weeks ago. With Iowa Renewable Fuels, we put on a tour and Carla was able to go around with us. I think we were able to show people from Washington exactly what happens and exactly how a community and a family and a country can live together in Nevada, Iowa. There are all these little communities all over our State, and that is why we are so rich here.

So, when you look at what is going to happen with 300– bushel corn, we are all talking about expenses. And, the farmer today, we are always trying to cut back on expenses.

We are very heavily involved with manure management plans in our feedlot. We are very heavily involved with a new project called GreenSeeker that is an instrument that we put on our applicators to go out and apply nitrogen, and it can read that leaf tissue and tell exactly what it needs.

We are very interested in Lincolnway Energy because it is a coal-fired ethanol plant that we can, with our fluidized beds, we can use this source of cellulose for energy. And, what is it going to take to bolt on to at least try it and get started?

When you look at the ethanol plants and the biodiesel plants that are all around Iowa here, they are very strategically located. We do not need any more today. As he stated, we can bolt this on to the side. We do not need to build any more.

I think we just need the help to educate the farmer. I see a huge challenge there on what is the value of that product and how do you stay out of the way of the chisel plow behind the combine because a farmer has basically two goals when it comes to harvest: get the corn out and get it black or get it tilled under.

I guess in closing I would like to say we all remember where we were at 9/11, and we were in the middle of a seedfield picking seedcorn when the news came over the radio. My dad walked up to me, and he is one of the men from the Great Generation. He

opened the door of the cab, and he said: Son, you are going to be asked to do great things now. You are going to be asked to do things that you have never been asked to before because your Country is going to ask it.

We stepped up to the plate. The families, the communities, we built the ethanol plants. We have raised local investment, and we are very proud of what has happened. When I look up and down this table, that is the reason this Country is so strong, because of our families and our communities.

I guess when you look at what is going on, whether it is the RFS2 debate, the E–15, cellulosic feedstock, I just want you to know that we as farmers, we are out there doing our job. We are protecting the environment. We are raising livestock in a very safe manner. We are helping feed the world.

You know we have strong communities. We are going to have a strong Country. So I just want to give you that promise from the farmers.

Thank you to both of you.

[The prepared statement of Mr. Couser can be found on page 49 in the appendix.]

Chairman HARKIN. Mr. Couser, thank you very much for a very poignant and timely statement. Thank you. I have some things I want to ask you about when we get into our questions and discussion.

Now we go to Ms. Anna Rath, Director of Business Development for Ceres, Thousand Oaks, California.

**STATEMENT OF ANNA RATH, DIRECTOR OF BUSINESS DEVELOPMENT, CERES**

Ms. RATH. Thank you, Mr. Chairman and Senator Thune.

I am here representing Ceres. We worked very closely with this Committee in the development of 2008 Farm Bill and look forward to continuing to work with you on the Climate Bill and other future endeavors.

Ceres is a leading, dedicated energy crop seed company. We develop and market crops such as switchgrass and high-biomass sorghum for biofuels and biopower under our Blade Energy Crop brand.

Our 2008 field trials were very successful. We had over three dozen trials nationwide and demonstrated that academics and policymakers have often been too conservative when it comes to forecasting grower economics and bioenergy economics and perhaps too aggressive when estimating a land use change that could result from biofuels and biopower.

Our average across all of our field trials for our Blade switchgrass varieties were 10 tons per acre, and our yields for high-biomass sorghum today are roughly 12 to 15 tons per acre, depending on the location.

As the Committee knows, higher yields per acre have a significant impact on farm and conversion economics and can dramatically reduce harvest and delivery costs per ton, the largest single expense in providing raw materials to bioenergy facilities. Higher yields mean greater above and below ground carbon sequestration as well. So similar benefits would be seen in calculating greenhouse

gas reduction by displacing petroleum with biofuels made from dedicated energy crops.

We all understand the role of biofuels is threefold: First, to improve U.S. energy security as the demand for transportation fuels worldwide continues to increase; second, to reduce greenhouse gas emission; and, third, to provide agricultural producers new and expanded revenue opportunities.

With this in mind, I would suggest the Committee should have two objectives in mind for the continued development of the U.S. biofuels industry in the short term. The first is continuing to improve the starch ethanol industry's environmental profile and amount of fossil fuel displacement, and the second is facilitating the commercial scale-up of cellulosic and advanced biofuels.

To bring both of these two together, I am going to talk for a little bit about repowering. A simple, relatively low cost opportunity using available technology exists today to help starch ethanol facilities further improve their environmental profile and increase their displacement of fossil fuels. This is the opportunity to transition from natural gas or coal to biomass as their onsite source of heat and power. Existing coal boilers can be used as is or can be retrofitted or replaced. Small-scale gasifiers can be used to create a biomass-based syn gas that will work in natural gas boilers. Several facilities are either already using or have at least experimented with use of biomass in their boilers.

The combination of the Repowering Assistance Program and the Biomass Crop Assistance Program, both included in the Food, Conservation and Energy Act of 2008, provide good support for this transition.

Adoption of biomass as a heat and power source by the starch ethanol industry will not only provide benefits to the starch ethanol but will also provide benefits in helping the commercial scale-up of the cellulosic biofuels industry.

Two critical elements of the cellulosic biofuels industry achieving scale are growers gaining experience with growing dedicated energy crops and facilities gaining experience dealing with the logistics of biomass harvest, transport and storage at large scale. Often, these elements of successful cellulosic scale-up are overlooked relative to the need to generate large-scale facilities.

Use of dedicated energy crops for repowering would provide the necessary market for agricultural producers to begin growing dedicated energy crops. The experience gained with biomass handling by the companies using this biomass would provide useful knowledge and serve as a stepping stone to commercial-scale handling of biomass for cellulosic biofuels production.

So what I would like to do now is share with you just a few policy priorities that we believe will help support these objectives.

The first is expanded funding of the Repowering Assistance Program. When used in conjunction with the BCAP, the Repowering Assistance Program provides an attractive opportunity for starch-to-ethanol facilities to transition from coal and natural gas to biomass as their source of heat and power. Given the benefits of establishing a market for dedicated energy markets, the program should be expanded to accommodate this increasing demand.

Second is planning appropriately for the funding requirements of BCAP. Because the Repowering Assistance Program creates an immediate market opportunity for biomass, it could lead to considerable early market demand for the BCAP program. We encourage the Committee to work with the USDA and the Office of Management and Budget on such matters to ensure adequate funding for 2010 success. Ceres will provide assistance wherever possible.

The third priority would be extension of the BCAP matching payments for collection, harvest, transport and storage. As USDA implements this important BCAP provision, Congress should help ensure that facilities have the right incentives to make the transition from coal and natural gas to biomass. It is important that 2–year time line on matching payments for collection, harvest, transport and storage costs under BCAP be extended.

The fourth is inclusion of high-biomass sorghums under BCAP. High-biomass sorghums are the only one of the primary dedicated energy crops that is an annual and that achieves a full yield in its first year. Having an annual dedicated energy crop will be critical for allowing rotation with other crops and for enabling immediate implementation of biomass as an alternative to coal and natural gas. It is, therefore, important that high-biomass sorghums are encompassed by BCAP.

Ceres is working with the USDA to ensure that such sorghums, importantly, those designed for production south of Interstate 20, are not trapped in a no man's land between Title I crops and BCAP. We will keep the Committee advised of this work.

Next would be limitation on BCAP establishment assistance. So, while we are supportive of rapid implementation of the establishment assistance that is due to be in place in time for the 2010 growing season, we would suggest caution regarding the magnitude of support that would be offered on a per acre basis. If the United States wishes to encourage energy crop production on the largest number of acres possible, it may want to carefully consider the high establishment costs associated with vegetatively propagated crops and avoid the experiences of the United Kingdom wherein they may have actually hampered biofuels expansion by dedicating too many resources to support the establishment of more costly crops that would not be able to stand on their own without the support program.

Finally would be carbon offsets for below ground biomass. Biomass and, in particular, dedicated energy crops are the only source of renewable transportation fuels or power that has the potential to be not just carbon-neutral but, in fact, carbon-negative. If farmers are to profit in a carbon-constrained world, we need to have a good handle on the amount of carbon sequestration that is provided by perennial dedicated energy crops root-based carbon sequestration. We would encourage the Committee to encourage the USDA to pursue public-private research to measure how much carbon is sequestered in the roots of dedicated energy crops and how this accumulates over time.

Together, we believe these policy priorities will help achieve the dual objectives of continuing to improve the environmental profile and fossil fuel displacement of the starch ethanol industry and fa-

cilitating the commercial scale-up of cellulosic and advanced biofuels.

Thank you again for providing me with the opportunity to discuss our efforts and policy priorities. We look forward to working with you to help continue the rapid and successful development of these industries. I look forward to your questions.

[The prepared statement of Ms. Rath can be found on page 79 in the appendix.]

Chairman HARKIN. Thank you, Ms. Rath. I just learned something I never knew before, the difference between seedcrop propagated and vegetatively propagated, and I still do not know if I understand it.

Ms. RATH. I can talk more about it.

Chairman HARKIN. We will get into that.

Mr. Steve Corcoran, Chief Executive Officer, KL Energy Corporation, Rapid City, South Dakota, thank you for coming over.

**STATEMENT OF STEVE CORCORAN, CHIEF EXECUTIVE OFFICER, KL ENERGY CORPORATION**

Mr. CORCORAN. Thank you. Mr. Chairman, Senator Thune, thank you for the opportunity to provide testimony on the expanding role of biofuels in America.

I am Steve Corcoran, the President and CEO of KL Energy Corporation, a biofuels energy company located in Rapid City, South Dakota. I am accompanied today by Dave Litzen, our Chief Technical Officer and Vice President of Engineering.

Over the last several years, KL Energy has transformed from a first generation biofuels company to an organization which today is focused on providing second generation technology for the conversion of lignocellulosic feedstock to ethanol. Our experience from deploying and using first generation biofuels is being transferred to support and guide our second generation biofuels development. While there are several technological pathways to second generation biofuels, KL Energy has focused its research and development on a unique thermal mechanical pretreatment process to make ethanol from biomass feedstock.

The use of wood waste, biomass for transportation fuels and power is increasingly being viewed as an opportunity to enhance energy security, provide environmental benefits and increase economic development particularly in the rural areas. Beyond the current accepted benefits of biomass-derived ethanol, our Nation's car manufacturers and fuel suppliers have a unique opportunity to leverage the elevated octane that ethanol in gasoline provides. The current energy policy identifies specific targets for increasing automotive fuel economy by 2020 and represents a great challenge to our car manufacturers.

KL energy would also encourage that the industry take advantage of the increased octane of higher ethanol blends. The octane rating of an automotive fuel is frequently misunderstood or misapplied by the general public, but, in general, the higher fuel octane rating enables higher energy compression, resulting in improved mileage efficiency without losing power. We need only to look at the engines used in the fuel design laboratories of the racing industry to prove that point.

Since 2001, KL Energy Corporation made significant investments in research and development predominantly from private sources and self-funded efforts. Beginning at the laboratory and pilot scale, our R&D efforts have been focused on pretreatment. The purpose of pretreatment is to alter the structure of the biomass so that cellulose, which is entrapped in the lignin and hemicellulose matrix, can become more amenable to the enzymatic process.

Some of the desired characteristics of our pretreatment are enabling the high conversion of all biomass carbohydrates to ethanol and minimizing the sugar degradation during the pretreatment, all in an environmentally friendly and cost-effective manner. Our pretreatment is effective on soft woods, hard woods and other herbaceous forms of biomass because the process retains these characteristics.

The research at the laboratory and pilot level resulted in the construction of our commercial demonstration facility in 2007. Capable of commercial operation using wood waste from the Black Hills National Forest to produce ethanol, the facility, Western Biomass Energy, is located in Upton, Wyoming and includes pretreatment, hydrolysis, fermentation, distillation and co-product recovery stages, allowing us to evaluate our process for making ethanol at scale and validate the cost and performance assumptions to prepare for the deployment of commercial plants.

Our business model for the commercialization of our technology is referred to as Community Energy Centers which will produce cellulosic ethanol and a co-product called lignin. Our model focuses on the economic development of our rural economy and is guided by three basic principles:

First, to understand the locally available biomass feedstock. The economic competitiveness of cellulosic ethanol production is highly dependent on feedstock cost. Consequently, as the deployment of Energy Centers approaches, feedstock cost and availability are the driving factors that influence locations. KL Energy believes that providing flexible plant designs on the basis of feedstock availability, rather than ethanol production, will result in low-cost niche feedstock opportunities, minimizing the ethanol production cost.

The recent provisions of the BCAP program, which provides matching payments for the collection, harvest, storage and transportation will encourage sustainable feedstock availability for the ethanol production.

Second, to work with local economic developers. We want to keep the footprint of our operation small and in close proximity to the feedstock source. Our modular, decentralized design also offers better access to the synergistic opportunities such as locating with wood pellet production plants, existing cogeneration facilities and sawmills. The small Energy Center concept will create local jobs and energy alternatives in many communities that might not normally have that opportunity.

Third, to optimize and leverage the value of the lignin co-product. Our technology has the ability to take lignin, which is the outer layer that binds and protects the biomass fiber, and creates and a pellet. Lignin pellets yield up to 20 percent higher energy content over conventional wood pellets since most of the lower energy cellulosic sugars were removed during the ethanol process. As

a natural consequence of KL Energy's process, the lignin co-product can be compressed into a highly durable pellet having a bulk density that is 20 percent higher than a typical wood pellet. Consistent with recent EPA studies, KL Energy's process will achieve at least 85 percent reduction in greenhouse gas emissions as compared with gasoline.

In utilizing waste generated continuously by the forest products industry and the forest itself, we see the impact of strategically placed small Energy Centers as a win for locally produced, locally consumed energy and a win for the forest management by providing a destination for slash piles that are currently being burned or simply left to rot. The positive impact of turning forest waste into usable fuels and other products benefit the environment by reducing or eliminating the prescribed burning of the waste, eliminating the generation of particulate matters during the burn and the cost of soil remediation after the burn.

The current energy policy restricts the use of waste from public lands, a restriction that must be reversed to help facilitate the implementation of all the positive benefits of a biomass utilization. If the government continues to aggressively pursue second generation biofuels research and development, enact investor-friendly tax incentives for the production and blending and enable the use of waste material from public land, the prospects for achieving sustainable biofuels markets will become a reality. Cellulosic ethanol represents a new way to pursue goals and increase energy security and economic development, especially for the rural areas, while protecting the quality of our environment.

Mr. Chairman, thank you for the opportunity.

[The prepared statement of Mr. Corcoran can be found on page 42 in the appendix.]

Chairman HARKIN. Thank you very much, Mr. Corcoran. The question is about fermentation.

Now, Mr. John Sheehan, Scientific Program Coordinator for Biofuels and the Global Environment, Institute on the Environment, University of Minnesota, Mr. Sheehan, welcome.

**STATEMENT OF JOHN SHEEHAN, SCIENTIFIC PROGRAM COORDINATOR FOR BIOFUELS AND THE GLOBAL ENVIRONMENT, INSTITUTE ON THE ENVIRONMENT, UNIVERSITY OF MINNESOTA**

Mr. SHEEHAN. Chairman Harkin, Senator Thune, thank you very much for having me here.

I am going to attempt to talk from my PowerPoint and stay within my time limit here. So let me jump right in.

I was asked to talk about the promise of advanced biofuels technology, but in my subtitle for my talk I want to make a point of saying this is not just about advances in the technology for making biofuels. It is also about ongoing advances in agriculture, not unlike what Anna talked about in terms of breeding new energy crops for farmers, not unlike the kind of astoundingly high yield improvements that we heard about that are possible just for corn, and it is really the combination of those advances that are going to lead us to real sustainable production of fuel down the road and not just one or the other.

A lot of what I am talking about here actually was just recently published. They devoted an entire issue of the journal Biofuels, Bioprocessing to a series of studies that I was a part of with folks from Michigan State, Dartmouth College, Princeton University, the Natural Resources Defense Council, who, by the way, were a major part of making this study happen and for whom I think this was a great learning experience because I think this was an opportunity for the NRDC and other environmental groups to learn that there are some real positive elements to what agriculture can do in the role of not only producing fuels like ethanol but also being positive contributors to environmental sustainability. If there was actually an outcome from that study that I think was the most important, that might have been it.

So, advanced technology, I am helped a lot by some of the comments that have already been made here about the technology of producing fuels from biomass. I generally talk about these technologies in two different flavors.

One is biological, biochemical processing, otherwise known as fermentation. Take something like starch from corn or cellulose from a plant, break it down to its sugar which is something that you can feed to a yeast or a bacterium, and they can convert it into ethanol.

Actually, given the explosion in biotechnology that is going on today, there is an awful lot more these bugs can do than just make ethanol. If you want them to, they will make a renewable gasoline. They will make a renewable diesel for you. These are longer-term technologies, but they are options that are being considered down the road.

Then there is thermo-chemical processing. Typically, what people are talking about is using a lot of high pressure, high temperature conditions, heat and pressure to bust biomass apart into really small chemical compounds that can then be converted into virtually anything you want, anything from ethanol to a diesel or a gasoline substitute or something that is indistinguishable from gasoline or diesel fuel.

So those are sort of the two big technology camps. One of my frustrations, and this is a running theme for my testimony here, is that there are too many opposing camps, whether technologists or environmentalists or for the farm community or others who are battling with each other about who has the right or the wrong answer. The thermo-chemical technologists, who have things like gasification technology, are just as important to the fermentation folks as part of the solution. In fact, the ultimate advanced technology is going to be the run that brings those two pieces of technology together to give us the greatest, most efficient use of the biomass that we are trying to make.

In fact, that fractionation step that is in the center block here of this integrated scheme I am showing is the kind of thing like the pretreatment technology we have been hearing about, where we can get the sugars away to do what the bugs like to do with them and we can take the rest of it, the lignin and the other things that bugs cannot eat, and use them for heat power and fuels themselves. That is what makes ultimately a really effective, sustainable technology.

Again, new versus old technology, I wish we could throw this away. What we are really seeing is that the existing corn ethanol industry is going to be the industry that begins to adapt a lot of these new technologies. So it is not about old technology or old industries being replaced by a new industry.

In this case, touching a little bit on what Anna said, and we did not talk about this in advance, in Minnesota at the Chippewa Valley Ethanol Facility, they have put in a demonstration scale gasifier where they are taking all sorts of biomass and most recently collecting corncobs and gasifying it for heat and power and replacing 25 percent of their natural gas demand with that biomass. What are they doing besides saving the cost of natural gas? They are reducing their carbon footprint. So what is viewed as a typical corn ethanol plant is not a typical corn ethanol plant, and I do not think that there are a lot of those out there.

Continuing along those lines, the POET facility in Emmetsburg is a case where both cellulosic and corn ethanol technology are being put together, and that is the kind of thing that is going to succeed, building on what is effectively—I do not know—it must be somewhere between ten and twenty billion dollars in invested and in-the-ground capital in the existing corn ethanol industry.

Economics, I am not going to spend a whole lot of time here except to say that when you look at where this technology can get to, between prices of say $75 and $125 a barrel oil, there is a huge amount of room for all sorts of thermal or biological or combined thermal and biological processes to compete with oil for fuel production.

I want to point out one of the problems you will often see in the economics that are developed by DOE and other places is one of the ways they sort of get themselves down to a low-cost fuel is to assume a low-cost feedstock.

Well, guess what, folks? That is the profit margin of a farmer you are talking about. So, at typical numbers of $35, $40 a ton, which you will quite often see as the basis for projecting costs of a technology, you will see farmers perhaps getting $175 to $300 per acre depending on the yield of the biomass they are collecting. And, after transport costs, that is not enough to convince them to become a biomass producer rather than some other crop producer.

What we have seen is that even up to prices of $100 a ton, where the revenue to the farmer I think becomes serious, you can have cost-effective technology.

The numbers are like the numbers we have already heard about. For 14 different permutations of biological and thermal processing that we looked at, all of them have an extremely high capability for reducing carbon emissions and for reducing dependence on petroleum.

I want to touch very briefly, because my clock is running out, on the issue of indirect land use change which is something we can come back to. I have done a little bit of simple modeling which actually suggests that even if all we do as a globe, as a planet, is to continue to improve agriculture at the rate that we have been doing it over the last 40 or 50 years, we could be coming to a place where we could feed our planet on less land. Well, if we are feeding our planet on less land, we are not causing land clearing in the

rainforests of Brazil, and that changes the so-called indirect land use and food versus fuel issue into a completely different matter.

I am actually going to stop here.

I am very glad to hear Senator Harkin talk about the policy issues that are related all along the supply chain because there is a lot of chicken and egg problems going on now with the development of this industry.

I have done modeling of looking at what it takes to make that whole supply chain grow into a successful industry, and not to get into the details, but among the findings we have seen is at the kind of oil prices we are seeing and have seen in the last year or two, certainly by 2050, probably even without policy help, there is a potential for somewhere between—let me get my numbers right—100 billion and 200 billion gallons, that is with a B, production of cellulosic and corn ethanol down the road. But that might not be until 2050. What we need are policies that make that happen faster today.

So, with that, I will stop.

[The prepared statement of Mr. Sheehan can be found on page 85 in the appendix.]

Chairman HARKIN. Very interesting and thought provoking. Thank you very much.

Now we will finish off with Mr. Ed Olthoff, Cedar Falls Utilities, Cedar Falls, Iowa, who is going to talk about different processes that they are using.

**STATEMENT OF ED OLTHOFF, CEDAR FALLS UTILITIES**

Mr. OLTHOFF. Thank you, Mr. Chairman and Senator Thune.

My name is Edward Olthoff, and I am representing Cedar Falls Utilities. It is my privilege to share with this Committee the ideas proposed and experiences gained in our Cedar Falls Utilities' biofuel project.

Cedar Falls Utilities, or CFU, is a municipal utility located in Cedar Falls, Iowa. CFU provides electricity and three other utility services to the city of Cedar Falls. The electric utility owns coal-fired baseload generation at three remote locations, backup coal-fired generation at Streeter Station in Cedar Falls and emergency natural gas-fired generation at West 27th Street in Cedar Falls.

The electric utility also owns shares of two existing wind farms and is a partner in developing a new wind farm project. CFU anticipates generating 15 to 20 percent of its electric needs with wind in 5 years.

CFU is also investigating the potential to generate baseload electricity from biofuels at Streeter Station in Cedar Falls. Streeter Station has two electric generation units which have been operating 3,000 to 5,000 hours annually. Unit 6 is a stoker coal-fired boiler. Unit 7 is a pulverized coal-fired boiler.

Unit 6 was designed to burn stoker coal, but the stoker has the flexibility to handle most solid fuels. In 2004, CFU began short duration biofuel test burns in Unit 6. In the next 2 years, CFU was able to complete a series of test burns using five potential biomass feedstocks densified into two solid fuel configurations: pellets and cubes. Fuels for these test burns included corncob pellets, hard-

wood pellets, cornstalk pellets, corn stock cubes, switchgrass cubes and oat hull pellets.

These short test burns demonstrated technical feasibility of the project. Future plans for longer duration test burns and continuous generation point to several significant challenges. All of the economic modeling shows biofuel-based electric generation to be significantly more costly than coal-fired generation.

Existing policies and proposed policies have potential to equalize the cost just as policy has encouraged the development of wind energy. These policies include tax credits to benefit municipal utilities, renewable energy production incentive funding, Department of Agriculture policies, Department of Energy grants, green credits and carbon taxes. CFU has investigated the impact of these policies on the cost of biofuel and has advocated policy changes that would equalize the costs.

Another significant challenge is the development of a supply chain for the biofuel. Electric production consumes large quantities of these biomass fuels. Preliminary calculations indicate the need for 200 tons of biofuel daily to operate Unit 6 at half of its rated capacity. Until fuel production capacities are increased, there is not sufficient supply to perform extended test burns, much less continuous generation.

Links in the supply chain are the producers of the raw material, a transportation infrastructure to move the material from production sites to a processing facility, space to store the raw material, a processing facility to densify the material to the specifications needed for electric generation and a transportation system to move the densified material from the production site to Streeter Station. These links need to be developed or strengthened before a robust supply chain can emerge with a sustainable production capacity needed for continuous generation of biofuel-based electricity at Streeter Station.

A third significant unknown is the effect of the biofuel combustion on the boiler. A thorough study of the performance of the boiler during biofuel combustion is needed. Impacts of mineral deposition and mechanical abrasion on the boiler tubes from biofuel combustion must be determined. The simplest way to determine these effects is to perform extended test burns, monitor the boiler during the burn and inspect the boiler after the burn.

