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2002

U.S. ENERGY SECURITY: OPTIONS TO DECREASE PETROLEUM USE IN THE TRANSPORTATION SECTOR

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY
COMMITTEE ON SCIENCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED SEVENTH CONGRESS

FIRST SESSION

NOVEMBER 1, 2001

Serial No. 107–43

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U.S. ENERGY SECURITY: OPTIONS TO DECREASE PETROLEUM USE IN THE TRANSPORTATION SECTOR

THURSDAY, NOVEMBER 1, 2001

House of Representatives,

Subcommittee on Energy,

Committee on Science,

Washington, DC.

The Subcommittee met, pursuant to call, at 10:12 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Roscoe G. Bartlett [Chairman of the Subcommittee] presiding.

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HEARING CHARTER

SUBCOMMITTEE ON ENERGY

COMMITTEE ON SCIENCE

U.S. HOUSE OF REPRESENTATIVES

U.S. Energy Security: Options to

Decrease Petroleum Use in the

Transportation Sector

THURSDAY, NOVEMBER 1, 2001

10:00 A.M.–12:00 P.M.

2318 RAYBURN HOUSE OFFICE BUILDING

1. Purpose of the Hearing

On Thursday, November 1, 2001 at 10:00 a.m. in Room 2318 RHOB, the Subcommittee on Energy will hold a hearing on "U.S. Energy Security: Options to Decrease Petroleum Use in the Transportation Sector." The Subcommittee expects that testimony will center upon the relationship between national security and the Nation's dependence on imported petroleum, particularly in the transportation sector. The Subcommittee will explore the extent to which research and development on alternative fuels—such as electricity and biofuels—and enhanced vehicle fuel efficiency can help enhance energy security. The Subcommittee also expects to hear testimony on the status of the public-private sector Partnership for a New Generation of Vehicles (PNGV) and the United States Council for Automotive Research, or USCAR, an industry research and development (R&D) consortium.

The Subcommittee will receive testimony from James Woolsey, former Director of the U.S. Central Intelligence Agency; David Garman, Assistant Secretary for Energy Efficiency and Renewable Energy at the U.S. Department of Energy (DOE); Gregory Dana, Vice President of Environmental Affairs at the Alliance of Automobile Manufacturers; Robert H. Burnette, Project Manager for Bulk Power at Dominion Virginia Power representing the Electric Vehicles Association of the Americas (EVAA); David D. Doniger, Policy Director of the Climate Center at the Natural Resources Defense Council; and Dr. James J. MacKenzie, Senior Associate for the Climate, Energy and Pollution Program at the World Resources

Institute.

2. Overview

The attacks of September 11th underline the Nation's vulnerability to terror attacks; the economic repercussions of the attacks will be felt for some time. The U.S. economy is highly dependent on imported oil; around 56 percent of U.S. petroleum demand comes from overseas with around 20 percent coming from the Middle East. A disruption of petroleum supplies, as witnessed after the Iraqi invasion of Kuwait, could have a devastating effect on the already weakened worldwide economy.

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In 1998, the U.S. accounted for about 23 percent of the world's oil consumption. U.S. consumption ran at around 17.2 million barrels per day mb/d of which approximately 11.5 mb/d was used in the transportation sector.(see footnote 1) Remaining U.S. domestic oil reserves, estimated at nearly 21.8 billion barrels, are becoming increasingly costly to produce because much of the lower-cost oil has already been largely recovered.(see footnote 2) The remaining resource has higher exploration and production costs and greater technical challenges because they are located in geologically complex reservoirs, (e.g., deep water and harsh environments).

U.S. oil production is expected to decline over the next two decades—from about 5.9 million barrels per day to 5.05 million barrels per day. One result—without factoring in significant conservation, energy efficiency or increases in domestic alternative energy production—would be further increases in U.S. dependence on imported oil.

The Committee on Science has jurisdiction over energy efficiency and alternative fuel R&D. These are essential tools to promote U.S. energy independence, or at least minimize our dependence on imported energy. Recently, the Science Committee played a major role in H.R. 4, a bill that would provide for significant increases for Federal energy R&D funding.

PNGV History and Funding

R&D to develop more energy efficient vehicles took on a new urgency during the energy shocks of the 1970's. The fruits of these R&D efforts have brought significant increases in mileage from both improved engine designs and advanced, lightweight materials used in vehicle bodies. President Clinton created the PNGV(see footnote 3) program in September 1993, which had among its goals the development of an environmentally friendly car that would triple the fuel efficiency of present day mid-sized cars without any decrease in performance, safety or increase in price relative to comparable vehicles. PNGV combined the resources of seven Federal agencies, the national labs, universities and USCAR(see footnote 4) (a research consortium between DaimlerChrysler, Ford and GM) in an effort to reduce U.S. dependence on oil, improve the environment and enhance safety. Production prototype vehicles were to be available by 2004. In recent years, R&D efforts have focused on innovative engine designs and lightweight materials.

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PNGV research programs are to continue under a new name and with a new focus under the Bush Administration. The program will apparently abandon the goal of an 80 mile-per-gallon mid-size sedan, and move to increase mileage in larger vehicles, including SUVs. Changes in program structure and emphasis make it difficult to track comparable funding levels from the FY 2001 request to the FY 2002 budget.

DOE Office of Energy Efficiency and Renewable Energy (EERE) R&D Funding

The Department of Energy budget contains funding for R&D for transportation, biomass and biofuel, and hydrogen research as indicated in the table below. DOE also devotes significant funds to wind, solar and hydropower generation, as well as related areas of energy efficient electricity generation. The Federal government has also invested in research and development on other renewable, alternative fuels for power generation. These include biomass, biofuels, solar, geothermal and wind power.

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Alternative Transportation Fuels

The transportation sector of the U.S. economy runs primarily on fuels derived from petroleum. The primary transportation fuels are gasoline and diesel fuel. Other fuels used in transportation include natural gas, electricity, bio-based fuels and fuel blends such as bio-diesel and E–85 (ethanol 85% gasoline 15%), among others.

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A brief survey of the leading transportation fuels follows:

Natural Gas

The U.S. natural gas resource is large-estimated at over 170 trillion cubic feet.(see footnote 5) However, U. S. conventional production is projected to peak as early as 2015, while demand for natural gas will most likely continue to outpace domestic production.(see footnote 6) Increasingly, the U.S. will have to rely on natural gas from unconventional resources, such as tight sands, deep formations, deep water, and gas hydrates. Much of the increased demand for natural gas will come from electric utilities. This demand may increase further if low or zero-emissions vehicle mandates are imposed on a large scale requiring at least part of the fleet to convert to natural gas or electric drive vehicles. While electric cars may be able to recharge during off-peak hours, they will further increase the demand for natural gas.

