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VEHICLE AND FUELS TECHNOLOGY: NEXT GENERATION

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND AIR QUALITY

OF THE

COMMITTEE ON ENERGY AND COMMERCE
HOUSE OF REPRESENTATIVES

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VEHICLE AND FUELS TECHNOLOGY: NEXT GENERATION

WEDNESDAY, MAY 24, 2006

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ENERGY AND COMMERCE,
SUBCOMMITTEE ON ENERGY AND AIR QUALITY,
Washington, DC.

The subcommittee met, pursuant to notice, at 1:00 p.m., in Room 2123 of the Rayburn House Office Building, Hon. Ralph M. Hall [Chairman] presiding.

Present: Representatives Hall, Whitfield, Norwood, Shimkus, Radanovich, Bono, Sullivan, Burgess, Ross, Green, and Dingell (ex officio).

Staff Present: Kelly Cole, Counsel; Elizabeth Stack, Policy Coordinator; Margaret Caravelli, Counsel; Anh Nguyen, Legislative Clerk; Peter Kielty, Legislative Clerk; Bruce Harris, Minority Professional Staff Member; Sue Sheridan, Minority Senior Counsel; and Lorie Schmidt, Minority Counsel.

MR. HALL. I would like first to welcome everyone to today's hearing entitled "Vehicle and Fuels Technology: Next Generation," and to thank the two panels that are witnesses for being here today to testify and educate us on this topic. You really do us a great favor by, first, being as qualified as you are and as recognized as you are; and, then, giving us your time today. And that is the way we write laws here. We get people that know more about it than we do, and we listen to them. And we thank you for being here.

The U.S. dependence on foreign oil is a pending national security and economic crisis. While we are working to improve oil production, we must also work toward becoming more fuel-efficient. The U.S. Congress can facilitate that with the production of new technologies that will improve fuel efficiency. Technologies that could have an impact within the next 2 to 4 years is what is really needed.

Historically, we have been focusing on long-term technologies at our national laboratories and universities. And while that is good, we have to consider now, due to the staggering increase in the cost of fuel, technology that can be used in the near term. Major automotive companies have both the financial and manufacturing resources to do what is needed, but I think Congress has to make the greatest difference

by helping smaller companies that don't have those vast resources at their disposal.

I am aware of several technologies being developed with just such potential. For example, there is a new concept for a continuously variable transmission that would reduce both the weight and cost of present-day continuously variable transmissions and improve the fuel efficiency of the vehicle. This same technology also has applications in hybrid electric vehicles, improving their already good fuel efficiency. This technology is available now, but because of limited resources, it will not be in full-scale production for five more years. We have an opportunity with technologies such as this to work together with developing technologies for exploration of oil and gas and to help ease our dependence on foreign oil. And I think we should certainly nurture them.

In regards to hydrogen, regardless of the number of hydrogen fuel vehicles produced, without a reliable and adequate infrastructure, the vehicles are going to be useless. To progress to a hydrogen economy requires large-scale hydrogen production, and I am aware of an effort in Texas where the automobile manufacturers, fossil fuel industry, and the renewable energy industry are coming together as a coalition with this goal in mind. The effort in Texas is boosted by the abundance of domestic resources in the State suitable for the large-scale production of hydrogen, and these new efforts must be encouraged and expanded across the country so that a network of infrastructure is in place to support the vehicles of the future.

I believe we have a lot to look forward to. It is a very exciting time in our history as we look for new ways to build and power our vehicles. There are many promising developments, several of which we will hear about today, not only with new next-generation vehicle technology, but also the fuels that make them run: cellulosic ethanol, the production of which has the potential to turn what we call waste material into a valuable resource; biodiesel, the replacement fuel made from renewable food stocks, including vegetable oils and animal fats; coal to liquid, the conversion of solid coal into liquid fuels; and chemicals and natural gas as a transportation fuel.

Again, I thank you for being with us today, and I look forward to your testimony.

[The prepared statement of Hon. Ralph Hall follows:]

PREPARED STATEMENT OF THE HON. RALPH HALL, CHAIRMAN, SUBCOMMITTEE ON ENERGY AND AIR QUALITY

I'd like to welcome everyone to today's hearing entitled "Vehicle and Fuels Technology: Next Generation", and to thank our two panels of witnesses for being here today to testify and educate us on this topic.

The US dependence on foreign oil is a pending national security and economic crisis. While we are working to improve oil production, we must also work towards becoming more fuel efficient. The US Congress can facilitate the path to production of new technologies that will improve fuel efficiency. Technologies that could have an impact within the next 2 to 4 years are what is needed. Historically, we have been focusing on long-term technologies at our National Laboratories and Universities. While that is good, we must consider now - due to the staggering increases in the cost of fuel - technology that can be used in the near term. The major automotive companies have both the financial and manufacturing resources to do what is needed, but I believe that Congress can make the greatest difference by helping smaller companies that don't have those vast resources at their disposal. I am aware of several technologies being developed with just such potential. For example, there's a new concept for a continuously variable transmission that would reduce both the weight and cost of present day continuously variable transmissions, and improve the fuel efficiency of the vehicle. This same technology also has applications in hybrid electric vehicles--improving their already good fuel efficiency. This technology is available now, but because of limited resources it will not be in full scale production for five more years. We have an opportunity with technologies such as this to work together with developing technologies for exploration of oil and for gas, to help ease our dependence on foreign oil, and I think we should nurture them.

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Again, thank you to our witnesses for coming today. I look forward to your testimony.

Without objection, the Chair will proceed pursuant to Committee Rule 4(e) and recognize Members for 3 minutes for opening statements. If they defer, this time will be added to their opening round of questions.

MR. HALL. Without objection, the Chair will proceed pursuant to Committee Rule 4(e) and recognize Members for 3 minutes for opening

statements. If they defer this time it will be added to their opening rounds of question.

The Chair now recognizes Ranking Member Mr. Ross, from the great city of Texarkana, Arkansas, my neighbor. We both represent Texarkana. He represents Texarkana, Arkansas and I just represent Texarkana, Texas. I recognize you at this time.

MR. ROSS. Actually, Mr. Chairman, it is an interesting town. You can drive south down State Line Avenue and on the right side of the road you can vote for Ralph Hall and buy lottery tickets. On the left side of the road you can vote for me and buy liquor. And you can't do either one on the other side of the street. It is a unique situation.

But, thank you. And I am glad we are holding today's hearing to discuss vehicle and fuel technologies and what the future holds for American consumers. As we continue to experience record fuel prices, the demand for alternative fuels, hybrid and flex fuel vehicles, and other energy-efficient technologies will continue to increase. I strongly believe the substance of our discussions in this hearing today will be a significant piece in the puzzle of meeting our future energy needs. We all recognize that our Nation's transportation sector is the primary contributor to the United States' consumption of roughly 20 million barrels of oil a day. Reducing the transportation sector's use of this commodity will require future implementation and advancement of the many technologies that will be discussed today.

High fuel prices have certainly increased the awareness and interest in alternative fuels and vehicles. Even in the State of Arkansas, where pickup trucks far exceed cars, my constituents are talking more and more about hybrid and flex fuel vehicles. My district spans 21,000 square miles, 29 counties, and 150 towns. It is not uncommon for my constituents to drive 50 miles or more each way to and from work; and in most cases, they commute these distances for a job that pays well below the national average. These long commutes and frequent costly stops at the gas station are forcing not only Arkansans but all Americans to think about alternatives. As this trend continues, it is increasingly important for industry, government, and the consumers to engage in these issues and work together to advance energy-efficient technologies.

As a member of this committee, we have received testimony from the Department of Energy's Energy Information Administration regarding their forecast indicating both fuel prices and demand are going to remain high. With these record cost projections, it will be cost-effective for us to make the necessary investment and aggressively advance alternatives.

I have been pleased with the automobile industry and their efforts toward the development of hybrid and flex fuel vehicles. They have

embraced the consumers' demand for increased energy efficiency and are working to expand the production of their hybrid and flex fuel models.

I am also supportive of the provisions in the Energy Policy Act regarding hybrid vehicles. This legislation, which was passed last August, provides tax credits to consumers who purchase hybrid vehicles. This has been a successful incentive program and has stimulated hybrid vehicle sales. However, I believe we can and should do more. I hope to hear from our witnesses today on ways and ideas to improve this tax credit, allowing more consumers to access these technologies. I am not 100 percent convinced eliminating the 60,000-unit cap is the answer, but I think it is an option that should be investigated, and I look forward to receiving input from the industry representatives here today. And the more consumers who can access the tax credit, the more hybrid vehicles there will be on our highways, therefore, reducing our dependence on foreign oil.

I also look forward to hearing from our two panels about the development of hydrogen fuel-cell vehicles. Ironically, this morning, I test drove a hydrogen fuel-cell car and I was very impressed. It had a lot of pick-up, or get-up, as we would say in south Arkansas. I understand the challenges facing hydrogen fuel-cell vehicles, especially the needed infrastructure to support them and similar problems facing expanded use of E-85. I do believe hydrogen fuel-cell technology will be a significant part of our future, and I look forward to working with the industry on its continued development.

Being from Arkansas, I am extremely excited about the growing potential for biodiesel ethanol and biomass ethanol in this country. The increased use of ethanol and biodiesel provides new markets for our farm families, reduces our dependence on imported oil, and lowers greenhouse gas emissions. Efforts are underway in my congressional district and across the Nation on the development of ethanol, which is derived from biomass feedstocks such as wood chips, switchgrass, and other plant fibers. We must make the investments to continue the development and expansion of ethanol, including the E-85 infrastructure needed to support flex-fuel vehicles.

And Mr. Chairman, I will conclude by simply asking that I can submit the rest of the statement to you for the record.

[The prepared statement of Hon. Mike Ross follows:]

PREPARED STATEMENT OF THE HON. MIKE ROSS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ARKANSAS

Thank you Mr. Chairman. I am glad we are holding today's hearing to discuss vehicle and fuel technologies and what the future holds for American consumers. As we

continue to experience record fuel prices, the demand for alternative fuels, hybrid and flex fuel vehicles, and other energy efficient technologies will continue to increase.

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High fuel prices have certainly increased the awareness and interest in alternative fuels and vehicles. Even in the state of Arkansas, where pickup trucks far exceed cars and sedans, my constituents are talking more and more about hybrid and flex fuel vehicles. My district spans 21,000 square miles, 29 counties, and 150 towns. It is not uncommon for my constituents to drive 50 miles or more – each way to and from work. And in most cases they commute these distances for a job that pays well below the national average. These long commutes and frequent, costly stops at the gas station, are encouraging, not only Arkansans, but all Americans to think about alternatives. As this trend continues, it is increasingly important for industry, government, and the consumers to engage in these issues and work together to advance energy efficient technologies.

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I also look forward to hearing from our two panels about the development of hydrogen fuel cell vehicles. Coincidently, I test drove a hydrogen fuel cell car this morning and was impressed. I understand the challenges facing hydrogen fuel cell vehicles, especially the needed infrastructure to support them– a similar problem facing expanded use of E-85. I do believe hydrogen fuel cell technology will be a significant part of our future hybrid vehicle fleet and look forward to working with industry on its continued development.

Being from Arkansas, I am extremely excited about the growing potential for biodiesel, ethanol and cellulosic biomass ethanol in this country. The increased use of ethanol and biodiesel provides new markets for our farm families, reduces our dependence on imported oil, and lowers greenhouse gas emissions. Efforts are under way in my Congressional District and across the nation on the development of cellulosic ethanol, which is derived from biomass feedstocks such as wood chips, switch grass, and other plant fibers. We must make the investments to continue the development and expansion of ethanol, including the E-85 infrastructure needed to support flex fuel vehicles. The reality is this: the energy bill, which I voted for, authorizes $632 million for the next fiscal year for renewable energy research, development, demonstration, and

commercial application activities by the Department of Energy- $213 million of which is for bio-energy purposes--including $100 million for bio-refinery demonstration projects. This funding is authorized, but not yet appropriated. And yet we send $1.9 billion to Iraq every week. I want to make sure the American people understand that while there is a lot of talk these days about alternative and renewable fuels, over the next fiscal year we are going to spend **less than half** as much money toward research and development of alternative and renewable energy as we will spend this week alone in Iraq. It is about priorities, and we as a nation need to re-evaluate our priorities and make the desperately needed investments in alterative and renewable energy.

Coal-to-Liquid technology and natural gas are also exciting alternative sources of transportation fuels being used and developed. The public transportation buses here in the District of Columbia are using natural gas technology and have proudly printed on the side of each bus that "they are running on clean burning natural gas."

Our future will have a strong blend of alternative fuels and hybrid vehicles that will hopefully provide a choice to consumers when they go to purchase a car and fill up at the pump. We must work together toward making these technologies affordable and reasonable for all Americans – and work to build our nation's infrastructure to support these technologies. I thank our panel for being here today and look forward to receiving their testimony.

MR. HALL. Without objection, so ordered.

The Chair recognizes the gentleman from Illinois, Mr. Shimkus.

MR. SHIMKUS. Thank you Mr. Chairman. A couple of things, real quick. We appreciate you all coming. We appreciate the auto industry's getting on board on the flexible-fuel vehicle bandwagon. It is a long time in coming, but now the marketing is just great.

I have been driving a flex-fuel vehicle, as a lot of people on the committee know, for a couple of years. I am in my fourth year. I have got a Ford Explorer. And In southern Illinois where we have 200 retail locations for E-85 pumps, in my district I have 20. So I can really--and I represent a large rural district, from Springfield to Metropolis, which is right across from Paducah, Kentucky, from Collinsville, my hometown, right outside St. Louis, all the way to the Indiana border. So that is progress, and we need to talk about that.

Part of that progress came from the Energy Policy Act where we sent a signal. When Ralph Hall starts talking about biofuels, I know that the world has changed dramatically. And we welcome that, because that is one way that we are going to decrease our reliance on imported crude oil. And now everybody is on board with that. And everybody is on board with biodiesel.

I am focusing now on over the horizon, the next obtainable assistance. And I dropped a bill with Rick Boucher just yesterday. I will encourage all my colleagues to get on board. It is H.R. 5453, and it basically will extend the excise tax credit on refineries to 2020. And here is the premise. It is very simple. I am holding in my hand a vial of diesel fuel, Fischer-Tropsch diesel fuel, diesel fuel produced from coal. And some of the folks came up and checked it out before the hearing.

And you can--I will encourage my friends in the media to come and take a whiff of it. And it is cleaner-burning diesel fuel. But if you look here, this is the premise: U.S. coal, on top of the coal field in southern Illinois, a refinery; a coal to liquid refinery. You pipe that on U.S. pipes to--the DOD has great interest in this type of fuel for diesel applications and for aviation applications. This is an issue whose time is right. We are all tired of the reliance on imported crude oil. We are going to have a chance to expand our ability to get our own resources with a vote tomorrow, Mr. Chairman, or on Friday, on ANWR.

But this battle is a wide battle on multiple fuels. So that is why the biofuels debate is great. We are glad to have you here. Coal to liquid is an application already in South Africa, and we want to continue that and do our other petroleum research that we have.

So this is a timely hearing, Mr. Chairman. Thank you for the time.

MR. HALL. I thank the gentleman. It is well said, and you are right about tomorrow. You could also say that we have a shot at voting for ultra-deep today, that people are trying to back away from what might keep our kids from having to fight a war or something.

MR. SHIMKUS. I am with you, Mr. Chairman.

MR. HALL. At this time I recognize the Honorable Gene Green from the great State of Texas. Mr. Green.

MR. GREEN. Thank you Mr. Chairman. Just a note; I signed that letter you asked me about a while ago, so your staff should have it.

MR. HALL. I thank you and the generations that follow. Thank you for that.

MR. GREEN. Mr. Chairman, I have a statement I will put in the record. But I really want to thank you for calling the hearing because coming from a State that is basically hydrocarbons, but we are producing less than we are used to, I will literally leave no stone unturned to see how any other way we can move our vehicles, power our factories and our homes. But I appreciate your calling this hearing. Thank you.

[The prepared statement of Hon. Gene Green follows:]

PREPARED STATEMENT OF THE HON. GENE GREEN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. Chairman and Ranking Member thank you for convening this hearing today on vehicle and fuel technology.

This hearing is another in a long string of recent hearings focusing on the rapid rise in fuel costs.

Many working American families have budgets that are border right on the line between financial health and serious financial problems.

Rapid increases in the price of gasoline are causing the drive to work, to school, or to visit family and friends to become a serious drain on the family budget.

I am interested to hear today from the US automakers about how their fleets are evolving to reduce gasoline consumption in the future.

I am especially interested to know whether fuel efficiency and fuel alternatives will bring relief to working class and middle class Americans, or whether these new technologies will be too expensive to afford.

Biodiesel is also an important part of our future fuel mix, and I am pleased that at least one chemical manufacturer along the Houston Ship Channel, which is the heart of our nation's gasoline refining supply, is also in the biodiesel business.

I have a lot of professional truck drivers in my district and they are hit coming and going by gas prices, as a cost of doing business and a consumer cost just like the rest of us.

Biodiesel needs to increase rapidly if we are going to help out on diesel prices and keep a lot of trucking operations is business.

MR. HALL. The Chair is honored to recognize the gentleman from Georgia, Dr. Norwood.

MR. NORWOOD. Thank you, Mr. Chairman. I will simply submit for the record, and thank you for having this hearing, and yield to the panel. I am anxious to hear what they have to say.

MR. HALL. I am honored to recognize Mary Bono from the great State of California.

MS. BONO. Thank you, Mr. Chairman. I also have a statement I will submit for the record. And I welcome the witnesses. I am so happy you are here and look forward to hearing what you have to say. Thank you.

[The prepared statement of Hon. Mary Bono follows:]

PREPARED STATEMENT OF THE HON. MARY BONO, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. Chairman,

Thank you for holding this hearing today.

I believe the subject of this hearing is not only about how we can promote fuels and vehicles that are more environmentally friendly but more importantly, how we can use good old fashioned American ingenuity to wean ourselves off foreign oil.

Of course, oil, and for that matter foreign oil, will always play some role in our economy. But as of today, the United States is too dependent on stability in the Middle East and on various dictators in South America. It troubles me to have foreign oil serve as the keystone to our economic and even national security. We must become more self sufficient.

Self sufficiency involves supporting our domestic suppliers of oil but it also means looking beyond oil as the sole means for fueling our economy. There are a variety of experimental fuels out there. I believe that between private industry, our colleges and universities as well as government, we can identify the most promising of those alternative fuels and then focus on how to bring them to market in an efficient manner so it they are widely available as well as affordable.

Our country must make a concerted decision to forge ahead on this front. We must be bold because it is, in sorts, a race. We don't know when international incidents will slow or stop the flow of oil to the U.S. We don't know when and if our own source of domestic oil will be unable to keep up with demand. But we do know that at some point, our economy could come to an abrupt halt if we do not have an adequate supply of oil. So, we must set out upon this course of finding and developing alternative forms of energy right here and right now

It is my hope to work with those involved in the process to see how government can best help. Too often, the federal government gets in the way of good ideas. It is my hope that when it comes to this, government can serve to facilitate a process that in the end, makes sense for the consumer and gives greater security to our country.

Again, thank you Mr. Chairman. I yield back the balance of my time.

[Additional statements submitted for the record follows:]

PREPARED STATEMENT OF THE HON. JOE BARTON, CHAIRMAN, COMMITTEE ON ENERGY AND COMMERCE

Thank you, Chairman Hall, for holding this hearing today on the future of vehicles and fuels technology in the United States. I would also like to thank our witnesses for appearing before us today to tell us about their work putting the U.S. on a path towards transportation security through innovation and diversity.

Vehicles and fuels constitute approximately 25 percent of the energy demand in this country and they are vital to the continued growth of the national economy.

Advanced technologies will balance supply and demand. On the supply side, a diverse spectrum of fuels can and will reduce our dependence on foreign oil, benefiting our economy, our environment, and our national security.

On the demand side, innovation in vehicle design allow us to use those fuels more efficiently, cutting both emissions and the strain on fuel distribution networks.

A new fuel, even if it's the perfect fuel, is useless without the vehicle that can run on it. And even of millions of cars can run on it, the perfect fuel won't do much good if it can't reach your tank.

The Energy Policy Act of 2005, or EPACT took bold steps on supply-side and demand-side energy issues. For example, EPACT law directs DOE to partner with industry to enable and promote hydrogen and fuel cell technology This law provides a virtual roadmap to energy independence and is being used today to make hydrogen transportation a reality.

EPACT also gives consumers tax incentives to buy fuel-saving advanced vehicles. These incentives are technology-neutral – the law does not favor hybrids over diesel, or fuel cells over flex fuel vehicles. By creating vehicle and fuel diversity in our transportation sector, we can decrease our dependency on imported oil.

I am eager to learn today about all of the advances in vehicle technologies. There are literally billions of dollars being invested in research and development efforts both by government and by industry. The goal, as we will hear today, is to move from the petroleum-fueled vehicles we rely on today to running our transportation infrastructure on the cleanest of fuels, hydrogen. Moving to hydrogen is seen as the most promising long-term way to eliminate our dependence on foreign oil.

However, most will agree that we are many years from the commercial realization of hydrogen-powered vehicles. But we should be creating plans and strategies for the intervening years. The Department of Energy has a Transition Strategy which we will hear about today that will help improve our energy security until fuel cell hydrogen vehicles are a market reality.

I also look forward to hearing what advanced technologies automakers are developing that will improve fuel economy, maintain freedom of mobility, and a wide range of vehicle choices. Today consumers have multiple options to the gasoline-powered internal combustion engine, such as lean burn diesel, hybrids, and flex fuel vehicles. These are the technologies that will take us from here into the future of fuel cell hydrogen vehicles.

The Energy Policy Act of 2005 included a Renewable Fuel Standard, requiring a significant amount of renewable fuel be part of our national fuel supply. Beginning in

2013 we required 250,000,000 gallons of renewable fuel derived from cellulosic biomass be incorporated in the Renewable Fuel Standard. Given the state of the art in cellulosic, this schedule is very ambitious. Cellulosic ethanol will diversify ethanol supply, with many different feedstocks.

The Energy Policy Act of 2005 provided production incentives for cellulosic biofuels, conversion assistance for cellulosic biomass producers for the production of renewable fuels, and loan guarantees for the construction of facilities for the production of fuel ethanol from cellulosic biomass.

Other next generation fuels in use today include biodiesel and natural gas. Biodiesel in a blend with petroleum diesel reduces harmful particulate matter emissions making our air cleaner. Natural gas as an alternative fuel is clean burning and efficient.

The production and use of coal-to-liquid fuels is appealing given the vast coal reserves in this country. This ripe technology can make coal-based liquid transportation fuel one of the cleanest on the market. All these sources will move us into an era of greater choice, greater freedom and greater security.

Beyond pushing technology development in fuels and vehicles designs we must take other steps to win our energy security. Unlocking America's conventional energy resources in Alaska and offshore is crucial. And applying common sense rules to developing energy projects especially with regard to the permitting process is also critical. Taking all these steps, not just a few here and there will be required to get the job done.

PREPARED STATEMENT OF THE HON. MICHAEL BURGESS, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. Chairman, thank you for convening this hearing today.

In recent months, and indeed since Hurricane Katrina reminded us how perilously dependent and accustomed we have become, as a nation, to cheap oil and gasoline, there have been dozens of hearings, held in multiple committees, on both sides of the Capitol, on the subject of high gasoline prices.

I continue to believe that the most important thing that we can do to alleviate high gas prices in the short term is to increase domestic supply of crude oil. We should allow, and in fact encourage, exploration and production here at home. This includes traditional exploration and development in the Outer Continental Shelf and the Arctic National Wildlife Refuge, as well as non-traditional sources like oil shale.

But in the mid to long term, we need to look at other solutions. Since the transportation sector consumes the lion's share of oil used in the United States, the future of transportation will play a vital role in weaning our addition to foreign oil.

It is no secret that I am an avid supporter of hybrid vehicles, but I am looking forward to hearing the panelists discuss the other types of vehicle technologies as well as the other possible motor fuels.

I'd like to thank our panelists again for giving up their time to testify before us this morning. And with that, Mr. Chairman, I yield back.

MR. HALL. Thank you. Don't be discouraged by the empty seats up here. This is a terrible time for Congress, and we are trying to right some wrongs that have been going on for 30 years and all telescoping it into these last few weeks. But they all have other committee meetings, and you have the main ones here. You have the staffers that are here that tell us what you all say after you leave. And we glean from that the legislation that we are going to do. But it is being taken down, and I

have a good court reporter here. Everybody gets a copy, and everybody will read it. So your testimony is not just going to four or five people. You are talking to the most important people on this committee, other than Chairman Barton. And please tell him I said that, how important he is.

But we will at this time recognize the Honorable Alexander A. Karsner, Assistant Secretary, Energy Efficiency and Renewable Energy, U.S. Department of Energy.

The Chair recognizes you for about 5 minutes. We don't hold you to 5 minutes, but try to give us just a brief statement of what you are going to tell us, and then we will ask you questions about it and let you enlarge on it. I might even ask you something you can knock clear out of the park, by golly.

STATEMENTS OF HON. ALEXANDER A. KARSNER, ASSISTANT SECRETARY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY; SUSAN M. CISCHKE, VICE PRESIDENT, ENVIRONMENT AND SAFETY ENGINEERING, FORD MOTOR COMPANY; DEBORAH MORRISSETT, VICE PRESIDENT, REGULATORY AFFAIRS, DAIMLERCHRYSLER CORPORATION; WILLIAM REINERT, NATIONAL MANAGER, ADVANCED TECHNOLOGY GROUP, TOYOTA MOTOR SALES, USA, INC.; AND ELIZABETH LOWERY, VICE PRESIDENT, PUBLIC POLICY CENTER, GENERAL MOTORS

MR. KARSNER. I want to thank you, Mr. Chairman and members of the subcommittee. I appreciate the opportunity to testify today on the next generation of vehicles and fuel technology. I have submitted a fuller statement of written testimony for the record so I will summarize during my time here.

To paraphrase President Bush in his State of the Union address this year, breaking out of our national addiction to oil is an imperative for our time. Today no sector of energy consumption is more in the spotlight than vehicles, cars and trucks, and the fuels that propel them. In the President's Advanced Energy Initiative, a broad program for developing cleaner, cheaper, and more reliable alternative energy sources and technologies, vehicles and fuel initiatives hold a central place.

I would like to give you an overview of the Department of Energy's research and development and deployment programs in these areas, including technologies that will make a difference for today's drivers and those that can usher in a generational change over time. Biomass is the

predominant clean renewable energy resource that can make a short-term impact on diversifying our liquid transportation fuels, thereby reducing our dependency on imported oil.

The President's Biofuels Initiative aims to make cellulosic ethanol cost competitive by 2012. If successful, this research could lead to the production of biofuels equivalent to 30 percent of today's gasoline consumption by 2030. The additional impetus created by the President's Biofuels Initiative will enable program RD&D to accelerate the development and deployment of cost-competitive biobased liquid transportation fuels. The Department presently addresses near, middle, and long-term vehicle technology outcomes with two cooperative government industry activities: the FreedomCAR and Fuel Partnership and the 21st Century Truck Partnership. The FreedomCAR and Fuel Partnership is a collaborative effort among the U.S. Council for Automotive Research, five energy companies and DOE, for research on advances that may possess significant potential to reduce oil consumption. Activities in FreedomCAR focus on the technical challenges of advanced and high-efficiency vehicle technologies such as fuel cells, advanced combustion engines and enabling fuels, hybrid and plug-in hybrid vehicle systems including high-power and high-energy batteries, power electronics and motors, and lightweight materials. Near-term activities also include developing and deploying biofuels to displace petroleum.

This year we will spend at least $3 million to provide assistance for fueling stations to add E-85 capabilities and each DOE dollar will be leveraged by cost share, from either the private sector or State and local governments. Through ongoing discussions with auto makers, the Department is encouraging increased production of flex-fuel vehicles. The Department is also working with the National Biodiesel Board to tighten fuel standards and to develop real-time fuel quality tests for biodiesel to enhance performance in advanced engines. Advanced catalysis research at our national labs could enable more efficient diesel engines to replace gasoline engines in light-duty vehicles without sacrificing air quality.

Research focused on advanced batteries, power electronics, motors, and lightweight materials is essential for improved hybrid electric vehicles in the near and mid term as well as fuel-cell hybrid electric vehicles in the long term. Hydrogen offers a strategy for long-term energy security and reduced emissions. The Department is pleased to have Congress's support of the hydrogen program in Title VIII of the Energy Policy Act of 2005. The requirements in this act are consistent with the Department's plans and include important provisions for coordination of efforts across the Federal government and for

independent advice from outside of the Department on our hydrogen efforts.

Indeed, much progress has been made since 2003, when President Bush committed $1.2 billion over 5 years to accelerate hydrogen research. Our hydrogen program is focused on research to overcome the technology barriers that would be a precondition to broad commercialization. Over 3 years our ongoing research has contributed to reducing the high-volume costs of automotive fuel cells from $275 per kilowatt in 2002 to $110 per kilowatt in 2005. In addition to supporting fuel-cell cost reduction, this work will help us achieve the durability target of 5,000 hours which equates to the vehicle lifetime required.

Hydrogen storage on board a vehicle to meet all performance and cost requirements is one of the most technically challenging barriers we face. The Department has a diverse portfolio through three centers of excellence as well as independent projects both in applied and basic science, with a total of about 40 universities, 15 companies and 10 Federal laboratories. In just 1 year, we are starting to see promising results with some completely new materials being developed in different areas, such as metal hydrides, chemical hydrides, and carbon-based materials. Through cost-shared partnerships with the automotive and energy industries, four teams are installing hydrogen refueling stations and putting cars on the road to test the technology and real-world conditions as part of the Department's learning demonstration. Data collected on vehicle performance, durability, and fuel economy is feeding back into our research program to ensure our research is focused on the most relevant problems.

We are working with our indispensable partners in the economic community, at the national labs, and, as importantly, in private industry; and we are putting our research dollars in the most promising areas to address critical technical barriers, and I believe, with confidence, that the next generation of vehicles and fuels is already in sight.

This concludes my opening remarks and I would be happy to answer any questions the committee may have.

[The prepared statement of Hon. Alexander A. Karsner follows:]

PREPARED STATEMENT OF THE HON. ALEXANDER A. KARSNER, ASSISTANT SECRETARY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to testify today on the next generation of vehicle and fuels technology.

To paraphrase President Bush in his State of the Union address this year, breaking our national addiction to oil is an imperative for our time. Today, no sector of energy consumption is more in the spotlight than vehicles (cars and trucks), and the fuel that propels them. In the President's *Advanced Energy Initiative*, a broad program for developing cleaner, cheaper, and more reliable alternative energy sources and

technologies, vehicle and fuels initiatives hold a central place. I would like to give you an overview of the Department of Energy's (DOE) research and development (R&D) programs in these areas, including technologies that will make a difference for today's drivers, and those that can usher in a generational change. In general, the Department supports efforts that would reduce petroleum consumption both through improved efficiency of use and through substitution of domestic alternatives to petroleum, such as biomass derived ethanol.

Biofuels

Biomass is the predominant clean, renewable energy source that can make a short-term impact on diversifying our liquid transportation fuels, thereby reducing our dependency on imported oil. The President's *Biofuels Initiative* aims to make cellulosic ethanol cost competitive by 2012. If successful, this research could lead to the production of biofuels equivalent to 30 percent of today's gasoline consumption by 2030. In FY 2007, the Department requested $149.7 million for EERE's Biomass program. The additional impetus created by the President's *Biofuels Initiative* will enable program RD&D to accelerate the development and deployment of costcompetitive, bio-based liquid transportation fuels.

The program's research focus is in three areas: Feedstock Infrastructure, for reducing the cost of collecting and preparing raw biomass, and for the sustainable production and delivery of future energy crops; Platforms R&D, for reducing the cost of outputs and byproducts from biochemical and thermochemical processes; and Utilization of Platform Outputs, for developing technologies and processes that utilize intermediates such as sugars and syngas to co-produce fuels, valueadded chemicals and materials, and heat and power. The program's strategy is to integrate those technologies and processes in biorefinery configurations that industry will validate at an industrial scale. We ultimately envision the development of biorefineries that will produce transportation fuels along with value-added chemicals and materials, and/or power from nonconventional, low-cost feedstocks such as agricultural and forest residues and other biomass.

For the near-term, the program supports expansion of the existing biofuels industry by helping current producers become the early adopters of our advanced cellulosic conversion technology. The leveraging of the technology through the use of the existing plant and delivery infrastructure should enable earlier deployment. The deployment is supported by our current cost-shared projects, and we plan to continue this support.

The mid term expands the Government's focus in two important ways. The first is meeting the President's objective of cost competitive cellulosic ethanol by 2012. The Department is accelerating research and development efforts to continue to reduce the barriers to cost effectiveness. Second, we will continue to work with industry to apply that research and reduce the capital, operating costs, and risks associated with these future facilities. Deployment may be initiated in the further expansion of the existing industry and through niche opportunities ultimately leading to sustainable biorefineries.

EERE's Biomass Program's long-term focus is on further reducing the cost of producing domestic biofuels by continuing to develop advanced technologies to transform the Nation's domestic biomass resources into affordable biofuels, biopower, and high-value bioproducts. Working with the U.S. Department of Agriculture (USDA), the program leads a multi-agency initiative that coordinates and accelerates all Federal bioenergy R&D in accordance with the Biomass Research and Development Act of 2000. The long-term objectives require the development of the feedstock and the associated infrastructure discussed by the USDA and DOE in their jointly published "Billion Ton Study" report. It is anticipated that feedstock development will be the culmination of regional feedstock development efforts leading to costeffective collection and use of agricultural and forest residues as well as regionally indigenous energy crops, such as switchgrass in the South Central region and willow in the Northeast. Research efforts

combined with limited, targeted demonstrations to further focus research efforts should continue to lower conversion costs leading to the growth of the biofuels industry.

Vehicle Technologies

The Department presently addresses near, middle and long-term vehicle technology outcomes with two cooperative Government/industry activities: the FreedomCAR and Fuel Partnership (where CAR stands for Cooperative Automotive Research) and the 21st Century Truck Partnership.

The FreedomCAR and Fuel Partnership is a collaborative effort among the U.S. Council for Automotive Research, five energy companies, and DOE for research on advanced automotive technologies that may possess significant potential to reduce oil consumption. The National Research Council of the National Academies published a 2005 report on the research program of the partnership, describing it as "an extremely challenging program, whose ultimate vision involves a fundamental transformation of automotive technologies and the supporting fuel infrastructure." The report went on to say that "the committee believes that research in support of this vision is justified by the potentially enormous beneficial impact for the nation."

Activities in FreedomCAR focus on the technical challenges of advanced and high-efficiency vehicle technologies, such as fuel cells, advanced combustion engines and enabling fuels, hybrid and plug-in hybrid vehicle systems (including high-power and high-energy batteries, power electronics, and motors) and light weight materials. Hybrid technologies can lead to near-term oil savings when used in advanced combustion hybrid electric vehicles; they are also the foundation for the hydrogen fuel cell hybrid vehicles of tomorrow. The requested 2007 funding level of $166 million for EERE's FreedomCAR and Vehicle Technologies Program fully supports the FreedomCAR and Fuel Partnership goals.

In support of the President's *Advanced Energy Initiative*, the Vehicles Technologies program requests $31 million, an increase of 27 percent, for advanced battery technology research.

Advances in battery and other technologies can help accelerate development of "plug-in" hybrid electric vehicles. It is anticipated that plug-in hybrid electric vehicles should look and perform much like regular cars, but have a high energy battery that can be charged from an electrical outlet. Plug-ins would run on the stored energy for much of a typical day's driving – depending on the size of the battery--up to 40 miles per charge, satisfying the daily commuting needs of many Americans. In fact, some analysts say that a 40 mile battery range would allow substitution of electricity for petroleum in up to two-thirds of all miles driven by average Americans.

Most of the goods we consume cover part of their journey to us by truck. The 21st Century Truck Partnership involves key members of the commercial highway vehicle industry such as truck equipment and engine manufacturers, along with three other Federal agencies. The R&D centers on improving the efficiency of large combustion engine and fuel systems, while reducing "parasitic" losses (such as wind resistance and rolling resistance) to decrease the overall fuel consumption of highway freight transportation.

Other activities focus on accelerating the adoption of alternative fuel and advanced technology vehicles, deployment of alternative fuel infrastructure, and expansion of advanced vehicle fleet evaluations to include plug-in hybrids. There are three activities--regulatory and rulemaking support for the Energy Policy Acts of 1992 and 2005, alternative fuel and fleet activities, and Clean Cities--that work to accelerate alternative fuel infrastructure installation. Clean Cities promotes deployment of vehicle technologies and alternative fuels that can reduce petroleum consumption. Advanced Vehicle Competitions provide educational opportunities for university students to learn and use real-world engineering skills while demonstrating the performance of advanced

vehicle technologies. We think of these competitions as building the next generation of automotive engineers. A couple of years ago the Department found that 60 percent of graduating seniors that had participated in one of these competitions were hired by an automaker or one of the major automotive suppliers. Next week students from 17 university engineering departments will face off in the second round of the Challenge X competition at GM's Desert Proving Grounds, and see who has done the best job of improving the fuel economy and emissions of a Chevy Equinox while maintaining vehicle comfort and capabilities. GM is our headline co-sponsor this year, but they are joined by over 30 corporate sponsors from the supplier community.

Near-term activities also include developing and deploying bio-fuels to displace petroleum. This year, we will spend at least $3 million to provide assistance for fueling stations to add E-85 capabilities. Depending on the results of a solicitation out right now (closing June 8), the total committed to E-85 deployment could reach $4.5 million. And each DOE dollar will be leveraged by cost-share from the private sector or state and local governments. Through ongoing discussions with automakers, the Department is encouraging increased production of flex fuel vehicles. The Department is also working with the National Biodiesel Board to tighten fuel standards and to develop real-time fuel quality tests for biodiesel to enhance performance in advanced engines. Advanced catalysis research at our National Laboratories could enable more efficient diesel engines to replace gasoline engines in light duty vehicles without sacrificing air quality.