CFU has sought assistance for this project at the local, State and Federal levels. A Congressionally directed grant is now pending to advance the project.

Three test burns are planned using three new feedstock and densification combinations. These are mixed native prairie grasses in a cube, mixed agriculture residue in a pellet and sugar cane bagasse in a bripell configuration.

Following completion of the three short test burns, one test burn of a 10–day duration is planned. The choice of fuel for the 10–day burn will be guided by our assessment of the best densification configuration, the most available feedstock and the capacity of a producer to manufacture the quantity of densified material needed for the test.

Additional long duration test burns are needed before any long-term commitments or contracts can be made. Further advance of

the project will be dependent on development of a supply chain of sufficient quantity to initially support long duration test burns and, ultimately, continuous generation at a cost equivalent to the fossil fuels.

Capital is needed to develop the supply chain required for sustainable production of the biofuel supply and dedicated energy crops grown on conservation reserve land will be needed to augment and satisfy the need for additional raw material. Public policy or funding favorable to biofuel-based electric generation will be critical to continue the development of this project.

That is all I have. Thank you for the opportunity to present my ideas.

[The prepared statement of Mr. Olthoff can be found on page 53 in the appendix.]

Chairman HARKIN. Thank you very much, Mr. Olthoff, and thank you all for stimulating statements and also the written prepared statements you had.

I think what I will do, John, is I will just start. I will take five or 6 minutes, you take five or 6 minutes and then we will just kind of open it up for a general free for all.

Senator THUNE. Sounds good.

Chairman HARKIN. OK. I think, first, I have a lot of things I want to talk about here. Productions, though you talked about that, I had a hearing about a year ago in Omaha, and Pioneer—I can say that, can I not, Pioneer?

Senator THUNE. Quietly.

Chairman HARKIN. Quietly, OK. One of your competitors there said that they anticipated a 40 percent increase—no, I will correct my words. They are going to have a 40 percent increase in yields with both corn and soybeans within a decade.

I asked the question of the CEO at the time. I said, well, is this sort of what you are thinking about?

He said, no, this is based on results already confirmed in their experimental plots.

So, just think about that, in a decade, buttressing what you said, a 40 percent increase.

Mr. COUSER. Can I add one thing to that, Senator.

Chairman HARKIN. Yes, yes.

Mr. COUSER. We pick a lot of the small seed plots around the community there too for the research plots. Last year, we picked one seed plot that every stalk had 11 shanks on it. Five out of those eleven shanks had kernels on them. Can you imagine what happens if we get two big ears?

Chairman HARKIN. Instead of one per stalk, you mean get two. Well, we have 20 now on some stalks, but they are always small.

Mr. COUSER. But two big ears, it is coming very fast.

Chairman HARKIN. Will stalks stand? You have to have more cellulose.

Mr. COUSER. Well, that is one of the problems we have in the seed business is developing the machinery just to harvest the seed corn because of the size of the stalk and some of those new hybrids are so wide and the ear is small.

Chairman HARKIN. I heard it in a different context, and that was if you just added—I forget what it was—four kernels per ear, you

would increase your production per acre by a lot. I forget the figures, if you just put a few more kernels on an ear, and you know ears are getting bigger.

Mr. COUSER. If we could just educate every farmer in the United States how to set a combine correctly, we would not have a food problem here.

Chairman HARKIN. Thanks. I am not going there.

Mr. COUSER. I said that. You did not.

[Laughter.]

Chairman HARKIN. Dangerous, dangerous territory for a politician.

But the other thing is, and I want to pursue this a little bit because we just have got to put to rest this whole thing about food or fuel.

The other thing that is happening is through genetics at Monsanto and Pioneer and others, and this is being done in universities also, that they now are finding out how to grow corn in areas where before they could not. For example, right now, we know that there are certain plants that use photosynthesis, just like corn, but utilize saltwater. They have the genetic capability of separating the salt out and taking the water out, and they can grow fruit.

The most prominent ones being coconuts, of course. Coconuts grow in seawater. We know about other plants too. I can get the names of them.

So they are now looking at changing the structure of corn using genetics. If you can find the gene that does that, and you can put that in corn, you can now start growing corn in brackish water areas. Places they have never grown corn before in the world can now start growing corn.

This is not pie in the sky. This is research that is happening right now.

So there are a lot of things underway. That is why when they say, well, if you are going to go to fuel, then you are going to cut down forests and stuff, that is nonsense. That is just nonsense. The way to keep a forest from being cut down is through land use policies that are international in scope.

Well, I did not mean to get off on that, but some of the things you said just brought that to my attention, and I think that is just something that we have really got to pay attention to because we are getting sidetracked on this. The indirect land use issue is at the heart of that, that whole thing of food or fuel.

Mr. Corcoran, you talked about removing CO2 in your testimony. Let me see if I can find that right here. Oh, yes. By applying the fermentation process to convert biomass, the potential exists to actually remove atmospheric carbon dioxide, the only industrial process we know of that can make this claim.

Well, now what about algae? Algae takes CO2 out of the atmosphere. That is one of the feedstocks for algae.

Mr. Sheehan, you have done a lot of research in this area. So would not algae also be an area where we can actually remove carbon dioxide out of the atmosphere during the production of fuels? Mr. Sheehan?

Mr. SHEEHAN. Well, I will comment on the algae. I was actually the program manager for algae at a point when the Department of

Energy had made the decision to shut it down, and it has been really gratifying to watch the level of interest, certainly coming from the private sector and now from Congress and from the public sector in this area.

But algae are really not that different from other crops. In my view, they are really carbon recyclers. They are capable, particularly in the case of a coal-fired power plant, of reusing the carbon dioxide that is coming from that coal and reprocessing it. That is perhaps their biggest advantage, that they can actually help the coal industry bring down its carbon footprint while we are contributing to secure production of fuels.

Chairman HARKIN. I just wanted to make that point because I have seen some test results on algae which look very promising for liquids.

Mr. CORCORAN. My statement, sir, was as we are biochemical process, unlike a thermal chemical process, and as a biochemical process we can isolate the CO2 during the fermentation process and therefore remove that atmospheric CO2 unlike a thermo-chemical process that does not isolate the CO2 because it gasifies the CO2.

Mr. SHEEHAN. I would like to build onto that just briefly. One of the fascinating ideas that is being pursued by some ethanol companies is that biological process from a fermentation produces absolutely clean CO2. It is the cleanest, richest source of CO2 you could ask for.

Chairman HARKIN. From where?

Mr. SHEEHAN. From the fermentation process of making ethanol from starch or any sugar, there is this wonderfully clean CO2 stream at just goes right out the top. You can do two things with it. You can do, I think, what Mr. Corcoran was suggesting, and you can sequester it. You can bury it underground. Or, you can feed it to algae.

Chairman HARKIN. Feed it to algae.

Mr. SHEEHAN. And, algae will reuse that carbon dioxide and improve the overall footprint of the ethanol facility itself.

Chairman HARKIN. I never thought about that. That is interesting.

Mr. Corcoran, before I turn it over to Senator Thune, you mentioned the fact that the public needs more info on the benefits of increased octane. Do you have some more on that you could give to us about the benefits of higher octane, what it means in terms of more efficiency, in terms of compression ratios?

That was the first reason for using ethanol a long time ago. We first put lead in gasoline, right, and then we found out lead was a no-no.

So then the oil companies decided, well, we have this new blend that we can put in to increase octane. It was polylene and benzene and something else, and then we found out that was really carcinogenic.

So they said, how are we going to keep the octane up? Well, ethanol was the way to keep the octane up. I think we could use some more information. I never thought about that until you just mentioned it here.

Mr. CORCORAN. Chairman, I can provide that as part of my addendum.

Chairman HARKIN. Yes, any additional information you have got on how we might use that as a selling point.

Mr. CORCORAN. Yes.

Chairman HARKIN. Well, I have got a lot more, but I will turn it over to Senator Thune.

Senator THUNE. Yes, it has prompted a lot of questions, Mr. Chairman. I think we could probably keep this discussion for a long time.

Mr. Stowers, what are the infrastructure restraints to approving E–15 today?

Is it a fuel that can be used in existing gas station pumps? Could it be used in existing on-road vehicles? What is the infrastructure restraints that might get in the way of that?

Mr. STOWERS. Today, there are really no infrastructure constraints that would need to be alleviated to bring E–15 forward.

As early as the late eighties and through 1993, the automotive industry worked on standards that set forth a test fuel that all engine components and emissions systems would have to go through. It actually set up a synthetic fuel that included 15 percent methanol, and methanol is much more aggressive than ethanol. And so, all of our engines, should all of the automakers adhere to their own standards, al the materials, compatibility and emissions would be acceptable within the cars that are produced today.

Second would be the issue of the pumps and tank and so forth. The UL has actually stated that the existing pumps and dispensers would be acceptable up to E–15. That is part of the reason why we chose E–15, to fit within that infrastructure requirement.

Other minor details that we would have to go through, should the EPA approve the waiver, would be to go through an ASTM certification of that fuel which is something that we can do very simply. We are only adding a very small amount of additional oxygen to the overall fuel.

So, in a real sense, though, the automotive should be able it. The pumps should be able to handle it. There are some mechanical issues relative to certification that we would need to go through.

I might add that whereas there is a lot of public statements against using ethanol in general, and E–15 in particular, in small engines or marine applications, there is no information, no studies that have been done to date that would support the degradation of engine components in those equipment or a failure related to emissions.

Senator THUNE. So, if you went to an E–15 in a filling station, would the small engine users that come in to get fuel for their lawnmowers or whatever, because that has been one of the arguments that has been raised, that that would be a problem, would they still have to access that type of fuel even if EPA approves E–15 or do you think that E–15 would burn? You just said that you thought it would burn in there, but one of the arguments that is raised consistently by those who oppose moving to a higher blend is the small engine issue.

Mr. STOWERS. Yes. I mean from a strictly science and technological perspective, there should be no issues whatsoever. Recog-

nizing that the public and choice may be an important factor in getting E–15 approved, as part of the waiver request we allowed for the opportunity of blends up to 15 percent. So there actually could be lower level blends in particular regions or application areas that would afford a small engine user, a snowmobiler or a boater, to actually have E–0 if that made more sense to them in that application.

Senator THUNE. What are the environmental impacts of using, of approving E–15?

Mr. STOWERS. Well, with the use of ethanol in general and the increased use of ethanol, you have a reduction in the nonmethane organic gases. You have all the hydrocarbons are reduced. The overall regulated emissions are reduced relative to even E–10.

Senator THUNE. Is there, to your knowledge, any scientifically sound way to measure U.S. ethanol production's impact on land use decisions that are made in countries like Brazil? I would ask you that, and then maybe, Mr. Sheehan, if you would like to comment on that too.

Mr. STOWERS. Well, the first observation I would make is that as ethanol has increased in the United States over the past 5 years there has been a steady increase, as we have noted, 9 billion, 10 billion this year. Rainforest deforestation in Brazil has decreased on an almost equal decreasing slope. So first order is I cannot see any relationship between what we do here in Iowa versus what happens in Brazil, and I think that hardwoods, Brazilian hardwoods or Amazonian hardwoods are being used for another purpose and can be regulated by other means.

The thesis that one acre of corn use for ethanol in again Iowa corresponds to one acre of deforestation just holds no validity. The models that the EPA is using and the ones that the Air Resources Board in California are using are flawed at many levels, and we have made public comment to both agencies in that regard.

Senator THUNE. Do you want to add any to that, Mr. Sheehan?

Mr. SHEEHAN. Well, here is a hornet's nest. I guess a couple of comments.

I have been heavily engaged in the discussions with the analysts in California as well as at EPA on the modeling that they have done. My general response is that they have done the best modeling that can be done right now, but certainly by the modelers' own admission, and again the folks in California, the folks at Purdue and elsewhere who have looked at this, they will tell you that we are in very early days with this kind of analysis. And, trying to make a direct cause and effect linkage between a farmer's decision in Iowa and a farmer's decision in Brazil is really, really problematic.

In fact, I have shared some of this initial modeling work that I have done, which does not even try to do cause and effect. It just says: We have so much land. We know how yields have been improving, and we know, we think, how much new demand for food there is going to be. If I add all those up, can I construct scenarios where land demand does not have to rise globally for food production. The answer, I believe, is yes, there are scenarios where that can happen.

What I think the analysts in California and at EPA are doing is taking a conservative, from an environmental point of view, worse case perspective on the question. They are basically saying let's assume that land demand must continue growing globally. If you make that assumption, the conclusion you will come to is that you will cause land-clearing if you take land in the U.S. away from food production.

But that is a circular answer. It is saying I think we have a land demand problem. Therefore, if I add to the land demand, I am going to create a worse problem. The answer to that will be that is true.

But are there things that we can do to mitigate? The Brazilians have talked a lot about the idea of one of the big issues for Brazil being how inefficient at raising cattle, and cattle is the really, really big land footprint item for food production. So, if you can address issues in more efficient cattle production in Brazil, and they are trying to do that, that will do more to solve, to eliminate a potential problem than not allowing biofuels.

So that is a little bit of a roundabout answer.

Senator THUNE. Has anybody done any modeling on what happens if you get to 300–bushel corn or if you are at 250 already, how that impacts land use not only here but around the house? I mean how that bears on this whole question of international indirect land use and its impact in the calculation of the carbon footprint of biofuels.

Mr. SHEEHAN. In effect, I will say quickly the numbers I showed here, that showed that somewhere around 2020 land demand starts declining. It starts declining because average agricultural yields, even if they just continue at that lower rate, are already going to cause that land demand to go down.

I have not had the nerve yet to put a number like 300 bushels per acre in there, but it would be very interesting to see how that plays out.

Senator THUNE. But would not EPA be factoring that in too?

Mr. SHEEHAN. They are not doing that very effectively. Their models are static models that are not good at accounting for the future improvements that could occur.

Plus, you also have a lot of environmentalists who will argue that we hit the peak for future yield improvement. So, if you believe that, then it becomes a moot point.

You mean if you hold corn acreage constant today out to 2030, and you hit these 300–bushel break or yield targets. So we are fixing land and not putting any more land into corn production. Run through the math, and you can adjust the numbers how you want, but you can look at a way in which you can increase food production from corn by 40 percent and ethanol production by 400 percent on the same land.

There is no change in land use. You are using the same amount of land that was envisioned after the enactment of ASIA, 2007. So I do not see where we need more land to produce food and fuel in this Country.

Ms. RATH. The single largest, most important factor, variable, in almost all of these models is in fact the yield assumptions. They tend to make very conservative yield assumptions in terms of im-

provements in corn, and, for energy crops, they tend to hold them absolutely constant and absolutely constant at a level that is typically less than half of the yields we are already achieving.

So, when you put together the yields that we are currently getting in energy crops plus the potential for yield improvement in energy crops, which have not had the benefit of all for the breeding that a lot of our major row crops have had, plus the potential for yield improvements in row crops, a lot of these models start predicting that in fact we are going to have lots of excess land. So that is the key assumption underlying all of these models.

Senator THUNE. Just one, and then I will yield back, Tom. Just a follow-up on that point then, and this bears on the question of corn-based versus advanced cellulosic. We are at a 15 billion gallon cap on corn-based and 21 billion on cellulosic.

I guess the question for people who are involved with trying to scale-up cellulosic ethanol production and get it on a commercial level is can we hit those targets and/or should we be adjusting the 15 billion gallon cap that we have today attributable to corn-based ethanol, assuming that we are going to see higher yields going forward, because it seems like right now the cellulosic thing has not caught on yet quite to where it is going to ramp up quickly enough to meet the targets.

I hate to see us go backwards and allow waivers of the RFS because we are not getting to where we need to be in terms of the goal. So anybody want to comment on the balance between corn-based versus cellulosic and whether or not we are going to be able to achieve the targets for cellulosic in the time lines that are called for in the RFS?

I think the first point that I would make with regard to corn ethanol production is there is tremendous capacity. There is tremendous capacity to produce that at a very low greenhouse gas impact. To say it another way, we can reduce greenhouse gases compared to gasoline by greater than 50 percent. If we add in indirect land use, it is just a crazy calculation. So, in order to get to the next level, we need to have E–15 or E–20 or another, to get past the blend wall.

So there is a real opportunity from environmentally sound corn ethanol, and that technology is going to continue to improve not only at the farm gate level but also at the plant by improved efficiencies.

The same thing is happening at the cellulosic side. It is behind corn ethanol. It is rapidly catching up. Our cost structure for cellulosic ethanol is decreasing almost at an inverse hockey stick in terms of lowering our overall costs.

I think the point I would make is we are going to need both, and we have the potential to release all of our foreign oil requirements and produce all of our liquid transportation fuels from corn and cellulose. We have run the numbers, and, by 2030, we could get close to 140 billion gallons liquid transportation fuel. That is what we are using in gasoline. So I think you need both.

Cellulose is lagging corn ethanol. We started a little bit later, but it is rapidly catching up.

Senator THUNE. Thank you.

Thank you, Mr. Chairman.

Chairman HARKIN. Anybody else want to comment?

Mr. COUSER. Well, I would just like from a farmer's perspective. The last few years, it has been a real privilege to grow a corn crop and sell it on the open market for a profit and not burden the taxpayer. LDP payments, I am sorry. I mean it was a great program while it lasted, and we are very proud of what has happened there. Hopefully, we can continue that.

Just to go off of his thoughts, we need to increase this. Now do we need to raise the corn from starch cap even higher yet? I think we have to. I think that is a number that is a moving target, and it has to go up. But it would sure be great to be able to market this corn on the open market.

Mr. SHEEHAN. I would like to touch on Anna's notion of repowering the ethanol industry as an important part of the failsafe step of allowing corn ethanol to increase more in order to maintain meeting the goals of the RFS.

Even if we take the indirect land use issues aside, the amount of fossil energy that is consumed in a conventional corn ethanol plant is now so high that it offers some but not a whole lot of greenhouse gas reduction capacity. Clearly, one of the targets of the RFS and the low carbon fuel standard in California is to reduce carbon emissions. So, if we could do things to encourage the existing industry to expand and utilize biomass and renewable energy for its heat and power, its carbon footprint comes down so much, but that would be a very, very nice middle road to take while we are waiting for dedicated cellulosic ethanol technology to take hold.

Chairman HARKIN. If you are talking about dedicated cellulosic crops, now, Bill, in your area, that Story County land in central Iowa is so productive that it would not make much sense to grow a dedicated cellulose crop. I would think you would want to use residue from corn.

Mr. COUSER. We have it both. We have the corn, and we have the residue in Story County.

Chairman HARKIN. Yes, both. But there might be some areas, southern Iowa and places like that, where row crop production is both environmentally not very good but production-wise, where you might be able then to do dedicated kinds of crops. I am sure that is true in South Dakota and probably every other State. There are areas that would be more amenable to growing a dedicated cellulosic type of a crop.

Now what that kind of leads me to is this. The other thing that is coming at us here is the Climate Bill, and what are we going to provide for offsets for farmers and what role agriculture can play in reducing our carbon footprint—is that the right word—or reducing the CO2 emissions.

Right now, the data I have seem to say that agriculture is responsible for about 12 percent of the reductions. We grow crops. We take CO2 out of the air. Some of it, we do not put back. Some of it is sequestered. So it is about 12 percent.

I have seen figures that say we could double that easily. In other words, agriculture could be responsible for removing 25 percent of the carbon emissions, but that has to be sequestered. Now that is where you get into things like switchgrass, and I do not understand this vegetative seed propagation.

But someone came into my office, John, about 2 weeks ago or 3 weeks ago. Who was that? He came in from Tennessee and had that picture of the root structure.

Unidentified Staff. Wes Jackson from the Land Institute of Kansas.

Chairman HARKIN. Wes Jackson from the Land Institute in Kansas, and he had a picture of a cutaway of the root structure of switchgrass, and the roots go down almost 20 feet. He had a 20–foot long picture in my office. Well, that is a lot of carbon sequestration. You know.

So I am thinking to myself, wait a minute, maybe we can have our cake and eat it too. We can grow a dedicated kind of crop in certain areas, like switchgrass which is perennial, and harvest that, and yet you get these 20–foot deep root structures that are going to be there for a long time.

So is that a part of what we ought to be thinking about in terms of cellulosic ethanol, not just for the ethanol itself but for what we can do to provide the offsets?

Ms. RATH. This is why I mentioned earlier that the amazing thing about using perennial dedicated energy crops to create biofuels or biopower is that they have the potential to not just be carbon-neutral as you cycle that above ground biomass into the facility, but in fact be carbon-negative because of that below ground sequestration. And so, switchgrass is a great example of a crop that provides for a lot of below ground carbon sequestration in the form of that root biomass.

What has not been done is enough study to show how that sequestration takes place over time. Does it taper off? If you use no-till and plant a new crop, do you get to add yet more? And so, one of the things that needs to happen is for there to be a better understanding of how much sequestration is taking place so that growers would be able to get proper credit for that below ground carbon sequestration that their crops are providing.

Chairman HARKIN. Anybody have any other views on that?

Mr. SHEEHAN. There is actually another huge benefit outside the world of carbon reductions, which, by the way, I think we spend obsessively too much time on because there are a lot more issues than just carbon out there in terms of sustainable fuels. But the issue I am thinking of is those root structures actually are the reason why land in the Midwest was as productive as it was when the pioneers first came and broke the soil. That is because of the grasses that were there for I do not know how many thousands of years, that built up the organic matter in the soil, that really created soil that is the healthy soil that was so productive. So, for sustainable agriculture, for maintaining that stewardship of the land, the value of rotating in these kinds of crops is tremendous.

Ms. RATH. I thought you were going to say yet another one which is switchgrass requires a lot less fertilizer. One of the things that happens when you put down fertilizer is you get NOx emissions back into the atmosphere. NOx is a very potent greenhouse gas. So, by reducing your fertilizer usage per acre, by growing a crop like switchgrass, you also reduce your greenhouse gas emissions from the agricultural piece of it, as will all the nitrogen use efficiency

technologies that are coming down the pipelines for corn and other crops.

Senator THUNE. Do you see any potential for sort of blending CRP program and energy-dedicated crops? We are seeing a lot of acreage taken out of CRP in South Dakota and being put back into production because the economic incentives are to plant as opposed to keep it in CRP.

We saw a demonstration up at South Dakota State University a couple of weeks ago, not of switchgrass—we have switchgrass there planted too in plots—but also of cordgrass which can be grown in areas that will not grow anything else. You eliminate the food versus fuel argument because it grows in areas where you flat just would not be able to plant another crop, and it grows well, and it could be an energy-dedicated crop.

But I am just trying to think if there is a way, and this comes back. I know it is partly the way our Farm Bill is done. We had a great conservation title in that. But what I am concerned about is seeing the reduction, significant reduction in CRP acreage in our State, a lot of it coming out and being put back into production, and that has implications not just for conservation but wildlife production and other things that are important to our economy.

An energy-dedicated crop, in many cases it might be a switchgrass or something like that could serve or fulfill a function, deliver a conservation value, continue to promote wildlife production and be harvested at the right time a year as an energy-dedicated crop. We might be able to marry up some things. I think we have several objectives obviously in this part of the Country with the CRP program, but it might tie into the planting of an energy-dedicated crop that could be used for biofuel production.

I mean do you see the potential for that?

Ms. RATH. Absolutely. There are many different reasons why acres have gone into the CRP program, and so many of them have gone in because of issues of soil erosion. Well, that same deep root structure we have been talking about as a source of carbon sequestration is wonderful for preventing soil erosion. So there are many acres in CRP that would be perfectly appropriate for the growing of switchgrass.

Mr. SHEEHAN. I will just add to that. You know I spent 17 years at the National Renewable Energy Lab, and we eyed CRP acres. We drooled over those acres for years because of their potential, if done sustainably, to become a source of harvested energy and still deliver the benefits that the CRP program delivers for those lands.

Chairman HARKIN. If I may, Mr. Olthoff?

Mr. OLTHOFF. Yes, I would like to address that question as well.

We are kind of on the edge of technology. We do not use enzymes or those kinds of things to produce our product. We just direct burn.

But we found that something like a switchgrass or mixed prairie type of planting, on conservation property or roadsides have several advantages for us. Since we are not particular about single species, we do not care whether they are mixed species or mono-cultures.

They can be harvested at a different time, and they offset the corn harvest which is a small window of opportunity in the fall.

Our experience shows that a spring harvest of grasses is probably the most appropriate time to harvest them for energy production.

There are a lot less minerals left in spring. The biomass is less, granted that, but we are happy to sacrifice a little bit of biomass for the reduction in minerals which are problematic for us in combustion.

Chairman HARKIN. Are you familiar with the Chariton Valley Project?

Mr. OLTHOFF. Yes.

