

**ADVANCED TECHNOLOGY VEHICLES:  
THE ROAD AHEAD**

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**HEARING**  
BEFORE THE  
SUBCOMMITTEE ON ENERGY, NATURAL RESOURCES,  
AND INFRASTRUCTURE  
OF THE  
COMMITTEE ON FINANCE  
UNITED STATES SENATE  
ONE HUNDRED TENTH CONGRESS  
FIRST SESSION

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MAY 1, 2007  
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Printed for the use of the Committee on Finance

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U.S. GOVERNMENT PRINTING OFFICE

44-739—PDF

WASHINGTON : 2007

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# CONTENTS

## OPENING STATEMENTS

	Page
Bingaman, Hon. Jeff, a U.S. Senator from New Mexico, chairman, Subcommittee on Energy, Natural Resources, and Infrastructure, Committee on Finance .....	1
Thomas, Hon. Craig, a U.S. Senator from Wyoming .....	2

## WITNESSES

Chernoby, Mark, vice president, advanced vehicle engineering, Daimler-Chrysler Corporation, Auburn Hills, MI .....	3
Vieau, David, CEO, A123 Systems, Watertown, MA .....	5
Eberhard, Martin, CEO, Tesla Motors, San Carlos, CA .....	8
McManus, Dr. Walter, University of Michigan Transportation Research Institute, Ann Arbor, MI .....	10
Baxley, Phillip, president, Shell Hydrogen, LLC, Houston, TX .....	12

## ALPHABETICAL LISTING AND APPENDIX MATERIAL

Baxley, Phillip:	
Testimony .....	12
Prepared statement .....	31
Bingaman, Hon. Jeff:	
Opening statement .....	1
Chernoby, Mark:	
Testimony .....	3
Prepared statement .....	34
Eberhard, Martin:	
Testimony .....	8
Prepared statement .....	37
Kerry, Hon. John:	
Prepared statement .....	41
McManus, Dr. Walter:	
Testimony .....	10
Prepared statement .....	42
Thomas, Hon. Craig:	
Opening statement .....	2
Vieau, David:	
Testimony .....	5
Prepared statement .....	49

## COMMUNICATION

National Hydrogen Association .....	63
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## **ADVANCED TECHNOLOGY VEHICLES: THE ROAD AHEAD**

**TUESDAY, MAY 1, 2007**

U.S. SENATE,  
SUBCOMMITTEE ON ENERGY,  
NATURAL RESOURCES, AND INFRASTRUCTURE,  
COMMITTEE ON FINANCE,  
*Washington, DC.*

The hearing was convened, pursuant to notice, at 10:04 a.m., in room SD-215, Dirksen Senate Office Building, Hon. Jeff Bingaman (chairman of the subcommittee) presiding.

Present: Senators Salazar and Thomas.

### **OPENING STATEMENT OF HON. JEFF BINGAMAN, A U.S. SENATOR FROM NEW MEXICO, CHAIRMAN, SUBCOMMITTEE ON ENERGY, NATURAL RESOURCES, AND INFRASTRUCTURE, COMMITTEE ON FINANCE**

Senator BINGAMAN. Why don't we ask the witnesses to please take a chair at the witnesses table and we will go ahead and get started here.

This is a hearing of this new subcommittee in the Finance Committee. This is the Subcommittee on Energy, Natural Resources, and Infrastructure. Today we are hearing testimony on advanced technology vehicles.

As we discuss energy policy and what policy path we ought to pursue, we obviously turn to the issue of transportation. Right now, over 50 percent of the nearly 21 million barrels of oil that we use each day in the U.S. is imported; 70 percent of that oil consumption is used in the transportation sector. In 2007, we expect Americans to use over 14 million barrels of oil to drive to work and do their chores, to travel within their communities and take vacations.

We also will use over 4 million barrels of fuel in industrial transportation. Ten million gallons of that fuel will be imported. These numbers suggest that in order to achieve energy security we need to reduce our use of imported fuels.

In the tax code, we have several incentives aimed at encouraging manufacturers and consumers across many industries to build and purchase more fuel-efficient vehicles. There are tax credits for the purchase of vehicles that feature technologies that will increase fuel efficiency. We have tax penalties that apply to the purchase of the least fuel efficient vehicles. The tax code also features credits against both the income tax and excise taxes for bio-based fuel blends that displace imported fuels.

Our vehicle tax credits have minimum emission standards as well, and our alternative fuel credits are intended to encourage clean-burning fuels. It is my hope that this hearing can help us establish a record regarding how the market has responded to some of these current tax incentives and what we should change in the tax code in order to get better policy implemented.

In particular, we sought testimony today from manufacturers who employ cutting-edge power storage technologies, manufacturers who are active in the traditional and diesel markets, producers of alternative transportation fuel who can speak to fueling station needs, and scholars from the automotive industry who have long studied the response of the industry to Federal energy policies. I think this will be a very useful hearing, and we have some very distinguished witnesses here.

Before I introduce the witnesses, let me call on Senator Thomas for any comments he has.

**STATEMENT OF HON. CRAIG THOMAS,  
A U.S. SENATOR FROM WYOMING**

Senator THOMAS. Thank you very much, Mr. Chairman. I am glad you are having this hearing.

It seems like we are in kind of a difficult situation in this whole business of energy, trying to understand. I think we all know we are going to have to make some tremendous changes over a period of time. I think we are all fairly confident that can happen.

I think the real challenge is in the shorter period, how we get there and how we can make movement without creating real problems with the economy, and be able to get there, but without great pain. So, gas-fueled automobiles are the core of our transportation system, and have been for a very long time. Technology is changing those, and that is, of course, what we are here to talk about.

One thing that has not changed until now is, still, today's vehicles continue to be powered generally by gasoline, and that is our system. That is the way we are. Despite the prices approaching \$4 a gallon in parts of the country, it is unlikely that our reliance in the near future is going to change all that much.

But what will the system look like in 15 or 20 years? That is really where we are, and that is, I think, the challenge. What do we do in the fairly short term, what do we do in the longer term, and how do we get there?

So as we look at these issues, it is important to keep in mind, I think, that technology must be used to produce safe, efficient, and reliable modes of transportation. Average Americans must be able to afford the transportation of the future, and preferably without large government subsidies. Changes need to result in more friendly environmental measures, in that we do no harm.

I think one of the real challenges that we have, frankly, in terms of the policy, is people look and hear about alternatives and say, oh, yes, that is going to be great, but they do not think about the difficulty that is going to be there and the difficulty in making those changes, as if it is going to happen, just happen like that. Well, it is not going to happen like that.

So we need to make sure that we get it moving in the best direction, and that's what we're here for today, and we appreciate what you all do.

Thank you, Mr. Chairman.

Senator BINGAMAN. All right. Let me just briefly introduce each of the witnesses, and then just have them speak to us, maybe from left to right the way we are facing the panel here.

Each take 4, 5, or 6 minutes to sort of give us the main points that we need to try to understand here, and then both Senator Thomas and I will have some questions, and maybe there will be other members who will have come to ask questions as well.

Senator THOMAS. A little more from the right than from the left.

Senator BINGAMAN. You think more questions from the right? It is possible.

Let me also mention, Senator Kerry, who very much wanted to be here to hear your testimony, Mr. Vieau, is having to be at the funeral for Jack Valente this morning and is not able to be here right now. I do not know if he can come before the hearing adjourns or not.

First, we have Mr. Mark Chernoby, who is vice president for Advanced Vehicle Engineering with DaimlerChrysler Corporation in Auburn Hills, MI. Next, David Vieau, who is the CEO of A123 Systems in Watertown, MA; Mr. Martin Eberhard, who is the CEO of Tesla Motors in San Carlos, CA; Dr. Walter McManus at the University of Michigan Transportation Research Institute in Ann Arbor; and Mr. Phillip Baxley, who is president of Shell Hydrogen in Houston, TX.

Thank you all very much for being here. Why don't we start with you, Mr. Chernoby? Please give us your thoughts as to what we need to focus on as we consider any changes in the tax code relative to these issues.

**STATEMENT OF MARK CHERNOBY, VICE PRESIDENT, ADVANCED VEHICLE ENGINEERING, DAIMLERCHRYSLER CORPORATION, AUBURN HILLS, MI**

Mr. CHERNOBY. Thank you, Mr. Chairman. Mr. Chairman and members of the committee, thank you for inviting me to testify before you today on the subject of advanced technology vehicles. DaimlerChrysler is committed to developing new advanced technologies that reduce the effects that our products have on energy consumption, climate change, and the environment in general. We are engaged in developing and producing technologies that will address these issues in the near, mid-, and long term.

For example, we continue to improve the fuel efficiency of our gasoline-powered engines. As the comment was made earlier, gasoline is going to be here with us very strongly in the near term, and we need to continue to focus on incremental improvements in those technologies, as we see in our line of new four-cylinder world engines being produced right here in the United States.

We are also in joint development with GM and BMW to develop advanced hybrid systems, which we will launch next year. Our first consumer hybrid products, the Dodge Durango and the Chrysler Aspen hybrids, will be on sale in 2008.

In addition, Orion bus, a subsidiary of DaimlerChrysler, has sold, or has on order, more than 1,400 diesel hybrid buses to transit authorities in the U.S. and Canada.

Within our test fleets, we are the only manufacturer to have a fleet of plug-in hybrids on the road today, as well as more than 100 fuel cell vehicles—hydrogen fuel cell vehicles—in operation around the world. While I would be pleased to further discuss these important initiatives, today I would like to focus on advanced clean diesel technology.

DaimlerChrysler is the world leader in this technology. This leadership is demonstrated through a broad range of diesel-powered vehicles, as well as our involvement in expanding the biodiesel fuel industry.

Our worldwide experience with diesels has led us to conclude that they are an important addition to our product portfolio, helping our country meet its common goals for energy security and reducing the effects of greenhouse gases on the environment.

This year, we have seven light-duty clean diesel offerings here in the United States. These vehicles are approved for the use of B5 biodiesel fuel, and selectively approved for the use of B20 biodiesel fuel in the Ram heavy-duty pickup and medium-duty cab/chassis trucks. Today's diesel-powered vehicles absolutely are clean, quiet, energy efficient, powerful, and exceed customer expectations for hauling, towing, and general utility.

In Europe, more than 50 percent of the light-duty fleet is powered by diesels, while our U.S. sales are currently approximately 3 percent. The European consumer values diesel's improvement in fuel efficiency, performance, and the associated reduction in CO<sub>2</sub> emissions.

In terms of U.S. energy objectives, diesel can be a key part of our country's strategy to reduce reliance on petroleum. Today's advanced technology clean diesels achieve approximately 20 to 40 percent—20 to 40 percent—better fuel economy than an equivalent gasoline engine, and the lifetime fuel savings are substantial.

For example, based on data from today's EPA 2007 Fuel Economy Guide, a diesel Grand Cherokee will use 418 fewer gallons of fuel each year than the gasoline-powered Grand Cherokee. This fuel savings is nearly 3 times what you would get if you compared a hybrid Honda Civic, which would only save 154 gallons of fuel per year, compared to the gasoline-only Civic.

With these benefits, one may wonder why we have not seen more significant penetration of diesels in the U.S. Market. Several factors have influenced the consumers' decision on diesel-powered vehicle purchases.

First, there are price premiums on diesel engine options. An advanced technology diesel engine costs several thousand dollars more than an equivalent gasoline engine. Furthermore, diesel fuel often costs more than gasoline. An additional reason why diesel has not significantly penetrated the U.S. passenger and light truck market is the lack of a consumer tax credit incentive.

As part of the Energy Policy Act of 2005, Congress enacted the section 30B tax credit for purchases of advanced technology vehicles. The credit has been pivotal in establishing consumer accept-



ance of hybrid passenger cars, but to date the section 30B tax credits have not helped to promote clean diesel technologies.

The section 30B rules require diesels to meet more stringent emission standards than the EPA currently requires. In short, 30B requires meeting emission standards that do not take effect for another 2 years in order to qualify for consumer tax credits. Because of the different stages of technology development, no passenger car or light truck diesel vehicle offered today meets these emission requirements.

New technologies will help DaimlerChrysler's diesel passenger cars and light trucks meet the EPA emission standards on schedule by 2009. In the meantime, in 2007 and 2008, we will continue producing early entrant diesels that we hope will establish a marketplace foothold for deployment of these new technologies in a broad array of vehicles.

To help foster clean diesel, which is one of the goals of the 2005 legislation, DaimlerChrysler would urge the committee to consider modifications to the section 30B tax credit that would encourage pre-2009 diesel purchases.

For example, we strongly support legislation introduced by Senator Biden that would eliminate the special emission requirements under section 30B for "lean burn" vehicles. Enactment of this legislation would be a small—in terms of the budgetary impact—but important step in Congress's pursuit of a multifaceted U.S. advanced technology vehicle strategy.

I would also note that introduction of diesel passenger vehicles and light trucks would establish an altogether new market for biodiesel and renewable diesel, so, not only can we reduce our reliance on foreign oil by encouraging diesel, we can also help grow the marketplace for alternative diesel fuels, whose production Congress is trying to encourage.

I appreciate the opportunity to testify before you today.

Senator BINGAMAN. Well, thank you very much.

[The prepared statement of Mr. Chernoby appears in the appendix.]

Senator BINGAMAN. Mr. Vieau, go right ahead.

**STATEMENT OF DAVID VIEAU, CEO, A123 SYSTEMS,  
WATERTOWN, MA**

Mr. VIEAU. Mr. Chairman and members of the committee, knowing of the committee's efforts to foster new technology, to slow down global warming, and to reduce dependency on foreign oil, I want to thank you for the opportunity today to share the story of A123 Systems and the work that we are doing to bring about a plug-in hybrid vehicle revolution.

A123 Systems started just 5 years ago with some licensed technology from MIT in Boston. We got \$100,000 from the Department of Energy as an SBIR grant. We had five people and a goal of creating game-changing batteries for portable electrical devices and for transportation.

Today we have over 300 employees, we have raised over \$100 million in private equity, and we are operating facilities from our headquarters in Watertown, MA; TJ Technology Division in Ann

Arbor, MI; and the High Motion Division in Toronto, Canada. And we are producing millions of batteries annually.

What we did is, we focused on what we consider are very practical commercial applications of a new nanophosphate technology that we inherited from MIT. We created batteries that had better power, better safety, and better life than that previously available.

The first application to demonstrate this was with Black & Decker's DeWalt division, where we created a new generation of power tools that demonstrated 4 times the power and twice the life of any product in that category ever produced.

What this did for an American company is, we demonstrated that A123 technology was not a lab curiosity, that in fact it was a real, competing technology on a global scale.

What we are doing now is, we are working in the automotive world and beginning to apply our technology in the transportation space. If you, for example, take a look at the nickel metal hydride technology that is currently used in the Toyota Prius hybrid vehicle—which has been very successful—that weighs in at 100 pounds; if the same product were made for the same application using A123 technology today, it would weigh 20 pounds. The smaller size, the smaller weight, basically leads to more powerful vehicles.

Plug-in hybrid vehicles operate very similarly to a hybrid vehicle, but they use a higher-capacity battery, providing much longer performance on electric power and much, much less use of gas.

Today, we are developing batteries for General Motors's Saturn Vue plug-in hybrid vehicle. We are a partner with General Electric to produce a fuel-cell hybrid bus using battery power. We have teamed with BAE Systems, the world's largest hybrid bus drive maker, to create a battery system that will save 3,400 pounds per bus in the weight of the battery system.

But we all have to realize that the time that it is going to take to commercialize plug-in hybrid vehicles with the automakers and the makers of the hybrid vehicles will take 3 to 5 years of very closely coordinated effort.

Scaling the cells. What we make today—I have a sample up here that is used in a power tool, and a sample of the product that we are developing for the automotive application. You can see, there's a difference between the two. Scaling the size, scaling the power, performance, and reliability is what the engineering work that we are currently doing is about.

Teaming with the system makers and the car makers to create full-scale battery systems that operate in vehicles with automotive reliability and safety is what this is all about over that time. But in the meantime, we can take advantage of the benefits of plug-in hybrid vehicles by converting existing hybrid vehicles into plug-in hybrid vehicles by use of an add-on module. A123 recently acquired High Motion out of Toronto, Canada, a firm that has created an advanced and a novel system that utilizes our batteries to convert standard hybrid vehicles into plug-in hybrid cars.

Our standard hybrid vehicle uses a 1 kilowatt-hour battery, and it has improved, by demonstration in that Prius example, mileage from 25 to 45 miles per gallon. The high-motion pack that we are installing in the Prius, and the sample that we have outside, is a 5 kilowatt-hour pack. It can yield 100 to 150 miles per gallon for

people who drive less than 40 miles a day, which is 4 out of 5 Americans.

The beautiful part about this design is that it is small enough to fit in the trunk space of a car, unobtrusively and without removing storage area. It can be installed in two hours or less, and it complements the existing hybrid system in the sense that we do not remove the hybrid system or modify the vehicle design in any significant way.

By the end of this year, there will be one million hybrid vehicles in the United States; in 8 years, there will be 15 million. Allowing users, or incentivizing users to upgrade their vehicles from the hybrid design to the plug-in hybrid design is going to not only increase public awareness, it is going to broaden the market adoption.

It is going to help us gather a lot of experience in applying these systems, and it is going to accelerate the benefits that we achieve for our country in terms of reduced consumption of gasoline.

The CLEAR Act and the lessons that have been demonstrated by this committee in providing incentives for hybrid electric vehicles have successfully stimulated HEV demand, and we have moved from 25 mile-per-gallon to 45 mile-per-gallon vehicles. We need to do the same thing from 45 miles per gallon to 150 miles per gallon with plug-in hybrid electric vehicles.