Electricity

Electricity may be used in transportation in several ways: battery storage and electric motors, gas/electric hybrids and on-board generation of electricity using hydrogen fuel cells. Much of the electricity to power so-called "plug-in" electric vehicles will be generated at centralized electric utility plants. Gas/electric hybrids

will continue to be powered by gasoline, though at much higher efficiencies, reducing gasoline consumption significantly. Hydrogen fuels cells will either operate on fuels converted to hydrogen using on-board reformers, or will require an extensive pure hydrogen infrastructure.

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Electric drive trains can get their energy from a number of feedstocks. This flexibility may become attractive to manufacturers and consumers in the future, especially if specific fuel supplies become uncertain. Battery electric vehicles have a drawback of limited range. This may be addressed through a number of R&D approaches such as new battery storage designs, or quick charge capability. On-board generation of electricity using hydrogen fuel cells could be an attractive option because it will extend range.

Alternative Fuels and Biofuels

An increasing number of vehicles can run on alternative fuels, including "flexible fuels" and other biofuels such as E–85, which is derived from many different types of biomass, ranging from corn to agricultural waste. Other sources include synfuels from oil shale and tar sands and coalbed methane. Many of these sources are unable to compete with gasoline or diesel prices without a subsidy at current gas price levels.

The ability to use alternative and renewable fuel derived from fossil synfuels and agricultural biofuels in a significant portion of the Nation's automotive fleet will be critical. To gain widespread acceptance, alternative fuels will have to meet or exceed emissions standards while being economically competitive with traditional fuels.

Questions:

What role does imported petroleum play in national security and how can alternative fuels reduce our national dependence on imported transportation fuels?

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What specific options are currently available, or are likely to be available in the future to reduce the Nation's consumption of petroleum for transportation? How will these changes affect consumption?

What is the status of DOE and government-wide research efforts to improve transportation energy efficiency and promote the use of alternative fuels?

How will industry research improve energy efficiency and promote the use of alternative fuels in vehicles?

How can industry or the Federal Government promote the use of electricity as a transportation fuel?

What role do the Nation's universities play in research to improve energy efficiency in the transportation sector and how do these efforts differ from government research programs, such as PNGV?

Chairman **BARTLETT.** We will now convene the hearing. The hearing will come to order. Today we will hear from a distinguished panel of witnesses on the Nation's energy security, an issue that has taken on renewed importance since the terrorist attacks of September 11.

This Subcommittee has already held a number of hearings this year on the realities of our energy situation. Today's hearing adds the additional critical element of national security. We have seen how vulnerable this country, our people, and our economy can be to savage terrorist attacks. Our energy situation contributes to our vulnerability. We need to address these concerns in an urgent manner.

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In 1973, at the time of the Arab Oil Embargo, we imported 34 percent of our oil. Today we import 56 percent of our oil. It is really unconscionable that we should have permitted ourselves to be in this very vulnerable position. It was bad enough in 1973 with that brief Arab Oil Embargo. What would happen today if a single tanker were sunk in the Straits of Hormuz, through which a very large percentage of our oil comes.

Today, this country imports 56 percent of its petroleum. The lion's share of that goes into transportation fuels. Around 20 percent of this petroleum comes from the Persian Gulf. The Gulf has seen more than its share of conflict over the last 30 years. Ten years ago we fought a war to keep an unfriendly government from gaining hegemony in the area. Twenty years ago, two major oil-producing countries in the Persian Gulf were at war with each other. Somehow we have managed to keep the oil flowing through the Straits of Hormuz, but we should not count on our luck holding forever.

We also have a long-term problem—world oil production rates are expected to peak later this decade, while demand continues to rise.

Today, I will ask our witnesses to soberly assess our energy vulnerabilities, particularly as they relate to the transportation sector. I do not wish to dwell on disaster scenarios. We have had enough of those lately. Rather, I hope to focus on possible solutions to our energy security problems, so that we will not have disasters in the future.

I see today's hearing is very well attended. It is also well attended by visitors to our Committee, and I want to thank those who are here on the dais who are not members of our Subcommittee. That is certainly a sign of the importance that this Committee places on finding solutions to our problems through science. There are several ways this Committee is involved in enhancing the Nation's energy position, two of which are energy efficiency and alternative energy research and development. And I am very pleased that in our authorization bill this year there is a large commitment to renewable and alternative energy development.

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Conservation also plays an important role in reducing energy use, and certainly will be a part of the discussion today. I would just like to note that the absence of blackouts in California this summer, widely

predicted, was probably attributable to the fact that Californians voluntarily reduced energy consumption by 11 percent. Nobody thought that that kind of voluntary conservation was doable, but they did it. And I think that we need a larger focus on conservation across the country.

It is simple common sense to get as much energy out of a gallon of gas or a watt of electricity as you can. I drive a highly efficient hybrid electric vehicle that squeezes twice the mileage out of a gallon of gas as an average vehicle, without sacrificing comfort, convenience, or safety. And, by the way, it pollutes as little as 1/10 as much as the other cars in its class.

Unfortunately, energy efficient vehicles alone cannot address our energy security concerns. We need to develop alternative sources of energy that can be used in place of petroleum by both our existing and future vehicles. These new sources of energy should be sustainable, if possible, and take into account concerns about emissions.

I know that Americans are resourceful and resilient people. The attacks of September 11 have steeled our resolve against terrorism. I also think that the American people are ready to accept change and sacrifice, especially if that sacrifice, in the short term, brings long-term benefits. The challenge to scientists and to this Committee is to help find ways to stretch our existing energy reserves through efficiency. That may give us sufficient time to transition to the new forms of energy that will be discussed in this hearing. It is incumbent on all of us, as Americans, to help out wherever possible by using our common sense to conserve energy and to be as efficient as we can in our daily lives.

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The House recently passed H.R. 4, the S.A.F.E. Act, which not only increases funding for R&D on energy efficiency and alternative fuels, but also encourages adoption of alternative fuel vehicles in the Federal fleet. That will be an important step in gaining acceptance and building alternative fuel infrastructure around the country. There are many other provisions in H.R. 4 that are forward looking and a few that I do not agree with, but, on balance, I think it is a very good effort by this House.

Today, our witnesses will discuss how efficiency and alternative fuel research and development are meshing together, both in the lab and out on the road. As we speak, there are electric, natural gas, and hybrid electric vehicles on the road in and around the Capitol. Many of these alternative-fuel and hybrid vehicles were purchased to help improve air quality in Washington.