In the mid-term, advanced combustion research seeks to use electronic controls and new fuel formulations to operate compression ignition engines in the zone between soot formation and nitrogen oxide formation. Research success in homogeneous charge compression ignition (HCCI) and other low temperature combustion regimes could result in passenger vehicles greater than 40 percent more fuel efficient than today's best gasoline cars. Additional gains are possible since advanced combustion engines will still generate waste heat. One of our most tantalizing research opportunities is the direct conversion of waste heat to electricity using solid state thermoelectric devices. Our 2007 budget request commits over $3 million to solid state thermoelectric research.

Research on hybrid electric vehicle (HEV) technologies (batteries, power electronics, motors), addresses reduced component cost, improved performance, and extended lifetimes. Efforts are being expanded to include technologies that would enable plug-in HEVs. Materials research emphasizes new processes to make raw carbon fiber cheaper, and allow carbon fiber parts to be manufactured at speeds appropriate for automotive mass production. Use of carbon fiber parts, along with magnesium, titanium and lightweight steel alloys would enable fabrication of lighter vehicles that use less fuel while maintaining occupant safety and comfort. We are also examining new processes for recycling these vehicles in our pilot recycling facility at Argonne National Laboratory. Research focused on advanced batteries, power electronics, motors and lightweight materials is essential for improved hybrid electric vehicles in the near- and mid-term as well as fuel cell hybrid electric vehicles in the long-term.

The Hydrogen Frontier

Now that I've discussed the near- and mid-term options for reducing foreign oil dependence, I'd like to move on to hydrogen, which offers a strategy for long-term energy security and reduced emissions. Hydrogen is a transportation fuel that can be made from a variety of domestically available resources, while removing criteria pollutants and carbon from the tailpipes of vehicles. The Department's research explores pathways to manufacture and deliver hydrogen from fossil, nuclear and renewable resources.

The FY 2007 Budget requests $289.5 million for the President's Hydrogen Fuel Initiative, including $195.8 within the Office of Energy Efficiency and Renewable Energy. The balance is requested in our basic science, fossil and nuclear offices, as well

as the Department of Transportation. We are closely coordinating our efforts with other Federal agencies through a special task force led by the Office of Science and Technology Policy.

The Department is pleased to have Congress' support of the hydrogen program in Title VIII of the Energy Policy Act of 2005. The requirements in the Act are consistent with the Department's plans and include important provisions for coordination of efforts across the Federal Government and for independent advice from outside the Department on our hydrogen efforts.

Indeed, much progress has been made since 2003 when President Bush committed $1.2 billion over five years to accelerate hydrogen research. Since then, the Department's program has been twice reviewed by the National Academies. In the latest review released last summer, the chair of the review committee said the program "is making significant headway" and that "it could have an enormous beneficial impact on energy security and the U.S. economy."

Our hydrogen program is focused on research to overcome the technology barriers that would be a precondition to broad commercialization. Over three years, our ongoing research has contributed to reducing the high-volume cost of automotive fuel cells from $275 per kilowatt in 2002 to $110 per kilowatt in 2005.[1] Further research and development are required to meet our ultimate cost target of $30 per kilowatt. In FY 2007, the Department will initiate new projects in several areas, including improved fuel cell membranes, cold-weather start-up and operation, and the effects of impurities on fuel cells. In addition to supporting fuel cell cost reduction, this work will help us achieve our durability target of 5,000 hours which equates to the vehicle lifetime required.

Hydrogen storage on board a vehicle to meet all performance and cost requirements is one of the most technically challenging barriers we face. The Department has a diverse portfolio through three Centers of Excellence as well as independent projects both in applied and basic science with a total of about 40 universities, 15 companies and 10 Federal laboratories.

In just one year we are starting to see promising results with some completely new materials being developed in different areas such as metal hydrides, chemical hydrides, and carbon-based materials. Some of these materials can store 6 to 9 percent by weight of hydrogen. This is up from a maximum of 5.5 weight percent a year ago. Another step taken is to tailor these materials for storing and releasing hydrogen under practical temperature and pressure conditions.

Further research breakthroughs on materials and systems engineering is required to meet our system target to provide consumers with a 300-mile driving range. The Department's basic research is carefully coordinated with our applied research in materials development for hydrogen storage.

We are also analyzing transition scenarios on how the Nation might initiate hydrogen production and delivery infrastructure investment during the early years of potential vehicle market penetration and growth.

Working with our nuclear and basic science offices, we are pursuing revolutionary approaches to hydrogen production. For example, heat from nuclear reactors or solar energy can be used to split water into hydrogen and oxygen. This approach involves thermochemical cycles that are still under development. Other high risk, high pay-off production approaches also involve harnessing the huge potential resource of solar energy. Working with the DOE Office of Science, we are developing "photobiological" hydrogen production where micro-organisms produce hydrogen and "photoelectrochemical" hydrogen production where solid state devices use photon energy to convert water into hydrogen and oxygen.

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[1] Cost Analysis of PEM Fuel Cell Systems for Transportation, September 30, 2005, Carlson, E.J., et.al., Tiax, LLC

In our coal-based hydrogen program, we plan to scale up membrane reactors for separating hydrogen gas and carbon dioxide streams. This research is closely coordinated with our FutureGen effort to create the world's first near zero-emission fossil fuel plant by using clean coal technology and sequestering of greenhouse gas emissions.

In our nuclear-based hydrogen program, we plan to complete the assembly and preliminary testing of a laboratory system to demonstrate hydrogen production by using nuclear heat to drive chemical cycles, just discussed, that split water to produce hydrogen and oxygen. In another approach, we plan to demonstrate hydrogen production from a higher temperature electrolysis system that can be more efficient than electrolyzers used today in standard industry practice.

Through cost-shared partnerships with the automotive and energy industries, four teams are installing hydrogen refueling stations and putting cars on the road to test the technology in realworld conditions as part of the Department's Learning Demonstration. Data collected on vehicle performance, durability and fuel economy is feeding back into our research program to ensure our research is focused on the most relevant problems.

As mentioned, hydrogen is critical to our Nation's long-term strategy for energy and environmental security. Developing hydrogen technologies that can be manufactured domestically will improve our economic competitiveness as well. Our manufacturing research and development effort is new in FY 2007 and will address the need for high-volume manufacturing processes for components like fuel cells that are currently hand-built. These processes are important to lowering the costs of fuel cells and to developing a supplier base. Establishing an early supply base for fuel cell applications such as portable, stationary, remote and emergency backup power lays the groundwork for much larger supply chains needed for automotive applications. In January, Secretary Bodman released a draft roadmap for public comment on manufacturing research for the hydrogen economy. This roadmap is being finalized and will be the foundation for executing this important research.

Investments are not only occurring in the Federal Government but also at the state and local level. From Aiken, South Carolina, to Sacramento, California, hydrogen research facilities and infrastructure investments show a commitment to hydrogen and may provide the earliest catalysts for a hydrogen economy. These diverse investments increase our probability of success in solving technology barriers that would enable industry to make fuel cell vehicles that consumers will want to buy and to invest in hydrogen refueling infrastructure that is profitable. These investments can ultimately help displace demand for oil and reduce greenhouse gas emissions.

Conclusion

Our national pathway to a secure energy future will be composed of a variety of invaluable components, from making today's internal combustion engines more efficient to developing home-grown biofuels, plugging in our cars, and harnessing the renewable, pollution-free potential of hydrogen. Working with our indispensable partners in the academic community, at our National Labs, and in private industry, we are putting our research dollars in the most promising areas to address critical technical barriers, and I believe, with confidence, that the next generation of vehicles and fuels is already in sight.

MR. HALL. I thank you very much. And we recognize at this time Ms. Susan Cischke, Vice President of Environmental and Safety engineering, Ford Motor Company. I'm honored to recognize you.

MS. CISCHKE. Members of the committee, my name is Susan Cischke, and I am the Vice President of Environmental and Safety Engineering at Ford Motor Company. Energy security is a significant

issue facing our Nation and the role of the next generation of vehicles and fuels is of great importance to the auto industry. I appreciate the opportunity to share with you Ford Motor Company's view on this issue.

We believe that our Nation's energy challenges can only be properly addressed by an integrated approach; that is, a partnership of all stakeholders, which includes the automobile industry, the fuel industry, government, and consumers. The truth is that we must all accept that these are long-term challenges, and we are all part of the solution.

From our perspective, no one factor can be ignored in the highly competitive U.S. marketplace. As a result, we are working to accelerate the commercial application of all areas of advanced vehicle technologies, including hybrids, flexible-fuel vehicles, advanced clean diesel, hydrogen-powered internal combustion engines, and fuel-cell vehicles. The diversity of customer needs within and across the market is why we are investing in a portfolio of solutions. At Ford we recognize that hybrids have an important place within this portfolio of solutions. They deliver excellent benefits in lower-speed stop/start traffic and offer many customers significant improvements in fuel economy, up to 80 percent in city driving without compromise.

And much of this technology is also applicable to our fuel-cell and our ethanol vehicle development efforts. In 2004, we launched the world's first gasoline electric full-hybrid SUV, the Escape hybrid. In 2005, we expanded this technology to the Mercury Mariner hybrid and have announced plans to offer this technology on the Mazda Tribute SUV, the Ford Fusion, the Mercury Milan, the Ford 500, and Mercury Montego sedans, plus the Ford Edge and Lincoln Mark X crossover vehicles.

Ford's U.S. HEV volume for the 2005 model year was over 10,000 units and has almost doubled in 2006. And we have over 130 hybrid-related U.S. patents issued or pending. Expansion of our hybrid offering is clearly an important part of our overall innovation strategy, which embraces our recent commitment to increase our production capacity to up to 250,000 hybrids per year by 2010 and to offer hybrids on half of our Ford, Lincoln, and Mercury products. Nevertheless, a key challenge facing hybrids is the incremental costs both in terms of higher prices for components and engineering investments that must be overcome for this technology to transition from niche markets to high-volume applications.

In addition to hybrids, we believe that the greater use of renewable fuels, like ethanol, a domestically produced renewable fuel, will help reduce reliance on foreign oil. We applaud Congress's efforts that resulted in the Energy Policy Act of 2005, as well as the President's recent commitment to address our Nation's addiction to oil. Ford has

been building flexible-fuel vehicles, or FFVs, for over a decade, and we are an industry leader in this technology. These FFVs are capable of operating on up to 85 percent ethanol or gasoline or any mixture in between, and all of our gasoline-powered vehicles are capable of operating on 10 percent ethanol or E-10.

FFVs are a great alternative for our customers because they provide them with an option to choose between E-85 and gasoline as they desire. And as ethanol production increases driven by growing availability and demand, competitive pricing will help to lower the cost of E-85, further increasing its use as well as the demand for FFVs. In 2006, Ford Motor Company will produce 250,000 FFVs and by the end of this year will have placed a total of nearly 2 million FFVs on the road, including America's best selling vehicle, the Ford F-150. As a whole, U.S. auto makers will have produced a total of nearly 6 million vehicles. And if all these vehicles were operated on E-85, over 3.6 billion gallons of gasoline a year could be displaced. That is like saving a full year of gasoline consumption in a State like Missouri or Tennessee.

And we are not stopping there. Earlier this year, we unveiled the Ford Escape hybrid E-85 research vehicle, which marries petroleum saving technologies, hybrid electric power and E-85 flex-fuel capability. Though there are many technical and cost challenges to address, we believe that if just 5 percent of the U.S. fleet were powered by E-85 HEVs, oil imports could be reduced by about 140 million barrels a year.

Unfortunately, there is a problem. Even though the volume of E-85 vehicles continues to grow rapidly, there are less than 700 E-85 fueling stations in the U.S. and that is out of over 170,000 retail gasoline fueling stations nationwide. For ethanol to compete as a motor fuel in the transport sector and play an increasingly significant role addressing our Nation's energy concerns, we need a strong, long-term focus on policies that increase U.S. ethanol production and accelerate E-85 infrastructure development.

Ford is also working on advanced light-duty diesel engines. Today, clean diesels offer exceptional driveability and can improve fuel economy by up to 20 to 25 percent. This technology is already prevalent in many markets around the world. Nearly half the new vehicles sold in Europe are advanced diesels and Ford continues to accelerate our introduction of diesel applications in these markets.

There are, however, many hurdles that inhibit wide-scale introduction of this technology in the U.S. We are working to overcome the technical challenges of meeting the extremely stringent Federal and California tail pipe emission standards and to address other issues such as fuel quality, customer acceptance, and retail fuel availability.

Looking to the future, we are working on what we think is an important transitional technology to sustainable transportation: hydrogen-powered internal combustion engines. Ford is a leader in this technology, and we think it is a bridge to the development of a hydrogen infrastructure and ultimately fuel-cell vehicles. And we are in the process of developing hydrogen power shuttle buses for a fleet demonstration in North America starting later this year.

Even further down the road, hydrogen-powered fuel cells appear to be another promising technology for delivering sustainable transportation. Hydrogen can be derived from a wide range of feedstocks to increase energy diversity, and fuel cells are highly energy efficient and produce no emissions. Our Ford Focus fuel-cell vehicle is a state-of-the-art hybridized fuel-cell system, sharing much of the same hybrid technology we developed for our Escape hybrid SUV. We have already placed a small fleet of these vehicles in three U.S. cities as part of the U.S. Department of Energy's hydrogen demonstration program collecting valuable data.

As you can imagine, the R&D investment that goes with all this work is a very big number, certainly in the billions, not the millions, and it will only grow in the future. We would like to see more R&D support for vehicle technologies and renewable fuels. Government incentives for advanced vehicle technologies and E-85 infrastructure can accelerate the introduction of these vehicles and fuels into the marketplace.

Government must play a critical role to promote U.S. innovation and can do so by approving a seamless extension of the R&D tax credits and enhancing the level of credit for a broad range of energy-efficient technologies and energy security initiatives. Consistent implementation of an integrated approach will allow us to achieve much more in a shorter time frame and at a significantly lower cost than if each stakeholder were to pursue its own agenda in isolation, however well-intentioned they may be.

The challenges are considerable, but not insurmountable, and there is an enormous amount we can achieve if we act together in an integrated manner. Thank you again for this opportunity to address the committee.

MR. HALL. And we thank you.

[The prepared statement of Susan M. Cischke follows:]

PREPARED STATEMENT OF SUSAN M. CISCHKE, VICE PRESIDENT, ENVIRONMENT AND SAFETY ENGINEERING, FORD MOTOR COMPANY

My name is Susan Cischke and I am the Vice President of Environmental and Safety Engineering at Ford Motor Company. Energy security is a significant issue facing our nation, and the role of the next generation of vehicles and fuels is of great importance to the auto industry. I appreciate the opportunity to share with you Ford Motor Company's views on this issue.

Energy is literally the fuel that powers the industrial and manufacturing growth of the United States. The energy supply disruptions of last summer, increases in global demand, and geopolitical concerns with some of the oil rich regions of the world led to significantly higher energy prices and consumer angst at the fuel pump. It's our view that action must be taken in all sectors, if we are to meet these challenges as a nation.

At Ford, we recognize that we have a responsibility to do something to help address America's energy security needs, and we are accelerating our efforts to develop innovative solutions. As Bill Ford has said, "Ford Motor Company is absolutely committed to making innovation a central part of everything we do." That innovation begins with alternative fuels and vehicles. Ford produced the first American hybrid on the road today – the Ford Escape Hybrid. We have committed to building up to a quarter-million hybrids a year by 2010 and to continue our leadership in ethanol powered flexible fuel vehicles.

These new product initiatives are a strong commitment for Ford and our customers, and they recognize a changing marketplace. But there is a limit to what we can achieve on our own. We believe that our nation's energy challenges can only be properly addressed by an Integrated Approach: that is, a partnership of all stakeholders which includes the automotive industry, the fuel industry, government, and consumers. The truth is that we must all accept that these are long-term challenges and that we are all part of the solution.

So let me set out how we at Ford Motor Company believe each stakeholder can play its part. I'll start with the automotive industry itself, because we clearly have a central role to play. The industry has taken significant steps in improving the fuel efficiency of our products. At Ford Motor Company we see this not only as being socially responsible but a business necessity, and we are moving ahead with a range of technological solutions simultaneously – because there is simply no single solution, no "silver bullet". We know that when customers consider purchasing a vehicle, they are concerned with numerous attributes including price, quality, safety, performance, comfort and utility.

From our perspective, no one factor can be ignored in the highly competitive U.S. marketplace. As a result, we are working to accelerate the commercial application of all areas of advanced vehicle technologies, including hybrids, flexible fuel vehicles, advanced clean diesels, hydrogen-powered internal combustion engines and fuel cell vehicles.

The portfolio approach that we are taking ensures that we are able to offer consumers a range of products that meet their specific needs and circumstances. And make no mistake; it will ultimately be the consumers who decide.

This diversity of customer needs within and across markets is why we are investing in a portfolio of solutions. The result is a period of unprecedented technological innovation. Innovation – in matters of the energy, renewable fuels, safety and design – is the compass by which we are setting our direction for the future. At Ford, we recognize that hybrids have an important place within this portfolio of solutions. They deliver excellent benefits in lower speed stop/start traffic and offer many customers breakthrough improvements in fuel economy – up to 80% in city driving – without compromise. And much of this technology is also applicable to our fuel cell and ethanol vehicle development efforts.

In 2004, we launched the world's first gasoline-electric full hybrid SUV, the Escape Hybrid. In 2005, we expanded this technology to the Mercury Mariner Hybrid, and have announced plans to offer this technology on the Mazda Tribute SUV, and the Ford Fusion, Mercury Milan, Ford Five Hundred and Mercury Montego sedans, plus the Ford Edge and Lincoln MKX crossover vehicles. Ford's U.S. HEV volume for the 2005 model year was over 10,000 units and has almost doubled in 2006, and we have over 130 hybrid-related U.S. patents issued or pending.

Expansion of our hybrid offering is clearly an important part of our overall innovation strategy which embraces our recent commitment to increase our production capacity to up to 250,000 hybrids per year by 2010 and to offer hybrids on half of our Ford, Lincoln and Mercury products. Nevertheless, a key challenge facing hybrids is the incremental costs – both in terms of higher prices for components and engineering investments – that must be overcome for this technology to transition from "niche markets" to high-volume applications.

In addition to hybrids, we believe that greater use of renewable fuels like ethanol, a domestically produced renewable fuel, will help reduce reliance on foreign oil. We applaud Congress' efforts that resulted in the Energy Policy Act of 2005, as well as the President's recent commitment to address our nation's addiction to oil.

Ford has been building flexible fuel vehicles (FFVs) for over a decade, and we are an industry leader in this technology. These "FFVs" are capable of operating on up to 85% ethanol, or gasoline, or any mixture in between. And all of our gasoline powered vehicles are capable of operating on 10% ethanol or "E10". FFVs are a great alternative for our customers because they provide them with an option to choose between E-85 and gasoline as they desire. As ethanol production increases, driven by growing availability and demand, competitive pricing will help to lower the cost of E-85 further, increasing its use as well as demand for FFVs.

While I'm talking about FFVs, let me clear the air about what it takes to make an FFV. We've heard from many people that all it takes to make a FFV is "a little tweak to the chip that runs the engine". I really wish it was that simple – but it's not. Because ethanol is a unique fuel with unique properties, fuel tanks with low permeation characteristics are required. They also require a special fuel pump and fuel lines to deliver the fuel to the engine. Unique injectors introduce the fuel into the engine where special calibrations programmed into the on-board computer determine how much ethanol is in the fuel and how best to set spark timing and fuel flow. And because there is more than one fuel calibration within an FFV, costly development and certification testing is doubled. Many of the FFV parts and processes are patented by Ford and are the result of innovative ideas by our best engineers, and we're proud of them. Nevertheless, making an FFV is a significant investment for auto manufacturers.

In 2006, Ford Motor Company will produce 250,000 FFVs and by the end of this year, we will have placed a total of nearly 2 million FFVs on America's roads, including America's best selling vehicle--the (5.4L) Ford F-150.

As a whole, the U.S. automakers will have produced a total of nearly 6 million vehicles. If all of these vehicles were operated on E-85, over 3.6 billion gallons of gasoline a year could be displaced. That's like saving a full year of gasoline consumption in a state like Missouri or Tennessee.

And we are not stopping there. Earlier this year we, unveiled the Ford Escape Hybrid E-85 research vehicle which marries two petroleum-saving technologies – hybrid electric power and E-85 flexible-fuel capability. Though there are many technical and cost challenges to address, we believe that if just 5% of the U.S. fleet were powered by E-85 HEVs, oil imports could be reduced by about 140 millions barrels a year.

Unfortunately there is a problem. Even though the volume of E-85 vehicles continues to grow rapidly, there are less than 700 E-85 fueling stations in the U.S. – and that's out of over 170,000 retail gasoline fueling stations nationwide. For ethanol to compete as a motor fuel in the transport sector and play an increasingly significant role addressing our nation's energy concerns, we need strong, long-term focus on policies that increase U.S. ethanol production and accelerate E-85 infrastructure development. At the same time, as the President pointed out in the State of the Union address, we need national research efforts to pursue producing ethanol from more energy-efficient cellulosic materials like rice straw, corn stover, switch grass, wood chips or forest residue.

Ford is also working on advanced light duty diesel engines. Today's clean diesels offer exceptional driveability and can improve fuel economy by up to 20-25%. This technology is already prevalent in many markets around the world – nearly half of the new vehicles sold in Europe are advanced diesels – and Ford continues to accelerate our introduction of diesel applications in these markets. There are, however, many hurdles that inhibit wide scale introduction of this technology in the U.S. We are working to overcome the technical challenges of meeting the extremely stringent Federal and California tailpipe emissions standards, and to address other issues such as fuel quality, customer acceptance and retail fuel availability.

Looking to the future, we are working on what we think is an important transitional technology to sustainable transportation – hydrogen-powered internal combustion engines. Ford is a leader in this technology. We think it's a "bridge" to the development of a hydrogen infrastructure and, ultimately, fuel cell vehicles, and we are in the process of developing hydrogen powered E450 H2ICE shuttle buses for fleet demonstrations in North America starting later this year.

Even further down the road, hydrogen powered fuel cells appear to be another promising technology for delivering sustainable transportation. Hydrogen can be derived from a wide range of feedstocks to increase energy diversity, and fuel cells are highly energy-efficient and produce no emissions. Our Ford Focus Fuel Cell vehicle is a state-of-the-art, hybridized fuel cell system – sharing much of the same hybrid technology we developed for our Escape Hybrid SUV. We have already placed a small fleet of these vehicles in three U.S. cities as part of the U.S. Department of Energy's hydrogen demonstration program collecting valuable data.

As you can imagine, the R&D investment that goes with all this work is a very big number--certainly in the billions, not the millions--and it will only grow in the future. Many of our competitors and suppliers are also investing heavily. But there is only so much we can achieve without the help of others outside our industry. We need an integrated approach.

It is clear that the solution to the energy issues associated with road transport will need to come from advances in fuels as well as vehicle technology. We need the oil industry to endorse an Integrated Approach here in the U.S., just as they are beginning to do with automakers and government officials in Europe. We at Ford are clearly excited about the potential role of renewable fuels. However, the fact is that without the wholehearted involvement of the fuel industry, we cannot move forward far enough or fast enough. We obviously need key partners like the oil industry to invest in developing and marketing renewable fuels like E-85 – and we need it to do so now and rapidly. We fully support government incentives to encourage the industry or others to accelerate this investment.

There is a great deal that policy makers can do at all levels as well. We would like to see more R&D support for vehicle technologies and renewable fuels. Government incentives for advanced technology vehicles and E-85 infrastructure can accelerate the introduction of these vehicles and fuels into the marketplace. Government must play a critical role to promote U.S. innovation and can do so by approving a seamless extension of the R&D tax credits and enhancing the level of credit for a broad range of energy efficient technologies and energy security initiatives.

We would also like to see greater investment in improved road traffic management infrastructure in order to reduce congestion and save fuel. According to the American Highway Users Alliance, about 5.7 billion gallons of fuel are wasted annually due to congestion. Effective traffic light synchronization is a good example of a change that could lead to big reductions.

There is also a role for government in educating the public on how to drive in an energy efficient manner. In the end, it will ultimately be the size of the car park, and consumers' choices of vehicles, how many miles they drive, and driving behaviors that

will determine how much motor fuel we consume. A person who drives in an energyconscious way – by avoiding excessive idling, unnecessary bursts of acceleration and anticipating braking – can enjoy much better fuel consumption today. And government can play a key role to raise public awareness. We believe that awareness is a simple and effective early step which is why we have introduced driver training programs in Europe and recently developed on-line training for all Ford Motor Company employees.

Consistent implementation of an Integrated Approach will allow us to achieve much more in a shorter timeframe and at a significantly lower cost than if each stakeholder were to pursue its own agenda in isolation, however well-intentioned they might be. The challenges are considerable but not insurmountable, and there is an enormous amount we can achieve if we act together in an integrated manner.

We have to ensure that our business is sustainable by making vehicles that continue to meet the changing needs of the 21st century. That's a responsibility we owe to our customers, shareholders and our employees. But at another level, all of us have the opportunity to do something about energy independence – and that's a responsibility we owe future generations.

Thank you again for the opportunity to address the Committee.

One Page Summary of Major Points

- Ford believes that our nation's energy challenges can only be properly addressed by an *Integrated Approach*: that is, a partnership of all stakeholders which includes the automotive industry, the fuel industry, government, and consumers. The truth is that we must all accept that these are long-term challenges and that we are all part of the solution.
- Ford is working to accelerate the commercial application of all areas of advanced vehicle technologies, including hybrids, flexible fuel vehicles, advanced clean diesels, hydrogen-powered internal combustion engines and fuel cell vehicles.
- Ford is the only American auto company with full hybrid vehicles on the road today and we plan to increase our production capacity to up to 250,000 hybrids per year by the end of the decade.
- Ford is also leading the way in vehicles operating on renewable ethanol – putting up to 250,000 ethanol-capable vehicles on the road this year and working to develop ethanol infrastructure.
- Ford Escape Hybrid E-85 is the world's first ethanol-fueled hybrid, a research project that combines hybrid and FFV technology to provide an innovative solution to U.S. national energy concerns.
- If the nearly 6 million FFVs that will be on the roads by the end of this year were operated on E-85, over 3.6 billion gallons of gasoline could be displaced.
- For ethanol to compete as a motor fuel in the transport sector and play an increasingly significant role addressing our nation's energy concerns, we need a strong, long-term focus on policies that increase U.S. ethanol production and accelerate E-85 infrastructure development.
- We think hydrogen internal combustion engines are a "bridge" to the development of a hydrogen infrastructure and, ultimately, fuel cell vehicles, and we are in the process of developing hydrogen powered E450 H2ICE shuttle buses for fleet demonstrations in North America starting later this year.
- Further down the road, hydrogen powered fuel cells appear to be another promising technology. Ford has placed a small fleet of hydrogen fuel cell vehicles in three U.S. cities as part of the U.S. Department of Energy's hydrogen demonstration program collecting valuable data.

- Government must play a critical role to promote U.S. innovation and can do so by approving a seamless extension of the R&D tax credits and enhancing the level of credit for a broad range of energy efficient technologies and energy security initiatives.

MR. HALL. The Chair at this time recognizes Mrs. Deborah Morrissett, Vice President, Regulatory Affairs, DaimlerChrysler Corporation.

MS. MORRISSETT. Good afternoon. I am Deb Morrissett, Vice President for Regulatory Affairs for DamilerChrysler. I want to thank you for providing this opportunity to appear today to discuss DaimlerChrysler's involvement in the development of advanced power trains and to tell you what we are doing to advance to the next generation of vehicles and fuels for America.

At the Chrysler Group we are committed to producing products that customers want to buy and for continuing to innovate in all aspects of our business. Reducing fuel consumption is an important part of that innovation. We are developing a broad range of advanced propulsion technology, including more efficient gasoline engines, clean diesels, hybrids, biofuel-capable systems, and, in the longer term, fuel cells.

We are focused on providing the market with the ability to select the propulsion technology that best fits the needs of the individual consumer.

Today, hydrogen appears to be the eventual successor to fossil fuels and a long-term energy solution for our Nation. DaimlerChrysler has been working on fuel-cell technology for over 10 years. We have the largest worldwide fleet of fuel-cell vehicles, more than a hundred, including small passenger cars, delivery vans, and mass transit buses in use, and demonstration projects in the United States, Europe, and Asia.

On the strength of government and industry partnerships, we have made good progress in advancing hydrogen fuel-cell technology. These partnerships are absolutely vital to providing the significant investment necessary to further develop fuel-cell technology and a hydrogen infrastructure.

DaimlerChrysler Commercial Buses North America. The Orion brand is the leading manufacturer of diesel electric hybrid buses worldwide. Compared to standard diesel buses, the hybrid units provide significantly better fuel economy while greatly reducing emissions. Drivers enjoy faster acceleration and passengers experience a quieter, smoother ride compared to conventional buses.

I would like to focus the remainder of my comments on diesel engines and biofuels. Advanced diesel technology offers up to 30 percent better fuel economy and 20 percent lower CO_2 emissions when compared to equivalent gasoline engines. The modern clean diesel

is a technology that is available today and can help reduce our Nation's consumption of petroleum.

Last year the Chrysler Group became the first North American-based manufacturer to offer a modern diesel engine in a light-duty vehicle market with our Jeep Liberty. Currently, DaimlerChrysler offers three models with diesel engines: Jeep Liberty, the Dodge Ram Pickup, and the Mercedes-Benz E-320. This fall we will introduce diesels in the Mercedes M and R classes. And in the next few weeks we will announce another diesel product for the Chrysler Group.

Also in the 2006 calendar year, DaimlerChrysler will introduce the cleanest and most efficient diesel technology in the world, called Blue Tech. To give you a benchmark for performance, the Mercedes E-320 full-size sedan, powered by a 6-cylinder engine, will be the cleanest diesel in the world. It delivers the torque of an 8 cylinder, the fuel economy of 35 miles per gallon in real-world driving, and has the potential to meet emission standards in all 50 States. To meet these fuel economy and stringent emission goals, it is essential that the introduction of low-sulfur diesel fuel later this year continue on schedule and not be delayed.

While diesel technology and improved gasoline engines can make big strides towards helping us to meet our Nation's energy, environment, and security objectives, biofuels represent a huge opportunity to further reduce our consumption of petroleum. Every Jeep Liberty diesel leaves the assembly plant in Toledo, Ohio, fueled with B-5, a 5 percent biodiesel mix derived from locally grown soybeans. Beginning with our 2007 Dodge Ram, we endorse the use of B-20, a 20 percent biodiesel mix, for use in our military, government, and commercial fleet customers. We believe that allowing our fleet customers to use fuel made to the current military specification will help accelerate the development and adoption of a strong national B-20 standard, a standard that OEMs and engine manufacturers can endorse for all of their vehicles, including the millions of diesel vehicles on the road today.

Biofuels, including ethanol, reduce life cycle greenhouse gas emissions. Biodiesel reduces tail pipe emissions of particulates, carbon monoxide, and hydrocarbons compared with conventional diesel fuel. Biofuels are proof that at least part of the solution for our energy, environment, and national security issues can be home grown. Biofuels support the American agricultural economy. Incentives for the introduction of biodiesel and E-85 flex-fuel vehicles should continue in order to help us reach the critical mass of vehicles on the road required to spur fuel infrastructure development.

At DaimlerChrysler, and all of the other manufacturers represented here today, we are doing our part to improve existing technology, to

accelerate the introduction of new technologies, to encourage the use of renewable fuels, and to invest in the research necessary to deliver the long-term future technologies that America needs. We stand ready to do our part, but to achieve our ambitious goals we need action from government policymakers, the fuels industry, and ultimately the American consumer. Thank you.

MR. HALL. Thank you.

[The prepared statement of Deborah Morrissett follows:]

PREPARED STATEMENT OF DEBORAH MORRISSETT, VICE PRESIDENT, REGULATORY AFFAIRS, DAIMLERCHRYSLER CORPORATION

Good afternoon. I'm Deb Morrissett, Vice President for Regulatory Affairs for DaimlerChrysler. I want to thank the chairs and distinguished Members of the Subcommittee on Energy and Air Quality for this opportunity to appear today.

I am coming before you today to describe our involvement in the development of advanced technologies for vehicles to reduce petroleum consumption and what DaimlerChrysler is doing to advance the transition to the next generation of vehicles and fuels for America.

Speaking for the Chrysler Group only, we have the most aggressive product plan in the history of our company. In 2004 we set a company record for new vehicle launches in one year with nine. This year we'll break that record by introducing 10 all-new vehicles, among which will be some of the most fuel-efficient vehicles we've ever built. Over the next five years we plan to invest $30 billion in our product program. Over the past four years we've committed $7.0 billion in total program investments to upgrade the flexibility and competitiveness of our manufacturing facilities to world-class levels.

These investments and our product development are essential to ensure that our company and our people can compete against global competition. We are responsible for producing products that customers want to buy and for continuing to innovate in all aspects of our business. Reducing fuel consumption is an important part of that innovation.

There are several forces shaping energy policy at a national level including "acts of God" such as hurricanes Katrina and Rita last year that exposed the fragile state of domestic oil refinement capability. Ultimately, an effective response to all of the concerns about petroleum usage includes 1) use less oil; 2) more cleanly and efficiently burn the petroleum-based fuels we do use; and, 3) find alternatives. We must do all three without adversely affecting the economy or employment in the auto and related industries.

Clearly, the federal government and auto manufacturers have leading roles to play in achieving those goals. We stand our best chance of success when we work hand-in-hand to achieve them.

Take the example of fuel cell technology. Today, hydrogen appears to be the eventual successor to fossil fuels and a long-term energy solution for our Nation. On the strength of government and industry partnerships, we've made good progress in advancing hydrogen fuel-cell technology.

DaimlerChrysler has been working on fuel cell technology for transportation utilizing hydrogen for over ten years. We have invested more than $1 Billion in R&D and have developed five generations of vehicles (NECAR1, 2, 3, and 4, and the F-Cell). Of all manufacturers, we have the largest worldwide fleet of fuel cell vehicles—more than 100—participating in several international demonstration projects in the United States, Europe, and Asia with over 1.2 million miles of accumulated real world experience. As

part of these projects, we are demonstrating the viability of the fuel cell in the entire fleet of vehicles—from small passenger cars to delivery vans to large mass transit buses.

Government-industry fuel cell partnerships are working. These partnerships will continue to be absolutely vital to providing a jumpstart to the significant investment necessary to develop fuel cell technology and a hydrogen infrastructure. It is clear that we can work together toward solving our long-term energy, environmental and national security needs. We need to expand this cooperation to find solutions to the problem of petroleum consumption in the near term as well.

DaimlerChrysler is engaged in a broad range of advanced propulsion technologies. Fuel cell vehicles are one long term focus of this technology portfolio, which also includes more efficient gasoline engines, advanced diesels, and hybrid powertrain systems. DaimlerChrysler is focused on providing the market with the ability to select the advanced propulsion technology that best fits the needs of the individual customer.

In October of 2005, DaimlerChrysler Commercial Buses North America received a contract for 500 Orion VII diesel hybrid-electric buses from New York City transport services. This is the largest order for hybrid buses in history. Orion, DaimlerChrysler's North American city bus brand, will begin deliveries in the second quarter of 2006. This is the third hybrid order in New York City for Orion complementing the prior orders of 200 units and 125 units respectively.

Orion, along with partner BAE Systems, producer of the HybriDrive® series hybrid propulsion system, is the leading brand of hybrid buses worldwide with more than 300 units in revenue service and 700 more units on order for the Toronto Transit Commission, San Francisco MUNI and now New York City Transit and MTA Bus. Trusted for their significant emissions reductions and fuel savings compared to standard diesel buses, Orion Hybrid buses also outperform conventionally powered vehicles.

Compared to standard diesel buses, the hybrid units will provide significantly better fuel economy while greatly reducing emissions: 90 percent less particulate matter, 40 percent less NOx, and 30 percent fewer greenhouse gases. Drivers will enjoy faster acceleration and customers will experience a quieter, smoother ride free of the frequent transmission shifts encountered in conventional buses.

Regarding hybrids for light duty vehicles, DaimlerChrysler, GM and BMW have recently combined efforts to develop a two-mode hybrid drive system that surpasses the efficiency of today's hybrids. The partnership will cut development and system costs while giving customers an affordable hybrid alternative that improves fuel economy. Our first use of the system will be in early 2008 with the Dodge Durango.

DaimlerChrysler has developed and implemented technologies that improve the efficiency of the current gasoline propulsion system. We must continue to enhance the gasoline combustion propulsion system since it will be the dominant choice in the market for many years to come. We offer the Multi-Displacement System (MDS) available in the HEMI in seven Chrysler Group vehicles. MDS seamlessly alternates between smooth, high fuel economy four-cylinder mode when less power is needed and V-8 mode when more power from the 5.7L HEMI engine is in demand. The system yields up to 20 percent improved fuel economy. We also recently launched a new world engine coupled with a continuously variable transmission (CVT) to further improve fuel economy and reduce emissions of the all new Dodge Caliber. We will expand the application of this technology to several additional new products starting later this year. We are also working on further development of gasoline direct-injection which considerably enhances fuel economy by closely monitoring fuel atomization.

Yet another alternative, and the one I wish to focus on in the remainder of my testimony, is the diesel engine. Modern diesels are only beginning to make inroads in the light duty fleet in the U.S. Meanwhile, diesels account for nearly 50 percent of the new car market in Europe and about two-thirds of the Chrysler and Jeep® vehicles sold in Europe in 2005. Advanced diesel technology offers up to 30 percent better fuel economy

and 20 percent lower CO2 emissions when compared to equivalent gasoline engines. Modern, clean diesels are a technology that is available today and can help reduce our nation's consumption of petroleum based fuels.