Chairman HARKIN. Some of you are familiar with that. We started that back in the nineties.

We were always told that you could not really crop CRP ground because it would erode, leading to runoff and that kind of stuff. So we had this project in Chariton Valley to grow switchgrass on CRP ground, harvest the switchgrass and burn it in a coal-fired plant. Alliant Energy was doing it, and they went through several years, and they experimented with different processes and everything.

But I think what finally came out of it was, one, they had absolutely no erosion on the CRP ground whatsoever. They could harvest the grass. And, they experimented with different kinds of pellets and other approaches to packaging and compressing it. The last thing I saw was a bale of hay that weighed a thousand pounds.

Senator THUNE. One of their stages was they just chopped the material and blew it in.

Chairman HARKIN. Just blew it in, just chopped it and blew it in off those big bales.

The only reason I say that again is not to belabor the point but that it seems to me that following up on what John was just saying, that we have to, we want to produce a lot of fuel in this Country, a lot of liquid fuel. Corn is always going to be the leader. It is always going to be out in front because it is an established technology, we are improving it all the time, we know the conversion ratios. So it is going to be out in front.

But I am safe in saying it cannot do it all. We are going to have to have something else, and that is where the cellulose comes in and why we worked so hard on the cellulose part of it in the Farm Bill.

John is right. We are going to have to think about how all this CRP ground in South Dakota.

Now there is probably some of it coming out of CRP. As you know in the old CRP, in the old formula, every county had to have an allotment of CRP ground. There are probably some counties in Iowa, up in your area, that do not really need CRP ground. So, as that land will come out, and it will. It is just too productive to be not used for high-yield production, for crops, row crops.

But then in other CRP areas, where you probably do not go to your crops. A farmer needs income. It can be productive. We want to protect wildlife, as you said, and address the conservation issues, but we can grow a cellulosic crop on those lands.

Then, one of the arguments that we are making for the Climate Bill that came out of the House, that has come over now, is what I call stackability. It is to allow farmers to stack benefits.

In other words, if you have got CRP ground, you get your CRP payment. If you want to grow switchgrass on that in a conserving

manner and use that for electricity or for fuel production, whatever, you can do that. If you then are also sequestering carbon, you should be able to get an offset on that also, to stack these benefits one on top of the other. That way, a very nonproductive piece of land becomes highly productive, and you can actually make money on it, and at the same time have the benefits of conservation and carbon sequestration.

So I just think there can be some real benefits for agriculture.

Senator THUNE. And raise pheasants.

Chairman HARKIN. What?

Senator THUNE. And raise pheasants.

Chairman HARKIN. And raise a lot of pheasants, that is right.

[Laughter.]

Chairman HARKIN. And bring all those hunters out. They can come out in the fall and spend money and everything.

I just think that there is a lot of promise there that we can move ahead on.

I was going to ask some questions about algae here, but, no, I do not want to get into algae. I guess I could get into algae, but I am not.

There is another thing I want to get into with you. Could you address yourselves to this? We are talking about liquid fuels. We are talking about taking cellulose or corn, making liquid fuels. Now we also are doing work on pipelines and getting dedicated pipelines going. Hopefully, that is going to happen pretty soon, but there's also the idea of using biomass for electric generation.

Now I do not know how soon this is going to happen, but I think, looking ahead, I really think that we are going to be moving more and more to electric vehicles in this country, especially in heavy urban areas. I just think there is going to be more and more push to go to electric vehicles.

Well, you have to produce electricity. You do not want to use coal to produce electricity. But, if we can use biomass to produce electricity, then again I know you are still putting CO2 in the atmosphere, but it is taking it out. So you have no net gain in greenhouse gases by doing that.

There has been a lot of talk and thought about using biomass also as a feedstock. Now that is where you come in, Mr. Olthoff. You have been experimenting with how to use pellets or cubes or however you do this. We did this. That is what the Chariton Valley Project was about.

You are all experts on this. What about the idea of using biomass as a boiler fuel for producing electricity, any thoughts on that?

Mr. OLTHOFF. Well, I mean today we use biomass wood chips to power our boiler at Chancellor, South Dakota, a 100 million gallon facility, along the use of landfill gas that we have piped to the facility. We can offset about 60 percent of our natural gas utilization.

Chairman HARKIN. That is interesting.

Mr. STOWERS. Those are technologies that are ready and raring to go and can be deployed at all of the existing corn ethanol plants to reduce their overall carbon footprint.

I guess I would highlight maybe a contrarian view on electric vehicles. Whereas I think electric vehicles have potentially a significant opportunity in dense urban areas as you indicated, one of the

things that troubles me a little bit is the overall conversion to an electric economy for transportation, personal transportation in particular. There have been estimates that, for example, it would require extensive rewiring of charging stations in order to get a charge completed overnight, for example, to 20/40–amp lines and so forth, and an increase of the overall grid by 2–fold.

So I think that is an interesting opportunity, but I think it needs to be thought through very carefully to see why one would do that when you have a clean-burning liquid fuel that is already in the distribution channel.

Mr. COUSER. I guess I will touch real quick. I think that is one reason that in Lincolnway when we decided to put on the fluidized bed we spent an extra $12 million instead of putting a gas pipe into it with the hopes in the future that we would burn a corncob, a cornstalk, clean construction waste out of Des Moines.

There are recyclables and renewables that we are very excited about, and we have started testing with some of the wood chips, and now this next fall we are going to be getting set up to do the corncobs and whatever else we can do. We have got to get some tests in because I think the DNR is a little troubled right now. They really do not know what is going to come out the stack. So I think we are going to have to help prove to the regulators too that this is a viable situation.

Mr. CORCORAN. In the Black Hills, we are working with a small community to develop a project. This community runs on propane. Its small clinic, its schools, its administrative buildings run on propane, and they are interested in putting in a biomass boiler and using the lignin as our co-product from our cellulosic-based ethanol plant and taking that lignin and burning it into a biomass boiler and then utilizing that to power their facilities—so lots of different avenues with regards to using woody biomass.

Chairman HARKIN. I do not know if you wanted to comment?

Mr. OLTHOFF. Yes, I would like to say a couple things just from the electric utility industry perspective. We do not start with a value-added product like ethanol and say, "well, now can we add another stream and maybe fuel our boiler or something to that effect, with a pulp product or another fuel."

In the electric industry, the challenge is to try and come up with a fuel that can generate the electricity we can sell onto the wholesale market or generate locally to replace wholesale market price electricity. The electric industry is very good at making low-cost electricity. When we compare what it costs to generate electricity with biofuels, in whatever form will work, it cannot compete. We do not run biofuel because we know that it will be either a loss to the company or an extra charge to the community. It is an extra expense that we cannot pass on or will not pass on.

Being a municipal, the board looks at us and says, no, we are not going to pay extra for electricity just because it is biofuel generated. We cannot sell that to the board. So that is one of the challenges for the electric industry to jump into biofuels, not only the whole problem of supply lines and transportation and all that but just the very fact that we cannot find the fuel at a price that actually make electricity compete on the market.

Mr. SHEEHAN. I would just add a little bit to that. Again, I think part of what this comes down to is there will be no single use for biofuels. It will not be just one form. It will not be one single source of energy that we rely on.

There was a recent Science paper that came out that suggested that because electric engines or electric motors are so efficient they will actually give you more miles per acre or per ton of that biomass than taking that biomass through a liquid fuel. The one weakness in that analysis is it requires us to have battery technology that we currently do not have. So that is one issue.

But the other is I think we have to break transportation down into two big categories. One is personal transportation that you alluded to, but the other is in some ways more strategic, and that is freight transportation and air transportation. They are never going to run on electricity. They will always require liquid fuels, and they will always require high density in terms of energy content for that liquid fuel.

So this is where in some ways I take the food versus fuel argument and say, OK, when it comes to some of those strategic uses for our land, there is a food and fuel requirement societally to deliver, but we need to be able to send our freight around and to get from Point A to Point B in a plane.

Ms. RATH. There are two really good reasons to turn biomass into power. The first is what I have touched on before, which is not only is it carbon-neutral but because of the below ground sequestration with perennial energy crops it can actually be a carbon-negative source of power. The other is that it is, other than geothermal which is limited in scope, it is the only one of the renewables that offers baseload supply of power.

So solar is on during the day, not on at night and not on, on cloudy days. Also, we do not have enough solar to do solar in all places in the Country.

Wind actually peaks in the middle of the night when energy demand is at its lowest, causing in some places in the Country energy prices to drop to zero overnight because the supply is not coming when the demand is coming.

So biomass, either as something used to co-fire with coal or in dedicated facilities, offers you that opportunity to have baseload power.

We are actually talking to a lot of major utilities who are interested in biomass. Most of them are interested for one of two reasons. One is that they have a high renewable portfolio standard in their State and they have as much wind and solar as they can handle. The need baseload in their renewable portfolio, and so they are looking at biomass to supply that.

The other is large utilities who have major coal footprints who are in areas where maybe wind and solar are not as plausible and see this as a really easy way to start co-firing 10, 15 percent biomass in their existing coal facilities and, as a result, meet some of their renewable obligations.

So, it does depend on renewable energy credits or mandates or things like that until you get a price of carbon that makes biomass competitive with coal. But where you have those things, like in Eu-

rope, you do see rapid adoption of use of biomass for power both in dedicated and in co-firing situations.

Chairman HARKIN. I think that certainly the challenge for us in agriculture is that. We are going to need liquid fuels for a long time, and so we have to make sure that we use biomass for liquid fuels but then also for baseload electricity production.

The battles are going to be ferocious over the next few years on coal. It is cheap. It is abundant, and certain States produce a lot of coal. But we know the environmental impacts of that.

So if the environment is not free—if the environment is free, what the heck, go ahead and do it. If the environment is not free, well, then you have to start calculating the cost of that. Once you start calculating it, then I think biomass is going to be looked upon as a valuable source of feedstock for baseloading for electricity.

I have often thought about that as we proceed on our agricultural bills, not pushing just for ethanol but for biomass production for making electricity, and there are a lot of things I think that lend itself to that. I mean I have seen everything from willows, fast-growing willows out in the West to trees in the Northeast, fast-growing pines in Saxby Chambliss's area where they grow fast. They can be used for that kind of baseload power and harvested in a very conserving manner.

So it seems to me that I still come back to the same thing, that anything you can get from a barrel of oil we can get from a bushel of corn or other crops out there.

Ms. RATH. A ton of biomass, yes.

Chairman HARKIN. We can do it here in this country, and we can provide a lot of jobs, a lot of jobs, and it clean up our environment. So it seems like we can have our cake and eat it too with this whole approach of using biomass for both liquid fuels and for the production of electricity.

I think all we have to do is just make sure we have policies in place, and that is why we need to hear from you about those kinds of policies and how we move ahead.

Well, that is my 50–cent speech. John, do you have anything else.

Senator THUNE. Well, just a couple quick questions, and this will not take long. By the way, this was not focused on wind, but I do not understand why Iowa has more wind energy production when we are up there breaking the wind for you all the time in South Dakota. We should be having it.

Chairman HARKIN. Well, I have something on that, but I cannot say it in public.

[Laughter.]

Senator THUNE. I was setting you up there, Mr. Chairman, but, no.

I am curious in knowing. Somebody, I cannot remember, Mark, if it was you or, Ms. Rath, if it was you, talked about the cost, the current cost of production for cellulosic ethanol. About $2.50 a gallon, is that what you said?

Mr. STOWERS. Right.

Senator THUNE. So how soon are we going to be competitive in cost of production with corn-based ethanol and, beyond that, with petroleum-based gasoline?

Mr. STOWERS. By the time we Project Liberty in Emmetsburg, we expect to be about 50 cents per gallon higher than corn ethanol, and within 5 years we expect to be competitive with corn ethanol. Corn ethanol is a moving target of lower and lower cost. So I think that we are going to be very competitive. I mean even today ethanol is sold at a discount compared to gasoline based on the current Iraq prices.

Senator THUNE. And, Mr. Corcoran, just for purposes of what you all do in terms of trying to commercialize cellulosic ethanol from biomass in places like the national forests, the Black Hills, how important is getting that biomass definition changed for you, for you to be able to take that to the next level?

Mr. CORCORAN. It is absolutely imperative. I will just give you an example, in the Black Hills, roughly 1.2 million in forestland. Today, in slash piles alone, there is about 760,000 tons of slash piles that today get burnt or it just rots away.

Senator THUNE. Convert that. What would that be in terms of gallons of fuels if you were able, say, 760,000 tons? That is probably not fair to ask.

Mr. CORCORAN. Thirty million gallons.

Senator THUNE. Thirty million gallons, OK. So it is an equivalent of a 30–million gallon ethanol plant every year. Right?

Mr. CORCORAN. Right.

Senator THUNE. I mean that is something that is going to be an annual amount.

Mr. CORCORAN. Right, and the selection of the site is determined as we go through our analysis as the availability of public land. If that public land is not available, we would evaluate that and maybe not select a site because the public land cannot be used in order to take advantage of some of the incentives.

Senator THUNE. If I might, Mr. Couser, this is for you. One of the probably biggest opponents of biofuels has been the livestock industry. I mean maybe not as much in the Midwest as it is in other parts of the Country, but it is kind of the oil companies, the people who feed livestock, some of the food marketers, some of the environmental groups. They have really put together a coalition of groups out there that have really, I think, misinformed. I am not saying livestock groups, but I am talking a lot of folks out there have misinformed the public about this whole food versus fuel thing and if there is not enough grain out there to do all these various things, which I think has set us back a lot in terms of the public relations argument that we have on this.

But I am interested from your perspective, what impact has the availability of DDGs had on cattle feeders in Iowa and across the Midwest and is there enough DDGs? Is there a shortage or a surplus?

Mr. COUSER. Do I get an hour to talk about this?

[Laughter.]

Mr. COUSER. You know that has been one of the greatest things that has happened to Iowa in the cattle industry are the coal products that come out of the soy diesel and the ethanol plants. When you look at 5 years ago, it used to take 75 bushels of corn to finish out a 500–pound steer to 1,350 pounds. Today, when you look at that at our feedlot, we are using from 11 to 16 bushels of corn.

Everything else is coal products, from bean straw to distiller grains to syrup. There is an array of products that we use. Basically, what we do is we have about 10 different additives or feed co-products that we put into a computer every Monday and get a least cost ration.

We look at what it is going to do for the livestock industry and especially as the ethanol industry grows and these co-products are changing so we can get the inclusion rates higher in the feathers and the pigs because right now we are limited to certain amounts that we can put in the feed. And, I really think there is going to be a driving force here to change those co-products. I think you would agree with that, so that we can get the inclusion higher in these feed rations.

We look at Iowa and the Midwest here and what we can do with agriculture in both the animals and growing crops. It is just we do not see the end of the rainbow yet. We have still got a tremendous future.

Chairman HARKIN. Can I just ask one thing? How about pork production? You are cattle. It is more adaptable for cattle feeding, but Iowa State has been trying to do a lot of research in how to adapt this to hogs.

Mr. COUSER. And, it is coming too. I mean, like I say, it is going to be driven. When we look at what has happened to the hog market here in the past 12 months, we are going to find cheaper feed sources. Do we need to pull more oil out of the back side of that ethanol plant so it makes the co-product a little different, so the inclusion rate can be higher so that the feed costs can compete with corn or whatever other feed ingredient?

I mean the whole variable just goes up and down. So we are very excited about what is going to happen.

Senator THUNE. I guess my broader point was, Mr. Chairman—and I think that we have to obviously do a better job of communicating this—that there is, with the higher yield and with the DDGs and with the future of advanced biofuels, this whole notion that we cannot accomplish, that we cannot feed the U.S. and continue to feed the world and lessen our dependence upon, our dangerous dependence upon foreign sources of energy. It is a misnomer. I think we have to debunk and dispel that out there.

The other side, those who oppose the biofuels industry have made it very challenging, I think, economically in some ways and probably more so politically for us because they have tried very hard to convince the American public and thereby people who make policy decisions in Washington that we cannot accomplish all these objectives at the same time. I happen to believe that we can, and I think we have to do a much better job of communicating that with the American people.

Chairman HARKIN. Bill, I have one more question on your testimony, sort of along that line. You said here, and I put a big question mark because I do not understand it. You said corn oil extraction should give us a carbon credit as a co-product.

Of course, I circled that because you know we have this coming at us, this whole Climate Change Bill. And so, anything I am looking at, anytime I see something where we can give credits to farm-

ers for something, a light bulb goes off. But I never heard about this.

Mr. COUSER. I think you can answer that. I would talk in farmer's terms. This is science.

Chairman HARKIN. But I do not understand that. Well, I mean I would like to be able to promote it. I just need to know what it is about.

Mr. COUSER. Well, I am not sure I can explain it all that way. We are evaluating this approach. We see that there is a great deal of opportunity to reduce the overall carbon footprint by separating out the corn oil and using that as a separate source for diesel application. The resulting overall footprint left in your ethanol plant is carbon-favorable by doing so. Perhaps offline, we can go into a little more of the details of how that actually works.

Chairman HARKIN. Since this is coming at us pretty fast, can you give us, give my staff something?

Mr. COUSER. Absolutely.

Chairman HARKIN. That way, we can talk about this.

Mr. COUSER. We would be happy to do so.

Chairman HARKIN. I am looking for every little item I can get in there. OK?

Mr. COUSER. You bet.

Chairman HARKIN. So I just do not understand it, but if you just help me understand it and how we might weave that into our Climate Change Bill, assuming it is coming at us sometime this fall.

Mr. COUSER. The reason I think that is such an important statement is we look at the value of what we can do with these ethanol plants. Just about all these plants are going to be spinning oil off some place in that plant. So it is very important.

Chairman HARKIN. Yes. I guess I just do not understand how it reduces the carbon footprint, but you are going to help me.

Mr. COUSER. We will give you the background.

Chairman HARKIN. Yes, you will do.

Well, this has been great. This has been a great exchange.

Anything else that any of you wanted to bring up that we have not asked? Any questions, anything that you would like to have us ask that either one of us did not ask, that you would like to bring out here for us to think about?

Senator THUNE. How soon will we be competitive making biomass into electricity?

I mean you said the reason is your board and the people, your customers obviously are not going to tolerate higher cost associated with some other source of electricity. Are we going to be competitive cost-wise out there in the not too distant future?

Mr. OLTHOFF. Without any changes to any of the present policies, actually, I cannot say that it ever would be. I will just cite a couple numbers for you.

We did a small project this spring. We harvested some mixed species prairie grass plantings on Black Hawk County conservation land. It cost the utility about $$1,000 to harvest the material. We got 22 tons of material. It cost about $1,000 to harvest it, about $1,000 to densify it. It cost $3,000 to ship it to Indiana and back to get it densified. So, for $5,000, this will produce about $440 worth of electricity.

Now there is a lot of fat in this thing. We know that if we can eliminate the transportation by doing it locally we are going to eliminate three-fifths of the cost.

Chairman HARKIN. We did that it Chariton Valley.

Mr. OLTHOFF. Pardon?

Chairman HARKIN. In Chariton Valley, it just went from there to a tumbler.

Mr. OLTHOFF. Right, right. For Cedar Falls Utilities, we are looking at a very local collection system. Just north along the Iowa Northern Railroad would be our model, where we would work with the railroad for short-line transportation of the material but have the collection sites located along the rail line so they can gather the material locally, densify it and then just have it short-run. But that is still leaves about $2000 for the material.

We are looking at ways to minimize the cost, and that is a challenge with the remaining cost. The densification process, if you could optimize that, would be $20 per ton instead of $50 per ton.

You do not want to cut the $50 per ton production cost. That is the $40 per ton farmer share basically. We do not want to dig into that very much, but we still end up with about a $70 per ton product, $70 per ton for fuel to produce $20 of electricity.

Further to the detriment of the biofuels, it only has half the energy. So we almost need twice as much quantity to produce the same amount of electricity.

Chairman HARKIN. Is it also true that there are more BTUs per pound of switchgrass than in a pound of coal? More BTUs for a pound of switchgrass than for a pound of coal?

Mr. OLTHOFF. Well, not for us.

Chairman HARKIN. That is just fact, yes, except that a pound of coal is this big and a pound of switchgrass is this big. That is the problem. But per pound—per pound—there are more BTUs in switchgrass than there is in coal per pound.

Ms. RATH. Switchgrass BTUs per pound range. Actually, the grasses are over a pretty wide range. Switchgrass is typically about 8,300 BTUs per pound which makes it about the same as PRB coal but less BTUs per pound than bituminous coal. And so, it depends on for a given coal facility where they typically get their coal as to whether something like switchgrass can slot in very easily or whether it creates this issue for them of being less energy-dense.

There are technologies being developed to try to improve the energy density of biomass by getting rid of some of the volatiles, but these all need to come down on the cost curve.

So, just to sort of build on some of the points that you were making, the big difference between biomass to power and cellulosic ethanol is that biomass to power does not need to come down any, it does not need to improve its technology. The technology is there. You just burn the stuff. Right?

There may be some improvements that can be made in densification technology, but you are not going to take costs out of through technology improvement the way you are in cellulosic ethanol.

The sources where you are going to fix your cost problem are increasing the yields of dedicated energy crops because the higher your yield are the more revenue goes to the farmer, the lower your

harvest and transport costs are, the lower your delivered price, the ton of feedstock can be. So yield is one.

The second one is improving the efficiency of the supply chain, improving our densification technologies, improving our harvest and transport methodologies.

Then, the third is putting a price on carbon because fundamentally as long as coal is not burdened by that, then biomass just will not measure up because biomass takes work to generate whereas coal, that work happened over the course of a million years. It is all plant material. It is just over a different time scale.

Senator THUNE. It has been very helpful, Mr. Chairman. I appreciate this. Thank you for calling the hearing.

Chairman HARKIN. Well, good, I thought this was great. Some of you came a great distance, and I appreciate it very, very much.

We will leave the record open for a week for additional inputs and other things that people might want to put into the hearing record.

Again, John, thank you very much for your leadership on this issue and it is great working with you and thank you again for coming here today to Sioux City.

Bob, thank you again for hosting us here.

Mr. Rasmus, thank you for hosting us here today.

With that, the Committee will stand adjourned until we do not know when. Sometime in the future.

Senator THUNE. Whenever you call the next hearing, Mr. Chairman.

[Whereupon, at 3:40 p.m., the Committee was adjourned.]

# APPENDIX

SEPTEMBER 1, 2009

**Hearing before the**
**United States Senate Committee on Agriculture, Nutrition and Forestry**

**The Expanding Role of Biofuels for America**

**Tuesday, September 1, 2009**
**12:30 pm**

**Western Iowa Tech Community College**
**4647 Stone Avenue**
**Sioux City, Iowa**

**Testimony of Steve Corcoran**

**KL Energy Corporation**

**Rapid City, South Dakota**

**www.klenergycorp.com**

KL Energy Corporation Testimony
1 September 2009

Senator Harkin, Senator Thune, thank you for the opportunity to provide testimony on the expanding role of biofuels in America. I am Steve Corcoran, the President and CEO of KL Energy Corporation, a biofuels engineering company located in Rapid City, South Dakota. I am accompanied today by Dave Litzen our Chief Technical Officer and Vice President of Engineering. Over the last several years, KL Energy has transformed from a first generation biofuels company to an organization which today is focused on providing second generation technology for the conversion of Lignocellulosic feedstock to ethanol. Production of first generation biofuels, particularly corn ethanol will continue to improve and therefore will play a continuing role in future biofuel demand. Our experience from deploying and using first generation biofuels is being transferred to support and guide our second generation biofuels development.

Technology combined with a sound business model will be central to boosting the role of advanced biofuels. While there are several technological pathways to second generation biofuels, KL Energy has focused its research to develop a unique thermal-mechanical pretreatment process to make ethanol from biomass feedstocks in a fermentation process. The use of biomass feedstocks for transportation fuels, bio-products and power is increasingly being viewed as an opportunity to enhance energy security, provide environmental benefits and increase economic development, particularly in rural areas. Beyond the currently accepted benefits of biomass-derived ethanol, our nation's car manufactures and fuel suppliers have a unique opportunity to leverage the elevated octane that

ethanol/gasoline blends provide. The current energy policy identifies specific targets for increasing automotive fuel economy by 2020 that present a great challenge to our car manufacturers. KL Energy would also encourage the industry to take advantage of the increased octane of higher ethanol blends. The octane rating of an automotive fuel is frequently misunderstood or misapplied by the general public, but in general the higher fuel octane rating enables higher engine compression, resulting in improved mileage efficiency without loss of power or performance. While the nation's public appears to be quite vocal about the loss in mileage when using alcohol-blended fuels in the current engine designs, the public is strangely silent on utilizing this positive characteristic of an alcohol-blended fuel. We need only to look as far as our engine and fuel design laboratory, the racing industry, to prove this point.