We also recently had a visit to the Hill by a number of hydrogen internal combustion engine and fuel cell vehicles. I joined other members in putting these vehicles through their paces. They were excellent examples of how research over the last couple of decades will improve our lives today.

Our witnesses today are Mr. Jim Woolsey, Former Director of the U.S. Central Intelligence Agency; Dave Garman, Assistant Secretary for Energy Efficiency and Renewable Energy at the U.S. Department of Energy; and, sir, if you don't do your job well, we may be in a heap of trouble in the future. And Gregory Dana, Vice President of Environmental Affairs at the Alliance of Automobile Manufacturers; Robert Burnette, Project Manager for Bulk Power at Dominion Virginia Power, representing the Electric Vehicles Association of the Americas; David Doniger, Policy Director of the Climate Center at the Natural Resources

Defense Council; and Dr. Jim MacKenzie, Senior Associate for the Climate, Energy, and Pollution Program at the World Resources Institute.

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I am looking forward to hearing today's testimony and pursuing these subjects in greater detail. Before we get started, however, I would like to remind the members of the Subcommittee and our witnesses that this hearing is being broadcast live on the Internet, so please keep that in mind during today's proceedings.

I would also like to ask unanimous consent that all members who wish may have their opening statements entered into the record. Without objection, so ordered. Our Full Committee chair has joined us and I would like to recognize him now for any statement that he might wish to make.

[The prepared statement of Mr. Bartlett follows:]

PREPARED STATEMENT OF CHAIRMAN ROSCOE BARTLETT

Today we will hear from a distinguished panel of witnesses on the Nation's energy security, an issue that has taken on renewed importance since the terrorist attacks of September 11th. This Subcommittee has already held a number of hearings this year on the realities of our energy situation. Today's hearing adds the additional critical element of national security. We have seen how vulnerable this country, our people, and our economy can be to savage terrorist attacks. Our energy situation contributes to our vulnerability. We need to address these concerns in an urgent manner.

Today, this country imports 56 percent of its petroleum. The lion's share of that goes into transportation fuels. Around 20 percent of this petroleum comes from the Persian Gulf. The Gulf has seen more than its share of conflict over the last 30 years. Ten years ago we fought a war keep an unfriendly government from gaining hegemony in the area. Twenty years ago, two major oil-producing countries in the Persian Gulf were at war with each other. Somehow we have managed to keep the oil flowing through the Straits of Hormuz, but we should not count on our luck holding forever.

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certainly will be a part of the discussion today.

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Our witnesses today are:

Jim Woolsey, former Director of the U.S. Central Intelligence Agency;

Dave Garman, Assistant Secretary for Energy Efficiency and Renewable Energy at the U.S. Department of Energy (DOE);

Gregory Dana, Vice President of Environmental Affairs at the Alliance of Automobile Manufacturers;

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Robert Burnette, Project Manager for Bulk Power at Dominion Virginia Power representing the Electric Vehicles Association of the Americas (EVAA);

David Doniger, Policy Director of the Climate Center at the Natural Resources Defense Council; and,

Dr. Jim MacKenzie, Senior Associate for the Climate, Energy and Pollution Program at the World Resources Institute.

Chairman **BOEHLERT.** Thank you very much, Mr. Chairman. I do appreciate it. And this is the subject of a very important—of great importance to America. I have just come back from the Senate where I testified on a bill over there before Energy and Public Works, and one of the interesting exchanges we had dealt with reducing our dependence on foreign-source oil. And one of the recommendations I had, and it won't surprise anyone, is that we increase CAFE standards for light trucks and SUVs. We will save a lot of oil by doing that.

But I am anxious to be here as long as I can be before going on to the next thing and to hear our distinguished panel of witnesses. And I want to thank them for being resources for this Committee. We value greatly your input and, thank you, Mr. Chairman, for that courtesy.

Chairman **BARTLETT.** Well, thank you very much. I now turn to my distinguished colleague, Ms. Woolsey, for an introduction and—I am sorry—and her opening remarks.

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Ms. **WOOLSEY.** Well, thank you, Mr. Chairman, and thank you, Mr. Super Chairman, for being here and being interested in this today and for rescheduling this hearing. I am really impressed with this panel and I think we are going to learn a lot. I would like, for the record, everybody to know that I am not related to Director Woolsey, but he looks so much like my ex-brother-in-law, that I think we are related somehow. I mean, we just have to know that. We—some time we need to sit down and figure out where those lines go. Yeah. It is. The hairstyle and the face.

Earlier this year, when the Committee—this Committee debated National Energy Policy, the issue of energy independence was brought up over and over again and it was referred to frequently by members on both sides of the aisle. But now, as we contemplate the world of post-September the 11th, the topic takes on a more urgent tone as it is mostly spoken about in relation to our national security.

In this sense, I don't think there is any dispute, particularly in this room, that we must decrease our dependence on foreign oil. With the transportation sector being the biggest user of petroleum, it has become —actually it has become a no-brainer that it is a smart place to start in cutting petroleum usage.

The American people are behind us because they know it is also in their interest, as consumers, to be independent of foreign oil. What this debate actually focuses on, and where I know our witnesses will share their professional insight with us, is how and by what means we reduce our oil/petroleum reliance.

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On behalf of my constituents in Marin and Sonoma Counties, the two counties just north of San Francisco, across the Golden Gate Bridge, I have long championed that our focus must be to reduce our overall reliance on fossil fuels and instead make renewable energy and energy efficiency a much greater priority in this Nation.

By adapting this philosophy, we know that we will be able to improve the transportation sector arguments for greater funding in this regard. Likewise, we could help reach the goal of reducing our dependence on petroleum by strengthening CAFE standards for all cars and SUVs. And what my constituents and I also know, and many of my colleagues agree, is that we absolutely should not drill the 1b million acres of pristine wilderness up in Alaska to get a meager 6-months' supply of oil in—just so that we can say we are getting our oil domestically. We know there is a cause and effect and a balance that must be struck, and that is not part of it.

While CAFE standards and drilling in the arctic refuge may not be under the jurisdiction of this Committee, and I know it isn't, we do have the ability to increase R&D funding in areas that show promise to help reduce petroleum usage in the transportation sector. That is why, Mr. Chairman, I look forward—and to the panel—hearing our panel's recommendations on what alternative methods they would propose on our path to increase national security through more diverse energy sources, and what type of R&D investments are needed to make this vision a reality, because that is where we can help you. Thank you. With that, Mr. Chairman, I yield back my time.

