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OVERSIGHT TO EXAMINE TRANSPORTATION FUELS OF THE FUTURE

HEARING

BEFORE THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

WEDNESDAY, NOVEMBER 16, 2005

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ONE HUNDRED NINTH CONGRESS
FIRST SESSION

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OVERSIGHT TO EXAMINE TRANSPORTATION FUELS OF THE FUTURE

WEDNESDAY, NOVEMBER 16, 2005

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
Washington, DC.

The committee met, pursuant to notice, at 9:30 a.m. in room 406, Senate Dirksen Building, Hon. James M. Inhofe (chairman of the committee) presiding.

Present: Senators Inhofe, Chafee, Thune, Jeffords, Boxer, Carper, and Obama.

Senator INHOFE. Good morning. The hearing will come to order. We always start promptly. We have the important people here, so we will get started.

OPENING STATEMENT OF HON. JAMES M. INHOFE, U.S. SENATOR FROM THE STATE OF OKLAHOMA

This oversight hearing is to consider transportation fuels in the future. I am especially pleased to welcome two witnesses from my State of Oklahoma, Mr. Jeffrey McDougall of JMA Energy out of Oklahoma City and Mr. Jack Holmes from my hometown of Tulsa, with Syntroleum.

With higher prices at the pumps and a great reliance on foreign sources of oil, it is important for Members of Congress to know what else is out there. This is not a new concept. The United States has sought to develop alternative approaches in the past and should continue to do so. In a 1979 nationally televised speech, former President Carter claimed that the Nation, and this is a quote now, "The Nation was facing a crisis that was morally equivalent to war." He instituted a number of market control programs that sent the economy into a tailspin. Twenty-five years later, we have hopefully learned something from those mistakes.

Historically, the American people have chosen oil over other options for two important reasons. First, oil can be refined to meet the environmental requirements and automotive performance of the public demands; and second, oil is the most affordable option.

That said, the President and Congress have worked together to develop alternatives to supplement oil. Most recently, the Energy bill established a Renewable Fuel Standard. Currently, the EPA and affected industries are working toward implementation, and this committee will ensure that happens. Also, this committee included in the Energy bill a new Cellulostic Ethanol Loan Guarantee Program that could diversify biofuels use even more.

Unfortunately, too many of my colleagues today would rather gloss over or even ignore the facts, and instead choose and make sensational populist statements that suggest similar economy shrinking and price increasing policies that helped to sink the Country in the late 1970's. The fact is that oil can be explored for and produced in environmentally responsible ways and refined into clean fuels. It can be done relatively cheaply.

Although some members may think it politically beneficial or even fun to criticize and deride oil companies, I think it is incredibly short-sighted and exhibits a certain amount of arrogance on the part of Congress. Americans demand and deserve solutions and results, not bluster and hot air.

My colleagues should think beyond the major national corporations. Small independent oil and gas producers have played and continue to play a critical role in meeting our domestic needs. In fact, independents produce 68 percent of the Nation's oil. Not many people are aware of that. It is a very significant fact that they produce 68 percent of all the Nation's oil. The independent producer is often times a small business person, more like a family farmer than the Archer Daniels Midland.

Like agriculture, oil is the foundation on which several States were built and has provided jobs for generations of people. Perhaps, this is most evident in my home State where some believe that oil made Oklahoma. In fact, oil did make Oklahoma.

I am excited to learn about developing syn fuels technology like Syntroleum's coal to liquids demonstration plant in my hometown of Tulsa. Some years ago, I looked at the national security benefits of deriving diesel and jet fuel from domestic oil and domestic coal, and initiated a program at the Department of Defense. As long as it is price-competitive, coal to liquids is something that we should be encouraging and doing.

In my recent Chairman's mark of the Gas Price Act, I broadened our concept of refining to include coal to liquids and renewable fuels. I put a plan that does not change environmental laws, one that is well supported by a number of State and local groups. It is a shame that partisan rhetoric frustrated the advance of the reasonable and responsible legislation. I am hopeful that my friends will consider pro-economy, pro-jobs policy, rather than a frightening return to the Carter Era approach that failed then and would fail now.

Let me just say also that it is important that we in Washington recognize that there is a difference between the majors and the independents that happens. I am not sure that some of my colleagues are aware of this, that I started out when I was very, very young in the independent oil business. In fact, I think I dare say I am a little older than anybody on this panel.

You may not remember this technology, but I was a tool dresser on a cable tool rig, and there is nothing hotter and more difficult than that. That was back in Oklahoma where it wasn't uncommon to have temperatures, normal temperatures of 100 degrees down in that Arkansas River bottom and up in the Osage Hills, and I can recall having to sharpen that bit in front of a forge. The forge had to be going. It was always about 120 degrees in front of that forge. So it was very difficult.

I also remember when I was working for a famous man named A.W. Swift, who was kind of a father of the marginal well business in that area. He had one son. The well blew up that we were working on. I lived; he died. So I almost at that point decided to get into that business as his adopted son. I always wondered where I would be today if I had done that. So I do come here with some background in this industry, and I look forward to sharing the knowledge that I have from this industry with my colleagues.

I can assure you that even though our numbers are few in terms of the Senators here, all the staff is here, and your testimony will be listened to and read very carefully.

[The prepared statement of Senator Inhofe follows:]

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Like agriculture, oil is the foundation on which several States were built, and has provided jobs for generations of people. Perhaps, this is most evident in my own state where some believe that oil made Oklahoma.

I am excited to learn about developing syn-fuels technologies like Syntroleum's coal-to-liquids demonstration plant. Some years ago, I looked at the national security benefits of deriving diesel and jet fuel from domestic coal and initiated a program at the Department of Defense. As long as it is price competitive, coal-to-liquids is something that we should be encouraging and doing.

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It is a shame that partisan rhetoric frustrated the advance of this reasonable and responsible legislation. I am hopeful that my friends will consider pro-economy, pro-jobs policy rather than a frightening return to the Carter-era approach that failed then, and will fail now.

I look forward to hearing from the witnesses.

Senator Jeffords.

OPENING STATEMENT OF HON. JAMES M. JEFFORDS, U.S. SENATOR FROM THE STATE OF VERMONT

Senator JEFFORDS. Thank you, Mr. Chairman.

I want to extend a welcome to the witnesses. I appreciate the time they have taken to appear before us today.

Today's hearing is on transportation fuels for the future. As the Ranking Member of this committee, I agree that it is important that we have oversight hearings like this one that allow the panel and members alike to peek into the future and make educated guesses on what we will find there. Given that we are now in the new millennium, it seems to be natural but human inclination to wonder what the future will bring.

Particularly given the high pump prices we are now experiencing, we need to help shape that future into one that will provide stable, clean, domestic supplies of transportation fuels at affordable prices. Our lifestyle and our economy in this Country is based on an abundant supply of petroleum in the forms of gasoline and diesel. Today, the internal combustion engine powers most of our vehicles.

However, nothing lasts forever, and we are seeing our plentiful oil and low prices disappear. The outlook for petroleum reserves in the United States is not cozy. As the oil supply decreases, especially of clean burning sweet or low sulfur crude, prices will increase. We need to make sure that we have a good idea where we go next. We need to continue to increase our efficiency and reduce pollution in existing internal combustion engine designs and ultimately transition from a petroleum-based economy into a new clean fuel-based economy. Such a transition will be crucial to our national well being into the next century and beyond.

I do not mean to suggest that a solution is easy. There are incredible complexities involved in forming a well rounded and flexible approach to meeting the Nation's fuel requirements, while at the same time protecting our environment, but we have taken important steps. Our efforts to reducing harmful components, such as sulfur in fuels, and to boost the use of ethanol while maintaining refinery flexibility has worked well. It should be a model for our pollution policies today and in the future.

When I visited Iceland last year, I rode on a fuel cell bus and saw firsthand the promise of that technology. The fuel cell holds the possibility of marrying low or non-polluting engines with renewable fuels. This opens the possibility of a future free of the constraints of limited fuel and production. It is exactly the kind of environmentally friendly solution I have always advocated. These innovations have the potential to propel us into an era when driving a car or truck will no longer mean polluting the environment or using scarce resources.

Thank you, Mr. Chairman, and I look forward to the hearing.

[The prepared statement of Senator Jeffords follows:]

STATEMENT OF HON. JAMES M. JEFFORDS, U.S. SENATOR FROM THE STATE OF VERMONT

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The outlook for petroleum reserves in the United States this century is not rosy. As the oil supply decreases, especially of clean burning sweet or low sulfur crude, prices will increase. We need to make sure that we have a good idea where we go next.

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Thank you, again, Mr. Chairman, and I look forward to hearing from the witnesses.

Senator INHOFE. Thank you, Senator Jeffords.

Senator Thune, one of the witnesses is from your State. You may want to make a recognition of that, and you are recognized.

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

Senator THUNE. Thank you, Mr. Chairman, and I want to express my appreciation to you for holding this hearing. This is an important hearing.

There is no bigger economic issue facing the Country right now than the cost of energy. It is having a profound economic impact all across this Country and is extremely acute in States like South Dakota that are very energy-dependent. I appreciate your leadership in helping us with the Energy bill that we passed last summer to include a Renewable Fuel Standard which will increase and provide a market for ethanol going forward.

So I think it is important that the energy policy that we have in this Country be a balanced energy policy, that it include a robust Renewable Fuel Standard, and I appreciate your assistance and help in helping us achieve that goal.

We do have with us today Bill Honnef with VeraSun Energy. He is the Director of Sales and Marketing or Vice President, I should say, of Sales and Marketing for that company. They are the No. 2 producer of ethanol in the Country.

Mr. Chairman, one of the things that Bill will testify to here in a few moments is the pioneering work that they are doing in forging partnerships with other parts of the industry in order to promote the use of renewable fuels. VeraSun has been on the leading edge when it comes to working with manufacturers, auto manufacturers, both General Motors and Ford, with retailers, fuel retailers across the Country in getting more use of E85.

We have a number of stations in Sioux Falls, SD, that now market E85. In fact, the Energy bill has a provision in there that provides a tax credit for those fuel retailers that will install E85 pumps, and basically what that is, is 85 percent ethanol. We want to see more of those across the Country.

More of the manufacturers now are producing fuel flex vehicles, which again provides an incentive for more use of renewable fuels and moves us in a direction where we lessen our dependence upon the very unreliable partners we have in the Middle East. We would rather see our partners be the corn farmers of the Midwest than the sheiks and the mollahs in the Middle East.

So Mr. Chairman, I appreciate your holding this hearing. I am delighted to be able to welcome Bill Honnef to be one of our panelists today. I think that you will enjoy and appreciate the light that he will shed on this issue and the, as I said, innovative and pioneering strategies that they are bringing to our Country in terms of further promoting the use of renewable fuels.

Thank you, Mr. Chairman. I look forward to the other panelists as well this morning and hearing their testimony.

Senator INHOFE. Thank you, Senator Thune.

Senator Boxer.

OPENING STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE STATE OF CALIFORNIA

Senator BOXER. Thanks so much, Mr. Chairman, for holding this hearing. It is really a wonderful thing that you have done this, and I really look forward to working with you because you and I know we have our differences, but when we do agree, it is a good combination. I think this is an area where we can really move forward. It was wonderful to hear Senator Jefford's statement this morning.

You are right about this. We need to take a look at what else we can do to make our economy stronger and, of course, with energy independence comes, I think, much better national security for our Country. So it is such a win-win to look at these other options.

You did reference some confrontational hearings that were held in another committee. I happened to be there, and I am sure I was on the side that you would call populist. I won't go into that hearing, because I don't want to irritate you in any way, shape, or form.

[Laughter.]

Senator BOXER. What I would like to say is that it was contentious, and it wasn't satisfying for anybody there. It was just one of these things where everyone was talking past each other, and I think we have to do better than that.

The way I look at things is that right now we are in a transition. First, I think we were in denial about the fact that we have to look at alternatives. Now we know we must do that. In the meantime in this transition, I see hybrid vehicles, for example, as one way to reduce the demand with a very good technology. My family owns about three hybrid cars, and the latest one we got is 52 miles to the gallon easy, and that is terrific. I know a number of colleagues on this committee actually drive those cars.

However that is not the long-term solution. The long-term solution is to look for these alternative fuels. On the ethanol issue, California has always had problems with ethanol, although we go against the grain. I know I am saying that on purpose. We go against the grain of a lot of our Midwestern friends, but we just know that it is going to be costly for us because you have to ship the ethanol from the Midwest to California. Then we have certain requirements.

What we are excited about is the possibility, and Senator Inhofe mentioned this, of getting that ethanol from, for example, rice straw, getting that ethanol from agricultural products. What we did together is we put an incentive in the Energy bill to give more credit if you use, or your State would get more credit if it uses this type of ethanol.

So, in any event, I will put the rest of my statement into the record. Mr. Chairman, I am very happy that you have had this hearing. I am looking forward to hearing from the witnesses.

[The prepared statement of Senator Boxer follows:]

STATEMENT OF HON. BARBARA BOXER, U.S. SENATOR FROM THE STATE OF CALIFORNIA

Thank you, Mr. Chairman, for holding this hearing today. This hearing is very relevant with the skyrocketing gasoline prices that the American public is confronting.

Last week, the Commerce and Energy Committees had before us the CEOs of the major oil companies. They took no responsibility for our struggles with energy prices—shifting the blame to others—and were unwilling to make sacrifices, at a time when middle-class Americans are suffering at the gas pump.

I believe we ought to be doing more to control the price of gasoline such as imposing a windfall profits tax and giving the FTC more authority to go after the price gougers.

I also believe we need to reduce our dependence on oil by increasing CAFE standards, by promoting the use and further development of hybrid cars, and by strengthening our Nation's public transportation systems. This year's Highway bill, spearheaded through the Senate by Chairman Inhofe, actually contained many provisions that will benefit public transportation, and thereby reduce our consumption of oil.

In addition to those efforts, we can, as today's witnesses will testify, reduce America's dependence on oil by providing consumers with alternatives to gasoline when they fill up their tanks.

That is why we need to promote promising new fuels such as hydrogen. California has been a leader in this area with its Hydrogen Highway, a program that will put 50-100 hydrogen fueling stations in service throughout the State by 2010. In addition, several California transit Agencies are, or soon will be, demonstrating and operating buses powered by fuel cells.

Another potential future fuel is ethanol. Although it is not ideal, and although all potential health effects are not clear, ethanol does reduce emissions of toxic air pollutants, such as benzene, a cancer causing chemical. It can also lower smog forming emissions.

Mr. Chairman, we have the technical know-how to reduce our reliance on fossil fuels. The question is, do we have the political will?

I hope so. It was clear from last week's hearing that Big Oil will do nothing to help the American people pay their energy bills and reduce their dependence on oil. Congress must.

Thank you, Mr. Chairman.

Senator INHOFE. Thank you, Senator Boxer.

Senator Obama.

OPENING STATEMENT OF HON. BARACK OBAMA, U.S. SENATOR FROM THE STATE OF ILLINOIS

Senator OBAMA. Thank you very much, Mr. Chairman. I think I share the view of most of the committee here, that you couldn't have scheduled a more timely hearing. I think this is an absolutely critical issue for us to face our future.

In a committee hearing several weeks ago, I made the point that if the United States were serious about reducing its dependence on imported oil and insulating our economy from future supply and disruption shocks, then we have to start looking at alternative fuel use as part of our strategy. Actually, thanks in part to your help, Mr. Chairman, I think that we have actually made some progress this year. With your support, we enacted a Renewable Fuel Standard that requires 7.5 billion gallons of ethanol in our gasoline supply in 7 years.

I should add, by the way, that I think that support for corn-based ethanol and improving technologies there is in no way contradictory to Senator Boxer's interest and concern in making sure that we look for additional efficient ways of manufacturing cellulose-based ethanol.

I worked with Senator Baucus and others to include a tax credit in the Energy bill that promotes the installation of more E85 pumps at gas stations. One of the problems we have right now is distribution. A lot of gas pumps don't provide E85, the ethanol-based blend that can significantly cut down gasoline use. So, we have got some incentives there. These measures by themselves, it is estimated will reduce oil consumption by an estimated 6 percent in 7 years.

There is a problem, though. Despite this significant progress, United States oil consumption during this period will far exceed the reductions that we are making, the increases in oil consumption. So we still have a lot more to do.

I recently introduced a bill with Senator Carper to create a Renewable Diesel Standard, calling for 2 billion gallons of diesel substitutes in our 40 billion National diesel pool by 2015. Last week I joined Senators Harkin and Lugar in calling for all our Nation's cars and trucks to be ethanol capable in 10 years, and I have worked to encourage new technologies that would convert coal into diesel.

So, as we embark on a search for new transportation fuels, we need to understand, as I know you do, Mr. Chairman, that realistically petroleum will not be eliminated from our economy anytime in the foreseeable future. However we can pursue existing proven technology that can provide a bridge, as Senator Boxer indicated, to energy diversity that will begin us down the path of energy independence.

I know this will be a challenge, but this hearing is a useful place to start, and I appreciate your taking the time to hold this hearing.

[The prepared statement of Senator Obama follows:]

STATEMENT OF HON. BARACK OBAMA, U.S. SENATOR FROM THE STATE OF ILLINOIS

Mr. Chairman, thank you for scheduling this important hearing on transportation fuels. It's certainly a very timely topic.

At a committee hearing several weeks ago, I made the point that if the United States were serious about reducing its dependence on imported petroleum and insulating our economy from future supply disruption shocks, then increasing alternative fuel use should be part of that strategy.

I am pleased that over the past year, we've made some progress on this front.

With the support of Chairman Inhofe, we enacted a Renewable Fuels Standard to require 7.5 billion gallons of ethanol in our gasoline supply in 7 years. I worked with Senator Baucus and others to include a tax credit in the energy bill to promote the installation of more E85 pumps at gas stations. These measures, by themselves, will reduce oil consumption by an estimated 6 percent in 7 years.

Although this is significant progress, we need to remember that the growth in United States oil consumption during this period will far exceed this small reduction. So, much more needs to be done.

Recently, I introduced a bill with Senator Carper to create a Renewable Diesel Standard, calling for 2 billion gallons of diesel substitutes in our 40 billion national diesel pool by 2015. Last week, I joined Senators Harkin and Lugar in calling for all our Nation's cars and trucks to be ethanol-capable in 10 years. I have worked to encourage new technologies that would convert coal into diesel fuel.

As we embark on a search for new transportation fuels, we need to understand that realistically, petroleum will not be eliminated from our economy any time in the foreseeable future. We can, however, pursue existing, proven technologies that will provide a genuine bridge to energy diversity that will begin us down the path of energy independence.

No doubt, this will be a challenge, but I look forward to working with my colleagues on both sides of the aisle in moving our country in this direction.

Thank you.

Senator INHOFE. Thank you very much, Senator Obama.

We will go ahead and start. We will start over here with you, Mr. Cavaney, and then work across. Your entire statements will be made a part of the record. If you could abbreviate them and try to hold your comments down to maybe 5 minutes, it would be very helpful.

Mr. Cavaney.

STATEMENT OF RED CAVANEY, PRESIDENT AND CEO, AMERICAN PETROLEUM INSTITUTE

Mr. CAVANEY. Thank you, Mr. Chairman and members of the committee.

API appreciates this opportunity to discuss the future of transportation fuels. Our industry has met the transportation needs of Americans for more than a century and will continue to rely on state-of-the-art technology to do so in the decades to come.

Looking ahead, we believe that advances in technology, consumer preference, and the workings of the marketplace will best determine the fuels of the future. We need to rely on these forces to shape our energy future rather than attempt to dictate what fuels are to be used. Past efforts by Government involving non-market mechanisms have only complicated the search for solutions to our energy problems.

While it may come as a surprise to some, gasoline, diesel fuel, and other petroleum products have provided energy for consumers for well over a century. Why have these fuels endured for so long?

There are a couple of reasons. First, hydrocarbons have been the choice of consumers worldwide because they contain more than twice the energy per gallon as many other energy sources.

A second reason is that technology has reduced dramatically the environmental impact of their use, enabling the production of cleaner, more efficient, and environmentally responsive fuels. For example, the average sulfur content in gasoline has been reduced by more than 90 percent to less than 30 parts per million. A new car today, running on the latest low sulfur gasoline and equipped with the most advanced emissions reduction technology, has 97 percent less emissions than had a new vehicle in 1970.

There is a misperception by some about the time and cost involved in any transition to the next generation of fuels. Consider what would be involved in replacing the dominant role of oil with a substitute like hydrogen or solar power. Most agree that such a transition would require dramatic advances in technology, and massive capital investments, and take several decades to accomplish. The United States and the world cannot afford to leave the Age of Oil before realistic alternatives are fully in place.

It is important to remember that man left the Stone Age not because he ran out of stones. Someday we will leave the Age of Oil, but it won't be because we will have run out of oil. Yes, eventually, oil will be replaced, but clearly not until practical alternatives are found, alternatives that are proven more reliable, more versatile, and more cost competitive than oil.

We expect that the dominant transportation fuels will remain gasoline and diesel for at least two or three more decades. That is the minimum amount of time required to fully retire any existing and still growing fleet of automobiles and trucks powered by these fuels, and to deploy any replacement fuel source throughout the United States fully. We cannot afford to prematurely retire these century-old champions of gasoline and diesel without full and complete assurances that worthy successors are, in fact, in place to serve the consumer.

Those who write off gasoline and diesel fuels fail to recognize how advanced technology is providing new and more efficient ways of using these time-tested products. As was mentioned by Senator Boxer, hybrid vehicles, powered partly by gasoline and partly by electricity, are a star that has actually arrived on the scene. Already they are moving aggressively into the market, and their rate of growth will depend in large part on their price and ultimate performance.

In addition to hybrids and advanced internal combustion engines, ICEs if you will, oil companies are working alone and with auto makers and have invested millions and millions of dollars researching new fuel cell technologies. Some of these companies have also partnered with the Federal Government through the Department of Energy's Freedom Car and Fuel Partnership, which is a public-private effort to examine the precompetitive research required to develop technologies for a full range of affordable vehicles as well as the fueling infrastructure to support them. These technologies hold the potential for up to double the fuel efficiency of the current gasoline powered automobiles and essentially with zero tailpipe emissions.

However, creating and maintaining a national fleet of such vehicles will face significant technical, economic, primary energy source availability, and infrastructure challenges.

So the bottom line at the moment is that gasoline and diesel will likely remain the dominant transportation fuels for a number of decades to come. In view of the history of its reliability and environmental progress, gasoline's continued dominant role should be reassuring to the American public.

Thank you very much.

Senator INHOFE. Well, thank you, Mr. Cavaney.

Mr. McDougall.

STATEMENT OF JEFFREY MCDOUGALL, JMA ENERGY COMPANY, LLC

Mr. MCDOUGALL. Good morning. My name is Jeffrey McDougall, and I am the owner of JMA Energy Company located in Oklahoma City. I appreciate the opportunity to appear before this committee today.

I will offer my remarks from the perspective of an independent oil and natural gas explorer and on behalf of the Oklahoma Independent Petroleum Association, which is an association of more than 1,600 independent oil and natural gas producers. Although our membership includes some publicly traded companies, the majority of our members are small, family owned businesses. Our members explore for and produce oil and natural gas. We do not refine oil into gasoline or heating fuels, and we do not market gasoline.

I entered the oil and natural gas industry in 1984 after receiving a degree in Petroleum Engineering. I was laid off in 1986 when energy prices plummeted. I subsequently started my own company and have built my business from the ground up by drilling for oil and natural gas. I currently have 35 employees. In the last 4 years on a cumulative basis, I reinvested more than 113 percent of my cash-flow through participation drilling of over 350 new wells. My share of this drilling has found enough energy equivalence to supply this Nation's natural gas energy needs for one day.

Oklahoma has a rich history in energy production. During World War I, we were the largest oil producing region in the world. We were responsible for supplying critical energy resources needed for our war effort. Although oil production is still important to Oklahoma, it has declined through the years. Oklahoma's exploration focuses turned to natural gas, making it the No. 2 State in the Nation in natural gas production.

Independent producers are responsible for more than 85 percent of the oil and natural gas production in the State. Nearly half of this production is from marginal wells which account for 42 million barrels of oil annually or an average of slightly more than 2 barrels per day from each of the 48,000 marginal wells. The overwhelming majority of this production is owned by small family businesses.