Since 2001, KL Energy Corporation made significant investments in Research and Development predominantly from private sources and self-funded efforts. Beginning at the laboratory and pilot scale, our R&D efforts focused on pretreatment. The purpose of pretreatment is to alter the structure of the biomass so that cellulose, which is entrapped in the lignin and hemicellulose matrix, can become more amenable to the enzymatic process. Some of the desired characteristics of our pretreatment are: enabling high conversion of all biomass carbohydrates to ethanol, enriching the lignin while preserving lignin chemistry, minimizing sugar degradation during pretreatment, and achieving high slurry consistencies, all in an environmentally friendly and cost effective manner. Our pretreatment is effective on softwoods, hardwoods, and other herbaceous

forms of biomass because the process retains these characteristics. The research at the laboratory and pilot level resulted in construction of our commercial demonstration facility in 2007 capable of commercial operations using wood waste from the Black Hills National Forest to produce ethanol. The facility, Western Biomass Energy, is located in Upton, Wyoming and includes pretreatment, hydrolysis, fermentation, distillation, and co-product recovery stages, allowing us to evaluate our process for making ethanol at scale and validate cost and performance assumptions to prepare for the deployment of commercial plants.

Our business model for the commercialization of our technology is referred to as Community Energy Centers which will produce advanced biofuel (cellulosic ethanol), and bio-coproducts: lignin wood pellets, and syrup (value as animal feed or boiler to supplement heating demand). Our model focuses on economic development for our rural economy and is guided by three basic principles:

First -- to understand the locally available biomass feedstock. The economic competitiveness of cellulosic ethanol production is highly dependent on feedstock cost. Consequently, as the deployment of Energy Centers approaches, feedstock cost and availability are the driving factors that influence locations. KL Energy believes that providing flexible plant designs on the basis of feedstock availability rather than ethanol production will result in low cost, niche feedstock opportunities, minimizing the ethanol production cost. The recent provisions of the Biomass Crop Assistance Program (BCAP) which provides matching payments for the collection, harvest, storage, and transportation

(CHST) will encourage sustainable feedstock availability for the production of ethanol production.

Second -- to work with local economic developers. We want to keep the footprint of the operation small and close proximity to our feedstock source. The availability of sustainable, cost effective feedstock is essential for an economically viable cellulosic advanced biofuel facility. Our modular, decentralized design also offers better access to synergistic opportunities, such as co-locating with wood pellet production plants, existing cogeneration facilities, or sawmills. Because rail access is generally not necessary, the small energy center concept will create local jobs and energy sustenance in many communities that might not normally have the opportunity. A movement for decentralizing electrical power generation is afoot, and is a concept that can benefit liquid and solid fuel generation, too.

Third -- to optimize and leverage the value of the lignin co-product. Our technology has the ability to take lignin -- the outer layer that binds and protects the biomass fiber -- and create pellets that can be burned in place of coal in power plants. Lignin pellets yield up to 20% higher energy content over conventional wood pellets since most of the lower energy cellulosic sugars were removed for conversion to ethanol. As a natural consequence of the KL Energy ethanol process, the lignin co-product can be compressed into a highly durable pellet having a bulk density that is 20% higher than a typical wood pellet, reducing transportation yield loss and transportation costs. KL Energy is also developing value-added uses other than fuel for the lignin co-product.

Consistent with recent EPA studies, KL Energy's process will achieve at least an 85% reduction in GHG emission as compared with gasoline. By applying the fermentation process to convert biomass, the potential exists to actually REMOVE atmospheric carbon dioxide, the only industrial process we know of that can make this claim. In utilizing waste generated continuously by the forest products industry and the forest itself, we see the impact of strategically placed small energy centers as a win for locally produced and locally consumed energy -- and a win for forest management by providing a destination for slash piles that are currently burned or simply left to rot. The positive impact of turning forest waste into usable fuels and other products benefit the environment by reducing or eliminating the prescribed burning of the waste, eliminating the generation of particulate matter during the burn and the cost of soil remediation after the burn. The current energy policy restricts the use of waste from public lands, a restriction that must be reversed to help facilitate the implementation of all the positive benefits of biomass utilization presented by myself and my colleagues joined here today.

If government continues to aggressively pursue second generation biofuels research and development; enact investor-friendly tax incentives for production and blending; enable the use of waste material from public lands, and help to promote research & development in new biofuels feedstocks such as cellulosic ethanol, the prospects for achieving sustainable biofuels markets will become a reality. Cellulosic ethanol represents a new way to pursue the goals of increased

energy security and economic development for our rural economy, while protecting the quality of our environment. Thank You.

**Committee on Agriculture, Nutrition and Forestry**
**United States Senate**

**Hearing on**
**The Expanding Role of Biofuels for America**

**Written Testimony of**
**Bill Couser**
**Couser Cattle Company**
**Nevada, Iowa**

**September 1, 2009**

Good afternoon Chairman Harkin. My name is Bill Couser and I am a 4th generation farmer from Nevada, Iowa. Together with my wife Nancy, I farm roughly 5000 acres, raise seed corn for Monsanto, and feed out 4000 to 5000 head of cattle. Our feedlot is involved in an Alternative Technology Project with Iowa Department of Natural Resources and U.S. EPA to demonstrate methods to reduce feedlot run-off. I am a current board member and past president of the Iowa Renewable Fuels Association and I also serve on the board of Lincolnway Energy, a 50 million gallon ethanol plant in Nevada, Iowa. As you can imagine, I have thought about and participated in the evolving biofuels industry from just about every angle possible.

I want to thank you for holding this hearing and for your outstanding leadership in defending agriculture and biofuels. I am pleased to be able to offer some insights into the challenges facing farmers and biofuels producers. Quite frankly, we believe some of the decisions made in the next 6 months will set the tone for agriculture and biofuels for the next decade – and we are nervous.

Whether it's indirect land use change in the Renewable Fuels Standard 2 (RFS2) rule, the debate over E15, or conflicting views of how cellulosic feedstocks will change our landscape, those of us living and breathing this industry day in and day out feel that some in Washington, DC are prisoners of old "data sets" that fail to grasp the rapid evolution of farming and biofuels production and that others hide behind unproven scientific "theories" to push what is really an anti-agriculture agenda.

We hear about being "cautious" toward expanding the production and use of biofuels because we don't want any unintended consequences. That's fair to a point. But what we see in Washington, DC today is "over caution" – not supported by sound science or the latest data – that leads to the very unintended consequences biofuels opponents claim they want to avoid. For example, the EPA is using flawed models and inaccurate data to conclude that biofuels production here leads to the burning down of the rain forest in Brazil. The corresponding rules and regulations stemming from this conclusion would create high barriers to the growth of renewable fuels production in the U.S.

However, better models and data have shown this indirect land use change theory to be unsupported. Therefore, the "caution" of the EPA will reduce the amount of low carbon ethanol replacing gasoline produced from tar sands; resulting in more carbon in the atmosphere, not less. As a proponent of the farmer's ability to both feed and fuel the world, this type of policy making is frustrating to say the least.

Let me expand on this from my personal perspective.

As a seed corn grower for Monsanto I have witnessed first hand the wonderful improvements in corn and soybean genetics over the last few years. The simple fact is that yields are not only increasing, they are increasing at an increasing rate. Coupled with improved farming practices, I have no trouble believing Monsanto's national average projection of 300 bushels per acre corn by 2030. Iowa will likely hit that mark much sooner. And we will do it with fewer inputs and less impact on soil and water than today. Quite frankly, the Senate Agriculture Committee shouldn't be worried about the so-called food vs. fuel debate; you ought to be worried about the arbitrary 15 billion gallon cap on corn ethanol in the renewable fuels standard. With 300 bushel per acre corn, we either turn it into ethanol and other bio-products or we'll have huge surpluses, cheap prices and a farm program costing billions and billions of dollars again.

As a corn and soybean grower, I can tell you that it's not just the natural stewardship instinct of a farmer that is driving better farm practices like no-till. It is economics as well. Diesel costs money. Nitrogen costs money. Herbicide costs money. Farmers are increasingly using technology – in their seeds and in their equipment – to reduce these costs, which also improves the environmental profile of crops we produce.

Farmers are excited about the new income opportunities that cellulosic ethanol and other next generation biofuels present. Farming is like any other business – you want to maximize profits within the context of being a good neighbor and being able to hand down to the next generation a tradition to be proud of.

Therefore, we are eager to find ways to sustainably and profitably produce biomass for fuel and power in addition to our current crops. But the enthusiasm for this potential doesn't seem to be matched by government attention to the huge hurdles standing in our way.

Harvesting biomass will take new, very expensive equipment that might be out of reach for most farmers. Storing biomass in the necessary quantities and under proper conditions is a factor most folks seem to brush over. And don't forget, we're supposed to store this biomass <u>in addition</u> to the 300 bushel per acre corn. Harvesting and storage of biomass will create seasonal and long term farm employment challenges that typical Midwestern agriculture has not faced before. Efficient transportation of biomass may require us to rethink how we design and regulate farm-to-market roads.

I don't want to be seen as "negative" or to use my earlier phrase, "over cautious," but the best biomass seed in the world and the best enzymatic or thermal-chemical conversion process won't matter if the biomass itself cannot be efficiently and cost-effectively taken from the field, stored,

and eventually delivered to the biorefinery. I understand these challenges better than most because we currently bale about 5000 big round bales per year of corn stocks and soybean stubble for feed and bedding. Further, we are working in cooperation with John Deere and Vermeer Manufacturing to develop experimental equipment to harvest corn cobs and stover in a single pass along with the corn kernel. The challenge is that farmers do not want to delay or slow down the combine during key harvest periods in order to collect the less valuable biomass. While progress has been made, this remains a chief concern. In addition, farmers and equipments providers simply do not know today what end users need as a final product. Do they want the whole cob or stock? Or do they prefer pellets or partially processed biomass? All options create different equipment, storage and transportation challenges for the farmer for what today is considered a low value commodity.

There also seem to be some folks in DC who sincerely believe corn ethanol will fade away to be replaced with cellulosic ethanol. I believe nothing is further from the truth. We have come through a bruising battle over so-called "food vs. fuel." While the facts are clear that ethanol did not drive up food prices, opponents of ethanol scared a lot of people. Let me remind you that only the starch of the corn kernel is used for ethanol. The rest goes back into the feed market as co-products like distillers grains. Just imagine the "food vs. fuel" argument if vast areas of highly productive Iowa corn ground were planted to perennial energy crops that produce no food or feed at all. This may not be true for all areas of the country, but it is certainly true for Iowa.

Cellulosic ethanol will be a great addition to existing corn ethanol plants. Probably starting with corn cobs and stover and eventually adding some dedicated energy crops, existing ethanol plants are the logical place to convert biomass into fuel and other products. Once the cellulose is broken down into sugars, the back two-thirds of existing ethanol plants can be used to complete the conversion. Infrastructure like rail, storage and buildings are already in place. Therefore, spreading the fixed costs over both corn and cellulosic ethanol production will ease the startup burden on cellulosic conversion.

As the founding president of the locally-owned Lincolnway Energy ethanol refinery, I can also tell you that many folks writing these regulations don't have a handle on the rapid improvements taking place in the dry mill ethanol industry. According to one analysis conducted by Christianson & Associates, between just 2004 and 2007, ethanol plants producing dried distillers:

- Reduced BTUs by 4,700 per gallon – or nearly 14%.
- Reduced electricity use by nearly 15% per gallon.

In addition, ethanol yield per bushel of corn has gone up and water use per gallon of ethanol has gone down. All of the input arrows are in the environmentally friendly direction. The same cannot be said for petroleum products.

Lincolnway Energy is one of many ethanol plants adopting new process technologies to create marketplace opportunities while, at the same time, reducing our carbon footprint. We have installed equipment that removes non-food grade corn oil from our syrup stream that otherwise ends up as part of our distillers grains. The result is a new, valuable co-product that can be used as a feedstock for biodiesel production. The resulting distiller grains provide ration flexibility for a wider variety of livestock.

Corn oil extraction should give us a carbon credit as a co-product. However, it also improves the energy efficiency of the plant by, among other things, reducing the energy use as we no longer have to dry the corn oil as a part of the distillers grains. This type of innovation is happening so quickly the regulators in DC and their models can't keep up. Yet, the ethanol industry is on the verge of being held back by these outdated models.

I mentioned livestock a second ago. I can't end without expanding on that a little bit as I think of myself as a cattleman. Ethanol co-products, like distillers grains, are a huge part of our feed ration. Their use is growing and helping bring the cattle industry back to Iowa. But even here the folks in DC get it wrong. They want to give ethanol a carbon credit based on distillers grains replacing corn on a pound-for-pound basis. This is not reality. With the starch gone, distillers grains is a high protein feed ration. On a protein basis, I back out more than a pound of corn and soybean meal when I add distillers grains. I can make up the difference by adding roughage like soybean straw. Just getting the true feed value of distillers grains right goes a long ways toward correcting ethanol's carbon footprint.

Finally, I'm also a consumer. I drive a big truck, and believe me, it is used for work. I need the opportunity to put E15 into my truck. All this talk today about next generation fuels and cellulosic feedstocks doesn't matter if there's nowhere to use the fuel. You know about the blend wall – it's time to act. EPA needs to allow E15 for all vehicles. And that is just the first step. We need to enact your bill Senator Harkin, S. 1672, that will require more flexible fuel vehicles (FFVs) sold in the U.S. and more blender pumps to fuel them. Without swift and aggressive action on E15 and FFVs, the discussion of next generation fuels is, in fact, meaningless.

The next six months in DC may very well determine my livelihood for the next ten years – and I am nervous. I urge you to work with regulators to prevent "over caution" from unnecessarily restraining the role biofuels can play in not just reducing carbon emissions, but also in creating green collar jobs, reducing our dependence on foreign oil and boosting farm opportunities. Again, thank you for holding this hearing and for listening to Iowans who are actually engaged in agriculture and biofuels production. I look forward to answering any questions you may have.

**Committee on Agriculture, Nutrition, and Forestry**
**United States Senate**

**Hearing on The Expanding Role of Biofuels for America**

**Written Testimony of Ed Olthoff**
**Cedar Falls Utilities**
**Cedar Falls, IA**

**September 1, 2009**

Cedar Falls Utilities is a municipal utility providing four separate utility services to the City of Cedar Falls, Iowa. Included in these services is The Municipal Electric Utility of the City of Cedar Falls, Iowa. The electric utility generates electricity in several locations, owns fractional shares of strategic transmission lines, and distributes energy within the City of Cedar Falls and in the rural area north and west of the city limits. One of the electric generation locations is Streeter Generation Station in Cedar Falls, where two small electric generating units are located. Streeter Station was the primary electric generation site for electricity for the City of Cedar Falls until 1978, when the electric utility bought into fractional shares of large remote generation facilities and transported the electricity to Cedar Falls via the transmission system. At that time, Streeter Station became a peak generation facility instead of a baseload generation facility. In the last five years, economics have been favorable for 3000 to 5000 hours of operation per year at Streeter Station. Both units have been active in electric generation in those years.

There are two electric generation units at Streeter Station. Unit #7, built in 1973, is rated at 35 megawatts and burns pulverized coal. Unit #6, built in 1963, is a stoker fed coal fired steam electric generation unit with an output rating of 16 megawatts. Stoker units scatter solid fuel onto a grate, where the fuel is burned and the released heat is transformed into steam to drive the turbine. Stokers are designed for stoker grade coal, but have the capability to handle any solid fuel. With this in mind, the electric utility began investigations into the possibility of combusting densified bio-based fuels instead of coal in Unit #6. The investigations were based on the assumption that the unit had the potential to combust exclusively biofuel as the primary fuel instead of coal.

On the Electric Utilities initiative and at the Utilities cost, a series of test burns were performed in 2004, 2005 and 2006. Eight short term test burns were conducted in that time period. The first two test burns used corn cobs, ground and reformed into pellets. A 10 ton test burn demonstrated compatibility of the pellets with the fuel handling system, and the 50 ton test burn demonstrated the heat potential of these pellets to produce steam. The third test burn was fired with 10 tons of commercially available wood pellets, made from ground hardwood reformed into pellets. For the fourth test burn, the utility contracted the custom manufacture of larger diameter pellets made from ground corn stalks. After several manufacturing challenges, 12 tons of corn stalk pellets were produced, and these were the fuel for the fourth test burn. The search for a more economical densification process lead to the agricultural process of cubing, originally designed to densify hay for consumption by livestock. Using rented equipment, the cubing process was used to densify corn stalks and switchgrass. An attempt was made to densify oat

hulls into a cube, but this was unsuccessful. Commercially available oat hull pellets were purchased as an alternative. The final three test burns were of longer duration, and the fuels were corn stalk cubes, switchgrass cubes and oat hull pellets. The corn stalk cubes deteriorated between production and combustion, and this burn was unsustainable. A small portion of the deteriorated material was redensified, and a short duration test burn of recubed corn stalks was sustainable but could not achieve full capacity. The test burn of the switchgrass cubes was sustainable but also could not achieve full capacity. The oat hull pellets burned very well, with minimal handling problems and full capacity electric generation.

Retrospective analysis of the first series of test burns pointed to several significant challenges. All of the economic modeling showed biofuel based electric generation to be more costly than coal fired generation, and in the competitive wholesale electric market, the cost was excessive. A municipal utility is responsible to the community it serves to provide the best value at the lowest cost, and generation with biofuels could not be justified because of the cost. Existing policies and proposed policies have potentials to equalize the costs, just as federal policy has encouraged the development of wind energy. These policies include tradable tax credits (municipals do not benefit from standard tax credits), Renewable Energy Production Incentive, Department of Agriculture policies, Department of Energy grants, green credits and carbon taxes. Cedar Falls Utilities has investigated the impact of these policies on the cost of biofuels, and advocated policy changes that would equalize the cost. Until these costs could be equalized, no significant advances could be made in the biofuel project.
Another significant challenge is development of a supply chain for the fuel. Electric production is an energy intensive process. Rough calculations indicate the need for 200 tons of biofuel daily to operate Unit #6 at half of the rated capacity. Quantities needed for short duration test burns can be obtained, but the production capacities for any longer duration test burns are not available. Until these capacities are increased, there is not sufficient supply to perform extended test burns. Included in this supply chain are the producers of the raw material, a transportation infrastructure to move the material from production sites to a processing facility, storage of the raw material, a processing facility to densify the material to the specifications needed for generation, and a transportation system to move the densified material from the production site to Streeter Station for in time delivery. Development of the supply chain is in its infancy, biofuel suppliers are emerging, but a sustainable capacity does not exist for continuous production at Streeter Station.

A third significant unknown is the affect of biofuel combustion on the boiler. Before any long term contracts or commitments can be made, a thorough study of the performance of the boiler during biofuel combustion is needed. Impacts of mineral deposition and mechanical abrasion on the boiler tubes from biofuel combustion must be determined. The appropriate procedure to determine these affects is to perform extended test burns and determine the impacts with monitoring during the burn and an inspection of the boiler after the burn. This requires a fuel supply sufficient to perform the extended burn, which has been unavailable.

In the time following the initial test burns, the utility has been active in presenting the requirements of the project to potential suppliers, updating the economic analysis of the project, presenting the project to interested parties locally, regionally and nationally, and advocating the project politically at the local, state and federal levels. No additional test burns have been

performed since then. Recent developments in the biofuel sector of the economy have brought new biofuel suppliers into the market with capacity to manufacture larger quantities of fuel, several other potential fuel feedstocks have been identified, and one promising new densification configuration has become available.

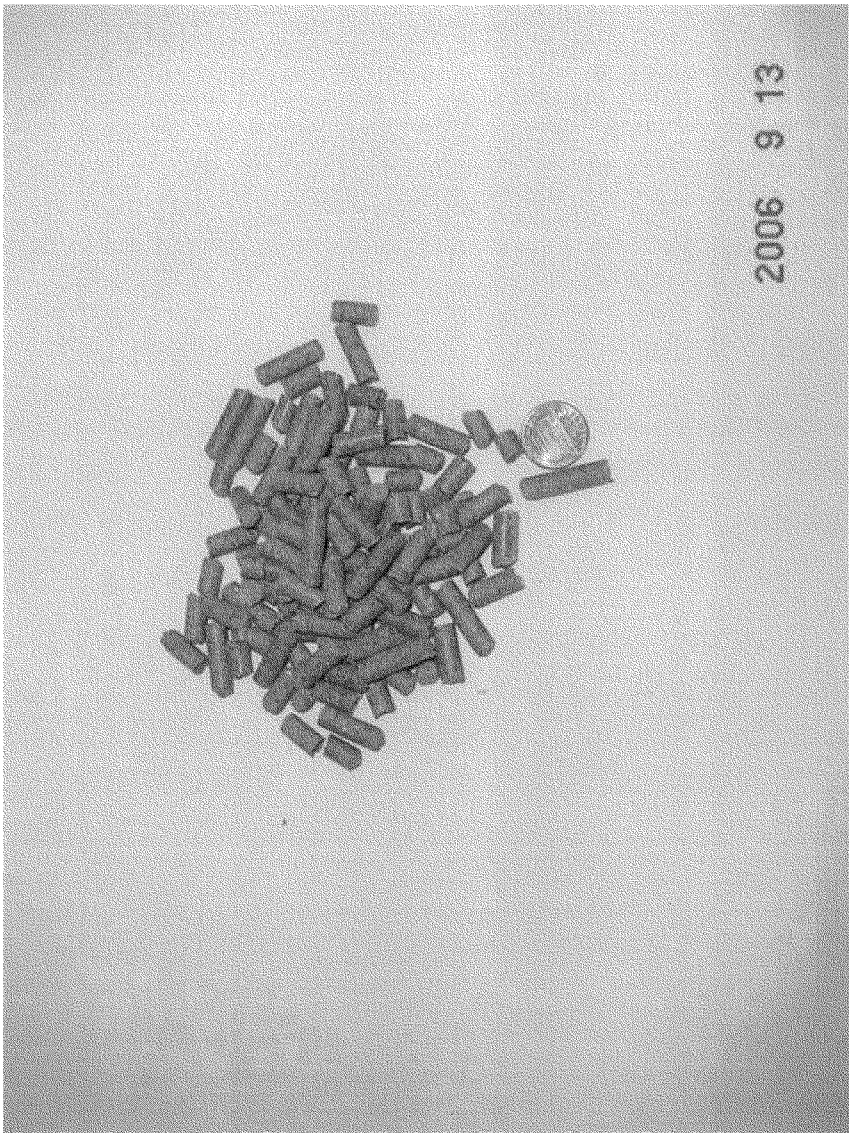
In March of 2009, the Utility again presented the project in Washington, D.C.. A Congressional Appropriation was designated to this project, to be administered through the Department of Energy. With this funding and a cost share from the utility, another step is planned for the project. The Utility intends to test three new biofuel options in three densification configurations, mixed prairie grasses in cubes, mixed agriculture residues in pellets and sugar cane bagasse in bripells. These three test burns will be short duration test burns. Following completion of the short test burns, one potential fuel and densification configuration will be selected for a ten day test burn. The selection will be influenced by the quantity of the potential fuel available, the most suitable densification process for mechanical handling and combustion, and the production capacity of the densification configuration. Production of the biofuel will be contracted with a biofuel manufacturer; the product will be shipped to Streeter Generating Station, and burned in Unit #6 for electric generation. The unit will be monitored during the test burn, and following the completion of the ten day burn, the boiler will be entered and inspected to determine the effect of the combustion process on the internal components of the boiler.

The findings at the end of this step are critical to the future of the project. If the selected biofuel appear to be compatible with the combustion process in the boiler, a longer test burn of thirty days duration is planned. The results of the thirty day burn will provide sufficient information for the utility to begin contract discussions with biofuel providers for long range, large quantity supplies of biofuels. The utility will determine specifications and provide a steady demand to encourage expansion of the biofuel supply chain. Transportation costs will heavily favor regional or local suppliers, adding local economic development and increasing the local demand for raw materials. The anticipated raw material would consist of primarily low value agricultural by products or underutilized crops which could function as energy crops.
However, if the mineral content in the biofuel causes excessive fouling or slagging in the boiler, the project will require re-evaluation. The mineral content of the biofuel feedstocks varies significantly. With the assistance of mineral analysis, the tendency of the biofuel feedstocks to foul or slag could be predicted, and the densification feedstocks can be selected to minimize the impact on the boiler. If this is an unavoidable consequence of the combustion of all biofuels, the entire project will need to be reassessed and possibly terminated.