The problem today is, the plug-in hybrid electric vehicles do cost too much, and at \$2.70 or \$3 a gallon, there is still inequity in terms of the value and the trade-off on the cost per mile. Early plug-in hybrid vehicle tax incentives can create and stimulate demand, which will drive manufacturing efficiencies and reduce costs over time.

We have been working with your staff and with others to create tax incentives for the OEM, original equipment, car maker plug-in hybrid vehicles that we expect to see on the road in the next 3 to 5 years, and we have been working with them on module tax incentives that will allow us to, in the near term, provide plug-in hybrid capability.

We have also worked to provide incentives for additional research to lower material costs and for grants to expand manufacturing in the U.S. to even the global playing field for battery technology.

Over the past 17 years, advanced battery technology has been a focus area in Japan and Asia, and the Asian governments have funded it substantially. No one has understood this any better than you, Mr. Chairman. Overall, we have lost much commercialization edge and we are far behind on a global basis in the development of battery technology. Your act, S. 1115, recognizes the need for a level playing field. It is in our best interests to own the battery technology.

We have a few comments on S. 1115 that I would like to share with you. In section 303, it proposes 30-percent grants to fund expansion of existing manufacturing facilities. We really believe that, because there are no existing manufacturing facilities for high-volume production of lithium-ion batteries, that this should be applied to new facilities as well.

In section 302, it suggests loan guarantees, which we believe will be interesting, but will burden already strained balance sheets of start-up companies, so grants would be preferred.

And sections 304 and 305 suggest pooling technology between competitors. We believe that entrepreneurs are fiercely competitive and not very good sharers of technology, and we must preserve the confidentiality and the intellectual property that is being developed.

Our conclusion is that new technologies open the door for changing the game in transportation. Outside, we parked a 150 mile-per-gallon plug-in hybrid vehicle made possible by batteries that we have developed in conjunction with TJ Technologies of Michigan, and High Motion in Toronto.

We can turn the Nation's vulnerability of dependence on foreign oil into an automotive renaissance, and we believe it can start today. Thank you very much.

Senator BINGAMAN. Thank you very much.

[The prepared statement of Mr. Vieau appears in the appendix.]

Senator BINGAMAN. Mr. Eberhard, why don't you go right ahead?

**STATEMENT OF MARTIN EBERHARD, CEO, TESLA MOTORS,  
SAN CARLOS, CA**

Mr. EBERHARD. Good morning, Chairman Bingaman, Ranking Member Thomas, and members of the committee. Thank you for the opportunity to testify.

The efforts of this committee properly reflect our country's renewed emphasis on global climate change and dependence on oil from nations that do not have our best interests in mind always. These concerns are my own top priorities and are the reasons I founded Tesla Motors.

Four years ago, I had no bias toward electric cars, or any other technology. I set out, from an engineer's perspective, to understand which technologies could best break America's dependence on oil.

After considerable research, I came to the conclusion that electric cars are by far the more efficient technology, even when the electricity is made from coal, more so with cleaner sources. Electric cars have the added advantage of being the only kind of car that breaks the trade-off between performance and efficiency.

Tesla intends to become a major car company with a full line of highly efficient, but highly desirable electric cars. Our strategy is to enter the high end of the market, where customers are prepared to pay a premium, then move down market as quickly as possible to higher production levels and lower prices with each successive model of car.

This strategy allows us to change rapidly the public perception of electric cars, opening the market for many electric car models. Tesla Motors is not looking for government handouts. Our business model is sensible. Our cars are designed to be desirable and profitable, and I must answer to shareholders who expect a decent return on their investment.

However, there are two ways that the tax system can help catalyze consumer acceptance of zero emissions vehicles. The first is to restore and enhance the EV tax credit. Until 2006, taxpayers who

purchased electric cars could claim up to \$4,000 tax credit, and now this credit is gone.

Over the years, many have proposed measures to restore, and even enhance, this tax credit; none of these measures passed. I suspect that this is in part because, after the rewrite of California's zero emissions mandate, no car companies offered electric cars for sale anyway.

Meanwhile, new legislation created tax credits for purchases of hybrid cars, up to \$3,400 for a car that still, in fact, burns gasoline and emits carbon dioxide. This is the piece of legislation described by Bill Ford as the "Buy Japanese" bill.

Please do not misunderstand me: hybrids are fine. They usually have higher gas mileage than their non-hybrid equivalents. But in the end, they are gasoline-powered cars. The only way to put energy into your Prius is through its gas tank.

However, a real electric car does a whole lot more to reduce our dependence on foreign oil and reduce our emissions of greenhouse gases than any hybrid ever can. We should encourage new car buyers to consider an electric car instead of a gasoline car, or even instead of a hybrid.

For this reason, I propose reconsidering some of what Senator Rockefeller proposed in his Alternative Fuel Promotions Act a few years back, and that is to reinstate the EV tax credit and increase this credit for advanced technology electric vehicles, specifically providing a tax credit of up to 10 percent of the EV purchase price up to \$4,000 and an additional \$5,000 credit for any EV that has at least a 100-mile range, and do not sunset this credit for another 4 years. Two, is to give a tax deduction for the cost of installation of charging stations.

The second way that the tax system can help catalyze consumer acceptance is to level the playing field with large SUVs. Under the Jobs and Growth Creation Act of 2003, Congress raised the deduction ceiling for heavy-class vehicles—those over 3 tons—to \$100,000, bumped the "bonus deduction" to 50 percent, and continued the accelerated 5-year depreciation schedule.

This, in effect, made virtually all 3-ton, so-called business-use SUVs fully deductible in the first year. More than 50 vehicle models qualified for this tax break, and many were sold because of it.

The American Jobs Creation Act of 2004 lowered this SUV loophole to \$25,000, while retaining both the 50 percent bonus deduction and the 5-year depreciation schedule. This deduction is still claimed by many Americans who use their SUVs at least 50 percent for business uses.

While I certainly sympathize with the need to help sell Hummers, I would like to propose a similar incentive program for zero emissions, zero gasoline vehicles. Surely an accountant, a home inspector, or an attorney can use an electric car to visit his clients just as well, and getting those business people out of gas-guzzling, 3-ton SUVs and into cars that burn no gasoline is good for America and good for the environment.

I, therefore, propose leveling the playing field for electric cars purchased for business use, amend the American Jobs Creation Act to allow zero emissions vehicles also to qualify for a \$25,000 reduc-

tion, a bonus deduction of 50 percent of the car's cost, and an accelerated depreciation schedule.

Note that the Energy Policy Act of 2005 provided incentives for practically every type of alternative automotive vehicle except electric cars. Why? Did somebody really kill the electric car? I am here to inform you that rumors of the electric car's demise have been greatly exaggerated.

To quote Rick Wagoner, CEO of General Motors, at the opening of the most recent L.A. Auto Show: "Why electricity? First, electricity offers an outstanding benefit, beginning with the opportunity to diversify fuel sources upstream of the vehicle. In other words, electricity that is used to drive the vehicle can be made from the best local fuel sources—natural gas, coal, nuclear, wind, hydroelectric, and so on—so before you even start your vehicle you are working toward energy diversity. Second, electrically driven vehicles are zero emissions vehicles. When the electricity itself is made from a renewable source, the entire energy pathway is emissions-free. Third, electrically driven vehicles offer great performance, with extraordinary acceleration, instant torque, improved driving dynamics, and so on."

I could not agree with Mr. Wagoner more. Electric cars are far from dead and need to be included, even highlighted, in every government program that promotes energy independence and minimizes global climate change. They are our best hope.

I also have a lot to say about batteries and our dependence on batteries from foreign countries. Particularly, domestic manufacturing of batteries is what we need to do, but I do not have the time for that now. With another 3 minutes, I could talk about that further. But I encourage you to please read my written testimony if the subject interests you.

Once again, thank you very much for your time. I hope you find my testimony helpful.

Senator BINGAMAN. Thank you very much. We will have some questions once we finish with the other two witnesses.

[The prepared statement of Mr. Eberhard appears in the appendix.]

Senator BINGAMAN. Dr. McManus, go right ahead.

**STATEMENT OF DR. WALTER McMANUS, UNIVERSITY OF MICHIGAN TRANSPORTATION RESEARCH INSTITUTE, ANN ARBOR, MI**

Dr. McMANUS. Thank you, Mr. Chairman, members of the committee, ladies and gentlemen. It is an honor to be here today to share my views on how advanced technology vehicles can help us overcome our oil dependence and reduce our greenhouse gas emissions.

The views that I will express today are mine, not the university's or the organization that I head, and they are the result of 25 years as an economist, 17 of which I spent in the auto industry at General Motors, JD Power & Associates, and in my current position.

Vehicles are responsible for 20 percent of America's greenhouse gas emissions and 40 percent of our oil dependency, and things are going to get worse. By mid-century, the world's vehicle population is expected to be 2 billion, triple today's level.

To limit global vehicle emissions to just 50 percent more than what they are today, the average fuel economy of cars and trucks on the road mid-century is going to have to be 60 miles per gallon.

Now, let us turn to look at various features in the tax code or government programs that affect the fuel economy and the greenhouse gas emissions of vehicles. First, I would say that today's market is distorted against oil conservation.

There are a number of Federal market-based programs that encourage conservation, and some of them have already been mentioned. They include the fines that are part of CAFE for automakers that do not meet the standard; the gas guzzler tax, which really applies only to high-end luxury cars and sports cars and not to trucks at all; and then also consumer tax deductions or tax credits for advanced technology vehicles.

However, these programs that encourage conservation are more than offset by other programs that go the opposite direction, and they would include: probably the biggest is the car/truck distinction in CAFE, as well as the car/truck differential in the tax code. We just heard some mention of that by my fellow witness here.

Then, also, the flex fuel provision in CAFE, while it may help reduce our dependence on foreign oil, does not necessarily help with greenhouse gas emissions. In sum, the existing regulations and existing programs tend to favor oil consumption rather than oil conservation.

Now, I just want to say a couple of things about CAFE. Automakers, many of them say that CAFE did not work, and they point to the fact that the price of gasoline and oil was going up at the same time that CAFE was being implemented.

However, CAFE continued to increase for cars and trucks for several years after the price of gasoline started to come down, and average fuel economy continued to increase at that time, so the price increase alone would not have been sufficient to get the increase that we got in fuel economy.

Going forward, if you look at how much the penalty is for violating CAFE—today it is now \$55 for each mile per gallon above the standard that a manufacturer's fuel economy is—it is really not sufficient, in itself, to get compliance with CAFE, or probably even to get increased fuel economy at all.

The gas guzzler tax, which applies only to those high-end luxury and sports cars, is, on average, about \$585 per mile per gallon, so it's 10 times what the CAFE fine is.

In addition, the work that we have done at UMTRI, as well as some other academic researchers, say that the value that consumers put on fuel economy is about \$600 per mile per gallon.

In order to have an influence on automakers and on consumers, either the fee or the rebate on either side would have to be in that order of magnitude, similar to the gas guzzler tax and about \$600, at least, depending on how much you want.

Of course, not all auto manufacturers have complied with CAFE. European manufacturers are usually the ones that have not complied. The Big Three in Detroit have complied.

I would say that the reason they complied is because non-compliance is unlawful, illegal behavior and, therefore, there were more

serious considerations than just dollars and cents that motivated their compliance.

I want to kind of get back to my recommendations, recognizing my time. The inconsistencies in the current policies have reduced the effectiveness of instruments that are directed specifically at reducing oil consumption and greenhouse gas emissions. Any attempt to correct or to stimulate more technology development that does not take account of these inconsistencies will have problems succeeding.

I would suggest that the committee should consider a fee-bate policy to replace the complex and often conflicting incentives provided by current vehicle tax policy. Fee-bates complement CAFE by using the power of the market to guide consumers toward cost-effective, high fuel economy vehicles. Together, CAFE and fee-bates address both the supply and the demand side of the energy challenge.

Thank you.

Senator BINGAMAN. Thank you very much.

[The prepared statement of Dr. McManus appears in the appendix.]

Senator BINGAMAN. Mr. Baxley, go right ahead.

**STATEMENT OF PHILLIP BAXLEY, PRESIDENT,  
SHELL HYDROGEN, LLC, HOUSTON, TX**

Mr. BAXLEY. Mr. Chairman and members of the committee, thank you for the invitation to testify. My testimony today will focus on Shell's progress in developing hydrogen as a transportation fuel, and the infrastructure required for its growth.

First, let me begin with a description of how Shell sees hydrogen fitting into our energy portfolio. Shell Hydrogen is part of the larger Shell Renewables, Hydrogen, and CO<sub>2</sub> Group within Royal Dutch Shell.

Shell believes that fossil fuels will continue to be the most affordable and accessible energy source, fueling economic growth and powering our lives for decades to come. It has been estimated that, with current rates of growth, the global energy demand may double by 2050.

It is also estimated that alternative energies can provide approximately one-third of that energy mix. Therefore, at Shell we see our ability to manage CO<sub>2</sub> emissions to be important to the delivery of energy products and fundamental to future growth.

Hydrogen can be an important part of that path forward and is part of a broad energy portfolio Shell is developing to meet the energy challenge before us.

Before I go further into hydrogen, I would like to mention that Shell is also investing in wind energy, thin-film solar energy, second-generation biofuels, and synthetic fuels from coal and natural gas.

Now, more than 50 million tons of hydrogen are produced, transported, and used by a wide variety of industries around the world each year. Most of that hydrogen available today is used in our refineries to produce cleaner fuels.

In fact, hydrogen is so common that most Americans live already within 60 miles of a major hydrogen production facility. So in an-



answer to the perennial question, when is the hydrogen economy coming, I would say that in many respects it is already here. Shell Hydrogen is building hydrogen fueling infrastructure in three key markets: the United States, Europe, and Asia.

We introduced Tokyo's first hydrogen refueling station, opened the first hydrogen and gasoline station right here in Washington, DC—and, Senator Thomas, I think you have been out to visit the station—and we sponsored the first hydrogen refueling stations in Luxembourg and Amsterdam. In the United States, we are also working to introduce hydrogen fueling stations in Los Angeles and the New York metropolitan areas.

Our experience shows that we can supply and deliver hydrogen today safely and reliably. Our aim now is to move to the next level, from single stations to urban mini-networks.

We will continue to coordinate the availability of our hydrogen stations with the automakers' roll-out of the first small-scale mass production of hydrogen vehicles within the 2015 to 2025 time frame.

Shell believes that any roll-out of a retail hydrogen network should be focused in regions of the country where the cars will be first introduced, and we believe that the commercial roll-out of fuel cell vehicles, with the proper hydrogen infrastructure, is an immense task, and that the successful introduction of these new vehicles and this new fuel depends on an unprecedented coordination between government, energy companies, and automakers in these formative stages.

In order to make hydrogen more available and more affordable, Shell is looking for new feedstocks. In a world increasingly sensitive to carbon emissions and energy diversity, we are looking for ways to produce hydrogen with less carbon, or store the carbon associated with hydrogen production, as well as secure feedstocks readily available in this country.

Shell is developing technologies for carbon capture and storage with several large-scale projects under development worldwide. We are also investing in novel technologies to produce green hydrogen, forming alliances and joint ventures to develop technologies that we believe will produce hydrogen from biomass and other renewable sources.

Energy companies and automakers are working to make hydrogen transportation a reality within the next decade, but we need the Federal Government's continued involvement and support.

Let me outline five ways I think the government can engage to make the hydrogen economy a reality sooner. Public acceptance does not happen overnight. An enhanced education and outreach program directed at students, consumers, and permitting authorities will aid in the challenges of siting and permitting hydrogen stations.

We need increased coordination of Federal, State, and local hydrogen station permitting processes. We need to encourage early adoption by government organizations of hydrogen vehicles for fleet application and fuel cell-based portable and backup power systems. Similarly, we need to encourage support to municipalities to lease or purchase hydrogen-fueled autos and bus fleets.

Finally, the government has a key role in working with auto-makers and hydrogen suppliers to develop ways to ensure coordination of the vehicle and infrastructure roll-out, especially in early markets.

This is an exciting time to be in the energy and transportation business. We are shaping the future with our choices. Shell considers hydrogen an important part of the broad energy portfolio that we are developing to meet the energy challenge before us all.

Thank you for allowing me to speak today. I would be happy to answer any questions you have.

Senator BINGAMAN. Thank you very much.

[The prepared statement of Mr. Baxley appears in the appendix.]

Senator BINGAMAN. Thank you all for your excellent testimony.

We will just take 5-minute rounds here. Let me start with a general question. One of the things that is urged on us, and I think with some good reason, is that we try, in the tax code, to be performance-based instead of technology-based, instead of picking a particular technology and saying, all right, you get a tax incentive for using this technology.

I think we have demonstrated over the years that we are pretty inept at choosing the right one. Perhaps the fact that we provided an incentive for hybrid electric vehicles, but allowed the incentive for electric vehicles to lapse, is a good example of that.

But is it possible to do a technology-neutral tax incentive that works so that, if you have vehicles with improved vehicle fuel efficiency, whether they are diesel, whether they are hybrid electric, whether they are electric, whether they are hydrogen-based, whatever the technology that they use, they are entitled to the same incentive? Does that make sense or is that too simple? Mr. Chernoby, maybe you have a thought, or any of the rest of you?

Mr. CHERNOBY. That absolutely makes perfect sense. If you think about the testimonies you heard here today, we at DaimlerChrysler believe that there are going to be a broad range of these technologies that enter the marketplace, and 30B has shown us that this technique works. It makes a difference. And these technologies are going to stage in the marketplace over time.