I want to emphasizes the independent oil and natural gas producers reinvest their cashflows back into the ground here in the United States to find vitally needed domestic reserves of oil and natural gas. In fact, a recent study shows that independent oil and natural gas producers reinvest more than 100 percent of their

cashflow back into the domestic oil and natural gas development. The result is the independent oil and natural gas producers drill 90 percent of the domestic oil and natural gas wells in the United States while producing 70 percent of the domestic oil and 82 percent of the domestic natural gas.

Twenty-five years ago a windfall property tax was imposed upon this industry, and domestic production decreased while energy exports increased. The $80 billion taken from the industry during that 8 years the tax was collected prevented producers from investing in the industry's infrastructure, resulting in an energy network unable to keep up with growing United States demand.

A new tax on energy producers today could be expected to produce the same domestic supply destruction. The domestic industry is currently hampered by a shortage of experienced and technically trained employees as well as shortage of drilling rigs and well servicing capacity, but this infrastructure is being rebuilt by market forces. The domestic rig count has been climbing since the Spring of 2002 in response to higher product prices.

Independent producers are now, more than ever, aggressively searching for more oil and natural gas reserves. Independent producers are using new technology to enhance mature oil fields, exploit unconventional resource plays; and drill to depths in excess of 20,000 feet at costs approaching $8 million per well. We are doing what we can to make our Country more energy secure and less reliant on foreign sources of energy, and in the process, we are creating American jobs and buying American products.

While our greatest contribution is finding more oil and natural gas, we should emphasize that independent producers have a history of giving back in other ways as well. A majority of the foundations, endowments, museums, and community projects in Oklahoma's history have been created primarily through the generosity of the State's independent oil and natural gas industry. We are also environmental stewards. We comply with a myriad of local, State, and Federal environmental requirements.

In Oklahoma, oil and gas producers instigated the creation of the Oklahoma Energy Resources Board 16 years ago. Through the OERB, producers have voluntarily contributed over $30 million to clean up more than 6,300 abandoned sites and an additional $30 million for science-based education projects. Currently, the Oklahoma Energy Resources Board and the Oklahoma Independent Petroleum Association are addressing the impact of high energy prices on the State's low income citizens, encouraging the State to fully fund the LIHEAP program with additional dollars collected from the State's 7 percent gross production tax on producers. We are producing conservation messages to inform the public of higher heating costs this winter and advise them of ways to save on their heating bills.

In conclusion, independent producers are reinvesting their profits to help Americans become less dependent on foreign supplies. However, we must face the fact that we may never achieve energy independence. The energy industry is technically complex and capitally intensive, and an effective energy policy will require intelligent and realistic people to work together.

We must learn to do a better job of conserving energy. We must also look to alternative fuels to supply a larger portion of our Nation's energy needs. At the same time, we must develop policies that encourage, not discourage, the expansion of our energy supplies here at home.

Thank you.

Senator INHOFE. Thank you, Mr. McDougall.

Mr. Goodstein.

STATEMENT OF RICHARD GOODSTEIN, WASHINGTON REPRESENTATIVE, AIR PRODUCTS AND CHEMICALS, INC.

Mr. GOODSTEIN. Chairman Inhofe, and Senator Jeffords, and Senators Thune, and Chafee, and Boxer, and Carper, and Obama, thank you very much for the opportunity to speak with you today about the promise of hydrogen as a fuel of the future, the role in our economy that hydrogen already plays, and ways in which this committee and Congress generally can accelerate progress toward a hydrogen economy.

I am the Washington Representative for Air Products and Chemicals, the world's largest supplier of third party hydrogen. Air Products is an $8 billion a year company with operations throughout the world. We have over 60 hydrogen generating and processing facilities, more miles of hydrogen pipeline than anyone else, an unparalleled safety record, and 50 percent of the market share. So I say that Air Products is the E.F. Hutton of hydrogen, and I appreciate the opportunity to be here.

You will recall that President Bush heartily embraced the role of hydrogen in his State of the Union Address in 2003. He vowed that the first car of a child born that year could be—should be—a hydrogen fuel cell vehicle. Air Products was excited by such a strong endorsement from the White House, as were our friends in the auto industry and among fuel cell manufacturers.

There are many reasons, of course, and some of you have referenced them, why a hydrogen economy is such an important goal. Energy independence will free us from the whims and power of the oil cartel. It will render the United States less vulnerable to terrorists. We will no longer need a defense posture predicated on maintaining open sea lanes for the movement of oil. Renewable hydrogen will radically clean the air and will end such an unsustainable trade imbalance.

Hydrogen is spoken of as if it is very futuristic, but in fact hydrogen is generated in enormous quantities for industrial purposes today. You will see attached to my testimony, if you have it handy, a map showing hydrogen facilities around the Country.

[The referenced map can be found on page 44.]

I will just hold it up in case you don't have it handy. It shows that virtually every State in the Union has a hydrogen facility within it or nearby. Hydrogen is used by oil refineries to make cleaner burning gasoline and in a wide variety of other industries: steel, glass, semiconductors, food processing, and many others.

Air Products has a large number of hydrogen generating facilities as well. Again, let me hold up a photo of one. It kind of looks like an oil refinery. Again, it is attached to my testimony.

[The referenced photo can be found on page 43.]

What it says at the bottom is that this hydrogen production facility, of which Air Products has many in the United States, generates enough hydrogen to fuel 50,000 vehicles per day.

Currently, there are all of about 100 hydrogen fuel cell vehicles on the roads of the United States today. The point is that it will be many, many years before the demand for hydrogen fuel reaches levels that are even detectable at a single plant, let alone put a dent in the amount of hydrogen generated nationally. The point is we have got hydrogen.

Most hydrogen is generated by reforming natural gas, but one benefit of hydrogen is that it can be derived from oil, coal, biomass, from waste heat from nuclear, and therefore whatever alternatives to conventional fuels are pursued, hydrogen is quite compatible with it. The holy grail in the hydrogen world is totally renewable hydrogen, where renewable energy sources such as wind and solar are used to generate the electricity that separates the hydrogen from the oxygen in water. As has been said, the only emission from a hydrogen fuel cell vehicle is water vapor.

Air Products is the leader in the design and deployment of hydrogen fueling stations, in particular mobile hydrogen fuelers. Mobile fuelers dispense hydrogen but function independently of utilities. They don't have to be hooked up to water or power. Again, I have attached a photo in my testimony. The advantage of these mobile fuelers is that we don't have to invest in a permanent fueling station on the ground, waiting for the auto companies to decide where they want to commercialize their fuel cell vehicles.

If auto companies want to test vehicles in San Francisco, we can move a mobile hydrogen fueler there, and, indeed, we already have. However if they want to test them in Tulsa, or Burlington, or Warwick, or Wilmington, you get the point, these mobile fuelers can be moved there, too. One of these mobile fuelers, I might add, costs less than a single hydrogen fuel cell car does today.

I have also attached photos of stationary hydrogen fueling stations which dispense compressed hydrogen into fuel tanks in a gaseous form.

[The referenced photos can be found on pages 45-46.]

You don't need a moonsuit or a long instruction manual to use one. There is one two miles away at a Shell station here on Benning Road that I am sure they will allow you to use just like they did President Bush with the hydrogen that he pumped into a car that was generated actually at a facility in Delaware.

The point is, that between the existence of technology to dispense hydrogen and the existing network of hydrogen facilities around the Country, the development of a hydrogen infrastructure is quite feasible. But because the benefits, energy security and a clean environment, are embraced by society as a whole, individual consumer decisions aren't working with the free market and are probably not enough to get us where we want to get. The Government is going to play an important role.

This committee can help through its Public Works jurisdiction by encouraging Government purchase of hydrogen fuel cell vehicles, by supporting hydrogen infrastructure in the next Highway bill—I realize the ink is just barely dry on this past one, but it is not too early to be thinking about the next one—and by encouraging the

development of codes and standards applicable to hydrogen production and dispensing.

Congress generally can advance the ball through tax preferences, robust R&D at the Department of Energy, and even creative ways to use hydrogen-based technologies for soldiers on the battle field who don't have to haul around tons of batteries, and hydrogen fuel cells are totally quiet. So there is no imprint for the enemy to find.

Hydrogen has great promise and is more here and now than many think.

Thank you for spending the committee's time on this important subject, and I look forward to any questions.

Senator INHOFE. Thank you, Mr. Goodstein.

Mr. Honnef.

STATEMENT OF BILL HONNEF, VICE PRESIDENT OF SALES AND MARKETING, VERASUN ENERGY

Mr. HONNEF. Good morning, Mr. Chairman and members of the committee.

My name is Bill Honnef. I work for VeraSun Energy Corporation. We are based in Brookings, SD. We are the second largest ethanol producer here in the Country. We have a 120 million gallons a year plant in Brookings, SD; we have a 110 million gallons a year plant in Fort Dodge, IA, that just opened up a couple of months ago.

I greatly appreciate the opportunity to testify today as the committee examines transportation fuels of the future. With crude oil and gasoline costs at near record highs and the potential for natural gas shortages across the Country, it is clear the Nation needs to do more to promote the increased production of alternative fuel sources and domestically produced renewable fuels, like ethanol, which can build a sustainable energy future.

Mr. Chairman, I am happy to report the United States ethanol industry today is playing an increasing role in achieving this objective. As a result of the Energy Policy Act of 2005, which includes a historic Renewable Fuel Standard, domestic ethanol production is expanding at an unprecedented rate. I would like to start my comments by first commending Congress, this committee, and specifically Senator Thune for your support in passing that very meaningful legislation.

As a direct consequence of that bill, today there are 24 new ethanol plants under construction and several others under expansion, that when completed will add 2 billion gallons of ethanol capacity to our current production capacity. This represents a 50 percent increase in domestic ethanol supply over what we had just last year. In addition, there are literally scores of ethanol plants seeking various forms of financing in various stages of development. This is a fantastic success story unfolding, and it is happening as a result of your actions.

The challenge now is to assure that the legislation is implemented as intended by Congress. Our objective is to make the program work effectively for our customers in the refining industry, including specifically a credit trading mechanism to lower the overall costs of the program. Our understanding from EPA is that they assume we will issue an interim rulemaking that we believe will

maximize flexibility for refiners and allow this program to be successfully implemented and on time.

While the RFS provides a baseline for ethanol demand, the ethanol industry is working hard to create additional demand through E85. E85 is a blend of 85 percent ethanol and 15 percent gasoline. It is designed for use in flexible fuel vehicles or FFVs, for short. With approximately 5 million FFVs on the road today, E85 has great potential as an alternative fuel. However because flexible fuel vehicles can run on both gasoline and E85, most owners are not aware they are driving an FFV and simply use gasoline. Our research indicates that nearly 70 percent of the flexible fuel vehicle owners are unaware they are driving one.

Based on these research findings, we launched VeraSun E85 or VE85, for short, the Nation's first branded E85 earlier this year. The program was founded on three basic principles. First, E85 must be widely available in the target market. Second, E85 must be priced fairly to the consumer. Third, an E85 rollout must be accompanied by a comprehensive consumer awareness campaign.

In May, we began the program with the conversion of 35 pumps in the Sioux Falls, SD metro area. Simultaneously, we launched a marketing program to raise awareness to the benefits of FFV ownership and E85 use. VeraSun enlisted the support of General Motors, various local car dealerships, the National Ethanol Vehicle Coalition, and other organizations across the State to assist with the rollout of the program. The program includes elements such as advertising, direct mail, point of purchase marketing, and retailer education.

Jonathan, if you will show these.

I brought a couple of samples just to show you some forms of advertising that we are using, which are creating quite a stir within the community and quite a bit of support around E85. Here is one billboard that you would see if you drove around Sioux Falls, SD, or various areas in eastern South Dakota, Fuel Up For Freedom, obviously playing on energy independence, the fact that it is 85 percent renewable fuel that is produced right in the State of South Dakota. People very much support this.

This is just another example of another billboard, Fuel Up For The Future. Obviously, we are trying to do this not only for the here and now but for the future generations. Again, this has stirred quite a bit of interest.

As a result, E85 awareness has increased, E85 fuel cells are on the rise, and demand for flexible fuel vehicles in the local market is up. The community is embracing the fuel as a viable alternative gasoline. The program is working, and it is working today.

The success of the program attracted national attention and the attention of Ford Motor Company. Just 10 days ago, we announced a first of a kind partnership with Ford to expand VE85 to other markets throughout the United States with a public commitment to the partnership from none other than Bill Ford himself. The initiative will serve to convert existing fuel pumps to E85 in select markets. A consumer awareness campaign, like the one shown here, will promote the benefits and use of E85 and FFV ownership. Local gasoline stations and Ford dealerships will be asked to participate in the campaign.

Increasing FFV production and E85 use represent the best near term solutions to significantly reducing our dependence on our foreign oil, but today only about 500 of the nearly 180,000 retail stations offer E85. In order for retailers to more widely adopt E85, station owners must have confidence that there will be sufficient consumer demand. The demand must come from FFV owners. Today FFVs represent approximately 2 percent of all vehicles. Without a significant ramp-up in the production of FFVs, E85 use will remain relatively small.

Auto manufacturers clearly hold the keys to the future of greater E85 use. With Ford, General Motors, and potentially auto manufacturers as partners, we believe we can make great strides in boosting FFV production and E85 use. We are very optimistic.

In conclusion, Mr. Chairman, as the committee contemplates future motor fuels markets, please recognize that ethanol is a viable bridge to the future. Today ethanol is blended into one-third of our Nation's fuel as a clean blend component. As we see growth in FFV production, ethanol will play a larger role in the gasoline replacement market.

In the future, ethanol shows great promise as renewable feedstock for hydrogen fuel cells. VeraSun Energy Corporation and the Renewable Fuels Association are committed to working with you and members of your committee to promote the expanded use of domestically produced renewable fuels.

Thank you.

Senator INHOFE. Thank you, Mr. Honnef.

Well, Mr. Holmes, welcome from what used to be the oil capital of the world, the city of Tulsa.

Mr. HOLMES. We are going to make a comeback, Senator.

Senator INHOFE. Good. Good.

STATEMENT OF JACK B. HOLMES, JR., PRESIDENT AND CEO, SYNTROLEUM CORPORATION

Mr. HOLMES. Good morning, Mr. Chairman and other members of this committee.

Syntroleum appreciates the opportunity to speak to you today about transportation fuels of the future. My name is Jack Holmes, and I am the President and CEO of Syntroleum, a Tulsa based company that is focused on developing ultra-clean fuels using Fischer-Tropsch technology. The Syntroleum process produces a superior quality diesel fuel, jet fuel, or home heating oil.

Across the world, we continue to see energy demand increase at rates greater than the growth of their domestic supplies. Recently we witnessed the immediate negative impacts of unexpected disruptions of our Nation's refineries along the Gulf of Mexico as the result of Hurricanes Katrina and Rita. Our future economic and energy security rely upon our ability effectively to utilize our domestic sources of fuels. The world supply and demand balance dictates that we use our clean coal technology for development of secure domestic transportation fuel.

We often categorize Fischer-Tropsch technology as going back to the future because it was developed in the 1920's in Germany to produce liquid fuels from coal. Other countries, such as South Afri-

ca, have also utilized Fischer-Tropsch technology to produce over 1.5 billion barrels of fuel from coal over the last 50 years.

With over 270 billion tons of proven reserves, the United States is the Saudi Arabia of coal. Much of this coal is located in remote areas of Western and Midwestern States. Our plan is to build the plant at or near the mine to maximize transportation savings. If we convert just 5 percent of the estimated proved coal reserves in the United States to ultra-clean fuel, it would double our proved oil reserves without drilling a single well. Also, these projects won't require additional refining capacity because our technology produces finished fuels onsite.

Syntroleum's 20 years and $200 million of Fischer-Tropsch research and development have shown our fuels are among the cleanest in the world with virtually no aromatics and no sulfur. They are non-toxic and biodegradable. Here, I have got a sample of Fischer-Tropsch diesel. It is as clear as water and has no aroma. It is the cleanest fuel in the world.

This chart behind me shows the dramatic reduction in pollutants achieved in tests using our fuel. This includes hydrocarbons, carbon monoxide, $C0_2$, NOx, and particulate matter. Our fuels are compatible with existing energy infrastructure and run well in current diesel engines with no modifications necessary.

Finally, our fuel is of interest to the military where we have done extensive research with the Department of Defense to test a single battlefield fuel. We want to thank Senator Inhofe for his leadership in this effort.

Congress does not need to fund this new industry forever. However, support from the U.S. Government for the first coal to liquid plants will be critical. Syntroleum applauds you for your action in passing the Energy Policy Act of 2005. This bill was a major step in the right direction by providing funding for research and development of clean coal technology and loan guarantees for construction of commercial scale coal to liquids plants.

We urge the Government quickly to follow through with its commitment to dedicate money for loan guarantees and to encourage long-term contracts to purchase Fischer-Tropsch fuels. We are sure that the first commercial coal to liquids plants will have significant impact on the capital markets to fund additional plants. As we say, everyone wants to be the first to build the second plant.

Recently, this committee held hearings on the proposed Gas Price Act, Senate bill 1772. By introducing this bill, Senator Inhofe has recognized the benefit to this Country in bringing clean fuels to the market soon.

Americans today are worried about the high cost of fuel and rightfully so. The effects of Katrina alone are estimated at several billion dollars in increased energy costs. Whether it is filling their automobile tanks or heating their homes, Americans are being hit in their pocketbook because of our Nation's dependency on foreign oil and our limited refining capacity. We don't have to continue down this path of energy insecurity. We have the resources and technology today.

In summary, ultra-clean coal-based Fischer-Tropsch fuels can have a significant impact on the energy security and supply balance in this Country and add high paying jobs here at home.

Mr. Chairman, members of the committee, thank you for allowing me this time to speak about transportation fuels of the future.

Senator INHOFE. Thank you, Mr. Holmes.

We will do a series of 5 minutes, maybe two rounds. We will try to see how we come with votes.

I appreciate, Mr. Holmes, your making a reference to the refinery bill that we, unfortunately, were not able to get out of committee. It was a very modest bill. It was one that I think would have been very helpful, and we are still hoping that there is some way of doing this to get this out and make that a reality.

Mr. McDougall, right now, things are pretty good in the industry for independents, but it wasn't long ago things weren't so good. So, you have the ups and the downs. As one who has lost his job during one of the low periods, how do you react when you hear people in Washington making allegations about the oil industry and wanting to make it harder for you to do business? What is your response?

Mr. MCDOUGALL. Well, Chairman, my first response would be let the market forces work. That is spoken by people that probably are uninformed about our industry. They haven't studied us as close during the down time as they have the up time.

We are an industry that is heavily regulated. We are heavily taxed. We take tremendous risks. One thing that we do is spend our own money. There are lots of nights during the slow times that I lost a lot of sleep, spending my own money to try to survive in the slow times. There has also been during that same period that they weren't experiencing, it was a slow destruction of the industry and the infrastructure that was there. Now that prices are up, people are affected by the consequence of that.

Senator INHOFE. Well, I think it is pretty heroic of you to make the statement, let the market work, having lost your job at one time. So I appreciate that very much.

Mr. Cavaney, the President recently signed a bill that establishes a historic and sizable renewable fuels mandate, yet some people are already advocating that we have more mandates for other biofuels. I would just like to know in your opinion what new mandates would do to the economy. Do you have any thoughts about that?

Mr. CAVANEY. Yes, sir, Mr. Chairman. First of all, we appreciate the work of this committee in helping craft together a renewable fuels mandate that had the kind of flexibility that would allow us to absorb significantly more of the ethanol and biofuels without a lot of the constraints that we faced when we used to be on a per gallon basis. I think what we will find is that is a pretty ambitious amount to absorb. I think we will be able to do that well.

However if we now, on top of an existing structure, tend to build more mandates or structures that are less flexible, I think what will happen is our capacity to move fuel quickly when tight conditions arrive, whether it is because of a failure of a pipeline or a problem in a refinery or something God forbid as terrible as the two hurricanes that hit us down in the Gulf, you really see the problems.

For example, boutique fuels which is a phenomenon that has developed over the last 10 years, are all individual fuels that are

mandated by certain municipalities and certain regions. Had the Government not been willing to grant waivers as a result of Katrina, we would not have been able to have the gasoline there where people needed it.

So, Mr. Chairman, I think we need to move with caution. There is an incentive for the industry. We, in the oil and gas business, feel that we can use all the energy we can get. Right now, we are actually out with strong conservation and energy efficiency messages. Biofuels will have a good place in the industry. I think this was mentioned earlier.

You are going to see ethanol expand beyond just corn into other areas. We welcome that addition. I think there is plenty of room for everyone. So let the market and let the consumer make those choices and put the fuels where the demand is, and I think everyone will end up benefiting from that.

Senator INHOFE. Yes, I think so too, Mr. Cavaney. I appreciate your remarks about it is important to realize that we were at 100 percent refinery capacity before Katrina. So, this is something that Washington needs to hear from you.

Mr. Holmes, there are some members who are suspicious of the coal to liquids for two reasons. One is that it would not be price competitive, and second, that it is a fossil fuel and therefore should not be encouraged. How do you respond to those two criticisms?

Mr. HOLMES. Well to answer the first question, we believe in the current energy price environment that we are cost competitive, and we have done a lot of work on economics. We believe that we think what we need is a little push to get the first plant built and can demonstrate that. I would remind you that the LNG industry, for example, the early plants that were built some 20 years ago, they are much cheaper now.

In fact, a new LNG liquefaction plant today is probably one third the cost of an original LNG plant. So we believe if we can get the industry started, demonstrate its viability, that there will be improvements over time.

Second, it is a fossil fuel, but, as was mentioned earlier, this Nation is going to need fossil fuels for years to come in the future. It is a fossil fuel, but it is the cleanest fossil fuel, if you recall the chart that I put up here. We believe it is an ideal bridging fuel to get to the future. As we said, there is such a vast amount of coal in this Country, that just a very small fraction of our coal could have a big, big effect on our energy supply. Not only diesel fuel on the road but jet fuel and, more importantly, home heating oil can be made using our process.

So we think there is a very bright future for it, and we look forward to participating and helping America solve its energy problems.

Senator INHOFE. Thank you, Mr. Holmes.

Senator Jeffords.

Senator JEFFORDS. Mr. Cavaney, you stated that refining capacity grew between 1994 and the present, and that currently planned expansions will result in increase in capacity of at least one million barrels per day from 2005 to 2009. These expansions will allow us to refine a greater quantity of oil into transportation fuels. Are similar technological advances occurring with respect to refining ef-

ficiency that will allow us to get more refined product from each barrel of oil?

Mr. CAVANEY. Yes, Senator. What we find is increasingly these refineries, some of them as many as 50 and 60 years of age, constantly with each improvement, whether it is for an environmental improvement or for increased capacity, they go back in and put in new state-of-the-art technology. So, the yields that are coming out of refineries as well as the energy efficiency have moved quite significantly. That is what has allowed us to be able to take these earlier generation, smaller refineries and continue to add onto them.

What we have found is that it is much easier, quicker, and less expensive, ultimately benefiting the consumer, by adding existing capacity to make more and more capacity in a similar place. If you start a new greenfield refinery today, you are generally going to be going to a community that is not familiar with you; you have a lot of problems with the permitting process; and you have no guarantee that you are ultimately going to be able to get permission to do that.

Where if you go to an existing refinery that has been geared toward accepting incremental increases in capacity, you are in a community that generally appreciates you, looks at the value of the jobs, and the tax payments that come to the local community. For about 60 percent of the cost, we can add additional barrels of capacity, and again at about half the time. About 4 years would be about the maximum to add to an existing refinery as opposed to maybe eight or more if you were going to build a new greenfield mill. So most of the additions have come incrementally.

The amounts that we have talked about, a little over a million barrels here, will represent about 1 1/2 percent growth per year which exceeds the traditional growth. So we not only will be taking care of the built-in growth, but we will be adding a little more spare capacity. These also, I might say, are not likely to be the only additions that will be announced. These are the ones we have on the docket right now that we know about. There may well be others, and therefore we will continue to see capacity grow.

Senator JEFFORDS. Thank you. That is very helpful.