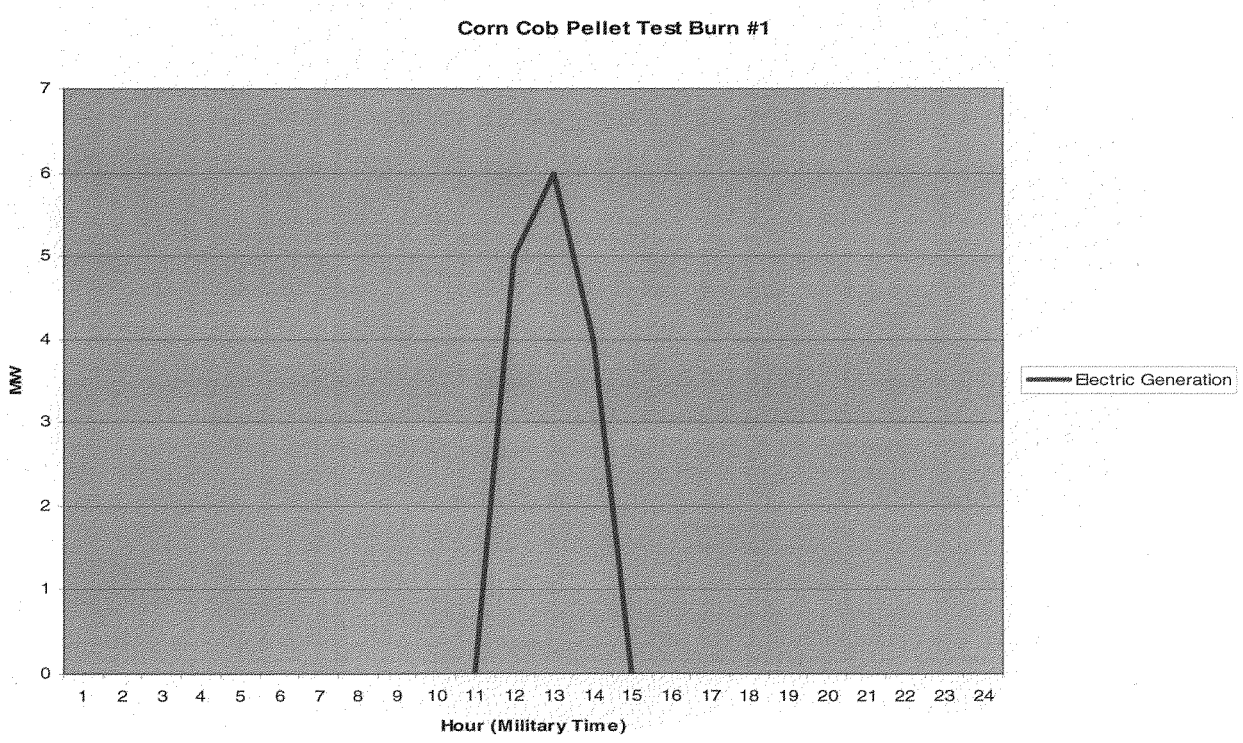
Test burns are helpful to determine compatibility of the biofuels with the mechanical handling system and the combustion process in the boiler. However, the economic modeling is still the most important factor to be considered, and if the cost of the fuel is more than the value of the end product, electricity, the project will not proceed. Economic modeling by the utility using the most reliable information at the present time and the best economy of scale achieved in the best biofuel scenario shows biofuels to be still more costly than coal. Again, changes in policy have the potential to change the model in the future.

# Corn Cob Pellets

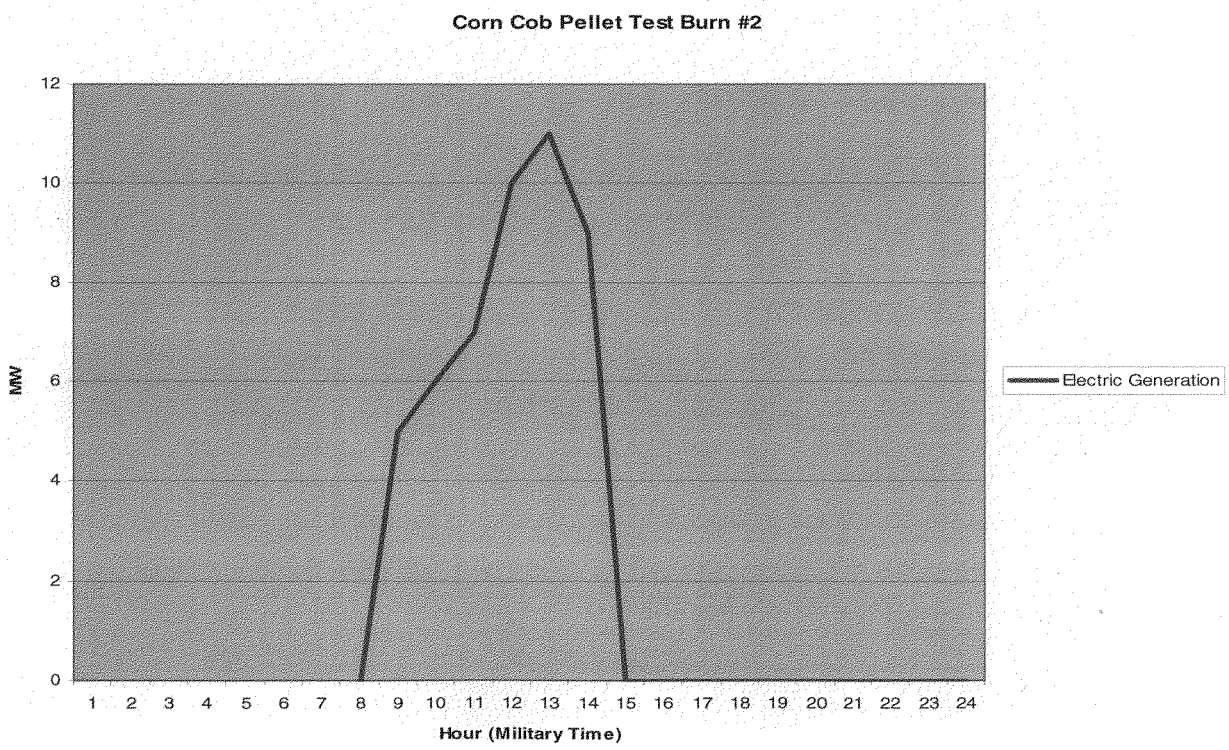
- Manufactured from an agricultural byproduct
- Produced locally
  - Independence Corn By Product, Independence, IA
- 2 test burns
  - July 16, 2004 – 10 tons
  - July 23, 2004 – 50 tons
- Successfully generated electricity
- Pellet size too small
- More costly than coal ($100/ton)


2006 9 13

# Test Burn 7/16/04

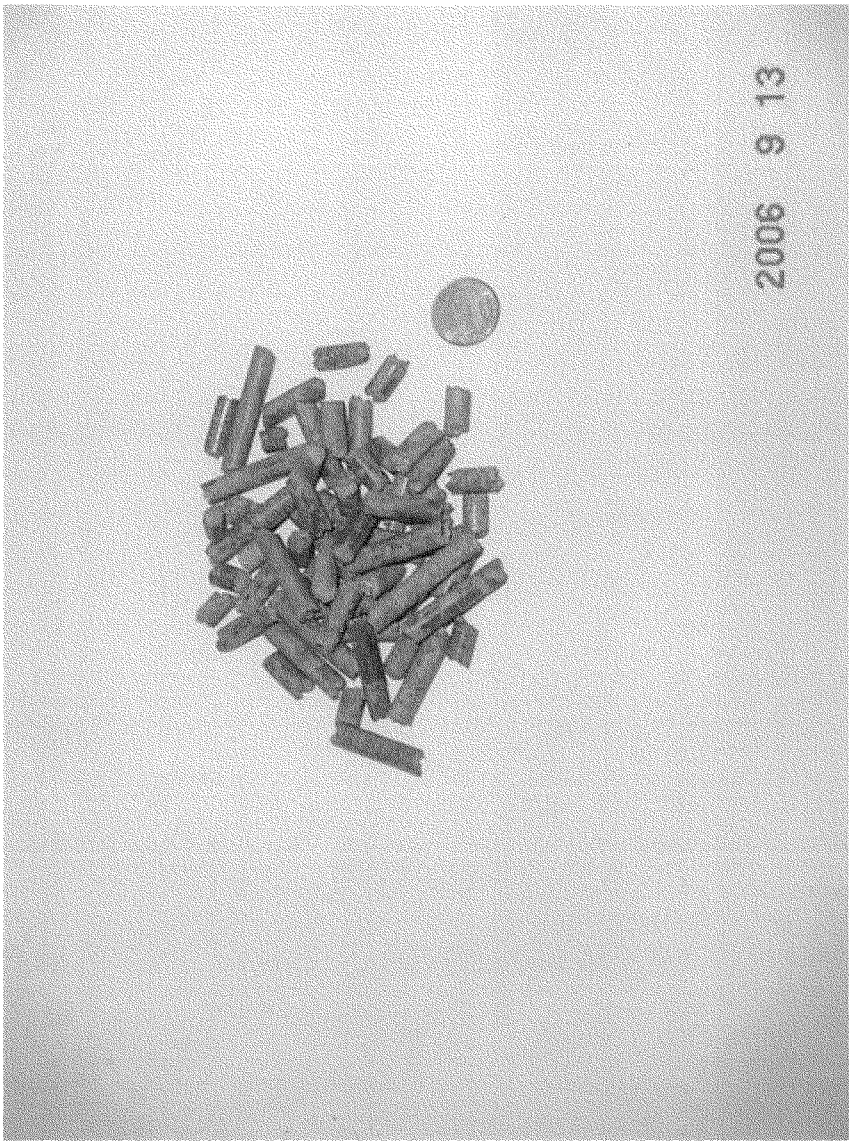


# Test Burn 7/23/04

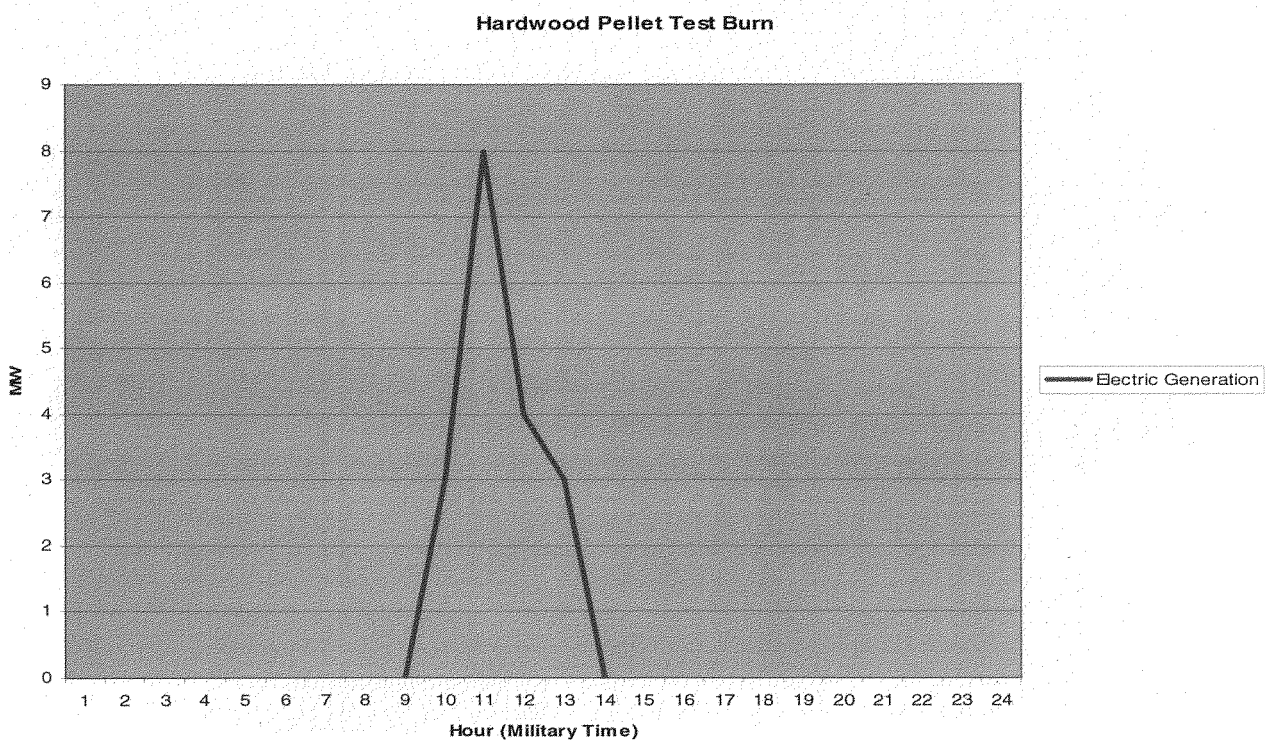


# Hardwood Pellets

- Manufactured from industrial wood waste
- Produced locally
  - Fuel King Pellets, Spencer, IA
- 1 test burn
  - March 23, 2005 – 10 tons
- Successfully generated electricity
- More costly than coal ($115/ton)

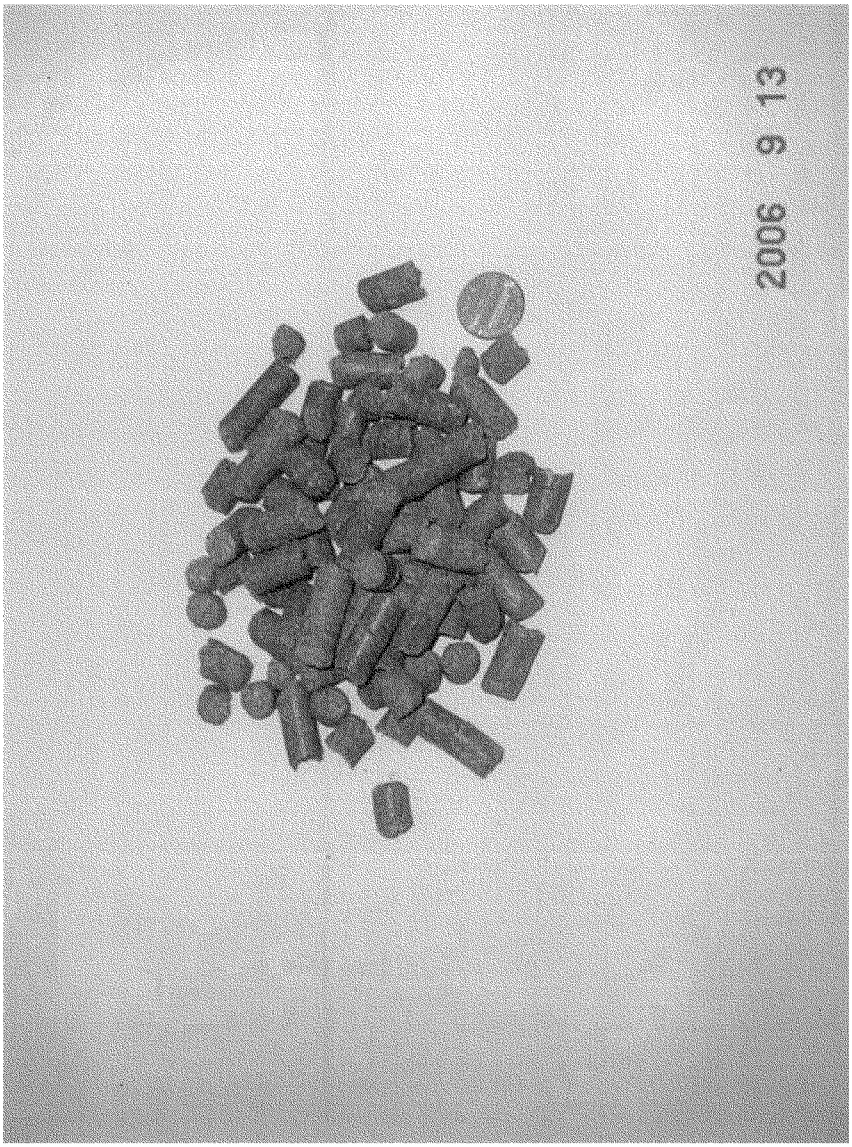

2006 9 13

# Test Burn 3/23/05

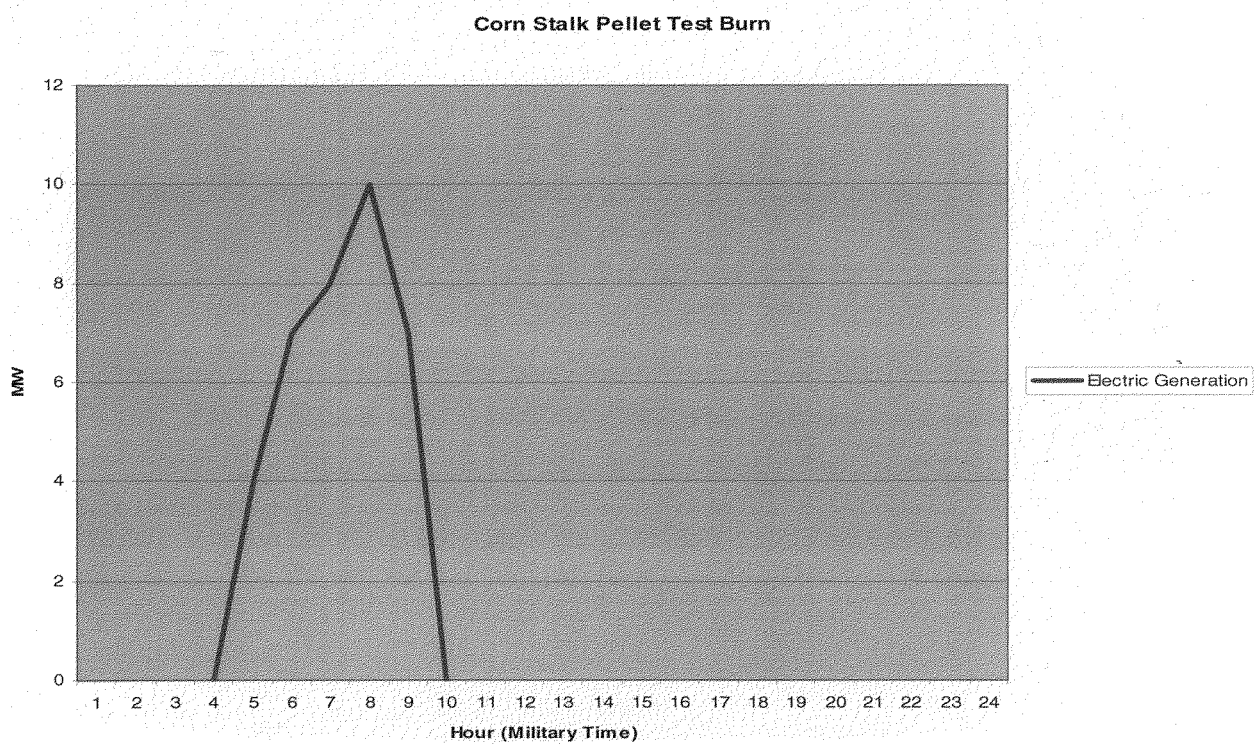


# Corn Stalk Pellets

- Manufactured from agricultural waste
- Custom manufactured by CFU
  - Larger pellet size
- Difficult material to process
  - Multiple steps in size reduction
  - Difficult to handle
  - Abrasive
- Costly process (estimated at $85/ton)
- 1 test burn
  - March 23, 2005 – 12 tons
- Successfully generated electricity
- Abandoned

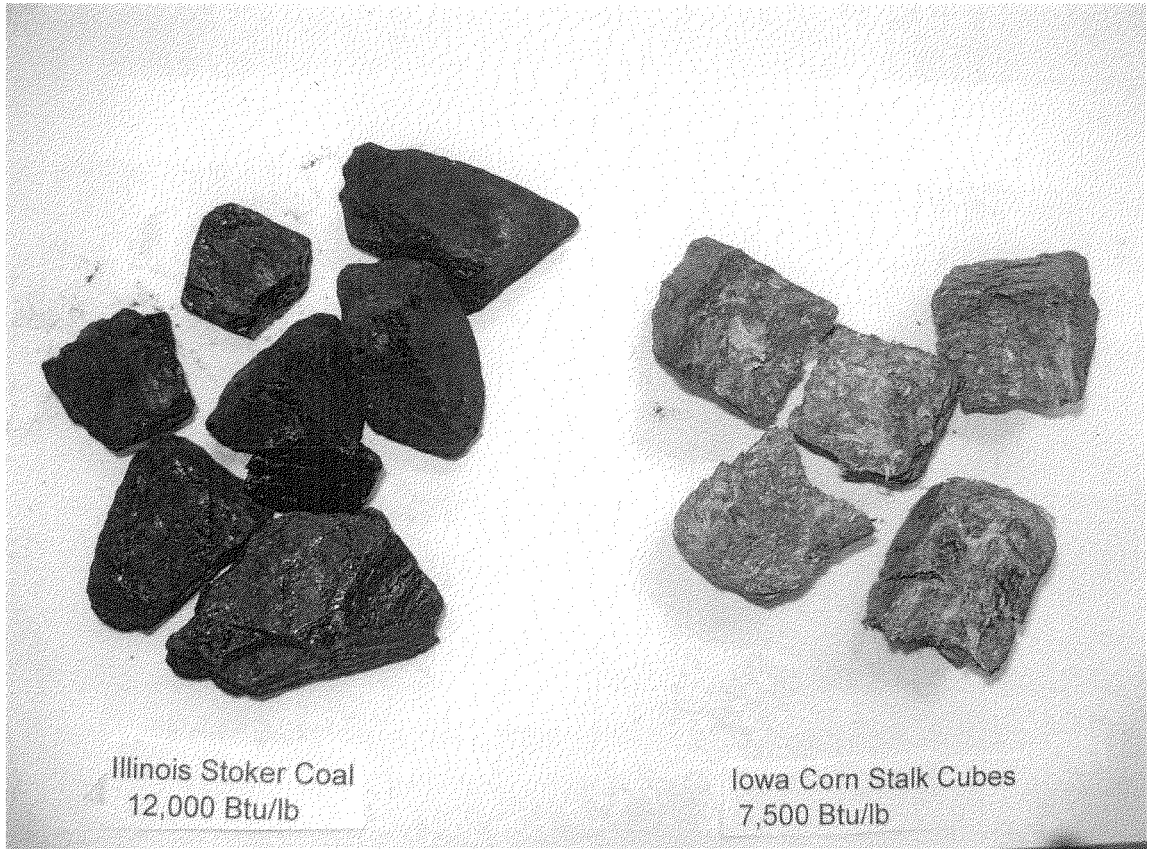

2006 9 13

# Test Burn 3/23/05



# Cubing

- Originally a forage densification process for storing and handling livestock feed
  - Several manufacturers (Lundell, John Deere)
  - Miniature hay bales
- Marginal acceptance in intended application
- Developed into a niche market
  - Horse owners
- Limited availability through one manufacturer