What 30B does is, it helps us kick-start these technologies in the marketplace, and that is exactly the kind of incentive we want to move forward with. So we absolutely think it can be technology-neutral, and we think that that links very well with the reality of the multiple technologies that are going to enter the marketplace over the next decade.

Senator BINGAMAN. Mr. Vieau, did you have a thought?

Mr. VIEAU. Well, I think that if we see the legislation—and some of it has been drafted today—in our particular case we focused on kilowatt-hours of power in a battery, but it really translates into electrons driving wheels, and overall it drives efficiency.

So, as you have seen a hybrid electric vehicle take mileage from 25 to 45 miles per gallon, and the proposal made today is to put a larger battery pack that would get you to 125, say, 100 to 150 miles per gallon, it seems to me that you could make that conversion away from electrons and into miles per gallon, in terms of the efficiency that it brings, which makes it somewhat lacking consideration for the means by which you get there.

Senator BINGAMAN. Mr. Eberhard, did you have a thought?

Mr. EBERHARD. I absolutely agree. I think that performance-based measurement is the right way to do it. I think the rub comes in how you compare the different technologies of clean diesel versus what is the actual gas mileage or mileage of a hybrid vehicle versus an electric vehicle.

So, the trick comes in how you define what the equivalent miles per gallon is for a car that burns no gasoline, for one that burns gasoline occasionally, for one that burns diesel.

Senator BINGAMAN. Now, does EPA currently do that, and do they do it properly, in your view?

Mr. EBERHARD. The EPA does provide a couple of different measures for comparing miles per gallon for electric cars versus gasoline. I have not actually looked at diesel. I do not know a lot about that. And I think that there is still work to be done there.

The number that is used for computing CAFE mileage for an electric car is different than the window sticker that an electric car company would be required to put in the window, for example. I think that our company is submitting some suggestions about how that ought to be done to the EPA.

Senator BINGAMAN. All right. What kind of a sticker are you expecting to have to put in your window to sell your Roadster?

Mr. EBERHARD. We will be putting a sticker that says how many kilowatt-hours we consume per mile.

Senator BINGAMAN. But not the number of miles per gallon?

Mr. EBERHARD. That is debatable. It seems we may be putting in an equivalent miles per gallon number on the window based on one conversion factor or another. We are in discussion with the EPA on that subject now.

Senator BINGAMAN. All right.

Do any of the rest of you have a comment? Yes, Mr. Baxley?

Mr. BAXLEY. Can I just make a general comment? There are three points on the question you asked. The first is, we at Shell feel very strongly that it is important for government to continue to support technology and innovation across the spectrum.

So, continue to set up the tax code to support broad innovation in technologies, vehicle technology, infrastructure technologies—that is one of the hallmarks of the industry—and not be too specific about picking technologies.

But the second and third things are that it is important to continue to support and fund the government agencies that are helping to drive those things forward—all the things forward—the education, the technologies, coordination between the different organizations.

A third thing, though, to overlay a little bit on this debate is, I think it is important for government to move, especially in the United States, to the next step around the CO<sub>2</sub> question. That is, get a consistent, stable, CO<sub>2</sub> policy that we can hang a lot of these things on that will drive a lot of these debates around what we do. What is the right choice? Because the big thing out there is CO<sub>2</sub>.

So there are really three parts. It is continuing to foster technology innovation through the tax code, continuing to make sure that the finance group in this organization makes sure the funding is available for supporting the technology initiatives in the depart-

ments, and the third thing is, supporting, as best possible, getting a stable set of policies around CO<sub>2</sub>.

Senator BINGAMAN. Senator Thomas?

Senator THOMAS. Thank you.

Mr. Chernoby, what would a shift to diesel fuel mean to the current refining structure?

Mr. CHERNOBY. Well, if you look at the current fuel availability, it depends upon, obviously, what magnitude of shift. Like the comment you made earlier, significant near-term shifts in any one energy source are difficult. It takes time to have a major shift.

But we think we can have a reasonably significant penetration, especially in the light truck market, where all the research has shown that there is a tremendous market pull for diesel technology, to have a big impact on actual fuel consumption, and clearly a direct link to CO<sub>2</sub> reduction. So we think that could be done without a major shift in refining capacity.

Senator THOMAS. If we need to develop a new source of diesel fuel to meet the demand, how would you react to the technology that produces clean-burning diesel from coal?

Mr. CHERNOBY. Well, obviously, on anything produced from coal we have to look at wells to wheel and give strong consideration to making sure we are managing carbon throughout the entire stream.

But if that technology works, absolutely. And the biodiesel work that the government has strongly supported is another extremely attractive alternative that supports many avenues of energy security, as well as CO<sub>2</sub> reduction.

Senator THOMAS. But diesel actually comes from oil, right?

Mr. CHERNOBY. Yes. Currently, yes.

Senator THOMAS. Which is what we are trying to conserve. Yes. All right.

What about the distribution system, Mr. Vieau, for your system? Is there a distribution system? What kind of a job is that to put it in place?

Mr. VIEAU. The modules that we are talking about are installable by a qualified technician, and the plan overall, and the suggestion or proposal, is that this become a nationwide distribution system with certified and qualified modules.

Senator THOMAS. Do you plug it in? You just plug it in in your garage?

Mr. VIEAU. Oh, yes. So the energy itself is a standard household outlet, and using the standard household extension cord you plug it in, and in 3 or 4 hours you can charge the system up.

Senator THOMAS. Hybrids to plug-ins. What is the difference?

Mr. VIEAU. Well, a hybrid electric vehicle is principally driven by a gas motor with electric assist. The battery is relatively small, and the battery and the motor work together in harmony to improve fuel mileage.

In a plug-in hybrid, you have a larger battery system, and that larger battery system increases the amount of miles driven on electricity. So you still have that synergy between the gas motor and the electric energy, but what you have done is you have increased the amount of energy storage. That plug-in hybrid, by the name,

means that you can actually plug it into an outlet and you can get energy from that source.

Senator THOMAS. All right.

Mr. Eberhard, how much additional power generation is going to have to come online to support the system that relies on plug-in cars?

Mr. EBERHARD. There have been studies already that look at this question. Understand, the electric generation facility in this country is designed to provide power at the peak. The peak in the afternoon typically is what the grid and the electric providers have to be able to provide energy for.

The nice thing about electric cars is, they tend to charge at night. People tend to come home and charge at night, during the least-used portion of the electric cycle. What this means is, something like 40 percent of American cars could be powered by electricity without any upgrade whatsoever to the grid or generating capacity.

Beyond that, that is a problem I would like to have. I think that we have an opportunity as we go forward, if we get up to 40 percent of our cars being electric, to consider large-scale generation of electricity through solar, wind, and the like to make up the difference.

Senator THOMAS. I see.

Dr. McManus, just in general terms, what do you think is our best alternative to reduce our demand on petroleum?

Dr. MCMANUS. Well, I think a lot of the things that people have been discussing already today, but technology neutrality would be very important so that it is by a common metric. And I would say the common metric should be greenhouse gases and oil dependence. We would want to look at both of those measures simultaneously in the analysis.

Then, also, while incentives and credits and so on do encourage investment, there should also be on the other side, for falling short of targets or goals, fees or penalties; either they have to be big enough that they encourage compliance or maintain compliance for some kind of behavior that is illegal.

Senator THOMAS. Thank you.

Very quickly, Mr. Baxley, how do you make hydrogen?

Mr. BAXLEY. Thank you for that question. Actually, the beauty of hydrogen is, you can make it in so many ways. In fact, in a lot of ways it is much more like electricity than it is like gasoline.

So currently we make it, as I mention, on a large scale from natural gas, but you can also make it from solar, from wind, from biomass, from coal, from nuclear, and that, in fact, is the strength of hydrogen. It is a universal fuel. It is unique in that sense.

Senator THOMAS. What do you mean, make it from wind? What does that mean?

Mr. BAXLEY. Well, make it from wind, meaning you convert wind to hydrogen through the process called electrolysis. Well established. In fact, we are doing it in some of our retail projects. We actually have a device called an electrolyzer mounted on the canopy above the hydrogen dispenser, and we actually make it on-site, converting wind energy off the grid directly to hydrogen. The same with solar.

Senator THOMAS. That is interesting.

Mr. Chairman, Senator Orrin Hatch sends his deep regret that he is not in attendance today. As a long-term close personal friend of Jack Valente, he is present at the funeral this morning.

As many of you know, Senator Hatch is intensely interested in promoting advanced vehicle technologies and would certainly like to be here under any other circumstances. If I could put that in the record, please.

Senator BINGAMAN. We will certainly include that in the record. Senator Salazar?

Senator SALAZAR. Thank you very much. Thank you very much, Chairman Bingaman, for holding this important hearing.

Let me just say, as we move forward at looking at advanced technology for increasing efficiencies and alternative fuels, one of the big challenges that we have is, there are so many ideas. Our big challenge, really, is how is it that we decide which ones we can really support, given the fiscal conditions of the Federal budget today?

There are a group of us, including the Chairman of this committee, Chairman Bingaman, who sponsored legislation last year that we called Set America Free legislation. This year, it is called the DRIVE Act. You may be familiar with it.

Included in there are a number of different incentives that would try to move us to a much higher fuel efficiency and to address many of the objectives which you have testified about in the panel today.

I would like any of you—all of you maybe—starting with you, Mr. Chernoby, to comment on some of those ideas. But one of the ideas we had in Senate bill 339, sponsored by Senator Bingaman, myself, and a number of other Senators, is an idling reduction tax credit.

That is a tax credit that would be given up to \$3,500 for the purchasing of idling reduction technology for heavy-duty trucks. It is technology that Gates Corporation and others have actually been out deploying and are trying to move forward into the market. We use a lot of diesel in those heavy vehicles simply by the amount of time that they spend idling.

Second, plug-in hybrid, electric hybrid, and hydrogen vehicle prizes, a continuation of the 2005 Act, where we had the Freedom prizes in that law.

Third, the Advanced Technology Motor Vehicles Manufacturing credit. What we are doing there is trying to incentivize the national manufacturers to transform their fleet systems over to these new technologies, and so we would have a credit that would be worth 35 percent of eligible investments in research, manufacturing, and engineering.

We would have consumer incentives to purchase plug-in hybrid vehicles. You have referenced those consumer incentives and how they might be enhanced. Tax incentives for private fleets. Reducing the incentives to guzzle gas, which I think, Mr. Eberhard, you referred to. Biofuels tax credits. Production incentives for cellulosic biofuels. So there is a lot in there.

I guess my question to you is, if you were to have the two or three most important things that we could do to move forward with this advanced vehicle technology that you have referenced today,

what would they be? And you have to keep your answers short, since I only have a few minutes.

So why do we not start with you, Mr. Chernoby?

Mr. CHERNOBY. I would say, make sure you conduct a deep dive analysis. If you had a broad range or a technology-neutral incentive, it is likely that there are certain technologies in the near term that are going to see the biggest usage of that incentive, not broadly across the base. And as you go through time, that technology will be kick-started and the next one will kick in, like my partner here.

Senator SALAZAR. So by "diving deeper," you mean by the best efficiency, the more mileage that one gets out of a gallon of gas?

Mr. CHERNOBY. Yes. In terms of number-one availability in the marketplace where, if you put a technology-neutral plan out there, I think you would see things like hybrids and diesels would be the focus in the next couple years. Then after we get those technologies kick-started in the marketplace, naturally the incentive could move to the plug-in hybrid technology, which is probably out in that 3- to 5-year window.

So we would advocate, the technology-neutral approach does have budgetary fiduciary responsibility. You still manage the money, and what it will do is, the market will drive to the place of the greatest penetration, driving the greatest improvement to the environment and energy security. Over time, the market will shift to the next one.

Senator SALAZAR. Thank you.

Mr. Vieau?

Mr. VIEAU. Yes. There is an important part of all these vehicle strategies, whether they use hydrogen, they use fuel cells, they utilize the grid for electricity. All of these advanced strategies utilize batteries. All of them do.

The transition that has been announced by General Motors, and by the industry overall, is a long-term view in which we will have electric motors driving the wheels as opposed to the internal combustion engine. If you do that, you need a battery source. Most of these large energy storage systems cannot deliver the power required to make the wheels go around, so batteries need to be there.

One of the points that we have been trying to stress is that we need to drive a significant amount of research and development of American resources to develop competency here so that we as a Nation have the ability to design and build battery systems for the future. It is going to be here for the next 100 years, so it is a very important point.

Senator SALAZAR. So you would say a major push, then, on advanced technology with batteries?

Mr. VIEAU. Absolutely. And doing it sooner, right now.

Senator SALAZAR. All right.

Mr. Chairman, I know my time is up, but could I have a 30-second response from each of the other witnesses?

Senator BINGAMAN. Yes.

Senator SALAZAR. Mr. Eberhard?

Mr. EBERHARD. I absolutely agree about battery technology. I think that battery production in the United States is equally im-

portant. Today we are getting all of our batteries manufactured in Asia, and that could one day be a big problem for us.

I think that in terms of looking at motivating the industry to move in the correct direction in a technology-neutral way, you should focus on three factors. First is the actual energy consumption per mile of a vehicle in a well-to-wheel way. Second is the actual petroleum consumption—that is to say, domestic or foreign oil consumption—per mile. Third, is the greenhouse gas emissions per mile. These are the things we should be focusing on in the industry to figure out how to reduce all three of those.

Senator SALAZAR. All right.

Dr. McManus?

Dr. MCMANUS. Yes. I would just add to it that rebates or credits are always very popular, but as you said, the Federal budget has limitations. By also adding fees on the other side for those vehicles that are dirty or very oil-dependent, that would not only help shift the market toward cleaner vehicles, but it would also help finance the credits and investments that need to be made.

Senator SALAZAR. Thank you.

Mr. Baxley?

Mr. BAXLEY. Yes. Just let me make a quick comment. First of all, the challenges that you are struggling with as a committee are the same ones we struggle with in Shell, as to which way this is all going. There are no silver bullets. We have not found them.

So my message is, you need to work on pushing the technologies forward, as the other speakers have said. You need to make sure the incentives are there. But picking one winner is difficult to do. There are some common platforms.

The second thing to consider is, you need to think not only about the technology platform of the vehicle, you need to think about, how does it affect the diversification of the feedstock, the fuel you are going to use? That is another element that we worry about, which is, you have a platform, but where is the fuel coming from? So, diversifying your supply and your energy system.

The third thing that you need to worry about then, and perhaps separate from that, is the CO<sub>2</sub> footprint. That is where I got back to, we need to do something about the CO<sub>2</sub> policy.

I think the fourth thing, to me, is you cannot take and say, all right, it is all batteries now, because the message that will come out from your leadership around that is—never mind anything else in the longer term or any other options—we have picked this option.

That is what you want to make sure you are careful to avoid, because there are near-term solutions or long-term solutions, and the market will help decide those. You need to help facilitate that. So I agree that there is a lot of value in batteries. I just do not want the message to come back that, hey, let us just do batteries and all the other stuff is going to wait for later.

Senator SALAZAR. Thank you, Mr. Baxley.

Thank you, Mr. Chairman, for allowing me to go over my time.

Senator BINGAMAN. Sure.

Let me follow up on this battery issue. Very broadly speaking, we can try to provide tax incentives for consumers to purchase more fuel-efficient vehicles, less-emitting vehicles, less-petroleum-



using vehicles. Then the other thing we can do through the tax code is to support the creation of some of these technologies, the manufacturers of some of these technologies here in this country.

What is the best incentive for us to use to do that? Is it an investment tax credit if you are willing to put in an advanced battery production facility here? Is it something more generic than that? What is the right public policy to try to encourage the development of some of these advanced technology manufacturing facilities in this country?

Any of you have thoughts? I know you have quite a bit in your testimony about that, Mr. Eberhard, but you do not seem to come down on a specific recommendation. But if you had any thoughts, I would be anxious to hear them.

Mr. EBERHARD. I think that the manufacturing tax credits and the like are the right approach. I think that, one way or another, we need to encourage domestic manufacture of the high-volume of commodity cells. I think that as we move into the future and think about other forms of energy, energy storage is going to be a key issue for us.

Right now, all of the batteries in the world, pretty much, are made in Asia—Japan, Korea, and coming up very, very fast is China. I think very soon, most batteries in the world will be made in China. This is not a good position to be in if we are making all of our transportation dependent on that. I think, one way or another, we want that manufacturing here in the U.S.

Senator BINGAMAN. Mr. Vieau, the battery cells that you use are made in Asia, as I understand it.

Mr. VIEAU. That is correct.

Senator BINGAMAN. What do we need to do to get to a situation where we could make those here?

Mr. VIEAU. The batteries themselves, in an automated fashion, have a tremendous capital intensity to them. We have taken advantage of the Chinese market to be able to take advantage of some low-cost labor and low-cost overhead to be able to create batteries that can compete on a global scale and minimize the capital outlay.

The amount of money to produce 60,000 to 100,000 electric vehicles, for a battery factory to provide that, is a \$100 to \$200 million capital outlay. Start-up businesses always have limited access to capital. To get tax credits there is certainly some benefit, but actually having grants or having matching grants, we find funding from private sources and funding from government to incentivize and put it in here.

The challenge for us in this particular case, we would much prefer to make batteries here, but if we make batteries that are not cost-effective it will retard the process of the integration of this into the vehicle. We need to make batteries that are cost-effective.

We need to lower the cost of these battery systems so that, long term, we do not need tax incentives for customers to be interested in buying these vehicles. We need to cut those costs.

So, we have a two-edged sword here. We want to reduce the cost of the batteries to make them more available to users on a cost-effective basis, but we want to provide jobs in America. I think there may be a mix of activities which will take advantage of what

we do best in North America, and what is done in the lowest-cost parts of the world to make this a real solution.