Mr. McDougall, you talked a good deal about the investments that independent oil producers in your State are making in order to be able to continue to recover more from existing wells. It is clear you have made significant investments, but you can't rival the financial investments the major oil companies are making in research into new technologies. Should the Federal Government be doing more to research drilling techniques that improve recovery, reduce losses of oil, and protect the surrounding environment?

Mr. MCDOUGALL. Senator, I believe yes on that. Anything that promotes efficiencies, promotes additional recoveries, that would provide more of our product to the Nation, we would be for that. As an independent producer, when we are out spending capital, as I referred to earlier, we drilled 90 percent of the new wells.

The majors have been through an exodus from the continental United States The moneys that we bring to bear are the lion's share of all the spending in the Country. Ninety percent of the drilling is done by independents. If the research wants to be done

by the Government to recover the mature production, we would be all for that.

Senator JEFFORDS. Mr. Goldstein, you stated in your testimony that the Clean Air Act's requirements to remove sulfur from petroleum benefits hydrogen producers. Will you clarify for the committee why this is the case?

Mr. GOODSTEIN. Well, crude oil has sulfur compounds in it. Hydrogen reacts with that sulfur to form hydrogen sulfide, which is removed by adding something like sand that bonds to it. Basically, hydrogen is used to take the sulfur out of the crude, and then it actually gets sent on to a chemical plant to make a usable product like sulfuric acid.

But the fact of the matter is beyond that. Not just insofar as hydrogen is used as an input to the refinery process, as I mentioned, hydrogen fuel itself has the promise of clean air, both with respect to being used in a fuel cell and being used in a hydrogen internal combustion engine. There are some auto makers that are going in that route.

So not only would we have no particulates, but if we have totally renewable hydrogen, we wouldn't even have to worry about carbon dioxide. How nice would that be to do that in a way for which there was a market and demand as opposed to having to turn the screws on industry?

So there are a lot of benefits from the standpoint of hydrogen, both with respect to serving our friends in the refinery business but also insofar as hydrogen becomes a stand alone fuel, again in fuel cells, stationary and mobile.

Senator JEFFORDS. I have two more questions. Is that all right?

Senator INHOFE. It will be all right.

Senator JEFFORDS. Mr. Honnef, you testified that ethanol producers are expanding at an unprecedented rate and that there are 24 plants and 7 expansions under construction today. I just want to be clear. Is it correct that this expansion is occurring in compliance with the existing environmental law and with the acceptance of the local communities in which the plants are located?

Mr. HONNEF. Absolutely, and furthermore, communities are encouraging ethanol plants to come to their communities, unlike our brethren in the oil industry and the refining industry that face real challenges with siting refineries, and those issues need to be dealt with. With ethanol plants, communities actually encourage ethanol plants to come to the communities, because our feedstock is obviously in most cases corn. By pulling corn from the local market, we create demand for the corn and increase rural economic development. So, in some cases, communities are actually competing to get plants to come to their town.

Senator JEFFORDS. Mr. Holmes, I just want to clarify some figures presented in your written statement. You stated that if the United States converted 5 percent of its recoverable coal reserves to oil, it would be the equivalent of the existing 29 million barrels of proven oil reserves in the United States. Five percent of the reserve amounts, in your testimony, to 14 billion tons. As I understand it, most processes for converting coal into liquids turn a ton of coal into a little more than a barrel's worth of oil or refined prod-

uct such as gasoline or diesel. Have you developed a process that is more efficient in the way it converts coal to oil?

Mr. HOLMES. No, sir. Our research shows that approximately two barrels of oil are created per ton. It varies. For lignite coal, for example, it is about 1.5; for bituminous coal, it is about 2.5. So a weighted average of the coal in the United States is about two barrels per ton, and that is the basis of that calculation.

Senator JEFFORDS. Thank you.

Thank you, Mr. Chairman.

Senator INHOFE. Thank you, Senator Jeffords.

Senator Chafee.

Senator CHAFEE. Thank you very much, Mr. Chairman and panelists for being here this morning.

I am curious as to the break-even point in each of your proposals for, say, ethanol, or for marginal wells, or for hydrogen, or for coal-based fuels. What is the cost per barrel where you start to make money?

Maybe I will start with you, Mr. McDougall. It seems when you left in 1985, the price per barrel at $11 or $12 was really low, but you went into marginal wells, it sounds like. Can you make money at $11 or $12 a barrel, or do you need it higher?

Mr. MCDOUGALL. Senator, first of all, I am primarily a natural gas producer.

Senator CHAFEE. Maybe I have my dates wrong. At one point, it was down.

Mr. MCDOUGALL. Yes, it was $11.15, I think is what the number was, somewhere in that area.

First of all, I am a natural gas producer primarily, so I think of economics in terms of MCFs. You know, at that time, it seemed like finding costs were near 85 cents, and then there were some lifting costs. We have to add on the lifting, and the processing, and everything else. Gas prices seemed to be about $1.25 at that time. It was very thin. I would say then that the rate of returns were probably in the 10 to 15 percent range would be probably the good ones that were steady.

Today, the break-even for natural gas is probably somewhere in the $5 range, $6 range, would be my guess. Now that is for a company that doesn't carry a lot of debt and all the other things that go with that. That is just straight up without having that as a cost component.

Senator CHAFEE. Thank you.

Mr. Goodstein.

Mr. GOODSTEIN. I think from the hydrogen standpoint FE—

Senator CHAFEE. By the way, thanks for remembering all our hometowns. I like that.

Mr. GOODSTEIN [continuing]. Yes, thanks. I think from the hydrogen standpoint, it is not so much a barrel price as it is a dollar per gallon of gas price. Right now, say in southern California, we have a hydrogen pipeline that links a couple large hydrogen generating plants to a number of oil refineries south of LAX Airport. Hydrogen off that pipeline is now appreciably less on a per gallon equivalency than gasoline is today.

The reason, though, that for us to get it basically delivered to service stations or to these mobile fueling stations and so forth,

then we have to load up a truck and put it on the road. You are looking at labor costs. You are looking at the trucking costs and so forth. Economies of scale, as I mentioned there are all of 100 fuel cell cars in the Country roaming around. So there is just not much demand.

I guess the point is, though, when we have demand, I think it has already been demonstrated, and certainly the Department of Energy is gearing toward about $1.50, $2 a gallon equivalent for hydrogen as being very feasible. I think you would hear from a company like Air Products that that is not beyond the realm of the possible by any means.

Again, what stands between us getting there now is just that there is not adequate demand, and therefore it is very expensive, kind of a onesies and twosies basis, to move hydrogen around in a metropolitan area.

Senator CHAFEE. Thank you.

Mr. Honnef.

Mr. HONNEF. On an ethanol basis, a break-even is somewhere in the neighborhood of $1.10 to $1.15 per gallon of ethanol to produce. The majority of that cost, about 66 percent of that cost, is represented in the cost of corn that we purchase to make the ethanol. As these plants get larger, similar to ours, the 100 plus million gallon a year plants, even drop that price lower. So the larger the plants, the more efficiencies that are brought into the industry which are seen today. That price continues to come down.

Senator CHAFEE. So if the price of oil were to drop again, it is unlikely but if it does, and thus the price of gas were to drop below $1.10 or $1.15, you cannot compete?

Mr. HONNEF. If it drops below $1.10, we could compete up to a point, especially with the Renewable Fuel Standard that is in place. There will be a market for ethanol up to 7.5 billion gallons by 2012. So we would continue to compete. What may happen is some plants, if they are above that, may end up closing down for a period of time until prices came back.

Senator CHAFEE. Mr. Holmes, any comparison to coal to gas?

Mr. HOLMES. Yes, sir. First of all, one of the things that a lot of people don't realize is that with higher prices come higher costs. One of the things that the industry is facing today is there is a demand for equipment and people, and so forth. The capital costs of building a new plant, drilling a new well, or whatever is significantly higher today than it was 2 years ago. So there is a little bit of a ratcheting effect. But at current costs, as we look at it, and I am going to compare mine to crude oil prices, somewhere in the $35 to $40 a barrel range gives an adequate rate of return.

If prices were to go down below that, first of all, if you have already amortized your capital investment and you are just paying operating costs, you can still stay in business and make money. Second, we would hope that the capital costs for construction would go down with that. So it is fairly flexible.

One of the ways we look at it is if energy prices drop significantly from where they are today, I think most people in this Country would be pretty happy. We wouldn't be happy in our industry if energy prices drop significantly, but that wouldn't be a bad thing for the Country.

Senator CHAFEE. These capital costs, your investors must be apprehensive about the swings in the price of energy and the price of oil.

Mr. HOLMES. Well, that is always there, but one thing I would point out is that the high energy prices that the world faces today, in our opinion, are a result of a true supply demand balance situation. What this Country experienced in the seventies and eighties was an artificially high price that resulted from political decisions made by the producing countries.

If you artificially close a valve, you can open it up just as easily. That is what happened to oil prices, and that is why a lot of the projects that were underway in the seventies and eighties turned out to be a problem.

If you look at the future price for oil today, it is a lot higher, a lot further out than it was in the past. So I think most people in our industry believe that this higher level of oil prices and energy prices, resulting from true demand in the world, will probably stay longer. Second, in financing these projects, typically the lenders insist that you hedge your prices, so that you take out some of that risk. If you can lock in your forward prices at a high enough level to service your debt, that is generally what people do.

Senator CHAFEE. Part of the testimony was about India and China coming on line.

Mr. HOLMES. Absolutely.

Senator CHAFEE. That must give some confidence to higher energy costs for your investors.

Mr. HOLMES. We run into the Indian companies and the Chinese companies all over the world. Our other business is gas to liquids which we use stranded gas around the world to try to develop. Everywhere we go, if there is an Indian company competing for a project or a Chinese company, they set the price pretty high.

Senator CHAFEE. Mr. Goodstein, I don't know much about hydrogen, but Mr. Cavaney testified that it comes from natural gas. On page 11, he says, most hydrogen must come from natural gas which, from an energy security standpoint, is in limited domestic supply. Is that a problem for you?

Mr. GOODSTEIN. Well, it is certainly true today that hydrogen, by and large, is generated by reforming natural gas. As I mentioned, hydrogen can also be derived from oil, coal, biomass, and renewables. It is true that if the only answer on hydrogen was natural gas, whether domestic or imported, OPEC would have us, or some other natural gas cartel would kind of have us in the same grip that they have us now.

But there is research that is being pursued at DOE and within the private sector to get to, as I said, the holy grail of renewable hydrogen, which is a ways off, but nonetheless the science is there. Taking renewable energy—wind, solar, or nuclear—and using the electricity generated from that to separate the hydrogen from the oxygen molecules in water.

That is not going to happen overnight, but once that happens, you have no emissions in the electricity generation process and no emissions at the car because the only emission out of a hydrogen fuel cell vehicle is water vapor.

So it is true. If all we had was a static world, and natural gas was our only source for hydrogen, and we made no progress going forward, no question. We see the world evolving in a way that actually gives a lot of hope.

Senator CHAFEE. I know more about hydrogen than I did a few minutes ago.

[Laughter.]

Senator CHAFEE. Mr. Honnef, Brazil went from 80 percent importing to self-sufficiency, pretty much based on sugar conversion to fuel. How different is corn than sugar?

Mr. HONNEF. Well, it certainly is a different process with sugar. Essentially, the ethanol process is in Brazil, they take the sugar; they convert that into ethanol. Here, we take starch from corn, but we first have to convert that starch to sugars, and then that sugar then we ferment to make alcohol. So there is one additional step in the process.

Sugar to ethanol is clearly a more efficient process. Brazil's market is approximately the same size as ours. We are about a four billion gallon a year industry here in the Country. I think Brazil is somewhere between four and five billion gallons a year.

What is interesting is what has happened in Brazil is there has been a growth in what they call total flex vehicles. They are vehicles that can run anywhere from zero percent ethanol, all gasoline, up to 100 percent ethanol, similar to the flexible fuel vehicles that I spoke of earlier. Those are growing in demand. Next year, 70 percent of the vehicles that will be purchased in Brazil will be total flex vehicles.

So they have really committed themselves, not only from a government standpoint but consumers have committed themselves to ethanol as a viable source of renewable energy. We are seeing some of that happen here in the United States now with the growth in E85 and flexible fuel vehicle production.

Senator CHAFEE. Thank you, Mr. Chairman, and good luck, gentlemen, on your research in helping us become more diverse.

Senator INHOFE. Thank you, Senator Chafee.

Well, it seemed when you made your opening statement, Mr. Goodstein, that you were a little surprised when the President back in 2003 made the statement about that someone who was born then would be driving a fuel cell at driver's age. That puts it at, what, 2019. Is that realistic?

Mr. GOODSTEIN. Well, you will have to ask the auto companies. We feel a little bit like the Maytag repairman. We have got hydrogen, and we are waiting for there to be demand. However the auto companies, their line is that they will be able to commercialize fuel cell cars in the 2015 to 2020 timeframe. I have heard them testify to that effect before Congress, and I haven't heard them back down from that.

I will say that I think, apropos to Senator Chafee's question, a lot of where advances are going to be made is China. I think there are some notions that they are going to leapfrog—I gather their environment is not a big selling point at this point, but I think they recognize it—in connection with a lot of technologies and perhaps autos being one of them, and they plan to showcase a little bit during the Olympics. So I think if you asked a lot of the auto compa-

nies to the extent that they are talking about commercializing, I bet China is a big market that they have in mind.

Will that United States child born in 2003 be able to have a hydrogen fuel cell car? Probably if they are very wealthy. I think we are talking a few decades. This is less than a 2050 timeframe, but as I said, 2020, they are going to have to know somebody to probably drive a hydrogen fuel cell car on a regular basis.

Senator INHOFE. Mr. Honnef, you made a reference, and I think all of you did, to the Gas Price Act. That was a great disappointment to me that we were not able to get that through. We have a huge refinery problem. If you remember, during the markup of that bill, your Senator, Senator Thune, had an amendment of the biorefinery amendment. Knowing that there is going to have to be a lot of the ethanol plants built, how would that bill have helped your industry?

Mr. HONNEF. Well, clearly stream FE—

Senator INHOFE. With the Thune amendment attached to it.

Mr. HONNEF [continuing]. Absolutely. Clearly, supporting streamlining the permitting process would help, help considerably, not only in the refining industry but also in the biorefining industry. As we grow this industry at a rapid pace, permitting is always an issue that we have to deal with. So anything to help streamline that process, we look for it. As long as it is not at the detriment of the environment, of course, we look at it as a positive step forward.

Senator INHOFE. I will tell my fellow Senators, I do have one last question. I will be asking it for Mr. Cavaney and Mr. McDougall. But why don't you go ahead and ask any other questions you might have, Senator Jeffords and then you, too, Senators.

Senator JEFFORDS. I just have one more.

Senator INHOFE. Yes.

Senator JEFFORDS. Mr. Goldstein, am I correct in my understanding that the Clean Air Act not only promotes the use of hydrogen in producing low sulfur petroleum fuels, but it also supports the use of hydrogen as a transportation fuel?

Mr. GOODSTEIN. Yes, that is absolutely correct, Senator. Again, because the Clean Air Act has the requirements that gasoline be clean, there is demand for hydrogen to take that sulfur out. But because the Clean Air Act, again, is looking to get cities free of the particulates that they deal with now, let us put carbon dioxide off to the side for current purposes. Again, a hydrogen fuel cell car or bus has only water vapor as an emission.

So clearly, to the extent that the Clean Air Act is trying to promote, and it does, it is effective in cleaning up urban air and air outside of cities, hydrogen is very much going to be used. Indeed, even today, hydrogen is used in conjunction with compressed natural gas, largely in an experimental basis but in some buses around different universities and other areas. California is somewhat on the cutting edge in this, but there are certainly other areas.

So, yes, the Clean Air Act very much drives the utilization of hydrogen. Hydrogen, I think indisputably, is used to clean up the air at present, and I think more so for the future.

Senator JEFFORDS. Thank you.

Senator INHOFE. Thank you, Senator Jeffords.

Let me just kind of wind up by acknowledging that we are developing a lot of technologies right now. We recognize that, and it has been very helpful to have this on record, although we still have a serious supply problem with crude oil and gas.

It goes all the way back, I say to my good friend, Senator Jeffords, to the Reagan administration. I can remember back then I was trying to get the Reagan administration, which was a Republican Administration, to accept, to put together some type of an energy program, the cornerstone of which would be some maximum amount that we could be reliant upon foreign countries for our ability to fight a war.

So Don Hodel, at that time, well, actually he was two secretaries; he was Secretary of Energy and Secretary of Interior at different times. We had a dog and pony show. We would go around the Country to the consumption States and try to impress upon them that our reliance upon foreign countries was not really an energy issue; it was a national security issue.

And we failed. So he did not establish a policy. I thought surely when Bush the First came along, coming from the oil fields, that he would, but that didn't work either. Of course, it didn't work during the Clinton administration. But this President has paid a lot of attention to it.

We do need an energy policy. One of the things we have to recognize, and certainly after everything that has happened in the Middle East, is that we need to achieve more independence. This is a serious problem that we have now.

China was mentioned several times during the course of this hearing. One of the things that bothers me the most about China is not just the fact that they have had military buildups in conventional weapons exceeding ours at about a 10 to 1 ratio, but they now are the No. 2 country in terms of reliance upon foreign countries for their ability to survive.

We see what they are doing. We see the $70 billion deal that they made with Iran, and now they are importing 13 percent of their oil from that country. We have seen the fact that they did not join us in our sanctions against Khartoum, and now they are importing some 7 percent of their oil from Sudan.

As I go around, a lot of people are aware of this, I have kind of a mission. I have been in Africa for many, many years. As I go around the countries, particularly around the Gulf of Guinea and the areas where they have huge oil reserves, I see everything that is new and shiny is built by the Chinese. So, they are making inroads, and there is where our competition is.

We can't ignore the fact that we are facing a crisis. With all the technologies coming along, we still are going to have to have some energy independence. At the time we started this back in the Reagan administration, we were dependent upon foreign countries for 35 percent of our oil, and now it is at, what, 65 percent. So it is a serious problem.

I would like to wind this up. We will start with you, Mr. Cavaney and then with you, Mr. McDougall.

One of the things that I have observed in the years that I have been here and having coming from the oil patch is that there is a

lack of knowledge on Capitol Hill, that oil is not just oil. The majors, which you are representing here, Red, today and the independents, where I actually started out, are kind of two different industries. So I would like to ask the two of you to define the differences between your part of the energy or the oil industry as opposed to the independents.

We will start with you, Mr. Cavaney, and then the different types of problems that you are facing.

Mr. CAVANEY. Well, the biggest challenge we have is that our companies tend to be larger, and therefore their comparative advantage is to tackle the world's most complex engineering problems. Therefore, they need to be huge in terms of scale. Seventy-seven percent of the world's oil resources belong to foreign governments and national oil companies. Those are the people that the investor-owned oil companies have to compete with, whether they are U.S., European, or Chinese.

So, as a result, what you need to do, the big challenge is to find significant locations where oil and natural gas are. Partner up with others so you can minimize your risk, but use your comparative brains to bring that product, that might not otherwise have gotten to market, to market. Finding the resources and having access is very important.

One of our big problems that the majors have had in the United States is that so much of the potentially attractive remaining reserves are off limits. They are not available. So, in order to get the product, there has been more of a concentration in the deep water Gulf, in both the Central and Western areas, which is the only area that is really left that is attractive that majors can use their technology to advantage, and then the rest of the world.

What we think is needed is we will always be able to get, in one form or another, crude oil because crude oil is a global commodity, and what you can't get from one part, you can get from the other.

But the bigger problem we have is natural gas. That is not a global market. That is a regional market, and it has a huge disadvantage for American consumers and American workers. Most of the world pays a couple of dollars for the MCFs of natural gas. Here in the United States, we are at about $11, and the reason it is so high is because there aren't very many opportunities to get access to that. Of course, the hurricane put a premium on it for a couple dollars, and that is probably going to come down over time.

But our point being that we have lots. The Government says we have over 1,000 TCF, trillion cubic feet, of natural gas that is undiscovered within the United States. That is enough to heat 125 million homes for 120 years. We have got the natural gas. So, we need to look to using LNG, liquefied natural gas, imports to help us. We need to bring what we call the Arctic Pipelines, the one from Alaska and also the one from Canada down.

But we also need to access the natural gas that we have here because not only do people pay a high heating bill, natural gas is so often used in many important industries like the fertilizer industry and like the chemical industry as a feedstock.

What we have done is we have been exporting jobs as companies had to close their operations here for non-competitive reasons and move jobs elsewhere. One chemical company owner told me he

never thought he would live to see the day when he had to close a chemical plant in Louisiana and move his production to Germany, but that is what is actually going on.

Mr. Chairman, discussing access and discussing an opportunity where we can bring some of that great technology to look into some of these new fields, and do it in an environmentally responsible way, is clearly the opportunity that is available for the Country if we want to take advantage of trying to make ourselves competitive again in the natural gas and products arenas.

Senator INHOFE. Well, Mr. Cavaney, Senator Voinovich, who couldn't be here today, will be very proud that you brought that up because his favorite, his major concern is what is happening to jobs. I think in Ohio maybe he is feeling it a little more than some of the other States. But the flight of the chemical companies to Western Europe is something.

Did I understand you right there? Compare the price of natural gas at current market between here and Western Europe.

Mr. CAVANEY. It is a difference that over there, on the high end, you could say $4; here, I think it is $11 and a little bit of change.

Senator INHOFE. Yes.

Mr. CAVANEY. You can't take a raw material and have to pay two or three times more than your competition does in businesses that are essentially commodity and expect to stay in business, and that is the challenge.

Senator INHOFE. Sure. That is really important for us to know, and not many people are aware of that. That gets to you, Mr. McDougall, because you could be part of that solution.

During the time, and I know you were asked a question by Senator Chafee on lifting a barrel of oil or producing gas, and how expensive it is, and how much more difficult it is for the smaller companies to be able to afford that, where your break-even margin is. But it is very significant.

I have heard that if we had all of the wells that were plugged in the last 10 years flowing today, it would equate to more than we are currently importing from Saudi Arabia. Now I am talking about crude oil, but the same thing applies. Draw that distinction that I asked you to draw, that Mr. Cavaney was referring to, between the majors and the independents.

Mr. MCDOUGALL. Thank you, Senator. First, I would like to clarify a point. The $2 gas price that they find in other nations and the price that is perceived in this Country is $11.98 which NYMX Net printed today or yesterday. Over the past weekend, I received around $5.10 in MCF for gas. The next day, when I picked up the telephone, they paid me $7.25 for gas. Even at those numbers, I have a basis of almost $5 under the NYMX.

So I would like everyone to understand that just because those numbers are printed on the NYMX board, we do not receive those numbers. The October contract went off $3 under the NYMX print at close there. So when you look at some of these percentages, some of those percentages are 40 and 50 percent less than what the public perceives that we are receiving for gas. So what producers receive and what is speculated on the NYMX are different. I wanted to make that point.

As to the contrast between the majors and the independents, the No. 1 contrast I would start out with is that as independents, we spend our own money. We drill 90 percent of the current wells in the Country. We are literally the foot soldiers of production growth in this Nation. As we go forward, all we do is produce. We employ Americans. We buy American products. We pay American taxes. The majority, and for our case maybe up to 100 percent in my case, is all done domestically.

As far as majors go, they have shareholders. They have refineries. They refine gasoline; they refine heating oil; and they retail gas at the pump to you. We do not do that. I can only say from what I have read, but my perception is that the majority of majors' capital is spent outside the Country. That would be my summary.

Senator INHOFE. All right, well, thank you, Mr. McDougall. Do you have anything else?

Let me just go ahead. The remaining three of you who didn't get quite as long a shot on that last question, if you have anything that you are just dying to share with this committee before we draw it to a close. We will start with you, Mr. Goodstein, and then work down to Mr. Honnef and Mr. Holmes.

Mr. GOODSTEIN. I actually want to buttress the very point that you were making and that Mr. Cavaney was making because Air Products is also in the chemical business. We probably have about a third of our revenues on the chemical side. Notwithstanding the variability in the price of natural gas, it is brutal for those of us in the chemical industry to have to deal with these prices. Forget the fact that natural gas is a raw material for hydrogen. It is a raw material for the chemicals that we manufacture.

So even putting that aside, even from the standpoint of Air Products as an industrial gas company, again, our companies that we list as our customers are Procter and Gamble, and General Motors, and companies that manufacture glass, and steel, and so forth. If natural gas prices remain anywhere close to where they are now, there is going to be this de-industrialization of the United States economy.