According to the EPA, if we had a light-duty vehicle population that was one-third diesel, we'd save up to 1.4 million barrels of oil per day in the U.S. That's the amount of oil the U.S. currently imports from Saudi Arabia. If Chrysler Group's diesel mix in the U.S. were the same as it is in Europe, our CAFE would improve by three miles per gallon!

Last year the Chrysler Group became the first North American-based manufacturer to offer a modern diesel engine in the light duty vehicle market with our Jeep Liberty. By the way, customer demand for the diesel Liberty exceeded our expectations. Sales are almost twice our initial target.

Our sister company, Mercedes-Benz, and our competitor, Volkswagen, also offer diesels here. We expect to see other manufacturers offering diesels in the U.S. in the not too distant future as well. For 2006, DaimlerChrysler currently offers 5 models with diesel engines—the Jeep Liberty, Dodge Ram 2500 and 3500 pickups, and Mercedes-Benz E-320, ML-320, and R-320. In the next few weeks we will announce yet another diesel product for the Chrysler Group.

Also in the 2006 calendar year, DaimlerChrysler will bring to this market the cleanest and most fuel-efficient diesel technology in the world, called BLUETEC. We introduced it in a Mercedes E-Class at the North American International Auto Show in Detroit in January.

To give you a benchmark for performance, the Mercedes E320 full-size sedan, powered by a six-cylinder diesel engine, will be the cleanest diesel in the world. It delivers the torque of an eight-cylinder, 35 miles-per-gallon in real-world driving, and has the potential to meet emissions standards in all 50 states. To meet these fuel economy and stringent emission goals, it is essential that the low sulfur requirements for diesel fuel set to become effective later this year, be maintained and not delayed.

While diesel technology alone can make big strides toward helping us meet our national energy, environment, and security objectives, when you add biodiesel and other biofuels, it gets really interesting. Biofuels represent a huge opportunity to reduce our consumption of conventional petroleum-based fuel.

Designing more engines to run on biodiesel is a current objective at DaimlerChrysler. Biodiesel fuel reduces emissions of diesel vehicles and lowers petroleum consumption. Every Jeep Liberty diesel we build leaves the assembly plant in Toledo, Ohio, fueled with B5 - a renewable fuel with a 5 percent biodiesel mix derived from locally-grown soy beans. Beginning with our 2007 model year Dodge Ram, we will endorse the use of B20—a 20 percent biodiesel mix—for use by our military, government and commercial fleet customers. We believe that allowing our fleet customers to use fuel made to the current military specification will help accelerate the development and adoption of a national B20 specification for general use.

Biofuels reduce lifecycle greenhouse gas emissions, because the plants from which they're derived absorb carbon dioxide from the atmosphere during growth. Biofuels also reduce tailpipe emissions of particulates, carbon monoxide and hydrocarbons compared with conventional diesel fuel. Biofuels also support the American agricultural economy.

To support this effort, we have teamed up with the Detroit-based nonprofit NextEnergy, the nation's largest chain of biodiesel refiners, industry-leading suppliers, and local universities to conduct much needed research and field testing. We even plan to study the use of biodiesel crops as possible tools to remediate old brownfield sites.

One of the key enablers to broad acceptance of biodiesel is the establishment of a national high quality B20 fuel specification. In order for manufacturers to produce, sell, and warranty diesel vehicles for operation on biodiesel, we feel a national B20 standard is critical to us and our customers. This standard is needed, and must be designed, to allow

manufacturers to endorse B20 for all of their vehicles, including the millions of diesel vehicles already on the road as well as the ones that will be built in the future.

Gas-ethanol flex-fuel is another option we need to revisit. Since 1998 the Chrysler Group has provided to customers about 1.5 million minivans, cars, SUVs and pickup trucks that are E-85 flex-fuel (a gas-ethanol mix) capable. Unfortunately, in the past, virtually all of those vehicles ran on pure gasoline, due to the lack of an E-85 fuel infrastructure. But flex-fuels can work, when government policy gets behind them and encourages infrastructure development.

Our current product plan commits us to producing, by the 2008 model year, just under 500,000 flexible fuel vehicles annually for our U.S. fleet. That's roughly 25 percent of our production. If all of them operated on E-85 instead of gasoline, it would save 250 million gallons of petroleum per year—roughly the amount of oil we import from Libya each year. In the same timeframe we will produce over 150 thousand diesels annually that could operate on biodiesel if we have a suitable national B20 specification.

Incentives for the introduction of biofuels and E-85 FFVs should continue to help reach the "critical mass" of vehicles on the road required to help spur the necessary fuel infrastructure development. Biofuels are proof that at least part of the solution to our energy, environment and national security issues can be homegrown.

We at DaimlerChrysler, and all of the other manufacturers represented here today, are doing our part to improve existing technology, to accelerate the introduction of new technologies, and to invest in the research necessary to deliver the long-term future technologies America needs. However, the solution rests not just with auto industry action. We need action from government policy makers, the fuels industry and ultimately the American consumer. According to our computer models, full deployment of FFVs operating on E-85, 10 percent ethanol in all conventional gasoline vehicles and full penetration of 20 percent biodiesel, in both the light and heavy duty diesel fleets, would lead to a reduction in U.S. demand for petroleum of 3.6 million barrels per day. We stand ready to do our part.

Thank you for your attention; I would be pleased to answer any questions the Subcommittee has.

MR. HALL. The Chair recognizes Mr. William Reinert, National Manager, Advanced Technology Group, Toyota Motor Sales, USA.

MR. REINERT. Mr. Chairman, members of the committee, my name is Bill Reinert, and I am National Manager, Advanced Technology for Toyota. I want to thank you for inviting Toyota to participate in this hearing and to provide our perspective on future technological advancements for automobiles. Today, I will emphasize hybrid electric and plug-in hybrid power trains.

Toyota recognizes that the competing priorities of energy security, environmental concerns, and emerging fuels may reshape the transportation and fuels market and may one day change customer perspectives on vehicle choice. As you can see from the slide above, today, we are seeing the emerging markets for biodiesel and tremendous expansion of corn-based ethanol production. We are also beginning to see previously overlooked hydrocarbon supplies such as tar sands and very heavy crude products making significant impacts in the market. In the coming years, our tremendous natural gas and coal reserve can be

brought to the market from the Fischer-Tropsch process providing zero sulfur diesel or gasoline.

We feel that our investments in hybrid development give us the opportunity to use these new fuels and maximize their benefits. Toyota believes there is no single fuel or technology that can solve all of transportation's needs. Simply put, there is no single silver bullet. That is why we are pursuing multiple technology paths in our continuing quest to reduce the impact of the automobile on society.

Key to our efforts is the ability to apply hybrid systems to any type of power train without constraint from the type of fuel or propulsion technology used. In other words, hybrids are a core technology for Toyota. By combining battery energy storage with conventional power trains, Toyota hybrid systems have the ability to greatly increase and in some cases double the efficiency of any propulsion system, while significantly reducing smog-forming emissions.

Some have characterized hybrid technology as an interim approach, a bridge to fuel cells. In our view, this underestimates the value of the hybrid system. The fuel cells we are now testing in the United States are hybrid designs and in fact use many of the same components that are found in today's Prius. Since our introduction of the Prius in 1997, Toyota's cumulative global hybrid sales have exceeded 600,000 units. Of this total, over 300,000 have been sold in the United States. Clearly the American market is a key to our plans to expand our hybrid technology. Currently, we offer five different hybrid models for sale in the United States, with one additional model scheduled for launch in 2007. All auto manufacturers try to find the right combination of features such as fuel economy, emissions, and power at the customer's value. But no matter how brilliant or appealing a product may be, it will not succeed in the marketplace unless it is better in every respect than the product it seeks to replace. That is why Toyota hybrid products reflect customers' preferences in each market segment in which they compete.

For instance, the Prius maximizes fuel economy while achieving class average performance. The Lexus LS 600h will provide 12-cylinder performance and class leading V8 fuel economy. And the 4-cylinder Camry hybrid offers a combined EPA fuel economy value of 39 MPG, while at the same time achieving V-6 performance. Importantly, hybrids are saving fuel today using infrastructure. The application of hybrid technology takes on different forms, and not all offer the same range of benefits. Toyota designs are known as full or strong hybrid. This means the battery and power electronic components of our design are the primary influences on system efficiency and provide the benefits of motor-assist and an all-electric EV range.

We believe that as future technologies are developed, the benefits of a strong hybrid approach will become even more pronounced. Evidence of Toyota's continuous development philosophy is the improvement in Prius performance. During the 6 years since it was launched, fuel economy has increased by over 30 percent. Our 0-to-60 mile-per-hour acceleration time has dropped by 4.4 seconds, and already low emissions were reduced even lower. These enhancements were primarily the result of weight and size reductions in electrical components and steady improvement in battery technology. We can foresee a time when we offer a hybrid in every segment in which we compete. Over time the cost and complexity of hybrid systems will be improved to the point that a hybrid becomes a normal check-the-box power train option, just like 4, 6, and 8 cylinders are today. It is reasonable to expect that Toyota's global hybrid production could exceed 1 million units per year sometime in the next decade.

Particularly interesting is the continuation of the lithium ion battery technology. We hope that this will lead to low-cost lightweight batteries with high-energy densities increasing the all electric range and the efficiency of hybrid products even further.

We are aware of the enthusiasm in some quarters for plug-in hybrid technology, and Toyota is investigating the idea of plug-in hybrid designs because this type of approach may have merit in the future. We believe that plug-in hybrids' ability to successfully compete in the marketplace to a large extent depends on the development of battery technology that is lightweight, inexpensive, and durable. Many current plug-in hybrid designs use deep-charge discharge cycles to improve their all electric range. The data demonstrate that battery life is adversely impacted by large swings in the state of charge. Battery management systems in the Prius restrict state-of-charge swings to a carefully defined level that is consistent with its long battery life. Successful plug-in hybrid designs must carefully balance the desire for longer all-electric range with cost and weight targets and the need to extend the lifetime of the battery systems. And ultimately, as I said earlier, customers must want the vehicle.

Mr. Chairman, I would be happy to answer any questions.

MR. HALL. All right. Thank you sir.

[The prepared statement of William Reinert follows:]

PREPARED STATEMENT OF WILLIAM REINERT, NATIONAL MANAGER, ADVANCED TECHNOLOGY GROUP, TOYOTA MOTOR SALES, USA, INC.

Mr. Chairman and members of the committee, my name is Bill Reinert and I am National Manager, Advanced Technology for Toyota. I want to thank you for inviting Toyota to participate in this hearing and to provide our perspective on technology advancements on future automobiles within the mid-to-long term, with a particular emphasis on hybrid electric powertrains.

Toyota recognizes that the competing priorities of energy security, environmental concerns and emerging fuels may reshape the transportation fuels markets and, may one day, change customer perspectives on vehicle choice.

Today, within the United States, we can see emerging markets for biodiesel and the tremendous expansion of corn based ethanol production. We are also beginning to see previously overlooked hydrocarbon supplies, such as tar sands and very heavy crude products, making significant impacts on the market.

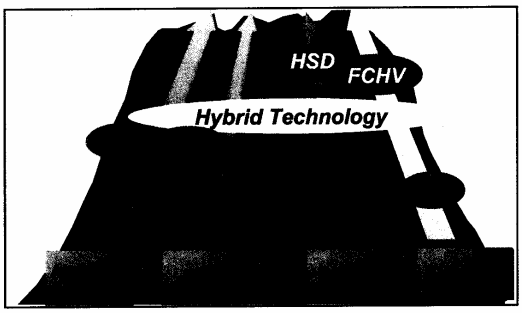
Fuels from abundant natural gas and coal reserves that are produced from the Fischer Tropish process may one day replace significant amounts of the petroleum we depend upon today.

We feel that our investments in hybrid development give us the opportunity to use these new fuels and maximize their benefits, especially during the time when production may be limited.

Expanded production of some alternative fuels may face land or water use limitations. Fuels produced by gas-to-liquids and coal-to-liquids may have water quality and CO_2 limitations. As alternative fuels replace increasing amounts of petroleum products, our consideration must also include methods to mitigate impacts to local eco-regions.

Advanced farming methods and the development of ethanol from cellulosic processes or from algae fed by CO_2 sequestered from coal fired power plants may eliminate many concerns. We are confident that in each of these instances technological developments can lead to sustainably-produced low-carbon or renewable fuels and reductions in oil imports.

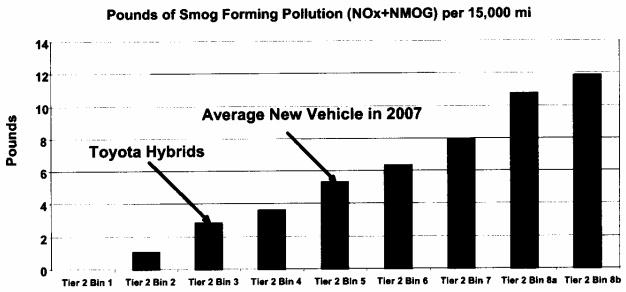
Sustainable Transportation



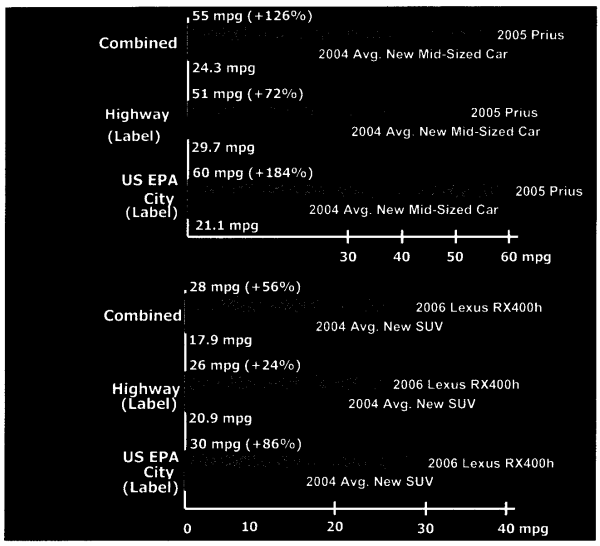
Toyota believes that there is no single fuel or technology that can solve all of society's transportation needs. Simply put, there is no single silver bullet. This is why Toyota is pursuing multiple technology paths in our continuing quest to reduce the impact of the automobile on society.

Key to our efforts is the ability to apply hybrid systems to any type of powertrain without constraint from the type of fuel or propulsion technology used. In other words, hybrids are a core technology for Toyota.

By combining battery energy storage with conventional powertrains, Toyota's Hybrid Synergy Drive system has the ability to greatly increase and, in some cases, double the efficiency of any propulsion system, while significantly reducing smog-forming emissions.

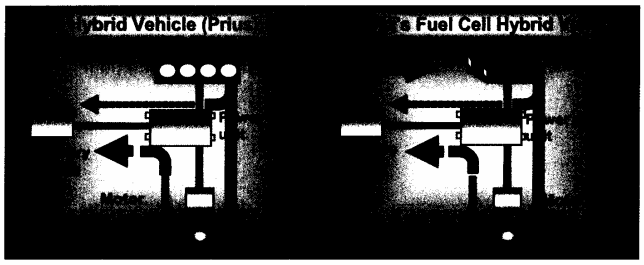


Fuel Economy of Hybrids vs. Class Average



Some have characterized hybrid technology as an interim approach, a bridge to fuel cells. In our view, this underestimates the value of the hybrid system. The

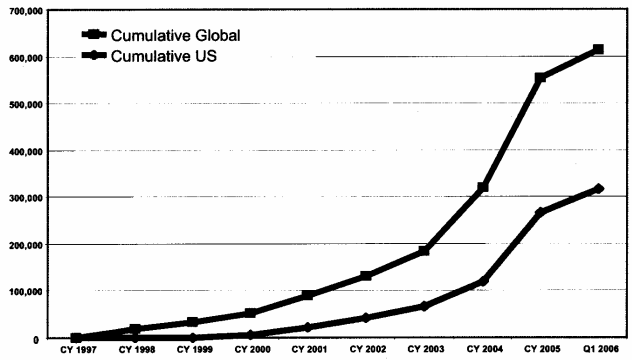
Hybrid Design Used in Fuel Cell Vehicle



fuel cell vehicles Toyota is now testing in the United States are hybrid designs and, in fact, use many of the same components that are found in today's Prius.

Since our introduction of the Prius in 1997, Toyota's cumulative global hybrid sales have exceeded 600,000 units. Of this total, over 300,000 have been sold in the United States.

Total Toyota Hybrid Sales



Currently, Toyota has five different hybrid models on sale in the United States, with one additional model, the Lexus LS 600h scheduled for launch in 2007. As can be seen in the chart above, the U.S. market contributes significantly to our global hybrid sales.

All auto manufacturers try to find the right combination of features, such as fuel economy, emissions, and power that customers value. No matter how brilliant or appealing a product may be, it will not succeed in the marketplace unless it is better in every respect than the product it seeks to replace. This is why Toyota's hybrid products reflect the customer preferences in each market segment in

which they compete. In all instances, with performance equalized, hybrids offer a superior combination of low emissions and higher fuel economy.

For instance, the Prius maximizes fuel economy, while achieving class average performance. The Lexus LS 600h will provide 12-cylinder performance and class leading V-8 fuel economy. And the 4-cylinder Camry Hybrid offers a combined EPA fuel economy label value of 39 mpg, while at the same time achieving 187 horsepower.

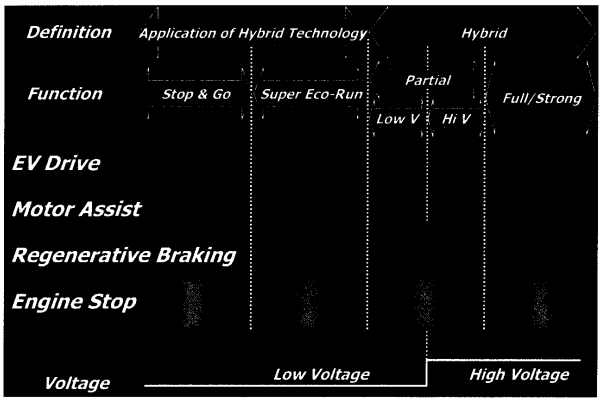
Importantly, hybrids are saving fuel today using existing infrastructure.

As more hybrid products enter the market, the balance between fuel economy, emissions and performance may shift and evolve over time as market forces change. Total cumulative sales by all manufacturers in the United States will soon exceed 500,000 units and further models are planned. In addition to the Toyota products that are already in the market or planned, 12 other models from other manufacturers are in the planning process or already on the market.

The application of hybrid technology takes different forms and not all offer the same range of benefits. Toyota's designs are known as a full or strong hybrid. This means the battery and power electronic components of our design are the primary influences on system efficiency and provide the benefits of motor assist and an all-electric vehicle (EV) range. We believe that as future technologies

are developed, the benefits of a strong hybrid approach will become even more pronounced.

Application of Hybrid Technology



Moving forward, we can easily see the results of Toyota's continuous development philosophy by examining the improvement in the Prius performance during the six years since it was launched.

Prius History

Model Years	1998-2000 *	2001-2003	2004-
City Label FE	43	52	60
Highway Label FE	41	45	51
Combined Label FE	42	48	55
0-60 Acceleration	14.5	12.5	10.1
Emissions	LEV	SULEV	AT-PZEV
Size Class	Subcompact	Compact	Midsize

* Japan only

We have increased the combined label fuel economy of the Prius by over 30 percent, improved the 0-60 mph acceleration by 4.4 seconds, and steadily reduced the already low emissions. These enhancements are primarily the result

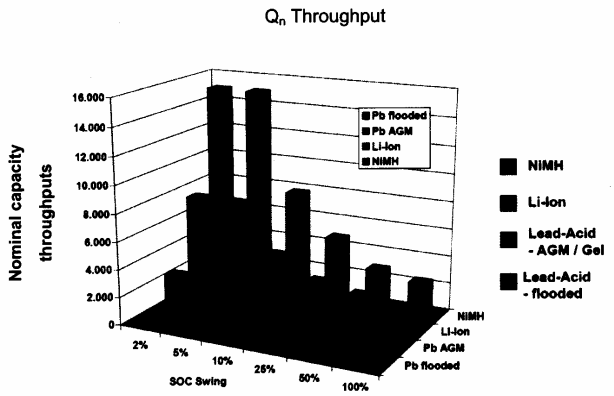
of reductions in weight and size of electrical components and steady improvement in battery technology.

As a direct result of this approach, we can foresee a time when we offer a hybrid in every segment in which we compete. Over time, the costs and complexity of hybrid systems may be improved to the point that a hybrid becomes a normal "check the box" powertrain option, just like four, six and eight cylinders are today. Under these conditions, it is reasonable to expect that Toyota's global hybrid production could exceed 1 million units each year some time early in the next decade.

Particularly interesting is the continuing development of lithium-ion battery technology. We are hopeful this will lead to low-cost, light-weight batteries with high energy densities, providing the ability to increase the all-electric range and efficiency of hybrid products incorporating full or strong hybrid approaches.

Plug-In Hybrids

We are, of course, aware of the enthusiasm in some quarters for plug-in-hybrid (PHEV) technology. The Prius, with its inherent advantages of a strong hybrid design, has been the candidate of choice for many early aftermarket conversions.



source:Christian Rosenkranz (VARTA) "Plug-in Hybrid Batteries" EPRI workshop at EVS20

Among other promising technologies, Toyota is investigating the idea of PHEV designs. In the future, this type of approach may have merit. We believe that PHEV's ability to successfully compete in the market to a large extent depends on the development of battery technology that is lightweight, inexpensive and durable.

There are other challenges to be met in the development of PHEVs. Many current PHEV designs use deep charge/discharge cycles to improve their all electric range. As we can see from the above data, battery life is adversely impacted by large swings in the state-of-charge (SOC). Battery management systems in the Prius restrict SOC swings to a carefully defined level that is consistent with its very long battery life. Successful PHEV designs must carefully balance the desire for longer all-electric range with cost and weight targets and the need to extend the lifetime of the battery system.

Hydrogen Fuel Cell

Our ultimate goal is to produce technologies that can eliminate vehicle emissions and greatly enhance energy security. That is the role of the hydrogen fuel cell and why Toyota considers it one of our key technologies for development. Fuel cell vehicles offer the promise of unparalleled operational efficiency, long driving range and a diversity of fuel sources. Although substantial progress is being made in developing this technology, the promises offered by a hydrogen economy must wait until sometime in the future to be fulfilled.

Conclusion

In closing, we believe that as new technologies are considered, three conditions must be satisfied before they can successfully enter the market:

1. All technical challenges must be met. The end product must offer advantages not provided by the product it seeks to replace and the emerging technology must be competitive in all traditional areas of evaluation.
2. Society must be prepared. For alternative fuels this means, at a minimum, development of fuel production and delivery systems that proceed at pace with market driven introductions of advanced technology. In the case of

grid connected technologies, this may mean the development of low carbon electrical generation plans. In every instance this requires education and outreach programs that inform and prepare consumers.

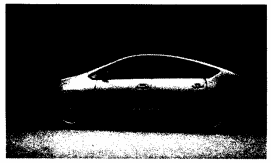
3. Market conditions that signal to consumers the movement to alternative technology is real and enduring.

Unless all of the conditions listed above are met, it is unlikely that any new technology can successfully replace its traditional competitor.

With regard to our transportation systems, the next few years will be challenging as new technologies and fuels begin to make substantial inroads into traditional markets. The challenges of geopolitics, energy security and environmental awareness will broadly impact this situation. Toyota strongly believes that our hybrid technology provides the fundamental basis necessary to capitalize on the various promises that are being offered.

HYBRID VEHICLE STORY

- Toyota introduced the world's first mass-market gas-electric hybrid vehicle in Japan in 1997
- Since 2000, Toyota has sold more than 300,000 hybrids in the U.S.
- Combined, all the hybrids Toyota has sold in the U.S. have saved more than 133 million gallons of gas
- In 2006, Lexus will introduce the GS 450h hybrid luxury sports sedan and Toyota will introduce the Camry Hybrid
- By early next decade, one quarter of the vehicles Toyota sells in the U.S. will be hybrids
- Worldwide, Toyota plans to sell a million hybrids a year by early next decade
- In 2006, Toyota will sell approximately 200,000 hybrid vehicles in the U.S.



- **Toyota Prius** was first introduced in the U.S. in 2000
- Now the most popular hybrid in the U.S. and the world
- More than 250,000 sold in the U.S. since 2000
- For 2006, Toyota will sell about 110,000 Prius in the U.S.
- 80 percent cleaner for smog-forming emissions
- AT-PZEV (advanced technology partial zero emission vehicle
- EPA Fuel Mileage Estimates: 60 city/51 hwy/55 combined
- MSRP: $21,725
- Federal tax credit: $3,150

- Introduced in April 2005
- **Lexus RX 400h** is the world's first luxury hybrid vehicle
- Provides V8 performance but saves gas and has fewer emissions
- 80 percent cleaner for smog-forming emissions
- SULEV (super ultra low emissions vehicle)
- EPA Fuel Mileage Estimates: 31 city/27 hwy (AWD model)
- MSRP: $49,060 (AWD model)
- Federal tax credit: $2,200

- **Highlander Hybrid** introduced in June 2005
- Offers convenience of an SUV, but with superior power and fuel mileage
- 80 percent cleaner for smog-forming emissions
- SULEV emissions rating
- EPA Fuel Mileage Estimates: 31 city/27 hwy (AWD model)
- MSRP: $33,030 (2WD model)
- Federal tax credit: $2,600

Rev. 04/19/2006

MR. HALL. The Chair now recognizes Elizabeth Lowery, Vice President, Public Policy Center, General Motors. You are recognized you for 5 minutes.

MS. LOWERY. Thank you, Mr. Chairman. Good afternoon, my name is Elizabeth Lowery and I am Vice President for Environment and Energy for General Motors. I am pleased to be able to speak to you today regarding GM'S near and longer-term plans for development and implementation of advanced technologies into our future vehicles.

TOYOTA

HYBRID VEHICLE STORY

LEXUS

- Toyota is putting Hybrid Synergy Drive in America's most popular car
- **Camry Hybrid** will go on sale in the spring and production in Kentucky will begin in summer
- For 2006, Toyota will sell approximately 30,000
- 80 percent cleaner for smog-forming emissions
- AT-PZEV rated like the Prius
- EPA Fuel Mileage Estimates: 40 city /38 hwy /39 combined
- MSRP: $25,900
- Federal tax credit: $2,600

- **Lexus GS 450h** will be the world's first front-engine, rear-wheel drive full hybrid
- On sale April 2006
- Provides V8 performance but saves gas and has fewer emissions
- 67 percent cleaner for smog-forming emissions, 30 percent more fuel efficient
- Zero to sixty acceleration is 5.2 seconds
- EPA Fuel Mileage Estimates: 25 city/28 hwy / 26 combined
- MSRP: $54,900
- Federal tax credit: $1,550

- **2008 Lexus LS 600h L** debuted at the 2006 New York Auto Show
- Introduced Lexus Hybrid Drive system
- On sale in April 2007
- World's first full V8 hybrid
- The 5.0-liter engine with large high-output motors will generate more than 430 hp.
- Power and performance on par with 12-cylinder premium luxury sedans with fuel efficiency that will be best in V-8 class
- SULEV rated – 70 percent cleaner than its cleanest competitors
- In addition to performance and environmental benefits, will set a new standard in noise, vibration and harshness (NVH) standards

Rev. 04/19/2006

GM has always been a leader in the development and use of technologies in vehicles. From the move away from hand-cranked starters, to the highly successful catalytic controls for vehicle emissions, to efforts to produce an innovative electric vehicle in the 1990s, GM has been instrumental in implementation of advanced technologies. Today, we are continuing to focus on ways to advance vehicle fuel economy, safety, and emissions. And GM is leading in all of these activities. We have a plan to address both the needs of our customers and the critical public policy issues facing us. This plan includes near-term steps, such as continuing to make improvements to today's internal combustion engines and transmissions and increased E-85 flex-fuel capability; mid-term steps, such as more affordable and flexible hybridization of vehicles; and long-term steps such as fuel cells powered by hydrogen.

The answer to today's energy issues is not simple. And we believe that all of these technologies play an important role in America's energy future.

Today I am here to speak about our work in two particular areas, E-85 capable vehicles and hydrogen fuel cells. GM is leading the effort on flex-fuel vehicles capable of running on gasoline or E-85 ethanol. These vehicles offer a choice to consumers, a choice that has significant energy and economic benefits. Ethanol is renewable and, in high concentration blends, helps reduce greenhouse gas emissions. As E-85 it helps reduce U.S. dependence on petroleum, diversifies our sources of transportation fuel, and reduces smog-forming emissions.

Ethanol usage provides great opportunity for the domestic agriculture industry and should help spur new job growth in other areas. Until last fall, there was limited interest in the development of ethanol as an alternative fuel, but when gasoline prices spiked in the aftermath of the hurricanes that devastated the Gulf Coast, ethanol became more visible, and GM recognized an opportunity to become part of the solution.

Earlier this year, General Motors launched a national advertising campaign beginning with the very visible 2006 Super Bowl hosted in our own home city of Detroit. After the Super Bowl we continued through the 2006 Winter Olympics, including launching our "Live Green, Go Yellow" Web site. Traffic to that Web site quickly rose to the millions as consumers wanted to know more about E-85, GM flex-fuel vehicles, and station location. But that was just the beginning.

With nearly 2 million E-85 capable vehicles already on the road and a plan to offer 14 separate E-85 capable models in 2007, we wanted to make sure our customers knew when they were getting this flex-fuel capability. So GM launched a labeling effort that included an external badge on the vehicle, noting its flex-fuel capability and a yellow gas cap

to remind customers that their vehicle is capable of running on E-85 ethanol. We have also embarked upon several significant partnerships to increase the availability of the ethanol fueling infrastructure.

Most recently, GM partnered with Meijer, Clean Fuel USA, the State of Michigan, and the State of Indiana to work toward approximately 40 new retail outlets. We have previously announced similar partnerships in California, Illinois, Minnesota, and Texas, working with a variety of energy companies, State agencies, and distribution outlets. For the U.S., the growth of the ethanol industry raises enormous potential for displacing gasoline consumption in the transportation sector. If all of the 5 to 6 million flex-fuel vehicles on the road today were fueled using E-85, the U.S. could offset the need for 3.6 billion gallons of gasoline annually. And for the individual consumer, regularly filling a 2007 Chevrolet Tahoe with E-85 would displace the use of over 600 gallons of gasoline each year. These are impressive numbers so they need to find ways to increase availability of E-85 in the marketplace.

Looking to the long term, General Motors has placed very high priority on fuel cells and hydrogen as a power source and energy carrier for automobiles. To accomplish this, GM's fuel-cell program has focused on lowering costs, and increasing reliability of the fuel-cell stacks. Demonstrating the promise of the technology through validation programs and collaborating with other parties on the infrastructure issues that need to be addressed. We have made significant progress in several of these areas.

In the last 6 years, we have improved fuel-cell power density by a factor of 7, while enhancing efficiency and reducing the size of our fuel-cell stack. We have significantly increased fuel-cell durability, reliability, and cold-start capability. We have developed safe hydrogen storage systems that approach the range of today's vehicles. We have made significant progress on cost reductions through technology improvements and system simplification. With respect to collaboration, we are working with key partners on virtually every aspect of fuel-cell and infrastructure technology.

The FreedomCAR and Fuel Partnership, managed through the U.S. Department of Energy, has proven to be an important forum for addressing these issues and challenges. Clearly, huge challenges remain. Reliability of the fuel-cell stacks and storage of the hydrogen on board the vehicle must be resolved to draw American consumers to these vehicles. And the fueling infrastructure must be available so the owners of these vehicles have no concerns about where to get the hydrogen.

In conclusion, there is no one single solution to the challenges we face. We are concentrating our energies on a number of different fronts and believe that many of these technologies will coexist in the

marketplace. General Motors has a rational advanced technology plan that goes from near term, focused on alternative fuels like E-85 ethanol, to long-term hydrogen-powered fuel cells. We are executing that plan. All of these will help to simultaneously reduce U.S. energy dependence, remove the automobile from the environmental debate and stimulate economic and jobs growth.

Thank you for your attention and I am happy to answer questions.

MR. HALL. Thank you Ms. Lowery.

[The prepared statement of Elizabeth Lowery follows:]

PREPARED STATEMENT OF ELIZABETH LOWERY, VICE PRESIDENT, PUBLIC POLICY CENTER, GENERAL MOTORS

Good afternoon. My name is Elizabeth Lowery and I am Vice President for Environment and Energy in the GM Public Policy Center. I am pleased to be able to speak to you today regarding GM's near and longer term plans for development and implementation of advanced technologies into our future vehicles.

GM has always been a leader in the development and use of technologies in vehicles. From the move away from hand-cranked starters--to the highly successful catalytic control technology for vehicle emissions--to efforts to produce an innovative electric vehicle in the 1990s, GM has been instrumental in the implementation of advanced technologies.

Today, we are continuing to focus on ways to advance vehicle fuel economy, safety and emissions. And GM is leading in all of these activities. We have a plan to address both the needs of our customers and the critical public policy issues facing us. This plan includes near term steps, such as continuing to make improvements to today's internal combustion engines and transmissions and increased E-85 flexfuel capability; mid-term steps, such as more affordable and flexible hybridization of vehicles; and long-term steps, such as fuel cells powered by hydrogen. The answer to today's energy issues is not simple, and we believe that all of these technologies will play an important role in America's energy future.

Today, I am here to speak about our work in two particular areas – E-85 capable vehicles and hydrogen fuel cells.

GM is leading the effort on flexfueled vehicles capable of running on gasoline or E-85 ethanol. These vehicles offer a choice to consumers--a choice that has significant energy and economic benefits. Ethanol is renewable and, in high concentration blends, helps reduce greenhouse gas emissions; as E-85 it helps reduce U.S. dependence on petroleum, diversifies our sources of transportation fuel, and reduces smog-forming emissions. Ethanol usage provides great opportunities for the domestic agriculture industry and should help spur new job growth in other areas.

Until last fall there was limited interest in the development of ethanol as an alternative fuel. But when gasoline prices spiked in the aftermath of the hurricanes that devastated the Gulf Coast, ethanol became more visible and GM recognized an opportunity to become part of the solution. Earlier this year, General Motors launched a national advertising campaign, beginning with the very visible 2006 Super Bowl, hosted in our own home city of Detroit. After the Super Bowl, we continued through the 2006 Winter Olympics, including launching our "Live Green, Go Yellow" website. Traffic to that website quickly rose to the millions--as consumers wanted to know more about E-85, GM flexfuel vehicles and station locations.

But that was just the beginning. With nearly two million E-85 capable vehicles already on the road and a plan to offer 14 separate E-85 capable models in 2007, we

wanted to make sure our customers knew when they were getting this flexfuel capability. So, GM launched a labeling effort that included an external badge on the vehicle noting its flexfuel capability and a yellow gas cap to remind customers that their vehicle is capable of running on E-85.

We have also embarked upon several significant partnerships to increase the availability of the ethanol fueling infrastructure. Most recently, GM partnered with Meijer, CleanFuelUSA, the State of Michigan and the State of Indiana to work toward approximately forty new retail outlets. We have previously announced similar partnerships in California, Illinois, Minnesota and Texas--working with a variety of energy companies, state agencies, and distribution outlets.

For the U.S., the growth of the ethanol industry raises enormous potential for displacing gasoline consumption in the transportation sector. If all of the 5 million flexfueled vehicles on the road today were fueled using E-85, the U.S. could offset the need for 3.6 billion gallons of gasoline annually. And for the individual consumer, regularly filling a 2007 Chevrolet Tahoe with E-85 would displace the use of over 600 gallons of gasoline each year. These are impressive numbers, so we need to find ways to increase availability of E-85 in the marketplace.

Looking to the long-term, General Motors has placed very high priority on fuel cells and hydrogen as the power source and energy carrier for automobiles. To accomplish this, GM's fuel cell program is focused on lowering cost and increasing reliability of the fuel cell stacks, demonstrating the promise of the technology through validation programs and collaborating with other parties on the infrastructure issues that need to be addressed. We have made significant progress in several of these areas:

- In the last six years, we have improved fuel cell power density by a factor of seven, while enhancing the efficiency and reducing the size of our fuel cell stack.
- We have significantly increased fuel cell durability, reliability, and cold start capability.
- We have developed safe hydrogen storage systems that approach the range of today's vehicles.
- We have made significant progress on cost reduction through technology improvements and system simplification.

With respect to collaboration, we are working with key partners on virtually every aspect of fuel cell and infrastructure technology. The FreedomCAR and Fuel Partnership, managed through the U.S. Department of Energy, has proven to be an important forum for addressing these issues and challenges.

Clearly huge challenges remain. Reliability of the fuel cell stacks and storage of the hydrogen on board the vehicle must be resolved to draw American consumers to these vehicles. And the fueling infrastructure must be available so that owners of these vehicles have no concerns about where to get the hydrogen.

In conclusion, there is no one single solution to the challenges we face. We are concentrating our energies on a number of different fronts, and believe that many of these technologies will coexist in the marketplace. General Motors has a rational advanced technology plan that goes from near term, focused on alternative fuels like E-85 ethanol, to the long term hydrogen-powered fuel cells. We are executing that plan. All of these will help to simultaneously reduce U.S. energy dependence, remove the automobile from the environmental debate, and stimulate economic and jobs growth.

MR. HALL. The Chair recognizes the presence of a long-time Chairman of the Committee on Energy and Commerce, Mr. Dingell. Would you care to make an opening statement, or do you want to put one in the record?

MR. DINGELL. Mr. Chair, you are most gracious. Thank you. I would just like to welcome the distinguished panel here. Thank you for being here. This is very helpful to us. It is a privilege to see you. I have a number of friends down there in the well and I am delighted that they are here with us. Thank you Mr. Chairman.