Senator BINGAMAN. I guess I would wonder, conceivably you could set up a grant program that anybody who is willing to establish a manufacturing facility for commodity cells for advanced batteries gets a grant. There again, we would be very much trying to pick a specific technology that we, in our ultimate wisdom here in Congress, have decided is the answer.

Is there a more generic solution to this that will allow us to—the concern obviously is, we do not want to replace the importation of enormous amounts of oil with the importation of enormous amounts of other manufactured items that we are using to avoid the use of oil. I do not know exactly how we get from here to there. Yes, Mr. Vieau?

Mr. VIEAU. Well, the Koreans are a good example of a market that did not have an advanced battery technology capability, and not too long ago, within the last 10 years, they made a decision and they have invested, I think, over \$700 million to try to create a capability. They did it through major manufacturing corporations, and they have become the number two, and leading towards the number one, maker of advanced battery technology.

So I think we have to make a decision of whether this is really important for us, and if it is important for us as a country, we need to get proactive and bullish about putting the money up there to get it done. And, certainly we have the technology.

Senator BINGAMAN. And the \$700 million the Koreans invested, did they invest that in manufacturing facilities, in research and development?

Mr. VIEAU. All of the above.

Senator BINGAMAN. They partnered with some of their cabals and then went ahead with it, is that what they did?

Mr. VIEAU. Yes. They had competing interests in manufacturing, competing companies. There was money invested both in research and development, and also in manufacturing.

Senator BINGAMAN. All right.

Senator Thomas?

Senator THOMAS. All right. Thank you.

Given the long distances, Mr. Chernoby, that people live—I grew up in Wapatee, WY, 40 miles from town—how are we going to use batteries for people who live out in the rural areas?

Mr. CHERNOBY. Well, if you think about, obviously, the broad portfolio of technologies, that is what we are focused on at DaimlerChrysler. We think in the end—and somebody else commented on the panel—there is probably not going to be one winner here.

If you think about the rural customer who drives primarily highway, high speed, 40 to 100 miles, or maybe you go on vacation, you take a long trip on a highway, the diesel technology probably is a superior choice to a hybrid, which provides very little benefit and actually can be a detriment on the highway.

Now, when we move to the eventuality of the plug-in hybrid, could part of that trip be on electricity, like Mr. Vieau mentioned? Absolutely. It will provide a benefit as long as we make sure the

upstream energy source is clean that is actually going into that battery through the plug.

So there is going to be some potential with batteries. You also have to remember, batteries are not only a hybrid play. If we get to the eventual point of a hydrogen economy, a hydrogen fuel cell car, again, is electrically driven and requires battery storage.

So, batteries play across many of these technologies and are here to stay. We are convinced, battery technology will be a very important part of our future no matter where this portfolio might shift and go.

Senator THOMAS. All right.

Mr. Eberhard, very briefly, in battery research, what is the next major breakthrough that you want to achieve, and what will be the impact, moving forward, on that?

Mr. EBERHARD. Today we can build a car that has a 200-mile range right now without even any major breakthroughs. Lithium ion batteries have been increasing in capacity historically by 8 percent per year. That is a doubling every 10 years. That has been historically true for the last 20 years. We see every indication of that happening, once again, for the next 10 years. So 10 years is not—

Senator THOMAS. So this range in mileage would be a breakthrough that you would look for?

Mr. EBERHARD. Range in mileage. But the point is, the majority of the improvements that have come in this technology have not come through major breakthroughs, although there have been some that have come along. It has come, rather, through the year-by-year improvement in the factories. That is why it is so important that we bring this technology here to the U.S. It is like chip fabrication.

Senator THOMAS. All right. Thank you.

Dr. McManus, if you were a politician, would you favor the fee to cause people to do these things?

Dr. MCMANUS. Well, I might not call it a fee. But, yes, it is an effective way to get change in behavior. We have taxes that we pay. There is the gas guzzler tax. I mean, one of the things that I think might help is, if we are talking about investment, if the fees are directly tied to investment. Then instead of going into the general fund, they would be earmarked for investment, that would be a little more palatable.

Senator THOMAS. I hope we can do most of it by incentives.

Mr. Baxley, I know you and your company look a lot into this whole thing. What would you say would be the breakdown of usage over a period of 25 years? Where will we be in terms of feedstock? What do you see we will be using?

Mr. BAXLEY. That is difficult for me to really forecast where we would be there. I would go back to saying that we continue to see that, largely, the world and the United States will be dependent on petroleum products through at least the rest of this century.

But increasingly, as we grow, as our economy grows, as our usage grows, the energy usage, as I said, is going to probably double between now and 2050. That means that we cannot be complacent.

Although we are going to have continued growth in our use of petroleum and in the need for petroleum and petroleum substitutes—

like gas-to-liquids technology, like clean diesels from bio-sources—we need to find other ways to solve the energy situation. Those are the areas we are working on.

But as I said, when we look out between now and 2050, we see a large element of renewable energy. We see a large element of biofuels in the mix. But in these scenarios we do depend on so many assumptions, and it is really difficult to nail that down. That is why we pursue a number of options, prudently. We think hydrogen is among those.

Biofuels is an important element of that. The timing of when those exactly emerge is very difficult to predict. It depends on technology, it depends on societal factors, it depends on political factors.

Senator THOMAS. Right. I think the real challenge we all have is, we know there are some changes coming in the future, significant changes. We know, on the other hand, that there are demands that are right there now. These significant changes are a while off.

So I hope we get a balance between looking at the alternatives out there in the future and how we are going to meet our needs in the near future, because we have 10 years of challenge before us before we make huge changes as to how we will be able to continue. So, like coal to oil and coal to electricity, using that fuel is certainly an interesting one.

Mr. BAXLEY. Senator Thomas, may I reiterate just one more point, though? And that is that I really do feel that, in this situation where there is so much complexity about what technology might win, the issues of diversification and energy security, the issues of CO<sub>2</sub>, those are all important factors, and they are all complicating factors. It is much, much more complicated than it used to be.

My guidance is to make sure you take advantage of the marketplace as much as possible. The innovation in the United States, the innovation of small businesses in the United States—take advantage of that. Let them go after that. Let them solve the problems. Consumers will make those choices about the value of import dependency and CO<sub>2</sub>.

Senator THOMAS. Thank you. I agree with you.

Senator BINGAMAN. Senator Salazar?

Senator SALAZAR. Just a comment on that comment, Mr. Baxley. While, yes, letting consumers make those choices, at the end of the day, one of the major drivers that brings us here to the formation of this committee and the legislation before the Energy Committee—and we are trying to do in the agriculture bill—really has to do with the driver of national security.

Sometimes when you look at what we have been paying for gasoline, given \$20 a barrel oil, probably the last 30 years has not placed the United States in the best national security situation that we would have been if we had been much more aggressive in terms of trying to get rid of the over-addiction on oil. So, just a quick comment.

A couple of questions. Mr. Chernoby, first, for you. You talk about biodiesel, or diesel, as one of the advanced technologies that we really ought to embrace and incentivize as one of those things that has happened. As we look at the agenda of alternative fuels

and efficiency, one of the major limitations that we have heard from witnesses in other committee hearings we have had has been with respect to the biodiesel aspect of a renewable fuels portfolio, whatever that might be. There are great limits on that.

So can you comment on, how much of our energy should we put into the expansion into biodiesel, given the limitations as I understand them, relative to the amount we might be able to generate from renewable resources?

Mr. CHERNOBY. Well, in the long term, that is why we are focused on all these joint programs with the Department of Energy, as well as the fuel providers and energy providers, to try to understand, what are the different types of biomass that we can be using to produce biodiesel?

The biomass we are using today—grain, corn, et cetera—may not be the biomass of the future, which would open up extra capacity in terms of how much can be processed into the biofuels we need to reach our Nation's goals.

Senator SALAZAR. Let me just follow up on that. Right now, I know we create diesel from petroleum. We do it out of soy. We do it out of spent grease and oils from restaurants. There are a couple other feedstocks that are on the line. How promising are those feedstocks in terms of expanding the diversity of feedstocks used for biodiesel?

Mr. CHERNOBY. Well, based on the very early work of the Department of Energy, I would say very promising. But we still have a couple years of research, I think, to pore through to really know for sure.

Senator SALAZAR. All right.

Mr. Vieau, on the battery technology, following up on Chairman Bingaman's question to you, South Korea decided they were going to be able to do this by investing in a whole host of things. The number I think you used was \$700 million into a new battery initiative.

Mr. VIEAU. That is correct.

Senator SALAZAR. Is that something we should be doing here in Congress, and is that the amount of money that we would be talking about in terms of manufacturer investment tax credits, as well as research and development, to try to get this manufacturing base created here in the United States that creates jobs here in the United States? What is the magnitude of what you think we ought to be doing to try to create this industry here in the U.S.?

Mr. VIEAU. I think the pool-based tax incentives for vehicles have been proven to work with the hybrid vehicle. I think it should be done for electric vehicles and plug-in hybrid vehicles. The numbers there in the range of \$3 to \$5 billion over 7 years are numbers that have been talked about, and I think would be significant.

I think, in the area of battery development—and I am not talking just about the cells, I am talking about the materials that are used in it. We have companies all over America that have great competencies in designing and developing the fundamental chemistries and the ingredients that go in batteries. We need to emphasize that, as well as research and development activity in the range of \$300 to \$500 million over 5 years in additional spending.

For manufacturing incentive, I think we need to put in there—

Senator SALAZAR. That was \$300 to \$500 million?

Mr. VIEAU. \$300 to \$500 million dollars in research activities for batteries and battery-related materials that will advance that. There are a couple of objectives of this. One is a significant reduction in the cost for a given energy. The other one is dramatic improvements in the energy and the efficiency of these cells, which will drive Mr. Eberhard's goals.

The last one is the manufacturing base, which I think needs in the range of \$300 to \$500 million to stimulate manufacturing activity here beyond what would naturally take place to give us a jumpstart on this activity.

I do tend to agree with my colleague, I think, in the sense that we do not like, as citizens in this country, to have the government paying for things. We want manufacturing companies to build this and we want consumers to create demand, and we want the natural competitive forces to take place.

But we are 15 to 20 years behind right now as a Nation. The single-largest and most successful advanced battery technology in the last 15 years has occurred by A123 Systems that had 5 people 5 years ago. We do not have a large, established lithium ion advanced battery technology capability in this country today. If we want to have it, we are going to have to step up and do it.

Senator SALAZAR. And is that because we have not paid the same amount of attention to this technology and the investment into the development of this technology as South Korea or any other countries that have done so?

Mr. VIEAU. That is correct. The Japanese, I believe, have done so. They led the way in the early 1990s. Quite a bit of the technology that was employed then had its roots in the national labs in the U.S. in the 1980s. So, it was not like we are in a vacuum of technology, but we did not capitalize on it.

I am not sure why the manufacturing organizations in place at the time did not capitalize on it. But the Japanese certainly did, and they did a great job of it, and followed by that, the Koreans. Now the Chinese are taking advantage of that.

Senator SALAZAR. Thank you, Mr. Chairman.

Senator BINGAMAN. Let me just follow up on that for a minute, Mr. Vieau. If history is any guide, would we not expect the Japanese to come to market with plug-in hybrid vehicles here in the very near future, I mean, just as they came to market with hybrid electric vehicles some time ago? What does that do to the marketplace, as you see it, for your technology and for the opportunity for American manufacturers?

Mr. VIEAU. Well, there have been announcements by some of the leading Japanese automakers that they will be producing plug-in hybrid vehicles in the relatively near future, within the next few years. Those announcements have been made, so we do expect them to show up here.

I think it is confirmation that this is heading in the right direction. They have successfully deployed hybrid vehicles on a global scale, and they are making big investments in plug-in hybrid vehicles because they see the benefit that can be brought from those vehicles.

Senator BINGAMAN. All right.

Senator Salazar, did you have more questions? If you do, go right ahead.

Senator SALAZAR. Thank you very much, Chairman Bingaman. I did have a couple more questions.

Mr. Eberhard, in your written testimony you talked about your company that has been in formation over 4 years, and you talked about the possibility of moving forward at the manufacturing plant in New Mexico, I think, by 2009.

You referred to the fact that now the Roadster, I think, that you have parked out here is probably marketed at \$90,000 or \$100,000. But this new car that you will manufacture in 2009 in New Mexico will be a \$50,000 family type of passenger vehicle.

Assuming that you get there with that vision in 2009, 2010, what is it that the U.S. Senate could do the most of to help you, and companies similarly situated, move forward with the expansion of your market and being able to move forward with that vision?

Mr. EBERHARD. I think the single biggest thing you can do for me right now is to fund and support the Department of Energy loan guarantee program. I think this is a very big piece for us that would help us move forward more quickly. I think we are on a trajectory to be a large-volume manufacturer as quickly as we can, which is still a rather slow process and rather capital-intensive.

Senator SALAZAR. When you talk about large volume, what kind of manufacturing do you contemplate?

Mr. EBERHARD. The Roadster, our first car, is designed to be built up to a few thousand cars per year only. The Whitestar, the car we will build in New Mexico, the plant is designed to build in the tens of thousands of cars per year, which is still a small step, but it is a giant step forward for us. The third car after that, we contemplate a car in the hundred thousand cars-per-year capacity, which will require further capital.

Senator SALAZAR. All right.

Have you chosen your location in New Mexico?

Mr. EBERHARD. Yes, we have. It is just outside of Albuquerque.

Senator SALAZAR. All right.

And so would your testimony be that the loan guarantees that are currently available through EPAct are good enough or that we need to change those in a new bill?

Mr. EBERHARD. I think that they are good enough, so long as they get properly funded. I believe that those are already helpful to us.

Senator SALAZAR. All right.

Maybe you can follow up on that later on if you want.

Mr. EBERHARD. I will follow up.

Senator SALAZAR. Mr. Baxley, I did not mean to be overly offensive to you and Shell. I value what Shell does in my State of Colorado, and I value what they are trying to do with oil shale, and also what you have done to try to embrace a broad array of menu items on this energy portfolio that we are trying to move forward with, so I appreciate that very much.

I want to ask you a question about hydrogen. You said in your testimony that hydrogen is common, available lots of different places within 60 miles of most Americans, and that you are moving

forward with creating markets not only here in the U.S., but in other places.

Yet, when you talk about the time frame for the point where you think we will be able to move forward with hydrogen as a real alternative for powering our vehicles, you talked about the 2015 to 2025 time frame. Is there any way to expedite that time frame, and how do you arrive at that time frame in the first place?

Mr. BAXLEY. All right. That is a great question. First of all, let me just, one more time, put in perspective that the amount of hydrogen we make in the United States now that is made in our refineries and our chemical plants, if you took that hydrogen that we have been making for over 50 years now, have great experience with it, and you converted it to fuel and you could get it to gasoline stations fairly easily, that is actually enough hydrogen that, if you took every passenger car in the United States and made it a fuel cell vehicle, which makes it at least twice as efficient as current gasoline engines, we already have enough hydrogen manufactured in this country to power all those vehicles.

There is a lot of hydrogen out there. We know how to manufacture it. We know how to manufacture it economically. The challenge is getting it from the points of manufacturing to the retail environment. So, that really is one challenge, putting the hydrogen at retail stations. So, adding hydrogen to an existing, usually already pretty crowded retail station—

Senator SALAZAR. So, Mr. Baxley, then it is not a question of a technology barrier that we have to break though here with respect to at least the manufacturing and availability of hydrogen.

Mr. BAXLEY. Correct.

Senator SALAZAR. We have the hydrogen.

Mr. BAXLEY. Correct.

Senator SALAZAR. So the barrier here is the deployment of hydrogen and the infrastructure to be able to have hydrogen available to those who would be driving hydrogen-powered vehicles. Is that the barrier?

Mr. BAXLEY. That is one of the major factors. And so one of the biggest factors is really getting out and making sure that the permitting process for this new fuel is put in place in the municipalities. We are working on that around the country, but it needs higher level coordination. It needs more exposure.

It needs more funding to make sure that all the standards that need to be put in place around hydrogen are put in place so it makes it easier to do, and quicker, and we can do thousands of stations, instead of doing one at a time now. The one in Washington, here, took us over 2 years just to get through all those processes.

Senator SALAZAR. Why is it so difficult to go through that permitting process at the local level? Is it that there is a lack of understanding of hydrogen or is it that it is so new, that people just do not understand, or are there inherent dangers with respect to hydrogen and filling stations?

Mr. BAXLEY. No. It is just that the standards organizations have not issued national standards for hydrogen deployment at retail stations. There are local standards, there are other standards.

Senator SALAZAR. Is there a role there that the U.S. Congress might be able to play if hydrogen is going to be a fuel that is going



to be available around the country? Is there a role that we could play here in the U.S. Congress in terms of some national standards?

Mr. BAXLEY. Yes. And that is one of the five points I mentioned. In fact, I think it was first or second of the points I mentioned, which was making sure that the activities that are going on within the different agencies, Department of Transportation, Department of Energy, to work on standards, to fund that activity and to staff that activity, with industry, make sure those are fully funded. That is an important thing to move forward.

Also, we found it extremely beneficial for government to express leadership around commitment to hydrogen. California is a great example, where the Governor, mayors, and so forth say, we want to see hydrogen fuel as one of the options, and that really helps the local politicians say, oh, all right, this is something we really should spend time making sure happens.

Senator SALAZAR. All right. Let me assume we work through that permitting barrier and that we have a more receptive local government and more expedited processing of permit applications for filling stations.

Then what are the other barriers that would keep us from moving faster? I mean, 2015. I had this conversation with Senator Bingaman. But I do not know that we have that much time. 2015 still seems to me to be a long way away.