It sounds draconian, but I think it is almost kind of hard to rebut. That means our customers are going to go away, putting aside the fact that we make chemicals and need natural gas as a raw material, even from the standpoint of being a natural gas supplier.

I realize there is a lot behind this whole natural gas issue in terms of what Congress can and can't do about it, not all of which is easy, but I can't overstate the fact that it is a huge, huge problem.

Senator INHOFE. You want to put into that equation also the plight of the farmers because I had occasion last Saturday to address the Farm Bureau in Oklahoma. The price of fertilizer and the relationship between natural gas is huge. It is a killer for them.

Mr. Honnef.

Mr. HONNEF. Yes, I just would like to reiterate my appreciation for your support for the Renewable Fuel Standard and the Energy bill. I know Congress took a lot of heat after the Energy bill was passed that it was meaningless and didn't do much. I am here to tell you that it is making a difference, and it is making a difference

in the renewable energy industry. Your support and leadership for the Renewable Fuel Standard and the Energy bill is much appreciated.

Senator INHOFE. Thank you.

Mr. Holmes, any last comment?

Mr. HOLMES. Senator, thank you very much. I have been in the energy industry for 36 years and seen the very good times and the very bad times. There is a feeling that I have that this Congress and the people here in Washington are recognizing that something needs to be done and moving in that direction. So I am very encouraged about that.

The one thing I would say is there is no silver bullet; we need to do it all. I am not here saying that our solution is the only solution. I think that this Nation is so great, and we have so many resources, and there is so much capital out there available to do these projects, that with the leadership that you all are providing, I am very confident that we are going to do a very good job of that.

Thank you.

Senator INHOFE. I think that is an excellent statement to make, and we have often said we need it all, too. I mean when we look at energy, and don't leave out nuclear, we need it all. I appreciate that very much.

Well, we thank you so much, all of you, for taking your time, for coming the distances that you have to testify before us today. We appreciate you very much, and it has been very helpful.

We are adjourned.

[Whereupon, at 11:05 a.m., the committee was adjourned.]

PREPARED STATEMENT OF RED CAVANEY, PRESIDENT AND CEO, AMERICAN PETROLEUM INSTITUTE

I am Red Cavaney, President and CEO of the American Petroleum Institute (API) the national trade association of the United States oil and natural gas industry, representing all sectors of the industry, including companies that make, transport, and market gasoline.

API very much appreciates this opportunity to discuss the future of transportation fuels. Our industry has met the transportation needs of Americans for more than a century, and we will continue to rely on state-of-the-art technology to do so in the decades to come.

Looking ahead, we believe that advances in technology, consumer preference, and the workings of the competitive market will determine the fuels of the future. We need to rely on these forces to shape our energy future and not attempt to impose fuels on the marketplace. Past efforts by government to interfere with the marketplace have only complicated and delayed solutions to energy problems, particularly in times of tight supplies and constrained operations.

We should also recognize that petroleum-based fuels are likely to continue to be the dominant transportation fuels well into this century. It is critically important that government not attempt to force a transition away from these fuels until affordable, reliable substitutes are available in ample supply. At present, such a transition would involve extremely high costs and a massive commitment of resources—with no assurance of success in meeting the broad-based and growing energy needs of United States consumers.

HYDROCARBON FUELS AND TECHNOLOGY

It may come as a surprise to some, but gasoline, diesel fuel, and other petroleum products have provided power for well over a century. Why have these hundred-year-old fuels endured for so long?

There are a few basic reasons. First, hydrocarbons have been the choice of consumers worldwide, because they contain more than twice the energy per gallon as many other energy sources. Thanks to advances in technology and market forces, our hydrocarbon-based economy is getting more and more energy efficient. In 1970,

the United States used about 1.4 barrels of oil for each thousand dollars of real GDP. By 2000, that had fallen almost in half to about seven-tenths of a barrel of oil for each thousand dollars of GDP. By 2025, the U.S. Energy Information Administration projects our nation will consume only about one-half a barrel of oil for each thousand dollars of GDP.

An additional reason why hydrocarbon fuels have endured so long is that technology has reduced dramatically the environmental impact of their use, enabling the production of cleaner, more efficient and environmentally responsible fuels. Seventy million more drivers—70 percent more—are on the road today in the United States than there were 30 years ago, driving 143 percent more miles. However, despite this enormous increase in drivers and miles, vehicle emissions are down 41 percent.

Gasoline improvements have helped bring about this sharp decline in auto emissions. A major contributor was the phase-out of leaded gasoline, completed in the 1980s, which cut lead emissions by 98 percent. Further, the introduction of reformulated gasoline has led to significant reductions in ozone precursors and toxics emissions.

In addition, the average sulfur content in gasoline has been reduced by more than 90 percent to less than 30 parts per million. A new car today running on the new low-sulfur gasoline and equipped with the most advanced emissions reduction technology has 97 percent less emissions than had a new vehicle in 1970. It takes 33 vehicles running on low-sulfur gasoline today to equal the pollution emissions of just a single 1970 vehicle.

API and the industry worked with biofuels manufacturers during this year's debate in Congress on the energy bill recently signed by the President. We recognized and agreed to a significant role for biofuels in the transportation fuels market. While there was debate about the extent of the role of biofuels, such as ethanol, at the end of the day, we agreed to support a significant role for these fuels. We assume that continued advances in technology and growing consumer acceptance will reduce the costs of producing biofuels, make them more competitive with conventional fuels, and reduce the need for Government subsidies.

United States refiners are working hard to keep up with the steadily growing fuel needs of United States consumers. Technological advancements have helped refineries produce more from existing facilities than they did in the past. Even though a new United States refinery has not been built from the ground up in 30 years, existing refineries are continually being upgraded and reworked to improve efficiency and output. United States refinery capacity has expanded from 14.7 million barrels per day in 1994 to 17.1 million barrels a day today, or 2.4 million barrels a day. This expansion is the equivalent of about 12 new 200,000 barrels a day capacity refineries. Based on publicly available data on announced refinery capacity expansion plans, at least 1 million barrels per day of additional refinery capacity projects are either planned or under strong consideration for the 4 years 2005 to 2009.

LESSONS OF HISTORY

If history has taught us anything, it is that markets work, and free markets—including the free flow of oil, products and technology with legal protections—work best. When Governments have allowed markets to function unhindered, the laws of supply and demand have ensured that supply meets demand at affordable prices over the longer term. Moreover, free markets spur competition—and competition advances technology to the benefit of consumers and society as a whole.

However, when Government has interfered with markets, the result has been price volatility, supply shortages, and other disruptions. In the early 1970s, many United States energy policymakers were "sure" that the reserves of oil and natural gas would soon be exhausted, and government policy was explicitly aimed at "guiding" the market in a smooth transition away from these fuels to new, more sustainable alternatives. Price controls, allocation schemes, limitations on natural gas, massive subsidies to synthetic fuels, and other measures were funded heavily and implemented.

Unfortunately, the key premises on which these programs were based, namely that oil and natural gas were nearing exhaustion, and that Government "guidance" was desirable to safely transition to new energy sources, are now recognized as having been clearly wrong and to have resulted in enormously expensive mistakes. For example, Congress created the Synthetic Fuels Corporation in 1980, but, in 1986, it was terminated by legislation signed by President Reagan. In less than six years, billions of dollars had been spent, plants constructed, and, in some cases, fuel produced. But the effort was judged a failure due to noncompetitive economics, project inefficiencies, and delays.

UNDERSTANDING ENERGY REALITIES

We need to understand the energy realities our world faces. Given the current and projected worldwide demand, we need all sources of energy. We do not have the luxury of limiting ourselves to a few sources to the exclusion of others. Nor can we afford to write off our leading source of energy before we have found cost-competitive and readily available alternatives.

There is a misperception by some about the time and costs involved in any transition to the next generation of fuels. Consider what would be involved in replacing the dominant role of oil with a substitute like hydrogen or solar power. Most experts agree that such a transition will require dramatic advances in technology and massive capital investments and take several decades to accomplish, if at all.

Despite the energy realities we face, we still frequently hear that we are "running out of oil" and that we must find other sources for the transportation fuels of the future. Nothing could be more at odds with reality.

The U.S. Energy Information Administration projects conventional oil alone is sufficient to supply increasing quantities to consumers each year through 2044. Conventional oil is recoverable oil using today's technology and does not include vast unconventional supplies, such as tar sands and oil shale. Moreover, energy analyst Daniel Yergin and his Cambridge Energy Research Associates recently completed a field-by-field global analysis that forecasts a 20 percent oil production capacity increase between 2004 and 2010, based on projects already planned.

It is interesting to note that forecasts about "running out of oil" have been made many times over the years but have been consistently wrong.

Back in 1874, the chief geologist of Pennsylvania predicted we would run out of oil in 4 years just using it for kerosene. Thirty years ago, groups, such as the Club of Rome, predicted an end of oil well before the current day. These forecasts were wrong because, nearly every year, industry has found more oil than used, resulting in reserves that have continued to grow.

The key factor here is technology. Advances in exploration and production technology have enabled our industry to find and develop oil and gas reserves that would have been far beyond our reach several decades ago. We can now find more and produce more—and we can increase the yield of our existing reserves.

These changes have been dramatic. Thirty years ago, "deepwater" operations meant those in 500 feet—today it can mean 10,000 feet. 3D seismic technology was still on the drawing board in the 1970s. Today, it is used widely in offshore operations, enabling drillers to better "see" underground oil and natural gas deposits, greatly improving their ability to develop these deposits.

Primarily due to these advances, the U.S. Geological Survey (USGS), in its 2000 World Petroleum Assessment, increased by 20 percent its estimate of undiscovered, technically recoverable oil. USGS estimates there are 649 billion barrels of undiscovered, technically recoverable oil outside the United States. But, importantly, USGS also estimates that there will be an additional 612 billion barrels from "reserve growth"—nearly equaling the undiscovered resources.

Looking into the distant future, the Age of Oil will end when technology finds a more cost-competitive, more desirable fuel. We can only speculate as to when and how that day will come about. For example, there is an even bigger hydrocarbon resource that can be developed to provide nearly endless amounts of energy—methane hydrates—methane frozen in ice crystals. The deposits of methane hydrates are so vast that when we develop the technology to bring them to market, we will have clean-burning energy for over a thousand years. It is just one of the exciting scenarios we may see in the far-off future. But, we won't be getting there anytime soon, and, until we do, oil and natural gas will likely remain our leading energy sources.

The United States and the world cannot afford to leave the Age of Oil before realistic alternatives are fully in place. It is important to remember that man left the Stone Age not because he ran out of stones. We will not leave the Age of Oil because we ran out of oil. Yes, someday oil will be replaced, but clearly not until alternatives are found, alternatives that are proven more reliable, more versatile, and more cost-competitive than oil. We must rely on the energy marketplace to determine what the most efficient alternatives will be, and technology will be a key determinant in that regard.

FUELING AUTOMOBILES OF THE FUTURE

We expect that the dominant transportation fuels will remain gasoline and diesel for at least two or three decades—the minimum amount of time required to fully retire any existing and still growing fleet of automobiles and trucks powered by these fuels and to deploy any replacement fuel source throughout the United States.

We cannot afford to prematurely retire these century-old champions, without full and complete assurances that worthy successors are in place.

In considering our future energy needs, we need to understand that gasoline-powered automobiles have been the dominant mode of transport for the past century and the overwhelming preference of hundreds of millions of people throughout the world. Regardless of fuel, the automobile—likely to be configured far differently from today—will remain the consumer's choice for personal transport for decades to come. The freedom of mobility and the independence it affords consumers is highly valued.

Rather than being phased out, gasoline and diesel are likely to be the leading fuels well into the future thanks to such advances in technology as advanced internal combustion engines (ICEs) and rapidly evolving "hybrid" vehicles. Those who write off gasoline and diesel fuels fail to recognize how advanced technology is providing new and more efficient ways of using these hundred-year-old products.

For example, significant improvements in internal combustion engine technology have been made, and advancements will continue to provide higher mileage efficiency and lower emissions. Enhanced vehicle emission control technologies, made possible by the introduction of low-sulfur fuels, will be an important component of future conventional systems.

Another advancing technology is the hybrid vehicle powered partly by gasoline and partly by electricity. Hybrids are already moving aggressively into the market; their rate of growth will depend in large part on their price and performance. Even though hybrids still face technological challenges, such as battery size and life, there is a high probability of hybrids being a significant, though possibly not dominant, part of the United States vehicle population in the not too distant future. Additionally, low-sulfur, modern day diesel engines, utilized in hybrid configurations, may hold even greater promise.

Hybrids already provide significant reductions in energy use and greenhouse gas emissions. Commercially available, they use the existing fuel infrastructure. Depending upon the hybrid technology and consumer driving patterns, efficiencies are up to about 1.5 times that of today's conventional internal combustion engine vehicles. From the standpoint of total useful lifecycle, hybrids are currently the most efficient and among the cleanest commercially available technologies. Moreover, additional cost reductions should make hybrids increasingly competitive.

In addition to hybrids and advanced ICEs, oil companies—working alone or with automakers—have invested millions of dollars researching new fuel cell technologies. Some energy companies have also partnered with the Federal Government through the Department of Energy's Freedom CAR & Fuel Partnership, a public/private effort to examine the pre-competitive research required to develop technologies for a full range of affordable vehicles and the fueling infrastructure to support them. These technologies hold the potential for up to double the fuel efficiency of current gasoline-powered autos. Fuel cell vehicles have essentially zero tailpipe emissions. However, maintaining a national fleet of such vehicles would face significant technical, economic, primary energy source availability, and infrastructure challenges.

Present fuel cell costs are at least 10 times greater than for internal combustion engines, based on current fuel cell technology being produced on a large, commercial scale. Long-term fuel cell durability must be improved and demonstrated. Safe, efficient, and cost-effective hydrogen storage solutions are needed to make possible acceptable driving ranges. The current delivered cost of hydrogen fuel to transportation markets is substantially greater than the energy provided by units of gasoline or diesel. Making hydrogen widely available will require extremely large infrastructure investments. Even hydrogen made from gasoline using an on-board reformer, which would take advantage of the existing refueling infrastructure, faces many challenges. Nonetheless, all options should be thoroughly evaluated, and it is premature to exclude any option at this point.

Our industry takes a balanced view of hydrogen. Like electricity, hydrogen is an energy carrier, not an energy source. To succeed in the market, it must be produced in large volumes at reasonable cost. But, without major breakthroughs, most hydrogen must come from natural gas, which—from the energy security standpoint—is in limited domestic supply. Present circumstances notwithstanding, to provide large amounts of hydrogen, United States producers will need to have access to the potentially large natural gas reserves on non-park, government lands in Alaska and the lower-48 States.

We believe consumer preference should and will play the key role in the choice of these new competing vehicle technologies. That preference will be based, in large part, on fuel supply availability, cost affordability, consumer acceptance and environmental compatibility.

We strongly believe that the private sector should continue to play a major role in applied research and that both the government and the private sector should be involved in basic theoretical research. The automobile and oil industries have made tremendous progress over the years, introducing a range of new products and technologies to improve emissions, fuel economy, and performance. We fully expect this trend to continue, both with respect to improvements to today's technologies and to the introduction of advanced vehicle technologies.

Moreover, whatever role Government plays on advanced vehicle and fuel technologies, including fuel cell development, it should be a broad one. Government should not pick winners and losers. It should not focus prematurely on just one approach which may not prove effective, while discouraging others that may ultimately have more potential in the long-term. While technological change can be encouraged by both public and private industry policies, it must not be forced by Government mandates. We can learn from the experience in California several years ago where electric vehicles were mandated by the State Government. They were not accepted by the driving public for a variety of reasons and, ultimately, the mandate failed and was withdrawn.

Consumers' acceptance is the key to the success of any vehicular system, and industry competition for their dollars is the fastest means of bringing forward the next generation of transportation options. Societal goals are best attained by setting performance standards. Government mandates, subsidies, preferential taxation, and the premature official selection of one technology over another cannot produce advances as swiftly, or as effectively, as market competition.

CONCLUSION

The intensive use of the latest, most advanced technology to provide transportation fuels has made the century-old oil and natural gas industry an innovative, visionary, and highly effective new industry. Our industry has been producing, and intends to continue producing, both the fuels and feedstocks that make life simpler and safer, more comfortable and more convenient for society.

The reality is that gasoline, the time-tested champion fuel of motor vehicle transportation, is likely to remain the dominant fuel for many years to come. Its composition may change and its uses may be shaped by evolving technology, but gasoline, in fact, will be the fuel of the future—at least for the near-term. In view of its history of reliability and environmental progress, gasoline's continued dominant role should be a reassuring prospect for United States consumers.

RESPONSES BY RED CAVANEY TO ADDITIONAL QUESTIONS FROM SENATOR OBAMA

Question 1. Are you aware of any branded petroleum companies that have internal business policies or practices that may discourage the construction, installation or operation of E85 fueling pumps?

Response. API is not aware of individual member company policies or practices regarding E85. However, API members have in the past marketed alternative fuels and many are currently working to determine how to bring hydrogen, for example, to the retail gasoline station.

Question 2. Are there branded petroleum companies that prohibit the sale of E85 in certain ways such as:

-prohibiting the dispensing of E85 from a branded pump
-prohibiting the location of an E85 pump under a branded canopy
-discouraging the location of an E85 pump within the refueling area?

Response. API is not aware of individual member company policies or practices regarding E85.

Question 3. Would API be willing to issue a directive to its members that they should not discourage the use of E85, with recommendations or steps outlining best practices to accomplish greater access to E85?

Response. The decision on whether to use E85 would need to be made on an individual company basis. Therefore, it would not be appropriate for API to issue any directive on the marketing of E85.

In addition to API's answers above, we thought it may be helpful to provide the following information regarding E85:

E85 fuel is a blend of 85 percent ethanol (alcohol) and 15 percent gasoline. Because it is 85 percent alcohol, it has significantly different chemical properties than both straight petroleum gasoline and E10 gasoline (a blend of 10 percent ethanol and 90 percent gasoline). The chemical properties of E85 make it incompatible with most existing gasoline station petroleum equipment. This equipment can be modi-

fied or replaced to allow the storage and dispensing of E85. However, it would require significant changes to the existing gasoline station infrastructure.

PREPARED STATEMENT OF JEFFREY MCDOUGALL, JMA ENERGY COMPANY, LLC

The following testimony is submitted in advance of the November 16, 2005 hearing before the U.S. Senate Environment and Public Works Committee, which will focus on the future of transportation fuels.

My name is Jeffrey McDougall, and I am the owner of JMA Energy Company located in Oklahoma City. I will offer my remarks from the perspective of an independent oil and natural gas explorer and on behalf of the Oklahoma Independent Petroleum Association, which is an association of more than 1,600 independent oil and natural gas producers. Although our membership includes some publicly traded companies, the majority of our members are small, family owned businesses. Our members explore for and produce oil and natural gas. We do not refine oil into gasoline or heating fuels and we do not market gasoline.

I have built my business from the ground up by drilling for oil and natural gas. After being laid off in 1986 when energy prices plummeted, I started my own business by drilling shallow wells. I currently have 30 employees and most would characterize our company as a small business. In the last four years, on a cumulative basis, we have invested more than 113% of our cash flow into the drilling of over 350 new wells. Putting this in perspective, we have found enough energy equivalents to supply this nation's natural gas needs for one day.

PROFILE OF OKLAHOMA PRODUCTION

Oklahoma has a rich history in energy production. During World War I, we were the largest oil producing region in the world, and were responsible for supplying critical energy resources needed for our war effort. Although oil production is still important, it has declined through the years. Oklahoma's exploration focus has turned to natural gas, making it the number two state in the nation in natural gas production. Independent producers are responsible for more than 85 percent of the oil and natural gas production in the state. Nearly half of this production is from marginal wells, which account for about 42 million barrels of oil per year, or an average of 2.35 barrels per day from each of the 48,000 marginal wells. The overwhelming majority of this production is owned by small family businesses.

INDEPENDENT PRODUCERS RE-INVEST THEIR EARNINGS

I want to emphasize that independent oil and natural gas producers re-invest their profits back into the ground here in the United States to find badly needed domestic reserves of oil and natural gas. In fact, a recent study shows that independent oil and natural gas producers re-invest more than 100 percent of their cash flow back into domestic oil and natural gas development. The result is that independent oil and natural gas producers drill 90 percent of the domestic oil and gas wells, produce nearly 70 percent of domestic oil and 82 percent of domestic natural gas.

Independent producers are now, more than ever, aggressively searching for more oil and natural gas reserves. New technology is helping independents find and recover more domestic oil and natural gas. Small oil operators are using new technology to enhance mature oil fields, unconventional plays are receiving new attention and companies like mine are drilling to depths in excess of 20,000 feet at costs approaching $8 million per well. We are doing what we can to make our country more energy secure and less reliant on foreign sources of energy.

INDEPENDENT PRODUCER ENVIRONMENTAL/PHILANTHROPIC ACTIVITIES

While our greatest contribution is finding more oil and natural gas, we should emphasize that independent producers have a history of giving back in other ways as well.

Almost every foundation, endowment, museum and numerous community projects in our State's history have been created primarily through the generosity of the state's independent oil and natural gas industry.

Also, we are environmental stewards. We comply with a myriad of local, state and federal environmental requirements, and in Oklahoma, oil and gas producers instigated the creation of the "Oklahoma Energy Resources Board" 16 years ago. Producers have voluntarily contributed approximately $30 million to clean up more than 6,300 abandoned well sites and an additional $30 million for science-based education programs in schools.

Currently the Oklahoma Energy Resources Board and the Oklahoma Independent Petroleum Association are addressing the impact of high energy prices on our state's low income citizens, encouraging the state to fully fund the LIHEAP program with additional dollars collected from the state's 7 percent gross production tax. We are producing conservation messages to inform the public of higher heating costs this winter and advising them of ways to save up to 35 percent on their heating bills.

CONCLUSION

Independent producers are re-investing profits to help America become less dependent on foreign supplies. However, we must face the fact that we may never achieve energy independence. We must learn to do a better job of conserving energy. We must also look to alternative fuels to supply a larger part of our nation's energy needs. At the same time, we need policies that encourage, not discourage, the expansion of energy supplies to further harvest the resources we have within our own borders.

PREPARED STATEMENT OF RICHARD GOODSTEIN, WASHINGTON REPRESENTATIVE, AIR PRODUCTS AND CHEMICALS, INC.

INTRODUCTION

Mr. Chairman, Senator Jeffords, thank you very much for the opportunity to testify on the subject of hydrogen and its role as an important transportation fuel, not just of the future, but indeed of the present as well. I am the Washington Representative for Air Products and Chemicals, Inc., which is an $8 billion per year company in the industrial gases and chemicals business. Air Products has operations throughout the United States and abroad in thirty countries. Air Products has previously testified before Congress on the subject of hydrogen and is regularly a key participant in domestic and international conferences on hydrogen and the hydrogen economy.

SUMMARY

My testimony will make the following points: (1) Hydrogen is not some futuristic concept. It is widely and safely used throughout industry today. (2) The public policy reasons for moving toward a hydrogen economy—energy security and environmental protection—are extremely compelling. (3) Technology for dispensing hydrogen into vehicles already exists and is being deployed, albeit slowly, today. (4) Hydrogen, mainly generated by reforming natural gas today, can also be derived from oil, coal, biomass,µwaste heat from nuclear reactors,µand renewable energy such as wind or solar power, so it is compatible with all alternative fuels. (5) The federal government must play an important role in the development of a hydrogen economy.

AIR PRODUCTS: WORLD LEADER IN HYDROGEN

Air Products is the world leader in third-party hydrogen production and distribution of hydrogen, with approximately a 50 percent market share globally. Air Products safely operates sixty hydrogen production and processing facilities throughout the United States and the world, including Asia and Europe. Air Products is recognized as the industry leader in safety. The company maintains over 350 miles of hydrogen pipelines worldwide, and has been operating pipeline systems for over 35 years without a single recordable incident. Air Products alone has supplied liquid hydrogen to NASA since its earliest launches.