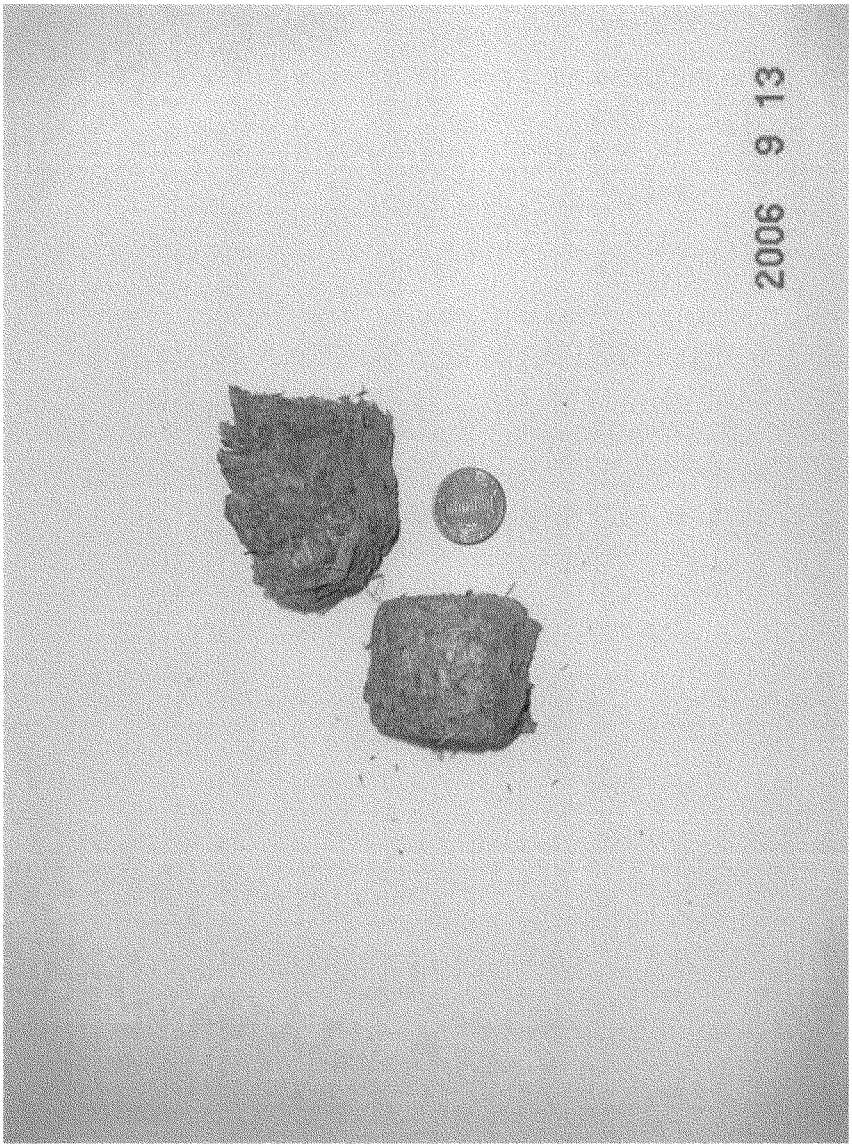

Illinois Stoker Coal
12,000 Btu/lb
Iowa Corn Stalk Cubes
7,500 Btu/lb

# Corn Stalk Cubes

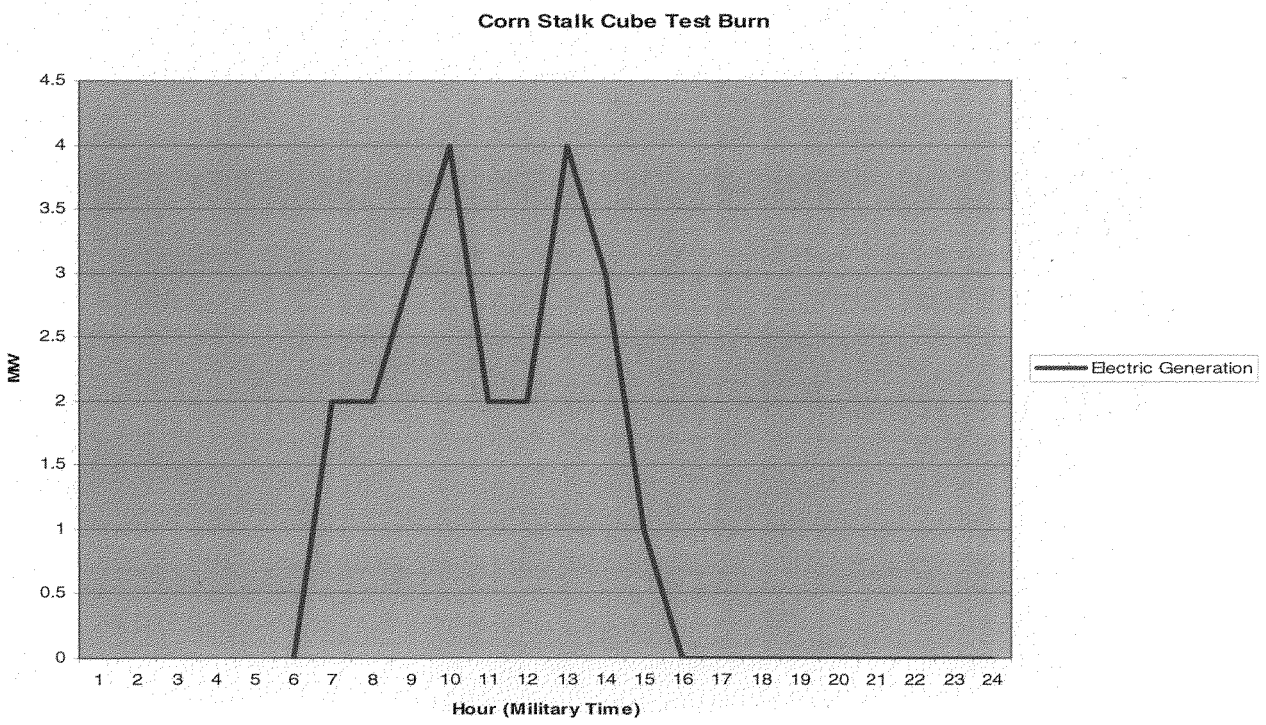
- Readily available low cost agricultural by-product
- Custom manufactured by CFU
- Small quantity test by alfalfa processor in Colorado
  - Damaged some equipment
- Large quantity test at cuber manufacturing site in California
  - Could not transport material into state
    - Prevented by California Department of Agriculture
    - California Department of Transportation rules markedly increased transport costs
- Rented mobile cuber and brought it to Cedar Falls

# Corn Stalk Cubes

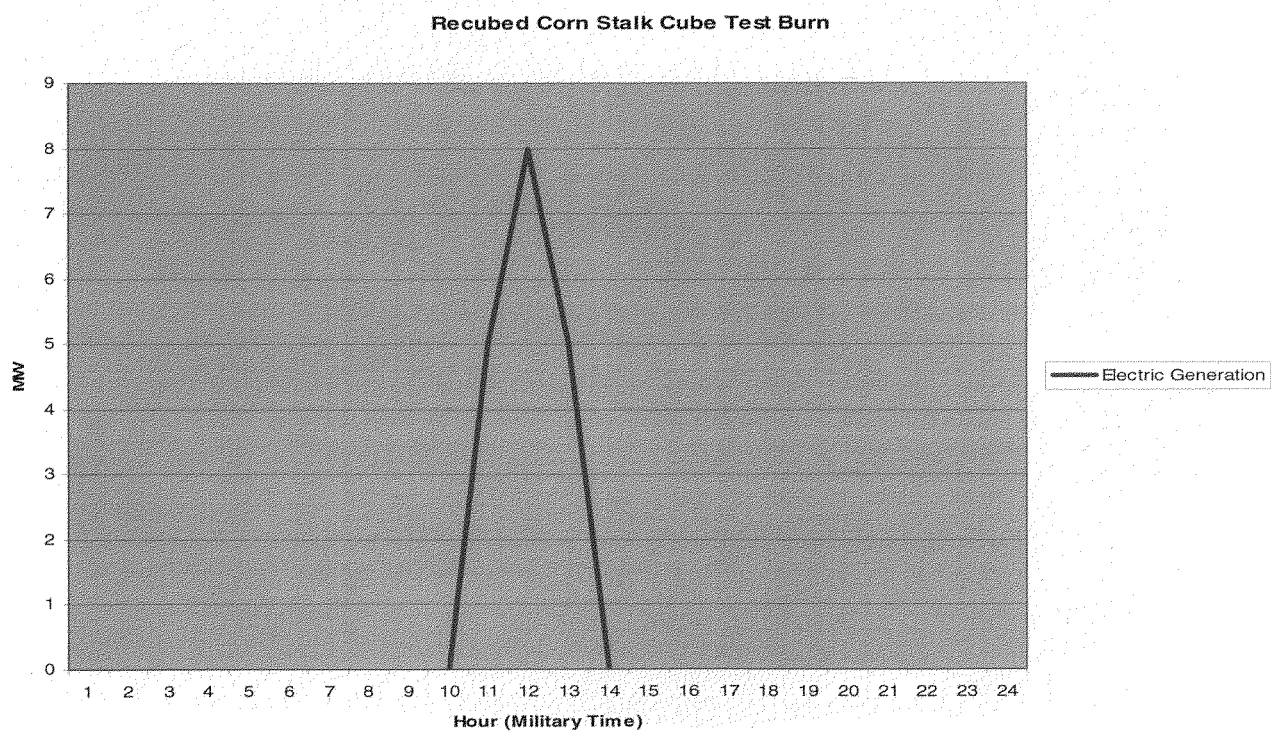
- Purchased 223 bales of corn stalks
  - High quality material
    - Minimal contaminants (soil, rocks)
    - Ideal moisture content (17-19%)
- Produced 150 tons of corn stalk cubes
  - No added moisture or binders necessary
  - Cube moisture content was 12.2%
- Quality degraded during storage
- Fuel quality was sub-standard
  - Cube deteriorated into silage
  - Unable to generate electricity
- Degraded material was recubed
  - Recubed material handled better
  - Generated 8 MW of electricity


2006 9 13

# Test Burn 3/22/06



# Test Burn 3/31/06

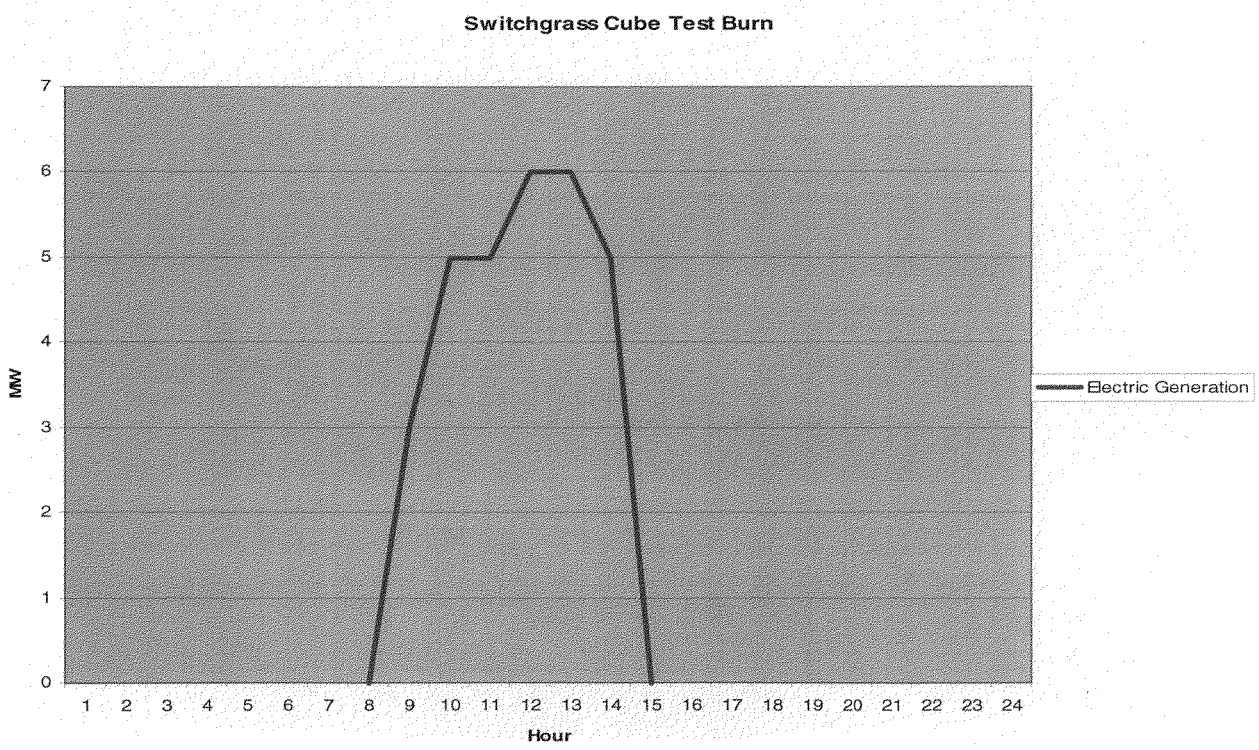


# Switchgrass Cubes

- Native grass found in tallgrass prairie populations
- Cover crop option for CRP land
- Large round bales obtained from two sources
  - Moisture content 20-25%
- Same cubing process as corn stalks
  - Inconsistent results
- Custom manufactured 70 tons of cubes
  - Cube moisture content was 15.6%
- Minimal degradation during storage
- Material performed well during handling
- Generated 8 MW of electricity

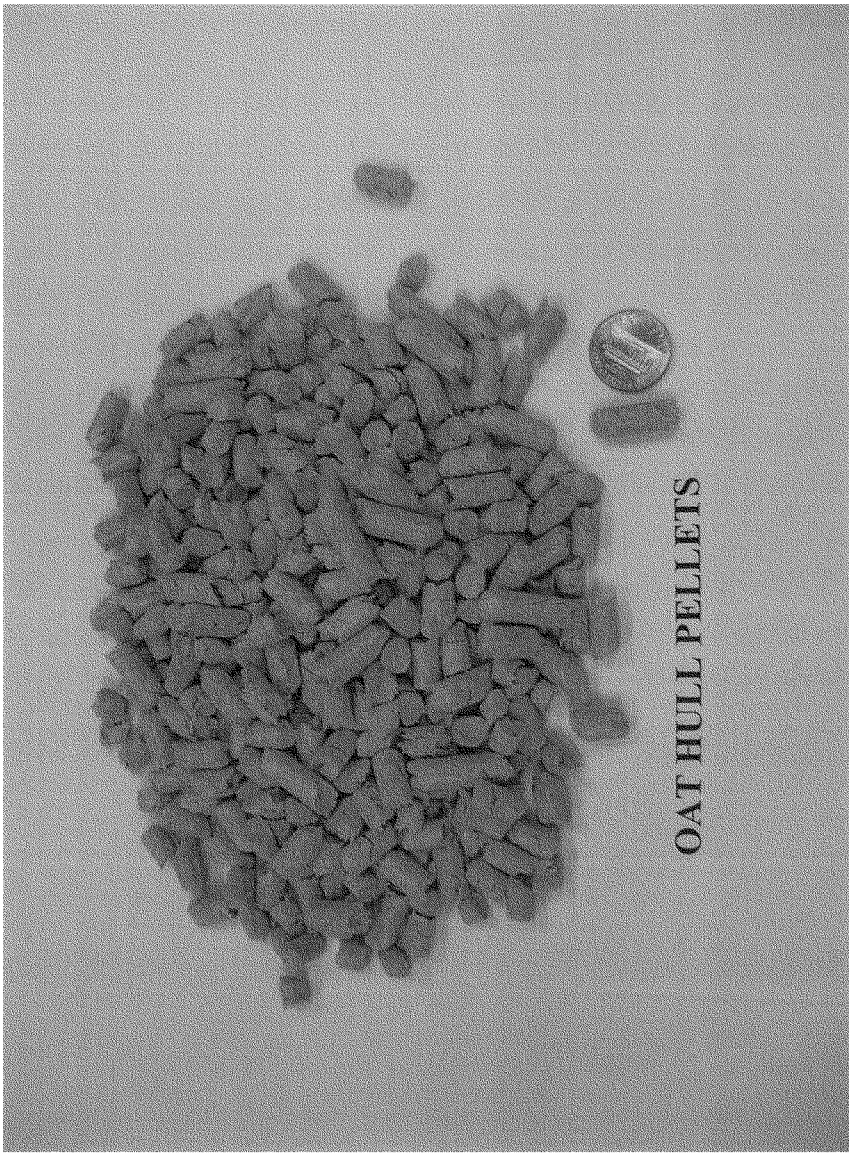
2006 9 13

# Test Burn 3/24/06

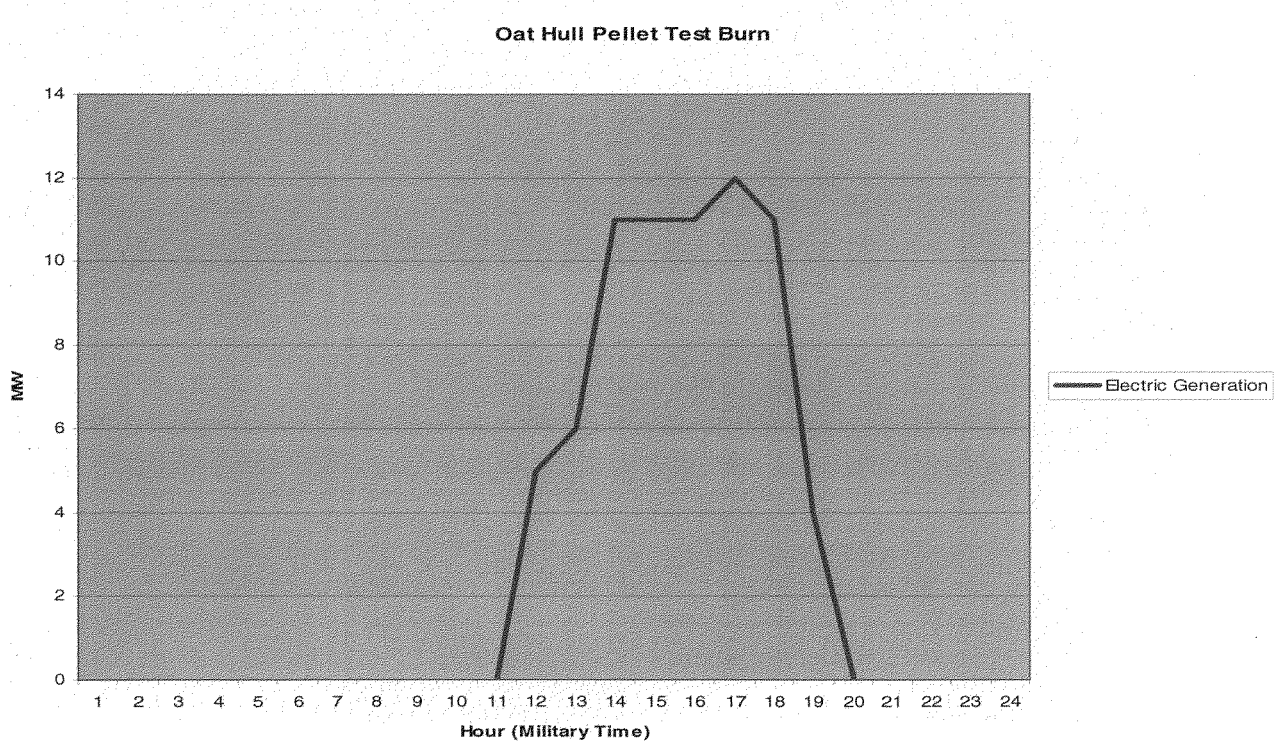


# Oat Hull Pellets

- Chose to investigate pelleting of available oat hulls
- Transported oat hull material to Oklahoma
- Produced quality pellets experimentally
  - Larger pellet size possible
  - No additives required
- Purchased pellets from Canadian supplier
  - Only standard sized pellets available
  - 90 tons delivered to Cedar Falls
- Product performed well
  - Ideal handling
  - Generated close to capacity
- Pellet size still small


OAT HULL PELLETS

# Test Burn 3/23/06



**Ceres Written Testimony to the Committee on Agriculture. Nutrition and Forestry of the United States Senate Field Hearing in Sioux City, Iowa:**

**"The Expanding Role of Biofuels for America"**

Anna Rath, Vice President of Commercial Development, Ceres
Thousand Oaks, California

Good morning, Mr. Chairman and Members of the Committee. Thank you for inviting me to testify. My name is Anna Rath, and I am here representing Ceres. Ceres is a leading dedicated energy crop seed company. We develop and market crops such as switchgrass and high-biomass sorghum for biofuels and biopower under our Blade Energy Crop brand.

## Where We Are In Biofuels Today

With more than 9 billion gallons of ethanol produced from starch in the United States in 2008, the first generation of the biofuels industry is a mature business successfully operating at scale and making a significant contribution to our transport fuel needs. Set backs have been encountered over the past year, but recovery is taking place, and signs point to biofuels playing a permanent and ever-increasing role in the U.S. fuel supply.

In cellulosic and advanced biofuels, significant technology advancements have been made over the past few years and further innovations are coming along every day. Industry leaders now believe the bottleneck is no longer conversion technology development but rather obtaining the necessary financing to build the first commercial-scale projects, having the opportunity to come down the technology cost curve associated with building the second, third and fourth facilities, figuring out how to deal with biomass supply logistics at scale and obtaining a reliable commercial-scale source of feedstock.

With Ceres' launch of Blade Energy Crops in the fall of 2008, the industry can now count on commercial-scale availability of high-quality seed for dedicated energy crops. Further work will be required, though, to move from a reliable supply of seed to a reliable supply of biomass that facilities can depend on and know how to handle.

## What We Want To Achieve In Biofuels

The role of biofuels in the United States is to help us reach the combined goals of improving national security, through use of domestic resources for fuel production, reducing our greenhouse gas emissions, through displacement of fossil fuels, and providing agricultural producers new and expanded revenue opportunities. Biofuels helps us meet these goals while at the same time enabling us to supply the ever-

increasing demand for transportation fuels. With this role in mind, we should have two major objectives for the continued development of the U.S. biofuels industry:

1) Continued improvement of the starch ethanol industry's environmental profile and amount of fossil fuel displacement

2) Facilitation of the commercial scale-up of cellulosic and advanced biofuels

**Improvement of Starch Ethanol through Re-Powering**

The starch ethanol industry has already taken steps to improve its environmental profile. Many facilities have transitioned from coal to natural gas as a source of heat and power to reduce greenhouse gas emissions. Lower temperature fermentation is increasingly employed to reduce energy usage. Advances in corn breeding have helped reduce greenhouse gas productions through decreasing the amount of fertilizer used per bushel of corn produced. Nitrogen use efficiency traits currently in development pipelines will offer further improvement.

More can be done. A simple, relatively low-cost opportunity using available technology exists today to help starch ethanol facilities further improve their environmental profile and increase their displacement of fossil fuels. This is the opportunity to transition from natural gas or coal to biomass as their on-site source of heat and power. Existing coal boilers can be used as-is or can be retrofitted or replaced; small-scale gasifiers can be used to create a biomass-based syngas that will work in natural gas boilers. Several facilities are either already using or have at least experimented with use of biomass in their boilers. The combination of the Repowering Assistance Program and the Biomass Crop Assistance Program, both included in the Food, Conservation and Energy Act of 2008, provide good support for this transition.

**Scale-up of Cellulosic and Advanced Biofuels**

Adoption of biomass as a heat and power source by the starch ethanol industry will provide additional benefits in helping the commercial scale-up of the cellulosic biofuels industry. Two critical elements of the cellulosic biofuels industry achieving scale are growers gaining experience with growing dedicated energy crops and facilities gaining experience dealing with the logistics of biomass harvest, transport and storage at large scale. Use of dedicated energy crops for re-powering would provide the necessary market for growers to begin growing dedicated energy crops. The experience gained with biomass handling by the companies using this biomass would provide useful knowledge and serve as a stepping stone to commercial-scale handling of biomass for cellulosic biofuels production.

The other critical element of the cellulosic and advanced biofuels industries achieving scale is scale-up of the conversion technology. This scale-up requires that significant capital investments be made. The first commercial-scale facilities need to be over-

engineered to allow for technology improvement and optimization at scale. The result is that these facilities are expensive to construct and will not be able to produce fuel at mature, competitive prices. It was because of the need to progress down a technology cost-reduction curve that the Cellulosic Biofuels Production Incentive program was included in the Energy Policy Act of 2005. The reverse auctions contemplated by this program together with the grants and loan guarantees to assist with facility construction provide appropriate incentives and support to help these facilities be built.

## How We Get There From Here: Policy Priorities

### Improvement of Starch Ethanol through Re-powering

Expanded funding of Repowering Assistance Program: When used in conjunction with BCAP, the Repowering Assistance Program provides an attractive opportunity for starch ethanol facilities to transition from coal and natural gas to dedicated energy crops as their source of heat and power. Now that both programs are in place there will be increasing demand for the Repowering Assistance Program. Given the benefits of establishing a market for dedicated energy crops - allowing growers to gain experience growing them and allowing companies the opportunity to work through biomass supply logistics - the program should be expanded to accommodate this increasing demand.

Planning appropriately for funding requirements of BCAP: Because the Repowering Assistance Program creates an immediate market opportunity for biomass it could lead to considerable early demand for the BCAP program. BCAP is authorized to be funded with "such sums as are necessary" to achieve its intent. The level of interest we are seeing from starch ethanol refineries in repowering suggests that the BCAP program may require larger amounts of funding sooner than some may be anticipating. We encourage the Committee to work with USDA and the Office of Management and Budget on such matters to ensure FY 2010 success.

Extension of BCAP matching payments for collection, harvest, transport and storage: The original intent of BCAP was to provide transitional assistance to help the industry get started. In the case of cellulosic and advanced biofuels it is clearly taking longer than anticipated for the industry to get started. More broadly, with the price of carbon still unclear, it is presently uncertain whether current climate change legislation will be enough to make the economics of using biomass for on-site heat and power competitive with the use of coal or natural gas. In order to help ensure that facilities have the right incentives to make this transition, it is important that the two-year time limit on matching payments for collection, harvest, transport and storage costs under BCAP be extended.