Chairman **BARTLETT.** Thank you very much. Without objection, the full written testimony of all the witnesses will be entered into the record. If you can summarize your remarks, rest assured that there will be more than ample opportunity to expand on any point you wish to expand on during the question and answer period. And time always seems much shorter when you are answering somebody's question than when you are—than when you are giving your opening statement. So if you could summarize your testimony, there will be plenty of time for expansion of your interest.

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Generally, we face a serious energy security predicament. How do you suggest we get ourselves out? Director Woolsey, I read, with great interest, your article with Richard Lugar, published several years ago on how we might, with engineered—bioengineered bacterium, split cellulose into glucose molecules, which can then be fermented to produce alcohol. We are really pleased that you are with us today, and you may proceed.

STATEMENT OF R. JAMES WOOLSEY, SHEA & GARDNER, AND FORMER DIRECTOR, U.S. CENTRAL INTELLIGENCE AGENCY

Mr. **WOOLSEY.** Thank you, Mr. Chairman. Mr. Chairman, Congressman Woolsey, I feel particularly welcome before this Committee, given its interests and my last name, as well. I thank the Committee for its indulgence. I submitted Senator Lugar's and my article, but due to travel and just getting back last night, I have not submitted a written statement. I will seek to summarize the points here very briefly on what the Committee is interested in.

First of all, our dependence on foreign oil, and particularly the world's dependence on Mid-Eastern oil, is bad and getting worse. The Middle-East holds h to j of the world's proven reserves, depending on whether you count the Caspian Basin or just the Persian Gulf. And, although deep exploration alternatives are interesting and useful, most of this technology relates to more rapid exploitation of fields rather than to new fields.

And if one sets aside the heavy oil and tar sands, which are—we are going to have rather high environmental and economic costs for exploitation—one ends up with a range of estimates of between one trillion and two trillion barrels of proven reserves. And what that means is that world production begins to turn down some time between 2010 and 2020, or between the time when a child born this year graduates from, say, the third grade and a child born this year graduates from high school. So as each year goes on, our dependence on the Mid-East, the world's dependence on the Mid-East is going to get greater and greater.

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Approximately four million oil wells have been drilled since the 1860's and approximately three million of them have been drilled in the United States. So we are not going to discover any Kuwaits underneath our territory. Indeed, Kuwait, alone, has about three times our reserves. We import more oil than any country in the world uses. And of our deficit of over a billion dollars a day in current accounts, we borrow a billion dollars a day from the rest of the world, more, really, last year, to finance our consumption. Over 100 billion of that, the largest single component, is for imported oil.

Now, since we are all depending more and more on the Mid-East, and since the Mid-East constitutes a set of governments outside Israel and Turkey, which, unfortunately, don't have any oil, that is composed either of pathological predators or vulnerable autocrats, this is not a recipe for long-term stability. And I trust even those who are reluctant to face that issue, as of last September 10, came to realize, at least by the afternoon of September 11, that dependence for the world on the Mid-East, for the foreseeable future, for our petroleum, is a disaster waiting to happen.

Second, we are a Nation of a lot of networks, whether it is the Internet or oil and gas pipelines or food distribution, and dozens and dozens of them—virtually, none of these were put together with a single thought being given to their vulnerability to terrorist attack or to centralization. They were put together reasonably well to deal with natural disasters or with random failures, but terrorist exploitation is quite another thing.

And, as we have seen now, two of these networks, civil air transport and mail delivery, can be used cleverly by terrorists, and we have to realize that our fuel distribution and our energy distribution and transmission systems are almost certainly going to come under attack in some way. Their high degree of centralization and their fragility to terrorist attack is a serious matter.

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And one thing we ought to always be looking at, as the years go on—and I fear we are going to be in this war that we are in now for a number of years—one thing we have to be looking at is how to decentralize and how to make more flexible and more—and less fragile our energy distribution networks. To me, that means more small electric generators, for example, rather than a few centralized ones. It means local production of renewable fuels and alternate energy, rather than relying on imports and central fuel stations and the like.

Approximately 20 years ago, Hunter and Amory Lovins wrote a book called, "Brittle Power," about the vulnerability of the American energy system. The former Chairman of the Joint Chiefs, Tom Moorer, and I wrote the foreword to that. Some people remarked, at the time, that the hawks met the greens and I said, yes, we hawks need a place—nice places to nest, and trees are a good place for hawks to nest and there is no incompatibility between being a hawk and being a green. Hunter and Amory said in that book that a few people without leaving Louisiana in one night could probably shut down something like h of the country's oil and gas pipelines. I don't know that that is still true, but I asked Amory Lovins the other day if it was close to true and he said it is a little better, but not much.

So we have a huge set of problems with respect to the vulnerability of our energy systems and the need to decentralize them and make them more flexible, make them more resilient, make them more representative in a sense of the genius of this country, which is decentralization and federalism and local autonomy and local independence.

Let me say a quick word about several potential steps and then I leave it for others to make their statements. Certainly, I think, renewable and alternate fuel credits are extremely important. I believe that one major untapped resource in this country is waste of all sorts. And, by volume, agricultural wastes are far and away the largest, not only from the fields, but also from packing plants, from pig farms, and the like. There are processes that turn this type of waste into energy and we should give as much credit as possible to exploiting those as much as we can.

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Flexible fuel vehicles—alternative fuel vehicles are an excellent idea, but one interesting aspect of flexible fuel vehicles, FFVs, which now get CAFE standard credit, is that they can use up to 85 percent ethanol. And they have come under criticism, from some in the environmental community in recent years, because—that is, the credits have come under criticism because there is not the ethanol there to use. And there will never be the ethanol there to use as long as ethanol is only made from feed grains, because feed grains' starch constitutes way under 1 percent of what grows in the world.

But if one can make transportation fuel out of waste, then we are beginning to have something. And if we have a fleet of flexible fuel vehicles in being so that that energy may be used in those vehicles, even though they burn gasoline now, they could burn other things later, including particularly ethanol gasoline mixtures, then we don't have to wait year by year for just a few electric vehicles or a few of these or a few of those or a few fuel cell cars to be produced to make an impact on our fuel use. We have a fleet in being that can burn up to 85 percent ethanol. And this is not rocket science. All cars in Brazil are flexible fuel vehicles. This is a computer chip in the fuel system and a little bit of different kind of plastic in the fuel line. And millions of them have come off the production lines already.

So as we look at the steps we want to take, by way of giving production credits for the right types of alternative fuels and renewable fuels, as we give CAFE standard credits for the right types of vehicles, we need to look at what we can do quickly and what can be done in order to make the current infrastructure compatible with changes that could occur with relative quickness compared to long-term ideal solutions. And to my mind, that means rapid commercialization of some of these technologies. It means a great deal of attention to what can be done with the current infrastructure, modestly adapted, as distinct from brand new and ideal situations.