Air Products supplies hydrogen through a variety of supply modes. The company operates hydrogen pipelines domestically in Texas, Louisiana, and southern California; delivers hydrogen—both liquid and gaseous—in tanker trucks throughout the country; and produces hydrogen on-site, at oil refineries and steel and glass plants. In short, Air Products is a fully-integrated supplier of hydrogen and also has unparalleled know-how in handling hydrogen safely.

Air Products has formed collaborations and alliances with the full range of automotive companies worldwide that are committed to developing hydrogen-fueled vehicles, whether fuel cell or internal combustion vehicles. Air Products also works closely with companies that manufacture fuel cells, and with energy companies looking to dispense hydrogen fuel at their service stations. The company works closely with the Department of Energy in its research and development of the hydrogen economy, with many state and local governments, and with a range of universities that are moving the country more rapidly down the path toward a hydrogen economy.

WHY EMBRACE HYDROGEN?

Those of us in the hydrogen world were very excited when President Bush heartily embraced the role of hydrogen in his State of the Union address in 2003. He vowed that the first car driven by a child born that year would be a hydrogen fuel cell vehicle. Such a strong endorsement of a hydrogen economy from the White House was very big news for Air Products, and for our "partners" who manufacture fuel cells and hydrogen fuel cell cars as well as many in the petroleum industry.

The case for moving toward a hydrogen economy has been stated often in recent years, but it bears repeating. Nothing could be more important than energy security. To be free of the pricing power of the oil cartel would have tremendous value to the American economy. A hydrogen economy, especially once the hydrogen is totally renewable, will enable the United States to escape the stranglehold of the oil cartel.

Along with energy independence will come the savings from no longer having to maintain a defense posture predicated on maintaining open sea lanes for the shipment of oil. The hemorrhaging trade deficit would also be addressed in large part by eventually ending our dependence on foreign oil.

A hydrogen economy also provides a high degree of domestic security because it can be predicated on a system that delivers both electricity and hydrogen as fuel for vehicles. No one quite knows exactly how the hydrogen economy will develop, but there are likely to be several "right" answers to hydrogen production and delivery, depending on regional dynamics. One can imagine a series of regional hydrogen-generating facilities operating in hub-and-spoke networks. The natural gas lines that already exist in a city can be used to feed a hydrogen-generating plant. This plant, in turn, could be the starting point for the distribution of hydrogen within a metropolitan area. Such a system could free the United States from the fears of disasters, natural (consider the havoc wrought by Hurricane Katrina on our Nation's energy supply) or man-made (such as a terrorist attack on the originating point of oil pipelines).

Of course, the environmental benefits from a hydrogen economy are significant too. The only emission from a hydrogen fuel cell vehicle is water vapor. No carbon dioxide is generated in the production of renewable hydrogen, nor would there be particulates. A number of United States cities are currently experimenting with hydrogen fuel cell buses to help them address urban air quality degradation. While hydrogen today is generated mainly by reforming natural gas, the vision shared by hydrogen proponents is of a totally renewable fuel that would rely on renewable sources of energy to separate the hydrogen from the oxygen molecules in water and then use that hydrogen in a fuel cell or an internal combustion engine.

CURRENT ROLE OF HYDROGEN

A review of hydrogen production will help the committee understand its promise. Thanks to the Clean Air Act's requirement for cleaner burning gasoline, hydrogen—which removes sulfur from petroleum distillates such as gasoline and diesel—is generated at or near oil refineries nationwide. (See attached photo of hydrogen generating plant.) Hydrogen is thus widely available in the United States today. (See attached map.)

Hydrogen has many other industrial purposes. It is used in processes to make steel, glass, semiconductors, detergent, and an enormous variety of other products. For the most part, hydrogen is made by reforming natural gas. But a huge advantage of hydrogen is that it can be obtained from a wide variety of other energy sources, including oil, biomass, coal, and nuclear. As mentioned earlier, renewable sources such as solar and wind can generate the electricity to separate the hydrogen and oxygen atoms in water. Therefore, research and development into hydrogen should not be seen as taking away from alternative energy technologies, but instead as dovetailing perfectly with them. In a hydrogen economy, hydrogen will be derived from several major sources.

Once generated, hydrogen can be distributed by pipeline, as a compressed gas in truck trailers, or as a cryogenic liquid in tanker trucks, as well as by ship and by rail.

The hydrogen used in vehicles today typically is dispensed in a compressed gaseous form. One challenge for hydrogen is how to store enough hydrogen in a vehicle to provide the driving range that consumers demand. The Department of Energy and the private sector are working on this storage issue, and considerable strides have been made just within the past few years. Some auto companies have decided to utilize hydrogen in an internal combustion engine and store hydrogen onboard in cryogenic (super-cooled) form. Municipal buses are turning to a mixture of com-

pressed natural gas and hydrogen as their fuel. Others use hydrogen in fuel cells. Air Products works closely with all end users.

High-profile use of hydrogen and fuel cells is not new. NASA incorporated fuel cells into its early spacecraft, and liquid hydrogen, furnished by Air Products, has been used in space launches since the inception of the space program. While most of the current attention is on hydrogen to fuel vehicles, there is also a parallel effort to develop hydrogen fuel cells for everything from batteries for cell phones and laptops to backup power for hospitals and office buildings.

NO CHICKEN-AND-EGG PROBLEM: HYDROGEN IS AVAILABLE TODAY

In hydrogen circles it is often said that a chicken-and-egg problem exists: auto companies wonder whether they can assume the risk of putting large numbers of hydrogen-powered cars on the roads without an existing hydrogen infrastructure, whereas hydrogen generators question the wisdom of deploying a hydrogen infrastructure without enough hydrogen-powered vehicles to generate sufficient demand for hydrogen.

Air Products believes this argument is a red herring. Because an extensive hydrogen-generating network exists throughout the country, hydrogen is very much available today—not in a dispensable form, perhaps, but it is certainly available to be tapped by the auto industry for many years to come as we make the transition into a fully deployed hydrogen economy.

Moreover, Air Products has developed mobile hydrogen fueling stations devices that are approximately the size of one or two large U-haul trailers that can hold enough hydrogen to fuel 15-50 cars per week. (See attached photos of mobile fuelers.) They are self-contained and require no utility hook-ups. Air Products currently deploys a number of these throughout the United States, but nothing precludes rural deployment. Therefore, if an auto company decides to experiment with hydrogen fuel cell cars in Oklahoma or Vermont, for example, rather than Florida or California, no technical reason prevents a mobile fueler from being deployed to service these autos. What's more, one of our mobile hydrogen fueling stations actually costs less than a hydrogen fuel cell car does today.

Air Products also has developed a number of stationary hydrogen-dispensing facilities that look much like a standard gasoline pump at the corner gas station today. (See attached photos of hydrogen fueling products.) Indeed, the hydrogen that is used at the Shell station on Benning Road in Washington, DC (where a number of General Motors hydrogen fuel cell cars are fuelled) is generated by Air Products in Delaware and trucked to Washington. The dispensing equipment at this station is a proprietary design developed by Air Products. I encourage everyone on the committee to visit that Benning Road station to see that hydrogen is here and now, not simply some futuristic fantasy.

Air Products has deployed hydrogen fueling station equipment throughout the country. Seventeen of our fueling stations will have been deployed in California by the end of 2005, in part to meet Governor Schwarzenegger's call for a statewide "hydrogen highway." We also have hydrogen generation and fueling equipment in Las Vegas, in three California municipalities, at the University of California at Irvine and at Davis, and at Penn State University, among other locations. Air Products' stationary hydrogen fueling dispensers are in place with each of the Big Three auto makers in Michigan, and internationally in Japan, Korea, Singapore, China, Taiwan Germany, and Italy. Beijing is trying to use the 2008 Olympics as an opportunity to showcase a move toward cleaner technologies and we should expect to see a variety of hydrogen fueling stations and hydrogen fuel cell cars flitting about Beijing during the Olympics.

Of course, there are only about 100 hydrogen fuel cell cars currently deployed in the United States. It will be many, many years before hydrogen fuel cell cars number in the thousands, let alone in the millions. Given the enormous amount of hydrogen generated for industrial purposes today, it will be at least a decade in the United States before hydrogen-fuelled vehicles make a dent in the overall amount of hydrogen generated for industrial purposes.

The price of hydrogen fuel has come down substantially in the past few years. Hydrogen generated off our pipeline in Los Angeles, for example, can be competitive with gasoline in Los Angeles on a per gallon equivalent. Hydrogen delivered over the road gets more expensive than gasoline today because of the specialized hauling equipment that is required. Novel methods of hydrogen delivery that would reduce the distribution cost are being examined by Air Products. Once economies of scale are reached, those costs will drop. Moreover, the most commonly used hydrogen fuel cell is more than twice as efficient as a gasoline internal combustion engine.

LEGISLATIVE ACTIONS TO FACILITATE HYDROGEN GOVERNMENT'S ROLE IS VITAL

Government has a special role in proceeding toward a hydrogen economy. The goals to be accomplished—energy security, a clean environment—are unlikely to be ones that will affect most consumer behavior. Individual consumers do not purchase our national defense. The nation as a whole does that through taxation. Similarly, we should not expect the private sector solely to assume the cost of developing technologies that benefit society at large rather than any individual consumer. While the free market will certainly play a role in responding to consumer choice, government action will be indispensable to accomplishing the very meritorious objectives of the hydrogen economy.

THE CLEAN AIR ACT IS A PREDICATE TO THE HYDROGEN ECONOMY

Oil refineries presently use large quantities of hydrogen to comply with the Clean Air Act. Some in the petroleum industry counsel relaxing certain provisions of the Clean Air Act for a variety of reasons. To the extent that this committee believes that movement in the direction of a hydrogen economy is a worthy goal for the United States, we strongly advise that the Clean Air Act requirement to remove sulfur from petroleum distillates not be weakened (nor is anyone seriously suggesting that is should be).

Air Products, among others, has invested billions of dollars in building and maintaining hydrogen-generating facilities and the beginnings of a hydrogen pipeline infrastructure. This was largely in response to the requirement that oil refineries produce cleaner-burning fuels. Relaxing or negating these requirements would leave companies like Air Products with enormous stranded assets and would represent a huge setback regarding the deployment of a hydrogen fueling infrastructure in the United States.

We hope the Air Products hydrogen investments, originally intended to help our refinery customers meet their Clean Air Act and clean fuel requirements, will pave the way for a robust domestic hydrogen infrastructure. Indeed, the areas in which Air Products has major hydrogen generating and pipeline facilities—southern California and a Houston to Lake Charles corridor—are seen by some as opening up the possibility of a "Silicon Valley" for hydrogen: not just the widespread introduction of hydrogen-fueled cars and buses, but factories, dwellings, and commercial establishments that could be powered by hydrogen fuel cells.

ESTABLISHING CODES AND STANDARDS

Establishing codes and standards applicable to hydrogen storage, dispensing, and the operation of hydrogen-fueled vehicles is important to assure public confidence in this new technology. At present, local fire marshals—given very little guidance—are left to their own devices to establish setbacks or other requirements applicable to hydrogen fueling stations. Standardizing hydrogen dispensing equipment—to assure compatibility between the dispenser and the vehicle—is obviously essential, but not a forgone conclusion. Establishing requirements for pressurizing hydrogen, to assure uniformity, is vital. Given this committee's jurisdiction, to the extent that hydrogen-fueled cars and buses will be used at or near public buildings and grounds, the committee can have a major role in requiring the implementation of codes and standards that can be adopted throughout the country—indeed, throughout the world.

GOVERNMENT PROCUREMENT CAN BE A MAJOR CATALYST

Air Products, along with others in the hydrogen and fuel cell industries, encourages the federal government to be as aggressive as possible regarding procurement of hydrogen-fueled vehicles, including mass transit buses. There is particular value in having the government in this role. Until full-blown hydrogen fueling infrastructure exists, filling hydrogen-fueled vehicles will be easiest at centralized locations, where fleets are housed. Government fleets tend to fit this bill quite well. Whether the vehicles are buses that might run among Government buildings or serve a community, or cars used by Government employees during the day, we encourage the Federal Government to procure hydrogen-fueled vehicles wherever possible. To date, automobile companies have leased hydrogen fuel cell vehicles at costs comparable to other mid-range vehicle leases, so the high cost of hydrogen fuel cell vehicles need not necessarily be borne by the Federal Government.

THE NEXT HIGHWAY BILL WILL BE IMPORTANT

While we recognize that the ink on the Highway bill is barely dry, we encourage this committee to begin thinking of ways to pave the way for broader use of hydro-

gen-fueled vehicles in the next iteration of this legislation. Demonstration of hydrogen fuel cell vehicles in various contexts—high altitude versus low altitude, dry versus wet, hot versus cold climates, for example—is likely to still be necessary.

By the time of the next Highway bill, a consensus on the best way to develop a hydrogen fueling infrastructure is still unlikely. Therefore, we recommend that the committee consider supporting various hydrogen production mechanisms for purposes of generating hydrogen as a fuel—hydrogen generators at individuals' homes or at places of work, large-scale hydrogen production facilities as the hub of a network of regional hydrogen pipelines, perhaps, or other methods for assessing the applicability of different hydrogen fuel production methods. Certainly the next highway bill will be a welcome opportunity to integrate hydrogen-powered buses into municipal transportation systems.

TAX PREFERENCES INFLUENCE CONSUMER BEHAVIOR

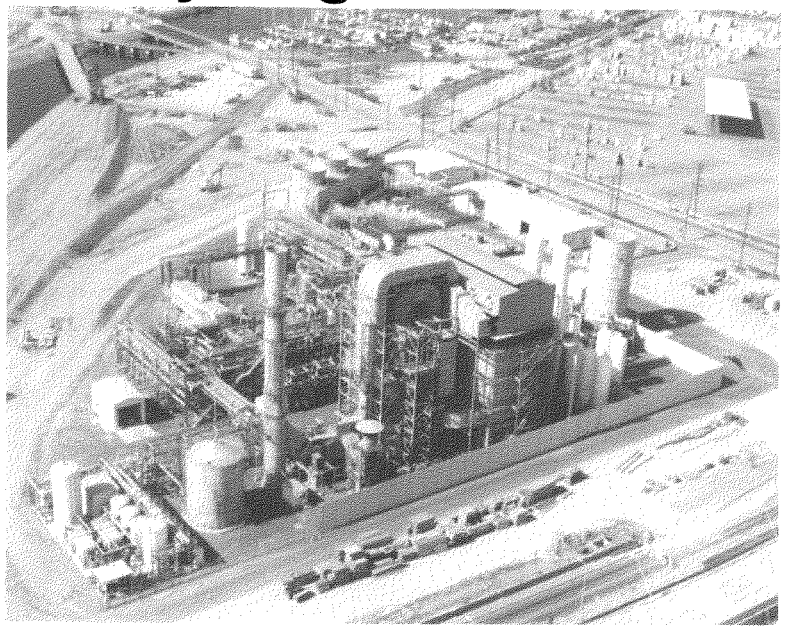
Legislation beyond the jurisdiction of this committee can certainly help as well. Tax preferences for the production of hydrogen used as a fuel will certainly encourage the establishment of a robust network of hydrogen fueling stations. Any reasonable tax preference that encourages consumer purchase of hydrogen-powered equipment—whether mobile or stationary—will provide an incentive for the full development of a hydrogen fueling infrastructure.

The Department of Energy continues to perform essential research and development on reliable and long-lasting fuel cells, hydrogen storage, and other essential ingredients of a hydrogen economy. We encourage Congress to fund this effort as robustly as possible. We recognize that the federal budget has limits. We merely urge the Congress to recognize that the closer we get to a fully deployed hydrogen economy, the more rapidly we will reduce our enormous trade deficit, expenditures on foreign oil and on the defense posture needed to facilitate importing foreign oil, and the expensive health impacts of polluted urban air.

CONCLUSION

On behalf of Air Products, I thank you for the opportunity to share with you this perspective on hydrogen, its current applications, and promise for the future. Hydrogen is not some pie-in-the-sky concept. It has been shown to work, yet needs the federal government's support to overcome the remaining technical hurdles and be widely integrated in society. We very much look forward to working with you, with the entire committee, and with staff and all stakeholders in achieving a reliable hydrogen economy as soon as possible.

Hydrogen Production



Steam-methane reformer

Capacity: 100 million cubic feet per day of hydrogen
If Used for Automobiles Only this Plant Could Supply
~50,000 Fuelings/Day or
~400,000 Automobiles on Road

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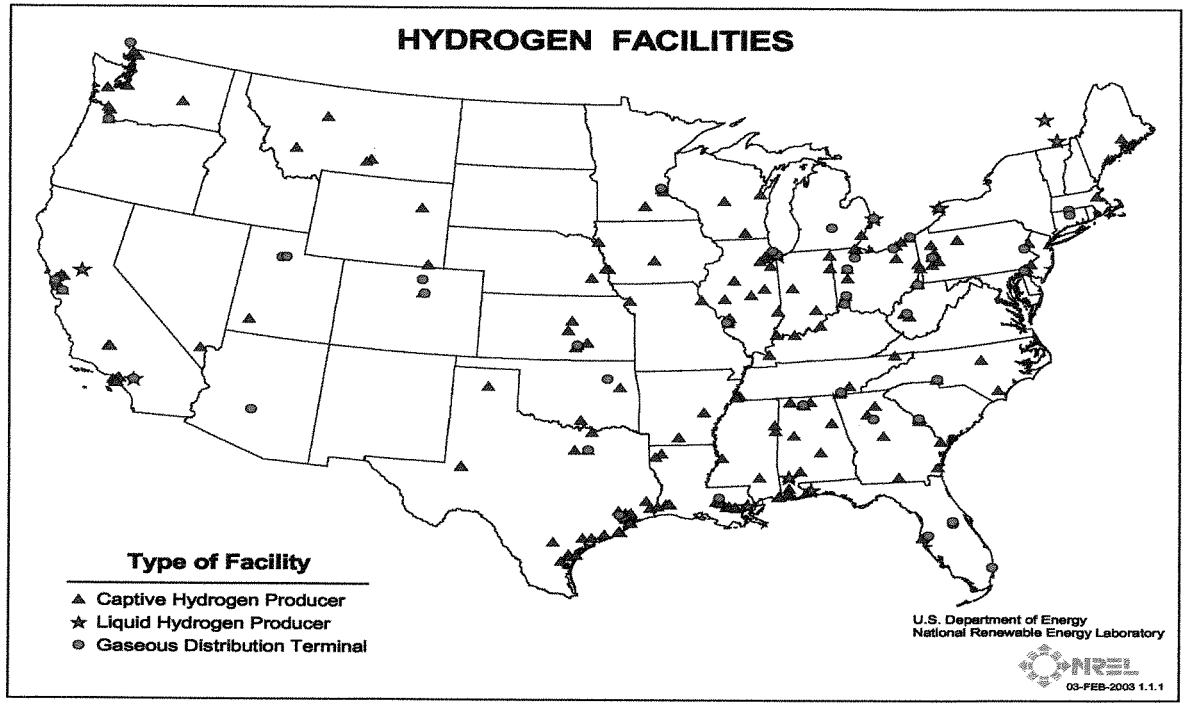
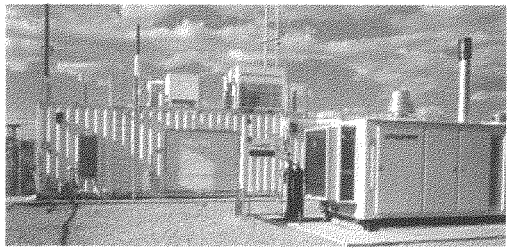
Current U.S. Hydrogen Infrastructure

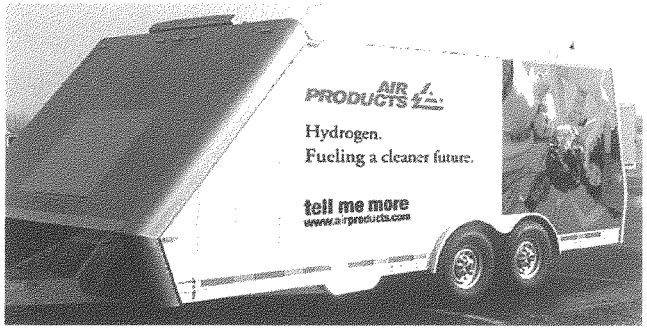


H_2 Fueling & Infrastructure Products

Mobile Fueler HF-150



Energy Station



Mobile Fueler HF-60

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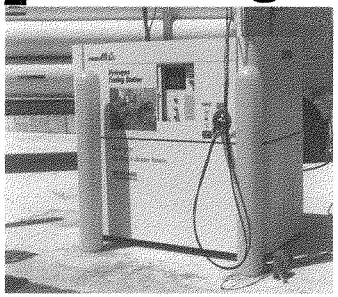
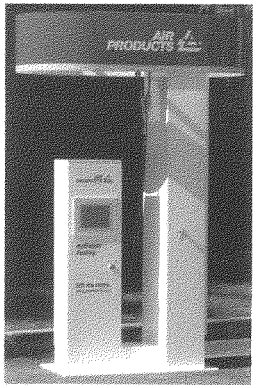
H_2 Fueling Products

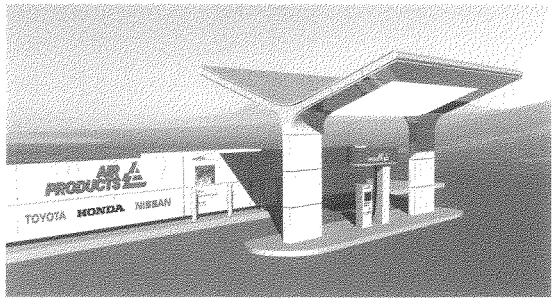


Series 100 Fueling Product

Series 200 Fueling Product



H_2 Fueling Dispenser



Pipeline H_2 Fueling Station

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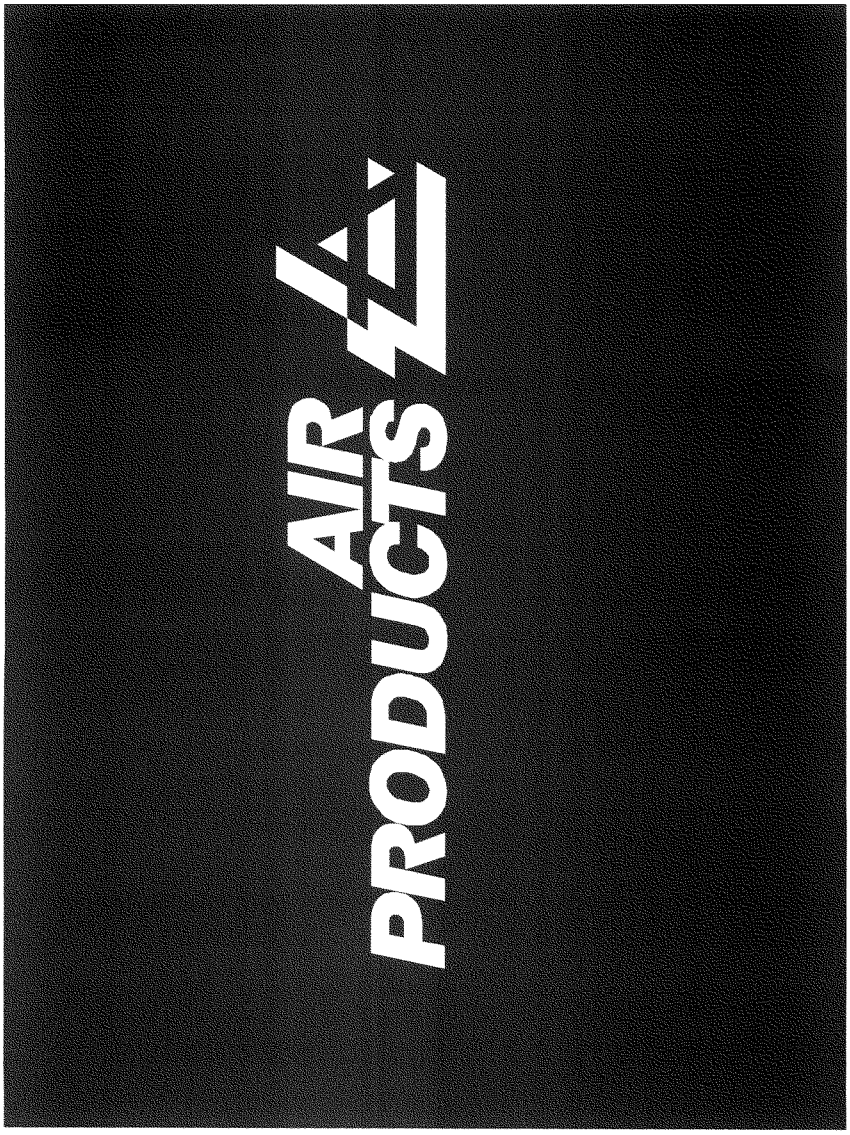
AIR
PRODUCTS