Mr. BAXLEY. It may seem that way to you. It seems like very soon to me, given all the things that really should be put in place to make that happen. But the second challenge, the second thing that slows things down a bit, is consumer and community acceptance, just unfamiliarity with a new technology like hydrogen.

So there is a lot of education that we do at Shell and other energy companies, the auto companies do, local governments, to go into communities and spend a lot of time with them, telling them about the benefits of hydrogen.

Senator SALAZAR. All right. So let us assume we can conquer the education barrier. What is the other barrier?

Mr. BAXLEY. And the third thing is very simple: the availability of the fuel cell vehicles. That is the real challenge. That is what drives it.

Senator SALAZAR. That is next.

Mr. BAXLEY. Yes. That is what drives the 2015 to 2025 time frame, because that is when we practically think, one, we can be there. We know how to manufacture it. We can put things in place, but it will take a while to get the standards in place, it will take a while to get the community accepting it, and we are working through that in what we call the Lighthouse program, and our focused mini-networks I mentioned between now and 2015.

Senator SALAZAR. Well, what could we do to advance the availability of these fuel cell vehicles? I mean, if that is the ultimate barrier, what is it that we can do in the Congress?

Mr. BAXLEY. Well, I would encourage you to continue funding the progressive technologies, like fuel cell vehicles, like plug-in hybrids, like the technology path forward. The batteries are a critical part of fuel cells. But continue to fund the work by auto companies, by small businesses around the technologies needed to advance to

these next platforms, whether they are fuel cell vehicles, whether they are fuel cell power plants, whether there are hydrogen sensors that are needed to control systems, or whatever is needed to make those vehicles a reality.

There is a whole host of things. It is not just one thing to single out, but there is a whole suite of advanced technologies where companies need to have a way to at least get a tax benefit, or a benefit, policy benefit, around investing in those high-risk areas.

Senator SALAZAR. Thank you very much, Mr. Baxley. Thanks to the panel.

Mr. Chairman, thank you for your patience. It has been a great hearing.

Senator BINGAMAN. Good. Well, thank you very much. Thank you all.

I understand we have a couple of vehicles outside that people can look at. DaimlerChrysler has a vehicle. I believe A123 has a vehicle we can look at. Thank you very much. I know Mr. Eberhard has had his Roadster here that I had a chance to ride in last week. Those are out by the Russell building, I believe, across the street. So, at any rate, we will try to go down and see those.

But thank you again for being here. I think it has been a useful hearing.

[Whereupon, at 11:32 a.m., the hearing was concluded.]

# A P P E N D I X

## ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

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Testimony for the U.S. Senate Committee on Finance  
Subcommittee on Energy, Natural Resources and Infrastructure  
Phillip Baxley  
President, Shell Hydrogen LLC  
May 1, 2007

Good morning Mr. Chairman and members of the committee. Thank you for the invitation to testify today. I am Phillip Baxley, President of Shell Hydrogen LLC, with responsibility for Shell's hydrogen business activities in North America. Additionally, I chair the National Hydrogen Association, whose membership includes energy providers, universities, automakers and many industries in the growing hydrogen business.

My testimony today will focus on Shell's progress in developing hydrogen as a transportation fuel and the infrastructure required for its growth.

First, let me begin with a description of how Shell sees hydrogen fitting into its energy portfolio. Shell Hydrogen is part of the larger Shell Renewables, Hydrogen, CO2 and Power Group within Royal Dutch Shell. Shell believes that fossil fuels will continue to be the most affordable and accessible energy source, fueling economic growth and powering our lives for decades to come. It has been estimated that with current rates of growth, the global energy demand may double by 2050. It is also estimated that alternative energies can provide approximately 30 percent of that energy mix. At Shell, we see our ability to manage CO2 emissions to be important to the delivery of energy products and fundamental to future growth.

Hydrogen can be an important part of that path forward. Hydrogen should be considered part of a broad energy portfolio Shell is developing to meet the energy challenge before us all.

Before I go further into hydrogen, I would like to mention that on a global basis, Shell is also investing in wind energy, thin-film solar energy, second-generation biofuels and synthetic fuels from coal and gas. We are a major importer of liquefied natural gas. We continue to be a world leader in oil and gas exploration.

Shell is a leader in the hydrogen market. More than 50 million tons of hydrogen are produced, transported and used by a wide variety of industries around the world each year. Within the industry, hydrogen is used to produce cleaner and better fuels. That is why most of the hydrogen available today is used to produce clean gasoline, and why we will use even more of it as we develop more carbon-intensive fuels like oil shale and tar sands. According to our internal analysis, hydrogen is so common that most Americans live within 60 miles of a hydrogen production facility. So, in answer to the perennial question "When is the hydrogen economy coming?" I would say that in some respects, it is already here.

Shell Hydrogen is building hydrogen infrastructure in three key markets – the United States, Europe and Asia. We introduced Tokyo's first hydrogen refueling station; opened the first combined hydrogen and gasoline station in Washington, D.C. and provided funding and project management support for the first hydrogen refueling stations in Luxembourg and Amsterdam. In the United States, we are working to introduce hydrogen-fueling stations in the Los Angeles and New York City metro areas. We are working with key automakers to support this endeavor.

Our experience shows us that we can supply and deliver hydrogen today – safely and reliably. Our aim now is to move quickly to the next level – from single stations to urban mini-networks, with market demand driving the consumer interest. We will continue to coordinate the availability of our hydrogen stations with the automakers' rollout of the first small-scale mass production of hydrogen vehicles, within the 2015 – 2025 timeframe. If they can be ready, we can be ready. Let me identify two challenges I see in rolling out a hydrogen retail network. First, station siting and permitting. We are talking about building stations in dense, urban areas where land is scarce and at a premium. We are also talking about getting permits for a new form of energy, a process that's proving to take much longer than permits for gasoline stations. Second, equipment for hydrogen stations can be fairly expensive. The storage and compression equipment is particularly expensive. The cost of this equipment may slow the deployment of hydrogen stations in some areas.

We have a big jump ahead of us. We dream about and talk about a future when cars are powered by hydrogen and we are almost ready to make that leap. We can do it in the next decade. But in order for this transition to be successful, it must be carefully coordinated. Governments, energy companies like Shell and automakers must work closely together to minimize the financial risk and ensure a positive experience for consumers.

Shell believes any rollout of a hydrogen retail network should be focused on regions of the country where the cars will be deployed. That is why we are now focused on New York and California. We are working with the California Fuel Cell Partnership and automakers to coordinate a California rollout. We are building a similar network in New York, which appears to be moving along a similar path as California. We believe that a massive rollout of fuel cell vehicles (FCVs) with the proper hydrogen infrastructure is an immense task, which is too large for any single industry. Again, Shell believes that the successful introduction of these new vehicles and new fuel depends on coordination between government, energy companies and automakers in these formative stages.

In order to make hydrogen more available and more affordable, Shell is looking for new feedstocks. Right now, most of the hydrogen that is produced for industrial applications comes from steam reformation of natural gas. Given its tight supply and volatile prices, natural gas can be an expensive source for making hydrogen. Hydrogen from natural gas also has a carbon component. In a world increasingly sensitive to carbon emissions, we are looking for ways to either produce hydrogen with less carbon or store the carbon associated with hydrogen production, as well as secure feedstocks readily available in this country.

We are investing in novel technologies to produce “green” hydrogen. We are working to form alliances and joint ventures to develop technologies that will produce hydrogen from sources like bioethanol and solar energy.

Shell is also exploring the production of hydrogen from other hydrocarbons besides natural gas. However, these processes would require the successful capture of CO<sub>2</sub> on a large scale. Shell is developing technologies for carbon capture and storage with several large-scale projects under development worldwide.

Energy companies and automakers are working hard to make hydrogen transportation a reality in the next decade. But we need the federal government's help. We need to help promote education of the American consumers about hydrogen transportation; we need the federal government to help set an example through vehicle fleets and other applications; and we need your help in preparing for and coordinating the rollout. Let me outline five ways I think the government can engage to make the hydrogen economy a bigger reality than it is today.

- Public acceptance does not happen overnight and an enhanced education and outreach program directed at students, consumers, and permitting authorities will aid in the challenges of siting and permitting stations.
- Harmonize station permitting processes at the state and local level to ensure that permitting officials/processes adhere to a common baseline to eliminate interpretation and variability (coordinate federal, state & local hydrogen permitting processes)
- Early adoption by large governmental organizations of fuel cell-based portable and backup power systems. As well as fuel cell vehicles for fleet applications.
- Provide support to municipalities to lease or purchase hydrogen-fueled auto and bus fleets.
- Cooperate with automakers and hydrogen suppliers to develop ways to coordinate vehicle and infrastructure rollout, e.g. in the form of public private partnerships.

This is an exciting time to be in the energy business. And it is an exciting time to be in the transportation business. We are at a crossroads very similar to where this country stood a century ago when cars replaced the horse and buggy. We are shaping the future with our choices. If we do this right, our children and our grandchildren may one day look back in wonder at a time when people thought only gasoline and diesel could power their cars. I look forward to working with you in building the hydrogen economy. Thank you for allowing me to speak to you today. I will be happy to answer any questions you may have.

**Statement of Mark M. Chernoby  
Vice President – Advanced Vehicle Engineering  
DaimlerChrysler Corporation**

**Before The Subcommittee on Energy, Natural Resources  
and Infrastructure  
Committee on Finance  
U.S. Senate**

**May 1, 2007**

Mr. Chairman and Members of the Committee, thank you for inviting me to testify before you today on the subject of Advanced Technology Vehicles. DaimlerChrysler is committed to developing new, advanced technologies that reduce the effects our products have on energy consumption, climate change, and the environment in general.

We believe it is not prudent for a vehicle manufacturer to rely too heavily on a single technology to address our nation's petroleum consumption and greenhouse gas concerns. Therefore, we are engaged in developing and producing technologies that will address these issues in the near-, mid-, and long-term. We continue to improve the fuel efficiency of our gasoline powered engines and our new 4-cylinder World Engine and announcement in April of a new, more fuel-efficient V-6 engine are evidence of that. We are in joint development with GM and BMW to develop advanced hybrid systems and our first products, the Dodge Durango and Chrysler Aspen hybrids, will be on sale in 2008. Our Orion bus subsidiary has sold, or has on order, more than 1,400 diesel-hybrid buses to transit authorities in the U.S. and Canada. We also are the only manufacturer to have a fleet of plug-in hybrids in service today and we have more than 100 fuel cell vehicles in operation around the world. While I would be pleased to discuss these important initiatives, I would like to focus my remaining remarks this morning on advanced, clean diesel technology.

DaimlerChrysler is the world leader in this technology. This leadership is demonstrated through a broad range of diesel-powered vehicles—from passenger cars to light duty trucks and from school and transit buses to truck tractors. In addition, we are actively contributing to the expansion of the biodiesel fuel industry, including processing, distribution infrastructure, and fuel standards. While DaimlerChrysler is best known for its Chrysler Group and Mercedes brands of light duty vehicles, we are also the world's largest manufacturer of commercial vehicles, nearly all of which are diesel-powered. In addition to owning Freightliner Corporation, the largest U.S. truck manufacturer, we own Detroit Diesel, a major supplier of heavy duty diesel engines.

Our worldwide experience with diesels has led us to conclude that they are an important addition to our product portfolio that will help all of us meet our common goals for energy security and reducing the effects of greenhouse gases on the environment. Thus, for 2007, we offer seven light duty, clean diesel offerings. They are: the Jeep Grand Cherokee; the Dodge Ram heavy duty pick-up and medium duty cab/chassis

trucks; the Mercedes-Benz E, M, R and GL classes; and the Dodge Sprinter van. DaimlerChrysler's Chrysler Group is the only manufacturer that fills its diesel-powered vehicles with B5 biodiesel fuel in its U.S. assembly plants. We started this policy several years ago when we introduced the Jeep Liberty diesel and continue it today with the Jeep Grand Cherokee and Dodge Ram pickup. DaimlerChrysler approves the use of B5 for all U.S. available diesel-powered models and selectively approves the use of B20 in the Ram heavy duty pick-up and medium duty cab/chassis trucks. The ability of diesels to use biofuels further enhances their ability to reduce petroleum consumption and greenhouse gas emissions.

Why diesels? A diesel engine provides superior fuel efficiency in a highway driving environment when compared to advanced gasoline or gasoline hybrid powertrains. In Europe, more than 50 percent of our light duty fleet is powered by diesels. In fact, diesels account for roughly half of all engines in Europe. The European consumer values diesel's improvement in fuel efficiency, performance, and associated reduction in CO2 emissions. In the U.S., however, the diesel share is less than 5 percent.

In addition to our worldwide experience with diesels, we want to demonstrate to the American consumer that these are not the diesels known by our parents and grandparents. Vehicles powered by today's advanced, clean diesel engines are vastly superior to the preceding generation of diesel-powered vehicles, which created the lingering consumer perception that diesel-powered vehicles are noisy, smoky, and generally customer-unfriendly. Today's diesel-powered vehicles are clean, quiet, energy-efficient, powerful, and exceed customer expectations for hauling, towing and general utility.

In terms of U.S. energy objectives, diesel use can be a key part of a strategy to reduce our reliance on foreign oil. Today's advanced technology clean diesels achieve 20 to 40 percent better fuel economy than an equivalent gasoline engine. And the lifetime fuel savings are substantial. For example, based on data from EPA's 2007 Fuel Economy Guide, a diesel Grand Cherokee will use 418 fewer gallons of fuel each year than the gasoline-powered Grand Cherokee. This fuel savings is nearly three times that of the hybrid Honda Civic—which would save only 154 gallons of fuel per year compared to the gasoline-only Civic.

And unlike the diesels of 25 years ago, today's advanced technology diesel engines are clean. Through engineering advancements that include exhaust-gas recirculation with electrically controlled valves, our new diesels can optimize the combustion process with the aim of further reducing fuel consumption and exhaust emissions. Our 2007 diesel lineup meets current EPA emissions standards by applying various combinations of advanced combustion control and exhaust aftertreatment technologies including DaimlerChrysler's trademark BLUETEC technology.

With all these benefits, one may wonder why we have not seen more significant penetration of diesels in the U.S. market. Several factors have influenced the consumer's decision on diesel-powered vehicle purchases. First, there are price

premiums on the diesel engine option. An advanced technology diesel engine costs several thousand dollars more than an equivalent gasoline engine, and we can not fully charge the consumer for this extra cost. In addition, diesel fuel is not as widely available as gasoline and it often costs more.

A further reason why diesel has not significantly penetrated the U.S. passenger and light-truck market is the lack of a consumer tax credit incentive. As part of the Energy Policy Act of 2005, Congress enacted the section 30B tax credit for purchases of advanced technology vehicles. The credit has been pivotal in establishing consumer acceptance of hybrid passenger cars and we believe it will be helpful in the future in encouraging more hybrid light trucks. To date, however, the section 30B tax credits have not helped to promote clean-diesel technologies.

The reason is that the section 30B rules require "lean burn" vehicles, such as diesels, to meet more stringent emissions standards than EPA currently requires. In short, 30B requires meeting emission standards that don't take effect for another two years in order to qualify for consumer tax credits. Because of the different stages of technology development, no passenger car or light truck diesel vehicle offered today meets these emissions requirements.

New technologies such as BLUETEC will help DaimlerChrysler's diesel passenger cars and light trucks meet the EPA emissions standards on schedule, by 2009. In the meantime, in 2007 and 2008, we will continue producing "early entrant" diesels that we hope will establish a marketplace foothold for deployment of these new technologies in a broad array of vehicles.

To help foster clean diesel, which is one of the goals of the 2005 legislation, DaimlerChrysler would urge the Committee to consider modifications to the section 30B tax credit that would encourage pre-2009 diesel purchases. For example, we strongly support legislation (S. 1055) introduced by Senator Biden that would eliminate the special emissions requirements under section 30B for lean burn vehicles. Enactment of this legislation would be a small – in terms of budgetary impact – but important step in Congress's pursuit of a multifaceted U.S. advanced technology vehicle strategy.

I also would note that introduction of diesel passenger vehicles and light trucks would establish an altogether new market for biodiesel and renewable diesel. Thus, not only can we reduce our reliance on foreign oil by encouraging diesel, we also can help grow the marketplace for alternative diesel fuels whose production Congress is trying to encourage.

I appreciate the opportunity to testify before you today.



**TESTIMONY OF  
MARTIN EBERHARD  
CEO AND COFOUNDER  
TESLA MOTORS INC.**

**BEFORE THE  
SENATE FINANCE COMMITTEE  
MAY 1, 2007**

Good morning, Chairman Bingaman, Ranking Member Thomas, and Members of the Committee. Thank you for the opportunity to testify about electric vehicles and battery technologies.

The efforts of this Committee properly reflect our country's renewed emphasis on addressing global climate change and dependence on oil from nations that do not always have our best interests in mind.

These concerns are my own top priorities and are the reason that I founded Tesla Motors. Four years ago, I had no bias towards electric cars or any other technology – I set out from an engineer's perspective to understand which technologies could best help break America's dependence on oil. After considerable research, I came to the conclusion that electric cars are by far the most efficient transportation technology – even when the electricity to power them is produced from coal; much more so with cleaner sources. Electric cars have the added advantage of being the only kind of car that breaks the tradeoff between performance and efficiency.

To put this in perspective, allow me a brief commercial to describe Tesla's first model, the Tesla Roadster. The Roadster is a great looking two-seat convertible designed to beat a gasoline sports car like a Porsche or a Ferrari in a head-to-head showdown, yet with twice the energy efficiency of a Prius. It is a great sports car without compromises:

- Breathtaking 0 to 60 acceleration in 4 seconds
- 135 mpg equivalent, per the conversion rate used by the EPA
- More than 200 mile driving range
- Fully DOT-compliant: crash tested, with airbags, crash structures, etc.