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Finally, Mr. Chairman, let me say that I know the issue of the ANWR has sharply divided the Congress and public debate. My view on that issue is not driven by the environmental concerns. Having grown up in Oklahoma, hunting and fishing around stripper wells, I am—I have always been, and I guess a lot of Okies are, somewhat tolerant of having oil wells around. That doesn't bother me so much, although I recognize that Alaska is a fragile situation. I think the problem with ANWR is not so much the environmental issue as it is the Trans-Alaska Pipeline, which is exactly the kind of example of a brittle part of the infrastructure, easily interfered with and easily disrupted, that I am concerned about.

So as the Committee looks at research and development, as it looks at public policy issues of that sort, it seems to me it is the vulnerability and the brittle nature of our energy and our energy transmission systems that ought to draw our—in these days and times, ought to draw our first and foremost concern. Thank you, Mr. Chairman.

[The prepared statement of Mr. Woolsey follows:]

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BIOGRAPHY FOR R. JAMES WOOLSEY

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R. James Woolsey is, in 2001, a partner at the law firm of Shea & Gardner in Washington, D.C. He returned to the firm in January 1995 after serving two years as Director of Central Intelligence. He has practiced there for twenty-one years, on four occasions, since 1973.

Mr. Woolsey's law practice has been in the fields of civil litigation, alternative dispute resolution, and corporate transactions; increasingly his practice has been international. He has served recently as counsel for major American and overseas corporations in both commercial arbitrations and the negotiation of joint ventures and other agreements. He serves regularly as a neutral (both as an arbitrator and a mediator) in commercial disputes between major companies.

Mr. Woolsey is presently a member of the Board of Directors or Board of Managers of: Linsang Partners, LLC; BC International Corporation; Fibersense Technology Corporation; Invicta Networks, Inc.; DIANA, LLC; Agorics, Inc. and Sun HealthCare Group, Inc. He is also a member of the Board of Governors of the Philadelphia Stock Exchange. He has served in the past as a member of the Boards of USF&G; Yurie Systems, Inc.; Martin Marietta; British Aerospace, Inc.; Fairchild Industries; Titan Corporation; and DynCorp.

Besides serving as Director of Central Intelligence, Mr. Woolsey has served in the U.S. government as: Ambassador to the Negotiation on Conventional Armed Forces in Europe (CFE), Vienna, 1989–1991; Under Secretary of the Navy, 1977–1979; and General Counsel to the U.S. Senate Committee on Armed Services, 1970–73. He was also appointed by the President as Delegate at Large to the U.S.–Soviet Strategic Arms Reduction Talks (START) and Nuclear and Space Arms Talks (NST), and served in that capacity on a part-time basis in Geneva, 1983–1986. During military service in the U.S. Army he served as an adviser on the U.S. Delegation to the Strategic Arms Limitation Talks (SALT I), Helsinki and Vienna, 1969–1970.

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Mr. Woolsey has been a Director or Trustee of numerous civic organizations, including The Smithsonian Institution, where he was Chairman of the Executive Committee of the Board of Regents, The Goldwater Scholarship Foundation, The Aerospace Corporation, and Stanford University. He has been a member of: The National Commission on Terrorism, 1999–2000; The Commission to Assess the Ballistic Missile Threat to the U.S. (Rumsfeld Commission), 1998; The President's Commission on Federal Ethics Law Reform, 1989; The President's Blue Ribbon Commission on Defense Management (Packard Commission), 1985–1986; and The President's Commission on Strategic Forces (Scowcroft Commission), 1983. He is currently a Trustee of The Center for Strategic & International Studies and Chairman of the Advisory Committee of the Clean Fuels Foundation.

Mr. Woolsey was born in Tulsa, Oklahoma, in 1941. He is married to Suzanne Haley Woolsey, the Chief Operating Officer of the National Academy of Sciences, and they have three sons: Robert, Daniel, and Benjamin. Mr. Woolsey attended Tulsa public schools, graduating from Tulsa Central High School in 1959. He received his B.A. Degree in 1963 from Stanford University (With Great Distinction, Phi Beta Kappa), an M.A. from Oxford University, where he was a Rhodes Scholar 1963–65, and an LL.B from Yale Law School in 1968, where he was Managing Editor of the *Yale Law Journal.*

Mr. Woolsey is a frequent contributor to major publications, and from time to time gives public speeches, on the subjects of foreign affairs, defense, energy, and intelligence.

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Chairman **BARTLETT.** Thank you very much. Mr. Garman.

STATEMENT OF THE HONORABLE DAVID K. GARMAN, ASSISTANT SECRETARY FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. **GARMAN.** Thank you, Mr. Chairman, and thank you for this opportunity to discuss our growing dependence on imported oil. I will focus my remarks on options to reduce petroleum use in the transportation sector.

The transportation sector, of course, is key since it consumes 67 percent of all the petroleum we use and is 95 percent dependent on petroleum. Our dependence on imported oil is expected to grow, and there is no single strategy that will free us from this dependency in the near term. Clearly, we must increase vehicle efficiency through new technology. We must promote domestic oil and gas production, and we must diversify our energy resources.

My first chart illustrates our decline in domestic production relative to increased demand. The growth of

light-truck passenger vehicles, which includes sport utility vehicles, vans, and pickups, is dramatically apparent in this chart. That is the light blue section.

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The next chart is another view of domestic oil production measured against projected transportation oil use with some policy action superimposed to illustrate the challenge we face in closing the gap. New oil production from the Arctic National Wildlife Refuge would certainly make a difference, but it does not close the gap. Research and development that incrementally improves the efficiency of vehicles helps as well, but business-as-usual R&D is also insufficient to close the gap.

The current business-as-usual approach is embodied in the program known as the Partnership for a New Generation of Vehicles, or PNGV. One of the goals of the PNGV program was to develop, by 2004, a production-prototype family sedan with three times the fuel efficiency of a comparable 1994 model without sacrificing affordability or marketability. While the PNGV program has delivered some technologies that can be seen in the market today, the program will not reach its 2004 goal.

Earlier this year, Secretary Abraham expressed his concerns about the orientation and goals of the PNGV program. He questioned the wisdom of pursuing production prototypes of passenger sedans when most new vehicle sales are in the light-truck category. The Secretary's observations were later validated through the National Research Council's annual review of the PNGV program. The Council found that a redefinition of the PNGV charter and goals is needed to better reflect societal needs and the ability to—of a cooperative, pre-competitive R&D program to address these needs successfully.