Meeting the Challenges for a Hydrogen Future

Robert N. Miller
Air Products and Chemicals
H_2 Energy Action Summit, Grand Forks, ND

7 November 2005

Today's Presentation

- Who is Air Products and Chemicals?
- What business do we have in Hydrogen?
- What are we doing to meet the challenges for a hydrogen energy future?
  - Placing safety "First" !
  - Validating infrastructure
  - Developing low-cost production
  - Researching advanced storage and delivery solutions

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Who is
Air Products?
4

Fast Facts

- Global gases, chemicals, equipment and services provider
- Serving technology, energy, healthcare and industrial markets
- Fortune 500 company: Annual sales >$7.4 B
- Chemical industry safety leader
- Headquartered in Allentown, Pa. and operating in 30 countries on 6 continents; ~20,000 employees
- Known for our innovation and operational excellence

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Diverse Business Mix

Gases and Equipment (75%)

- Cryogenic Air Separation
  - Oxygen
  - Nitrogen
  - Argon
- Hydrogen
- Helium
- Specialty Gases
- Noncryogenic Air Separation
- Equipment And Technology
- Cogeneration Facilities
- LNG Heat Exchangers

Chemicals (25%)

- Emulsion Polymers
- Amines
- Epoxy Additives
- Surfactants
- Polyurethane Intermediates
- Polyurethane Additives

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Focused on Growth

- Key markets / geographies:
  - Electronics
  - Performance Materials
  - Refinery Hydrogen and Energy Solutions
  - Healthcare
  - Asia

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Air Products – World leader in industrial hydrogen

- Largest third-party hydrogen producer – over 50% market share
- Operate over 60 plants – Americas, Europe, Asia
- Produce over 1.25 million tonnes per year
- 7 H_2 pipeline systems around the world (over 350 miles)
- 6 Liquid H_2 facilities
- Supply H_2 purification equipment (cryogenic, PSA, membranes)
- Cryogenic H_2 Tanker manufacturer
- >40 Hydrogen Fueling Stations

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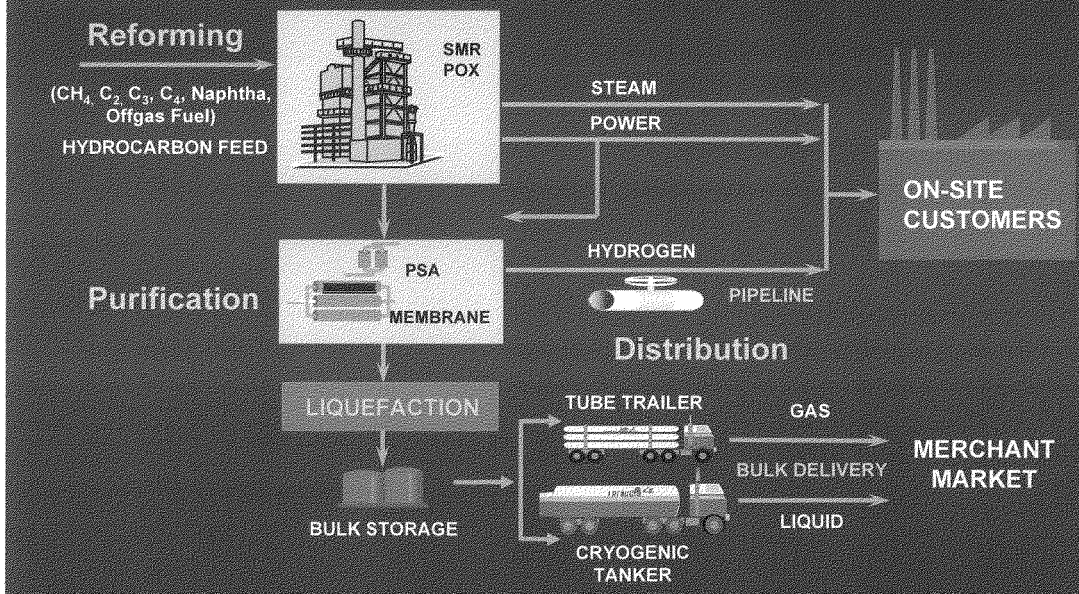
Industrial Hydrogen Production and Delivery Modes



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Hydrogen Safety

Air Product's Outstanding Safety Record

- Over 30 years of hydrogen pipeline operation without a single fire or incident.
- Safely operating over 60 hydrogen production and processing facilities in several countries producing over 1.8 million tons of hydrogen annually.
- Each year, in the U.S., our trailers haul 70 million gallons (265 MM liters) of liquid hydrogen over 8 million miles (12.5 MM km)
- Delivered over 200 million pounds (91 MM kg) of liquid H_2 to NASA

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Air Products and the H_2 Economy

Demonstration Leader

>40 H_2 fueling stations, energy stations, portable fueling

Industry Leader in Safety

- codes & standards team
- KnowH_2ow^{SM} Safety Training

Developing product solutions for the H_2 economy
- sourcing, onsite generation, storage

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Pioneering Hydrogen Fueling Station

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Low-cost H_2 Fueling Options

Series 100 Stations
2-20 kg/day

- Compression
- Storage
- Dispensing
- Flexible H_2 Source
- Portable
- Easy Installation
- Small footprint
- 10 Units Built

Series 200 Stations
20-40 kg/day

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Next Generation Fueling Stations

Penn State Integrated Commercial Fueling Station with On-Site Production

H_2 Fueling Station on the Torrance, L.A. Pipeline

Future-
Los Angeles Torrance Station
Near I-405

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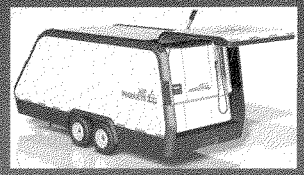
Early Infrastructure Solutions with Portable Fuelers

- Totally self-contained
- DOT and SAE approved
- No site installation
- High reliability
- Zero emissions
- Up to 150kg capacity
- 5000 psig



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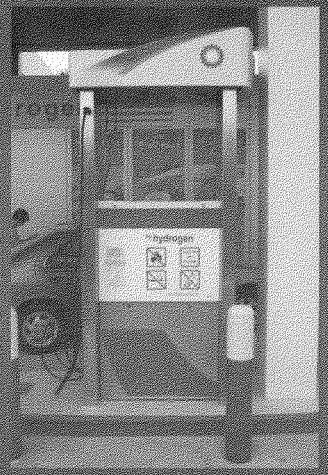
Retail Fueling and Dispensing

Shell Station
Washington DC

Air Products
Dispenser



BP Station
Singapore

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Validating Infrastructure:
The California Hydrogen Project (CHIP)

- Demonstrate lowest-cost model infrastructure in urban and regional settings.
- Anchor station on the LA H_2 Pipeline
  + 13-18 refueling locations statewide
- Drive down the cost of delivered hydrogen:
  - Use current infrastructure
  - Use mobile fueling
  - Use high pressure electrolysis
  - Use onsite reforming
  - Use hybrid station concepts

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Supply Infrastructure Challenge

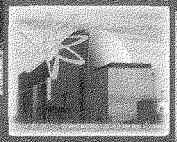
Today

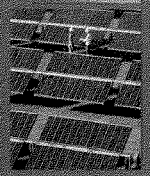
Hydrocarbon-sourced infrastructure exists to support industrial users of hydrogen.

Pathway ?

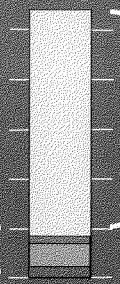
Tomorrow

Multiple-sourced low-cost production infrastructure to support transportation needs.





- USA H_2 Consumption (2003)
  - Industrial Use
  - Refining



total only ~8.3 million TPY

Massive increase ~46 million TPY to support transportation in USA alone.

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Storage and Delivery Challenge

Though Hydrogen has the highest mass energy density of any fuel, it's volumetric energy content at ambient conditions is 1000 X too low for practical applications.

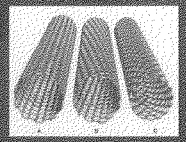
Cryogenic Liquid

Compressed Gas

CHOICES??

Advanced Materials

Chemical Carriers



Metal Hydrides

Carbon Sorbents

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Final Challenge . . . Gaining Public Acceptance

- Hydrogen is available now. We are using it!
- Making a gradual but continual investment in new infrastructure technology to achieve cost reduction validation!
- Remember, today's petroleum and diesel fuel infrastructure wasn't built in a day . . .
- . . . and doesn't need to be replaced in a day!

PREPARED STATEMENT OF BILL HONNEF, VICE PRESIDENT OF SALES AND MARKETING, VERASUN ENERGY CORPORATION

Good morning, Mr. Chairman and members of the committee. My name is Bill Honnef, and I am Vice President, Sales and Marketing of VeraSun Energy Corporation, a renewable energy company headquartered in Brookings, SD The company is the Nation's second largest ethanol producer. We operate a 120-million gallon per year production facility in Aurora, SD and a 110-million gallon per year production facility in Fort Dodge, IA.

VeraSun Energy Corporation is a member of the Renewable Fuels Association, the national trade association for the domestic ethanol industry. The RFA represents the 92 ethanol producing companies located in 20 States across the United States.

I greatly appreciate the opportunity to testify today as the committee examines transportation fuels of the future. With crude oil costs at record highs, declining gasoline inventories and natural gas shortages across the country, it is clear the nation needs to do more to promote the increased production and use of additional energy sources other than petroleum, including domestic renewable sources like ethanol that can help build a sustainable energy future.

Mr. Chairman, I can tell you the United States ethanol industry is already doing its part. The domestic ethanol industry has doubled in size in just the last four years. Today, there are 92 ethanol production facilities with the capacity to process more than 1.5 billion bushels of grain into four billion gallons of fuel ethanol annually. Ethanol today is the third largest consumer of corn, behind only feed and export uses, providing the single most important value-added market for farmers today.

Ethanol is also becoming a ubiquitous component of the United States motor fuels market. Today, ethanol is blended into more than a third of the Nation's gasoline. This level of ethanol production and use is providing significant economic and energy benefits for the Nation.

- In 2004, the ethanol industry added more than $25 billion to the Nation's gross economic output through annual operating spending and capital spending for new plants.
- The industry is now responsible for over 147,000 jobs across all sectors of the economy.
- Ethanol producers spent more than $3.1 billion on grain, using 13 percent of the corn and sorghum crops and becoming the third largest consumer of each, behind only feed and export. In fact, at a time when export markets are stagnating or declining, ethanol is providing farmers a critically important value added market.
- Another $4.4 billion went directly to consumers this past year through increased economic activity and new jobs—money that will go to pay for school shoes and college tuition and putting food on the table.
- And Federal and State Governments collected almost two-and-a-half billion dollars in needed tax revenues from the ethanol industry.

Domestic ethanol production displaced approximately 400,000 barrels of oil a day in 2004, about the volume of oil the United States imported from Iraq prior to the war. And the environmental benefits are significant also. According to Argonne National Laboratory, the use of ethanol in 2004 reduced greenhouse gas emissions by 7 million tons, or the equivalent of taking more than a million cars off the roads.

INDUSTRY GROWTH

Mr. Chairman, the tremendous growth in ethanol production continues. As a direct result of the Energy Policy Act of 2005, which includes an historic renewable fuels standard (RFS), ethanol producers are expanding at an unprecedented rate. There are 24 plants and seven expansions under construction today that when complete will add nearly two billion gallons of additional production capacity. This represents nearly a 50 percent growth in ethanol production capacity. And, there are literally scores of additional projects seeking financing or in various other stages of development.

Mr. Chairman, last week you heard from the oil industry about the challenges associated with expanding domestic oil refining capacity. Those challenges are real. But it is important to realize that new ethanol refineries are coming online throughout the country at a pace of almost one per month. We are expanding domestic fuel supplies. Unlike the issues that face oil refinery sighting, communities are encouraging and sometimes competing to have new refineries to be built in their back yard. This is due to the simple fact that these communities benefit from the additional demand for the feed source for ethanol production, corn. Processing corn into

fuel creates local demand for corn, increasing the price of corn in the local market, which creates local economic development. It is a clear win-win.

As the industry grows, it is changing. The industry is no longer a Midwest phenomenon. Ethanol plants are now under construction from California to Texas to New York. There is even a great deal of interest in producing ethanol in Oklahoma! The industry is also no longer dominated by a few large agribusinesses. Indeed, taken as a whole, the single largest ethanol producer today is the farmer-owned ethanol plant, as farmers have recognized the benefits of being energy producers and not just energy consumers.

Importantly, today's ethanol industry is becoming more and more energy efficient with new production facilities using the latest and most efficient technologies. According to the most recent analysis by the U.S. Department of Agriculture, ethanol now yields 167 percent of the fossil energy used to grow, harvest, transport and refine grain into ethanol. That represents a 24 percent improvement in efficiency since USDA completed a similar analysis just four years ago.

There will be other changes as well, including perhaps new feedstocks. Indeed, I would like to take this opportunity to thank you, Chairman Inhofe, for your leadership in supporting efforts to speed the commercialization of technologies that will allow us to expand the feedstocks from which we can produce ethanol. The inclusion of the Cellulosic Biomass Ethanol and Municipal Solid Waste Loan Guarantee Program in your committee's fuels bill and in the final Energy bill will help our industry with the commercial demonstration of these promising technologies.

Commercialization of the technologies needed to produce ethanol from agricultural residues (wheat straw, corn stover, etc.) could add significantly to the amount of fuel currently produced from domestic resources. As they develop, cellulose conversion technologies will allow more energy to be extracted from each acre of energy crop. These new biorefineries would also bring hundreds of permanent, high-paying jobs to rural America. We hope you will encourage the Department of Energy to commit funds to using the authority they were given by your legislation.

ENERGY BILL/RENEWABLE FUELS STANDARD

As noted, virtually all of this growth and the positive changes occurring in the industry are as a result of the energy bill and the RFS passed earlier this year. I would like to commend Congress for its foresight in creating this important program. If the terrible events along the Gulf Coast taught us anything this past summer, it is that we must diversify and expand our domestic energy resources. Congress had done that with the RFS, but Congress can and should do more. I must specifically praise the leadership of Senator John Thune, who has seen first hand the efficacy of expanded ethanol production as South Dakota's economy has been transformed over the past several years by the value-added benefits of ethanol.

The RFS included in the Energy Policy Act of 2005 boosts the demand for renewable fuels such as ethanol and biodiesel to 7.5 billion gallons by 2012. It provides certainty to farmers and ethanol producers that markets will exist for their product while providing refiners with the flexibility they have sought in meeting Clean Air Act requirements by eliminating the federal RFG oxygen standard. The law maintains the existing clean air benefits of Federal reformulated gasoline (RFG) with strong anti-backsliding provisions.

Importantly, the RFS does not require that any renewable fuels be used in any particular area, allowing refiners to use these fuels in those areas where it is most cost-effective. Moreover, there are several provisions allowing the requirement to be adjusted or eliminated if supply problems occur. Small refiners are exempted from the RFS for several years, allowing those companies an easier transition to the program.

The ethanol industry is well prepared and on track to produce more than the 4 billion gallons of renewable fuels required in 2006 under the law. The Renewable Fuels Association is currently working with EPA and other stakeholders to expedite an interim rulemaking that will allow the RFS to be implemented on schedule without unnecessarily complicating the marketplace for refiners. The industry intends to work to assure the RFS credit trading program is implemented as intended, providing maximum flexibility to refiners.

E85

E85 is a blend of 85 percent ethanol and 15 percent gasoline. It is designed for use in flexible fuel vehicles (FFVs). With approximately five million flexible fuel vehicles on the road today, E85 has great potential as an alternative fuel. But, because flexible fuel vehicles can run on both gasoline and E85, most owners are not

aware they are driving an FFV and simply use gasoline. Our research indicates that nearly 70 percent of flexible fuel vehicle owners are unaware they are driving one.

Based on these research findings, we launched VeraSun E85, or VE85 for short, the Nation's first branded E85 early this year. The program is founded on three basic principles:

- E85 must be widely available and convenient to the consumer;
- E85 must be priced fairly; and,
- An E85 rollout must be accompanied by a comprehensive consumer awareness campaign.

In May, we began the program with the conversion of 35 pumps at stations throughout the Sioux Falls, SD metro area. Simultaneously, we launched a marketing program to raise awareness to the benefits of FFV ownership and E85 use. The program is still ongoing today and includes elements such as adverting, direct mail, point of purchase marketing, and retailer education. The community is embracing the fuel as a viable alternative to gasoline.

VeraSun enlisted the support of General Motors, various local car dealerships, the National Ethanol Vehicle Collation, and other organizations across the state to assist with the rollout of the program. As a result, E85 awareness has increased, E85 fuel sales are increasing, and the demand for flexible fuel vehicles is up in the local market.

The success of the program attracted national attention, and the attention of Ford Motor Company. In early November, we announced a first-of-a-kind partnership with Ford to expand VE85 to other markets in the Midwest. The initiative will serve to convert existing fuel pumps to VeraSun's branded E85 -VE85- in existing retail outlets. A consumer awareness campaign to promote the benefits and use of E85 and FFV ownership will also be launched. Local retail outlets and Ford dealerships will be asked to participate in the campaign.

Increasing FFV production and E85 use represent the best near-term solution to significantly reduce our dependence on foreign oil. But a complex interplay between four constituent groups must be recognized before E85 will succeed as a mainstream alternative:

- Auto Manufactures-Auto manufactures hold the keys to the future of greater E85 use. Today FFVs represent approximately two percent of all vehicles. Without a significant ramp up in the production of FFVs, E85 use will remain relatively small.
- Ethanol Producers-The ethanol industry must continue to rapidly expand production of ethanol to assure that ample supplies will be available.
- Fuel Retailers-Today only 500 of the nearly 180,000 retail stations offer E85. In order for retailers to offer E85, the owner must have confidence that the product will be priced appropriately and that there will be sufficient consumer demand. Without greater FFV production and ample supplies of ethanol, the retailer will not see the value.
- Consumer-Consumers are demanding alternatives. Consumer must be made aware that today they have a choice when purchasing a vehicle and filling the vehicle. The fact that nearly 70 percent of these vehicle owners are not aware that they have a choice indicates that much more work needs to be done.

With Ford as a partner, we believe we can make great strides in all areas.

CONCLUSION

Mr. Chairman, as this committee contemplates future motor fuel markets, please recognize that ethanol is a viable bridge to the future. Today ethanol is blended into one-third of the nation's fuel as a clean blend component. As we see growth in FFV production, ethanol will play a larger role in gasoline replacement. And in the future, ethanol shows great promise as a renewable feedstock for hydrogen fuel cells.

VeraSun Energy Corporation and the Renewable Fuels Association are committed to working with you and members of the committee to promote the use of alternative, renewable fuels such as ethanol and biodiesel to ensure a reliable fuel supply, lower consumer fuel costs, protect the environment and stimulate further growth and development in communities across rural America. We are also committed to the expanded use of E85 to further reduce the nation's deepening dependence of foreign oil.

Thank you.

RESPONSE BY BILL HONNEF TO AN ADDITIONAL QUESTION FROM SENATOR OBAMA

Question 1. Are you finding obstacles in your efforts to expand the availability of E85 at local retail locations, particularly branded retail stations? Could you share some examples? What changes would you recommend to the business policies of retail stations that would encourage greater availability of E85 to consumers?

Response. While the recently enacted Renewable Fuels Standard provides a baseline for ethanol demand in the United States, VeraSun Energy believes that we must work hard to do more to lessen our dependence on foreign oil and expand the use of renewable fuels like ethanol.

As my testimony highlighted, VeraSun is aggressively working to increase the usage of ethanol by increasing the availability of and demand for E85. To this end, we launched VeraSun E85, or VE85 for short, the Nation's first branded E85 with the conversion of 35 pumps at stations throughout the Sioux Falls, SD, metro area in May 2005. More recently we added 20 stations in the Chicago metro area. We are now aggressively seeking to expand to additional metropolitan areas.

We have found that independent branded gas stations (those neither owned by a large oil company nor governed by one of their franchise agreements) are much more receptive to offering E85 than those carrying a major oil company brand. In a recent survey of just over 300 of the approximately 580 gas stations in the United States that offer E85, it was found that 91 percent of those stations offering E85 are independent stations. Only nine percent were branded retail stations, either directly owned and operated or franchised by a major oil company.

This fact is consistent with our experience and is why we are currently focusing our efforts on expanding the use of E85 at independent gas stations. After our successful launch in Sioux Falls, franchise owners of a specific major brand were told by their franchisor that non-branded fuels could not be sold or distributed to consumers at branded fuel islands or under branded canopies at their stations.

As my testimony at the hearing indicated, one of the fundamental principles of expanding E85 use is that it must be widely available and convenient to the consumer. This major oil company's policy creates an artificial barrier to increasing the availability of E85 by forcing station owners to install new equipment outside of normal traffic patterns. This artificial hurdle obviously impacts the franchise owner's ability to offer E85 at their stations since the major oil company does not provide E85 fuel.

While we will continue to aggressively market E85 across the country, it may take pressure from elected officials to convince the major oil companies to embrace E85 in a meaningful way. Anything that can be done at the Federal level to help facilitate the sale of E85 at the same pump as other blends of gasoline at branded gasoline stations will help in the promotion and growth of the use of E85 in the United States.

The State of Iowa specifically prohibits a franchisor (i.e., major oil company) from prohibiting a franchisee from purchasing ethanol-blended gasoline from a source other than the franchisor or limiting the quantity to be purchased when the franchisor does not normally supply the franchisee with ethanol-blended gasoline. We think this line of reasoning has merit. If a major oil company is going to offer a competitively priced branded E85 product to its franchisees, then they may have a right to ask that a competitor's E85 not be sold under the canopy. But if they are not going to offer E85, they should not be allowed to block the sale of E85 if a station owner wishes to offer it.

Our goal should be to decrease our dependence on foreign oil and increase our energy independence. We believe that E85 provides a real opportunity to do so, but we must dramatically increase the percentage of gas stations in the country that offer E85 from .3 percent, and the major oil companies must be involved in this effort.

PREPARED STATEMENT OF JACK B. HOLMES JR., PRESIDENT AND CEO, SYNTROLEUM CORPORATION

Good morning Mr. Chairman and good morning to other members of this committee. Syntroleum appreciates the opportunity to speak to you today about transportation fuels of the future. My name is Jack Holmes, and I'm the president and CEO of Syntroleum, which is a company based in Tulsa, Oklahoma that is focused on developing ultra-clean fuels utilizing Fischer-Tropsch technology.

Syntroleum would like to touch on several areas this morning, which include:

- The supply and demand issues across the world.
- Our nation's dependency on foreign energy.

- Benefits of Fischer-Tropsch fuels.
- And finally, coal-to-liquids opportunities in the United States.

Across the world, we continue to see energy demand increase at rates greater than the growth of their domestic supplies. This trend is especially true in the United States, China and India. Eight years ago, China was a crude oil exporter. According to the U.S. Department of Energy, China alone faces major oil shortages of 5.9 to 8.8 million barrels per day by 2015. This problem will not get better, it will only get worse.

Recently, we witnessed the immediate negative impacts of unexpected disruptions to our Nation's refineries and natural gas processing facilities in the Gulf of Mexico as the result of Hurricanes Katrina and Rita. It's apparent that our Nation needs additional energy resources, and we need to diversify our energy infrastructure away from the Gulf of Mexico.

Our Nation is too dependent on foreign energy. The United States currently imports about 60 percent of its crude oil and refined product requirements. It doesn't have to be this way.

Our future economic and energy security rests upon our ability to effectively utilize our domestic sources of fuels. The world supply and demand balance dictates that we use our clean coal technology for development of secure domestic motor fuel.

Syntroleum has spent 20 years advancing Fischer-Tropsch technology to produce ultra-clean transportation fuels.