MR. HALL. All right. The Chair notes that there is a vote on the floor, we have two votes. What do you think?

MR. SHIMKUS. We can get two people done.

MR. HALL. Okay. All right.

With that, I will ask some questions then. Thank you.

I, along with Chairman Barton, am interested in this question, and I am sure Gene Green, if he is here--most of us from Texas--and the Ranking Member here, Mr. Ross, who has great interest in Texas as his neighbor from Arkansas. But Texas has a unique confluence of automobile manufacturers, petrochemical industry infrastructure, oil and natural gas reserves, recoverable oil reserves, with the potential for carbon sequestration, nuclear power production, windfalls, and, importantly, 1,000 miles of existing hydrogen pipeline. And I understand that there is a coalition working toward the goal of large-scale hydrogen production, but there are no DOE hydrogen products that I am aware of in the State of Texas.

So, Secretary Karsner, can you tell me why DOE has not chosen to take advantage of the natural resources and infrastructure we have got in Texas? Doesn't it make sense to focus R&D efforts in the areas that can best support them? It is kind of a pro-Texas question.

MR. KARSNER. Mr. Chairman, as someone who has spent most of his life growing up in Texas, I don't have the answer to that, but I can assure you I will find out ambitiously.

MR. HALL. Thank you. Talk to Mr. Bodman about it. He is a great Secretary of Energy, and just sensible and kind and generous. I know he is probably going to put one in Texas, and we want one there.

MR. KARSNER. I know that would make my folks happy. I will do that.

MR. HALL. All right. Let's see. Again, to Mr. Karsner. I know that DOE is involved in pushing flex-fuel vehicles and the rollout of fuels that can run those vehicles, including E-85. Are you getting the support you need from the automakers on the rollout of the flex-fuel vehicles?

MR. KARSNER. Mr. Chairman, I have only been in this job for about 6 weeks and I can tell you that very few things occupy my time more than dialoguing with the automakers on that question. Secretary Bodman has tasked me quite deliberately on that issue, and, in fact, my first trip within 24 hours of joining DOE was to Detroit to put out that message and call for cooperation. I am happy to report that for the most part, we

are receiving good response from the automakers, particularly the members of the U.S. Car and FreedomCAR Coalition. We received that cooperation in varying degrees at various levels at various times, but it is proceeding forward and we do believe on a voluntary basis the automakers are taking their responsibilities quite seriously and engaging the Administration on ways that they could accelerate the rate of market penetration for flex fuel.

MR. HALL. And you are encouraging them.

MR. KARSNER. We are encouraging them.

MR. HALL. You are pushing them.

MR. KARSNER. I think that would be accurate to characterize it that way, sir.

MR. HALL. All right. Ms. Lowery, what is the future for fuel-cell vehicles? How do you see them evolving over the next 5 years, and the next 10 years?

MS. LOWERY. Well, I think there is a bright future for fuel-cell vehicles. There is a lot of work that needs to be done with respect to the hydrogen infrastructure, as well as the work that is being done through FreedomCAR and Freedom Fuel. We have an aggressive goal at General Motors to get the fuel-cell stack competitive with the internal combustion engine with respect to durability and reliability and all the important features of today's engines. And we have that in the 2010 time frame. And then in the next decade after that, we will look at production and the volume, with the development of the hydrogen economy.

MR. HALL. I thank you. At this time I will let the Ranking Member ask questions, if you like, Mr. Ross.

MR. ROSS. I have got quite a few, so you may want to tell me when we need to go vote, Mr. Chairman.

MR. HALL. When I go like that.

MR. ROSS. We will be back, I take it, after votes, Mr. Karsner, is that right?

MR. KARSNER. Yes, sir.

MR. ROSS. At the beginning of your testimony today, you mentioned the President's biofuels initiative and its goal to make cellulosic ethanol cost competitive by--what? 2012?

MR. KARSNER. Correct, sir.

MR. ROSS. Can you elaborate on the specific details within this initiative and how you plan to achieve that goal?

MR. KARSNER. Right now, cellulosic ethanol at today's prices, some could argue at the point of production, might be competitive. It is $2.25 and some odd cents. The program itself is designed to bring that number down by more than half, and it has a targeted goal of $1.07. In fact,

arguably, depending on the work that is done with the various feed stocks, it could be brought down more than that.

What really needs to occur between now and 2012 and what we are seeking to do at the fastest possible rate is to put up commercial-scale facilities and to measure how these interactions will work in real time. To that end, a solicitation for a cost share, as stipulated in the EPACT, has been put out by the Department; and the office has received in excess of 60 responses by private-sector participants and consortia seeking to be involved in putting up a commercial-scale facility based on different feed stocks in different geographic locations.

We are also seeking to work with those partners to see what their eligibility might be for financially structuring loan guarantee programs for those commercial facilities.

So that is what needs to occur in order to bring down the cost by 2012.

MR. ROSS. The Energy Policy Act of 2005 established an integrated biorefinery demonstration grant program.

MR. KARSNER. Correct.

MR. ROSS. I believe for the next 12 months for all of America, there is going to be a hundred million dollars in grant money available.

MR. KARSNER. That is right.

MR. ROSS. Roughly a third of what we spend in the next 24 hours in Iraq.

MR. KARSNER. I don't know about that.

MR. ROSS. Yeah, well it is $279 million a day that goes to Iraq, and we are going to spend a hundred million over the next 365 days basically for, you know, basically to fund a biorefinery demonstration grant program. So, basically, what we spend in Iraq in 8 hours is what we are going to spend in the next 365 days, trying to advance biorefinery. So we do a lot of talk in this town about alternative renewable fuels, but we really don't put our money where our mouth is.

My deal is this, that the program was created, as I understand it, to spur the development and implementation of a multifunctional commercial scale biorefinery. Legislation didn't specifically state that it needed to be built in Arkansas, but it does. I understand that the Department of Energy has released a notice of public interest in OPI and begun receiving applications from interested parties, such as Potlatch.

Can you tell me the status of this program, what other programs or initiatives is DOE pursuing to develop biorefineries in the United States?

MR. KARSNER. The status of that program is, as I referred to in an earlier answer, that we have received in excess of 60 responses that are currently being evaluated and that I believe the next significant milestone is August 10, which is the deadline for submissions.

I could report back with fuller details of what would happen procedurally after those initial submissions on August 10, but what I can tell you in the short time since I have been aboard is that we are also looking with those same partners who have made submissions to see whether we could save them from having to create the same workload twice and expand our efforts to reach them with the loan guarantee programs that are also available in the EPACT.

MR. ROSS. I would be very interested in personally following up with you after the August--

MR. KARSNER. Happy to do that.

MR. ROSS. --date that you mentioned, and I appreciate you doing that.

MR. KARSNER. Thank you so much, sir.

MR. ROSS. Mr. Chairman, I have 31 seconds left. Do we need to go vote or what do you want me to do here?

MR. HALL. I think we might recess for 15 minutes. You think we can be back in that time?

All right. At ease for 15 minutes. We will be back.

You know, used to be a store in my hometown that had--during the Depression, when he couldn't afford to miss a sale, he had a sign on his door when he would go for coffee, said "Going across to the cafe for a coffee, be back in 5 minutes. Been gone 3." That is one way of doing it.

[Recess.]

MR. SHIMKUS. [Presiding.] If I can have folks take their seats. And for their time and our time, we will get started.

Really, it is in the best interest of all of us that we move expeditiously, because you never know votes around here, never know how long they will keep you waiting. So Members can get their questions when everybody is around. We appreciate your patience, and I will begin to recognize myself for 5 minutes or until someone else comes back. Maybe I will have longer, pretty good deal.

Mr. Karsner, my understanding is that your office has conducted important research showing that vehicles burning biodiesel fuel blends generate lower levels of the other pollutant NOx, nitrous oxide--nitrogen oxide, excuse me--than vehicles burning exclusively petroleum diesel. You mentioned this in your testimony. Have you discussed the research with EPA policymakers?

MR. KARSNER. I am sorry. Have we discussed the--forgive me.

MR. SHIMKUS. This research and your numbers with our friends at the Environmental Protection Agency.

MR. KARSNER. Yes, sir, we have. In fact, we are collaborating with the EPA now to clarify the differences with the respective findings.

Fundamentally, we believe that the differences are related to differences in testing protocols; and, thus far, our conversations had led us and the EPA to believe that the future certification testing ought to be done more in the fashion that is being conducted in our national laboratories in real time, with the engines inside the trucks themselves, as opposed to outside of them on the bed.

MR. SHIMKUS. So it is your impression the two agencies will come to some agreement on how we do this testing and what is really the base?

MR. KARSNER. Yes, sir. I believe the collaboration is moving that way.

MR. SHIMKUS. Also, on the Office of Energy Efficiency and Renewable Energy, I know that is your arena, but I would be interested to hear your thoughts on coal-to-liquids--as I said in my opening statement--technology and what the Department might be doing for the advancement of its use.

MR. KARSNER. I appreciate that, sir.

As you mentioned, it actually belongs to my colleague, Jeff Jarrett, in the Office of Fossil Energy, but personally I can tell you that we in the Department--across the Department encourage the use of coal-to-liquids use and, in fact, anything that can cleanly accelerate the domestic installation of alternative fuel production capacity.

Specifically in my office, Energy Efficiency and Renewable Energy, we conduct testing of how those fuels might burn and burn well into the engines and into the fleet. So that is very promising; and it is a promising fuel that, in fact, enhances the cetane, is sulfur free, and can blend readily with conventional diesel. So we are encouraging its use and its acceleration as an alternative domestic fuel.

MR. SHIMKUS. Thank you.

And the great thing about the technology--and technology, as you all know in your business, can increase over the years, but the basic premise of this refinery technique was developed in the late 1920s, and so you have workable refineries out there now. So it is building on that. It is not inventing a whole new process from the bench top all the way up, and that is why I am very excited about it with our great coal reserves in this country.

For the car manufacturer folks, I am pleased with where we have progressed on the flexible fuel vehicles from--and now the major marketing campaigns that you all are involved with I think is great.

I do drive a Ford Explorer in my district. We do have 20 fueling stations in my district alone; and, of course, Illinois is a big ethanol State, as Iowa and those were their first showing, showing up.

Can you tell me what you are trying to do and encouraging and maybe investing on the facilities? I know, Ms. Cischke, you mentioned

fueling stations, fueling stations and inability in a lot of parts of the country to have it. Is there any focus you all are doing to try to encourage retail locations?

MS. CISCHKE. Yes. We have partnered with VeraSun Energy, which is the number two ethanol producer in the country, and we are working on developing a corridor in the Midwest to increase the number of fueling stations so somebody could drive from Chicago to St. Louis and on without having to do anything but fuel with E-85.

So we think that there is a real focus on putting it in the Midwest where there is a lot of the corn and other things. So we can heighten people's awareness as we are working with our partners, BP and other oil companies, to encourage them to also invest. We do think this is going to take the oil industry's support as well as the ethanol producers.

MR. SHIMKUS. Thank you.

Does anyone else want to add? Ms. Lowery?

MS. LOWERY. Sure. We have what is called the West-East Coast strategy, working on different State initiatives to encourage more fueling stations in different locations. So we have a project in California, we have a project in Illinois with Gas City and VeraSun, and we have decided that each of the States, if we can get some competition and grow the gas stations beyond just in the Midwest, E-85 ethanol will have a lot more success. So we are doing our part to encourage that with marketing efforts and bringing people to the stable.

MR. SHIMKUS. Thank you.

We have been tricked. So they just called me back to vote. I am going to ask a few more of my questions and then I will--unless someone jumps in back, we will recess and--I told you. You have to get it when you can.

I want to just make this point clear, and there is a lot of debate about the cost of E-85 refueling stations, and I know that people are looking for a lot of investment credits or help from the Federal government. I am telling you, the stations that we have employed in my district are mostly independent stations, and you know what the cost is? Zero.

Because what they do is they take the low-selling tank that they have in place right now, and most of that is 10 percent ethanol, and they drain it. They fill it with E-85, and they slap a sticker on the pump, and, voila, they are selling E-85 fuel out of a retail location.

So I get a little frustrated with some of the folks--especially the major energy refinery companies--that are moaning and groaning about the cost of--actually, the retail location. I personally say it is a bunch of hogwash, and they need to step up to the plate because of all the great benefits that you are doing now and what is being done on the refinery end.

So, with that, if I hope to make this vote, I had better start walking over, so I recess this hearing.

[Recess.]

MR. HALL. [Presiding.] They had a little mix-up. They didn't just have one vote over there. They had two votes.

I am watching the floor right now to see what they are doing and what they are going to do. They start making speeches again, and as soon as we get someone else in here, there will be others that will probably want to ask you something. I hate to hold you, but give them about another 10 minutes, and I think they will amble in here.

[Recess.]

MR. HALL. Okay. I know the questions that a lot of the others are going to ask. When they get in here, I will yield them time, and then I will take it away from them.

Mr. Reinert, what is the breakthrough technology we have been waiting for when it comes to batteries?

MR. REINERT. Well, I certainly hope, Mr. Chairman, that it is lithium ion batteries. They have the ability to be very lightweight.

Obviously, we have a materials problem with nickel. It is very high on the commodity markets. So we hope lithium ion technology is going to be a near and a mid-term solution. There are obviously some issues with lithium. It is a substance of concern, and we are not quite there with our cost targets and our PHEV targets, but we are fairly confident this will be very rapidly developed.

MR. HALL. I thank you.

Ms. Morrissett, what is the future for diesel and lean-burned diesel machines in vehicles? How do you see them evolving over the next 5 years or maybe the next 10 years?

MS. MORRISSETT. DaimlerChrysler, we see large growth in diesels and, in particular, biodiesels in the next 5 to 10 years. I announced to you today a few of the additional vehicles that we are adding, with some announcements coming in the next few weeks, but we see the growth over years.

Today, almost 50 percent of the market in Europe is diesel, and Chrysler products are two-thirds diesels in Europe. As you see fuel prices increasing, as you see customer demands for smaller engines, like you have in Europe, the things that you see are diesels that offer good performance in small packages. They have the torque and the towing capabilities in a smaller engine than you would see in gasoline.

If you look at J.D. Power numbers, J.D. Power predicts that we are going to go from about 4 percent of the products you see today to 7 to 15 percent in 2015.

That is just, you know, somebody else's thoughts. I really can't predict beyond that.

MR. HALL. Okay. I can't tell you who wants these questions asked, but they are questions that various members of the group had marked to ask, and I have got the gauge here.

So, Ms. Lowery, this is a very interesting question, and I don't know why I didn't think of it. I used to be in the aluminum business that sold parts for aviation. The goal was to have stronger material with less weight for the vehicle. If you could knock off some weight, well, you had really a breakthrough. So utilizing some materials such as carbon fiber seems to be an excellent way to reduce the weight of a car without compromising safety. Ms. Lowery, how expensive is it to create a car from carbon fiber materials, and how would that translate to the cost of the vehicle?

MS. LOWERY. Well, your reference to aviation is a legitimate one, given that a lot of the lightweight materials are in the aviation business. The automobile business is a little more robust with respect to all the different requirements and all the vehicles on the roads with respect to safety issues. So GM is looking at a lot of the lightweight materials. We have some of the leading experts in the business, and we are also working with a lot of the research institutes on lightweight materials.

I don't know the specifics with respect to the costs. I just know those materials are more expensive, but we are all looking at those kinds of materials in order to be able to get better fuel economy and not do anything with respect to safety issues.

MR. HALL. That is a real good subject for them to be upgrading, though, because it makes so much sense.

Mr. Karsner, do you think legislation is necessary to direct the Secretary of Energy to carry out a program of research development demonstration and commercial application for plug-in hybrid electric vehicles and electric drive transportation technology?

MR. KARSNER. I am not sure about the content of any new legislation. I think we have sufficient legislation on the books to move us that way, and it is integral to the President's Advanced Energy Initiative and the programming currently under way at the Department of Energy.

So plug-in hybrids are at the center of our agenda of research and development as was alluded to in the earlier answer, particularly with the focus on enhancing and bringing to market at a more rapid rate lithium ion technology.

MR. HALL. Well, what is the soonest we will have the infrastructure in place to support large fleets of hydrogen-powered vehicles?

MR. KARSNER. I am sorry. Did your earlier question ask about hydrogen or plug-in--

MR. HALL. If it wasn't, I didn't know it.

MR. KARSNER. What is the soonest we will have in place a fleet of--forgive me.

MR. HALL. Go ahead.

MR. KARSNER. I don't think, from the Federal standpoint, we are prepared to talk in terms of when we would have a fleet of hydrogen vehicles in place, depending on what you would characterize that fleet to be. We tend to leave the idea, dates, and timings of commercialization, i.e., the timing in which production would be economically and technically feasible, to the automotive companies.

So, under present planning, dates have been thrown around in the time range between 2015 and 2020 as to when initial production might be ready, based on technology readiness. We feel that it is really the automotive companies that would have to talk about what manufacturing transformation might be necessary for them to manufacture en masse to provide fleets.

MR. HALL. I notice in your testimony that the cost of fuel cells has diminished over the last 3 years. How much further does the price of fuel cells need to drop before they can be manufactured for commercialization?

MR. KARSNER. Well, that is, again, I think a subject for much debate and speculation. I have heard really on an order of magnitude of 10 times as much as where the total price adjustments need to fall. I would think that the auto manufacturers have different calculations themselves internally as to where that needs to be for them to put the capital costs into a manufacturing facility that would allow them to produce them en masse, but, fundamentally, all the research towards technology readiness is really about driving down that cost, and I think right now the price point we use is getting to a tenth of the current cost.

MR. HALL. Mr. Ross, would you like to ask questions, or would you like to get under way with the next panel?

MR. ROSS. I have a few questions.

MR. HALL. The Chair recognizes Mr. Ross for anywhere between 3 to 5 minutes, somewhere in there. Whatever you want.

MR. ROSS. That is better.

For, I guess, any of you that are automobile manufacturers on the panel, as I mentioned in my opening statement, I would like to discuss the hybrid, the vehicle tax credit as it relates to each of the manufacturers here today in an effort to continue and possibly provide additional incentives to consumers who purchase hybrid vehicles. Do you believe--and I would like to get an answer, I guess a short answer--from each of

you. Do you believe waiving the--or increasing the 60,000-unit cap is a viable option to consider?

And the reason I ask that, as we all know, the cost for a hybrid is somewhat more than for a nonhybrid vehicle. But, with the tax credit, it pretty much gets the hybrid on a level playing field. And until we are able to get the price of hybrid technology down, do you believe this tax credit is important to encourage people, consumers to buy these hybrid cars? And should we waive or raise the 60,000-unit cap in order to accomplish that?

MS. CISCHKE. I would like to just comment that we do know that incentives like that do help pull advanced technology. There are certain people that buy these advanced-technology vehicles without a lot of encouragement, but the vast majority of people are influenced by cost savings there.

I know that there is a limit on the resources for the Government in terms of being able to do this type of thing, but we would support increasing that. Maybe even doubling it would be appropriate.

MR. ROSS. Again, let me just point out that you mention that there is a limit to what the Government can do on this. Again, it is about priorities.

MS. CISCHKE. Sure.

MR. ROSS. It is about are we going to spend $279 million a day in Iraq, $57 million a day in Afghanistan, pass another $90 billion in tax cuts primarily for those earning over $500,000 a year, or are we going to invest in biorefineries and alternative renewable energy to reduce our dependence on foreign oil? So it is really about priorities.

I would like to get a response to the original question, before my little tirade there, from the rest of you that are in the car business.

MS. LOWERY. Incentives are important for the uptakers of advanced technology. There is no doubt about it.

I think with respect to the prioritization through the Energy Policy Act, there was a decision made with respect to prioritization and figuring out the economics of the entire bill. So I think it has to be looked at as a whole, and I also think that we have spent a lot of time now really looking at incentives for biofuels, which is an immediate response to some of the issues we are facing. So I think it has to be looked at in the whole package, not one piece.

MR. ROSS. And Toyota.

MR. REINERT. The situation is, we have had the Prius, which is probably the most popular hybrid on the road, for 6 years, and we are selling about a little over a hundred thousand cars per year in a 17 million-car market. Obviously, we are doing the best we can at preparing society for these cars. I believe that the tax credit does help

people become aware of the options under the hybrids and does help the market penetration greatly.

MR. ROSS. When I was out driving this hydrogen fuel cell car this morning--I won't mention the brand since none of you all are representing that one--but the point they made was this is a million and a half dollar car, and in 3, 4 years from now it may be a car that is affordable. So I think we are going to see a lot of changes in the technology and in the mass production that allows the cost of these things to come down, that really can reduce our dependence on foreign oil.

One of the things noted to me this morning was, with the hydrogen fuel cell if you do the math on it, it comes out to what we would know as about $2.75 a gallon for the fuel, and that would run you about 25 miles. So it is not that we are going to see that much savings in terms of what consumers are paying today, at least early on in some of these technologies, but it seems to me that these technologies could go a long way to reducing our dependence on foreign oil; and, hopefully, as we mass produce and end up with, hopefully, millions of these things on the road someday then that will, in fact, lower the price we pay at the pump, or whatever they call it for a hydrogen fuel-cell car.

I am still learning some of this, but I was really impressed with the technology and all the components that I have read about and studied. But actually to experience it this morning was quite fascinating.

Mr. Chairman, if you could indulge me, I have one other thing that I think is really important I would like to ask.

MR. HALL. Only if you tell us what kind of car it was in.

MR. ROSS. It was Honda. It was a Honda hydrogen fuel-cell car. And I don't know, some of y'all may be doing that now, too. Are you?

MS. LOWERY. Yes.

MR. ROSS. I want to give equal representation. I would love to ride in y'all's, too. Get it on up here, and I will ride in y'all's, too. It was pretty impressive. I guess I was kind of expecting something to go like a golf car goes, but it doesn't. It gets up and goes.

But, thank you, Mr. Chairman, for indulging me for this question.

The formula--because I think this is something that we do need to revisit--that is found in the energy policy that passed last year, the formula used to calculate the amount of the tax credit for hybrid cars applies a city fuel economy metric. Now it is my understanding that different hybrid technologies perform differently in city versus highway situations. So would changing this formula to use a combined city and highway fuel economy metric to calculate the credit provide a significant increase in the credit that consumers receive? And depending on which

manufacturer you are with may depend on how you answer that because of the technology and what you have invested in up until now.

The other part of that is, should Congress try to stay away from specifying city and highway and even the word hybrid and just leave it open for any alternative renewable energy forms out there to try to encourage development rather than limiting it to what we actually get specific with in the law?

I would like to get your thought on that as, I guess, a second part or follow-up to that question. I would love to get y'all's thoughts on that.

MS. CISCHKE. I would like to just comment a bit on the hybrid comment regarding the metric that you use for the benefit.

One of the challenges we all have in the industry is that we use hybrid technology to describe a lot of different things. So there are full hybrids, there are mid hybrids, there are hybrids that can run totally on electric engine, and there are others that coexist. That is why in the Energy Policy Act there was a metric that tried to define and classify the degree of hybridization, so to speak. So I think you do have to have some kind of measure. Otherwise, if they are all the same, I think you are not really pushing the technology along as far.

So that would just be one comment I would like to share.

MR. REINERT. I agree 100 percent with my colleague from Ford that there are a wide variety of approaches to hybrid technologies, and some of them have more and some of them have less benefit overall. So I do think we need to take a look, and I think we are addressing that or attempting to in the Energy Policy Act and do take a look at the performance of the cars.

MR. ROSS. Any thoughts on whether we ought to get away from the city and go to a combined city and highway fuel economy metric?

MS. MORRISSETT. If we go to a combined city and highway metric, what we do is we become more technology neutral. If you look at city, it favors certain types of technologies. If you look at highway, it favors others. So if you did a combination, it is more technology neutral.

MR. ROSS. Would you agree that we need to stay away from specifying technologies in laws and allow the private sector to compete with those technologies to get the most fuel economy and to reduce our dependence the most on foreign oil or do we, in the future, need to be specifying things like hybrid or hydrogen or leave the technology to y'all and put the incentives in for whatever fits within a broader scope?

MS. MORRISSETT. My position would be I just as soon that you did not dictate to us what the technology is. There are new emerging technologies every day, and you really don't want to limit that. Our customers are telling us what they require and what they need.

Back to your question on credits with hybrids before, my response would be I would prefer to have credits for any advanced technologies if we started talking about the biofuels, biodiesels, things that also accomplish some of the things that we are trying to do with energy security.

MR. ROSS. Mr. Chairman, I appreciate your indulgence; and next time I am introducing you in Texarkana, I will give you a favorable introduction.

MR. HALL. Okay. All right. You have been an informative and affable group. Thank you very much. We are going to release you at this time. We will have the second panel. Thank you for the time you have given us and the time preparing, the time of travel. Have a good, safe trip back to your office, and we thank all of you.

Okay. We are going to get under way. We don't have a full group, but they are on their way.

STATEMENTS OF MICHAEL A. PACHECO, DIRECTOR, NATIONAL BIOENERGY CENTER, NATIONAL RENEWABLE ENERGY LABORATORY; JON A. WARZEL, VICE PRESIDENT, BUSINESS DEVELOPMENT AND GOVERNMENT PROGRAMS, SYNTROLEUM CORPORATION; SCOTT HUGHES, DIRECTOR OF GOVERNMENT AFFAIRS, NATIONAL BIODIESEL BOARD; AND MITCHELL PRATT, SENIOR VICE PRESIDENT, CLEAN ENERGY

MR. HALL. At this time, I recognize Mr. Pacheco, Director of the National Bioenergy Center, National Renewable Energy Laboratory, and ask you to kindly just give us a synopsis of your testimony, and then we will ask you questions about it. Try to stay as close to 5 minutes as you can. You have been so patient and tolerant, go over if you need to, and I recognize you at this time.

MR. PACHECO. Thank you, Mr. Chairman.

Mr. Chairman, thank you for this opportunity to discuss how biofuels can provide our Nation with an abundant and renewable source of energy and, in particular, to help us reduce our dependence on imported oil.

I am the Director of the National Bioenergy Center at the National Renewable Energy Laboratory in Golden, Colorado. NREL is the U.S. Department of Energy's primary laboratory for renewable energy and energy efficiency. I am honored to be here today and to be able to speak with you.

The committee is to be commended on your hearings on new technologies. The director of NREL, Dr. Dan Arvizu, came before you

last week to address the entire range of renewable energy technologies. Given the seriousness of our energy challenges, there is a lengthy list of renewable and conventional energy options that must be pursued.

If we narrow our focus to just those things that can reduce our addiction to oil, then our choices become more limited. Developing an industry to produce biofuels like ethanol and biodiesel must be a priority, because biomass is the only renewable option that we have for liquid transportation fuels.

The biomass resource in this country is huge. A recent study by USDA and DOE found that the U.S. could annually produce 1.3 billion tons of biomass for fuels. This amount of biomass holds as much energy as 3 ½ billion barrels of oil. This equals the energy in 60 percent of all the oil that we consume in a year. It also equates to the most oil the United States has ever produced in a year. We envision that every State in the Nation can benefit economically from an expanding biofuels industry.

The U.S. currently produces more than 4 billion gallons a year of ethanol almost exclusively from corn grain, and this industry is growing 30 percent annually. To move the ethanol industry where we need it to be, we have to go beyond corn grain as the primary resource.

One of the most abundant potential resources we have is corn stover, the nonfood parts of the corn plant, includes the stalks, the leaves, and the husks. Other resources include forest thinnings to reduce fire hazards, residues from the forestry and agricultural operations, and eventually even energy crops like fast-growing trees and hardy grasses, like switchgrass.

Given this full range of resources, biofuels could supply at least 30 percent of what we use today. However, to use all of these resources and to maximize the impact ethanol can have, we need to perfect the technologies that convert cellulosic biomass. We need to reduce the cost of the technology and we need to improve its conversion efficiency.

With the President's biofuels initiative, we are on course to do just that. Our goal, as Mr. Karsner has said, is to make cellulosic ethanol as cheap as corn ethanol in the next 6 years. We have made very good progress over the past 4 years; and with the President's initiative we have established detailed R&D plans to reach the goal of $1.07 by 2012, while still shooting for the longer-term cost target of about 60 cents a gallon.

Inviting me here today, you asked me to talk about the energy efficiency of ethanol. The ethanol industry is much more efficient today than it was 20 years ago. Today, the energy benefits of fuel ethanol are clear and considerable. Corn ethanol delivers about 60 percent of the total energy that we use in order to make that ethanol. Most of the energy that we use is renewable energy in the form of the corn itself.

The energy actually delivered to the customer in the fuel ethanol is about 1.4 times greater than the fossil energy put into the process, and it is about 10 times greater than the petroleum energy input. Cellulosic ethanol will yield 45 percent of the total energy used to make it, and nearly all of the energy input can come in the form of biomass itself.

The take-away message is that ethanol can replace about 10 times the amount of petroleum that we use to make the ethanol. This is true for both corn and cellulosic ethanol.

In conclusion, biomass is our only renewable option for liquid transportation fuels. U.S. resources can supply a large portion of the transportation fuel that we need, and the energy balance is actually very good for such a young technology. Biofuels can come from resources in every region in the country and can stimulate rural economies. Ongoing research will reveal ways to expand our resource base, improve the conversion efficiency and create new fuels that go beyond ethanol and biodiesel.

As the Director of this Nation's National Bioenergy Center, I can assure you that a sustained high-level investment for basic biofuels research will provide sustainable benefits for all future generations. Biofuels are an environmentally and economically beneficial way for us to bridge the gap between rising energy demand and peaking oil production, while reducing U.S. dependence on imported oil.

Thank you, Mr. Chairman.

MR. HALL. Thank you.

[The prepared statement of Dr. Michael A. Pacheco follows:]

PREPARED STATEMENT OF DR. MICHAEL A. PACHECO, DIRECTOR, NATIONAL BIOENERGY CENTER, NATIONAL RENEWABLE ENERGY LABORATORY

Prepared Statement of
Dr. Michael Pacheco
Director, National Bioenergy Center
National Renewable Energy Laboratory
Golden, CO
May 24, 2006

Mr. Chairman, thank you for this opportunity to discuss how biofuels can provide our nation with an abundant, renewable source of energy, and in particular, help reduce our dependence on imported oil. I am the director of the National Bioenergy Center at the National Renewable Energy Laboratory, in Golden, Colorado. NREL is the U.S. Department of Energy's primary laboratory for research and development of renewable energy and energy efficiency technologies. I am honored to be here, and to speak with you today.

The committee is to be commended for your hearings on new energy technologies. The director of my national laboratory, Dr. Dan Arvizu, came before you last week to address the entire range of renewable energy technologies that are in the marketplace, and on the horizon. Given the seriousness of the energy challenges we face as a nation, there is a lengthy list of renewable and conventional energy options that must be pursued.

If we narrow our focus, however, and consider specifically just those things we can do to create a viable alternative to oil – then our choices become more limited. Developing an industry to produce biofuels like ethanol and biodiesel must be a priority – because biomass is the only renewable option we have for liquid transportation fuels.

The emerging biofuels industry

Biomass is plant material, most commonly, trees, grasses or agricultural wastes that can be turned into energy. There are a lot of ways biomass can provide energy, and for decades there has been a valuable biopower industry in this country that produces *electricity* from biomass. Your hearing this afternoon on the next generation of vehicle and fuel technologies is timely and appropriate. We only recently have come to fully comprehend just how valuable a contribution ethanol can make, and how we can mobilize the technology and the entrepreneurial wherewithal to make it happen.

Accelerated development of a cellulosic ethanol industry is a goal that I believe realistically can be accomplished – if we put adequate resources behind the effort.

When President Bush came to our Laboratory earlier this year, he talked about a national goal of replacing more than 75% of our oil imports from the Middle East by 2025. And he affirmed that the best way to do that is through increasing our research on advanced energy technologies.

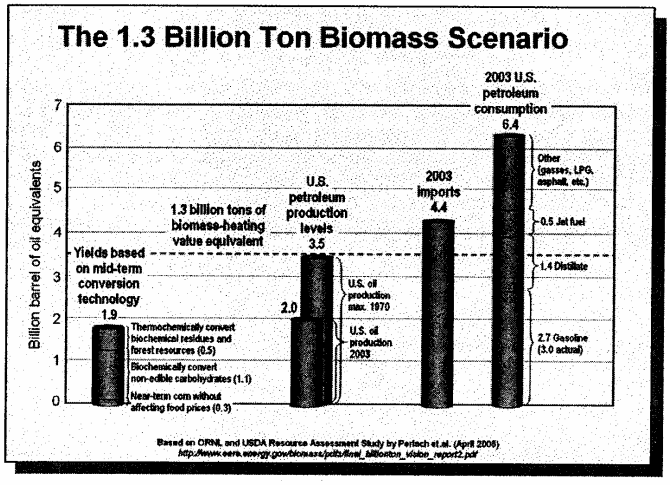
Dr. Arvizu and I were privileged to take the President through one of our key research buildings, the Alternative Fuels User Facility. We toured our process development equipment and I explained what goes on there - the research needed to accelerate the growth of a vital bioenergy industry in the United States.

Our goal is to make renewable biomass-derived fuels and chemicals the solution for ending, as President Bush himself memorably put it, our nation's "addiction" to oil. And with the

President's Advanced Energy Initiative, we are on course to bring the nation's first commercial cellulosic ethanol production facilities into existence by 2012.

Biomass: A plentiful resource

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



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

Let me provide some perspective on that. This 3.5 billion barrels is about 60% of the 6 billion-plus barrels of oil the U.S. consumes each year. Domestically, the United States, including Alaska, currently produces about 2 billion barrels of oil per year. That's only 67 percent of the potential we see from biomass. U.S. oil production peaked in the early 1970s at the same level of production, about 3.5 billion barrels per year. The U.S. has *never* produced more than 3.5 billion barrels a year of oil.

I should emphasize that such a transition to biofuels will not happen overnight. It will take a significant and sustained national effort to get us there. Still, "The Billion Ton Study" clearly demonstrates the biomass resource is real, and large enough to ultimately replace a large fraction of the petroleum-derived fuels we depend on today.

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

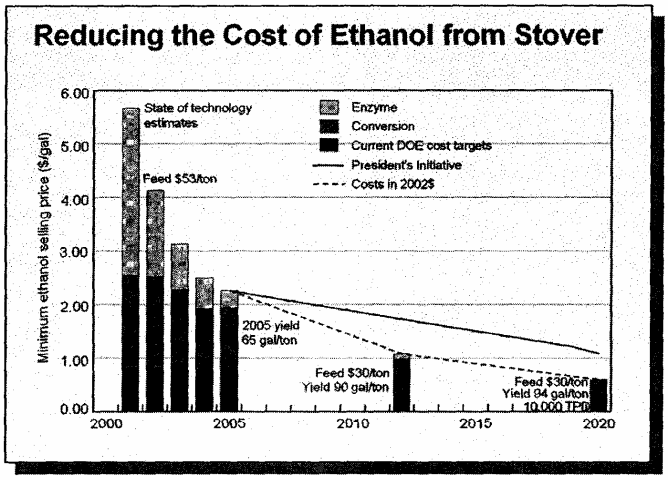
We also are encouraged by the fact that there already exists a strong and growing ethanol fuels industry in this country. The U.S. currently produces more than 4 billion gallons a year of ethanol, almost exclusively from corn grain, and the industry is growing 30 percent annually.

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

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

Breaking down the economic barriers

So, why aren't we producing ethanol from cellulosic biomass today? Simply put, the cost is too high. If we were to build a facility today for converting cellulosic biomass to ethanol, it would produce ethanol at about twice the price of one of today's existing corn grain ethanol facilities. But we are making steady progress. The focus of the DOE Biomass Program and the National Bioenergy Center is to make cellulosic ethanol as cheap as corn ethanol within the next 6 years. Longer term, DOE and NREL are targeting a cost of cellulosic ethanol as low as 60 cents per gallon, but this will require revolutionary approaches for producing, collecting, and converting biomass.



The targets we have set to accomplish this are ambitious, but we believe they can be met with adequate research support. Our goal is to reduce the cost of producing cellulosic ethanol from $2.25 a gallon in 2005, to $1.07 in 2012. To get there we are working to greatly increase production efficiencies, and boost the average yield from 65 gallons per ton as it is today, to 90 gallons per ton in 2012.

One of the reasons I'm optimistic that we will meet these targets is our encouraging progress to date. Over the past 5 years, we've been able to drastically cut the cost of ethanol from cellulosic

biomass, corn stover in particular, by reducing the cost of enzymes in partnership with two major enzyme manufacturers, and improving the biomass conversion process.

In the late 1990's, the high cost of cellulase enzymes forced the use of an entirely different process called acid hydrolysis, even though the acid hydrolysis process has inherent limitations in what it can yield. That has changed because of a partnership between DOE and NREL, and two of the world's largest bio-engineering firms – Genencor and Novozymes. The consequences of that research collaboration have been impressive. The cost of enzymes for producing cellulosic ethanol has been reduced from more than $3 per gallon of ethanol, to less than 25 cents per gallon. And, we are working to reduce that to 10 cents a gallon by 2012. As a result, all major process development work on cellulosic ethanol production has now turned to more efficient enzymatic hydrolysis – proof that the nascent industry already is benefiting from these scientific breakthroughs.

Integration of biorefineries into existing industries

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

A range of biorefinery R&D work is underway in partnership with industry. As Assistant Secretary Karsner has noted, DOE's biomass program is partnering with a number of the major ethanol technology providers and ethanol producers, including Abengoa, ADM, Broin and Cargill, to increase the yield of ethanol from existing corn ethanol facilities and expand the slate of feedstocks.

At the same time, DOE is partnering with existing chemical industry leaders such as DuPont and Dow Chemical to develop new opportunities for producing both fuels and chemicals from biomass and with NatureWorks to develop biorefineries that co-produce ethanol and polylactic acid, or PLA, a unique environmentally friendly and renewable polymer.