The PNGV program is near the end of its 10-year charter. And, as we would with any program coming to the end of its charter, we are assessing whether it represents the best approach to increasing vehicle efficiency and reducing our petroleum dependence.

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Secretary Abraham, at a recent DOE leadership meeting, asked us to take a bolder approach to our work. He directed us to focus our efforts on programs that revolutionize how we approach conservation and energy efficiency. He challenged us to "leapfrog the status quo and prepare for a future that, under any scenario, requires a revolution in how we find, produce, and deliver energy." He challenged us to seek potentially abundant new sources of energy with dramatic environmental results.

As a consequence of the Secretary's challenge and the recommendations in the President's National Energy Plan, we intend to be more aggressive in the pursuit of revolutionary transforming technologies. We view technology portfolio investment similar to the way that a stock investor would view a stock portfolio. The portfolio, as a whole, can be conservative with lower risks and modest returns, or it can be aggressive with potentially higher risks and potentially higher rewards.

The higher risk, higher reward strategy we have in mind leads to the use of fuel cells powered by

domestically derived hydrogen. There is a risk is overcoming the significant technological barriers along this path, not the least of which involve the cost and durability of fuel cells.

While we will boost our efforts related to fuel cells and hydrogen, we will also maintain some of our efforts in combustion and emissions control, power electronics, advanced batteries, materials, and advanced fuels. However, relatively mature technologies, such as those related to spark-ignited or natural gas engines, will receive less Federal emphasis. We expect that our private sector partners will assume the major burden of further development of the most promising of these mature technologies.

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And although we will be reorienting our technology portfolio to deliver a hydrogen fuel cell future, we cannot afford to wait, nor should we wait for the hydrogen fuel cell solution. As new technologies related to advanced internal combustion engines, hybrid vehicle systems, weight-reducing materials, and fuels are demonstrated, we will work with industry to facilitate their migration to the market.

My written statement goes into further detail on biofuels, alternatively fueled vehicles, and advanced truck R&D, however, with respect to biofuels, I must raise an important issue that limits our ability to pursue an aggressive, coordinated biofuels program. Yesterday's Energy and Water Development Appropriations Confidence Report came out and earmarked roughly 42 percent of our biomass, biofuels funding level. Frankly, a cohesive, results-oriented program will be difficult for us to achieve with this level of earmarking.

To conclude, we must, as a Nation, move more aggressively to increase fuel and diversify our domestic energy supplies and radically increase vehicle fuel economy through technology advances while maintaining vehicle safety, affordability, and performance.

Secretary Abraham has challenged us to leapfrog the status quo and to reach toward revolutionary transformational technologies. Our ultimate goal is to achieve emission-free, carbon-free, safe, and affordable personal transportation. We will reshuffle our technology portfolio toward that eventual goal. This will entail more risk, but it will invite greater reward. Thank you, Mr. Chairman.

[The prepared statement of Mr. Garman follows:]

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PREPARED STATEMENT OF DAVID K. GARMAN

Mr. Chairman, thank you for inviting me to discuss one of our Nation's most critical energy issues—our growing dependence on oil, and its related energy security implications. In keeping with the invitation, I will focus my remarks on options to decrease petroleum use in the transportation sector.

We often think of energy being consumed in three end-use sectors: buildings, industrial, and transportation. Of the three, transportation consumes 27 percent of our total energy and exhibits the least

variation in energy sources and uses. The most striking feature of the transportation sector is its nearly complete dependence on petroleum as an energy source. Our transportation sector is 95 percent dependent on petroleum, and it consumes 67 percent of all the petroleum used in our Nation.

The situation we face today is in some ways more acute than it was during the so-called "oil crises" of the 1970s. In 1975, we had net imports of 5.8 million barrels per day, or 36 percent of our needs. During the first seven months of 2001, net imports averaged 10.9 million barrels per day, or 55 percent of our demand.

Over the past 18 years the Nation's oil use for transportation has grown at an average annual rate of about 2 percent, with fuel use by heavy and light trucks both growing at a rate greater than 4 percent in the last decade. Present consumption for highway vehicles is about 10 million barrels per day. Last year, oil imports increased our balance of payments deficit by $109 billion.

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Our future dependence on imports is expected to grow because of our higher consumption, and a decline in domestic production. Today, the U.S. uses 26 percent of the world's oil but it produces only 12 percent of the total global supply and has only 2 percent of the world's petroleum reserves (at current prices).

There is no single strategy that will free us from this dependency in the near term. Clearly:

We must increase vehicle efficiency through the development and introduction of new technology.

We must promote domestic oil and gas production.

We should diversify our energy sources.

We should enhance the security and efficiency of our fuel delivery infrastructure.

The first chart illustrates our decline in domestic oil production relative to the increased demand needed to fuel the growing numbers of automobiles, light trucks, and heavy trucks. The growth in numbers of light truck passenger vehicles—which includes vans, pickups, and sport utility vehicles—is dramatically apparent in this chart.

My second chart is another view of domestic oil production measured against projected transportation oil use, with some policy actions superimposed to illustrate the challenge of closing the gap. New oil production from the Arctic National Wildlife Refuge (ANWR) would certainly make a difference. . .but it clearly does not close the gap. Research and development (R&D) that incrementally improves the efficiency of vehicles helps as well, but "business as usual" is also insufficient to close the gap.

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Clearly, we face a serious challenge, and "business as usual" approaches are not enough.

The Partnership for a New Generation of Vehicles: Some Lessons Learned

The current approach is perhaps best embodied in the program known as the "Partnership for a New Generation of Vehicles," or PNGV. One of the goals of the PNGV program was to develop, by 2004, a production-prototype family sedan with three times the fuel efficiency of a comparable 1994 model without sacrificing affordability and marketability. Unfortunately, the program will not reach this goal.

Begun in 1993, the PNGV program linked the resources of seven federal agencies with those of the auto industry and academia to conduct cooperative R&D on a portfolio of technologies with the potential to dramatically increase fuel economy in passenger vehicles. Among the agencies participating in PNGV, the Department of Energy (DOE) contributes the majority (86 percent in FY 2001) of the funding that is directly relevant to the PNGV goals in accordance with the plans developed by the PNGV government-industry technical teams.

The PNGV program has delivered some technologies that can be seen in the market today. Some of these results include:

New composite and thermoplastic materials—General Motors (GM) is using composites to produce the truck bed for its 2001 Silverado, saving 50 pounds over earlier models equipped with steel truck beds. DaimlerChrysler incorporated a recyclable thermoplastic hardtop in its 2001 Jeep Wrangler.