In short, the Tesla Roadster is the first electric car that people want to own because it is a great car. But at \$92,000, one could reasonably ask whether such a car does any good for the world. Do we really need of another high-performance sports car? Will an expensive car make any difference to global carbon emissions or to our oil dependence? The answers, of course are no and not much. However, that misses the point. Almost any new technology has high cost before it can be optimized, and this is no less true for electric cars.

Tesla's second model will be a roomy four door family car starting at \$50,000, to be manufactured in our own plant in New Mexico beginning in 2009. Our third model will follow as quickly as we can, and will be more affordable still.

Tesla intends to become a major car company with a full line of highly efficient – but also highly desirable – electric cars. Our strategy is to enter at the high end of the market, where customers are prepared to pay a premium, and then move down-market as quickly as possible to higher production levels and lower prices with each successive model. This strategy also allows us to change radically the public perception of electric cars, opening the market for a full spectrum of electric car models.

Tesla Motors is not looking for government handouts. Our business model is sensible, our cars are designed to be desirable and profitable, and I must answer to shareholders who expect a decent return on their investment. However, there are two ways that the tax system can help to catalyze consumer acceptance of zero emissions vehicles:

### **1. Restore and enhance the EV Income Tax Credit**

Until 2006, taxpayers who purchased electric cars could claim up to a \$4,000 tax credit through the Qualified Electric Vehicle Credit on IRS form 8834. In 2006, this deduction was reduced to \$1,000, and now it is gone.

In the past, Senator Rockefeller and Representative Camp – and others – have proposed legislation that would have restored and even enhanced this tax credit. None of these measures passed; I suspect this is in part because since the 2003 rewrite of California's Zero Emissions Vehicle Mandate, no car companies offer electric cars for sale anyway.

Meanwhile, the Energy Policy Act of 2005 created new tax credits for purchasers of hybrid cars – up to \$3,400 for a car that still, in fact, burns gasoline and emits CO<sub>2</sub>. (This is the piece of legislation described by Bill Ford as the “buy Japanese” bill.) Please don't misunderstand me: hybrids are fine – they usually do have higher gas mileage than their non-hybrid equivalents. But in the end, they are gasoline-powered cars. The only way to put energy into your Prius is through its gas tank.

However, a real electric car does a whole lot more to reduce our dependence on foreign oil and to reduce our emissions of greenhouse gasses than any hybrid ever can. We should be encouraging new car buyers to consider an electric car instead of a gasoline car – even instead of a hybrid.

For this reason I propose reconsidering some of what Senator Rockefeller proposed in his Alternative Fuel Promotion Act a few years back:

1. Reinstating the electric vehicle (EV) tax credit and increasing this credit for advanced technology electric vehicles. Specifically, provide a tax credit of 10% of the EV purchase price, up to \$4,000, with an additional \$5,000 credit for any EV that has at least a 100-mile range. Do not sunset this credit sooner than 4 years.
2. Give a tax deduction (not a credit) for the cost of installation of charging stations.
3. Continue to provide states the authority to allow single occupant, electric fuel vehicles in high occupancy vehicle (HOV) lanes, independently of allocations for hybrid access to these lanes.

### **2. Level the playing field with large SUVs**

Under the Jobs and Growth Act of 2003, Congress raised the deduction ceiling for heavy-class vehicles (those over 3 tons) to \$100,000, bumped the “bonus deduction” to 50 percent, and continued the accelerated five-year depreciation schedule. This, in effect, made virtually all three-ton, so-called business-use SUVs fully deductible in the first year. More than 50 vehicle models qualified for the tax break, and many were sold because of it.

The American Jobs Creation Act of 2004 lowered this SUV loophole to \$25,000 while retaining both the 50-percent bonus deduction and the five-year depreciation schedule. This deduction is still claimed as a Section 179 expense by many Americans who use their SUVs at least 50% for business uses.

While I certainly sympathize with the need to help sell Hummers, I would like to propose a similar incentive program for true zero-emissions, zero-gasoline vehicles. Surely an accountant, a home inspector, or an attorney can use an electric car to visit his clients. And getting these business people out of gas-guzzling 3-ton SUVs and into cars that burn no gasoline is good for America and good for the environment.

I therefore propose leveling the playing field for electric cars purchased for business use: amend the American Jobs Creation Act of 2004 to allow zero-emissions vehicles also to qualify for a \$25,000 deduction, a bonus deduction of 50% of the car's cost, and an accelerated depreciation schedule.

Moving from the tax system to the EPA, I would like to encourage you to allow car companies to buy and sell corporate average fuel economy (CAFE) credits. This kind of credit trading is widely supported, allowing more freedom in the marketplace while encouraging technological progress. CAFE credit trading would be a win-win-win, providing financing for new technology companies like Tesla Motors, solving

regulatory problems for larger car companies like General Motors, all the while costing the American taxpayer nothing. The EPA already clearly specifies how to convert electric consumption to equivalent gasoline consumption. All we need is the ability to buy and sell the credits.

I would like to turn your attention now to energy storage, specifically batteries. I believe that large capacity energy storage will become one of the key issues in the coming decade, as we strive toward energy independence. Batteries are at the heart of every electric or hybrid car. They are also critical to making clean energy generation technologies such as wind and solar truly useful by capturing the energy when it is generated, and releasing it when it is needed.

First a couple definitions: the big box that powers our car; the little box that plugs into your laptop computer – these are called batteries. If you take either box apart, inside you would find a collection of individual cylindrical or rectangular energy storage devices – these are called cells.

Tesla Motors has pioneered a radical battery technology for cars, and that is the use of commodity cells – the kind used in laptops and cell phones – as the energy storage element in its batteries. We did this so that we could ride on the commodity coattails of the highly competitive consumer electronics market. This is how we broke the chicken-and-egg problem that even the largest car companies suffers when trying to produce an electric car.

The auto industry battery consortium, USABC, set about to invent automotive batteries made from specialty cells for cars; Tesla uses commodity cells to make its automotive batteries. This is why Tesla's battery is cheaper, higher capacity, more reliable, and more available than anything produced by USABC. And we went into production for a fraction of the money already spent by the consortium. Note that Tesla Motors has been approached by quite a few of the car companies around the world about its battery technology, and has just signed a deal to provide batteries to one.

Here is the thing: practically all commodity cells today are made in Asia – mainly Japan, South Korea, and China. There is no significant production anywhere in the US. Even American battery companies – such as A123, Valance, and AltairNano – turn to Asia for mass production. As James Woolsey noted shortly after taking a test drive in a Tesla Roadster, this will become a national security problem as we become more dependent on stored electricity.

There is no good reason why commodity cell production could not be here in the US. A modern lithium ion cell plant – such as those in Japan – is a highly automated affair with very low labor content. These plants resemble chip fabrication plants more than anything else. And, like chip fabrication, the year-to-year advances in capacity, quality, and price come not from great leaps of innovation, but rather from constant manufacturing improvement driven by fierce competition.

The trouble is that this manufacturing progress is like a moving walkway – if you ever step off, the walkway moves on without you, and it is difficult ever to catch up. Companies that decided in the '80s to become "fab-less semiconductor companies" – outsourcing their chip fabrication to Asia – will never again make chips. Companies – American companies like Intel – that stayed on the walkway continue to drive the technology and remain among the best and most competitive chip makers in the world.

Every American battery manufacturer stepped off the moving walkway years ago. We have no choice but to buy our cells from Asia, and the US will soon discover a new energy dependence if we don't do something about it.

I do not have a specific recommendation for you here – I am simply pointing out an impending problem. I believe it is in all of our interest to encourage domestic production of competitive, commodity cells – cells that can be used by American electronics manufacturers like Dell Computer just as they can be used by American car companies. The key words here are competitive and commodity.

Tesla is not in the business of making cells, though I have thought about it a lot. If no one else steps up to the plate and if I can figure out how to finance such a venture, I might take a swing at it. Now if you are looking to invest about \$500M, please let me know...

Note that the Energy Policy Act of 2005 provides incentives for practically every type of alternative automotive technology *except* electric cars. Why? Did somebody really kill the Electric Car? I am here to inform you that rumors of the Electric Car's demise have been greatly exaggerated.

To quote Rick Wagoner, CEO of General Motors, at the opening of the most recent LA Auto Show,

Why electricity?

- First, electricity offers outstanding benefits... beginning with the opportunity to diversify fuel sources "upstream" of the vehicle. In other words, the electricity that is used to drive the vehicle can be made from the best local fuel sources – natural gas, coal, nuclear, wind, hydroelectric, and so on. So, before you even start your vehicle, you're working toward energy diversity.
- Second, electrically driven vehicles... are zero-emission vehicles. And when the electricity, itself, is made from a renewable source, the entire energy pathway is emissions free.
- Third, electrically driven vehicles offer great performance... with extraordinary acceleration, instant torque, improved driving dynamics, and so on.

I could not agree with Mr. Wagoner more. Electric cars are far from dead, and need to be included – even highlighted – in every government program that promotes energy independence and minimizes global climate change. They are our best hope.

Once again, thank you very much for inviting me here today. I hope you will find my testimony to be helpful.

**Senate Finance Hearing**  
**Advanced Technology Vehicles: The Road Ahead**  
**May 1, 2007**  
**Statement of Senator John Kerry**

Mr. Chairman, first I would like to thank you for holding this important hearing on advanced technology vehicles. I think we both agree that the road ahead – as this hearing is entitled – should be traveled with vehicles that reduce carbon emissions. I look forward to learning about the future wave of vehicles.

I am pleased that one of the witnesses includes Mr. David Vieau, CEO of A123 Systems of Watertown, Massachusetts. A123 Systems is developing a state-of-the-art lithium ion battery that is essential to plug-in hybrid transportation. As Chairman of the Senate Committee on Small Business and Entrepreneurship, I am proud to say that A123 started five years ago as a spin-off from MIT with a \$100,000 Department of Energy Small Business Innovation Research grant. With this start from an invaluable small business program, A123 has become the leader in cutting edge technology to develop a battery that can be plugged-in to hybrid cars. These types of vehicles will lessen our addiction to oil, substantially lower emissions, and achieve 100 miles per gallon or greater.

Along with Senator Snowe, I have introduced S. 485, the Global Warming Reduction Act of 2007. This legislation would require that the U.S. freeze emissions in 2010 and then call for a gradual reduction each year to 65 percent below 2000 emissions levels by 2050. The bill achieves these targets through a flexible, economy-wide cap-and-trade program for greenhouse gas emissions. As a part of this legislation, tax incentives for advanced technology vehicles are extended and expanded. In particular, this legislation provides a new tax credit for plug-in hybrid vehicles. Consumers who purchase these cars are eligible for a tax credit of \$3,000 and an additional credit based on fuel efficiency.

The witnesses today are familiar with a broad range of vehicles that will improve fuel efficiency. This hearing will help us determine which tax incentives will be the most useful in helping these new technologies reach the marketplace.

Last week, Lee Iacocca, someone who knows quite a bit about this industry, was interviewed by NPR and commented that, “Detroit is living in the past.” He added that his “follow-the market” philosophy should govern the next wave of automobiles, and the advice of environmentalists, including former Vice President Al Gore, should be followed. In addition, he mentioned that he is fan of plug-in hybrids.

I think that we should heed his advice. I look forward to learning how we can “follow-the-market” and help Detroit look towards the future in a manner that is based on sound energy, environmental, and economic policies.

**Finance Subcommittee on Energy Hearings  
Advanced Technology Vehicles: The Road Ahead  
May 1, 2007**

Dr. Walter McManus  
Director, Automotive Analysis Division  
University of Michigan Transportation Research Institute  
Ann Arbor, MI

Mr. Chairman, Members of the Committee, Ladies and Gentlemen, it is an honor to appear before you today to discuss the role advanced technology vehicles can play in addressing U.S. oil dependence and global warming. Thank you for the opportunity to share my views which are based on twenty-five years of professional experience as an economist, seventeen in the automotive industry as an analyst for General Motors, and J.D. Power and Associates and now the Director of the Automotive Analysis Division for the University of Michigan's Transportation Research Institute.

### **The Road Ahead**

- Vehicles are the source of 20 percent of U.S. greenhouse gas emissions and 40 percent of our oil dependency.
- By mid-century, the world's vehicle population is expected to reach 2 billion, almost triple the current figure. To limit global vehicle emissions to 50 percent more than today's levels, the average fuel economy of cars and trucks on the road would have to rise to about 60 mpg in 50 years or less, according to calculations by the Carbon Mitigation Initiative at Princeton University, a research effort funded in part by Ford.<sup>1</sup> Because it takes a decade or two for new technology to make it into every car on the road, all new vehicles within 35 years or less would need to reach 60 mpg.

### **Today's Market is Distorted Against Oil Conservation**

#### **Existing Market-based Incentives and Disincentives**

- There are a number of Federal market-based programs that encourage conservation. These include the automaker fines that are part of CAFE, the Gas Guzzler Tax (which mostly applies to high-end luxury and sports cars), and consumer tax deductions or tax credits for purchasing advanced technology vehicles.
- However, the programs encouraging oil conservation are more than offset by the flex-fuel provision of CAFE, the car-truck differential in CAFE, and the differential treatment of cars and trucks in the Federal Tax Code, such as exemptions for business owned SUVs and trucks.
- There is no such thing as a distortion-free market. On balance the current array of Federal incentives and disincentives exacerbate oil dependency and GHG

emissions. Whatever else Congress does to encourage oil conservation and reduced GHG emissions, these conflicting programs need to be revised so they do not work against each other.

- Among the tools available to Congress to decrease oil dependence and GHG emissions are programs that combine positive incentives that encourage oil conservation with negative disincentives that discourage oil dependency and GHG emissions. In addition to the existing Federal incentives and disincentives, such combined programs could include elements specifically aimed at reducing GHG emissions—clean car discounts and “polluter pays” fines.

## Existing Regulations

### CAFE Worked

Detroit automakers say that CAFE did not work to reduce fuel consumption. They point out that the price of oil was spiking in the late 1970s and early 1980s, at the same time that CAFE was being implemented, and that therefore fuel economy would have increased anyway. Let’s review the facts.

- After Congress set fuel economy standards for vehicles in 1975, our dependence on oil imports decreased very quickly from 46 percent in 1977 to 27 percent in 1985.
- After 1981, however, the price of oil fell rapidly.
- CAFE standards continued to be increased after 1981 and the actual fuel economy for cars and trucks separately continued to rise.
- **Combined** fuel economy for cars and trucks has been falling since 1986, not because “CAFE failed” but because of a loophole in the law that allowed trucks to meet a lower fuel economy standard. Automakers used that loophole, designed to protect farmers and small business, to build family vehicles on truck chassis – familiarly known as SUVs and Minivans.
- CAFE worked to increase average fuel economy for cars and trucks separately, but the steady growth in trucks from less than 20% of the market before CAFE to over 50% today, eventually offset CAFE. As a result, total fuel economy has been falling since 1986.
- Without CAFE standards, we would be using an additional 80 billion gallons of gasoline on top of the 140 billion gallons we will use this year. That would represent an increase in oil demand by 5.2 million barrels of oil per day, or a 25 percent increase in our oil addiction. At today’s average price for regular gasoline, about \$2.50 per gallon, that represents \$200 billion dollars saved.
- Even today, these standards continue to save nearly 3 million barrels of oil per day, according to the National Academies of Sciences. Since 1985, however, fuel economy has been stagnant and our imports have grown.
- According to data in the 2002 report by the National Academies of Sciences on CAFE, the technology exists to reach 37 mpg in a fleet of the same make-up as the NAS analyzed, even ignoring hybrids and cleaner diesels.<sup>ii</sup>
- Paul Portney, chair of the NAS committee, recently noted that, “It might be possible to meet more stringent fuel economy standards at lower costs than the committee foresaw.”<sup>iii</sup>

- The United States is falling behind other nations pushing for better fuel economy as concerns mount over global warming. Even China, oft touted as the reason why the U.S. shouldn't act, has tougher fuel economy standards.<sup>iv</sup>
- Because the automakers did not meet voluntary agreements to reduce greenhouse gas emissions, the European Commission in Brussels is moving mandate automakers to limit carbon-dioxide emission to an average of 130 grams per kilometer for all new cars by 2012.<sup>v</sup>

### CAFE Going Forward

CAFE is usually seen as mandating the average fuel economy that each automaker must attain for its vehicles. However, fines for not meeting the required average fuel economy support enforcement of CAFE. The current fine that an automaker not meeting the required average fuel economy pays is \$55 for each mile per gallon the automaker's average fuel economy falls short of the requirement, multiplied by total unit sales.

The CAFE fine is too small to have induced compliance by itself. The Gas Guzzler Tax applies only to cars and amounts to an average of \$585 per mile per gallon below 21.5 mpg. Recent estimates both by UMTRI<sup>vi</sup> and by Espey and Nair<sup>vii</sup> put the value that consumers put on fuel economy at about \$600 per mile per gallon. Compliance also depends on interpreting the CAFE fines as penalties for illegal behavior, which would have consequences far more serious for publicly traded corporations than the magnitude of the fines.

The Detroit automakers, as U.S. corporations, have been unwilling to risk being penalized under CAFE and have always met the CAFE requirements. Most of the Japan-based automakers have always exceeded the CAFE requirements, so the fines have not been an issue. The European automakers are the only ones who have consistently paid CAFE fines. The European automakers have a relatively small share in the U.S. and total fines collected annually have always been less than \$100 million.