Inclusion of high biomass sorghums under BCAP: High biomass sorghum is the only one of the primary dedicated energy crops that is an annual and the only one that will achieve a full yield in its first harvest. Having an annual dedicated energy crop will be critical for allowing rotation with other crops and for enabling immediate implementation of biomass as an alternative to coal and natural gas. Questions exist about whether high

biomass sorghum will be allowed to qualify for BCAP in all parts of the country because of pre-existing rules that allow certain forage sorghums to qualify for Title I payments in certain parts of the country. We need to ensure that there is a clear differentiation between crops designed to be used for feed and those designed to be used for biomass production. Those designed for biomass production must be encompassed by BCAP so that they are able to serve their desired role in helping these industries develop.

Expansion of Repowering Assistance Program beyond biorefineries: While the topic of today's meeting is biofuels, it has come to our attention that there are actually many types of facilities that would have interest in using the Repowering Assistance Program to help them transition from coal or natural gas to biomass for on-site heat and power generation. These facilities range from campuses such as schools, hospitals and prisons to manufacturing and refining facilities. Utilities aiming to displace coal with biomass for power generation also have interest. If the Congress has interest in promoting the transition from fossil fuels to biomass beyond the biofuel industry, expansion of this program could be a powerful tool in helping to accomplish this.

**Scale-up of Cellulosic and Advanced Biofuels**

Implementation of BCAP establishment assistance: We strongly support present efforts to implement the second phase of BCAP that will provide support for establishment of dedicated energy crops. Perennial dedicated energy crops have the potential to enable carbon negative biofuels through their below-ground carbon sequestration. Because of the time they spend generating these root systems they typically do not produce economically harvestable yields in their first year. Establishment assistance is therefore critical to helping farmers overcome this first year opportunity cost of growing dedicated energy crops.

Limitation of BCAP establishment assistance: While we are supportive of rapid implementation of establishment assistance, we would suggest caution regarding the magnitude of support that would be offered on a per acre basis. There are vast differences between the establishment costs of seed propagated crops like switchgrass and those of vegetatively propagated crops like miscanthus, arundo donax and elephant grass as well as most of the woody energy crops. The result of these differences is that vegetatively propagated crops often need to be left in the ground for more than a decade to be able to amortize this cost and give the grower an adequate return on their investment. With the current pace of improvement in energy crop development we believe growers will want to be able to replace their stands every five to seven years to maximize their productivity and their returns. If the United States wishes to encourage energy crop production on the largest number of acres, it may want to carefully consider the high establishment costs associated with vegetatively propagated crops and avoid the experiences of the United Kingdom, wherein that government may have hampered biofuels expansion by dedicating too many resources to support more costly crops that cannot stand on their own without the support program. We would therefore suggest that a cap on establishment costs per acre be used to ensure that growers have the correct incentives to select the most economically attractive crops.

Carbon offsets for below ground biomass: Biomass is the only source of renewable transportation fuels or power that has the potential to be not just carbon neutral but actually carbon negative. This is because of the massive root systems created by perennial energy crops. As long as no-till practices are used to keep these root systems intact, stands of perennial energy crops replaced at regular intervals have the potential to serve as nearly perpetual carbon sinks. It is the growers producing these crops who will be responsible for generating this carbon sink. This contribution should be recognized by allowing them to generate carbon offsets with these crops that could be sold to carbon emitters. Doing this would help to encourage use of energy crops that are more efficient in their carbon sequestration as well as optimal management practices to reduce emissions and maximize sequestration. If farmers are to profit in a carbon-constrained world, the Committee should encourage USDA to pursue public-private research to measure how much carbon is sequestered in the roots of dedicated energy crops over time.

Crop insurance pilot program: As the cellulosic biofuels industry develops, we believe it is of critical importance that dedicated energy crops not be disadvantaged relative to other crops in terms of the safety net that the government provides for these crops. This safety net could come in a form similar to existing crop programs or could be substantially different. The goal must be to allow growers to make decisions about which crops to grow based on market forces, not based on which crops are or aren't supported by government programs. Toward this goal, we suggest a pilot program to begin collecting the data that will be necessary to enable a program like crop insurance. The objective of this pilot program would be to collect the necessary data to enable the roll-out of a crop insurance program for dedicated energy crops in time for the rapid scale-up of the industry.

Biorefinery grants and loan guarantees: We are supportive of the cost-sharing grant programs and loan guarantee programs that the government has created to help foster the construction of the first commercial scale biorefineries. We would hope that these programs are successful in getting needed support into the hands of leading companies as quickly and efficiently as possible to help hasten the growth of this industry. Generally, we are hopeful the loan guarantee effort for leading-edge biofuel projects is not as firmly stuck in place as it seemed in 2007 and 2008. Congress was wise to make these projects eligible under DOE loan guarantee programs authorized under the Recovery Act. Like you, we look forward to agency support for worthy efforts that can begin construction prior to September 30, 2011.

Reverse auction: The first commercial scale cellulosic biofuels facilities must be over-engineered to enable process improvements at scale. Because of this, these facilities will not be able to produce fuel at a cost that is competitive with mature technologies and, as a result, are not attractive opportunities for project finance. Implementing the reverse auction called for by the Cellulosic Biofuels Incentive Program would help target exactly this problem. Those taking the risk to create these first facilities would be assured that, within the reverse auctions, their competition for improving price points would be with

other pioneering facilities rather than with established technologies. This should help encourage private sources of capital to provide project finance for these facilities.

## Conclusion

Together, we believe these policy priorities will help achieve the dual objectives of continuing to improve the environmental profile and fossil fuel displacement of the starch ethanol industry and facilitating the commercial scale-up of cellulosic and advanced biofuels. Thank you again for providing me with the opportunity to discuss our efforts and policy priorities. We look forward to working with you to help continue the rapid and successful development of this industry.

# Biofuels—a critical part of America's sustainable energy future

Testimony presented to
The Senate Committee on Agriculture, Nutrition, and Forestry
Hearing on "The Expanding Role of Biofuels for America"
September 1, 2009
Sioux City, Iowa

John Sheehan
Program Coordinator, Biofuels and Global Sustainability
Institute on the Environment
University of Minnesota

## Coming to terms with biofuels

What do we mean when we talk about "biofuels"? There is no simple answer to that question. Figure 1 gives a sense of how diverse and numerous the options are for biofuels production. And, as complex as this figure looks, it does not capture all of the possibilities and permutations that exist for mixing and matching biomass feedstocks, conversion technologies and optional fuel forms.

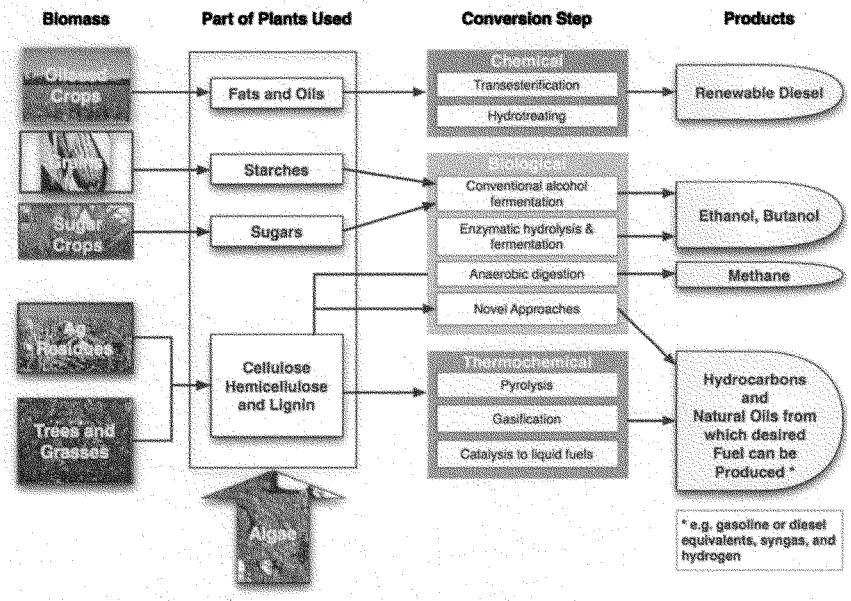



**Figure 1 Biofuels—Variations on a theme**

I define biofuels as any transportation fuel that can be produced from plant matter. Broadly speaking, the technology used to convert biomass into fuel can be classified as chemical, biological and thermochemical. The fuels can take any form—from electricity to gases to liquids. And there is no limit to the diversity of types and sources of plant materials that we can process. This diversity has its advantages and its disadvantages. On the one hand, it creates plenty of opportunities for biofuels to address the ever-changing demands placed on fuel suppliers. On the other hand, the variety of choices can be daunting and confusing to technologists, investors, regulators and policy makers.

### Today's biofuels industry

The first three boxes on the left in Figure 1 represent the major sources of biomass used by today's industry. Fats and oils from soybeans, waste fats and greases, and other oilseed crops can be converted into fuels suitable for diesel engines using well-established chemical technology. To make "biodiesel," fuel processors chemically combine these oils with methanol using a chemical reaction known as "transesterification." The oleochemicals industry has been practicing this kind of chemistry for many decades. The process is cheap, reliable and efficient.[1]

A new way to process fats and oils has been introduced commercially both in the US and abroad. It comes from an unexpected place—petroleum refiners. Refiners have borrowed from their own well-established tool set for converting petroleum to fuels to introduce a new fuel known as renewable or "green" diesel. By hydrotreating and hydrocracking fats and oils, refiners are able to make a bio-based diesel fuel virtually indistinguishable in performance and handling requirements from ultra low sulfur clean diesel—and perhaps even better. The largest source of biofuels in the US is corn. In Brazil, sugarcane is fermented to fuel grade ethanol at a level only slightly less than that of corn ethanol in the US.

### Emerging and future biofuels technologies

The remaining biomass sources shown in Figure 1 represent the future of biofuels, based on so-called "advanced biofuels" technologies. Trees and grasses are the largest source of organic carbon in the biosphere. Advanced biofuels technologies are designed to convert this organic carbon into useable forms of liquid fuels, heat, power and other chemical products. These vast resources of organic carbon are what Senator Richard Luger and former CIA director James Woolsey once referred to as "the New Petroleum" because, in combination with advanced biofuels technologies, they represent the largest renewable alternative to petroleum as our dominant source of liquid organic carbon feedstocks for production of transportation fuels.[2]

---

[1] Sheehan, J., Camobreceo, V., Duffield, J., Graboski, M., & Shapouri, H. (1998). *Life cycle inventory of biodiesel and petroleum diesel for use in an urban bus.* Golden, CO: National Renewable Energy Laboratory.

[2] Lugar, R.G. & Woolsey, R.J., 1999, "The New Petroleum." *Foreign Affairs,* 78(1), pp. 88-102.

**Leading technologies for converting trees and grasses to biofuels**

### *Biological processes*

Cellulosic ethanol is likely to be the first of the advanced technologies to hit the commercial scene in the next few years. Cellulosic ethanol is made by fermenting the sugars locked up in the cellulose polymers of trees and grasses into ethanol. Releasing those sugars has been one of the greatest hurdles facing the industry, but the recent large private and public sector investment in new enzymes and new microbes that can break down cellulose into its component sugars is rapidly eliminating this roadblock. Meanwhile, biotechnology tools are being brought to bear to create microbes that can turn these sugars into other, potentially more interesting, fuels—such as butanol and even bio-gasoline.

### *Thermochemical processes*

Thermochemical conversion of biomass includes gasification and pyrolysis. Gasification involves the use of high temperature and high pressure to bust up biomass into simple chemical building blocks. These chemicals can then be converted to hydrocarbons and almost any other chemical you can think of—including alcohols such as ethanol and butanol. Pyrolysis uses milder conditions to convert biomass into a complex chemical soup that can be upgraded to a fuel grade liquid. The advantage of thermochemical processing is that it is "omnivorous." Biological processes need sugars. By contrast, thermochemical processes will take organic carbon in virtually any form. This has two important implications: 1) thermochemical processes can yield higher amounts of liquid fuels because, unlike biological processes, they can use the non-sugar part of the biomass (primarily lignin); and, 2) they are not limited to high sugar-containing biomass.

### *Biological versus thermochemical technology—why choose?*

The picture I have just painted of advanced technology for biofuels actually offers a false dichotomy. Technologists tend to identify themselves with one or the other of these two camps. Investors and policy makers are often bombarded with competing claims of superiority about these two technologies. But the truth is that each has their place, and (more importantly) each can and must be used together. The ideal integrated biorefinery is (as shown in Figure 2) one in which both types of technologies are used to optimize fuel production from all of the components in biomass. It lets the microbes do what they do best—convert sugars into products without going through the step of destroying these chemicals, and it allows heat and pressure to convert the rest. And there is an added benefit to this approach. Thermochemical processes often produce a lot of excess (often viewed as waste) heat. In an integrated process, the "waste" heat can be used to supply heat and power to the biological processing side of the facility. This reduces overall cost and improves the energy efficiency of the facility.

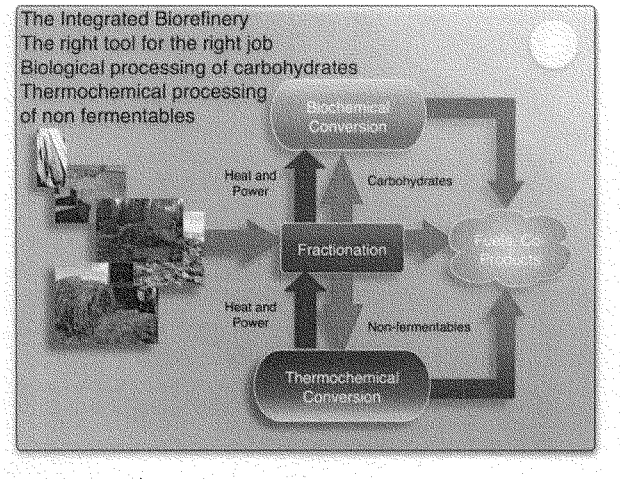



**Figure 2. The ultimate integrated biorefinery**

## The economics of a mature biofuels industry

The peer-reviewed journal *Biofuels, Bioproducts, and Biorefining* recently dedicated an entire issue to analysis of the future mature state of technology for biofuels. The papers in this issue came from a project entitled "The Role of Biomass in America's Energy Future," which I co-lead with colleagues at Dartmouth College, Princeton University, and the Natural Resources Defense Council while I was at the National Renewable Energy Laboratory.[3] We looked at the future prospects for economic and environmental performance of 14 different combinations of biological and thermochemical process technologies. Figure 3 shows the range of biofuels prices we found for a range of biomass feedstock costs.[4] The lowest cost options are for bioethanol facilities that coproduce thermochemical fuels. Even when feedstock costs rise to levels of over $100 per metric ton, the processes will be able to deliver fuel at prices that compete with oil priced at $50 to $125 per barrel. One of the limitations of analyses published by the Department of Energy and others is that they often assume biomass costs of $30 to $40 per metric ton. While such low prices may be feasible in the early days of the industry, they are unsustainable for a large industry. The ability to compete at higher feedstock prices is vital to a future biofuels industry if it wants to play a large role in our energy supply.

---

[3] Lynd, R. ; Larson, E.; Greene, N.; Laser, M.; Sheehan, J.; Dale, B.; McLaughlin, S.; Wang, M. "The role of biomass in America's energy future: framing the analysis." *Biofuels, Bioproducts, and Biorefining*, 3:pp 113-123.

[4] Laser, M.; Larson, E.; Dale, B.; Wang, M.; Greene, N.; Lynd, R. (2009). "Comparative analysis of efficiency, environmental impact, and process economics for mature biomass refining scenarios." *Biofuels, Bioproducts, and Biorefining*, 3:pp 247–270.

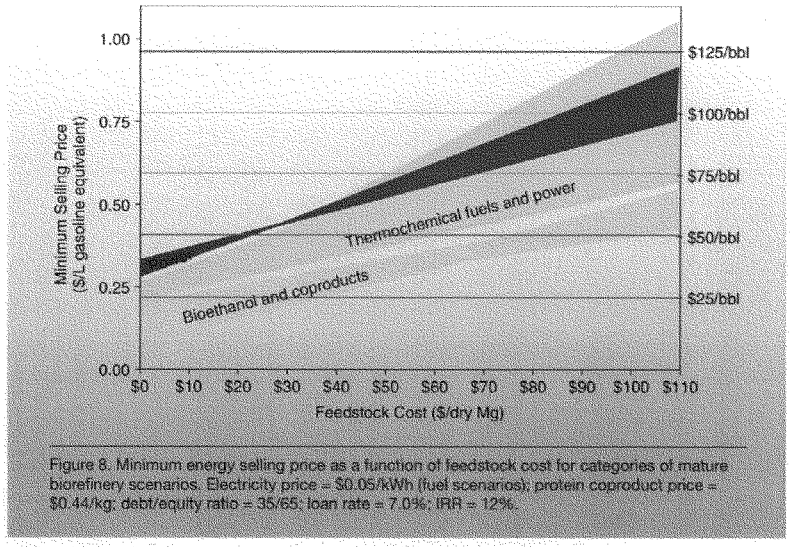



**Figure 3. Biofuels prices for future mature state of technology scenarios**

## Biofuels—How much by when?

The limiting factor for domestic biofuels production is biomass supply. Many estimates of supply are available. Among the most often cited is a joint study of the U.S. Department of Energy and the U.S. Department of Agriculture—the so-called "Billion Ton Study."[5] As the title suggests, it was intended to evaluate the feasibility of producing one billion tons of biomass for fuel production in the US. In round numbers, such a level of production could correspond to around 100 billion gallons of ethanol per year if all of the biomass were converted to ethanol.

My own preliminary modeling work evaluating the dynamics and economics of biomass production and biofuels industry growth suggest that this level of production is achievable in the next 30 years, depending on the price of oil and the kinds of policies that are put in place. Figure 4, for example, shows a scenario in which a renewable fuel standard of 20 billion gallons per year, in conjunction with a carbon mitigation value of $40 per ton and sustained high oil prices, could lead to 100 billion gallons per year of ethanol production by around 2039. (Note that this

[5] Perlack, R., Wright, L., Turhollow, A., Graham, R., Stokes, B., & Erbach, D. (2005). Biomass as feedstock for a bioenergy and bioproducts industry: The technical feasibility of a billion-ton annual supply. Oak Ridge, TN: Oak Ridge National Laboratory.

work was done in 2006, when DOE's high oil price scenario showed prices reaching $100 per barrel by 2030).[6]

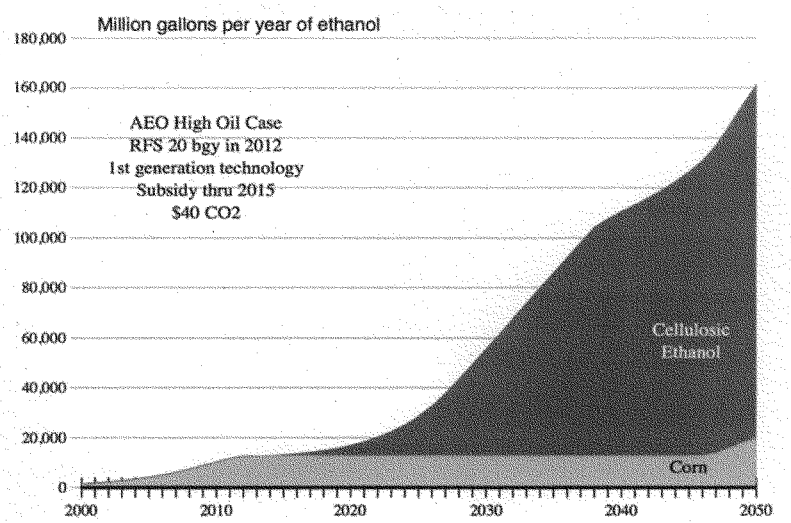



**Figure 4. System dynamics modeling of biofuels industry growth**

## Biofuels and the conundrum of sustainability

Beyond the complexity of characterizing the technology is the tougher question of how to define sustainability. As a concept, sustainability has a long and checkered history. Its roots go back to the controversial writings of Thomas Malthus, who dared to suggest (albeit prematurely with regard to both technology and human reproductive behavior) that the planet had reached the limit of its ability to support human population and the needs of society.[7] In the 1970s, the Malthusian perspective returned with public concern about the environment and population growth. Its essence was captured in the computer modeling work at MIT that led to the controversial "Limits to Growth" report.[8,9] Today, the Malthusian question continues to influence the debate over the sustainability of biofuels and society in general, leading to often-acrimonious debate in both the public sector and the technical community—particularly with respect to the question of "food versus

---

[6] A description of the modeling approach I have used is available in:
Bush, B.; Duffy, M.; Sandor, D. (2008). *Using System Dynamics to Model the Transition to Biofuels in the US.* Conference Paper NREL/CP-150-43153. National Renewable Energy Laboratory, Golden, CO.

[7] Malthus, T.R. (1798). *An Essay on the Principle of Population.* Oxford University Press; 1798.

[8] Cole, H.S.D. (1973). *Models of doom: A critique of the limits to growth.* Universe Books.

[9] Meadows, D., et al (2004). *Limits to Growth: The 30-Year Update.* Chelsea Green Publishing Co.

fuel." Unfortunately, one of the greatest challenges facing analysts in the nascent field of sustainability is the pace with which policy makers are moving forward with laws to promote sustainability. The field is struggling to keep up with these demands.

## Direct benefits of advanced biofuels

There is a growing literature supporting the benefits of advanced biofuels in terms of greenhouse gas reductions and petroleum savings—both important metrics of a sustainable energy supply. The work we have done under the "Role of Biomass in America's Energy Future" shows that, regardless of what combination of biological and thermochemical technology we considered, biofuels can achieve 80 to 90% savings in both petroleum and carbon emissions (see Figure 5).

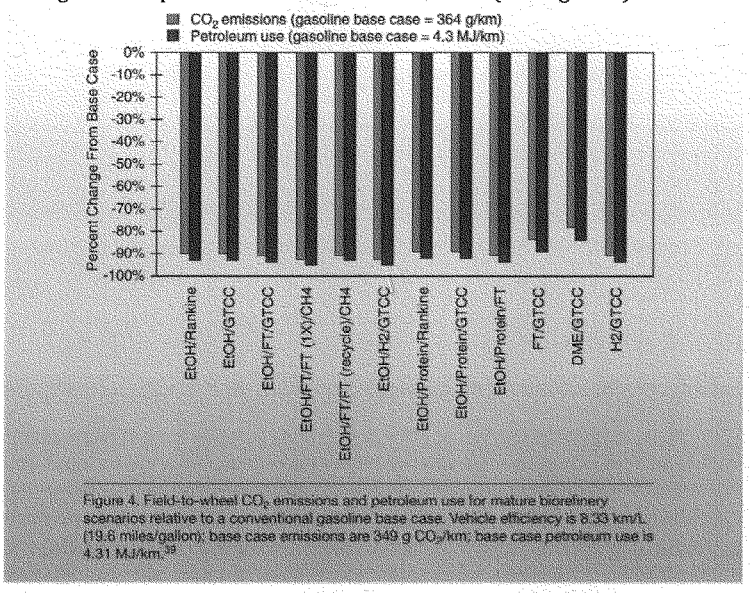



**Figure 5. Carbon and Petroleum savings of various biofuels production systems[10]**

## Biofuels and global land use

The debate about sustainable biofuels production has now expanded beyond the direct effects it has in the US to the broader question of how new demand for biofuels will effect the ability of global land resources to meet the needs for food,

---

[10] See footnote 4 for reference. Production system definitions: EtOH=ethanol; Rankine=conventional electric power production; GTCC=gas turbine combined cycle power production; FT=Fischer Tropsch fuel production; FT (1x)= Fischer Tropsch fuel production with "once through" syngas; CH4=methane production; FT (recycle)=Fischer Tropsch fuel production with recycled syngas; Protein=coproduct recovery of protein from biomass; DME=Dimethyl ether production; H2=hydrogen production. FT, DME, H2 and GTCC are all thermochemical conversion processes. Ethanol is a biological process.

feed and fiber. Recently, researchers have posed this question in terms of how much additional carbon emissions could be caused indirectly by the introduction of biofuels as a result of new land clearing that might occur.[11,12] Implicit in these analyses is the assumption that expansion of land for biofuels production must always lead to clearing of new land elsewhere in the world. If such expansion causes tropical deforestation, the added release of carbon could overwhelm any of the direct carbon savings that biofuels may offer.