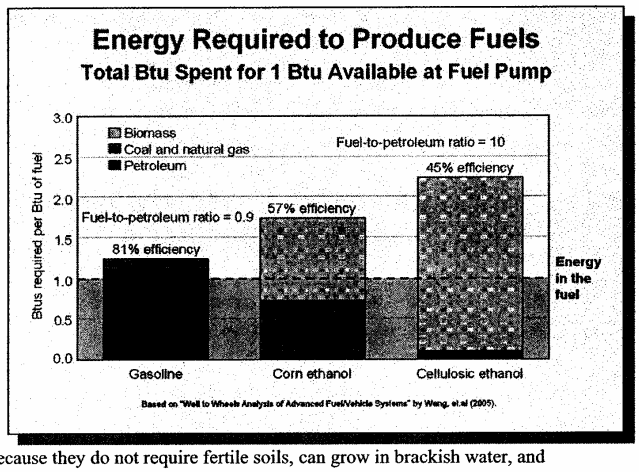
These and other partnerships are speeding the progress of new technologies to the marketplace.

In many ways, a cellulosic biorefinery can be viewed as an expansion of a starch ethanol facility. That's why we believe tomorrow's cellulosic ethanol industry will not replace today's corn grain ethanol industry, it will evolve from it. Similarly, DOE is partnering with the forest products industry to develop biorefinery concepts that can integrate into existing forestry operations.

Ethanol reduces use of petroleum

You may have heard some discussion about the energy efficiency of ethanol. The first ethanol plants built in the late 1970s were costly and energy-intensive, and that did spark a debate about whether it made good "energy sense" to replace gasoline with ethanol. Today's ethanol industry is considerably more cost effective and energy efficient. Researchers at DOE, USDA and elsewhere have shown that the net energy benefits of fuel ethanol are clear and considerable.

The figure below summarizes results from the "Well to Wheels" study conducted by Argonne National Lab, General Motors, and several other partners including two major oil companies. As shown in the figure, the energy contained in ethanol made from corn is about 1.4 times the fossil energy used to produce the ethanol, and 10 times the petroleum used. For cellulosic ethanol, the ratio of energy in the ethanol to the fossil energy used also increases to about 10 Btu's in the ethanol for every 1 Btu of fossil fuel used. From the perspective of science, at least, this debate has been decided in favor of continued development of ethanol. Ethanol is proving to be a very effective option for reducing our dependence on petroleum – regardless of whether it is made from corn or cellulosic materials.



There is little doubt that ethanol will be, and should be, the first biofuel that we can use to reduce our dependence on petroleum. However, NREL and the National Bioenergy Center recognize that other biofuel options need to be developed as well. Biodiesel and other derivatives of fats, oils and greases can make a significant contribution. Aquatic species such as algae can also play a major role in the long term, because they do not require fertile soils, can grow in brackish water, and yet, algae can produce very high yields of oil.

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

Other NREL vehicles and fuels research

I would be remiss if I did not note the other important research being conducted at NREL which also is contributing to the next generation of vehicles and fuels. NREL's Center for Transportation Technologies and Systems is working on many promising answers to our future transportation needs, including gasoline-electric hybrid systems, new, cleaner diesel fuels and a

number of fuel saving technologies. So-called "plug-in hybrids" are one dramatic example. These vehicles use both a gasoline engine and the electric outlet of your home to eventually achieve fuel economy of more than 100 miles per gallon.

It should be noted that among the benefits of biofuels are some significant advantages regarding air emissions. Both ethanol and biodiesel are oxygenates and hence can reduce the hydrocarbons, carbon monoxide and soot emitted from the tail pipes of gasoline and diesel vehicles. Ethanol additionally can cut by a quarter emissions of smog forming hydrocarbons from fuel evaporation.

Continued research hastens fuels development

In conclusion, let me review some key points: Biomass is the only renewable option for producing liquid transportation fuels. The U.S biomass resource can supply a large portion of demand for gasoline and we can greatly expand the resource base when world petroleum production begins its decline. The biofuels industry can use resources from every region of the country and could become a needed stimulus for ailing rural economies. Ongoing research, like research into biorefineries, will create many new products beyond the biopower, ethanol and biodiesel we are producing today.

The President's initiative holds the promise of accelerating our work so that we can help get this industry up and running, to benefit the American people, even sooner. His initiative envisions a more aggressive research effort in all key areas: further reductions in enzyme costs, advances in process technology to reduce capital and operating expenses and advances in feedstock R&D that will reduce the cost of production, collection and transportation of biomass to the biorefinery.

As director of the nation's research center for bioenergy, I can assure you that a sustained, high-level of investment for research in bioenergy will provide major benefits for future generations. We need to keep apace with this work because biofuels are an environmentally and economically beneficial way to bridge the gap between rising energy demand and peaking oil production, while reducing U.S. dependence on imported oil.

MR. HALL. The Chair recognizes Mr. Jon A. Warzel, Vice President, Business Development Government Programs, Syntroleum Corporation, for 5 minutes or whatever it takes you to give it.

MR. WARZEL. Thank you, Mr. Chairman, committee members, and guests. My name is Jon Warzel, and I am the Vice President of Business Development and Government Programs for Syntroleum Corporation. Syntroleum is a publicly held company based in Tulsa, Oklahoma, focused on the application of its proprietary Fischer-Tropsch technology for the conversion of natural gas and coal to liquid hydrocarbon transportation fuels.

We would like to recognize the efforts of Congressmen John Sullivan and Don Young and Senators Jim Inhofe and Conrad Burns as champions for domestic alternative fuels in the use by our Nation's military.

Syntroleum has over 20 years of comprehensive technology development. Currently, Syntroleum has the only fully integrated Fischer-Tropsch plant capable of producing a finished transportation fuel in North America and will be providing the Department of Defense with a hundred thousand gallons of product for their Assured Fuels Initiative later this summer. This program aimed at certifying Fischer-Tropsch product for military use is a critical step in reducing our Nation's dependence on crude oil and providing alternative energy resources.

As part of the military's program, a flight test in a B-52 will take place later this year using Syntroleum's alternative fuel. Currently, military operations consume in excess of 350,000 barrels a day of jet fuel, predominantly derived from crude oil.

My objective today is to provide you with a background and understanding of Fischer-Tropsch's history, technology, and the products produced by this process.

Syntroleum was founded by our current chairman, Mr. Ken Agee, in the mid-1980s. By the mid-1990s, the company was in a position to expand from a research lab to construction of a pilot plant for further testing.

In 2002, Syntroleum, in conjunction with the participation of Integrated Concepts Research Corporation, ICRC, and Marathon Oil Company, built the demonstration plant at the Port of Catoosa near Tulsa, Oklahoma. This effort was partially funded by the Department of Energy's Ultra Clean Fuels Program under a subcontract with ICRC. Finished fuels production for the nominal 70-barrel-per-day demonstration plant occurred in March of 2004.

Based on information from the Air Force, Syntroleum is the only company to date that has delivered sufficient quantities of 100 percent FT product to the U.S. military to perform extensive tests, including jet engine emissions testing.

The Fischer-Tropsch's chemistry and process was developed by two German scientists, Franz Fischer and Hans Tropsch, in the 1920s. The

basic reaction chemistry is the combining of carbon monoxide and hydrogen to form long chain hydrocarbon molecules. The initial German efforts were to provide the country, which lacked indigenous oil resources, a means of supporting chemical feedstock and military operation requirements. Due to the oil price collapse of the 1950s, synthetic fuel development essentially halted for the next 20 years or so, except for the development efforts in South Africa.

In 1950, the South African Coal, Oil Gas, and Gas Corporation, known as Sasol, was formed. First FT production by Sasol in 1955 was based on coal-driven synthesis gas at their Sasolburg facility. The Government-funded efforts continued, culminating in the start-up of additional plants in the 1980s. Currently, Sasol produces 150 to 160,000 gallons a day--or barrels a day--of FT products from coal.

From a chemistry standpoint, Fischer-Tropsch is the reaction of carbon monoxide and hydrogen in the presence of a catalyst, typically iron or cobalt. The carbon monoxide and hydrogen split and formed together to make a hydrogen product and a water product. The reaction requires a specific hydrogen-to-carbon-monoxide ratio and produces approximately a barrel of water for each barrel of FT product, essentially reducing water consumption requirements in the coal gasification process. The key concept for FT is that the synthesis gas can be produced from almost any carbon-bearing substance, the most abundant source being natural gas and coal.

In CTL, or coal to liquids, the application requires a number of steps required to convert the solid coal into carbon monoxide and hydrogen. The coal is mined, prepared for gasification, gasified, adjusted for the hydrogen-to-carbon-monoxide ratio and, finally, cleaned prior to the delivery to the Fischer-Tropsch's reactor. The component of the synthesis gas is to remove the carbon dioxide, which allows for sequestration or enhanced oil recovery opportunities. Upon final cleanup, the synthesis gas enters the reactors for conversion of the hydrocarbon product. Due to the size and complexity of these processes, there are only a few companies worldwide that have the experience of building these type of plants.

The Air Force results of the testing of Syntroleum's fuels have shown 90 percent reduction in particulate matter emissions, in excess of 50 percent reduction compared to low sulfur diesel fuel for hydrocarbon emissions and particulate matter and diesel running machines.

As far as industry status, there are a limited number of companies that have developed Fischer-Tropsch's technologies to the point of constructing commercial-scale plants. The FT industry is predominantly focused on natural-gas-based plants. In Qatar, at the moment, this effort is being led by the likes of Sasol, ExxonMobil, Shell, ConocoPhillips,

and Marathon Oil, which have all announced in excess of hundred-thousand-barrel-per-day plants.

In conclusion, the technology to convert the Nation's vast coal resources to ultra-clean fuels via the Fischer-Tropsch process exists today. I believe it is accurate to say Sasol, based on the development under a government program, has demonstrated large-scale Fischer-Tropsch plants using coal as a feedstock. Based upon 2003 Energy Information Administration data, the U.S. has a demonstrated coal reserve base of 496 billion tons. At a conservative conversion rate of 1.5 barrels of Fischer-Tropsch's product for each ton of coal, the potential for domestically produced CTL is approximately 750 billion barrels of product, greater than the estimated crude oil reserves of the Middle East.

It is our view that funding of loan guarantees specific to the CTL initiative and long-term offtake agreements by the Department of Defense are critical to moving forward with the domestic initiative, specifically for those smaller companies that do not have the balance sheets of the super major integrated energy companies at this time.

Finally, thank you for the opportunity to address the subcommittee on this important issue as industry and government work towards making CTL a reality in the United States.

MR. HALL. We thank you.

[The prepared statement of Jon A. Warzel follows:]

PREPARED STATEMENT OF JON A. WARZEL, VICE PRESIDENT, BUSINESS DEVELOPMENT AND GOVERNMENT PROGRAMS, SYNTROLEUM CORPORATION

Thank you Mr. Chairman, Distinguished Representatives, and guests, my name is Jon Warzel and I am the Vice President of Business Development and Government Programs for Syntroleum Corporation. Syntroleum is a publicly held company based in Tulsa, Oklahoma focused on the application of its proprietary Fischer-Tropsch ("FT") technology for the conversion of natural gas and coal to liquid hydrocarbon transportation fuels and other specialty products, such as lubricating oils. Syntroleum has over 20 years of comprehensive technology development, with a combined 127 US and foreign patent applications pending and issued. Currently, Syntroleum has the only fully integrated FT plant capable of producing a finished transportation fuel in North America. My objective today is to provide you with a background and understanding of Fischer-Tropsch history, technology, and the products produced by this process.

Syntroleum Background

Syntroleum was founded by our current Chairman, Mr. Ken Agee in the mid 1980's. Mr. Agee focused on the application of the FT chemistry for conversion of natural gas. Initial efforts were directed at the research and development of a suitable catalyst. By the mid 1990's the company was in a position to expand from the research lab to construction of a pilot plant for further testing of its proprietary cobalt catalyst and begin developing plant design details. By 2002, Syntroleum had advanced its technology to the next development stage, construction and operation of a demonstration scale plant.

In early 2000, Syntroleum in conjunction with Atlantic Richfield Company (ARCO) operated a demonstration plant at ARCO's Cherry Point refinery. In 2002 upon British Petroleum's acquisition of ARCO, Syntroleum, in conjunction the participation of Integrated Concepts Research Corporation (ICRC) and Marathon Oil Company, moved this demonstration plant from Cherry Point, Washington to the Port of Catoosa near Tulsa, Oklahoma. This effort was partially funded by the Department of Energy Ultra Clean Fuels Program under a subcontract with ICRC, allowing for the expansion of the demonstration plant to a fully integrated plant capable of producing a finished transportation fuels. Groundbreaking for the Catoosa Demonstration Facility ("CDF") took place in August 2002 and first finished fuels production for the nominal 70 barrel per day plant occurred in March of 2004.

Syntroleum continues to own and operate its facilities for the development of a commercial scale FT plant. Syntroleum's fully integrated plant has over 18,000 hours of runtime and has produced over 300,000 gallons of FT product. These fuels have been extensively tested by transit fleets, engine testing labs, product testing labs, universities, and specifically the Air Force and Army.

Based on information from the Air Force, Syntroleum is the only company to date that has delivered sufficient quantities of 100% FT product to the U.S. military to perform extensive tests, including turbine emissions testing. Recently, our plant was chosen to produce the initial fuels for the Department of Defense Assured Fuels Initiative. As part of the Assured Fuels Initiative, the Air Force is scheduled to test Syntroleum's product in a B-52 flight test this fall.

The History of Fischer-Tropsch

The Fischer-Tropsch chemistry and process was developed by two German scientists, Franz Fischer and Hans Tropsch in the 1920's, with the first German patent being issued in 1925. The basic reaction chemistry is known as a hydro-polymerization of carbon monoxide. Essentially, this is the combining of carbon monoxide ("CO") and hydrogen ("H_2") to form a long chain hydrocarbon molecule. The initial German efforts were to provide the country, which lacked indigenous oil resources, a means of supporting chemical feedstock requirements and military operations. Germany's first two FT plants, approximately 1,500 barrels per day of capacity, utilized cobalt based FT catalyst and generated the required feedstock (synthesis gas), a mixture of CO and H_2, from coal and coke. History reflect that the initial startup of these plants occurred in the 1935 - 1936 timeframe.

During the World War II years, a total of 13 FT plants were constructed, nine of which were located in Germany. All plants utilized cobalt catalyst in a fixed bed reactor system with coal or coke derived synthesis gas. Germany reached a maximum production of approximately 16,000 barrels per day in 1944; all based on their cobalt catalyst FT process. Significant research and development efforts were initiated on iron based FT catalyst due to the scarcity of cobalt in Germany and the desire to produce a high octane gasoline. The efforts on iron based FT catalyst research were not commercialized by the Germans. Additionally, development of large scale slurry reactors capable of producing more FT product were initiated, but never completed due to war related problems. Copies of the original German documents and their translation are available at the www.fischer-tropsch.org website.

Post World War II, extensive FT catalyst and process patents were issue primarily to US companies. Under the US Synthetic Fuels Act (1944 – 1955) the US Bureau of Mines constructed a nominal 50 barrel per day iron based FT plant located in Louisiana, Missouri. This plant produced approximately 1.5 million gallons of gasoline which was fleet tested by the Armed Services. A second US plant was constructed and operated in the 1947 to 1957 timeframe in Brownsville, Texas. This approximately 8,000 barrel per day plant employed iron based catalyst and utilized natural gas as the feedstock, making

it the first "gas-to-liquids" plant in the world. Technical difficulties and the oil price collapse in the mid 1950's rendered the plant uneconomic.

Due to the oil price collapse of the 1950's, synthetic fuel development essentially halted for the next 20 years or so except for development efforts in South Africa and German plants which were moved into Russia or areas controlled by Russia. Three plants were located within the Russian security zone (2 in East Germany and 1 in current day Poland). At least 1 and maybe 2nd German FT plants were relocated to the USSR and in operation during the 1952 – 1954 timeframe. Little is known about these plants, but Russian technical teams were active post WWII.

In 1950, the South African Coal, Oil Gas and Gas Corporation (Sasol) was formed. First FT production by Sasol in 1955 was based on coal derived synthesis gas ("CTL") utilizing iron based catalyst at their Sasolburg facility. The plant was built to operate both low and high temperature reactors initially producing gasoline and later switching to chemicals production. Capacity for the initial plant was approximately 8,000 barrels per day. The government funded efforts continued, culminating in startup of Sasol Two and Three at their Secunda facility in the 1980's. Currently, Sasol produces 150,000 to 160,000 barrels per day of FT product from coal derived synthesis gas with an iron based catalyst. Additional facilities are operated to provide required research and development activities for their natural gas and cobalt catalyst based FT applications.

Since 1990, three large scale FT plants have been constructed all utilizing natural gas as a feedstock. Mossgas, now PetroSA, built as part of a government project, operates a 30,000 barrel per day facility built in 1992 to produce bulk fuel by licensing the Sasol technology. In 1993, Shell completed a nominal 12,000 barrel per day facility utilizing Shell's fixed bed process (Shell "Middle Distillate Synthesis" – MDS). Currently in start-up is the Sasol Oryx plant located in Qatar. This nominal 34,000 barrel per day plant utilizes a cobalt based FT catalyst for the primary purpose of producing diesel fuel and possibly synthetic lubricants with the primary market being Europe.

Industry Status

Sasol clearly has the most experience in FT technology and operations, in part to the early efforts of the South African government program. Public information indicates Sasol is currently working to expand the Oryx (Qatar) project by 66,000 barrels per day and develop an additional fully integrated GTL project in Qatar with their partner, Chevron, of 130,000 barrels per day. Additional work is proceeding on their 34,000 barrel per day GTL plant in Nigeria and a significant expansion (30-40%) of their South African facilities. Additional business development efforts include feasibility studies for two nominal 80,000 barrel per day coal to liquids plants in China and reported interest in Indian projects with India Oil Company. Sasol has recently discussed their potential interest in US based CTL projects in addition to the announced WMPI project in Pennsylvania.

Syntroleum continues to operate their nominal 70 barrel per day facility located near Tulsa, Oklahoma in support of technology enhancement and to provide FT product to the US Department of Defense. Business development efforts are focused on deploying Syntroleum's marine and land based FT technology and the potential development of several domestic CTL projects.

Shell continues operation of their GTL plant in Malaysia providing FT diesel to the Far East and European markets focused on reduction of air emissions. Shell has announced a 70,000 – 140,000 barrel per day GTL plant in Qatar, but the current project status is unknown. To date, Shell has not announced any additional projects.

Statoil-PetroSA continues to operate the 1,000 barrel per day GTL demonstration plant located at Mossel Bay, South Africa. To date, no definitive commercial projects have been announced.

ExxonMobil has announced a 150,000 barrel per day GTL plant to be located in Qatar. The current status of the project is unknown, but it appears this project will not be delayed by the Qatar government upon completion of commercial arrangements. ExxonMobil technology is based on cobalt catalyst and associated operating experience from their 200 barrel per day demonstration plant in Baton Rouge, Louisiana which was operated in the 1990 – 1993 timeframe. ExxonMobil would appear to be the leader in FT patents with over 3,500 patents assigned to it. In 2004, Syntroleum signed a worldwide license with ExxonMobil for access to their Gas to Liquids (GTL) patents to produce and sell fuels from natural gas or other carbonaceous substances such as coal.

ConocoPhillips also utilizes a cobalt based FT process and operated a 400 barrel per day demonstration plant at their Ponca City, Oklahoma facility from 2003 to 2005. Their announced 80,000 to 160,000 barrel per day GTL plant in Qatar has been put on hold by the Qatar government. BP and Institut Francais du Petrole (IFP) / Agip continue the development of their respective technologies with no known announcements of commercial projects. BP continues to operate their FT demonstration plant in Nikiski, Alaska which is not currently capable of producing a finished product. Rentech continues development of their proposed conversion of a natural gas based fertilizer plant in Illinois to a nominal 5,800 barrel per day CTL plant. Additional proposed projects that have been announced are a 10,000 barrel per day CTL plant in Natchez, Mississippi and a license for DKRW's proposed 40,000 barrel per day plant in Wyoming and construction of a 10 barrel per day demonstration plant in Colorado.

Fischer-Tropsch Technology and Products

From a chemistry standpoint, the Fischer-Tropsch reaction is the hydro-polymerization of carbon monoxide. In essence, a synthesis gas stream consisting predominantly of carbon monoxide (CO) and Hydrogen (H_2) is reacted in the presence of a FT catalyst. The CO molecule splits into carbon and oxygen and a hydrogen molecule attaches to each resulting in production of a stream containing hydrocarbon compounds and water. The reaction requires a H_2/CO ratio of in the range of 2.1 – 2.15 for production of transportation fuels and produces approximately 1.1 barrels of water for each barrel of FT product. The hydrocarbons produced by the FT reaction prior to product upgrading, range in carbon number from C_1 (methane) to C_{100+} . The typical carbon number range for a diesel fuel is C_8 thru C_{20}.

The key concept for FT is that the synthesis gas can be produced from almost any carbon containing substance, the most abundant sources being natural gas and coal. Additional carbon sources such as petroleum coke or biomass (wood, farming waste, grasses, sewage) could also be utilized as a feedstock with the appropriate technology for conversion to a synthesis gas. In a CTL application a number of steps are required to convert the solid coal into a CO and H_2 synthesis gas stream. The coal is mined, prepared for gasification, gasified, water-gas shifted to adjust the H_2/CO ratio, and finally cleaned prior to delivery to a FT reactor for conversion to a hydrocarbon product. A component of the synthesis gas clean-up process is to remove the carbon dioxide prior to the FT reactor. Removal and capture of the CO_2 allows for sequestration or enhanced oil recovery opportunities.

Individual companies have developed specific FT catalysts, but iron and cobalt based catalyst are the predominate formulations utilized currently. Each catalyst type has specific attributes, but the current commercial project developments in Qatar all utilize a cobalt based catalyst. Cobalt based FT catalysts have been shown to be more selective towards the production of mid-distillate range hydrocarbon product, which is the range for diesel and aviation finished fuels. Additionally, cobalt catalysts are more active, and as a result produce more barrels of FT product per lb of FT catalyst, which equates to smaller FT reactors for equivalent FT production. Iron based FT catalyst is more suited

to the production of chemical feedstock due to their inherent selectivity towards producing olefins and aromatics at high temperature operation.

The primary issue with using a cobalt based FT catalyst in a CTL plant is the ability to clean the synthesis gas to acceptable impurity levels. It is believed that through the use of Lurgi's Rectisol process and subsequent synthesis gas clean-up processes, such as charcoal beds, levels required for economic use of a cobalt catalyst can be achieved. For example, Eastman Chemical Company has been producing methanol from a coal derived synthesis gas for approximately 20 years. Although the catalyst is different, the methanol stream Eastman produces is utilized for a variety of end products and healthcare feedstock where high quality synthesis gas is a requirement.

Upon final clean-up, the synthesis gas enters the FT reactor for conversion to a raw hydrocarbon product. For a commercial scale GTL facility, 17,000 to 20,000 barrel per day, a single FT reactor is approximately 34 feet in diameter and 180 feet tall. These vessels can weigh in the range of 2,000 tons each. As a reference point, the new MIA2 tank weighs about 68 tons, so a single GTL FT reactor can approximate the weight of 30 MIA2 tanks. The FT reaction is a vigorous reaction which produces significant heat which must be removed. In addition to the basic reactor shell, the FT reactor internals are essentially a piping system to evenly distribute the synthesis gas within the reactor and a set of heat transfer tubes to remove excess heat. Due to the size and complexity of these reactors, only a limited number of companies can construct FT reactors. For CTL projects, due to the potential transportation, logistical, and safety issues associated with moving a vessel of this size, on-site construction may be required.

The raw hydrocarbon product is further processed / upgraded to enhance the properties of the finished fuels, chemical feedstock, or waxes. For the transportation market, typical FT finished diesel contains non-detectable levels of sulfur, aromatics and has a cetane index of 74+. Syntroleum has been working with and supplied the Air Force, Army, and Navy FT product. Based on our understanding from discussions with the Air Force, Syntroleum's FT product is the only fuel that has been extensively tested to date with respect to emissions reduction. The Air Force results, dependent upon equipment and operating conditions, have shown in excess of 90% reduction in particulate matter emissions. Testing performed by the Army – National Automotive Center, has shown particulate matter and hydrocarbon emission reductions of 50+% and 60+% respectively compared with low sulfur diesel fuel.

The testing performed on Syntroleum's FT fuels by the Air Force, Army, and Navy has shown that FT fuels also provide a number of other performance benefits, such as increased thermal stability and cold performance properties. Currently, FT fuels are not fully certified for use in aircraft. Our understanding based on meetings with the Department of Defense, is that a component of the Assured Fuels Initiative is to certify the use of FT fuels for turbine applications which would eventually crossover to the commercial sector.

In conclusion, the technology to convert the nation's vast coal resources to ultra-clean fuels via the Fischer-Tropsch process exists today. The capital cost associated with a CTL plant have been estimated in the $80,000 to $100,000 per barrel range with 70% to 75% associated with the gasification and clean-up process required to produce a synthesis gas. As an example, a 20,000 barrel per day plant is estimated to cost between $1.6 and $2.0 billion. Based upon 2003 Energy Information Agency data, the US has a demonstrated coal reserve base of 496 billion tons. At a conservative conversion rate of 1.5 barrels of FT product for each ton of coal the potential for domestically produced CTL is 744 Billion barrels of product, essentially equal to the crude oil reserves of the Middle East.

Finally, thank you for the opportunity to address the Subcommittee on this important issue as industry and government work towards making CTL a reality in the United States.

MR. HALL. The Chair recognizes the Director of Government Affairs, National Biodiesel Board, Mr. Scott Hughes, for 5 minutes.

MR. HUGHES. Good afternoon. Thank you, Mr. Chairman.

Thank you, Mr. Chairman, committee members. We appreciate the opportunity to be here and come before you today on this important issue.

I would like to focus my comments today on providing you with some background about biodiesel, our industry, as well as an overview of the collaborative work between the biodiesel industry, engine and automakers, and the role that we see biodiesel having in the national energy pool.

Biodiesel is the name of a cleaner burning, alternative fuel produced from renewable resources such as animal fats and cooking oils. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. Biodiesel blends can be used in any compression, ignition engine or i.e., a diesel engine with no major modifications. Biodiesel in its pure form is simple to use, readily biodegradable, nontoxic, and essentially free of sulfur and aromatics.

In chemical terms, biodiesel has a composition similar to that of conventional diesel fuel. It is what is called an alkyl ester, where conventional diesel fuel is a hydrocarbon, the difference being that biodiesel alkyl ester contains oxygen in addition to carbon and hydrogen, about 11 percent by weight, where conventional diesel fuel contains no oxygen.

Biodiesel is produced using a chemical reaction. A fat or an oil is reacted with an alcohol such as methanol and the presence of a catalyst to produce two products, glycerin or methyl esters or biodiesel. The glycerin is removed in the production process, and it is then further refined and marketed as a value-added product. Everything that goes into the production process of biodiesel comes out.

Soybeans are the largest oilseed crop grown in the U.S., and, as a result, soybean oil makes up about half the raw material available to make biodiesel. The other half consists of all other vegetable oils, recycled cooking oils, and animal fats. But approximately 90 percent of the biodiesel that is produced today in the U.S. is made from soybean oil.

As the industry has developed, we have made it a priority to work with automakers, engine makers, and the petroleum industry to develop a fuel specification for biodiesel, just as they have for diesel and gasoline. This collaborative effort has resulted in the adoption of an ASTM standard for biodiesel.

Additionally, we recognize the importance of fuel quality to the consumer and our stakeholders. As a result, industry has developed a

comprehensive QAQC program called BQ9000. This program is aimed at assuring that biodiesel fuel is produced and maintained at the industry standard, which is ASTM D6751.

The biodiesel industry has shown slow but steady growth since the early 1990s. However, in the past 2 years, its growth has gone up exponentially. A critical contributing element to the strong growth has been the implementation of the volumetric biodiesel fuels tax credit that you passed in 2004.

Back in 2004, there were approximately 25 million gallons of biodiesel sales. That increased to 75 million gallons in 2005, and we are currently on track to exceed 150 million gallons this year.

Likewise, capacity has also increased significantly. The industry went from 22 biodiesel plants in 2004 to more than 60 biodiesel plants in operation today, and there are over 40 more plants currently under construction. Production facilities are located and being located in just about every region of the country from coast to coast.

Biodiesel is primarily marketed as a blended product with conventional diesel fuel typically in concentrations up to 20 percent. It is distributed utilizing the existing fuel distribution infrastructure with blending most commonly occurring with what we call "below the rack" by fuel jobbers. Biodiesel is beginning to be distributed through the petroleum terminal system. To date, biodiesel has positions in approximately 25 terminals around the country, and we anticipate this trend to increase.

Historically, biodiesel's primary markets have been regulated fleets for EPAct or various other Executive Order requirements for petroleum reduction, as well as the agricultural industry. However, biodiesel is increasingly being introduced into private-sector fleets, home heating oil, light duty diesel vehicles, marine applications, and even some electrical generation. All of these markets represent significant volume opportunities for our industry.

The American Trucking Associations has endorsed the use of B5--it is the 5 percent blend--as a way to supplement our Nation's energy supply. Likewise, Sysco Corporation, the largest private truck fleet in the Nation, has begun using B5 in its trucks. So, today, the biodiesel industry has worked diligently through the development of a national fuel standard, interaction with stakeholders, and a focus on fuel quality to establish a solid foundation to support our industry's future growth.

Looking ahead, recent regulatory changes aimed at improving the emission profile of diesel engines and improving air quality require significant advancement in engine and emission control technologies. Auto and engine makers are stepping up to meet the challenges presented by these standards which will take effect in model years 2007 to 2010.

A critical element in meeting these standards will be the fuel that is used. Biodiesel will be used in these engines, and consumers are ever increasing their demand for biodiesel both in fleet applications and light duty markets.

The biodiesel and OAM industries are working collaboratively in this area. The biodiesel industry has spent about $1.4 million to date, with an additional $700,000 committed for fiscal year 2007. Automakers and engine makers are also committing significant time and resources towards this effort.

We foresee strong growth for biodiesel and it becoming further integrated into the national fuel distribution system and energy pool.

The President has laid out a vision of significantly reducing our Nation's dependence on foreign sources of oil. Biodiesel can be one of the first tools used to begin reaching that goal, because it is a liquid renewable fuel that is available right now, ready for blending into our existing fuel supply and use in existing vehicles.

So, in short, biodiesel has many benefits for the consumer Nation as a whole. It is a viable tool in our toolbox of available options to enhance our Nation's energy security as it, one, adds to the distillate fuel pool; two, adds to U.S. refining capacity; three, directly replaces imported finished diesel fuel; and, finally, utilizes domestic agricultural products.

With that, Mr. Chairman, I will conclude welcome my remarks.

MR. HALL. Mr. Hughes, thank you very much.

[The prepared statement of Scott Hughes follows:]

PREPARED STATEMENT OF SCOTT HUGHES, DIRECTOR OF GOVERNMENT AFFAIRS, NATIONAL BIODIESEL BOARD

Good afternoon Mr. Chairman, Ranking Member Boucher, and committee members. It is a pleasure to be here today. We appreciate the committee holding this hearing and providing the opportunity to examine this important issue.

My name is Scott Hughes, Director-Governmental Affairs, with the National Biodiesel Board (NBB). The NBB is the national not-for-profit trade association representing the commercial biodiesel industry as the coordinating body for research and development in the US. State soybean commodity groups who were funding biodiesel research and development programs, founded NBB in 1992. Since that time, the NBB has developed into a comprehensive industry association, which coordinates and interacts with a broad range of stakeholders including industry, government, and academia. NBB's membership is comprised of state, national, and international feedstock and feedstock processor organizations, biodiesel suppliers, fuel marketers and distributors, and technology providers.

In examining vehicle and fuels technology with a focus on the future, I would like to focus my comments on providing background about biodiesel, the industry, as well as an overview of the collaborative work between the biodiesel and engine/automakers, and the role we see biodiesel having in the national energy pool.

Biodiesel

Biodiesel is a cleaner burning, renewable diesel fuel replacement made from agricultural fats and oils meeting a specific commercial fuel definition and specification. Soybeans are the primary oilseed crop grown in the United States, and soybean oil makes up about half of the raw material available to make biodiesel. The other half consists of all other vegetable oils and animal fats. Biodiesel is made utilizing a chemical reaction process where the oil/fat is reacted with an alcohol to remove the glycerin in order to meet specifications set forth by the American Society for Testing and Materials (ASTM). Biodiesel is one of the best-tested alternative fuels in the country and the only alternative fuel to meet all of the testing requirements of the 1990 amendments to the Clean Air act.

Industry Background & Overview

In the early 1990's, soybean farmers struggled to maintain profitability because of high energy prices and low commodity prices. Investment in the development of a biodiesel industry was a priority to farmers eager to contribute to our energy supply, while finding ways to add value to their crops. Farmers have invested more than $50 million of their check-off dollars to date to conduct research and development on biodiesel. Much of that effort has focused on the testing of biodiesel to ensure performance, establish quality standards, and gain acceptance by engine and equipment manufacturers.

The biodiesel industry has shown slow but steady growth since the early 90's, however, in the past two years, it has grown exponentially. In 2004 there was approximately 25 million gallons of biodiesel sales. That increased to 75 million gallons in 2005. We are currently on track to exceed 150 million gallons in 2006. Likewise, we went from 22 biodiesel plants in 2004 to more than 60 biodiesel plants currently (395 million gallons of production capacity). There are over 40 more plants currently under construction (estimated additional 713 million gallons of production capacity), with another 30 projects in pre-construction.

Biodiesel is primarily marketed as a blended product with conventional diesel fuel typically in concentrations up to 20%. It is distributed utilizing the existing fuel distribution infrastructure with blending most commonly occurring "below the rack" by fuel jobbers. Biodiesel is beginning to be distributed through the petroleum terminal system. To date, biodiesel has positions in approximately 25 terminals. We anticipate this trend to increase.

Three major factors are contributing to the industry's current strong growth: relatively stable feedstock prices, crude oil prices, and public policy (federal and state). The combination of these drivers has made biodiesel priced more competitive in the market. As a result, we are starting to see biodiesel entering several new price sensitive markets.

Historically biodiesel's primary markets have been regulated fleets (alternative fuel use/petroleum reduction—EPAct, Executive Order 13149) and the agricultural industry. However, biodiesel is increasingly being introduced into private sector fleets, home heating oil, light duty diesel vehicles, marine applications, and even some electrical generation. These markets all represent significant volume opportunities for industry.

The industry's early investment in technical research; pursuit of an ASTM standard; public education efforts; outreach to automakers, engine and component makers, and the petroleum industry are allowing us to maximize our growth potential under current market dynamics.

Regulatory and Policy Impacts

The need for increased use of biofuels has never been more pressing with diesel fuel prices at an all-time high. As crude oil prices continue to rise, America's trade deficit continues to balloon. America relies on imports for 60 percent of its petroleum needs.

Imported petroleum makes up the single largest component of our national trade deficit amounting to approximately one third of the total. Every gallon of domestic, renewable biodiesel that is used to replace diesel fuel refined from imported crude reduces the need for imported crude and finished fuel, extends the diesel supply, and expands domestic refining capacity. Even a small reduction in demand has a positive effect on straining price pressures.

The majority of diesel fuel in this country is used in over-the-road trucks. The trucking industry serves as a critical part of our economy, and impacts every industry, business, and consumer in America. Virtually every product that we use everyday is brought to us by a diesel-powered truck. Fuel is the single largest operational cost in the trucking industry. Average diesel fuel prices have nearly doubled over the past four years. This dramatic increase in operational cost offers enormous challenges to the trucking industry, and will be felt throughout our entire economy.

The American Trucking Association (ATA) has endorsed the use of B5 as a way to supplement our nation's energy supply. Likewise, Sysco Corporation, the largest private truck fleet in the nation has begun using B5 it its trucks. Truckers often become interested in biodiesel because they would rather rely more on farmers for their fuel and less on the Middle East. However, after they begin using it, they are most often impressed by its premium fuel characteristics. Biodiesel contains oxygen so it burns cleaner, reduces smoke and smell, increases cetane, and improves lubricity. As ultra-low sulfur diesel (USLD) fuel gets phased in beginning in June of this year through June of 2007, biodiesel is well positioned to replace the lubricity that will be lost in ULSD. Diesel fuel injection systems rely on the lubricating characteristic of fuel to keep them functioning properly. Just 2 percent biodiesel can improve lubricity by as much as 65 percent.

Recent regulatory changes aimed at improving the emission profile of diesel engines and improving air quality requires significant advancement in engine and emission control technologies. Auto and engine-makers are stepping up to meet the challenges presented by these regulatory standards which take effect in model years 2007/2010.

A critical element in meeting these standards will be the fuel that is used in advanced engine and emission control technologies. Biodiesel will be a fuel used in these engines and consumers are ever increasing their demand for biodiesel both in fleet applications and light-duty passenger markets. It is therefore imperative the necessary research is conducted to demonstrate biodiesel's compatibility with new engine technologies to meet this growing demand.

The biodiesel and OEM industries are committing significant resources toward this effort. The biodiesel industry has spent $1.4 million dollars to date with an additional $700,000 committed for fiscal year 2007. Automakers and engine makers are also committing significant time and resources toward this effort.

Additionally, three federal policy measures have been extraordinarily effective in stimulating biodiesel's increased production and use. Because of these three policy measures, biodiesel is beginning to make a small but significant impact on our nation's energy supply. These three measures are all working extraordinarily well, but are soon scheduled to expire, and must be continued in order to keep the growth in biodiesel going strong.