In order to induce automakers to significantly increase fuel economy, the fees for falling below the goal would need to be much higher than the current \$55 per mpg in CAFE—on the order of \$600 per mpg or more—or the illegal nature of noncompliance would need to be maintained or strengthened.

### What Consumers Want

Detroit insists they are responding to U.S. consumer demand. Do they really understand what American consumers want?

There are several important consumer indicators that have gone unheeded by automakers.

### Fuel Prices and Vehicle Sales

As fuel price doubled between 2002 and 2006, SUV unit sales were seemingly strong. But in reality, automakers were forced to offer expensive incentives, and deep discounts, dropping the SUV and truck price to offset fuel price increases. Sales may have stayed even, but revenue fell and profits fell.



Used vehicle prices are another critical indicator. From 2002 to 2006, large SUVs lost a third of their resale value. The market shift to trucks slowed, then reversed. Consumers respond to higher fuel prices by buying more fuel-efficient cars.

Other key indicators point to consumer demand for fuel economy:

- Fuel efficiency and hybrid technology are no mere passing fancies, but represent a “permanent” consumer shift that automakers must address, industry executives say. Their belief is captured in a global survey of auto industry leaders released today by the U.S. tax and audit firm KPMG LLG.<sup>viii</sup>
- Nearly one in five prospective buyers polled for an exclusive study conducted by J.D. Power and Associates for The Detroit News indicated that they would not consider a domestic brand -- and 40 percent of them named poor fuel economy as a reason. Coates, David and Christine Tierney.<sup>ix</sup>
- New survey of automakers, suppliers and industry experts released by UMTRI shows surprising agreement that fuel prices are on a steep upward trajectory, and CAFE standards will rise.<sup>x</sup>
- “Oil is much more likely to finish the decade at \$100 or more per barrel than at \$50,” argues Stephen Leeb, president of Leeb Capital Management in NYC, and author of several books on energy markets and investments.
- Oil addiction undermines our security because the volatility of oil prices threatens our economy. Because there is a world market for oil, supply interruptions anywhere affect the price of oil everywhere – therefore whether we import oil or make our own is relatively unimportant. Higher CAFE can mitigate the effects of oil price volatility, but real security can only come through finding a way to keep prices stable through more diverse supplies writes economist Ronald Minsk.<sup>xi</sup>
- A Wall Street Journal survey of economists found strong support for government intervention in the transition away from fossil fuels. “Economists generally are in favor of free-market solutions, but there are times when you need to intervene,” said David Wyss at Standard & Poor's Corp. “We're already in the danger zone” because of the outlook for oil supplies and concerns about climate change.” When asked to pick the greater geopolitical threat to the economy, by nearly a 3-to-1 margin the economists chose a disruption in crude oil supplies caused by tensions in the Mideast over the impact on spending and confidence that could follow a major terrorist attack.<sup>xii</sup>
- A “strong and bipartisan” 78% of Americans want Washington to impose a 40-mpg fuel-efficiency standard for American vehicles, according to a new Opinion Research Corporation national opinion survey.<sup>xiii</sup>

- Forty-six percent of today's car shoppers say the feds ought to force automakers to meet higher fuel economy standards, according to Kelly Blue Book Marketing Research.<sup>1</sup>

How is it possible for Detroit to spend millions on market research and yet be so dependent on price and incentives to sell? Easy, assume that you already know what customers want and "adjust" or ignore market research if it disagrees with your assumptions. When the automakers say, "consumers say one thing and do another about fuel economy," they are really confessing to market research abuse. And then, when products engineered and built to meet these incorrect assumptions about what real consumers want are finally sold, it is at fire sale prices -- far lower than had the assumptions been accurate.

### **Higher Fuel Economy means Higher Profits and Jobs**

In July 2004 (before Katrina and spike in oil) UMTRI predicted that if fuel price went over \$3/gallon that Detroit would lose \$11 billion in profits. Detroit media ignored the story, and Detroit automakers denied it. One even said, "To link fuel prices and SUV sales is bad analysis and bad journalism."

But when fuel price spiked two years later, Detroit lost more than \$20 billion. The only thing wrong with our analysis was that we underestimated the extent of losses.

As a result, Detroit is now in the painful process of dramatic downsizing, closing plants, laying-off workers. And a new wave of large SUVs and trucks are facing difficulties in the market.

UMTRI released another study recently that shows if U.S. automakers increased their energy efficiency to accommodate increasingly conservation-minded customers, they could collectively increase profitability by \$2 billion in model year 2010. Following their current plans, we concluded, they are projected to lose \$3.6 billion that year.<sup>xiv</sup>

Increasing their fleet wide fuel economy 2-3 miles above CAFE would increase profits in Detroit even if the price of gasoline falls to \$2 a gallon.

The dilemma the Detroit automakers face is that while they may believe that they cannot afford to make fuel economy a high priority, in actuality, it turns out that they cannot afford not to.

### **Detroit Automakers Strongly Support Alternative Fuels In Part Because They Already Have Flex Fuel Vehicles**

- Another loophole in the CAFE law allowed automakers to meet CAFE standards with cars that can run on a combination of ethanol and gasoline called E85, despite the lack of availability of this fuel.
- Producing these vehicles required minimal investment in technology and proved an easier route to meeting CAFE.

- An unprecedented 1.5 million alternative fuel automobiles were sold in 2006, surpassing automaker sales' expectations by 50 percent, and bringing the total number of flex-fuel vehicles on U.S. roads to 10.5 million. <sup>xv</sup>
- But today only a fraction of U.S. service stations enable a driver to fill up with ethanol.
- Without tighter fuel economy standards, and before ethanol fuels become widely available, the more flex-fuel cars and trucks that are produced, the more gasoline is consumed, thereby dramatically increasing greenhouse gas emissions and deepening the country's dependence on petroleum. Union of Concerned Scientists estimates that without the flex fuel loophole in place, the U.S. would have burned 4 billion fewer gallons of gasoline since 1998. " <sup>xvi</sup>
- Vehicles powered by ethanol get 20-30 percent fewer miles per gallon than they do with gasoline, so in order to reduce spending at the pump any renewable fuels mandate must be coupled with significant improvements to auto fleet efficiency. <sup>xvii</sup>

### **Market Based Program needs Combination of Incentives and Disincentives**

- UMTRI is conducting research on a proposed program that combines incentives and disincentives to encourage consumers to purchase and manufacturers to produce cleaner vehicles. This 'clean car discount/polluter pay' program, sometimes called 'Feebates' combine incentives for clean, high fuel economy vehicles (rebates) with a similar disincentive for low fuel economy vehicles (fees). Such programs, which can be designed as self-financing, can have much greater impact on oil consumption and GHG emissions than one-sided rebates or fees alone. This is especially true when the feebate uses a sliding scale so that the size of the rebate or fee a vehicle has depends on the vehicle's fuel economy relative to other vehicles. By shifting consumer demand toward more fuel-efficient vehicles, feebates give a manufacturer the incentive to improve its entire product range.

### **Recommended Approach: Combine Regulations with Market-Based Incentives and Disincentives**

- The inconsistencies in current policies have reduced the effectiveness of instruments directed specifically at reducing oil consumption and greenhouse gas (GHG) emissions. Any attempt to create new instruments that does not also address inconsistencies will have limited success.
- CAFE includes both a mandate and a market-based disincentive, but the magnitude of the disincentive is too small to have much impact, so the mandate is responsible for most of CAFE's impact.
- The two most important policies that create inconsistencies and weaken efforts to reduce oil consumption and GHG emissions are the differential treatment of cars and trucks in the Federal tax code and the existence of separate CAFE standards for cars and trucks.
- Consumer tax deductions and tax credits for advanced fuel efficient technology have given automakers incentives to produce and sell them.

- In spite of conflicting policies, there is more than enough evidence that consumers and automakers respond to incentives and disincentives.
- Regulations alone, incentives alone, disincentives alone will not achieve what a combined approach can achieve in reducing U.S. oil consumption and GHG emissions.
- The committee should consider a feebate policy to replace the complex and often conflicting incentives provided by current vehicle tax policy. Feebates complement CAFE by using the power of the market to guide consumers towards cost-effective, high fuel economy vehicles. Together, CAFE and feebates address both the supply and demand side of the vehicle energy challenge.

<sup>i</sup> Brown, Peter and Harry Stoffer. "The heat is on/How global warming is closing in on the U.S. auto industry." *Automotive News* (Feb. 7, 2007)

<sup>ii</sup> NRC, 2002

<sup>iii</sup> Portney, Paul. February 9, 2005

<sup>iv</sup> Freeman, Sholnn. "Democrats Plan to Press Automakers on Fuel Efficiency." *Washington Post* (Mar. 10, 2007).

<sup>v</sup> Hutton, Ray. "Emissions row divides carmakers/Europe's motor industry can't decide how to deal with tough new limits on carbon emissions." *Sunday Times* (Mar. 18, 2007).

<sup>vi</sup> McManus, Walter, "Can Proactive Fuel Economy Strategies Help Automakers Mitigate Fuel Price Risk?" UMTRI Research Report, Sept. 2006.

<sup>vii</sup> Espy, M. and Nair, S., "Automobile Fuel Economy: What is it Worth?" Contemporary Economic Policy (Western Economic Association). Vol. 23, No. 3, July 2005, 317-323

<sup>viii</sup> Chappell, Lindsay. "What's sparking car buyers now? Fuel efficiency." *Automotive News* (Jan. 4, 2007).

<sup>ix</sup> "Detroit carmakers push to be greener." *Detroit News* (Jan. 6, 2007).

<sup>x</sup> Hoffman, Bryce G. and Sharon Terlep. "AUTOMOTIVE NEWS WORLD CONGRESS Wagoner calls for U.S. to focus on alternative fuel." *Detroit News* (Jan. 17, 2007).

<sup>xi</sup> Minsk, Ronald. "Praying at the Pump." *New York Times* (Feb. 2, 2007).

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49

**Testimony Of**

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**Watertown, Massachusetts**

**Before The**

**United States Senate Committee On Finance**

**Subcommittee On Energy, Natural Resources, And Infrastructure**

**Concerning**

**Advanced Technology Vehicles: The Road Ahead**

**May 1, 2007**

**A123Systems Role In The Coming Hybrid And Plug In Hybrid  
Revolution**

**A123SYSTEMS' ROLE IN THE COMING HYBRID AND  
PLUG IN HYBRID REVOLUTION**

Mr. Chairman, Senator Thomas and Members of the Subcommittee;

Knowing of your and the Committee's interest in fostering new American technologies in the critical effort to slow down climate change and reduce our dependence on foreign oil, I thank you for the opportunity to appear before you today to explain and answer questions about A123Systems' progress in developing what we and others believe is the state-of-the-art lithium ion battery that will help enable this nation to lead a worldwide plug-in hybrid transportation revolution starting now.

Let me explain.

**The Company And Its Products**

A123Systems started 5 years ago as an MIT spin off with a \$100,000 DOE SBIR grant. Today it has raised over \$100 million, has over 300 employees and operates facilities in Watertown, Massachusetts and Ann Arbor, Michigan. We sell millions of batteries annually to Black and Decker, Dewalt and others for high powered handheld applications. We also are developing higher powered solutions for the aerospace and defense industries and have been chosen by GM, and other major American and European automakers, to help develop and power their hybrid and plug-in hybrid sedans,

SUVs, trucks, buses and heavy equipment moving vehicles which will be coming on line over the next 3 to 5 years.

This has all been made possible by our development of a unique Nanophosphate based lithium ion battery with a combination of power density, durability and safety in excess of anything mass produced on the market today. This assertion is confirmed by the ever growing list of partners who are choosing A123Systems as the power source of choice in enabling them to enter the increasingly attractive and profitable hybrid era.

The automotive industry is in the middle of a critical transition to electric drive. Fueled by strong consumer demand for greener vehicles and a growing awareness of our greater responsibilities to our planet and our national security, there are now over 65 hybrid vehicle launches planned by 2010. We are working with leading American and European automakers to develop batteries for upcoming hybrids and are working with the DOE and the USABC to optimize our technology and provide leading price performance in this market.

The next generation of technology beyond the conventional hybrid is the plug-in hybrid. This game changing technology is one where the US automakers have established technological leadership and which delivers many benefits including 100 MPG or greater efficiencies at a fraction of the cost of gasoline. A123Systems is a leading supplier of battery technology for plug-in hybrids. We are working with General Motors and other

leading American and European automobile and heavy equipment manufacturers to validate and introduce this technology into the market.

In fact, this week A123 and BAE Systems will be announcing that, starting in 2008, BAE Systems will be offering A123's lithium ion battery technology as part of its HybriDrive® Propulsion System used in hybrid busses. The HybriDrive® Propulsion System is currently in use in New York City, Toronto, and San Francisco.

From passenger vehicles to large trucks and busses to fleet vehicles, these new technologies, enabled in part because of the performance metrics of A123Systems batteries, can change both the emissions and fuel consumption profiles of some of our largest concentrations of polluting commerce.

Over the years, this Committee has been in the forefront of recognizing the need to nurture these kinds of breakthrough technologies by insuring early stimulation through the wise use of tax credits to kick start consumer demand. Putting the CLEAR ACT in place in 2005 was critical to both educating the public and producing the sale volumes that have lead to ever improving costs and economics. As a result, today's growing demand for hybrid vehicles is a tribute to the public's underestimated desire to do something about the health and national security risks of ever rising petroleum dependency when presented with economic choices.



Clearly the number one message I want to leave you with today is that since we now know it made sense to provide several thousands of dollars in tax credits to start moving consumers from 15 MPG vehicles to 45 MPG vehicles, it certainly makes sense to do at least as much to achieve the 80% oil savings and 50% emissions reductions which will come with each comfortable, high performance plug-in hybrid vehicle designed to achieve 100 MPG or more.

And the sooner we do that, the cleaner and safer this country will be. Which is why A123Systems has strategized on how to best to move along the continuum from producing millions of high performance A123Systems lithium ion batteries for handheld applications to adding the bandwidth required in 3 to 5 years to supply the major manufacturers with batteries for their fully designed and tested original equipment plug-in hybrid vehicles.

So we asked ourselves how best to fill that gap in the most supportive way to maximize the earliest and ultimate success of the tens of millions of original equipment plug-in hybrids that will need to be rolling off the major manufacturers production lines through the next decade. The answer was to team with Hymotion, a leader in the field of companies utilizing our batteries in Battery Range Extender Modules that can be installed in the spare tire well of any existing hybrid.

The result of that effort is parked right outside this building. On its face, it is one of the almost 1 million standard production hybrids now on the road in the US. Its original

equipment nickel metal hydride battery provides enough power to go about one to two miles on electricity alone. But this car differs from most of its brethren in that it also has a supplemental module small enough to fit into its spare tire well. This module contains our current production battery cells and delivers enough usable energy for the vehicle to travel the equivalent of 40 miles on electricity, achieving as much as 150 MPG in urban driving and 100 MPG in highway driving. This module is charged overnight from a regular 120 volt extension cord which plugs into the bumper.

Since the average commuter travels under 30 miles per day, off peak nightly charging of this module both improves a utility's load factor and efficiencies while reducing total gasoline consumption and emissions dramatically. In fact, DOE's Argonne National Lab has tested an earlier version of this module providing independent validation of the 150 MPG urban efficiencies that plug-in hybrids provide. Prototypes now being driven around the country, including here in Washington, have been obtaining the same results which are several multiples of the 45 to 55 MPG today's production hybrids achieve.

Now let me be clear. Over 100 MPG from a standard production hybrid with a supplemental battery module filled with our current production lithium ion batteries sitting out on the street right now for anyone to drive. And yes, it is affordable, reliable and a logical bridge between the even more efficient OEM plug-ins that will become available in mass by the beginning of the next decade and the ever growing millions of conventional hybrids that will be sold in the interim. We will be testing this technology with various fleets in 2007 and now intend to market this standardized module

nationwide in 2008. It will be certified to meet all applicable new car test standards and will be installed by trained mechanics in less than 2 hours, without any changes to the underlying electronics, mechanics or materially useable space of the production hybrid other than the installation of the plug in the rear bumper.

The applicable market in the US for standard production hybrids will be approaching 1 million through the course of this year. With almost two dozen hybrid models expected by the end of 2008, there will be 5 million standard hybrids on the road by 2010. At an initial 40 mile module installed price of \$10,000 supported with a \$3500 tax credit, the payback period for a fleet owner with \$3.00/gallon gas is 2.5 years, against an expected life of 10 or more years. The payback period for the average commuter driving 11,000 miles per year would be 5.5 years. These calculations place no value on the net reduction of approximately 100 tons of carbon dioxide and other emissions over the life of the vehicle and take no account of the cost reductions which could accrue from additional materials research and increasing production volumes.

I urge all of you to come look at the car and see what can be available to the American public starting later this year. With a modest tax credit, the average American can be in a full, responsive, comfortable sedan that can get over 100 MPG and cut net emissions by 50% for under \$30,000. And as volumes increase, prices also can be expected to eventually fall as in any new breakthrough product.

Clearly the original equipment hybrids due out early in the next decade utilizing even better batteries integrated directly into the vehicle at the factory will be more efficient and less costly. But there can be as many as 15 million standard hybrids on the road when plug-in volumes skyrocket from 2012 to 2017. This A123Systems' technology can start today to stimulate the major oil and emission savings from the plug in equivalent of the first bulky cell phones and large laptop computers. In all these cases, it's much better than what was there before and not as good as it is going to get. But it can be an important part of a logical technology and policy continuum leading to an earlier 80% reduction in oil imports as we move to a dominantly plug-in hybrid national fleet.