Syntroleum often categorizes Fischer-Tropsch technology as going back to the future because it was developed in the 1920s in Germany. Back then, Germany was facing decreasing domestic energy supplies, so researchers developed Fischer-Tropsch technology to allow companies in Germany to convert coal into fuel.

Other companies in places such as South Africa have also utilized Fischer-Tropsch technology to develop fuels, where over 1.5 billion barrels of Fischer-Tropsch fuels have been produced from coal over the last 50 years. Our technology is real and now this country needs it.

With over 270 billion tons of proven reserves, the United States is the Saudi Arabia of coal. Much of this coal is located in remote areas of western and midwestern states. Our plan is to build at or near mine mouths to maximize transportation savings. If we convert just 5 percent of the estimated recoverable coal reserves in the United States, it would be equivalent to the existing 29 billion barrels of proven oil reserves in the United States. This data is significant for our country and can no longer be ignored. We could virtually double our motor fuel supply without drilling a single well. And, we wouldn't need to build another refinery because our technology demonstrates that the ultra-clean middle distillate fuel can be developed on site, where the coal reserves are located. A growing coal-to-liquids industry would produce good, high-paying jobs for decades to come.

Because most of this coal is disbursed throughout the heartland of the United States, it removes concerns about hurricanes in the Gulf of Mexico and potential terrorist acts by sea.

Based on our 20 years and $200 million of Fischer-Tropsch research and development, Syntroleum is prepared to deploy its cobalt-based Fischer-Tropsch technology together with existing coal gasification technology for the production of ultra-clean transportation and home heating fuels. Our research has revealed significant findings about the products, including:

- Our fuels have virtually no aromatics, no sulfur and are non-toxic and biodegradable. You can actually drink this fuel.
- Our fuels can be used as a blending stock to meet environmental requirements and dramatically extend the volume impact.
- Our fuels are completely compatible with today's infrastructure, meaning no hidden infrastructure cost.
- Our fuel will work in today's diesel engines with no modifications.
- And, our fuel can be used by the military. In fact, we have done extensive research with the U.S. Department of Defense to test single battlefield fuels.

(See attachments for environmental properties of fuel)

The Government does not need to fund this new industry. However, support from the U.S. Government for the first coal-to-liquids plants will be critical. Syntroleum applauds this Congress for their actions this year in passing the Energy Policy Act of 2005. This bill was a step in the right direction in developing a long-term energy strategy by providing funding for research and development of clean-coal initiatives and loan guarantees associated with the construction of commercial scale coal-to-liquids plants. The recorded vote shows the bipartisan support for the need to research alternative forms of energy and the growing interest in clean coal and coal to liquids technologies.

Syntroleum urges the Government to follow through with its commitment to dedicate money for loan guarantees and mandate long-term contracts to purchase Fischer-Tropsch fuels. We believe that the first coal-to-liquids plant will have a significant impact on the capital market to fund additional plant projects.

Recently, this committee held hearings on the proposed Gas PRICE Act, S. 1772. As a revolutionary industry still in its infancy, coal-to-liquids technology can look forward to many advances in the years ahead. Improvements already under evaluation will continue to reduce capital and operating costs, increase plant energy and carbon efficiency, and permit continued scale-down of plant size. By introducing this bill, Senator Inhofe recognizes the benefit this country would receive in bringing clean fuels to the market sooner rather than later.

We encourage government to accelerate the rule making to enable the energy bill to take effect and continue down the path of supporting innovators to meet today's energy needs, which can be done by creating an environment of regulatory certainty and favorable market conditions for the development of alternative energy supplies. The downstream effect translates into more jobs in this country, not overseas, and heads us toward a future reduction in our dependence on foreign sources of supply.

Americans today are worried about the high cost of fuel, and rightfully so. The effects of Katrina alone are estimated at several billion in increased motor fuel cost. Whether it's filling their automobile tanks or heating their homes, Americans are being hit in their pocketbooks because of our nation's dependency on foreign oil and our limited refining capacity. But, we don't have to continue down this path of energy instability. Ultra-clean, coal-based Fischer-Tropsch fuels can have a significant impact on the energy supply balance in the United States.

In closing, Syntroleum believes that consumers, regulators, policy makers, environmentalists and progressive energy companies can agree on one crucial point—responsible use of our resources and the protection of the environment is not the job of just one, but of everyone. Focusing on alternative energy—such as coal-to-liquids development—will not only enhance and diversify our energy supply and offer a cleaner product, but can provide thousands of jobs and boost our national security. There are significant opportunities to create new sources of energy right in front of us here at home. Now is the time to embrace these proven technological advancements and start securing our energy independence.

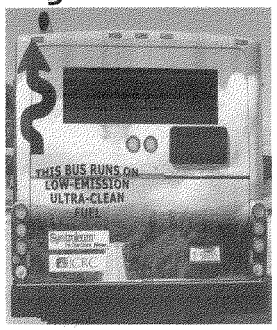
In summary, we depend on motor vehicles in this country. We need to depend less on foreign supply and create jobs utilizing our own technology and natural resources.

Mr. Chairman, members of the committee, thank you for allowing me this time to speak about the transportation fuels for the future.

Clean Fuels, Easily Sold

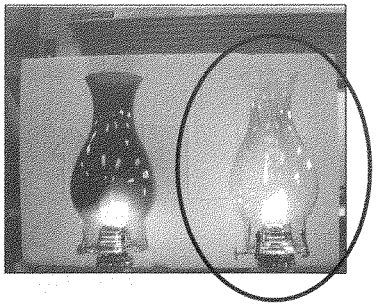
Syntroleum

Property	Current EPA Diesel	2006 EPA Diesel	Current E.U. Diesel	Syntroleum GTL Diesel
Sulfur (PPM)	350	10	50	0
Aromatics (%)	30	30	N/A	0
Cetane Number	45	45	49	74+



Syntroleum GTL Diesel –

- Can be sold in existing markets
- Compatible with existing infrastructure (pipelines, storage terminals, retail pumps)
- No sulfur or aromatics
- Biodegradable and non-toxic
- Performs better than conventional diesel
- Valuable blending stock to meet new guidelines



Syntroleum Diesel Burns Cleaner Than Regular Diesel

1

Assessment of Fischer-Tropsh Fuel for Military Use in 6.5L Diesel Engine

Patsy A. Muzzell
US Army
Research, Development and Engineering Command (RDECOM)
Tank-automotive Research, Development and Engineering Center (TARDEC)
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Presentation Content

Fuels

- Single Battlefield Fuel Policy
- Fischer-Tropsch (FT) fuel (emissions and lubricity testing)
- Reference fuel (emissions testing)

Exhaust Emissions Testing

- 2 different transient cycles
- FT fuel versus reference fuel

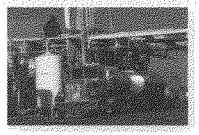
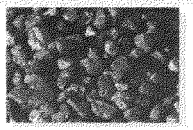
Fuel Lubricity Testing

- Rotary injection pump evaluations
- Bench-top tester evaluations

Summary

Single Battlefield Fuel

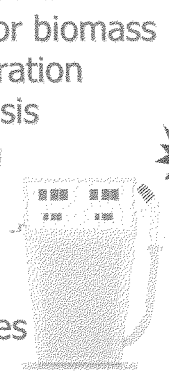
Using Fischer-Tropsch (FT) synthesis, produce conventional-like fuels from variety of non-petroleum feed stocks

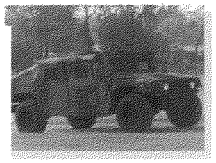
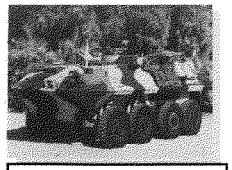
natural gas or coal or biomass
+ syngas generation
+ FT synthesis
+ refining

FT Jet A-1

+
Additives



Finished FT Fuel
Forward:
FT JP-8 / FT JP-5

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Fischer-Tropsch (FT) Fuel Evaluated

Synthetic aviation turbine fuel

- Manufactured by Syntroleum Corp., designated "S-5"
- Produced with properties similar to a JP-5
- Emissions and lubricity evaluations

Reference Fuel for Emissions Testing

Low Sulfur Certification Diesel Fuel (LSCD) Specification

Property	*ASTM Method*	*CFR Spec.*, Type 2-D*
Cetane Number	**D 613**	**40–48**
Distillation Range, °C	**D 86**	
IBP / 10% Point		**171–204 / 204-238**
50% Point		**243–282**
90% Point / EP		**293–332 / 321-366**
Gravity, API	**D 287**	**32–37**
Total Sulfur, wt %	**D 2622**	**0.03-0.04**
Aromatics, vol % (min.)	**D 1319**	**10**
Flashpoint, °C (min.)	**D 93**	**54**
Viscosity, 40°C, mm^2/c	**D 445**	**2.0-3.2**

* CFR40-Part 89-Subpart D-Appendix A-Table 4, non-road CI engines

Fuel Properties

Property	*Units*	*LSCD [ASTM Test]*	*S-5 [ASTM Test]*
Density	**kg/L**	**845** [D 287]	**765** [D 976]
Total Sulfur	**wt %**	**0.037** [D 2622]	**<0.0001** [D 5453]
Aromatics	**vol %**	**30.9** [D 1319]	**<1.0** [D 4052]
Cetane No.		**47.9** [D 613]	**765** [D 976]
Distillation		[D 86]	[D 86]
IBP	**°C**	**190**	**186**
10%	**°C**	**223**	**196**
50%	**°C**	**260**	**220**
90%	**°C**	**309**	**254**
EP	**°C**	**358**	**271**
Flashpoint	**°C**	**62** [D 93]	**64** [D 93]
Viscosity, at 40°C	**mm^2/s**	**2.48** [D 445]	**1.67** [D 445]

Emissions Testing Overview

Objective

- Determine emissions difference with direct replacement of LSCD fuel with FT fuel in diesel engine of interest to the military

6.5L Diesel Engine

- Used in High-Mobility Multipurpose Wheeled Vehicle (HMMWV)
- 8-cylinder indirect injected
- 2002 model
- Rated power of 160 hp at 3400 rpm

Transient Test Cycles

- Federal Test Procedure (FTP) Hot-start Transient [CFR40, Part 86]
- Non-Road Transient Composite (NRTC) [69 FR 38957-39273]
  - formerly known as San Antonio Transient (SAT)

Emissions Testing Protocol

Per Federal Test Procedure

- Calibrate instruments, validate sampling systems
- Purge fuel supply, change fuel filters
- Operate engine at rated speed+load to validate power capability
- Conduct transient "full throttle" torque map, save resulting transient command cycle
- Conduct duplicate tests, measure pollutants and fuel use

Notes

- LSCD torque map used to generate both transient test cycles
- Engine speed limited to 3400 rpm

programmed

Test Cycle	*Rated Speed*	*Max. Cycle Speed*
Hot-Start Transient	**3100 rpm**	**3412 rpm**
NRTC	**3250 rpm**	**3377 rpm**

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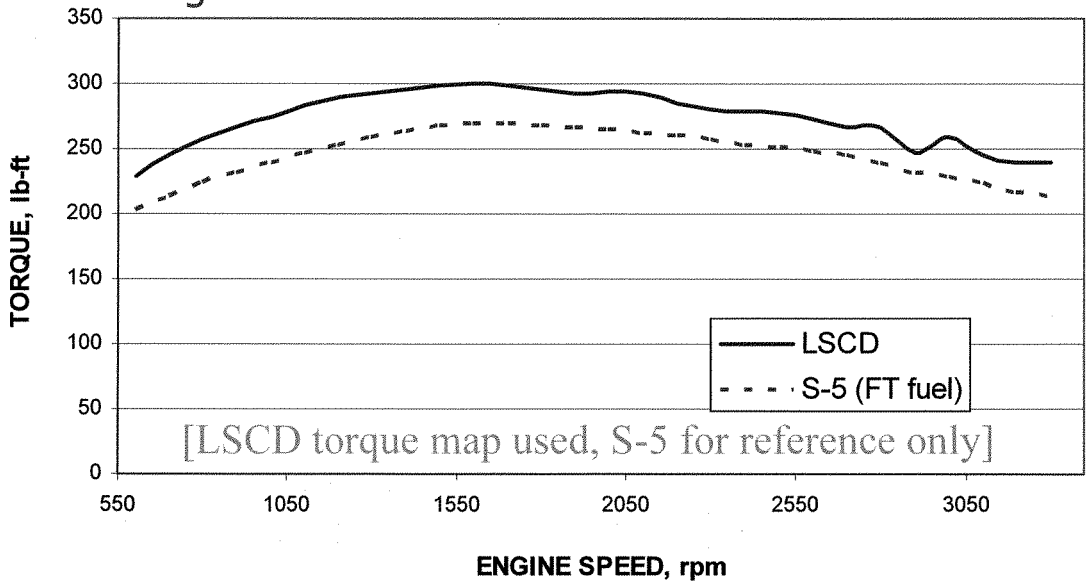
Engine Torque Maps

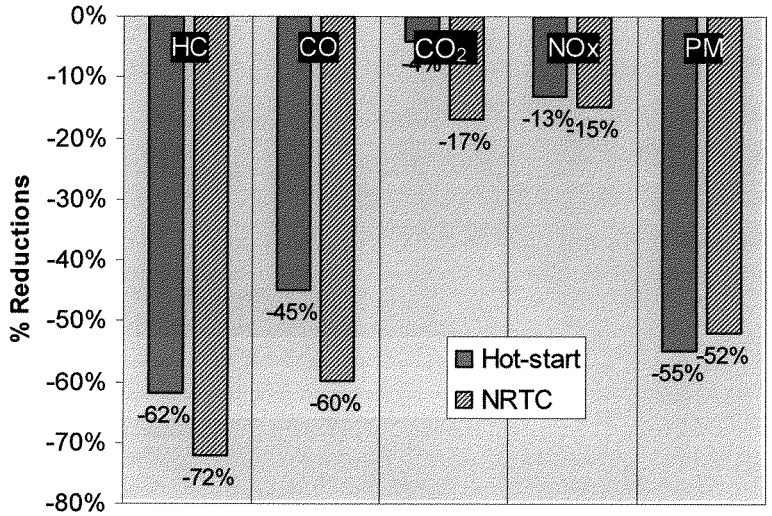
Transient Torque Maps for LSCD and S-5 fuels, 6.5L heavy-duty diesel engine



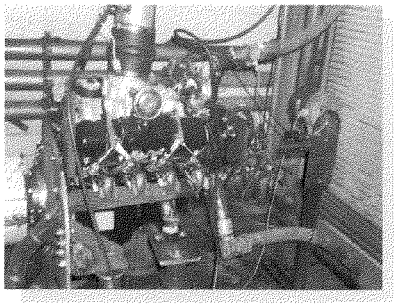
Summary of Emissions Results

Test	Fuel	Brake Specific Emissions (g/bhp-hr)					Work (hp-hr)	BSFC (lb/bhp-hr)
		HC	CO	CO2	NOx	PM		
NRTC	LSCD	0.72	3.23	788	3.53	0.155	16.7	0.551
	S-5 (FT fuel)	0.20	1.28	735	3.01	0.074	17.5	0.523
Hot-start Transient	LSCD	0.96	3.45	779	3.58	0.253	9.3	0.546
	S-5 (FT fuel)	0.36	1.87	752	3.12	0.114	9.5	0.536

Emissions Reductions with FT Fuel



Reduced exhaust emissions with FT fuel relative to low sulfur certification diesel fuel as determined for transient test cycles in 6.5L diesel engine



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Fuel Properties Influence Emissions

Properties influence on emissions typically intercorrelated

Higher cetane no. → less NOx

- reduces ignition delay, premixed combustion
- slower rise in combustion pressure

Lower density → less PM

- from prior studies, especially for older polluting engines
- can lead to large increase in HC, but in this case higher cetane no. appears to outweigh counter-effect of lower density

Property	*LSCD*	*S-5*
Density, kg/L	**845**	**765**
Viscosity at 40°C, mm^2/s	**2.48**	**1.67**
Cetane No.	**47.9**	**69.3**
Aromatics, % vol	**30.9**	**ND**
Sulfur, ppm	**370**	**<1**

Pollutant	*% Reduction S-5 vs. LSCD*
HC	**62-72**
CO	**45-60**
CO_2	**4-17**
NOx	**13-15**
PM	**52-55**

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Lubricity Testing Overview

Objective

- Evaluate the lubricity of FT fuel and its response to lubricity improver (CI/LI) approved for use by the military in standard testing protocols typically used to assess military fuels

Rotary Fuel Injection Pump Evaluations

- Rotary injection pumps are fuel lubricated
- Used in HMMWV

Lubricity Bench-top Tester Evaluations

- ASTM test methods typically used to assess diesel fuel lubricity
  - High-Frequency Reciprocating Rig (HFRR)
  - Scuffing Load Ball-on-Cylinder (SLBOCLE)
  - Ball-on-Three-Disks (BOTD) [proposed, not approved method]
- ASTM test method typically used to assess jet fuel lubricity
  - Ball-on-Cylinder (BOCLE)

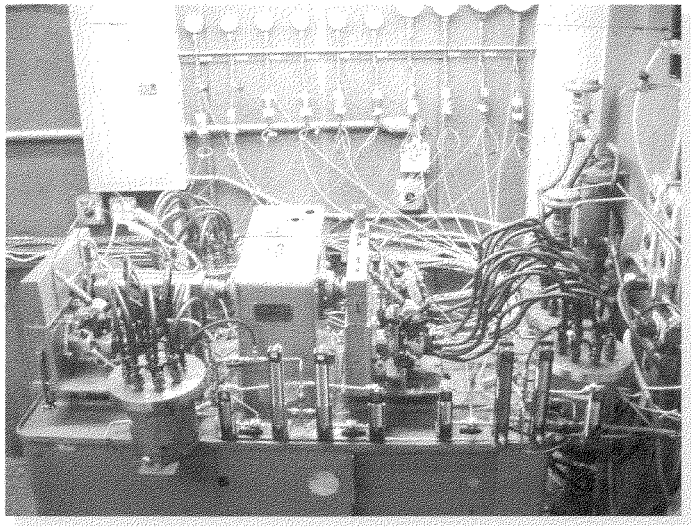
2004-01-2961

Rotary Fuel Injection Pump Testing

Test Protocol

- Similar to proposed ASTM test method "Evaluating Diesel Fuel Lubricity by an Injection Pump Rig"
- Stanadyne "Artic" pumps (GM)
  - opposed-piston, inlet-metered, positive displacement, rotary-distributor, fuel-lubricated
  - Roller-to-roller dimensions pre-set per Stanadyne specs
- Pumps operated at 1800 rpm, fuel levers in wide-open throttle position, for targeted 500-hour test
- Conduct duplicate tests on "matched" pump pairs
- S-5 fuels tested
  - Untreated
  - Treated with CI/LI (per QPL-25017)

Rotary Fuel Injection Pump Stand



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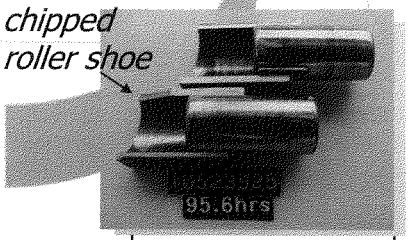
Rotary Fuel Injection Pump Test Results

Test	Pump	Duration (hours)	Pre-test (mm)	Post-test (mm)	Change (mm)	S-5 Fuel CI/LI, mg/L
1	1	95.6	5.017*	5.113	0.096	None
	2	150.7	5.017	5.085	0.068	
2	3	500	5.017	5.024	0.007	12 (minimum treat level)
	4	500	5.017	5.011	-0.006	
3	5	500	5.017	5.022	0.005	22.5 (maximum treat level)
	6	500	5.017	5.019	0.002	

*= Roller-to-Roller Dimension Pump Assembly Specification is 5.017 cm ± 0.001 cm

Treated fuel tests go to 500 hours with minimal wear — indicative of acceptable field performance

Excessive wear occurred with untreated fuel



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Summary of All Lubricity Test Results

Test Description	ASTM Test Method	S-5 (FT fuel) untreated	+12 mg/L CI/LI (minimum)	+22.5 mg/L CI/LI (maximum)
High-Frequency Reciprocating Rig HFRR at 60°C, wear scar diameter (μm)	D 6079	**629**	**662**	**668**
Scuffing Load Ball-on-Cylinder SLBOCLE, load (g)	D 6078	**975**	**1450**	**1333**
Ball-on-Cylinder BOCLE, wear scar diameter (mm)	D 5001	**0.95**	**0.76**	**0.68**
Ball-on-Three-Disks BOTD, wear scar diameter (mm)	(Not approved) dated 09/00	**0.786**	**0.649**	**0.59**
Rotary Pump Testing test hours for pump 1, pump 2	similar to D 6898	**96.5, 150.7**	**500, 500**	**500, 500**

Notes
1) ASTM D 6079 repeatability is 80 micrometers
2) ASTM D 6078 repeatability is 900 g

HFRR not sensitive to addition of CI/LI; SLBOCLE shows trend of improved fuel lubricity with addition of CI/LI

BOCLE, BOTD are sensitive to addition of CI/LI

2004-01-2961

Summary

The FT Fuel (S-5) evaluated was found to --

- produce less emissions than LSCD in 6.5L heavy-duty diesel engine during transient test cycles
  - 62-72% less HC
  - 13-15% less NOx
  - 52-55% less PM
- have poor fuel lubricity as untreated fuel
- have improved fuel lubricity when treated with military approved lubricity improver
  - lubricity improved to acceptable levels as determined in rotary injection pump testing
  - lubricity improvement detected by some bench-top test methods

RESPONSES BY JACK B. HOLMES JR. TO ADDITIONAL QUESTIONS FROM SENATOR OBAMA

Question 1. I understand that the Energy bill provides loan guarantees for the construction of coal-to-liquids facilities.

Response. Yes. The loan guarantees as outlined in the Energy Policy Act of 2005 ("Energy bill"), specifically TITLE XVII "Incentives for Innovative Technologies" provide the foundation for technologies, such as Syntroleum's proprietary Fischer-Tropsch process, to develop a domestic coal-to-liquids ("CTL") industry to assist in meeting our Nation's long-term energy requirements.

Question 2. Is it essential for the commercial success of your technology within a reasonable timeframe?

Response. Yes. It is essential that Congress fully fund the loan guarantees and the research and development programs as outlined in TITLE IX of the Energy bill to expedite the development of a domestic CTL industry to make the necessary first steps to reduce our reliance on foreign sources of energy. These provisions provide a crucial component required for small United States based companies to compete in the most capital intensive industry.

To facilitate the development of a CTL industry within a reasonable timeframe strong consideration should be given to a loan guarantee program specifically outlined for CTL projects similar to the legislation enacted by the Congress to develop the ethanol industry during this session. It is critical to move forward quickly as commercial scale CTL plants have a construction schedule of 4 to 5 years.

Question 3. Is it your sense that the Department of Energy intends to move forward with this loan guarantee? Is it as the speed that you find helpful, and if not, do you have recommendations as to how Congress can encourage the Department of Energy to pursue swifter implementation?

Response. Yes. Based upon my meetings with Department of Energy officials I am encouraged that the current DOE administration is supportive of the development of CTL plants. The success of this program will depend upon the Congressional funding received by the DOE for both the loan guarantee and research and development programs.

As previously mentioned, the speed of implementation specific to CTL would significantly benefit from Congressional direction to the Department specific to the development of CTL plants, similar to the ethanol loan guarantee provisions in-place. In addition, legislation to expedite the permitting process would reduce the overall timeframe for project implementation. These additional provisions would reduce the timeframe required to initiate the development of a domestic CTL industry to make the necessary first steps to reduce our reliance on foreign sources of energy.

Question 4. Would the economics of commercialization suggest a collaborative effort between your company, Rentech, or Sasol?

Response. Syntroleum welcomes the opportunity to collaborate with other knowledgeable companies in our industry. However, the nature of a developing industry, such as the Fischer-Tropsch industry, does not readily lend itself to a collaborative effort due to the proprietary nature of the technology and the competitive marketplace. The intellectual property of a company, such as Syntroleum, is critical to its success. Any efforts toward collaboration must be tempered to protect the independent growth and development of one's technology. We continue to examine opportunities for collaboration with other parties, provided appropriate safeguard are implemented.