First, the biodiesel blenders tax credit, which was part of the restructured Volumetric Ethanol Excise Tax credit or "VEETC" legislation in the JOBS Act of 2004. The new blender's tax credit for biodiesel went into effect in January of 2005. It functions similarly to the ethanol tax credit, and it has been extraordinarily effective incenting the blending of biodiesel into the nation's diesel fuel supply. It has been the primary stimulant in 2005 for the dramatic increase in new plants, jobs, and local investment in biodiesel, bringing economic opportunity to both rural and urban areas.

The second policy measure that has been very effective in energizing biodiesel's growth is the Bioenergy Program. The program was initiated by the USDA in 2000 to stimulate the use of crop surpluses for energy needs. It was memorialized as part of the 2002 Farm Bill. However, the program is set to expire in July of this year. This program provides a production incentive which has been highly effective in the growth of the biodiesel industry. A 2005 OMB Program Assessment Rating Tool or "PART" evaluation reported that the program did an excellent job of stimulating biodiesel growth, and indicated that the program could continue to be effective for the emerging biodiesel industry. The report stated, "Increases in the production of biodiesel indicate a rise in the supply of domestically produced renewable fuels. It's also an indicator of the viability of the biodiesel industry and its expanded consumption of agricultural commodities."

The third program that has greatly contributed to biodiesel's success is the USDA's Biodiesel Fuel Education Program. This program was a part of the energy title of the 2002 Farm Bill. The program provides educational funding to support increased fuel quality measures, increased acceptance of biodiesel by engine and equipment manufacturers, petroleum partners, users, and the general public. The USDA has done a superb job in implementing this program and it has been a key ingredient to biodiesel's recent growth. A recent survey done to benchmark the program's progress showed that the public's awareness of biodiesel rose from 27 percent in August 2004 to 41 percent in December of 2005. To impact the American public's awareness that significantly on any given issue is remarkable. In addition to greater awareness from the general public, market research shows familiarity among trucking executives increased from 27 in 2004 to 53 in 2005. Also of note:

- Four-in-five consumers continue to support a tax incentive that would make biodiesel cost-competitive with regular diesel fuel.
- 88 percent of environmental group leaders and 84 percent of health organization leaders support biodiesel as a transitional fuel, because biodiesel can make an immediate impact on reducing emissions until zero emissions technology is developed.

Looking Ahead

We foresee strong growth for biodiesel and it becoming further integrated into the national fuel distribution system and energy pool.

During the 2006 State of the Union speech, President Bush outlined his Advanced Energy Initiative, which stated the goal of reducing petroleum imports from the Middle East by 75 percent by the year 2025. Biodiesel and ethanol can be the first tools used to begin reaching that goal, because they are liquid renewable fuels that are available right now, ready for blending into our existing fuel supply and used in our existing vehicles. As an illustration of how biodiesel can play a role in that effort, please note that Iraq is the second largest provider of crude oil into the United States from the Persian Gulf region. Of the crude that comes from Iraq, approximately 1.85 billion gallons of diesel fuel is refined for the US market. If long-term, America was to replace just 5 percent of its 37 billion gallons of on-road diesel fuel with biodiesel, it would equal 1.85 billion gallons – the same amount of diesel fuel that we get from Iraq.

In addition to the significant benefits that biodiesel offers to increase our domestic refining capacity and overall energy supply, biodiesel offers enormous benefits to our agricultural sector. Biodiesel does much more than just utilize surplus agricultural commodities; it adds multiple layers of value to agricultural economics. There have been 5 major comprehensive economic studies evaluating biodiesel in the last 4 years. All of these studies, using different economic models, had similar conclusions: that increased utilization of fats and oils for biodiesel increases the value that farmers receive for their crops, while making protein meal cheaper as a feed for our domestic livestock producers and more competitive in international protein markets for food and feed. Not only does

this allow farmers to more profitably supply global food markets, it may have the effect of increasing agricultural processing in the United States. Additional biodiesel production further increases domestic chemical processing from renewable by-products.

Conclusion

Rising crude oil prices and political uncertainties in strategically sensitive regions of the world are focusing the public's attention on the need to enhance our nation's energy security. Biofuels are a viable option to begin re-taking control of our energy future. There are many market dynamics that are working in favor of the biofuels industry today and which if continue into the future, as anticipated, will provide a bright future not only for the industry but the nation overall.

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

- Adds to the distillate fuel pool;
- Adds to U.S. "refining" capacity;
- Directly replaces imported finished diesel fuel;
- Utilizes domestic agricultural products;
- Stimulates rural and urban economies and creates jobs; and
- Helps potentially create new chemical industry jobs and activity.

Mr. Chairman, members, we appreciate the opportunity to come before you today on this most critical issue. On behalf of the biodiesel industry, I want to thank you for all of the support you have given not only to the biodiesel industry, but the development of the biofuels industry overall. We look forward to continue working with you in this important endeavor. I would be happy to answer any questions you may have.

MR. HALL. Mr. Pratt.

MR. PRATT. Good afternoon, Chairman Hall and members of the committee.

My name is Mitchell Pratt. I am before you today representing Clean Energy, North America's leader in clean transportation, and as the company's Senior Vice President of Operations in Governmental Affairs.

Clean Energy provides fueling daily for over 30,000 vehicles with clean, affordable, and domestically produced natural gas. Our company has over 160 fueling stations and is on track to sell 73 million gallons of natural gas this year. We at Clean Energy strongly believe that natural gas has an important role to play in providing an immediate solution to help combat our rising fuel prices, foreign oil dependency, urban air pollution challenges, and offers the purest and cleanest bridge to a hydrogen future. Natural gas as a transportation fuel is the best untold story and is a solution today that will remain so well into the future.

I would like to quickly highlight several main points to demonstrate the immediate feasibility of launching a natural gas national program.

First, fuel supply. We have over 70 years of current reserves, 30 more than oil, with no accounting for biomethane or other new sources and supplies, including the long-range hope of methane hydrates.

Next, price. How would you like to pay substantially less today for the fuel you are burning? With all the costs rolled in, capital recovery and placed on an energy equivalent cost per gallon of natural gas today, it is approximately $1.82 per gasoline gallon or $2.02 per diesel gallon equivalent, a substantial savings that is critical for the fleets that we serve and those that are serving the backbone of our economy in moving goods and services today.

On to emissions. Natural gas is and will remain substantially cleaner than gasoline and diesel. In 2007, while diesel engines struggled to achieve the new standards, natural gas will be at the 2010 emissions standard, over 80 percent cleaner.

On to the critical piece you all have talked about and heard about today. The critical component of launching any new alternative fuel is infrastructure. We have found through an anchor tenant cost model and through public-private partnerships that we can and will cost-effectively finance and build the infrastructure necessary to rapidly expand the market. Also, with a newly introduced home refueling appliance that simply plugs in at your house, this will allow consumers greater convenience to fill up at home overnight, and it is helping to provide confidence as the public station network grows.

Now to vehicles. We have targeted the introduction of natural gases, viable fuel through fleet applications, systematically building infrastructure to support that and the growing product line. With thousands of NGVs in operation, they have proven to be safe and reliable, with many success stories like Los Angeles' MTA, the transit property with over 2,000 natural gas buses in operation daily. In fact, there are nearly 9,000 transit buses running on natural gas. Nearly one in four new transit buses on order are specified to run on natural gas. More than 25 airports around the country are using buses, shuttles, runway sweepers, dump plows, security, and maintenance vehicles that also run on natural gas.

Refuse is one of the fastest-growing areas for NGVs, with more than 2,500 vehicles in use today and more than 500 being added each year.

More than 140 school districts across the country are using natural gas buses and shuttles as well as deploying light-duty NGVs in white fleets for maintenance personnel. And there are dozens of short haul and port application fleets that make great sense. Just think of all the vehicles that pull into a 7-Eleven each morning. Snack foods, bakeries, soda and water, dairy distributors, etc., all great applications for natural gas.

Unfortunately, the growth in the U.S. has been slow. Globally, between August 2003, and January 2006, NGVs grew by more than 65 percent, to more than 4.6 million vehicles, and stations grew by more

than 40 percent. Many automakers offer tremendous selection of fully integrated natural gas vehicle products throughout Europe and other countries but have pulled back here at home. More action is required to have these bio fuel and dedicated natural gas vehicles made available to U.S. consumers.

Finally, natural gas is the best bridge to a hydrogen future. The road to a hydrogen future has many challenges, and the greatest is creating an infrastructure that enables society to utilize gaseous fuels. Natural gas provides this critical experience for society, and the stations can be modified to sell natural gas, blended natural gas, hydrogen, and pure hydrogen. With these blends, near zero emissions can be achieved much more cost effectively than with pure hydrogen.

So, in conclusion, as you can see, natural gas vehicles have had a wide experience of applications, truly successful applications, and are the best untold story, ready for immediate and tremendous growth in all light, medium, and heavy-duty vehicle applications. Federal and State fleet NGV purchase priority directives and DOE RD&D funding are needed to encourage new product development and introduce those foreign available OEM, NGV products here at home.

As we scan and consider all the feasible alternative fuels that are out there, natural gas makes the most sense commercially for all types of vehicles. With greater support, NGVs can provide an immediate and important solution to our urban air pollution issues. Foreign oil security challenges create a bridge to a hydrogen future, all in an excellent fuel price, thereby preventing the economic train wreck which can be caused from spiraling oil prices.

Thank you.

[The prepared statement of Michael Pratt follows:]

THE PREPARED STATEMENT OF MICHAEL PRATT, SENIOR VICE PRESIDENT, CLEAN ENERGY

Natural Gas is an Immediate Solution

- Natural gas provides an immediate solution to our foreign oil dependency, urban air pollution challenges, and serves as the clearest bridge to a hydrogen future.
- World demand-production gap could be as high as 30 million barrels/day by 2020.
- Natural gas is a domestic energy source (over 97 percent of current U.S. use comes from North America) today with over 70 years of additional supply.
- 11,000,000 light-duty vehicles, or 5 percent of the existing U.S. light-duty fleet, if powered by natural gas, would only account for 4 percent of the country's current natural gas usage.

Natural Gas is Clean

- Natural gas vehicles meet near-zero emissions levels for light-duty applications, already meet or exceed 2007 heavy-duty emission standards, and

are targeted to certify to the 2010 heavy-duty standards for the 2007 model year.

Natural Gas is Economic

- Natural gas is priced very competitively at a $1.82 gasoline gallon equivalent or a $2.02 diesel gallon equivalent versus today's national average price of a gasoline gallon at $2.88 and a diesel gallon at $2.89.
- Clean Energy can guarantee a long term fixed price for vehicle fleets for up to 5 years under today's gasoline and diesel prices.

Natural Gas Infrastructure

- Natural gas, unlike other alternative fuels, enjoys the advantage of a vast nationwide network of existing pipelines capable of delivering natural gas product to nearly every American community.
- Strategic use of public-private partnerships has lead to an extensive network of natural gas fueling stations in key national markets.

Natural Gas Vehicles

- Natural gas vehicles are currently used in transit, refuse, shuttle, taxi, police, airport, and municipal fleet applications throughout the United States.
- American and foreign auto manufacturers produce a wide range of natural gas vehicle offerings in Europe and elsewhere to combat high oil prices at the pump.

Natural Gas is the Bridge to Hydrogen

- Natural gas as a transportation fuel introduces gaseous fuel vehicles, fueling stations, and the societal experience necessary to make hydrogen fuel a reality.

Conclusion

- The country needs more national policies to help natural gas and other alternative fuels penetrate the marketplace and provide consumers with real options beyond oil.

Introduction

Good afternoon Chairman Hall and Honorable Members of the Subcommittee on Energy and Air Quality. My name is Mitchell W. Pratt and I am before you today representing Clean Energy, North America's leading clean transportation fuel provider, as the company's Senior Vice President of Operations and Government Affairs. Clean Energy provides fueling daily for over thirty thousand vehicles nationwide with clean, affordable, and domestically produced natural gas. Our company has over 160 fueling stations and is on track to sell approximately 73 million gallons of natural gas this year. We, at Clean Energy, strongly believe that natural gas has an important role to play in providing an immediate solution to our foreign oil dependency, urban air pollution challenges, and the clearest bridge to a hydrogen future. Natural gas as a transportation fuel is a solution today and will remain so well into the future.

Global Oil Supply

Some believe that the current run up in oil prices is a blip and that by 2010 we will be awash in oil. We are in the opposite camp. We believe we are looking at a looming supply-demand problem. Oil is a finite and dwindling resource and the world's demand

for it keeps growing. That is why we believe that the world will continue to face stubbornly high prices for the long term.

Let's take a look at the facts. In the Arab embargo back in the 70s, we were importing approximately 25 percent of our oil. In the first Gulf War, we were importing 42 percent of our oil. Today we are importing 57 percent. By 2010, we will be over 60 percent oil imports. We've been pumping oil out of the ground since 1859. The last time a world class oil field was found was in the Caspian Sea in the late 1990s. The easy oil has been found. There are no surprises out there. We've either peaked as far as oil production goes, or it's right around the corner.

Demand is growing globally. For example, ten years ago China used 3.4 million barrels of oil per day. Today they are using 6.5 million barrels per day. There are forecasts showing them using 11 million barrels per day a decade from now. Wait until they really start buying automobiles. We are using more than 30 billion barrels of oil a year worldwide. The last time we found as much oil in a year as we consumed was about 1985. Production worldwide is 84-85 million barrels a day. Current demand is about 85 million barrels a day and demand projections for 2007 are easily north of that given China and India's increasing demand.

The treadmill is getting faster and faster. The decline curve for oil production is steady. Saudis say they can produce 10.5 million barrels per day, but they're only producing 9.5 million barrels per day. We all heard talk two years ago of Iraq production reaching 3 million barrels per day. They are producing less than 2 million barrels. To make matters worse, we've also got some serious geopolitical problems: Iran, Venezuela, Nigeria, and Russia. They are all wild cards. The Alaskan pipeline used to be full, running at 2 million barrels per day. It now carries less than half of that or 800,000 barrels per day. Further, because there are pipeline constraints, opening up ANWAR will not solve the problem because almost half the pipeline's capacity is already in use.

Alternatives to Oil

We must look at all solutions and we need to get serious about fuel diversity. We have known an oil shortage was coming for some time. Clean Energy believes that ethanol, biodiesel, and natural gas - as transportation fuels - each have a role to play. In fact, even if you assume biofuels achieve their greatest forecasted production targets, we believe demand will still outstrip supply by 3 million barrels per day by 2020. Over time, we believe that natural gas will be moved out of the power generation business by coal and nuclear, increasing the availability of domestic natural gas supplies for our country's transportation needs. Even assuming optimistic new production sources coming on line, balanced with estimated production decline curves, the demand-production gap could be as high as 30 million barrels per day in 2020. This gap requires federal actions supporting alternatives today.

Natural Gas is Domestic

Natural gas is a domestic source of transportation fuel with an estimated 77 years of additional supply or 30 years extra supply over oil. Over 97 percent of our current use of natural gas is produced in North America, which helps protect us from unstable international political situations which increases our energy independence by not importing as much foreign oil. To put natural gas and transportation fuel use into perspective, if we powered 11,000,000 light-duty vehicles or 5 percent of the U.S. light-duty fleet with natural gas today, it would only account for 4 percent of the country's current natural gas fuel usage.

Natural Gas is Clean

Natural gas is a clean and efficient fuel. Natural gas vehicles (light duty, medium and heavy duty trucks) are all cleaner than gasoline or diesel vehicles. Natural gas vehicles meet near-zero emission levels for light-duty applications and already meet or exceed 2007 heavy-duty emission standards with some engines targeted to certify to the 2010 standard as early as next year (2007). Natural gas is inherently cleaner than gasoline or diesel and will continue to offer this benefit well into the future.

Natural Gas is Economic

Natural gas is economic. The price for natural gas as a transportation fuel is very competitive with today's gasoline or diesel fuels. In fact, natural gas was very competitive with oil at $30 a barrel, let alone at the market's current price of $70 a barrel. Clean Energy views natural gas as a commodity tracking at a discount to oil, especially when compared to diesel. For example, if you assume a natural gas price at $7.20 per million cubic feet and 92 cents to cover transport, compression, taxes, and capital recovery costs, you can achieve a very competitive $1.82 gasoline gallon equivalent or a $2.02 diesel gallon equivalent. Today diesel ranges between $2.90 to $3.24 per gallon.

We further believe that when ultra low sulfur diesel fuel hits the market later this year, it will be an additional 25 to 30 cents, putting it in the $3.50 range. This assumes the overall oil market stays stable even though, historically, the market has suffered over a dozen global oil supply disruptions over the past half century lasting 1 to 44 months in duration with supply shortfalls of one to 14 percent of world demand. Despite the reality of volatile oil prices and unlike any energy provider we know, our company is able to guarantee a fixed price per gallon of natural gas to light, medium and heavy-duty fleet customers below today's gasoline and diesel prices for up to five years on a energy equivalent gallon basis.

In addition to the comparatively low cost of natural gas as a transportation fuel, Congress took an important step in passing the energy and highway bills last year. As the cost of uncertain diesel technology increases in an effort to meet new federal clean air emission standards, the energy bill provides up to a $32,000 tax credit for a class 8 natural gas truck. This will certainly help narrow the incremental cost differential between diesel and natural gas vehicles. When fuel price and operational maintenance savings are factored in, natural gas vehicles become even more cost-effective than their diesel counterparts. Because some of the incentives put in place are going to take awhile to have a real impact, we need Congress to continue to provide long-range policies that promote alternative fuels in the marketplace.

Natural Gas Infrastructure

Perhaps the greatest challenge for any alternative to oil is the ability to distribute product to the end user. Natural gas, unlike other alternative fuels, enjoys the advantage of possessing a vast nationwide network of existing gas pipelines capable of delivering natural gas product to nearly every American community. Clean Energy has developed a strategic business model enabling the cost-effective development of a natural gas station network. This revolutionary approach creates on secondary station infrastructure to gasoline and diesel by leveraging private and public-private partnerships to create an extensive network. These turn-key partnerships enable high-volume fleet users to benefit from privately financed refueling stations while providing smaller volume users with public access at these stations. Further, consumers can immediately take advantage of natural gas as a transportation fuel with the simple installation of a low cost home refueling system that is currently on the market. Moreover, natural gas stations can provide an early introduction of hydrogen by using a 10 to 30 percent blend, reducing the immediate need for high-cost fuel cells to achieve near-zero air emissions.

Natural Gas Vehicle Availability

Natural gas vehicles are currently available, proven, and tested in transit, refuse, shuttle, taxi, police, airport and municipal fleet applications throughout the United States. These applications were primarily driven by the clean air benefits inherently derived from the use of natural gas. However, for years American and foreign auto manufacturers have produced an ever increasing selection of natural gas vehicle products in Europe, and elsewhere, – both dedicated and bi fuel – for natural gas vehicles to address concerns over high oil prices. These OEM produced vehicles are fully integrated providing consumers the mileage range and conveniences of gasoline vehicles. Congress should follow Europe's lead by strongly encouraging auto manufacturers through incentives or mandates to produce a greater range of natural gas vehicles for the American consumer.

Natural Gas Bridge to Hydrogen

Natural gas is also viewed as a bridge fuel to hydrogen as it continues to be the most cost-effective way to produce hydrogen, provides invaluable experience and knowledge to users on how to handle gaseous fuels, and natural gas infrastructure can be leveraged to provide hydrogen as well as blended hydrogen/natural gas dispersing. In fact, the blending of hydrogen and natural gas provide even lower near zero emission performance. With fully integrated OEM produced natural gas vehicles, these vehicles can be enabled to operate natural gas, hydrogen, and blended hydrogen/natural gas fuels.

Conclusions

Natural gas vehicles offer a proven solution in light, medium, and heavy duty vehicles that are ready for wide-scale implementation today. Our resources of natural gas can play a critical role in diversifying our nation's transportation fuel needs. Natural gas is clean, inexpensive and domestically produced, and excellent fuel formula. In leveraging natural gas as a transfer fuel we not only support the creation of a secondary infrastructure but also foster more vehicle production. The societal experience of operating a natural gas vehicle is likely the only realistic approach to achieving a hydrogen future. That being said, we need more national policies like the 2005 energy and highway bills to help natural gas and other alternative fuels penetrate the marketplace and be available to the public. Without the firm support of the Congress, our nation's ability to free itself from it's current oil dependence will most certainly put our nation's economy, security, and overall public health at risk.

MR. HALL. Thank you. We will ask some questions here now, Mr. Pratt, on natural gas. I have been a great believer in natural gas. That may be the fuel of the future. It may be accidental that we have an abundance of it in my State, my area, but, in the late 1970s the President passed some terrible legislation, Fuel Use Act, a lot of that stuff. It took us 2 or 3 years to get them off the books by the time we got here. And I have a school district that adjoins my hometown school district that uses natural gas completely for their school buses. And they have saved maybe 30 percent over the years. And one of the questions that was always asked initially, because that is our school children was how dangerous was it. Have there been any accidents or fatalities associated with natural gas refueling stations or consumers filling up on their own tanks or on the school buses or anything that you know of?

MR. PRATT. Not that I know of.

MR. HALL. That really speaks well because it has been at least 20 years that they have been doing that; 15 that I know of right there close to me. How much energy is in a gallon of natural gas as compared with a gallon of gasoline?

MR. PRATT. The prices that I quoted in my testimony are all on an energy equivalent basis. So the $1.82 is on a gasoline gallon energy equivalent basis, and the $2.02 is on a diesel equivalent gallon basis.

MR. HALL. How long does it take to install natural gas refueling stations?

MR. PRATT. Depending on the size of the station, it can take anywhere from 6 months to a year.

MR. HALL. How long does the permitting cycle take?

MR. PRATT. That is included in that same timeframe.

MR. HALL. You know, Chairman Barton and his energy bill that we passed some several months ago had provisions there where if a Federal entity didn't answer the way, a lot of times the way they would hold it up is just not give you an answer. And you can't appeal unless you have a final answer from an entity. He set a provision in there that I think is just simply great to anybody that wants to build and be productive in solving our energy problem. That if they make an application to them and in 60 days it is not either denied or granted, it is granted. And I think that is a boon to those that want to build. Along that line, I would ask you, what permits are required for a natural gas refueling station or pump?

MR. PRATT. We have local city permits. All the building and safety inspection requirements, fire department inspections are required for constructing a station. Much like building anything at your home or a home addition, you have to go through all those standard permits. For natural gas there is nothing unique. And as there are so many stations that have been built, there is a lot of experience and our Fire Department officials are usually the most challenged in coming up to speed on it, but they have grown tremendously comfortable with natural gas stations.

MR. HALL. About what does it cost to install a natural gas pump?

MR. PRATT. Natural gas stations, again, it depends on size. A home refueling unit that you can install in your garage wall and fill up overnight is a little over $1,000 dollars. To a transit property that can handle hundreds of buses every night in a 6 to 8-hour window can be upwards between $1.5 and $3 million. Our typical station that we build for a gasoline station is in the neighborhood of about $750,000. We compare this, the ability to deliver natural gas just like you would a gasoline station, vehicle after vehicle with multiple dispensers for $750,000 investment, versus a hydrogen station, today that, with one reformer producing only 100 gallons is over a million, $1.2 million.

The economics and feasibility of natural gas is there today, and these stations can be equipped for that hydrogen future.

MR. HALL. I thank you very much. Quickly, Dr. Pacheco, could you tell me, what are the best types of plant material to make cellulosic biomass ethanol? Can you give me that answer in about 30 seconds?

MR. PACHECO. Mr. Chairman, many forms of biomass can be used to make ethanol. Switchgrass and corn stover and hardwoods are among some of the easiest feed stocks to use.

MR. HALL. Gosh. I have got 18 seconds left. I have heard that the energy balance for ethanol from corn is about 1.4 units of energy output for each unit of energy input. But for cellulosic biomass the ratio is much better, on the order of five or six times the units of output for each unit of input. Why is cellulosic biomass so much higher than ethanol from corn?

MR. PACHECO. The main reason for that is that in cellulosic biomass there is a component referred to as a lignin that doesn't exist in the corn feedstock. That lignin some people refer to sometimes as like a young coal. It is actually used for heat and power within the biorefinery so that the coal and natural gas that is currently used to provide heat and power for a corn ethanol mill is not required. And that is shown in the third figure in my written testimony.

MR. HALL. All right. I thank you. My time is expired, and I recognize the gentleman from Arkansas.

MR. ROSS. I appreciate the gentleman from Texas. Thank you all for being here today. And my first question is for Mr. Hughes. I am impressed by the amount of growth in your industry from 22 biodiesel plants in 2004 to 60 plants now. Hopefully soon, two more, one in McGee and one in Pine Bluff, Arkansas, and over 40 plants currently under construction. I don't believe my area is unique in the talk about moving toward this technology and the jobs that it creates. We are seeing it all over the country. Is there any reason to believe that these plants are not meeting current environmental requirements?

MR. HUGHES. No, sir, there is not. We have not run into any kind of calls or situations that I am aware of in that respect.

MR. ROSS. So I would be correct in assuming that State and local permitting authorities are issuing these plants whatever air and other environmental permits they need.

MR. HUGHES. That is my understanding.

MR. ROSS. There haven't been any governmental regulations at the local State or Federal level that it have served as an obstacle or slowed the development of these type plants?

MR. HUGHES. Not that I am aware of, and I have actually had some conversations with a few plants in that regard, and they have not indicated that is an issue.

MR. ROSS. Good. My next two questions are targeted for Mr. Warzel. You mentioned in your testimony that Fischer-Tropsch fuels are not fully certified for use in aircraft. I know there is a great deal of interest by both the Department of Defense and the private aircraft industry in the use of coal to liquids as a source of jet fuel. Can you speak to the current status of this certification? And if so, what needs to be done before these fuels are ready for aircraft use?

MR. WARZEL. Okay. Yes. Currently it is not certified. Diesel fuel that you can also make from the Fischer-Tropsch process meets all the ASTM guidelines and requirements. So it is fully fungible in today's market. On the jet fuel, it really becomes an issue of OEM certification because of the amount of money spent on the infrastructure. The Air Force has a very detailed plan put in place for certification which, depending on the best mechanism and blending that they look at, could be anywhere from a 3 to a 6-year process.

To give you an idea, the last time they certified a new fuel or an additive to a new fuel, they have not certified a new fuel in decades, it took about 8 years. The main component is going to be having supply of fuel for them to begin their work.

MR. ROSS. Follow up to that. It has been widely discussed that while the coal-to-liquids technology has been proven throughout the world, that its intense capital cost and lack of deployment in the United States are still barriers that must be addressed in order to gain the financing necessary to make the facilities more commercially viable for widespread use domestically. What do you think is needed in order to further the use of coal, CTL technologies?

MR. WARZEL. Let's kind of rephrase that. There is a lot of coal gasification to different types of liquids. There is only one plan as such now, Sasol, that does coal to liquid via Fischer-Tropsch. What is needed in our opinion is from a U.S. perspective, let's move the military away from crude oil-based fuels, and move them in off-take agreements for the military. That alone will provide a major impetus to the commercial sector to bring funding with long-term off-take agreements for the plants.

MR. ROSS. Let me ask a question, probably for Mr. Pratt, but any of you that feel qualified can answer it. I know there is some movement toward, and this is not really anything new, but automobiles that are operating today off of natural gas, and I guess the new component would be the fact that more people are now able to refuel at home in the evening while they sleep. I think one of the challenges, especially for a

rural district like mine, it is my understanding a typical car with natural gas can go like 225 miles, is that pretty accurate?

MR. PRATT. That is for the product that is available today.

MR. ROSS. And so in a district like mine I can get halfway to where I am going, but I can't get the rest of the way, and I can't get back home unless, and so it is the same issue that we run into with a lot of other things. I applaud the efforts to get it to where you can refuel it at home at night. But yet we still have the challenge when we move away from home, especially in rural areas to be able to have the infrastructure in place to be able to refuel, number one. Number two, do we really want to go in this direction given that this is just another fossil fuel? And then finally, given the cost of natural gas today, has it really become somewhat cost prohibitive compared to back when natural gas was running $2 to $4. Now it is $10 to $14 or $15, or whatever it may be today.

MR. PRATT. Sure. The first question on vehicle types. In Europe, they make over, I think it is, 22 different OEMs are making something in the magnitude of over 100 different vehicle types, maybe a little bit off on that, but it is a wide selection of natural gas vehicles. And they make both dedicated and bifuel. And in those vehicles, both dedicated and bifuel, they get much greater range than what we have experienced, the 200 miles, 225 that you talked about. The bifuel vehicle allows you to operate both on gasoline and natural gas, so that you can fill in the gap of the infrastructure. The infrastructure development for any alternative fuel here in the U.S., we believe we have figured out the right model to do that. And that is focusing on the large fleets that allow you to expand rapidly the infrastructure, all your trash haulers, your transit bus fleets, your school bus fleets, your municipalities, all can create an infrastructure to help you get around your State and manage your transportation on a dedicated fuel, let alone a bifuel vehicle.

I think, of the other questions, the most important was fuel price. And let me just walk you through that. Now, today, natural gas is below $7 an MCF. But even using $7.50 MCF, total rolled in capital cost recovery, profit, and operations is less than $2 a gallon. So when you talk about fuel price supply, natural gas can be offered to you at less than $2 a gallon. I think that is pretty price competitive, even as you talk about peaking, the last summers or last winters or winter before last, the peaking natural gas prices, we were still selling our customers fuel at $2 and a little bit more because we buy long-term contracts to manage that fuel supply.

MR. ROSS. But 6 years ago, that would have been more equal to what, 50 cents a gallon.

MR. PRATT. It would have been equal to probably less than that. But today's reality is that the price of natural gas provides you, even including building the stations, provides you a tremendous economic opportunity on fuel price, over and above anything else that we have and better than gasoline. And for fuel supply, we have over 70 years of supply here. We have renewable sources that they are doing in Europe that we haven't begun to tap here in biomethane well recovery and capturing, and then looking at methane hydrates as a long-term fuel supply that has more energy in it than all of the energy sources combined.

MR. ROSS. Well, I want to thank you and I want to thank you all for what you do. I mean, I have a strong conviction and believe that if we can put a man on the moon, if we can shoot a four wheeler on a rocket to Mars and control it from NASA in Houston, I mean, this is America, and I know we have got the technology and the people here that can help us develop alternative and renewable fuels that can really let us become self-sufficient and reduce our dependence, hopefully totally someday on this foreign oil. So I want to thank you for all of the things that you are doing to try and see that dream become a reality, and certainly want to continue to work with you. And again, Mr. Chairman, thank you for your gracious indulgence.

MR. HALL. I thank you sir. Mr. Shimkus, the gentleman from Illinois.

MR. SHIMKUS. Thank you, Mr. Chairman. It is great to have you here. I am sorry that I have been bouncing in and out. But let me ask a question to the entire panel. It may not apply, and it may, I don't know, to the natural gas side. But in SAFETEA-LU we passed an alternate fuels excise tax credit that expires in 2009, which I think is, I personally think is an important provision. We dropped--hopefully, again, I will use this opportunity to encourage my colleagues to get on the bill--yesterday, with Rick Boucher and myself and eight other members from five different committees, an extension of that to 2020. Would that be helpful and why? Why don't we go to Mr. Warzel first because this is really an industry question.

MR. WARZEL. With regard to coal to liquids, there are specific coal to liquids, yes. The move is incredibly helpful due to the plain and simple fact that if you look at the gas to liquids plant, which is an easier process to build and construct and operate than a coal to liquids plant in Qatar, which is much more favorable to construction because of regulatory issues, took about 7 years from the start of project till the time it starts operating. That is the best that you could expect to do from now, if you had the money to, say, start building a plant would be 7 to 8 years.

MR. SHIMKUS. And the money is about, what is the capital?

MR. WARZEL. Right now, because there have been very few of them built, our best estimates for coal to liquids, and this has also been reiterated by Sasol, is about $80,000 to $100,000 depending on location per barrel. So a nominal 20,000 barrel-a-day plant is about $1.6 billion. We have looked at DOE work on lignite coal in particular, and some of the sub bituminous coals. That achieves at $35 to $40 barrel crude, not looking at all the tax incentives, about a 15 to 18 percent rate of return project.

MR. SHIMKUS. So if you are about an 80,000 barrel facility, you are talking about $7 billion and a 7-year delivery. So if the current excise tax credit expires in 2009, you are not going to take advantage of it. There is no incentive.

MR. WARZEL. There is no incentive.

MR. SHIMKUS. So if some incredibly smart Members of Congress decided to extend that to 2020, do you think that would provide some incentives for industry to deploy coal to liquid and other technologies?

MR. WARZEL. It is helpful, but the real constraint is the companies that have the monies, i.e., the ExxonMobils and Shells that have announced their $7, $8 billion plants in Qatar are not coming to the U.S. right now for CTL. What we view as being a smaller, small business is that for us to do it, we need an off-take agreement, and that is why we pushed so hard for the military. That is an after-the-fact incentive. It doesn't allow me--

MR. SHIMKUS. I think my colleague from Arkansas addressed some of the DOD issues and the research, and I think that is step two. I have been trying to follow this debate a lot, and I concur that there are two things that we need to do, one is extension of the excise tax credit and the other one is to look at a long-term purchasing agreement with a buyer. The interesting thing we had about the slide, and if you notice what we did, but this is really, why does South Africa have coal to liquid technology? Because the Government invested to help take on the risk because of the cost of doing this.

And at today's price per barrel, it is now doable. But if you look at the slide, you have got the coal and it goes, look at there, you have got the military base for aviation fuel. You are not constrained by the sea traffic of oil tankers that could be shut down. We do have a strategic petroleum reserve to help address our national security concerns, but that is really small. But if you are able to use our great coal reserves, then you have a current feed stock for in my case the war machines. That is why we were very successful in getting Ike Skelton, the Ranking Member of the Armed Services Committee on our extension bill, and Duncan Hunter.

We hope to have continuing discussions about this process of long-term contracts by which will be the second step in ensuring deployment of coal to liquid. Yes, sir. Mr. Pratt.

MR. PRATT. I would just like to add that if you are looking at extending the excise tax, and last August that was expanded to--for the fuel tax credits that were available--include natural gas. And I would welcome that being extended for a longer period of time. In doing so, we hopefully can encourage the automakers to bring those foreign available natural gas vehicles here to the U.S., be invested in the technology they are exporting and not bringing here. I would welcome them to bring that back, and we can create the longer term proposition for them, for transit properties or refuse fleets to all go with cleaner fuels.

MR. SHIMKUS. And I appreciate that. And I will be honest with you. Natural gas is always a confusing thing for a lot of us, because it is defined as an alternate fuel. I mean, we know it is a fossil fuel. We know it is above a lot of the crude oil, so sometimes a lot of us have trouble defining what that is especially as an alternate fuel. I do know that we do have great concerns with additional users and the escalating price of natural gas, my farmers in the field, and that is a concern. Manufacturers have grave concerns about the escalating cost of natural gas. I believe in the market. Everybody gets to the table, everybody competes, competition brings lower prices.

So with that, Mr. Chairman, my time has long expired. I yield back.

MR. HALL. I thank the gentleman. The Chair recognizes the gentleman from Oklahoma, Mr. Sullivan.

MR. SULLIVAN. Thank you, Mr. Chairman. And I like what I have been hearing today. It is very important when we are going to talk about energy policy and the future of energy in this country it is great to see people like you exploring different alternatives like we need to be doing. And it is good to see John Warzel with Syantroleum, which is based in my district, the heart of my district, Tulsa, Oklahoma. And Mr. Pratt, I don't know if you know it, but we have some of yours in our district too, Tom Sewell, I don't know if you know who he is or not. But this it great.

And you know what is interesting is I always show people, and Congressman Shimkus has one too, bigger than mine, a thing like this, I mean. You have got to be careful when you say things like that. But this fuel is pretty interesting looking. It looks like water. I was telling the girls back here, you could probably drink it and it wouldn't kill you. And it doesn't smell like anything. It is running in some buses even here in Washington, D.C., and it is very interesting.

And I was just going to ask you, John, if you could kind of explain the process of this and how you make the gasoline diesel jet fuel out of it

and maybe the Department of Defense application of a one battle field fuel that has been talked about, a fuel that could be used actually in a tank as well as a jet.

MR. WARZEL. In essence, as previously discussed, you are just reacting a carbon monoxide hydrogen stream to create a fuel. The fuel is very similar to candle wax. It is what they call a normal paraffin. You then upgrade it and convert that a little bit to get the coal properties that the military is interested in. Why we have focused so much attention on military applications is they have tested this fuel, and this is a quote from the senior researcher at the Air Force, and he has made it publicly and said, it is by far the best fuel they have ever tested in the military.

And he has been doing this for 20-plus years. The reason is simply the fact that it has gotten phenomenal cold properties, meaning that when airplanes go up to the higher and higher altitudes such as the former SR-71, it doesn't freeze. Conventional crude oil-based fuel will actually solidify, and that is never a good thing when you are 100,000 feet off the ground. Second, it burns cleaner. So therefore, you have less temperature in your exhaust, which reduces the maintenance cost to the military. When they start looking at long-term impact, maintenance costs of their engines is one of the biggest cash drains. Third to that is it reduces pollutants: 90-plus percent reduction in particulate matter. Two aspects of that particulate matter is becoming one of the larger long-term health problems in congested cities such as L.A. or New York or Chicago.

Also, and they didn't go into much detail, and I guess I understand why, is that particulate matter is a carbon material. It is soot like you see come off a candle. That is what retains heat. Heat is what planes have, or radars detect the planes by. So they didn't go into much detail, but it is being looked at for something like the F-35 joint strike fighter. They have contacted us. We have had the Navy come in to Tulsa and a lot of Air Force and Army for those specific military applications.

MR. SULLIVAN. I think that is really--can you imagine, so on a battlefield, for example, we could some day have a mobile refinery, let's say, out on the battlefield. Could that happen?

MR. WARZEL. Depending on the location and how quickly. There is still work moving in that area.