So I would urge you to be sure that any tax incentive applicable to plug-in hybrid consumers of factory originals available some years out, also be applicable to the tested, standardized, nationally marketed through certified installers, plug-in modules offered earlier by qualified companies for the growing millions of regular hybrids that will be on our roads. We estimate a fivefold increase in demand for these modules from an increasingly responsive American public as a result of providing for this early responder tax credit. Kick starting this transportation revolution now, by moving up by years the availability of this breakthrough so important to our national security, will:

- Introduce a public hungry for tangible action now to a new American technology that lets them be part of the logical next step of a transportation revolution they have already started with their unprecedented demand for the standard hybrids available today.
- Gather invaluable experience and data for the next generation of factory produced vehicles through earlier wide spread use of these higher tech batteries in real volumes in the everyday world.
- Stimulate earlier battery cost reductions from the earlier volume sales
- Advance by years the much needed 80% reduction in oil consumption and 50% emissions savings associated with every plug in on the road.

- Serve the purpose of potentially speeding up the roll out of the all important factory produced plug ins as a result of the growing public awareness and response to module savings and availability.

Our folks have been working with your staff and others on the Committee and in the House to insure a workable mechanism and allocation for a standardized credit that provides for a seamless transition to the mass volumes of plug-in vehicles we will need to cut our oil imports and emissions. At the same time, we can begin to restore American leadership and jobs as a result of this technological breakthrough. We stand ready to provide you with anything else you may need to assess this request.

The Additional Importance Of a Truly Competitive Research And Job Creation Grant Program

I also would like to address the importance of translating the potentially massive resource requirement of a plug-in revolution driven by American battery technology advances into maximum advantage for American technological leadership and job creation. A123Systems has already created more American Li Ion related jobs in the past 5 years than any other American company. Having said that, I know you are aware that in many senses our major competition is as much foreign governments as it is domestic or foreign companies.

Mr. Chairman, no one has done more over the years to address the need for a better US policy to prevent the recurring story of American technologies being successfully commercialized elsewhere. We all know foreign governments provide subsidies through

investments and partnerships in the initial capital costs of research and manufacturing infrastructure that cannot be matched by investor owned US companies. You understand as well as anyone that in matters involving national security priorities like a restructuring of our energy consumption profile, we run the risk of losing our competitiveness again without finding an equitable way of leveling this playing field.

Let me provide you with a few insights into that question from our perspective in the battery industry. The 100 MPG or more car sitting outside that window today is proof positive that right now the US is in the lead on the development and marketing of the breakthrough required to make the massive oil savings associated with plug-in hybrids a reality, with the least amount of infrastructure change.

Currently, we plan to add further jobs in the US in the value added areas of materials research, battery engineering, module assembly and possibly pilot plant experimentation. But when it comes to actual mass production of Li Ion cells, we face an initial cost differential between the US and Asia that would make our products non-competitive. Without the kind of long term multi-billion dollar government support provided by countries like Japan and Korea to their battery company partners, A123Systems simply will not be competitive if these cell plants are built in the US, even with a substantial performance advantage.

Your and Senator Domenici's Energy Efficiency Promotion Act Of 2007 (SB1115) goes a long way toward starting to address these challenges with it's combination of grants,

expanded DOE demonstration programs, loan guarantees, and improved basic and applied research programs. From our perspective as a relatively small company with an increasingly recognized breakout technology, there are a few adjustments and clarifications we would like to point out to make the bill as competitive and effective as possible in keeping American leadership and jobs in America as the battery driven plug in boom takes off.

As written, the 30% grants for additional qualifying production facilities for automakers and component manufacturers in Section 303 applies only to expansion or renovation of existing facilities. Yet, the most important driver of this revolution – much better batteries – will only be built in the US at new plants that do not exist at this time, since the vast amount of lithium ion manufacturing capacity is already overseas as a result of the Asian government's superior support policies for this very industry.

It could be a mistake from our perspective to leave new battery plants in the US out of Section 303.

The grant portion of Section 203 is far more appealing to A123Systems than the loan guarantee provision. Debt on the books, even at a lower interest rate, tends to tip the scales for manufacturing to Asia given the massive capital cost differentials. The time and administrative risk of securing DOE grants can also be a factor in this fast moving new world of cascading negotiations and expanding new orders. Provisions encouraging

tight turn around time frames for decisions on the critical domestic applications for new plant construction grants in the US probably warrant consideration as well.

Finally, you have made a good start in the defined new industry research programs in Sections 305 and 304. To insure the true "Competitiveness" referenced in the title for "Energy Storage Systems" in Section 304, we think it is important to make clear that the designated industry wide R&D funding be done on a company by company basis as opposed to a pooled basis.

We want to see everyone encouraged to improve upon and beat everyone else in a fair and open competition. But if, as part of that process, industry wide funding involves industry wide sharing and publishing of data, smaller companies like A123Systems with leading technologies who most need the funding to keep the maximum number of jobs in the US, will not be inclined to sign up at the price of turning their advantage over to both their American and foreign competitors. The proprietary nature of each company's intellectual property should be preserved in the industry wide R&D program to push all participants to put forth their very best cutting edge efforts.

#### Conclusion

This nation can turn our current energy vulnerabilities into a new technological renaissance producing an increasing number of American jobs. We can do it by using a combination of demand pull tax incentives and grants to insure we shift our consumption



of foreign oil to a more efficient, diversified, balanced and cleaner domestic electric grid. With your political will and leadership, and the kind of technological breakthroughs represented by that 100 or more MPG car sitting outside powered by A123Systems cells developed here in Boston and at our subsidiary, T/J Technologies, in Ann Arbor, and being pursued diligently and prudently as part of a partnership with Detroit that holds the key to reestablishing their technological leadership and superiority, we will succeed.

Thank you Mr. Chairman and Members of the Committee for this opportunity to explain what we are doing and comment on what you propose. We appreciate your interest and support. We will now be glad to address any questions you may have on this or any other subject.



COMMUNICATION

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May 14, 2007

**U. S. Senate  
Committee on Finance  
Subcommittee on Energy, Natural Resources, and Infrastructure**

***Advanced Technology Vehicles: The Road Ahead***

**May 1, 2007, at 10:00 a.m. in 215 Dirksen Senate Office Building**

**Statement of Jerome Hinkle  
Vice President  
National Hydrogen Association  
1800 M St. NW Suite 300 N  
Washington D.C. 20036**

**Chairman Bingaman, Ranking Member Thomas and Honorable Members of the Committee:** on behalf of the over 110 members of the National Hydrogen Association (NHA), I would like to thank you for the opportunity to enter into the record testimony on tax incentives for advanced hydrogen infrastructure essential to the development of emerging vehicle markets. We appreciate the critical role the committee has in developing tools that will bring advanced technologies into widespread commercial use.

This testimony will respond to points made in the Hearing on May 1<sup>st</sup> and make several recommendations to the committee regarding tax incentives to promote hydrogen powered advanced vehicles. Specifically it will:

- Highlight existing opportunities for advancing hydrogen and fuel cells in H.R. 805 and H.R. 550
- Propose a package of key tax incentives to jumpstart the market penetration of hydrogen fueled equipment with tax credits for private hydrogen infrastructure investments and hydrogen fuel purchases
- Support the testimony offered by Phillip Baxley, President of Shell Hydrogen.

### ***Vehicles in the Hydrogen Economy***

A commercial Hydrogen Economy would dramatically reduce emissions and increase efficiency in the transportation sector, greatly ease our dependence on imported oil, evolve substantial new industries, and sharply reduce our balance of payments due to a rapidly growing oil import bill. Hydrogen is fundamentally a domestic product — every gallon of gasoline replaced by hydrogen helps to keep our wealth onshore and create U.S. jobs.

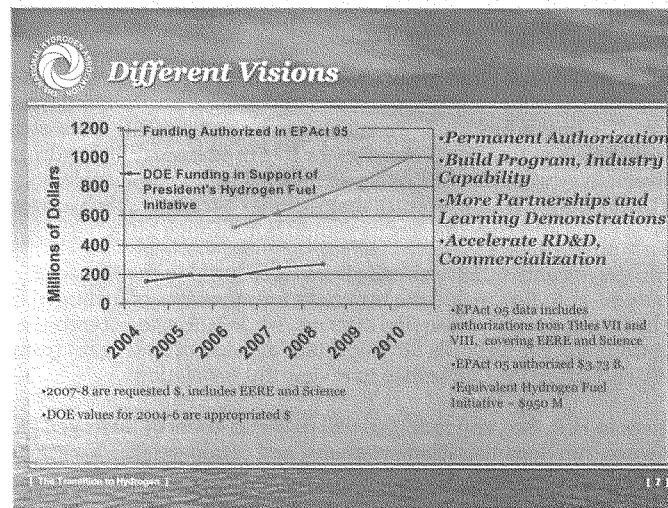
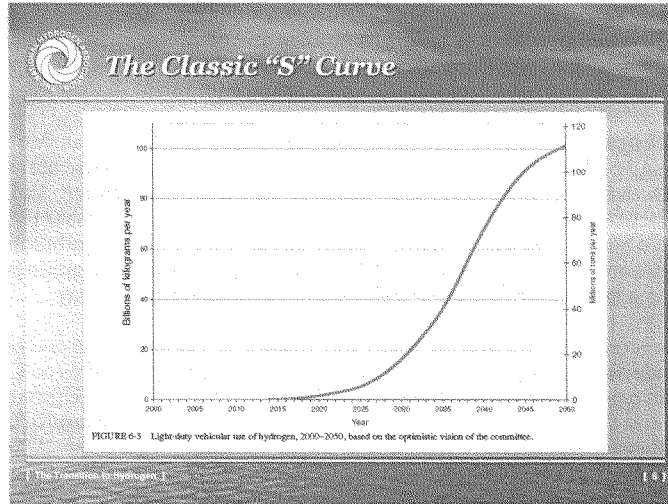
Phillip Baxley, President of Shell Hydrogen, who is also the Chairman of the NHA, testified that the foundations of the hydrogen economy are already in place. Hydrogen is widely produced at a large scale near urban areas where most vehicle demand is located. Technology exists to manufacture and distribute hydrogen to fueling stations in many urban areas, and from there into vehicles. U.S. automakers are pursuing better, cheaper hydrogen vehicles and are making significant strides in cost-shared demonstration programs with federal and state governments. Major public and private investments are paying dividends.

The president's Hydrogen Fuel Initiative has made substantial investments in research, development and demonstration through 2008, while the vehicle and hydrogen titles in the Energy Policy Act of 2005 nearly quadrupled the government's share of funding out through 2010, and beyond to 2020. EPAct broadened the Secretary's authority to accelerate the RD&D process, and made government a more reliable partner in ambitious public/private partnerships with the research community and energy and automotive companies. And it gave the hydrogen programs in DoE permanent authorization, while establishing a market transition program to fund early adoption of promising technologies by federal and state government.

***Deploying into new markets*** The classic shape of the introduction of a new technology into evolving markets is shown in the following graph from the National Academy of Engineering's study on hydrogen — their "Optimistic Case" (*The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs*, 2004). Government's R&D efforts are particularly important during the early years, and the President's Hydrogen Fuel Initiative (HFI) has successfully begun to address that during 2004-2008. In EPAct, Congress decided to move well beyond this benchmark to more aggressively fund research, development, demonstration and early market transition.

The next graph, "Different Visions", contrasts the funding levels in EPAct with the HFI — the intent of EPAct was to provide more resources more rapidly, accelerating program accomplishments and establishing more technical momentum by the time the market 'S' curve begins to form. Finally, supplementing the rollout of hydrogen infrastructure to enable key bridge technologies like materials handling, auxiliary power, fleets and buses would be accomplished by the tax incentives we offer here — working in concert with an

active and aggressive RD&D program like EPAct's during 2008-2015 and beyond. We believe these components are essential to success.



### ***Hydrogen Production and Use***

Mr. Baxley also noted that the cost of hydrogen supply needs to improve before it can be widely deployed. The rollout of a hydrogen supply infrastructure depends upon steadily declining costs of hydrogen storage and compression equipment for fueling stations. This infrastructure would need to be developed in concert with the availability of hydrogen fuel cell and combustion equipment.

***A tax package*** --We believe that some real movement in commercializing hydrogen and fuel cell technologies could be achieved with focused use of tax policy tools. A flexible approach would embrace a variety of equipment, and meet the particular needs of the materials handling business, where near term results could be a bridge to eventually serving larger truck, bus and automobile fleets. These are "gateway" applications that encourage commercialization soon, establishing a foundation for broader transition to a hydrogen economy.

There is an immediate application of hydrogen fuel cell fork lift trucks and other types of materials handling equipment at large warehousing operations and distribution centers, airports and other transportation centers. Pilot efforts at Wal-Mart and the Defense Logistics Agency show great promise for improving air quality, efficiency and speed of refueling at major distribution centers.

The fueling stations could also be used for the associated truck fleets, and later for public bus, delivery van and automobile fleets. In this way a network of more generally usable public fueling stations would emerge, and induce greater public acceptance of hydrogen and fuel cell technology. As an example, the equipment used for the Wal-Mart fork lifts was also used at our international conference and expo in San Antonio in March to fuel a dozen demonstration vehicles from six different manufacturers.

The incentives would encourage private capital investment in fueling stations by crediting some of the initial mix of capital and operating costs for infrastructure and the cost of hydrogen fuel used. To enable lease arrangements, both owners and users could elect to transfer the credits for fuel used in qualified hydrogen energy conversion systems, like fuel cells and internal combustion engines {see H.R. 805 (Doyle, Terry, Wamp, Wynn), that includes a transferable hydrogen fuel credit}. To be really effective, the credits should last through 2015.

Several hydrogen incentives have already been introduced in the House of Representatives. H.R. 805 includes a tax credit for purchases of hydrogen in qualifying hydrogen energy conversion systems, while H.R. 550 extends the investment tax credit for fuel cells (an important end-use of hydrogen) from 2007 to 2016. We encourage the Committee to review this legislation.

The incentives in H.R. 805 and H.R. 550 will help end-users of hydrogen grow their businesses, run demonstration programs, and commercialize exciting new

technologies. However, the larger supply infrastructure problems remain unaddressed.

### ***Hydrogen Supply Tax Credit***

The NHA proposes a tax package to enable the market introduction of hydrogen-powered fuel cells in nearer-term and transitional commercial applications, including forklifts, buses, auxiliary and backup power units and hydrogen combustion equipment. A key challenge for these early commercialization opportunities is the upfront cost of hydrogen fueling infrastructure and the fuel itself, problems that steadily recede once reasonable volumes are achieved in these emerging markets. To address this volume gap, a 7-year tax credit for hydrogen fueling infrastructure and fuel is proposed (these provisions would also generally incorporate the tax credit features of H.R. 805). The duration of the credits specified below spans the interval critical to industry expectations about market emergence. While supporting early market penetration, the tax credit will also more generally advance several key milestones toward the hydrogen economy:

- Volume production of distributed hydrogen fueling solutions and fuel cell technology, which means lower costs and a maturing supply chain — critical prerequisites to the market introduction of fuel cell vehicles;
- The market-driven installation of hydrogen fuelling stations, funded with private capital across the United States as distribution centers, manufacturing plants, and bus depots access the tax credit.
- Public acceptance of hydrogen and fuel cell technology.

### ***Hydrogen Tax Credit Mechanisms***

1. H<sub>2</sub> Infrastructure Installation Costs: 50% of installation costs associated with hydrogen infrastructure (i.e. facility improvements, safety systems, etc.) up to \$300,000 per taxpayer (a one-time credit).
2. H<sub>2</sub> Infrastructure Costs: 30% of monthly hydrogen infrastructure costs up to \$200,000 per customer per year. The credit is structured in this manner, versus a one-time capital expense credit, to reflect the prevailing industry practice of leasing the complete suite of hydrogen equipment (generation, compression, distribution equipment, among others) to the user (e.g. a distribution center, airport, manufacturing plant or bus depot) and paying a single monthly fee. For those businesses that actually purchase the equipment, they can claim \$200,000 of this expense per year for the duration of the credit.
3. H<sub>2</sub> Fuel Costs: 30% of hydrogen fuel costs up to \$2500 per hydrogen energy conversion device (HECD) of 25 kW per year; \$5000 per year per HECD greater than 25 kW and less than 100 kW; and \$10000 per year per HECD of 100 kW or

greater. A hydrogen energy conversion device is as defined in H.R. 805: a fuel cell or internal combustion engine that operates on hydrogen, however it may be produced.

***Support for Shell Hydrogen's Testimony***

In his testimony, Mr. Baxley offered five ways the government can more effectively engage the industry to create the hydrogen economy. The NHA enthusiastically supports all five suggestions:

- Enhance education and outreach programs to students, consumers, and permitting authorities to increase public acceptance and ease siting and permitting challenges
- Coordinate federal, state, and local hydrogen permitting processes
- Act as an early adopter of hydrogen and fuel cell technologies including transportation, portable fuel cell, and backup power applications
- Support state and local efforts at early adoption and hydrogen transportation fleet purchases
- Cooperate with automakers and hydrogen suppliers to develop ways to coordinate vehicle and infrastructure rollout, e.g. in the form of public-private partnerships.

Additionally, the Committee heard testimony from Mr. Mark Chernoby of DaimlerChrysler Corporation. Like Shell Hydrogen, DaimlerChrysler is a member of the NHA, and has made a strong commitment to hydrogen fuel cell vehicles. As mentioned in their testimony, DaimlerChrysler has over 100 fuel cell vehicles in operation, and more planned. Their commitment to a hydrogen fueled future is noteworthy.

We appreciate the opportunity to address the Committee on these key factors, and look forward to working with your staff on improving our proposal.