Our ability to quantify this indirect effect is contingent on our ability to predict how the combination of future yield improvements in agriculture and bioenergy crops, growing population and food demand will effect total demand for land globally. We don't know the answer to that question. My own preliminary analysis suggests that there are plausible scenarios in which continuation of historical yield trends, population growth and per capita food demand lead to a decline in overall demand for agricultural land (see Figure 6). To the extent that this is true (and I in no means can say with certainty that it is), we can add biofuels production without incurring large carbon debts from land clearing. If the scenario I show here is achieved, the decline in land demand could translate to an ability to produce 300 billion to 1 trillion gallons per year of biofuels production without incurring added land clearing.

Furthermore, even if it is true that—assuming business as usual—we will see increasing land demand for food, feed and fuel, why should we accept that future? Why not design a future of sustainable global land use in which we improve global land productivity and land management practices such that we can meet the critical needs of food, feed, fiber *and* fuel? Thus, the more important question may be *how* to ensure sustainable fuel production on our lands.

### Final thoughts

Advanced biofuels technology can and, I believe, should be a part of America's (and the world's) energy future. We need the will and the wisdom to make sure that it happens in a sustainable and responsible way. Economically and technologically, the hurdles to success are falling away. And we have an existing industry that can serve as a home for the new technology developments that are coming. We can transform the current debate about biofuels from one of "food versus fuel" to one of "food and fuel."

---

[11] Searchinger, T., Heimlich, R., Houghton, R. A., Dong, F., Elobeid, A., Fabiosa, J., et al. (2008). Use of U.S. Croplands for biofuels increases greenhouse gases through emissions from land-use change. *Science*, 319(5867), 1238-40.

[12] Fargione, Hill, Tilman, Polasky, & Hawthorne (2008). Land clearing and the biofuel carbon debt . Science, 319, 1235-1238.

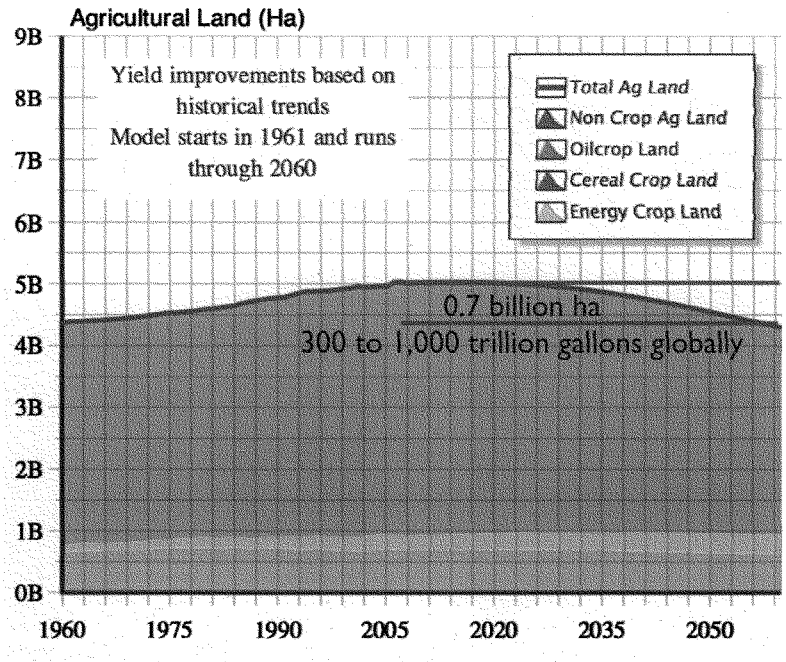



**Figure 6. A scenario for declining ag land demand?**

Statement Of Mark Stowers
Vice President of Science and Technology
POET

Senate Agriculture Committee

"POET's commitment to cellulosic ethanol"

September 1, 2009

PREAMBLE

Mr. Chairman and distinguished committee members, thank you for the opportunity to visit with you today. My name is Dr. Mark Stowers. I am Vice President of Science and Technology for POET. I would like to talk with you today about our company's commitment to cellulosic ethanol as well as the opportunities and challenges presented by that endeavor.

POET - INTRODUCTION

POET, headquartered in Sioux Falls, South Dakota, is the largest dry mill ethanol producer in the United States. POET is an established leader in the biorefining industry through project development, design and construction, research and development, plant management, ownership, and product marketing. Our 21-year old company has built and manages twenty-six (26) plants principally in the Corn Belt while marketing more than 1.5 billion gallons of ethanol and 4 million tons of distillers' grains annually. The one time capital investment made in POET biorefineries since 2000 exceeds $1,000,000,000, and POET through its corn purchases, corporate and plant operations contributes over $3 billion to the rural American economy each year. In addition POET has encouraged farmer investment in its operations. Today, we have over 11,000 farmer investors.

By leveraging business size and position, POET has become one of the most successful ethanol companies in the industry. POET has achieved breakthrough progress beyond ethanol processing, extracting extraordinary new value from each kernel of corn.

BACKGROUND AND RATIONALE

According to the recent US Department of Commerce International Trade Administration Study, "Energy in 2020: Assessing the Economic Effects of Commercialization of Cellulosic Ethanol" there is enough cellulosic feedstock available in the United States to produce nearly 50 billion gallons of cellulosic ethanol by 2020. At this production rate over 1.2 million barrels per day of crude oil could be displaced while creating over 54,000 jobs in US agriculture. In more practical terms at this level of

ethanol production the US could eliminate all oil purchases from OPEC and the Middle East - eliminating the $840 million per day export of US dollars to overseas oil producers (based on $72 per barrel oil).

Notwithstanding the economic benefit of cellulosic ethanol there are significant environmental benefits to cellulosic ethanol. Gasoline produces 25 pounds of carbon dioxide equivalent greenhouse gas (GHG) emissions. By comparison cellulosic ethanol reduces GHG emissions by a little more than 21 pounds of carbon dioxide on per gallon of gasoline equivalent - that's an 85% reduction. In order to monetize that benefit we can assign a value of $20 per ton of carbon dioxide equivalent based on current European futures prices for carbon dioxide equivalents. On that basis the GHG emission reductions resulting from the use of cellulosic ethanol would be about $0.19 per gallon or about $2.5 billion per year by using a little more than 20 billion gallons of cellulosic ethanol.

The impact of ethanol in relieving our dependence on foreign is profound. I would like to quote work of Adam Liska and Richard Perrin (University of Nebraska - Lincoln) who published a well reasoned summary of the costs associated with the maintenance of our foreign oil supply (© 2009 Society of Chemical Industry and John Wiley & Sons, Ltd | *Biofuels, Bioprod. Bioref.* (2009); DOI: 10.1002/bbb).

> Since 1979, there has been a strategic buildup of the US military in the Middle East for protection of exported oil. In addition to GHG emissions from military fuel use, emissions also derive from materials for military buildings, vehicles, and munitions. In 1997, it was estimated that the US military used 5-15% of all US materials consumed (e.g., steel and aluminum), but used up to 40% of other more GHG intense metals such as titanium, resulting in total military emissions at up to 10% of all US emissions. To our knowledge more recent estimates of military-related emissions are not available, but expenditures provide a starting point to estimate their current magnitude. Estimated expenditures related to Middle East oil security alone range from $138 billion annually (out of the $526 billion spent on US defense in 2007, not including Iraq and Afghanistan operations) to $3 trillion for the Iraq war. Whether Iraq operations were ultimately due to oil or national security is debated, but oil appears to be a dominant factor; even US involvement in Afghanistan has strong links to accessing oil reserves in Central Asia. If 10% of total US GHG emissions were due to the military, and if only 26% of those operations were for protection of oil supplies (assuming no expenditures for the Iraq war), total indirect military emissions would equal 187 TgCO2e yr-1 [more than 2 to 4 times as much as corn ethanol]. These indirect military emissions would add 98 gCO2e MJ-1

to gasoline produced from Middle Eastern petroleum and raise the GHG intensity of gasoline from this source by roughly two-fold.

The value of cellulosic ethanol to the US economy, the environment and national security is substantial. At POET we believe that cellulosic ethanol is real and achievable.

POET'S COMMITMENT TO CELLULOSIC ETHANOL

In 2006 POET developed and implemented a new strategy for cellulosic ethanol production involving the utilization of existing corn ethanol plants to 1) capitalize on the existing infrastructure (utilities, roads, rail lines, materials handling and so forth), 2) use the corn ethanol plant's existing farmer and often investor network to collect corn cobs as our primary cellulosic feedstock and 3) provide enough energy from the cellulosic waste streams to power the site. This approach would enable rapid deployment of the cellulosic ethanol process as across an expansive corn ethanol base through a "bolt-on" approach. POET is implementing this strategy through what it calls Project LIBERTY, an integrated corn cellulose biorefinery.

Project LIBERTY will transform the POET Biorefinery - Emmetsburg, an existing conventional corn dry mill ethanol plant located in Iowa, into an integrated corn-to-ethanol and cellulose-to-ethanol biorefinery. Once complete the facility will produce 125 million gallons of ethanol per year; 25 million gallons of ethanol will come from a feedstock of corn fiber and corn cobs. Also, the facility will produce annually 80,000 tons of Dakota Gold Corn Germ Dehydrated and 100,000 tons of Dakota Gold HP animal feed. The impact of Project LIBERTY in terms of ethanol production will be 11% more ethanol from a bushel of corn through the corn fractionation process and 27% more ethanol from an acre of corn through the use of corn cobs. In addition Project LIBERTY will reduce the need for fossil fuels by nearly 100%. The total cost of the project will be in excess of $200 million. In addition to the capital investment, it will create at least 30 new jobs at the facility.

The primary project goal is to design, construct, and operate the commercial-scale, integrated cellulosic ethanol bio-refinery. Technologies will be replicable. POET's longer-term plans are to rollout the technologies to other existing dry mills or new grassroots biorefineries. POET is partnered with the Department of Energy in Project LIBERTY whereby DOE will contribute up to 40% or $80 million in project costs. In addition to the DOE, the State of Iowa has also joined Project LIBERTY as a partner through the contribution of $14.75 million in research and development funds, reimbursement of some construction and tax

credits. Project LIBERTY is expected to be operational in late 2011.

Today I would like to share with you three requirements for the success of cellulosic ethanol and give you an update on where POET is in its cellulosic ethanol effort.

1. Cost competitive feedstock collection, storage and logistics systems
2. Effective and efficient cellulosic ethanol process technology
3. Elimination of the blend wall - a market constraint that will limit the use of cellulosic ethanol.

FEEDSTOCK COLLECTION, STORAGE AND LOGISTICS SYSTEMS

POET has established a leadership position in the collection of cellulosic feedstocks. Cellulosic feedstocks can be agricultural residues such as corn cobs, rice straw or corn stover. They can also be wood fibers such as forestry wastes or wood wastes or energy crops such as switchgrass. Cellulosic feedstocks could also be collected from municipal waste.

POET has selected corn cobs as the first cellulosic feedstock for the production of cellulosic ethanol. Corn cobs offer a significant advantage over other feedstocks based on technical, environmental and economic reasons. Corn cobs are typically left in the field as corn stover after the harvest of the corn kernels. Corn cobs are rich in sugars. They are heavier than the corn stalk making them easily separated. They can be removed from the field with little environmental impact because they contain little fertilizer value. And lastly they can be collected relatively easily by the same farmers that provide the ethanol plant the corn grain.

In 2007 and 2008 POET harvested nearly 13,000 acres of corn to supply over 7,000 tons of corn cobs in Iowa, South Dakota, and Texas. We worked with 13 equipment manufacturers using two cob harvest concepts - 1) a corn and cob mix (CCM), and 2) a towable corn stover - cob separator. With the CCM system, corn kernels and cobs are collected and stored in the combine hopper while the stalks are returned to the field; both corn and cobs are transferred to a grain cart in the field; then transported off the field to be separated with a grain separator creating a grain pile and a cob pile. Using a combine and towable stover - cob separator, grain is collected in the combine hopper and the stover that is released from the combine is received by the towable separator. The towable separator collects the cobs and releases the stalks to return to the ground to provide cover for erosion control and nutrients for soil fertility.

We have had excellent farmer participation and feedback with 100s of farmers in the Emmetsburg Iowa area participating in our LIBERTY Blast Off meeting and LIBERTY Field Day events in 2008.

For 2009 we have completed our planning for the harvest of 25,000+ acres in Iowa & South Dakota involving 15 equipment manufacturers. We will evaluate four cob harvest methods: Towable stover-cob carts, CCM, Flex-harvester, and baling. We have scheduled another LIBERTY Field Day in November to showcase equipment, brief farmers on the process and provide opportunities for farmer and equipment suppliers to discuss equipment performance and pricing for 2010. By 2012 we expect to collect over 250,000 tons of corn cobs on over 300,000 acres working with over 400 farmers in the Emmetsburg Iowa area to produce over 25 million gallons of cellulosic ethanol.

CELLULOSIC ETHANOL PROCESS TECHNOLOGY

POET has made significant investment in cellulosic ethanol research and expanded its collaborations across major corporations, universities and research institutes. Since 2006 POET has invested over $25 million in research and development and in excess of $10 million in capital expansions including a cellulosic ethanol pilot facility capable of processing 1 to 2 tons of lignocellulosic biomass per day.

Through our work with our collaborators and in particular the enzyme companies, we have been able to continually improve our cellulosic ethanol process. Recently we devised a process to breakdown corn cobs into simple sugars and optimized our fermentation process to produce more than 80 gallons of ethanol from one ton of cobs at a cost that approaches the cost of corn ethanol production.

We have also made significant progress in producing ethanol from simple sugars through better microorganisms and a better fermentation process. And lastly, through our own cutting-edge process engineering expertise, we have devised a synergistic concept for the integration of a corn ethanol plant with one using only cellulosic feedstock.

Let me highlight some of the achievements the POET research team has accomplished over the past 10 months.

1. Achieved lab scale performance in pilot facility - December 2008
2. Launched 24/7 pilot plant operation - January 2009
3. Completed process de-bugging - February 2009
4. Lignin removal process completed - March 2009
5. LIBERTY targets achieved at lab scale - April 2009
6. Anaerobic digester installed - May 2009
7. Achieved a >5 fold reduction in enzyme cost - June 2009

8. Total production costs below $2.50 per gallon - July 2009

While these are very important breakthroughs we expect to be able to further optimize this process over the next few months to achieve the necessary economics to make the process profitable. And we fully expect that over time we will continually improve the process much like what has occurred in the corn ethanol process.

IMPACT OF THE "BLEND WALL" ON CELLULOSIC ETHANOL

Today, approximately 10.6 billion gallons of ethanol is produced in the US. A little over 1.8 billion gallons of capacity is idled due to adverse market conditions and another 2.1 billion of capacity is scheduled to become operational this year. The total projected capacity for the ethanol industry is approximately 14.5 billion gallons, representing more than 10% of the available liquid transportation fuel market. Regulatory constraints limit the use of ethanol in this market to a) gasoline blends containing 10% ethanol (E10) for all vehicles or b) gasoline blends containing 85% ethanol (E85) for only flexible fuel vehicles. There are approximately 250 million cars and light duty trucks of which only 7.7 million are flexible fuel vehicles (FFVs). In addition, E85 is available in only 1900 or 1% of all fueling stations. E85 is not available in 5 states. The combination of a small number of FFVs and extremely limited E85 distribution results in little ethanol sold through this channel, roughly 1% of all ethanol produced. It is clear that the arbitrary regulatory cap of 10% ethanol in gasoline needs to be relieved in order to expand the ethanol market for future cellulosic ethanol.

Considerable research has been conducted by universities, national laboratories, automobile manufacturers, private testing laboratories and governmental groups to determine the impact of gasoline blends containing 15 to 30+% ethanol. Based on this research, Growth Energy, representing over 50 ethanol producers and supporters of ethanol, submitted a waiver request to the EPA to increase the ethanol content in liquid transportation fuels up to 15%.

Growth Energy's waiver application included recent comprehensive and independent studies representative of the American fleet that specifically evaluated the effect of higher ethanol blend fuels on emission control devices and systems. The included studies were based on thousands of hours of testing, more than one million miles driven, and evaluation of hundreds of vehicles (including over 100 different types of vehicles and engines) regarding exhaust and evaporative emissions, materials compatibility, and vehicle drivability for both E-15 and blends with greater than 15% ethanol. Many of the studies included extensive statistical analysis of the data and have been subject

to peer-review. Every relevant study included in the waiver application and subsequent comments provided by Growth Energy confirmed that vehicles and engines in today's American fleet can meet all applicable emission standards while using higher ethanol blends including E-15. Bottom line, fuels containing up to 15% ethanol do not cause or contribute to the failure of emission control devices or systems. The evidence is consistent and overwhelming. EPA should grant the requested waiver. In granting the waiver request the market for cellulosic ethanol could reach 6 billion gallons to fulfill the first cellulosic ethanol volumes mandated by the Renewable Fuel Standard. The economic benefit could exceed 136,000 new jobs and over $25 billion per year in GDP.

In conclusion I would like to bring to the attention of the committee the following items:

1. The importance of the Renewable Fuel Standard (RFS). The RFS provides an important target for cellulosic ethanol - a real and attainable target. Continued support of the RFS will be important in demonstrating to the ethanol, transportation fuel and financial industries that there will be a market for ethanol.

2. Market access for cellulosic ethanol. Increased usage of ethanol, greater numbers of flexible fuel vehicles, increased availability of blender pumps, enhanced distribution channels for ethanol such as pipelines. Important research has been released recently that supports the inclusion of greater concentrations of ethanol as a gasoline replacement - expanding the use of ethanol beyond its historical role as a fuel oxygenate. So called "Mid Level Blends" have shown to be equal and in some cases better in overall miles per gallon with little to no deleterious impact on vehicles that make up the current US automotive fleet. The increased commercialization of flexible fuel vehicles could help drive the greater usage of these mid level blends further reducing our dependence on foreign oil, reducing our fuel costs and helping the environment. We have been strong advocates to give consumers a choice in the fuels that they purchase - blender pumps allow consumers to select an ethanol blend that fits their pocketbooks. And POET has partnered with Magellan to develop a major pipeline for ethanol distribution to the northeast. We need your support with these ambitious endeavors.

3. Governmental support. Governmental programs are necessary, especially during the early stages of the cellulosic ethanol industry development to enable financing at the grower/farmer level as well as cellulosic ethanol producers

in terms of incentives, loan guarantees and market assurances.

4. Continued investment in research and development. Further cost reductions in the feedstock collection, storage and logistics and the cellulosic ethanol process are required. The initial cost of farm equipment to collect biomass and the cost of enzymes still remain among the most significant costs associated with the commercial success of cellulosic ethanol.

Cellulosic ethanol is not a magical solution or another shiny silver ball to attract and distract our attention from the critical issue of a clean, domestic fuel for today. The technology to achieve commercial scale cellulosic ethanol is here. We need market access to ensure that cellulosic ethanol becomes a reality. It's time to break big oil's monopoly on gasoline as our liquid transportation fuel. We can make a difference in our economy, the environment and national security by supporting ready-to-go domestic, clean-burning, agriculture-based ethanol.

Thank you for the opportunity to provide our perspective to the Committee. Thank you, Mr. Chairman and distinguished members of the Committee.

## QUESTIONS AND ANSWERS

SEPTEMBER 1, 2009

**Senator Tom Harkin**
**Hearing Questions**
**Expanding the Role of Biofuels for America**
**September 1, 2009**

Mr. Sheehan, your testimony on the future issue of land use for food, feed, fuel and fiber production is most interesting. We are in the midst of a heated debate in this country over the sustainability of expanding biofuels, and much of that centers around the implications for global land use.

I quite frankly believe that we do need to take care to insure that increasing biofuels use doesn't cause harm to our environment or climate. At the same time, I find the current analytic linkages that EPA and some others are making between biofuels production in America and deforestation elsewhere to be very tenuous. I wonder whether we aren't making a simple issue more complex than it is, and whether we aren't risking a major strategic error as a consequence.

Let me explain. Our oil use is a huge and accepted problem. Expanding biofuels are a key component to resolving that problem, along with efficiency and alternative technologies. At the same time, deforestation also is a major and accepted problem. We also need to solve that problem, to stop those land use changes. But the way to do that surely is directly through land use policies. We need to urge adoption of such policies, and to contribute our fair share to the economic costs of such policies. Let's not pretend that how we regulate biofuels production in the U.S. can or will have anything approaching the same impact on deforestation as land use policies will provide.

1. Is there a basic flaw in the international indirect land use change methods and assumptions?
2. Relatively speaking, how much more effective regarding greenhouse gas controls would it be to address land use change directly, including policies and payments to preserve forests, than to rely on indirect land use change policies?

**MEMORANDUM**

**DATE:** **November 6, 2009**

**FROM:** **Mark Stowers, Senior Vice President of Science and Technology, POET**
**Telephone +1 605 965 6438 email – mark.stowers@poet.com**

**TO:** **The Honorable Tom Harkin, US Senate**
**The Honorable John Thune, US Senate**

**CC:** **Rob Skjonsberg, POET**

**SUBJECT:** **Corn Ethanol and Biodiesel – GHG Impacts**

1. Today's Corn Ethanol process results in the reduction of greenhouse gas (GHG) emissions by greater than 50% in "well to wheels" life cycle analysis (Figure 1, Liska et al, 2009).
2. As a co-product of the corn ethanol process, corn oil can be extracted from syrup produced from the evaporation of the unfermented, liquid waste stream at great efficiencies.
3. EPA has projected that corn oil recovery from a corn ethanol plant will result in a 5% reduction in thermal energy while increasing electrical energy use by 9%.
4. The net GHG emissions impact on corn ethanol production resulting from the addition of corn oil recovery is a reduction of 0.6% or 0.4 g CO2e/MJ.
5. The GHG emissions reduction "well to wheels" life cycle analysis of corn oil-derived biodiesel is a reduction in 50 to 80% compared to petroleum-derived diesel (Figure 1).
6. On a per corn acre basis the GHG emissions are further reduced by 20% with the addition of corn oil recovery and use as a feedstock for biodiesel (Figure 2).

POET research

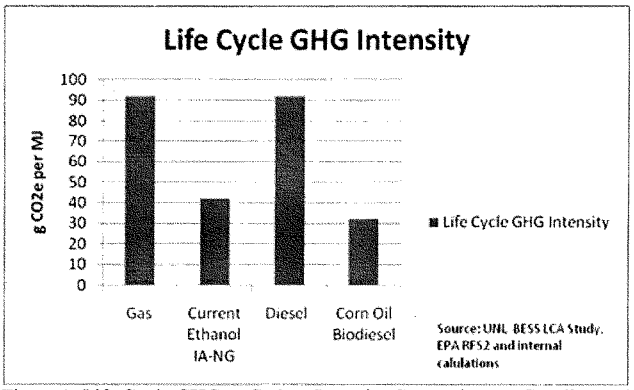



Figure 1. Life Cycle GHG or Carbon Intensity Comparison to Gasoline and Diesel with Ethanol and Corn Oil Derived Biodiesel.

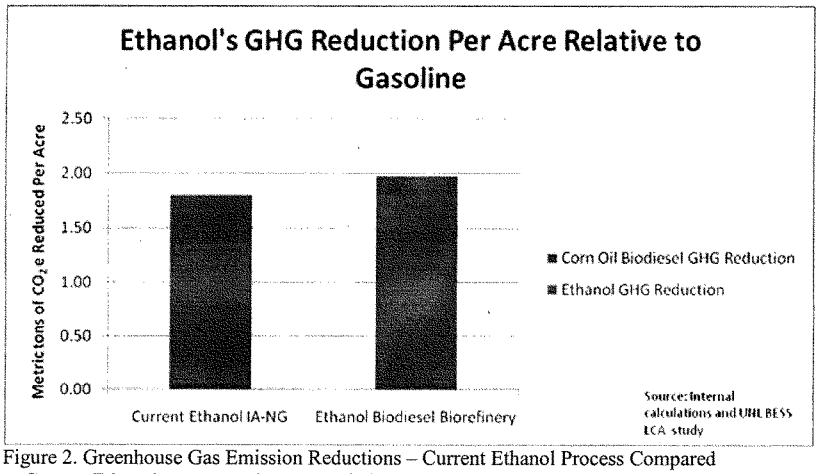



Figure 2. Greenhouse Gas Emission Reductions – Current Ethanol Process Compared to Current Ethanol Process Using Corn Oil for Biodiesel Production.

References

Liska, A., H Yang, V. Bremer, T. Klopfenstein, D. Walters, G. Erickson and K. Cassman. 2009. Improvements in Life Cycle energy Efficiency and Greenhouse Gas Emissions of Corn-Ethanol. Journal of Industrial Ecology 13: 58-72.