MR. SULLIVAN. And it could be used to fuel a jet or a tank?

MR. WARZEL. Yes.

MR. SULLIVAN. I think that is amazing. And also, Mr. Pratt, compressed natural gas in vehicles, I used to sell gasoline and diesel fuel, and we were talking about getting an infrastructure in place for that, and it was in Oklahoma and a lot of people, the consumer would think, well, it kind of went like that when they pulled it off. It scared them. They

thought they would blow up. But isn't it true that you--let's say an accident occurred with a gas vehicle, it occurred with a natural gas vehicle, wouldn't it be less dangerous because it would dissipate and wouldn't pool on the ground?

MR. PRATT. Yes, sir. That is the case. The State of New York has some great anecdotal stories of a Honda Civic GX that was rear ended by none other than a gasoline tanker and drove the back tanks all the way up into the back seat. And the safety investigator said if it wasn't for the natural gas tanks and the construction of that vehicle, the passengers would have been dead. The safety protocols around natural gas are very high, well proven, and very safe. I don't know if I could take a moment to address the fuel supply just one second.

MR. SULLIVAN. Sure.

MR. PRATT. Thank you. Just to put it in perspective for everyone, if you took 11 million vehicles today, which is about 5 percent of our vehicle fleet, that would only equate to about 4 percent of the natural gas sent out annually. It is a very small percentage to have a very big impact. And as we look at electric generation today, natural gas is being market driven out of natural gas generation because it is the highest priced fuel over coal and nuclear, and so we look at that supply long term as potentially displacing up to 20 percent of both the gasoline and diesel available in the marketplace. Thank you.

MR. SULLIVAN. Thank you very much.

MR. HALL. The gentleman from California, Mr. Radanovich.

MR. RADANOVICH. Thank you, Mr. Chairman. I think my question is going to be for you, Mr. Pacheco, but anybody else who wants to answer it. I am from California and represent a large farming area. It is about $35 billion, largest industry in California is specialty agriculture. And in California, we have got about three ethanol plants that are starting to go in, which I think is good news, and even though there is limited amounts of corn grown in California the costs of production are so high, we are getting it from the Midwest to be brought in to fuel these ethanol plants, which is good news for my friend John over here.

But to tell you a story about California agriculture, about 5 years ago, the price of grapes that are grown quite extensively in the valley went in the tank. And usually, there is a place to sell, if you grow grapes you can sell it in the wine market, you can sell it in the juice concentrate market, or you can sell it as raisins. And all three of them were just flat as a pancake. And it would have been nice to have that other alternative to be able to sell it for some type of fuel afterwards.

So I am wondering, I guess my question is, and I think this is a methanol, as much as I know about this. When are we going to be able to, in California have the option of selling some of these 250 crops or

byproducts from crops to be able to have that fuel option for the California ag industry? And is it methanol? And maybe you can educate me on that.

MR. PACHECO. No, you would be referring to ethanol in that case.

MR. RADANOVICH. It would be ethanol?

MR. PACHECO. Yes. And most of those food products, the sugar that is in them is fermentable directly. So it could be a lot like what the Brazilians are doing with sugar cane, and what we do with corn so it doesn't face the hurdles that the cellulosic ethanol faces. Also, in your State, you have a big rice industry, and the rice straw faces the same challenges that corn stover faces and that wood resources face, the cost of the technology to go from that cellulosic material. A good way to separate it is if you can eat the biomass, then it is probably fermentable and would be cost effective. And there are companies today that are taking waste from the food industry and producing fuel ethanol from them.

MR. RADANOVICH. So for grapes, for the actual grape product you could, you are not too far away from, in the technology, being able to make ethanol from grapes, but it would be prunings and things out of the orchards or vineyards that are cellulose or lignin based, cellulose, those are the tougher ones to get energy out of, right?

MR. PACHECO. Exactly. In fact, I understand Europeans face the same issue, and some years when the wine is in true excess, the same technology that is used to make wine is, in fact, the technology that is used to make fuel ethanol, things like corn grain or potatoes or waste grapes.

MR. RADANOVICH. That is interesting. Thank you. Mr. Pratt, real quick question. You had mentioned the natural gas infrastructure is more suitable, or would be a step toward a hydrogen-based economy. Is that because you can mix the fuels in the same tank, or why is that for natural gas and not for anything else?

MR. PRATT. Good question. There are several layers to that. First, building the infrastructure is very similar to building a pure hydrogen station infrastructure. So it gets all of our city officials and fire departments with longstanding experience in natural gas familiar with permitting natural gas stations and then that carries over to hydrogen. Second, for societal experiences, as we heard from Mr. Sullivan, the experience on filling a vehicle up or filling a bus or refuse truck up on natural gas is handling a gaseous fuel. Now, it is all very safe. It is a quick connect type of connection on to your vehicle. But that is a different fueling experience than gasoline. In fact, some people who fill with natural gas for a long period of time, I drive a natural gas vehicle every day and have been since 1998, after you go to a gasoline station,

the most notable thing is you can smell the gasoline. You don't smell anything with natural gas. That experience carries over into all the rest of the societal experiences of body mechanics, auto parts maintenance, all of that has to become familiar with gaseous fuels to get to a hydrogen future.

And finally, on the station itself, the stations can be accommodated with booster compressors to include delivery of blended natural gas, a 20 percent blend of hydrogen into natural gas by volume will reduce emissions by 50 percent. So it takes any car, or bus, or truck and makes it even cleaner. And then you can also sell pure hydrogen as well. So the stations have multi-level societal experiences that are important to continuing over, carrying over the hydrogen experience.

MR. RADANOVICH. Thank you. And real quickly if I might, just one more brief question. You had mentioned that it takes about what, 9 months to a year to convert a station or to add natural gas to a regular facility, petroleum facility. Is that just because it is the normal course of constructing, probably take just as long to add a gasoline station to a particular site, right?

MR. PRATT. That is correct. And when we have compressors in stock, and we have some of our pre-packaged skids in stock, we can install it in 6 months. And that is pretty much the permitting process and getting out the contracts all agreed to.

MR. RADANOVICH. I see. Okay. Thank you.

MR. PRATT. Thank you.

MR. HALL. Well, thank you. The Chair recognizes the gentleman from Kentucky, Mr. Whitfield.

MR. WHITFIELD. Mr. Chairman, thank you very much. And I know you all have had quite an interesting and informative hearing, and I apologize very much for not being here earlier. But I did have a few questions I would like to ask certainly, Mr. Hughes, with the National Biodiesel Board. Certainly, at this time, with the energy prices being what they are, all of us are focusing on alternative fuel sources and certainly biodiesel is one of those. But Mr. Hughes, does the President appoint the members of the National Biodiesel Board? How is it determined who sits on that board?

MR. HUGHES. The National Biodiesel Board is a membership organization, so anybody who is a dues-paying member is a member of the National Biodiesel Board. And then they have an election process for their governing board which is voted on by the full membership.

MR. WHITFIELD. Okay. Now it is my understanding that the ASTM standards became effective because of the American Job Creation Act of 2004. Is that correct? Or is that not correct?

MR. HUGHES. No, the ASTM process, we actually started back in the late 1990s working with the engine makers, automakers who saw biodiesel starting to grow and becoming more prevalent in the marketplace, and they wanted to make sure that there was a national standard in place for kind of uniformity for a product. And that started, like I said, in the late 1990s. They put in a provisional spec, I believe it was in 1999. December of 2001, I believe, that was when the ASTM standard D 6751 was actually adopted and put into place. It was in 2001.

MR. WHITFIELD. It was adopted by the board or was it adopted by--

MR. HUGHES. No, the National Biodiesel Board does not develop the ASTM standard. That is the American Society of Testing and Materials that does the ASTM standard. They developed that. We work with stakeholders, and ASTM for development of a standard.

MR. WHITFIELD. But is it a part of Federal statute today?

MR. HUGHES. It is, yes, sir.

MR. WHITFIELD. And that was adopted in which Act?

MR. HUGHES. That was included in the Jobs Act.

MR. WHITFIELD. So it became a Federal statute, those standards, in the Job Creation Act of 2004?

MR. HUGHES. It became, it was included, it has actually been included, I believe, in other places, but that was the one that comes to mind. It was in the Jobs Act as one of the requirements that must be met in order for a fuel biodiesel to be eligible for the fuels tax credit, the blenders tax credit.

MR. WHITFIELD. And of course the board, which I certainly understand, will support only those technologies that meet those standards, the ASTM 6751 standard, of course, but there are, I am aware of more than one biodiesel producer who has come up with a fuel that, from at least the scientific evidence that I have seen, is actually cleaner burning with more BTUs, but because it doesn't meet that standard, cannot be approved. And it seems to me that at a time when we are trying to do everything possible to encourage more development, that being very rigid on this standard can be counterproductive at times. Would you agree with that or not agree with that?

MR. HUGHES. Well, the National Biodiesel Board absolutely, 100 percent supports domestic fuels, renewable, and other domestic fuels. The automakers and engine makers and components manufacturers, when it comes to biodiesel, they wanted to have a very specific standard for what is biodiesel, so when people are selling biodiesel, there is uniformity in the marketplace about what this is. We absolutely support any kind of a domestic fuel that has gone through the health effects testing, that has gone through an ASTM process and those kind of things, absolutely, sir.

MR. WHITFIELD. Well, Mr. Chairman, I will yield back the balance of my time. I do think that this matter is so important that, while this legislation that has formalized the standard was adopted in the Job Creation Act, I do think that may be something that maybe our Energy Committee could look at as well, because I think we have a vested interest in this issue. And I want to thank all of you for your testimony today and the great leadership you are providing. Thank you.

MR. HALL. Thank you. The gentleman said it all. We appreciate you. We thank you for your time and thank you for your ability to give us information on which to base good legislation. You are dismissed. The subcommittee is adjourned.

[Whereupon, at 3:58 p.m., the subcommittee was adjourned.]

RESPONSE FOR THE RECORD BY SUSAN M. CISCHKE, VICE PRESIDENT, ENVIRONMENT AND SAFETY ENGINEERING, FORD MOTOR COMPANY

Susan M. Cischke
Vice President, Environmental & Safety Engineering

World Headquarters
One American Road
Dearborn, MI 48126-2798 USA

July 18, 2006

The Honorable Ralph M. Hall
Chairman
Subcommittee on Energy and Air Quality
Committee on Energy and Commerce
U.S. House of Representatives
Washington, DC 20515

Dear Chairman Hall:

Thank you for allowing Ford Motor Company the opportunity to present our testimony before the Subcommittee on Energy and Air Quality on Wednesday, May 24, 2006. Recently your staff submitted additional questions for the record. Our response is attached, including a restatement of the questions for clarity.

We look forward to working with Congress to address our nation's energy issues. Thank you again for this opportunity.

Sincerely,

Susan M Cischke

Questions for the Record
To Susan M. Cischke
From The Honorable Henry A. Waxman

1. On June 7, 2005, eleven national science academies issued a joint statement entitled "Joint science academies' statement: Global response to climate change." The joint statement was issued by the science academies of the United States, Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia and the United Kingdom. It can be reviewed online at the National Academy of Sciences website: http://www.nationalacademies.org/onpi/06072005.pdf. The statement begins:

> **Climate change is real**
> There will always be uncertainty in understanding a system as complex as the world's climate. However, there is now strong evidence that significant global warming is occurring. The evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities (IPCC 2001). This warming has already led to changes in the Earth's climate.

The statement proceeds to state:

> We urge all nations … to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies.

As the joint statement makes clear, climate change is clearly an issue of great importance to every nation on the planet. Given the substantial greenhouse gas emissions attributable to the transportation sector, climate change should clearly be a major factor in any discussion about the next generation of vehicles and fuels. Unfortunately, climate change was not meaningfully discussed at the May 24, 2006 hearing. Accordingly, please provide answers to the following questions:

a. Does Ford Motor Company agree that the joint statement represents the prevailing scientific views on climate change?

Ford Motor Company has publicly stated and published in our Climate Change Report our view on climate change. We recognize that some key conclusions have earned widespread support by scientists, policy makers and business leaders and therefore define the assumptions underpinning our approach to climate change. These conclusions are compelling enough to serve as a framework for our analysis and planning. For example:

- **The growing weight of evidence holds that man-made greenhouse gas emissions are starting to influence significantly the world's climate in ways that affect all parts of the globe.**

- **Many scientists, businesses and governmental agencies have concluded that stabilizing the atmospheric CO2 concentration at around 550 parts per million may help forestall or substantially delay the most disruptive aspects of global climate change.**

It is in the interest of society and business to reduce the uncertainty and increase the predictability of policy frameworks and market conditions around the issue of climate change. Ford Motor Company is committed to participating in a dialogue on energy policy and greenhouse gas emissions that promotes more energy security and lower GHG emissions across the entire economy, while ensuring stable economic growth and the viability of our business.

b. Does Ford Motor Company agree that it is the prevailing scientific view that "the threat of climate change is clear and increasing"?

See answer to 1a.

c. Does Ford Motor Company agree that it is the prevailing scientific view that "there is now strong evidence that significant global warming is occurring"?

See answer to 1a.

d. Does Ford Motor Company agree that it is the prevailing scientific view that "most of the warming … can be attributed to human activities"?

See answer to 1a.

e. If Ford Motor Company disagrees with the joint statement, or a portion of the joint statement, based on a scientific disagreement, please identify the portion of the statement with which Ford Motor Company disagrees and explain the scientific basis for the disagreement. Please provide references to any published, peer-reviewed studies that form the basis for Ford Motor Company's disagreement.

See answer to 1a.

2. The joint statement referenced in question 1 also recommends taking action to reduce the causes of climate change. It states:

> The scientific understanding of climate change is sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions.

It goes on to state:

> Action taken now to reduce significantly the build-up of greenhouse gases in the atmosphere will lessen the magnitude and rate of climate change. As the United Nations Framework Convention on Climate Change (UNFCCC) recognizes, a lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system.

Fortunately, the scientific academies report that "there are many potentially cost-effective technological options that could contribute to stabilizing greenhouse gas

concentrations." They also warn that "failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future."

In order to understand Ford Motor Company's views on reducing the causes of climate change, please provide answers to the following questions.

a. Does Ford Motor Company agree that current scientific understanding of climate change justifies nations "taking prompt action"?

In June 2005, Ford Motor Company participated in the G8 Climate Change Roundtable. Among other assertions, this group stated "We agree that science is sufficiently compelling to warrant action by both the private and public sector, and we acknowledge that, because of the cumulative nature and long residence time of greenhouse gases in the atmosphere, action must be initiated now."

Ford Motor Company published the industry's first report dedicated to the issue of climate change and its effect on our business as well as the automotive industry as a whole. The report can be found at www.ford.com/en/company/about/sustainability). In this report, we describe our approach to GHG stabilization, which is based on four key principles:

- **First, technical, economic and policy approaches to climate change need to recognize that all CO2 molecules (or GHG equivalents) produced by human activity make the same contribution to the atmosphere's concentration of greenhouse gases. The cost of mitigating those emissions, however, varies significantly depending on their source, and economically efficient decisions about how to reduce emissions depend on transparent cost signals.**

  The relatively high costs of emission reduction make it important that control policies be as efficient as possible, which implies that the marginal costs of compliance be equalized across all sectors. A pure pro-rata assignment of burden for reducing GHG emissions across individual sectors without the ability to trade-off costs and benefits may not be the most appropriate response.

- **Second, the auto industry represents a closely interdependent system, characterized by the equation: fuel + vehicle + driver = GHG emissions. Each link in this chain depends on the other. Automakers can produce a range of products to use fuels with varying carbon content; however, operating those vehicles on alternative fuels will require energy providers to bring the fuels to market and consumers to demand the vehicle and fuel. In a system in which no single player controls all inputs, changes in output – in this case GHG emissions – will require unprecedented coordination across all sectors.**

- **Third, the future developments of technologies, markets and political expectations are all uncertain. Accordingly, the business strategies we implement – and the public policies that we encourage – must be based on the flexibility to meet a range of potential scenarios. We know that almost any scenario will call for reduced GHG emissions, but inside that broad directional expectation lie a host of conflicting possibilities. For example, will hydrogen, bio-fuels, battery electricity, diesel or some combination**

emerge as the powertrain technology of choice? Will the emerging markets of China and India pursue a unique path toward lower GHG emissions in their road transport sectors?

- **Finally, Ford supports taking early affordable steps to reduce GHG emissions. Lack of agreement on long-term solutions cannot be used as an excuse to avoid reasonable near term actions that provide the flexibility to account for a range of potential technological, market and political outcomes.**

b. Does Ford Motor Company agree that it is "vital" that all nations "identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions"?

Yes, see response to 2a.

c. Does Ford Motor Company agree that "a lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system"?

Yes, see response to 2a.

d. Does Ford Motor Company agree that "failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future"?

Yes, see response to 2a.

e. What actions can be taken now "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does Ford Motor Company anticipate can be taken in 5 years? How about 10 years?

Ford Motor Company is participating fully in the larger public dialogue on actions required by governments, businesses and individuals to address climate change.

We believe that policies that put constraints on carbon need to focus on all sectors of the economy. They should encourage conservation and the introduction of lower-carbon and renewable-carbon fuels and energy sources, while increasing the demand for more energy efficient products across all sectors at the lowest possible social cost and at a pace consistent with technology maturation, consumer demand and economic viability. These policies need to be implemented in ways that mitigate any related transitions to avoid economic disruptions and unnecessary costs, with incentives playing a key role.

Future reduction programs should be based on upstream carbon trading systems that gradually reduce the limits on carbon introduced into the economy. In addition, they must include a safety valve that is based on economic/energy indicators that would allow for the release of additional emission allowances at reasonable prices to avoid unintended constraints on economic growth, maintain price stability and protect vital economic growth

and social development needed to help spur demand for more efficient products and support long-term investment, research and innovation.

f. What actions can be taken now in the transportation sector "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does Ford Motor Company anticipate can be taken in that sector in 5 years? How about 10 years?

Within the transportation sector, vehicle, fuels and fuel-use must be addressed as a system. Policies need to encourage the use of lower-carbon and renewable-carbon fuels and energy (e.g., bio-ethanol fuels and blends) through favorable market signals and incentives, as well as encourage energy efficiency, carbon sequestration initiatives, offsets, and credits across all phases of the energy value chain.

A properly structured, upstream system would allow all sectors of the economy to respond to the market signals and pursue the most cost-effective solutions to improve energy conservation and energy efficiency. From a transportation point of view, an effective system would require gradual but substantial changes in our product and technology mix to remain consistent with shifting consumer demand for more efficient products.

Initial policies can provide a foundation to help reduce GHGs. For example, educating consumers on their role – through programs like eco-driving training – will be a very important part of a comprehensive and consistent market-based solution. A person who drives in an energy-conscious way – by avoiding excessive idling, unnecessary bursts of acceleration and anticipating braking – can enjoy much better fuel consumption today. Government can play a key role in raising public awareness. Public awareness is a simple and effective early step to reduce GHGs, which is why we have introduced driver training programs in Europe and developed on-line training for all Ford Motor Company employees.

We also must focus on vehicle performance through advanced technology research and development, as well as manufacturing incentives and investments that reach to suppliers and OEMs. Finally, we must continue to pursue policies that improve road transport and infrastructure (e.g. mass transit) by reducing congestion and fuel consumption through improved traffic flow. An early step that can be taken already by municipal governments is traffic light synchronization to reduce overall vehicle idle time.

g. What actions can be taken now by Ford Motor Company "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does Ford Motor Company anticipate can be taken in 5 years? How about 10 years?

There are no simple solutions, and open debate among all the diverse stakeholders is necessary. A long-term solution will take time to evolve, but we also believe that early foundational policies can help reduce GHGs.

Ford Motor Company has announced publicly several product actions that will increase the number of higher fuel economy, lower GHG emissions vehicles

available to our customers. For example, we have announced plans to continue our leadership in ethanol powered flexible fuel vehicles.

We are also expanding the application of existing technologies that deliver fuel economy benefits including variable valve timing, fuel shut off, direct injection gasoline engines, clean diesel and six-speed transmissions. Additionally, we are increasing our investment in a portfolio of technologies that deliver improved fuel economy and lower GHG emissions, including:

- **Weight stabilization and reduction**
- **Expanded FFV vehicles and partnerships with fuel providers to increase infrastructure**
- **Gasoline engine downsizing, combined with Direct Injection Spark Ignition (DISI) and pressure charging**
- **Hybrid gasoline powerpacks, shared among the brands**
- **Clean diesels and the technology to allow them to run on bio-diesel above 5% blends**
- **Hydrogen Internal Combustion Engine (ICE) demonstration fleets**
- **Hydrogen fuel cell research and demonstration fleets.**

h. As an international business entity, please explain how your approach to climate change varies by the nation in which you are operating? For example, compare your approach in the European Union to the United States, and the United State to China.

The issue of climate change is closely related to the equally pressing issues of energy security and fuel prices (which drive market behavior). GHG emissions are a common currency for all of these issues; however, international approaches to customer and policy priorities differ around the world.

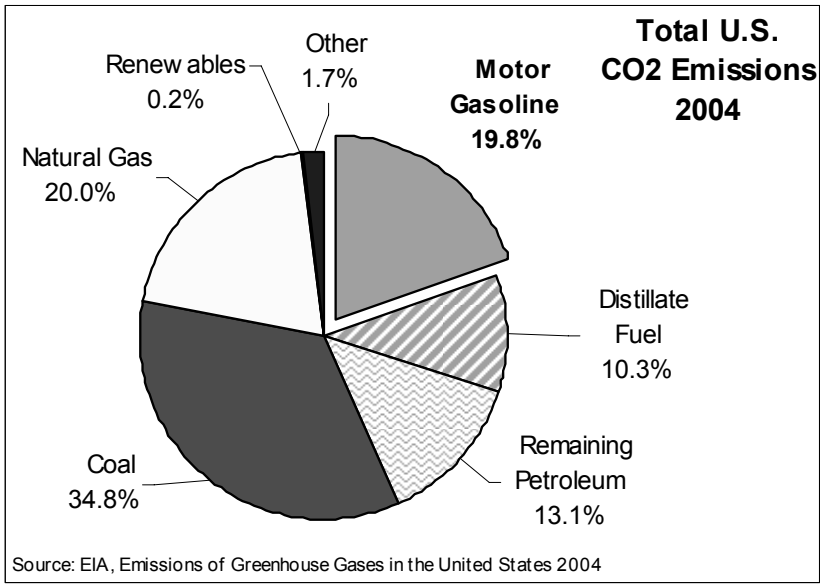
Ford Motor Company recognizes these differing customer and policy priorities and varies our approaches accordingly. For example, our voluntary agreement as part of ACEA in Europe has been focused directly on CO2 reduction. Our aggressive investment in hybrid production in the U.S. has been driven, in part, by consumer demand for more fuel efficient vehicle choices and innovative technologies. Our support for an expanded bio-ethanol infrastructure in the U.S. is underpinned by the call for less dependence on imported oil. China has adopted weight-based fuel consumption standards for 2005 with more stringent requirements set for 2008 vehicles. Each of these initiatives results in lower CO2 emissions, but emerges from different market and policy priorities.

3. About 20% of the United States' greenhouse gas emissions are emitted by light duty vehicles.

a. Does Ford Motor Company believe that the United States government should act to require a reduction of greenhouse gas emissions from light duty vehicles?

Ford Motor Company believes that government support is needed with near-term actions, such as consumer education on eco-driving and incentives to increase E-85 infrastructure.

Longer-term, government action on GHGs must include all sectors of the economy, including the other 80% of the contributors. Even a substantial reduction of GHGs from the gasoline sector would have minimal impact on GHGs without including emissions from other fuel sources. Beyond the auto industry, producers of natural gas, coal and even other petroleum products must be part of the solution.



Further, a simple pro-rata assignment of burden for reducing GHG emissions may not be the most appropriate response and will likely result in economic waste. All CO2 molecules produced by human activity contribute equally to the atmospheric concentration of CO2; however, the cost of mitigating those emissions can vary significantly across sectors of the economy.

b. If so, please discuss what requirements Ford Motor Company would consider reasonable to reduce greenhouse gas emissions while providing adequate time for adaptation by the auto industry. What is an appropriate timeframe for a requirement? What substantive requirements would Ford Motor Company suggest?

Reduction programs should be based on upstream, carbon trading systems that gradually reduce the limits on carbon introduced into the economy. This approach will most cost effectively involve all sectors of the economy and eliminate the need to regulate and enforce each sector/industry uniquely. The upstream system must include a safety valve that is based on economic/energy indicators that would allow for the release of additional emission allowances at reasonable prices to avoid unintended constraints on the economy, maintain price stability and protect vital economic growth and social development needed to help spur demand for more efficient products and support long-term investment, research and innovation.

c. If Ford Motor Company does not believe that the United States government should act to require a reduction of greenhouse gas emissions from light duty vehicles, please explain what alternative approach Ford Motor Company suggests for reducing greenhouse gas emissions.

See answers to 3a and 3b.

RESPONSE FOR THE RECORD BY WILLIAM REINERT, NATIONAL MANAGER, ADVANCED TECHNOLOGY GROUP, TOYOTA MOTOR SALES, USA, INC.

July 21, 2006

The Honorable Henry A. Waxman
Committee on Energy and Commerce
U.S. House of Representatives
c/o Mr. Peter Kielty
Legislative Clerk
2323 Rayburn House Office Building
Washington, DC 20515-6115

Dear Representative Waxman:

Thank you for your thoughtful questions and your committee's interest in Toyota's views on climate change. We are pleased to have this opportunity to share our understanding and some of our current thinking on this important issue.

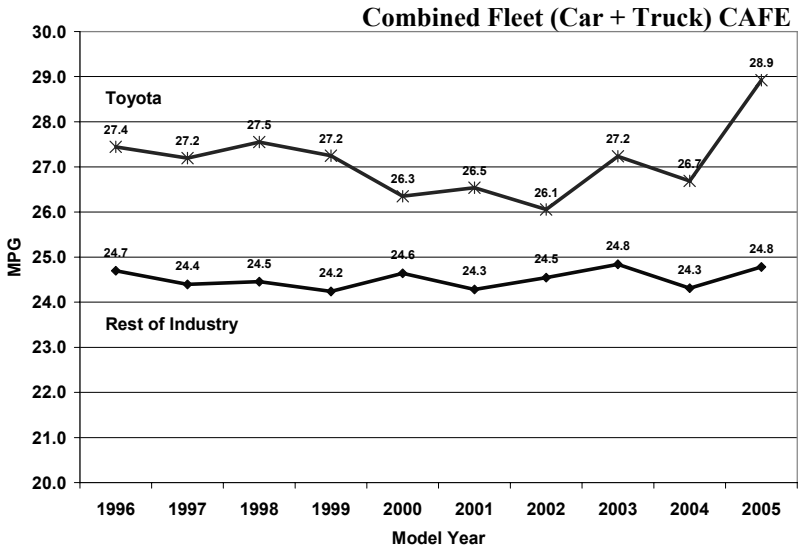
Toyota recognizes the broad and growing scientific consensus that climate change is occurring. Although some uncertainties remain, we also understand that the majority scientific opinion links anthropogenic activities to increases in Earth surface temperatures, and that these activities, considered in total, appear to be having a significant impact on global climate. Toyota also observes that the majority of the scientific community believes that both immediate and long term strategies and policies to reduce the impacts of climate change must be considered.

Although there appears to be growing alignment in the scientific community about the problem, there appears to be much less consensus on solutions. The prioritization of mitigation and adaptation options and objectives, the relationship between short-term and long-term greenhouse gas reduction activities, the design and viability of a global response – these are just a few of the key questions that are open to significant public debate.

Toyota Action

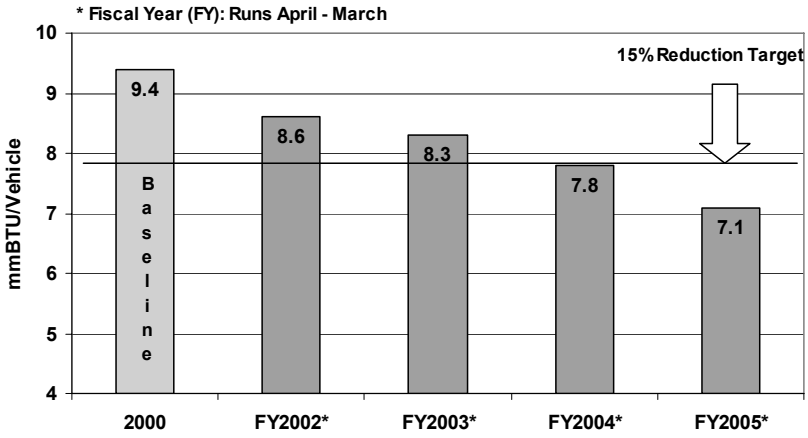
Although these types of critical questions and considerations remain, Toyota has long considered it prudent to look for ways to help reduce the impact of greenhouse gas emissions from our products and from our business operations.

The greenhouse gas impact from motor vehicles is inexorably linked to their fuel economy. As to Toyota's fleet in the United States, we have exceeded the Corporate Average Fuel Economy (CAFE) standards since their inception in 1978. In 2005 (the latest year for which complete public data are available), our combined car and truck CAFE was 28.9 MPG, exceeding the combined average of the rest of industry by 4.1 MPG, or nearly 17%. Further, we support the National Highway Traffic Safety Administration (NHTSA) raising future CAFE requirements for both cars and trucks and, indeed, in our comments on the recently promulgated light truck rule encouraged NHTSA to immediately undertake another multiyear rulemaking for trucks.



Our commitment to reducing the greenhouse gas footprint of our products does not stop there, however--energy conservation and energy efficiency are core considerations in the full life cycle of our business. To this end, we also participate in the Department of Energy's 1605(b) program, and have been reporting our greenhouse gas emissions from our U.S. manufacturing operations since 2003. In addition, we set an internal target to reduce energy consumption, and thus CO2, from our North American manufacturing operations by 15% per unit of production by FY2005 compared to a baseline year of 2000. We achieved our 15% reduction target two years ahead of schedule and are in the process of developing a new, even more challenging target.

Average Manufacturing Energy Consumed per Vehicle



We also have set targets to reduce energy use and track greenhouse gas emissions generated during the sales and distribution of our products. In March 2005, we achieved our goal to reduce energy use from this part of our business by 15%, and we set a new target of 20% reduction (compared to 2000 base year). In addition, we have developed a greenhouse gas inventory using a protocol developed by the World Business Council for Sustainable Development (WBCSD).

All of the goals and targets for Toyota's North American operations are contained in our 5-Year Environmental Action plan, which is published annually in our North American Environmental Report. This year's report, scheduled to be published in November 2006, will contain an all new set of goals and targets that we will work to achieve over the next 5-year period.

Advanced Vehicle Technology and Alternative Fuels

As we work with these federal and voluntary programs and exceed federal fuel economy requirements, Toyota is also committed to developing and marketing advanced vehicle technology to address global climate change and the growing demand for fossil fuels. With these concerns in mind, the Prius and Toyota hybrid technology were launched in 1997 in Japan and in the U.S. market in 2000 (and at a time when gasoline hovered around $1 a gallon). Toyota sees hybrid technology as a core technology for the future that will increase the fuel efficiency and reduce the environmental impact of gasoline powered vehicles, as well as an essential and enabling element of future powertrains. Toyota pioneered the market development for hybrid vehicles and has sold over 600,000 hybrids globally with more that 300,000 of them being sold in the United States. We have previously announced the goal of hybrid sales in excess of 1,000,000 each year, starting in the early part of the next decade. We also have announced our intention to advance our research and development of plug-in hybrid vehicles.

We also continue to explore the use of alternative fuels, including biofuels (ethanol) and hydrogen. We have hydrogen fuel cell demonstration programs in place in California, and are considering introducing flex-fuel vehicles in an effort to promote bioethanol fuels. Further into the future, we also continue to look to hydrogen fuel cells to one day replace traditional combustion engines.

Other Sectors and Other Markets

Our primary business falls within the transportation sector; therefore, we do not have a formed opinion over how other sectors should be addressed. Toyota does, however, recognize that there may be serious challenges ahead in shifting away from fossil fuels. In this sense, we encourage the move to more renewable fuel sources and practices in the production of electricity, hydrogen, biofuels or gasoline. How fuels are produced and distributed is perhaps the key factor in determining the life cycle greenhouse gas impact of specific vehicle powertrain options.

As an automaker, Toyota believes its primary responsibility is to optimize the fuel efficiency of our products. We must accomplish this, however, while also keeping our customers' needs and local markets in mind. Toyota responds to the regulatory climate and market forces in each market where we do business. In every case we meet, and most times exceed, all applicable regulatory requirements. We believe that some markets, like the European Union and Japan, have long been shaped by regulatory and tax policies that favor carbon-equivalent reduction strategies based upon high fuel taxes. Many economists believe that these policies have led to market conditions that favor smaller, more fuel efficient vehicles, and Toyota products in these regions reflect these preferences.

Similar conditions do not currently exist within the United States. In-use conditions and fuel prices are much different and reflect a different set of customer priorities. Market conditions in the United States have historically favored larger, gasoline-fueled vehicles and a full line of vehicle offerings. Again, Toyota's products within the United States reflect these conditions. However, Toyota strives to provide class-leading fuel economy in each market segment in which we compete.

Reducing In-Use Impacts and Fostering Technology Development

While we certainly have control over our product offerings, automakers' have little control over fuel supply, distribution and pricing. In addition, although we can (and do) play a role in fostering consumer interest in fuel economy, we also cannot dictate how – and how much – consumers use our vehicles. Toyota considers it worthwhile, therefore, for society to look for additional ways to influence how automobiles are used by the American public. As examples, in-use impacts might be reduced through smarter land use planning, increased reliance on mass transit and the greater use of so-called "intelligent transportation systems" to reduce traffic congestion and gridlock. There may also be merit in additional government policy designed to foster consumer interest in advanced technology and fuel efficient vehicles, such as tax credits for hybrids.

We also encourage the federal government to continue to play a leadership role in the development of alternatives to the internal combustion engine and conventional fuels. Hybrids, "clean" diesel, biofuels, hydrogen – these are just a few possible pathways that show promise for addressing both climate change and energy diversity. The federal government can continue to help these nascent technologies find their way into the mainstream.

Addressing climate change will require some fundamental changes in how we view and use energy. There are certainly ways that energy conservation and energy efficiency can have positive economic effects for businesses and consumers, but it is critical that any mandatory requirements on business or on our society be viewed with the additional prism of economic impact. We believe it critical that any government requirements be designed to distribute the burden for climate change impacts across multiple sectors,

while also recognizing prior and voluntary action. We therefore generally support energy intensity and performance based standards (such as the existing CAFE standards), as opposed to absolute caps or other limits that may penalize growing companies or companies that have taken early voluntary action to reduce their greenhouse gas impacts.

Continued Collaboration and Innovation

Toyota also strongly believes that addressing climate change and energy diversity in a meaningful way will require collaboration. Toyota is investing time, funding and know-how to joint efforts designed to respond to climate change and help diversify energy. These cooperative efforts include joint research projects with universities on climate change reduction technologies and participation in global and U.S. policymaking organizations, but we are also engaged in strategic alliances with energy providers to explore advanced technologies and alternative fuels. We are also sharing our advanced hybrid technology with other automakers.

Tackling climate change and fostering energy diversity calls for careful deliberation and balancing with other priorities, but it also demands innovation, unconventional thinking and most of all, action. Toyota is committed to continued action to do its share to help solve these challenges, and to exploring multiple pathways to achieving sustainable mobility. Toyota continues its search for cost-effective, mass market solutions, and we encourage the U.S. government to continue to foster the flexibility and innovation that our industry – and our society--will need to reduce the greenhouse gas impact of the automobile.

Thank you again for your interest in our views, and this opportunity to share some of our current thinking with you.

Sincerely yours,

Bill Reinert
National Manager
Toyota Motor Sales, U.S.A.

RESPONSE FOR THE RECORD BY ELIZABETH LOWERY, VICE PRESIDENT, PUBLIC POLICY CENTER, GENERAL MOTORS

June 28, 2006

Congressman Ralph M. Hall **FE-6313**
Chairman, Subcommittee on Energy and Air Quality
Committee on Energy and Commerce
U.S. House of Representatives
2323 Rayburn House Office Building
Washington, DC 20515-6115

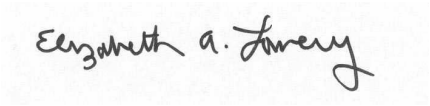
Dear Congressman Hall:

Thank you for the opportunity to appear before the Subcommittee on Energy and Air Quality on Wednesday, May 24, 2006 at the hearing entitled "Vehicle and Fuels Technology: Next Generation."

General Motors Corporation is pleased to provide the attached responses to the follow-up questions that you sent us in your letter of June 9, 2006.

If you have any questions regarding this material, please let me know.

Sincerely,



Attachment

c: Peter Kielty, Legislative Clerk (Fax 202-225-2899)

The Honorable Henry A. Waxman

1. On June 7, 2005, eleven national science academies issued a joint statement entitled, "Joint science academies' statement: Global response to climate change." The joint statement was issued by the science academies of the United States, Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, and the United Kingdom. It can be reviewed online at the National Academy of Sciences website: http://www.nationalacademies.org/onpi/06072005.pdf. The statement begins:

> **Climate change is real**
> There will always be uncertainty in understanding a system as complex as the world's climate. However there is now strong evidence that significant global warming is occurring. The evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomena such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities (IPCC 2001). This warming has already led to changes in the Earth's climate.

The statement proceeds to state:

> We urge all nations . . . to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies.

As the joint statement makes clear, climate change is clearly an issue of great importance to every nation on the planet. Given the substantial greenhouse gas emissions attributable to the transportation sector, climate change should clearly be a major factor in any discussion about the next generation of vehicles and fuels. Unfortunately, climate change was not meaningfully discussed at the May 24, 2006, hearing. Accordingly, please provide answers to the following questions:

a. Does General Motors agree that the joint statement represents the prevailing scientific views on climate change?