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Increased application of lightweight aluminum for automobile construction—Ford is including 412 pounds of aluminum in the Lincoln LS, saving 188 pounds relative to conventional construction. GM is utilizing hydroformed aluminum door, deck and hood panels to reduce the weight of Cadillac, Oldsmobile and Chevrolet vehicles. DaimlerChrysler experimented with an aluminum-intensive vehicle and introduced the Prowler in model year 1998. These weight savings are accomplished without compromising safety.

New manufacturing techniques—GM Saturn vehicles are using axle shafts produced with a process controller developed with DOE support. The resulting shaft is lighter and requires less energy to produce. Ford has installed and is evaluating a similar controller.

While PGNV-derived hybrid-electric technologies are not yet in the market, they are expected soon. DaimlerChrysler, Ford and GM have announced that hybrid electric drive options will be available in popular market segments during the 2003–2004 time frame: Dodge Durango (2003), Ford Escape (2003), Chevrolet Silverado (2004) and Ford Explorer (perhaps in 2005). In general, these configurations are expected to deliver equal or better performance while also improving fuel economy by between 15 and 35 percent. In some situations, the fuel economy gain will be even greater.

For example, the Ford Escape hybrid will offer the performance of a standard V–6, while achieving nearly double the fuel economy of a conventional Escape in city driving. Each of these hybrids will incorporate technologies that were developed or enhanced through DOE's program. In contrast to the hybrids being offered in low volumes by Toyota and Honda, we are told that each of these U.S.-built hybrids will be available as options in popular, high volume market segments, and will be built on the same

assembly lines as conventional models.

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These are important results, but we will clearly have to significantly accelerate the pace of getting these and more dramatic technologies into the marketplace if we expect to make a substantial impact on our petroleum dependency.

Earlier this year Secretary Abraham expressed his concerns about the orientation and goals of this program. He questioned the wisdom of pursuing production prototypes of passenger sedans when most new vehicle sales in this country are in the light truck category, including minivans, SUVs and pickups. And, as we have seen, the PNGV program will not meet a key goal. We maintain that it is not enough to validate new technology. The advances of this program must find their way into the market, and they must deliver clearly demonstrable benefits to society.

The Secretary's observations earlier this year are consistent with the findings of the National Research Council's (NRC) annual review of the PNGV program, published this past August. The NRC found that a redefinition of the "PNGV charter and goals" is needed to "better reflect societal needs and the ability of a cooperative, pre-competitive R&D program to address these needs successfully."

Our experience with PNGV has taught us other lessons as well:

The "industry partnership" approach is a good approach. DOE and its predecessor agencies have been involved in supporting advanced automotive fuel economy research for over three decades. In the past, R&D were conducted through contracts with individual industry partners. PNGV pulled together ongoing advanced transportation programs under its partnership umbrella, providing valuable alignment and focus to the R&D. PNGV differed significantly from earlier efforts with a greater reliance on technical teams comprised of scientists and engineers from government, industry and the laboratories to establish technical targets and develop detailed research roadmaps.

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Contrary to the criticism often leveled that government doesn't know when to stop funding a technology that lacks promise, the PNGV partners have been successful in "deselecting" technologies, thanks in part to the approach to cost sharing. Stirling engines, gas turbines, ultracapacitors (for energy storage), and flywheels are all among the technologies that have been "deselected" for PGNV vehicles.

Research to develop technologies eventually judged "less promising" for automotive application should not be considered a failure, since research results can lead to the consideration of these technologies for use in other applications. For example, ultracapacitors from our automotive efforts have now been selected as appropriate for heavy bus applications and may be utilized in power electronics; gas turbine developers are employing technology advanced for use in transportation for stationary power source applications instead.

The R&D planned and guided by our PNGV partners has had some difficulty responding to new technology

opportunities due to the inflexibility of the budgetary cycle, in which initial planning and actual execution may be separated by as much as three years. And generally, only $500,000 or 10 percent of appropriated R&D funds, whichever is lower, may be redirected without congressional approval. When such approval is sought, it takes at least 6 months and is never assured. The PNGV experience suggests value in considering multi-year funding for major R&D efforts, and providing more flexibility in the appropriation language.

The multi-agency funding of projects was approached primarily through capitalizing on existing, ongoing research, with the expectation of research redirection and budget—augmentation. Redirection of research did not occur to the extent expected, and Congress did not provide augmentation of agencies' budgets. In retrospect, a modest (five percent) central budget would have been valuable to apply to "gap filler" research that could respond to new developments until more traditional funding sources could be tapped.

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The PNGV program is near the end of its 10-year charter, and as we would with any program coming to the end of its charter, we are assessing whether it represents the best approach to reducing our petroleum dependence.

The Need for a More Aggressive Approach Toward Hydrogen and Fuel Cells

Secretary Abraham, at a recent DOE leadership meeting, asked us to take a bolder approach to our work. He directed us to focus our efforts on programs that "revolutionize how we approach conservation and energy efficiency." He challenged us to "leapfrog the status quo and prepare for a future that, under any scenario, requires a revolution in how we find, produce and deliver energy."

We need to do this, according to Secretary Abraham, ". . .not simply because many of our resources are depletable. . .not simply because we are increasingly dependent on energy from areas of the world that are periodically unstable. . .(and) not simply because questions surrounding climate change force us to confront policies that focus on a carbon-free society."

"Success in this mission," according to Secretary Abraham, "could well be one of the greatest contributions to our energy and national security for generations to come." He further asked us to seek "potentially abundant new sources of energy with dramatic environmental benefits."

As a consequence of the Secretary's challenge and the recommendations in the President's National Energy Plan, we intend to be more aggressive in the pursuit of revolutionary, transforming technologies. We view technology portfolio investments similar to the manner in which an investor would view a stock portfolio. The portfolio as a whole can be conservative, with lower risks and modest returns. Or it can be aggressive, with higher risk and potentially higher rewards.

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The higher-risk, higher-reward strategy we have in mind leads to the use of fuel cells powered by domestically derived hydrogen. While fuel cell technology is promising, there are significant technological

barriers that must be overcome, not the least of which involve the cost and durability of fuel cells. For example, a light duty passenger vehicle powered by a fuel cell is currently projected to cost between five and six times more than a comparable internal combustion engine-powered vehicle. In addition, there are challenges involved in producing, moving, storing and dispensing hydrogen in an affordable manner.