Question 5. I know that Fischer Tropsch diesel can be used as a home heating oil substitute; is your company involved in efforts to address the supply issues associated with seasonal shortages typically faced in the home heating oil industry, and how?

Response. Currently, Syntroleum operates a small natural gas based feedstock (70 barrel per day) Fischer Tropsch demonstration plant located near Tulsa, OK, making this noncommercial facility inappropriate to address this shortage. Our domestic efforts are focused on extending our Fischer Tropsch technology to domestic plants utilizing coal as a feedstock. However, we believe that investment in CTL plants, such as fully funded legislative efforts on loan guarantees and research and development programs, make the necessary first steps to create solutions for this supply issue and other sin the transportation fuels market.

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American Forest & Paper Association
Statement for the Record

U.S. Senate Environment and Public Works Committee
November 16, 2005

Oversight to Examine Transportation Fuels of the Future

The American Forest & Paper Association (AF&PA) welcomes this opportunity to present its views on encouraging alternative automotive fuel technologies. The forest products industry has the potential to be an important resource for producing renewable, bio-based liquid fuels and hydrogen. Integrated Forest Products Biorefineries (IFPBs) represent an opportunity to augment domestic production capacity for renewable alternative automotive fuels using the forest products industry's existing infrastructure. A single medium-sized pulp mill adopting IFPB technology could produce on the order of 7 trillion BTUs/year of hydrogen. Industry-wide annual IFPB production potential is at least 2 billion gallons of ethanol and another 1.09 million barrels (oil equivalent) of other renewable liquid transportation fuels. In addition to re-invigorating a critical sector of the U.S. economy, IFPBs could revitalize the primarily rural communities where our industry is based. Finally, introduction of IFPBs will advance national goals for energy, environmental performance, and economic competitiveness of US industries. Our industry wants to build on the public policy foundation established by the Energy Policy Act (EPAct) of 2005 to realize this potential, for the benefit of both industry and the nation.

The Forest Products Industry

AF&PA is the national trade association of the forest and paper industry and represents more than 200 member companies and related associations that engage in or represent the manufacturers of pulp, paper, paperboard, and wood products. The forest products industry is proud to be one of the nation's primary materials manufacturers, making products that literally touch every facet of our society. Our industry accounts for approximately 7 percent of total U.S. manufacturing output, employs 1.3 million people, and ranks among the top 10 manufacturing employers in 42 states with an estimated payroll of $50 billion.

As is the case with many U.S. manufacturing industries, we face serious domestic and international challenges. Since 1997, 101 pulp and paper mills have closed in the U.S., resulting in a loss of 70,000 jobs, or 32% of our workforce. An additional 67,000 jobs have been lost in the wood products industry since 1997. New capacity growth is now taking place in other countries, where forestry, labor, and environmental practices may not be as responsible as those in the U.S. In addition, globalization, aging process infrastructure, few technology breakthroughs, as well as recent financial performance and environmental concerns, hinder the ability of U.S. companies to make new investments. Each year without new investments, new technologies and new revenue streams, we lose ground to our overseas competitors.

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Agenda 2020: Creating Value Through Innovation

One approach being taken by our industry to address these challenges is represented by Agenda 2020, our industry's technology alliance. Agenda 2020 was initiated in 1994 in partnership with the Department of Energy to improve energy efficiency and accelerate the delivery of new technologies to our manufacturing processes. Now organized as a membership alliance within AF&PA, Agenda 2020 is building on a decade of tangible results to expand its federal and state partnerships, and establish new international and cross-industry collaborations. Current federal partnerships, in addition to the existing efforts with the Department of Energy, include projects with the U.S. Forest Service and the CSREES (Cooperative State Research, Education and Extension Service) programs of the U.S. Department of Agriculture (USDA), as well as the National Science Foundation.

Agenda 2020's technology initiatives leverage these collaborative partnerships to drive innovation in the forest products industry's processes, materials, and markets. Technology objectives are defined to address shared industry and national strategic goals. The research, development and deployment (RD&D) projects coordinated through Agenda 2020 provide the foundation for new technology-driven business models. s***The objective is to create options to meet industry's competitive challenges, while contributing solutions to strategic national needs associated with energy, the environment, and the economy.***

Agenda 2020 builds on our industry's strategic advantage as stewards of abundant, renewable and sustainable forest materials. Since we are also owners of the fundamental infrastructure for its conversion, our industry has the potential to produce new renewable bio-based products – fiber, fuels, chemicals, and power – with "smart" properties and high performance characteristics. Agenda 2020 initiatives are designed to use emerging technologies, such as biotechnology and nanotechnology, coupled with breakthrough advances in process and conversion technologies, to create and capture value from both new and traditional products.

Integrated Forest Products Biorefineries (IFPBs)

Through Agenda 2020's *Advancing the Forest Biorefinery* initiative, the forest products industry can evolve existing infrastructure to develop *Integrated Forest Products Biorefineries (IFPB)* — geographically distributed facilities that process both forest and agricultural materials to produce renewable "green" liquid transportation fuels, hydrogen, and other bio-energy and bio-products. This can be done while preserving existing traditional product lines, creating higher skilled and better paying jobs, strengthening rural communities, and opening new domestic and international markets for forest products companies. These IFPBs would contribute to reducing greenhouse gas emissions and dependence on foreign fossil fuel by substituting domestic, renewable ligno-cellulosic materials as the feedstock for products now derived from nonrenewable carbon. If fully developed and commercialized, these technologies could produce enormous energy and environmental benefits for the industry and the nation both, including contributing to a diversified, more secure national energy supply. ***Early estimates show an industry-wide potential to reduce fossil energy consumption by over 250 TBTUs/yr, with an additional benefit of cutting approximately 40 million tons of carbon emissions annually.***

The general IFPB concept features both cultivation and conversion of ligno-cellulosic materials to produce bio-energy and bioproducts in conjunction with manufacturing traditional forest products. High-quality feedstocks can be cultivated in specially engineered softwood and hardwood plantations. Once the trees have been harvested, IFPBs present opportunities to make bio-based fuels or chemicals at several points in the manufacturing process. Hemicelluloses can be extracted from residuals from wood manufacturing or from wood chips destined for pulping. The hemicelluloses are then converted to ethanol, higher value liquid fuels, and even chemical intermediates. After the wood has been pulped, the residual pulping liquors can be gasified. The resulting synthetic gas can be converted to transportation fuels (including ethanol, Fischer Tropsch liquids, and DME) and hydrogen.

Agenda 2020 is focusing on three component areas to develop and implement the enabling technologies for the IFPB:

- ***Value Prior to Pulping*** seeks cost-effective, high-yield processes to separate and extract selected components from wood prior to pulping, and to process the extracted components to produce commercially viable chemical and liquid fuel products. Researchers are particularly interested in extracting hemicelluloses for conversion to ethanol or a biochemical feedstock. ***With adequate Federal co-investment in demonstration of emerging technologies, commercial-scale demonstrations are possible in 3 years.*** Assuming adoption by 75% of existing Kraft pulp mills, potential annual production of ethanol would be in the range of 1.9 to 2.4 billion gallons.

- ***New Value Streams from Residuals and Spent Pulping Liquors*** addresses the opportunity to manufacture bio-products from the co-products of the pulping process. The objective is to use gasification technologies to convert biomass, including forest residues and spent pulping liquor (black liquor), into a hydrogen-rich synthetic gas (syngas), which subsequently is converted into liquid transportation fuels, hydrogen, power, chemicals and/or other high-value materials. These IFPB processes will maximize utilization of energy streams and minimize waste.

  Past federal funding, matched dollar for dollar by industry, has successfully demonstrated black liquor gasification (BLG) feasibility. Yet further collaborative efforts are needed to address key technical barriers and to demonstrate gasification as an IFPB technology integrated with Kraft pulp mills. ***By reviving Federal policy in support research, development and demonstration (RD&D) of black liquor gasification and the processes to convert syngas to transportation fuels, commercial demonstration would be possible by 2012.*** Early estimates show that a single mill could have daily production of at least 55 million SCF of hydrogen, over half the capacity of a large natural gas-based hydrogen plant located next to a refinery. The industry-wide potential production volume for renewable liquid fuels is 1.09 million barrels.

- ***Sustainable Forest Productivity*** applies biotechnology and nanotechnology breakthroughs to sustainable forestry to manage US forest land at a high intensity to supply affordable, sustainable biomass supplies of high quality. This longer-term research focuses on developing fast-growing biomass plantations designed to produce economic, high-quality

feedstocks for bio-energy and bio-products. From an energy "life-cycle" perspective, these feedstocks could be vastly superior to the current use of crops or residues. In the short-term, IFPBs will draw from an abundant sustainable supply of forest-based biomass (estimated by USDA and DOE to be 368 million dry tons/year), which is 2.5 times current consumption. ***In the long term, the advanced forest management practices and customized biomass cultivation must be enabled by Federal funding of biotechnology and nanotechnology research that will not only augment IFPB yield, but will also lead to healthier forests.***

Table 1: IFPB Production Potential

Description of Process	Product	Annual Production Potential: Broad Industry Adoption	Displaced Petroleum Products
A. Production of Ethanol and Acetic Acid from Extracted Hemicelluloses	Ethanol	1.9 billion gallons	27.5 MM boe
	Acetic Acid	600 MM gallons	6.6 MM boe
B1. Power from Black Liquor Syngas	Electricity	Avoided: 83,400 GWh Export to grid:12,200 GWh	
B2. Fuels, Chemicals & Hydrogen from Black Liquor Syngas	Fuels and Chemicals	4.6 billion gallons	109.5 MM boe
	Hydrogen	5.5 billion SCF	100 MM boe
C. Bio-Diesel from Tall Oil	Bio-Diesel	140 MM gallons	3.3 MM boe
D. Fuels and Chemical from Biomass Syngas	Fuels and Chemicals	1.5 billion gallons	35.7 MM boe

Source: Agenda 2020 Task Group Estimates

Table 1 summarizes our preliminary industry estimates of the production potential from all technologies that could be integrated into a pulp mill to transform it into an IFPB. Broad industry adoption assumes that up to 75% of US Kraft pulp mills implement and integrate the related IFPB technologies. The table does not show the additional potential from manufacturing facilities for wood products and use of forest-based residues from other industry and forest maintenance activities.

Forest Products Industry Role in Alternative Transportation Fuels

The forest products industry is an important partner to achieve national goals related to encouraging production and use of alternative transportation fuels, reducing foreign oil

dependence, increasing the viability and deployment of renewable energy technologies, and creating the US bioindustry. We have much of the infrastructure and expertise – lignocellulosic feedstock harvesting, transportation and storage; manufacturing and conversion infrastructure; waste handling and recovery -- needed for successful commercialization of IFPBs. Raw material already is being supplied to our mills and the potential for doubling that flow exists at most facilities. IFPBs would require only an additional step of pretreatment and/or a modification to recovery processes. We have experience in chemical processing and handling in compliance with related environmental standards and regulations, as well as financial and regulatory experience with large scale procurement and sales of energy and fuels. We also have experience in manufacturing and marketing co-products in addition to our core product lines. In addition, we are located primarily in rural communities where we can realize important synergies between agricultural and forest-based feedstocks, allowing IFPBs to potentially triple production capability over time through the use of diverse lignocellulosic feedstocks. The "Value Prior to Pulping" processes developed for fermentation of complex pentose and hexose sugars found in wood-based hemicellulose can also be applied to complex sugars in agriculture residues such as corn stover. In addition, the gasification technologies of the "New Value Streams" pathway have the potential of using multiple biomass residues as feedstocks.

As a supply source, ***IFPBs at existing forest products mills can readily complement the development of agriculture-derived resources as feedstocks for cellulosic ethanol***, as well as supplement the supply from existing wet and dry mills. Current and projected production of corn-based ethanol will not be sufficient to meet the demand for renewable ethanol. Mandates under the EPAct of 2005 will only accelerate the need for larger volumes of domestically produced, renewable ethanol.

If fully developed and commercialized, the IFPB technologies being pursued by the forest products industry could produce enormous energy and environmental benefits for the industry and the nation both, including contributing to a ***diversified, more secure national energy supply***. IFPBs at existing wood-processing and pulp and paper mills would create a ***geographically distributed supply source*** that is less vulnerable to sabotage and natural disasters, and may provide advantages for transportation and logistics in supplying biofuels and bioproducts to major demand centers. IFPBs would continue to manufacture traditional forest products along with biofuels, allowing us to draw maximum value from renewable forest resources with reduced ***environmental impacts and improved energy efficiencies***. IFPBs would contribute to reducing greenhouse gas emissions and dependence on foreign fossil fuel by substituting domestic, renewable forest-based materials as the feedstock for products now derived from nonrenewable carbon. A portfolio analysis performed by our industry in collaboration with DOE's Industrial Technologies Program (ITP) in 2003-2004 ***quantified some of key potential benefits, including energy savings of 175.72 MM bbl/year, positively impacting the carbon balance by 153.7 MM tons/year, and creating up to 166,700 new jobs.***

The choice of whether to manufacture liquid fuels, hydrogen, electric power and/or chemicals would be driven by mill economics and location. Public policies that accelerate market growth, such as the renewable fuel standards in the EPAct of 2005, can provide an important market signal to drive private/public investments in RD&D need to bring IFPB

technologies into full commercial use. This is especially important to our industry, as our renewable fuel production capabilities will kick in more fully after 2009.

The forest products industry is committed to biorefinery pathways as top technical and commercial priorities. Indeed, demonstration of a commercial scale integrated forest biorefinery is a top priority of the industry technical program coordinated by Agenda 2020. Eight forest products companies, representing well over 65% of industry revenues, currently are investing their own funds in a collaborative project for core technology development, with the objective of having an industrial scale biorefinery demonstration of the fermentation pathway in place prior to 2009. Other similar, smaller scale efforts are taking place throughout the industry. Other companies currently have or are evaluating investments in enabling technology for the thermochemical pathway; demonstration of this IFPB option would allow us to take advantage of a time-sensitive window of opportunity to convert recovery capacity throughout much of the industry.

The technical and commercial risks involved in completing technology development and ultimately demonstration of IFPB technologies are of a scale and complexity that make it impossible for industry to proceed on its own. The need for ***risk mitigation*** is an important factor, as these emerging technologies will be integrated into existing, operating manufacturing infrastructure. In addition, the results of the IFPB technology development and demonstration will be readily transferable not only within the forest products industry, but also across industries for use with other biomass feedstocks that currently are not merchantable. It would also be possible to implement this model in several different geographic regions of the country. Thus there are large "spillovers" to IFPB development and demonstration that will not be captured by the industry partners who are taking the initial risk. The ***large potential social rate of return*** which would more than justify public sector investment.

The IFPB uses an abundant, renewable, sustainable resource: forest material. Because forest material is ***carbon neutral***, the bio-energy it produces helps ***reduce greenhouse gas emissions***. Bio-energy also helps ease dependence on foreign fossil fuel by substituting for products now derived from nonrenewable carbon. By installing key IFPB technologies such as black liquor gasification, ***existing manufacturing facilities could reduce emissions by 80-90 percent.***

Both the US national and regional economies stand to benefit from implementation of the IFPB. Global competition has led to numerous domestic mill closings as production moves overseas. These closings impact mostly rural communities. The IFPB offers an opportunity to preserve high paying, skilled jobs and revitalize manufacturing facilities in these communities – all while creating a new domestic bioindustry based on one of the world's largest sustainable biomass supplies.

These benefits cannot be realized if forest products mills continue to move overseas. Public policies to assist the development of domestic market demand that will make it economically feasible to keep operating existing infrastructure and install IFPBs throughout the country.

Public Policy to Realize This Potential

Our industry welcomes the opportunity to work with the Committee on public policy options that will permit the forest products industry to realize its potential as an important contributor to production and use of alternative transportation fuels.

First, sustained and adequate funding of RD&D partnerships are essential to overcome remaining barriers to achieving IFPB technical goals. For our industry, partnerships with the federal government are essential for accelerating the development and adoption of the new technologies. This is particularly important for the IFPB, where adequate co-investment for RD&D can help mitigate the technical risks (especially integration with capital-intensive, legacy infrastructure) of early adopters of emerging IFPB technologies. **Our industry plans to continue to work with Congress in order to ensure adequate overall funding of the federal research programs for development of enabling technologies for alternative fuel production, such as the joint USDA/DOE biomass research program. We also want to ensure inclusion of forest industry priorities for development and demonstration of IFPB enabling technologies in key research programs within the Department of Transportation and the Department of Defense.**

Second, federally-funded research institutions such as the US Forest Service's Forest Products Laboratory (FPL) are home to scientific expertise and research facilities that the industry relies upon to address IFPB research goals. The FPL's capabilities have been diluted by budget difficulties that have delayed facilities construction and resulted in cuts in scientific staff. **Our industry would like to work with you to ensure adequate resources for research infrastructure and personnel at FPL, to make more effective use of its research capabilities to meet both industry technical needs and USFS mission imperatives.**

Third, there are various definitions for renewable energy, biomass, and cellulosic fuels in federal legislation and in the federal agencies. Wood and other lignocellulosic materials have three primary components: cellulose, hemicellulose, and lignin. Some federal definitions exclude one or more of these key components, all of which can be converted to carbon neutral, renewable energy. At present, many companies in our industry produce energy from both cellulose (ethanol) and lignin (electric power). With IFPB technology, it will also be possible for us to directly convert hemicellulose to ethanol, and convert the lignin-based materials to a variety of bio-fuels and/or chemicals. Some of this technical capability will be transferable to the agricultural industry. **Our industry would like to work with Congress and the relevant federal agencies to construct an inclusive definition of biomass and/or renewable energy which includes the cellulose, hemicellulose, and lignin content of forest materials.**

Fourth, we must work in partnership with government, academia and other industries to ensure that IFPB technologies contribute to viable options for the nation to meet its transportation needs. In addition, funding for technology RD&D must also be accompanied by regulatory and market environments that promote, not penalize, traditional manufacturers for engaging in the production and use of renewable, bio-based alternative transportation fuels. It is imperative that there be an equalization of financial incentives for technology development and demonstration, biofuel production, and market access across all potential suppliers of alternative transportation fuels. **Our industry would like to work with Congress and the Administration to create and**

implement policies that support collaborative, cross-industry RD&D; provide a flexible regulatory environment for demonstration and deployment of emerging technologies; and ensure that the forest products industry is eligible for financial incentives (e.g. tax credits, production subsidies, loan guarantees, etc.) that support development and deployment for alternative fuels technologies.

Next Steps

Transforming forest products mills into IFPBs promises to reinvent the forest products industry and rapidly advance national goals for alternative transportation fuels, environmental performance, and new domestic bioindustry. We look forward to working with this Committee and other Members of Congress to maximize the industry role in contributing to these goals. The forest products industry recognizes that opportunity to advance these goals will build on the foundation provided by the EPAct of 2005 and will require cross-agency authorization of research funding for IFPB technologies. We look forward to working with you to identify other opportunities to ensure that our industry's contributions to national goals are fully realized.

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Written Statement of
The National Mining Association

Before the
Committee on Environment and Public Works
of the
U.S. Senate

November 16, 2005

Oversight Hearing on
"Transportation Fuels of the Future"

The National Mining Association (NMA) appreciates the opportunity to provide its views on "Transportation fuels of the future." NMA is a national trade association representing the companies that mine most of the coal, metals, industrial and agricultural minerals produced in the United States; manufacturers of mining and mineral processing machinery and supplies; transporters; financial and engineering firms; and other businesses related to mining.

Beyond making electricity, modern coal gasification and liquefaction technologies already in use can significantly reduce our dependence on imported natural gas and crude oil. These technologies can enable us to use our 250-year supply of domestic coal – the world's largest coal reserves – in innovative ways that will diversify our energy production, processing and fuel refining capacity away from the concentration in the Gulf of Mexico.

According to the Energy Information Agency (EIA), the U.S. now depends on foreign sources of petroleum for 56 percent of its needs. EIA forecasts that share will increase to nearly 70 percent by 2025 if nothing changes. Our dependence on foreign sources extends to both crude oil and refined products, the later due to the lack of new refinery capacity in the U.S. Our existing refining capacity is stretched to its limits and beyond. America's energy security is challenged by both a dependence on foreign supplies and a geographic concentration of refining capacity.

One solution to these, and other, problems related to the nation's critical need for a reliable and affordable domestic supply of liquid transportation fuels is coal-to-liquids (CTL). CTL fuel technologies are well-established and have been improved by 30 years of U.S. government research and development efforts. These efforts, undertaken directly and through industry partnerships, have produced innovative processes ready for widespread commercialization in the 21st century.

CTL is not a new technology. By 1944, Germany had 25 liquefaction plants that produced up to 124,000 barrels daily and met 90 percent of the nation's needs. In the 1950s, South Africa developed a commercial liquid fuels industry using synthesis gas to produce transportation fuels such as gasoline and diesel. Since the early 1980s, the technology has been developed further and has produced more than 700 million barrels of synthetic fuels. CTL is not new, but advancements over the years mean that the CTL plant of today is modern, efficient and environmentally sound.

Our nation, with its abundant and readily available supplies of domestic coal combined with the nation's critical need for reliable and affordable supply of liquid fuel, should be promoting the commercial development of CTL refineries. There are more than 250 billion tons of recoverable U.S. coal reserves, the equivalent of an estimated 800 billion barrels of oil. This is compared to Saudi Arabia's proven reserves of 260 billion barrels. United States coal can be converted into clean, zero sulfur synthetic oil and oil products at a cost of $35 to $40 dollars per barrel compared to current prices that are averaging over $62 per barrel for oil.

China, which is the world's second biggest consumer and importer of oil after the U.S., is planning a $6 billion investment in new liquefaction plants that would produce 440 million barrels of liquid fuel annually. While the stage is set for rapid commercialization and deployment in the U.S., China with its vast coal reserves and rapidly growing economy currently is ahead of the United States in developing the capability to use coal as a transportation fuel.

A number of factors have discouraged the development of CTL plants in the U.S. First, if oil prices stay above $35 to $40 per barrel, a coal refinery makes economic sense. If the price drops below that range (as it has been for most of recent history), there are no assurances that a coal refinery can remain competitive. The historic volatility of oil prices combined with the relatively steady supply of affordable

transportation fuel until now has made the risks unacceptable to investors.

Second, coal refineries are expensive to construct with capital costs in the $600 million to $700 million range for a 10,000 barrel per day plant. The technical and financial risks of a "first-of-a kind" plant in the United States have discouraged consideration of this type of investment in the past.

Finally, the lead time for a coal refinery, as with all refineries, is a minimum of five to seven years under optimal circumstances.

But, the many advantages of CTL fuels mean that this committee should take steps to encourage its rapid use. The deployment of CTL facilities can improve national and economic security by lessening dependence on foreign oil and substituting plentiful, more affordable U.S. coal. By using this domestic resource, CTL deployment can produce more jobs for Americans and provide a positive influence on the U.S. balance of trade and the economy in general.

From an environmental perspective, CTL is capable of carbon capture. CTL technology also can serve as a bridge to a hydrogen fuel future by linking multiple types of plants into one, such as co-production of liquid fuels, electricity, hydrogen and other products. Further, today's modern coal-to-liquids technologies produce a clean product with low emissions.

Coal reserves are located in 38 states and coal is mined in 26 states representing every region of the country. This means that CTL facilities can be constructed across the country providing a geographic diversity which will reduce threats to energy security which may result from natural or other disasters.

Although existing impediments to wide scale deployment of CTL technologies are challenging, they can be eliminated or mitigated through concerted and focused efforts by government, industry and public support. Targeted incentives designed to overcome current market barriers and streamlined permitting processes that eliminate duplicative information collection and approvals are critical.

The mining industry is all too familiar with multiple permit challenges and repeated appeals. The delays caused by repetitive challenges and appeals can make projects unattractive to lenders who require a return on their investment within a reasonable period of time. This is

particularly true with a first of a kind facility such as a CTL plant where the potential risks set out above are a considerable hurdle to obtaining project financing.

Failure to afford financial incentives as well as reasonable and predictable standards for permit review and approval for coal liquefaction facilities would deny the nation the opportunity to use its domestic resources to address a significant energy and national security challenge.

NMA appreciates the opportunity to provide the committee its views and urges it to take advantage of this opportunity to assume a leadership role in advancing the deployment of coal-to-liquids technology which could have a significant positive effect on our nation's energy and economic future.

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