> We are not experts in climate science, and thus are not in a position to judge the accuracy of the joint statement. However, we are aware that the concentration of greenhouse gases in the atmosphere is increasing. For this and other reasons, we are taking appropriate steps to reduce energy use and greenhouse gas emissions from our facilities and products. Development of advanced technologies for vehicles and manufacturing and alternative fuels are critical parts of this process.

b. Does General Motors agree that it is the prevailing scientific view that "the threat of climate change is clear and increasing"?

> See response to question 1a.

c. Does General Motors agree that it is the prevailing scientific view that "there is now strong evidence that significant global warming is occurring"?

> See response to question 1a.

d. Does General Motors agree that it is the prevailing scientific view that "most of the warming . . . can be attributed to human activities"?

See response to question 1a.

e. If General Motors disagrees with the joint statement, or a portion of the joint statement, based on a scientific disagreement, please identify the portion of the statement with which General Motors disagrees and explain the scientific basis for the disagreement. Please provide references to any published, peer-reviewed studies that form the basis for General Motors's disagreement.

See response to question 1a.

2. The joint statement referenced in question 1 also recommends taking action to reduce the causes of climate change. It states:

> The scientific understanding of climate change is sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions.

It goes on to state:

> Action taken now to reduce significantly the build-up of greenhouse gases in the atmosphere will lessen the magnitude and rate of climate change. As the United Nations Framework Convention on Climate Change (UNFCCC) recognises, a lack of full scientific certainly about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system.

Fortunately, the scientific academies report that "there are many potentially cost-effective technological options that could contribute to stabilising greenhouse gas concentrations." They also warn that "failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future."

In order to understand General Motors's views on reducing the causes of climate change, please provide answers to the following questions.

a. Does General Motors agree that current scientific understanding of climate change justifies nations "taking prompt action"?

See response to question 1a above.

b. Does General Motors agree that it is "vital" that all nations "identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions"?

Climate change is a global issue. Appropriately addressing concerns about climate change will require global involvement.

c. Does General Motors agree that "a lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response

that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system"?

See response to question 1a.

d. Does General Motors agree that "failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future"?

GM believes the most effective way to improve energy efficiency and reduce greenhouse gas emissions is the development and global implementation of cost-effective energy technologies in all sectors. We are working hard to accomplish this in the products that we make and sell worldwide and in the facilities that we operate.

e. What actions can be taken now "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does General Motors anticipate can be taken in 5 years? How about 10 years?

The basic challenge is to meet the world's growing demands for energy and mobility necessary to sustain economic growth while also addressing long-term concerns about the environment. GM believes the most effective way to improve energy efficiency and reduce greenhouse gas emissions is the development and global implementation of cost-effective energy technologies in all sectors.

f. What actions can be taken now in the transportation sector "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does General Motors anticipate can be taken in that sector in 5 years? How about 10 years?

In the near term, the deployment of flex fuel vehicle technology and a biofuel fueling infrastructure holds great potential to begin to move us away from current U.S. dependence on fossil fuels in the transportation sector. We believe investment in FFVs and biofuels will pay even greater dividends if cellulosic ethanol becomes a significant player in the marketplace.

In the longer term, fuel cells powered by hydrogen offer a sustainable energy pathway to decouple economic growth and personal transportation from CO_2 emissions. It is important that the research being undertaken by automakers to develop the capability of fuel cell vehicles be complemented by research into ways to better and more economically use renewable and other non-carbon emitting energy pathways so that as 'zero emission' vehicles are commercialized, 'zero emission' fuels are also made commercially available, resulting in a substantial reduction or elimination of CO_2 emissions on a well-to-wheels basis.

For developed countries, hydrogen fuel cells offer the opportunity for cleaner, more fuel efficient vehicles, enhanced energy security and reduced vulnerability to oil supply disruptions from unstable sources. For developing countries, hydrogen fuel cells offer the opportunity for enhanced mobility, which is a key enabler of economic growth, with very

limited or no environmental issues and from, in many cases, locally available energy sources. However, as with any 'leapfrog' technology, there are many technical and transitional issues still to be addressed before the benefits of hydrogen fuel cell vehicles can be widely realized.

g. What actions can be taken now by General Motors "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does General Motors anticipate that General Motors can take in 5 years? How about 10 years?

Products: GM is implementing advanced technologies in its internal combustion engines (such as Active Fuel Management, flex fuel systems capable of running on renewable ethanol E-85, and clean diesels), in its hybrid vehicles (which include GM's hybrid bus transmission systems and SUV and car hybrid systems that will be rolled out over the next few years) and in its hydrogen powered fuel cell vehicles that emit only water (moving us toward the ultimate goal of removing the automobile from the environmental equation). GM believes the pursuit of a hydrogen economy ultimately provides the best opportunity not only to reduce greenhouse gas emissions from the automotive sector, but also to diversify away from dependence on petroleum.

Processes: GM continues to set targets and monitor greenhouse gas emissions from its facilities and is taking steps to achieve near-term reductions. In 2004, GM's global facilities achieved a 12.5 percent reduction in CO2 emissions compared to 2000.

h. As an international business entity, please explain how your approach to climate change varies by the nation in which you are operating? For example, compare your approach in the European Union to the United States, and the United States to China.

General Motors operates as one company around the world – looking for opportunities to maximize the use of advanced technologies in products and processes in all regions in which it operates.

3. About 20% of the United States' greenhouse gas emissions are emitted by light duty vehicles.

a. Does General Motors believe that the United States government should act to require a reduction of greenhouse gas emissions from light duty vehicles?

No. The most effective thing the US government can do is to assist in the development and implementation of the advanced vehicle technologies and alternative fuels described above through a balanced program of incentives for vehicle manufactures, consumers, and fuel providers.

b. If so, please discuss what requirements General Motors would consider reasonable to reduce greenhouse gas emissions while providing adequate time for adaptation by the auto industry. What is an appropriate timeframe for a requirement? What substantive requirements would General Motors suggest?

c. If General Motors does not believe that the Untied States government should act to require a reduction of greenhouse gas emissions from light duty vehicles, please explain what alternative approach General Motors suggests for reducing greenhouse gas emissions.

See General Motors' response to question 3a.

RESPONSE FOR THE RECORD BY DEBEROH MORRISSETT, VICE PRESIDENT, REGULATORY AFFAIRS, DAIMLERCHRYSLER CORPORATION

DAIMLERCHRYSLER

DaimlerChrysler Corporation
Deborah L. Morrissett
Vice President - Regulatory Affairs
Product Development

June 30, 2006

The Honorable Henry A. Waxman
U.S. House of Representatives
Committee on Energy and Commerce
Washington, DC 20515

Attn: Mr. Peter Kielty
Legislative Clerk
2323 Rayburn House Office Building
Washington, DC 20515-6115
FAX: (202) 225-2899

Dear Congressman Waxman:

I was pleased to have the opportunity to testify at the May 24, 2006 hearing entitled "Vehicle and Fuels Technology: Next Generation" and to communicate DaimlerChrysler's extensive efforts to improve vehicle and fuel technologies to the House Subcommittee on Energy and Air Quality. I have compiled and attached responses to your additional questions regarding the climate change issue. If I can be of any further assistance please let me know.

With best regards,

Deborah L. Morrissett

Deborah L. Morrissett

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Phone 248.512.4946
Fax 248.576.7369
e-mail: dlm10@dcx.com

A Company of the DaimlerChrysler Group

The Honorable Henry Waxman

1. On June 7, 2005, eleven national science academies issued a joint statement entitled, "Joint science academies' statement: Global response to climate change." The joint statement was issued by the science academies of the United States, Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, and the United Kingdom. It can be reviewed online at the National Academy of Sciences website: http://www.nationalacademies.org/onpi/06072005.pdf. The statement begins:

> **Climate change is real**
> **There will always be uncertainty in understanding a system as complex as the world's climate. However, there is now strong evidence that significant global warming is occurring. The evidence comes from direct measurements of rising surface air temperatures and subsurface ocean temperatures and from phenomenon such as increases in average global sea levels, retreating glaciers, and changes to many physical and biological systems. It is likely that most of the warming in recent decades can be attributed to human activities (IPCC 2001). This warming has already led to changes in the Earth's climate.**

The statement proceeds to state:

> **We urge all nations…to take prompt action to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies.**

As the joint statement makes clear, climate change is clearly an issue of great importance to every nation on the planet. Given the substantial greenhouse gas emissions attributable to the transportation sector, climate change should clearly be a major factor in any discussion about the next generation of vehicles and fuels. Unfortunately, climate change was not meaningfully discussed at the May 24, 2006 hearing. Accordingly, please provide answers to the following questions.

1a. Does DaimlerChrysler Corporation agree that the joint statement represents the prevailing scientific view on climate change?

DaimlerChrysler supports the on-going climate change research and dialogue to ensure a fuller understanding of the controversies surrounding this issue and to avoid inappropriate responses by government or the private sector. An example of controversy was highlighted by the U.S. NAS president when he expressed concern to the UK Royal Society President on the process that produced the joint statement. Senator Craig entered this correspondence into the Congressional Record during the Energy Policy debate of 2005.

While DaimlerChrysler cannot assess whether this joint statement "represents the prevailing scientific view," we do share the concern expressed by many, that global climate change could affect future generations.

Vehicle manufacturers such as DaimlerChrysler are only one stakeholder in the energy/greenhouse gas equation and can only influence vehicle technology and manufacturing processes – other pertinent stakeholders include governments, consumers, interested NGOs and other industry sectors (e.g., energy industry) and their suppliers.

DaimlerChrysler is developing and implementing new advanced technologies now to minimize any potential impact our vehicles and processes might have on global climate or the environment in general. Our objective is to achieve a sustainable road transportation system by focusing on technological advances in energy efficiency and innovation.

We believe that the competitive marketplace is the best solution to this challenge and we expect to be a leader in developing and introducing advanced technologies designed to reduce greenhouse gas emissions. DaimlerChrysler is taking action on two of the conclusions in the joint statement now:

- *"Identifying cost effective steps that can be taken now to contribute to substantial and long term reductions in net global greenhouse gas emissions."* One example I included in my testimony is DaimlerChrysler's offering of MDS (Multiple Displacement System) technology on seven Chrysler Group vehicles. MDS seamlessly alternates between smooth, high fuel economy four-cylinder mode when less power is needed and V-8 mode when more power is demanded from the engine.

- *"Show leadership in developing and deploying clean energy technologies and approaches to energy efficiency…"* One example I included in my testimony is DaimlerChrysler efforts to design more engines to run on biofuels with lower lifecycle greenhouse gas emissions, because the plants they are derived from absorb carbon dioxide from the atmosphere during growth. We have teamed up with the Detroit-based nonprofit NextEnergy, the nation's largest chain of biodiesel refiners, industry-leading suppliers, and local universities to conduct much-needed research and field testing. I ask that Congress support funding requests for this and similar research programs.

DaimlerChrysler also continues to work cooperatively with government labs, suppliers and other companies in the industry to achieve breakthroughs in technology. Programs, such as FreedomCAR and the hydrogen initiative in the United States, and the Fuel Cell Partnership and Hydrogen Highways effort in California can have a long-term effect in reducing CO_2 emissions from vehicles.

1b. Does DaimlerChrysler Corporation agree that it is the prevailing scientific view that "the threat of climate change is clear and increasing"?

See answer to 1a.

1c. Does DaimlerChrysler Corporation agree that it is the prevailing scientific view that "there is now strong evidence that significant global warming is occurring"?

See answer to 1a.

1d. Does DaimlerChrysler Corporation agree that it is the prevailing scientific view that "most of the warming … can be attributed to human activities"?

See answer to 1a.

1e. If DaimlerChrysler Corporation disagrees with the joint statement, or a portion of the joint statement, based on a scientific disagreement, please identify the portion of the statement with which DaimlerChrysler Corporation disagrees and explain the scientific basis for the disagreement. Please provide references to any published, peer-reviewed studies that form the basis for DaimlerChrysler Corporation's disagreement.

See answer to 1a.

2. The joint statement referenced in question 1. also recommends taking action to reduce the causes of climate change. It states:

> **The scientific understanding of climate change is sufficiently clear to justify nations taking prompt action. It is vital that all nations identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions.**

It goes on to state:

> **Action taken now to reduce significantly the build-up of greenhouse gases in the atmosphere will lessen the magnitude and rate of climate change. As the United Nations Framework Convention on Climate Change (UNFCCC) recognizes, a lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system.**

Fortunately, the scientific academies report that "there are many potentially cost-effective technological options that could contribute to stabilizing greenhouse gas concentrations." They also warn that "failure to implement significant reductions in net greenhouse gas emissions now, will make the job much harder in the future."

In order to understand, DaimlerChrysler Corporation's views on reducing the causes of climate change, please provide answers to the following questions.

2a. Does DaimlerChrysler Corporation agree that current scientific understanding of climate change justifies nations "taking prompt action"?

NGOs routinely point to the corporate average fuel economy (or CAFE) program as the policy for reducing greenhouse gases through improved vehicle fuel economy. DaimlerChrysler has supported the National Highway Traffic Safety Administration's (NHTSA) national fuel economy standard setting process. In March of 2006, NHTSA finalized a second round of rulemakings

that has led to higher truck fuel economy standards for seven straight model years (2005-2011 MY).

DaimlerChrysler also participates in voluntary initiatives such as the DOE Climate VISION program to lower greenhouse gases from our facilities and reports its greenhouse gas emissions to the DOE 1605(b) program.

The United States government has committed billions of dollars to mobilize the science and technology community to enhance research and development efforts which will better inform climate change decisions. In fact, the Administration has initiated a Climate Change Science Program Strategic Plan that the National Academy has reviewed and endorsed. The United States is also engaged in extensive international efforts on climate change, both through multilateral and bilateral activities. The United States is by far the largest funder of activities under the United Framework Convention on Climate Change and the Intergovernmental Panel on Climate Change. DaimlerChrysler supports these efforts to avoid inappropriate responses by government or the private sector.

2b. Does DaimlerChrysler Corporation agree that it is "vital" that all nations "identify cost-effective steps that they can take now, to contribute to substantial and long-term reduction in net global greenhouse gas emissions"?

Ambient greenhouse gases are global in nature. Efforts to mitigate greenhouse gas emissions must be embraced by all sectors in developed and developing countries alike. Without a global commitment to reducing greenhouse gas emissions, little or no environmental benefit will be realized and economic disruption will result.

The U.S. Department of Energy's Energy Information Agency projects that developing country greenhouse gas emissions will exceed developed country greenhouse gas emissions within a decade, primarily due to the rapidly growing economies of China and India. Efforts that seek to include these countries, such as the Asia-Pacific Partnership on Clean Development and Climate, with its focus on technological development and deployment, have the potential to reduce global greenhouse gas emissions.

2c. Does DaimlerChrysler Corporation agree that "a lack of full scientific certainty about some aspects of climate change is not a reason for delaying an immediate response that will, at a reasonable cost, prevent dangerous anthropogenic interference with the climate system"?

While there are many unanswered questions, DaimlerChrysler continues to develop and implement advanced technology in its product line-up. We continue to support NHTSA and their charge from Congress to set national fuel economy standards for light duty vehicles at the "maximum feasible" level.

2d. Does DaimlerChrysler Corporation agree that "failure to implement significant reductions in net greenhouse emissions now, will make the job much harder in the future"?

See answer to 2c.

2e. What actions can be taken now "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does DaimlerChrysler Corporation anticipate can be taken in 5 years? How about 10 years?

There are three fundamental actions available to reduce fossil fuel energy use/greenhouse gas emissions:

- Conserve energy through behavior changes
- Improve energy efficiency
- Switch to a lower carbon energy source

Many economists have noted that the most efficient way to lower greenhouse gas emissions is to implement carbon controls on all fossil fuels at their upstream production point (i.e., the mine-mouth or well head). Controls that operate "upstream" on fuel producers versus "downstream" on fuel users hold the greatest promise for large greenhouse gas reductions at the lowest cost by educating the market regarding the overall value of all forms of energy.

While setting fuel economy standards will only impact new vehicles, upstream controls on fossil fuel carbon content will cause all energy end users, including owners of older vehicles, to value energy.

As I highlighted in my original testimony (attached), DaimlerChrysler continues to work on a broad portfolio of technologies to improve the energy efficiency and reduce greenhouse gas emissions of transportation through the implementation of advanced technology and increasing the use of renewable biofuels.

<u>Advanced Technology</u>

For the near-term, we continue to improve advanced gasoline and diesel internal combustion engines (ICE) with the development and implementation of technologies (including many noted by National Academies of Science "Effectiveness and Impact of Corporate Average Fuel Economy (CAFE) Standards" in 2002).

- DaimlerChrysler currently has seven models (The Chrysler 300, Dodge Magnum, Dodge Charger, Jeep® Grand Cherokee, Dodge Durango, Dodge Ram, and the Jeep® Commander) that feature the Multiple Displacement System (or MDS) fuel saving technology. By 2007, MDS is estimated to save over 60 million gallons of gasoline per year.

- The new Dodge Caliber and soon to arrive Jeep® Compass and Jeep® Patriot, feature the all new, more fuel-efficient World Engine and continuously variable transmission (CVT). This inline 4 cylinder engine comes in three displacements and features dual-cam Variable Valve Timing (VVT) and electronic throttle control (ETC).

- On June 13, 2006, we announced a new 3.0-liter turbo Common Rail Diesel (CRD) will debut in the 2007 Jeep® Grand Cherokee. The engine will have more torque than most eight-cylinder engines, equal acceleration and the fuel economy of a small six-cylinder gasoline engine. The

Mercedes built 3.0-liter CRD is one of the most advanced powerplants available in the marketplace today. New clean diesel vehicles improve fuel economy by up to 30 percent in all driving conditions, when compared to an equivalent gasoline engine, while providing durable and smooth performance. DaimlerChrysler also offers a Mercedes-Benz E320 diesel, which provides the highest fuel economy of any gasoline or diesel-powered mid-size car as well as diesel versions of its larger Dodge Ram pickup trucks. Later this year the company will continue its expansion of diesel offerings.

For the mid-term, we are developing a state-of-the-art full hybrid system, whose components are being co-developed by General Motors Corp., DaimlerChrysler and the BMW Group, utilizing electric drive systems, integrated power modules and advanced batteries initially to be used in the 2008 MY Dodge Durango.

In the long term, fuel cell vehicles with on-board hydrogen storage, fueled by hydrogen from a national hydrogen infrastructure will emerge.

Biofuels

Biofuels also have a key role in reducing petroleum use and greenhouse gas emissions. A recent study by Argonne National Laboratory's Center for Transportation Research compares gasoline to corn ethanol and cellulosic ethanol (ethanol made from plant stalks, agricultural byproducts, grasses or garbage). On a per-gallon basis, corn-based ethanol reduces greenhouse gases by 18%-29%, and cellulosic ethanol reduces greenhouse gases by 85%, the study found.

On April 25, 2006, our CEO, Tom LaSorda, had the honor of following President Bush to the podium of the Renewable Fuels Association conference and announced that, beginning in the 2007 model year, our Jeep® Grand Cherokee and the new Jeep® Commander with the 4.7 liter engine option will be capable of running on E-85 fuel (blend of 85% ethanol and 15% gasoline). This is in addition to DaimlerChrysler's other current flexible fuel vehicle (or FFV) offerings: the Chrysler Sebring, Chrysler and Dodge minivans, Dodge Dakota and Dodge Ram pickups, and the Dodge Durango SUV.

Our commitment to renewable fuels extends beyond ethanol use in FFV engines. Diesel fuel can also be blended with renewable fuels known as biodiesel. DaimlerChrysler is the only manufacturer to offer a diesel vehicle that leaves the factory fueled with bio-diesel. We have also announced that beginning this Fall, we will endorse the use of B20 diesel fuel, for use by our military, government and commercial fleet Dodge Ram customers. As the President said in his visit of May 16, 2005, to Virginia BioDiesel Refinery, "Biodiesel is one of our nation's most promising alternative fuel sources…"

In May, Mr. LaSorda made a new commitment to renewable fuels when he met with Congressional leaders along with Ford CEO, Bill Ford and General Motors CEO, Rick Wagoner and committed to the "25 x '25" campaign – an effort by the Energy Future Coalition to aim to get 25 percent of the country's transportation energy needs from renewable sources by 2025.

On June 28, 2006, DaimlerChrysler, General Motors and Ford reaffirmed work towards this commitment and pledged to double the annual production of vehicles capable of running on renewable fuels to two million cars and trucks by 2010. This production increase represents the single largest commitment to renewable fuels in the nation's history. The pledge toward more flex fuel vehicles that can use E-85 ethanol or biodiesel came in a letter to all Members of Congress from Mr. LaSorda and the other CEOs.

For DaimlerChrysler specifically, this translates to manufacturing nearly 500,000 E-85 FFVs annually by the 2008 MY building upon the 1.5 million FFVs manufactured since the 1998 model year. These 1.5 million vehicles represent about 10 percent of our total production since 1998, and the 500,000 figure is nearly 25 percent of our expected annual production. Both percentages are the highest for any manufacturer, a fact of which our company is very proud.

Today, there are more than 5 million flex fuel vehicles on the road and the three domestic automotive companies will add an additional million cars and trucks this year alone. If all of these vehicles were running on E-85, they would displace more than 3.5 billion gallons of gasoline a year, an amount comparable to the yearly gasoline consumption of Tennessee.

"We need business and government to work together to enhance the production, distribution and use of renewable biofuels," the CEOs said. "Our hope is that with this commitment, fuel providers will have even more incentive to produce ethanol and other biofuels and install pumps to distribute them."

As President Bush noted in his State of the Union Address regarding the Advanced Energy Initiative, additional research/invention on ethanol production methods from both corn and cellulosic biomass (e.g., wood chips, stalks or switch grass) is still needed to make ethanol a "practical and competitive" fuel to gasoline.

The CEOs noted that, "vehicles alone will not get the job done. To capitalize on this commitment, Congress and the Administration need to continue to promote the production of biofuels, increase incentives for refueling infrastructure, and continue incentives for automakers to produce biofuel vehicles." "Eventually, we need to get to the point where most Americans have reasonable access to these fuels at a price that is competitive with gasoline," they said. "Without this alternative fuel infrastructure, the U.S. could miss the opportunity to displace gasoline with homegrown and produced biofuels." Currently, there are only about 700 E-85 pumps among the nation's 170,000 gas stations.

DaimlerChrysler's renewable fuel commitments, coupled with our continuing efforts to improve the efficiency of gasoline-powered vehicles, increase our use of diesel engines, and our leadership in fuel cell vehicles (with more than 100 vehicles, ranging from small cars to transit buses, in operation around the world today) are testimony to our commitment to reducing petroleum consumption and greenhouse gases.

2f. What actions can be taken now in the transportation sector "to contribute to substantial and long-term reduction in net global greenhouse gas

emissions"? What actions does DaimlerChrysler Corporation anticipate can be taken in that sector in 5 years? How about 10 years?

See answer to 2e.

2g. What actions can be taken now by DaimlerChrysler Corporation "to contribute to substantial and long-term reduction in net global greenhouse gas emissions"? What actions does DaimlerChrysler Corporation anticipate that DaimlerChrysler Corporation can take in 5 years? How about 10 years?

See answer to 2e.

2h. As an international business entity, please explain how your approach to climate change varies by the nation in which you are operating? For example, compare your approach in the European Union to United States, and the Unites States to China.

DaimlerChrysler is one company operating in many markets. For any vehicle technology to be successful, it must be accepted by the marketplace and accommodate regional market differences such as differing: regulatory requirements, fuel taxation, engine size taxation, fuel quality, average distances driven, vehicle utility (size, towing, 4WD, etc.).

In the EU, where fuel prices are considerably higher than in the U.S., almost 50% of the new vehicle market (60% of Chrysler and Jeep® vehicles) is powered by advanced diesel engines compared to about 3% in the U.S. Diesel can improve fuel economy by an average of 30% and lower CO_2 emissions when compared to an equivalent gasoline engine.

The EPA has also noted that if the U.S. had a light duty fleet that was one-third diesel it would save up to 1.4 million barrels of oil per day. If Chrysler Group's diesel mix in the U.S. were the same as in Europe, its Corporate Average Fuel Economy (or CAFE) would improve by three miles per gallon. J. D. Power and Associates estimate that light-duty diesels could grow from a 3% market share in 2004 to 12% in 2012.

3. About 20% of the United States' greenhouse gas emissions are emitted by light duty vehicles.

3a. Does DaimlerChrysler Corporation believe that the United States government should act to require a reduction of greenhouse gas emissions from light duty vehicles?

Carbon dioxide (CO_2) accounts for 97% of vehicle greenhouse gases and is a direct result of fuel combustion. Controlling CO_2 emissions is therefore akin to controlling fuel economy. DaimlerChrysler is committed to develop new advanced technologies to minimize any potential impact our vehicles might have on global climate and continues to work with NHTSA, which was charged by Congress, to set maximum feasible national fuel economy standards.

The United States, specifically NHTSA, is acting now to reduce petroleum consumption by light-duty vehicles. DaimlerChrysler supported NHTSA's

efforts for its two light-duty truck rules that defined new fuel economy standards for the 2005-2011 MY vehicles. NHTSA's environmental analysis estimated the effect of these rules will be to lower greenhouse gas emissions by nearly five billon metric tons of CO_2 over the lifetime of these vehicles. President Bush has also recently asked Congress to authorize NHTSA to also reform fuel economy standards for passenger automobiles. DaimlerChrysler supports this effort.

While actions being taken by NHTSA address new vehicle fuel economy, upstream carbon controls would impact all vehicles on the road today.

3b. If so, please discuss what requirements DaimlerChrysler Corporation would consider reasonable to reduce greenhouse gas emissions while providing adequate time for adaptation by the auto industry. What is an appropriate time frame for a requirement? What substantive requirements would DaimlerChrysler Corporation suggest?

See answer to 3a.

3c. If DaimlerChrysler Corporation does not believe that the United States government should act to require a reduction of greenhouse gas emissions from light duty vehicles, please explain what alternative approach DaimlerChrysler Corporation suggests for reducing greenhouse gas emissions.

See answer to 3a.

SUBMISSION FOR THE RECORD BY HUNT RAMSBOTTOM, CEO AND PRESIDENT, RENTECH, INC.

Rentech is a publicly held, Denver-based firm listed on the American Stock Exchange. For 25 years, Rentech has engaged in research and development, focusing on enhancing the production of ultra-clean fuels made from coal, petroleum coke and natural gas.

Rentech's Clean Diesel

It is very different from petroleum diesel. It is clear, refined to a high degree of purity and extremely low in both particulates and sulfur. The familiar belching cloud you see when a diesel truck or bus starts to accelerate is caused by particulates, and recent studies have shown that they potentially have long-term harm to human and environmental health – but our fuel eliminates most of that concern. When the Air Force tested our fuels and similar fuels made by competitors, the tests showed reductions in particulates of up to and over 80%. The Rentech fuel is also extremely low in sulfur – less than 1 part per million, far under the new EPA standard of 15 ppm.

Rentech's fuel doesn't require any engine modifications. It can be used as is as the operating fuel for trucks, buses and barges. It can also be blended with petroleum diesel or alternative fuels such as biodiesel. It can even be processed into jet fuel.

The basic chemistry behind our fuel products has been known for 7 decades. The basic technology has been developed and used extensively in other countries. Rentech currently holds 20 US and 4 foreign patents making the process more efficient and effective. We have tested our innovations in six pilot plants over the past 20 years.

This technology is now being deployed in the US. The 7th pilot, our Process Demonstration Unit (PDU), is scheduled to be operating by the first half of 2007. It will produce 10 barrels per day (bpd) for demonstration, analysis and training by potential end users. And it will allow us to optimize our technology for variations in coal and other site-specific factors. We now have developed our technology extensively around Coal-to-Liquids – or CTL – gasification, and for Rentech, the future of CTL in the United States is no longer a theoretical, what-if, conversation. We plan to have a fully commercial, fully operational CTL plant up and running by 2010.

Our focus as a company is now on making clean transportation fuels in the US, from US resources for US consumption. We are targeting our commercial investments to production based on coal and petroleum coke (a byproduct of oil refining) feedstocks. We can locate plants anywhere with sufficient access to these resources, from coal-producing states to Hawaii (which has petroleum coke from its refinery).

Environmental Benefits

The product has none of the typical odor of diesel. There are two other critical differences between this and typical diesel. Our fuel has a shelf-life of at least 8 years, rather than 3-4 months for petroleum diesel – meaning that for the strategic reserve, for emergency first-responders, and the military, our fuel has incredible advantages. Next, our fuel is biodegradable. If it spills, it does not cause extensive or irreparable damage to waterways or wells.

Rentech is committed to being environmentally friendly – and both our production and fuels have environmental benefits.

As we manufacture our fuel, we remove most of the harmful regulated pollutants in the gasification stage. Sulfur and mercury come out as elements – they do not go up a smokestack to be scrubbed out, and do not leak into the environment. We are also working to reduce unregulated emissions, such as greenhouse gases. Our proposal for a second plant, to be located in Natchez, Mississippi, offers the opportunity for 100% carbon capture and storage. Our carbon dioxide output would be pumped into nearby

older oil well fields, both helping to produce additional oil by forcing out additional supplies and trapping the carbon underground.

Additionally, our fuel runs cleaner than petroleum diesel. Diesel itself has significant advantages over gasoline, providing greater power with fewer emissions – and using Rentech's diesel keeps the power advantage and reduces emissions even further.

Economic Challenges

At the moment, a number of trends are converging to jump-start the clean fuels industry in the United States--the soaring price of gas, the very real concerns about America's energy dependence and energy security, and the challenges posed by both the geopolitical and global environmental situations. Our fuel is part of the solution for each of these concerns.

With oil prices at historic highs, our fuel is also economically competitive. Including the financing and development costs, we can produce finished fuels for $36 to $42 per barrel, the equivalent of buying raw crude at $30 to $35 per barrel.

To start this industry however, you need to open the first plant in the US. Each successive plant will build on the economies of scale, improve on the lessons learned at previous plants, and expand the market. It is very capital intensive to build the industry, and one plant is only the start. You have to build second, third, fourth, and then successive plants. But, as the Governor of Montana likes to note, everyone wants to build the second plant. Nobody wants to finance the first in the US, even though these plants exist in several other countries.

Rentech has developed a five-point strategy for commercialization, designed specifically to overcome the financial hurdles of getting started in the US. First, we are jump-starting the deployment of our proprietary Rentech process by pairing off-the-shelf gasification and finishing plant technologies with our Rentech Reactor using our low temperature, iron-based catalyst. Second, we are aggressively pursuing multiple strategic projects in the US, with the goal of getting plants up and running at several sites very quickly.

Third, we are developing a repeatable and scalable design that allows for expansion of production up to 50,000 bpd per plant that will provide for a very rapid expansion of the industry once the first plants are operational and proved out. Fourth, we are continuing to invest heavily in research and development, to push the optimization of our technologies even farther. And fifth, we are examining selected licensing opportunities to expand use of our process and our proprietary technologies.

East Dubuque, Illinois: The First Clean Fuels Production Plant in the U.S.

Our first clean fuels plant is underway right now. In April 2006, Rentech purchased the fertilizer plant in East Dubuque, Illinois, and we plan to convert it in phases to CTL poly-generation over the next 3 to 4 years. By polygeneration, I mean that we will ultimately produce 3 core products: ultra-clean transportation fuels, ammonia fertilizer and electricity. When the conversion is complete, the overall plant emissions of criteria pollutants will decrease (as shown on the attached chart), while the plant production increases.

The plant currently makes ammonia fertilizer from natural gas, and it already incorporates basic technologies that are critical to successfully implementing CTL. The conversion will include changing the feedstock from expensive natural gas to affordable Illinois coal. In phase one, we will add a coal gasification unit to the fertilizer production line, generating syngas which is the first step in each of the products that will ultimately be generated.

Fertilizer will still be made in large quantities. Domestic fertilizer plants are shutting down rapidly because of high natural gas prices--the current primary feedstock for fertilizer. Since 1999, the US has switched from producing all its own fertilizer to

becoming a net importer. We will demonstrate that fertilizer production can still be a thriving domestic industry using clean coal technologies.

Electricity will also be produced, primarily for the plant's own use. A small surplus, however, will be provided to the local grid. But our primary focus is the production of our fuels. So in later stages, we will add a Rentech Reactor and a finishing plant, allowing production of 1,800 bpd of our diesel. Those additions will be on-line and producing in 2010.

Later, in phase two of our East Dubuque build-out, we will add a second gasifier. That will allow us to raise fuel production up to 6,800 bpd. Under our timeline, the East

Dubuque plant will be first commercial plant in the U.S. to produce marketable quantities of clean fuels from CTL.

Looking Ahead

Rentech is also pursuing a second larger scale plant in Natchez, Mississippi – the Natchez Adams Strategic Fuels Center – which would produce up to 11,000 bpd in phase one. We were invited by the local community to consider the possibility after Hurricane Katrina when Mississippi ran disastrously low on diesel. At Natchez, we can use two feedstocks--coal and petroleum coke, a byproduct of the local petroleum industry. And , there is the very real possibility of capturing and storing 100% of the carbon dioxide emissions through enhanced oil recovery in nearby oil fields. To our knowledge, this would be the first large-scale U.S. commercial capture and storage of man-made carbon emissions. Carbon dioxide injection is already being used in this oil-producing basin, but additional supplies are needed.

Looking even further ahead, we are considering several development opportunities in various regions of the US, including discussions with coal companies to utilize a replicable, iterative plant model at the mouths of mines. There, we would size a basic plant model that could be expanded. For twenty years, Rentech has researched and optimized its technology. We have refined our process to make it more effective and more environmentally-friendly. Now we are commercializing it.

Today, the US produces and consumes over 2 million barrels per day of diesel, and many experts project demand to double in the next twenty years. A thriving clean fuels industry is vital to our nation's future, both for our energy security and our environmental sustainability.

This is doable. Rentech (and Sasol) use a low temperature iron based catalyst and its use has been used commercial for years. Other industry vendors which use a cobalt catalyst have claimed that 34 foot reactors are needed, making transport and fabrication difficult. This is not the case for low temperature, iron-based catalyst as you can make smaller reactors so transport and fabrication is not an issue. The reactors will be 14 feet in diameter in the East and 20 feet in the West. The height of the reactors is not the 180 feet claimed, but rather 120 feet. The US has fabricated and built the most advanced processes in use so while initial plants, like any first, will be challenging, it will be done. Using low temperature, iron based catalyst, about 2.2 barrels of Fischer-Tropsch liquids will be produced from one ton of Illinois coal.

What the Government Can Do

As we launch this industry, we are planning to make full use of the EPACT 2005 incentives that the Congress designed to jump-start clean fuels. The States are also lending their assistance. The State of Illinois has been extraordinarily helpful – they helped us to complete feasibility studies, engineering studies and provided grants to assist with conversion to coal. The State of Mississippi has also been exceptionally supportive of the possibility of our second plant being located in Natchez, and just passed a $15 million bond bill for the proposal.

We are not asking the government to subsidize clean fuels. We need your help to create a climate where we can use private-sector funding to establish a fully commercial industry. There are four ways than you can help us jump-start the industry.

A Four-Point Plan to Jump-Start the Clean Fuels Industry

1) Support Appropriate Investment Tax Credits. To meet our aggressive timeline, we will apply for the industrial gasification investment tax credit provided by the Energy Bill. Recent initiatives to raise the current $350 million cap to $850 million would help even more. If Congress is serious about trying to reduce our dependence on foreign oil import then allow me to offer two observations. First, maintaining the current cap of $350M could slow the rollout of industrial gasification using coal to the point where the US winds up losing more industry. Even an $850M cap will assist the development and deployment of only 3 to 4 more plants – hardly the creation of a full-fledged industry. At $75 per barrel, the price of oil last week, the U.S. is paying $850 million to foreign countries for oil every two days. To create a real incentive, it might be better to lift the caps altogether. The second proposal is an additional investment tax credit specific to clean fuels to accelerate production

2) Make the Fuel Excise Tax Credit Available to Clean Fuels. Make the 50 cent-per-gallon fuel excise tax credit provided in the Highway Bill available to CTL fuels. To do that, you could extend the expiration of the current credit from 2009, when no CTL plants will yet be operational in the U.S., to 2020.

3) Fully Fund and Implement the Federal Loan Guarantees. We will also apply for the self-pay guarantees that the Congress initiated at the Department of Energy (DOE). This program is absolutely vital to our efforts. We understand that DOE's implementation has begun and we commend the Department for quickly moving to implement the authorized programs. We appreciate and hope you will continue your efforts to ensure that both of the DOE loan programs are fully funded and implemented expeditiously. And,

4) Support Military Consideration of Clean Fuels. The final idea for the government to help catalyze commercial deployment of the CTL industry is to examine usage of clean fuels for military applications. Long-term contracts for military use of diesel and jet fuel would assist greatly with private-sector financing of the first plants.

The Energy Information Administration's AEO 2006 projected long-term oil costs at $50 and above. The same forecast shows CTL production growing to 700,000 barrels per day by 2030. To get there, the first plants must be financed and built, paving the way for the industry to flourish. This 4-point combination of incentives and contracts would provide the initial climate and stability needed to propel private investment.

Conclusion

The great potential of clean fuels, especially using CTL, is that American resources, American know-how, and American innovation will help create environmentally-friendly energy and sustain American jobs. A robust clean-fuels sector can help us meet the challenge of our national energy needs, foster greater energy independence, and preserve a full measure of our energy security. At Rentech, we are moving today to produce clean fuels for America's future.

Thank you for all that you have already done to allow a jump-start of CTL and clean fuels in the Energy Policy Act of 2005. We intend to make use of your help to do just that – jump-start full scale utilization of CTL, and jump-start a new clean fuel manufacturing industry.

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