The Department of Energy's Hydrogen Program already supports research and development in the areas of hydrogen production, storage and utilization. Cooperative research includes the development of off-board production of low-cost hydrogen through steam-methane reforming of natural gas at refueling stations. This approach offers opportunities to produce hydrogen for fuel cell vehicles that can be cost competitive on a cents/mile basis with conventional gasoline vehicles. With increasing amounts of natural gas being consumed to generate electric power, production levels and infrastructure must be considered before adopting vehicle fuel strategies that depend on natural gas. However, advanced concepts can reduce hydrogen production costs even further. With continued improvements in renewable power systems, hydrogen could be produced without significant carbon emissions and would further reduce our reliance on fossil fuels. Recently, advances in the development of low-weight high-pressure (5,000 psi) storage tanks have reduced the projected weight of hydrogen vehicles. Breakthroughs in the development of transitional metal hydride storage systems offer reduced size and pressure storage options for hydrogen that will be important in supporting the introduction of fuel cell vehicles. Continued progress over the next decade should lead to economically competitive refueling station networks and the deployment of hydrogen fuel cell fleet vehicles and buses.

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We believe the technical challenges we face represent a significant but acceptable risk, given the potential rewards of a hydrogen fuel cell transportation system. But because our research is cost-shared with industry partners and funded in part with dollars appropriated by Congress, DOE alone cannot undertake this shift. We will need your help, and the cooperation and participation of our industry partners.

We will work to streamline and refocus our joint automotive R&D efforts to provide greater emphasis on those long-term technologies that offer major societal benefits. While we will boost our efforts related to fuel cells and hydrogen, we will also maintain some of our efforts in combustion and emission control, power electronics, advanced batteries, carbon-based materials, and advanced fuels. However, relatively mature technologies, such as those related to spark ignited engines or natural gas engines, will receive less federal emphasis; we expect that our private sector partners will assume the major burden of further development of the most promising of these mature technologies.

We understand that our private sector partners would welcome the increased flexibility that a restructuring of the PGNV program could provide, seeing opportunities to better align their efforts with market sectors where the best business cases for advanced technologies can be made. Discussions are ongoing between industry and the Administration to identify specific details of a restructured, refocused program.

We will be reshuffling our technology portfolio to be more aggressive, reorienting it to deliver a hydrogen/fuel cell future. But we cannot afford to wait, nor should we wait, for the hydrogen/fuel cell solution. As

new technologies related to advanced internal combustion engines, exhaust after-treatment, hybrid vehicle systems, advanced petroleum based fuels, alternative fuels, and weight-reducing materials are demonstrated, we will work with industry to facilitate their migration to the market, ultimately reducing our dependence on imported petroleum.

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Biofuels

We will also continue development of domestic biofuels as an alternative to imported petroleum.

Biofuels, including ethanol and biodiesel, have been part of DOE's portfolio since the origin of the Department. The Energy Security Act of 1978 created the Alcohol Fuels Office that supported ethanol R&D, as well as a program to financially support the development of an ethanol industry. Today, that industry utilizes approximately 600 million bushels of corn each year to produce over 1.8 billion gallons of ethanol. A record number of new corn-to-ethanol plants are scheduled to begin production in 2001, contributing to the industry's ability to respond to growing market demand for clean burning octane enhancers and oxygenates. Importantly, these new facilities will provide much needed economic stimulus to rural communities faced with record low commodity prices and shrinking export markets.

This Administration is continuing the support of ethanol at the national level. Today, ethanol can be used in gasoline blends at 10 percent ethanol—90 percent gasoline (E10) since no barrier exists in terns of vehicle availability; all gasoline-fueled cars are warranted for E10. The President's National Energy Plan recommends an extension of the ethanol excise tax exemption. The report further acknowledges that ethanol is the most widely used biofuel.

Corn (and other grain) starch to ethanol is a technology that has greatly improved in efficiency over the years and is approaching a relatively high level of maturity. Extraordinary growth in the near term is expected due to the decline in MTBE use. To sustain significant growth in ethanol production, we will need to look beyond starch as the sole feedstock.

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The Biomass R&D Act of 2000 has become an extremely important instrument in shaping the future direction of biofuels R&D at DOE's Office of Energy Efficiency and Renewable Energy (EERE). It is also leading to much closer coordination among programs at the Department of Agriculture and DOE. The Act emanated from bills sponsored by Senator Richard Lugar of Indiana and Representative Mark Udall of Colorado. One of the tenets of the Act is that a much greater research effort is needed to overcome "recalcitrant" biomass. In particular, it directed that the R&D programs on biomass conversion should be heavily pursued through the development of more efficient methods of pretreatment and enzyme development (sometimes referred to as the sugars platform), the improved ability to ferment these multiple sugars to ethanol and other industrial chemicals (sometimes referred to as the yeast platform), and the production of multiple products from these sugars as one approach to a "biorefinery of the future."

The EERE R&D program in ethanol has been aligned to support the provisions of the Act. Major partnerships have been developed with two of the leading enzyme manufacturers in the world. One of these companies recently announced that it has reduced the cost of production by a factor of two, well on its way to the goal of having a ten-fold reduction in costs of enzymes used for the production of ethanol.

A commercial, biomass-to-ethanol technology could play a major role in reducing our reliance on imported oil. Ethanol can be used as an octane enhancer and oxygenate blended with gasoline, or with diesel fuel as E-diesel. Beyond that, given investment in required infrastructure, it can supply the growing number of ethanol flexible-fueled vehicles on the market today, and could be a source of hydrogen for advanced vehicle platforms of the future.

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Since biomass feedstocks include agricultural residues, municipal solid wastes, wood products, industry wastes, and energy crops, every State in the union has a biomass to ethanol potential.

In addition to supplying needed product diversity for agricultural crops, biomass-to-ethanol technology could help address other environmental problems. For instance, biomass from hazardous fuels reduction in forests could be collected and used to produce ethanol, while lessening the fuel loading problems that have led to catastrophic wildland forest fires. Air quality problems associated with the burning of rice and other straws could be lessened through the utilization of these materials to produce ethanol, biomass power, and other industrial chemicals. Volumes of municipal solid waste could be greatly reduced by utilizing the organic fraction to produce ethanol, steam, and electricity.

I must add an important caveat, however, that limits our ability to pursue an aggressive, coordinated biofuels program. The result of yesterday's House-Senate Energy and Water Development Appropriations FY 2002 Conference Report was to earmark roughly 42 percent of our biomass/biofuels funding level. Frankly, a cohesive, results-oriented program is difficult to achieve with this level of earmarking.

Alternative Fuel Vehicles

We also believe that alternative fuel vehicles can make an important contribution to helping our transportation sector decrease its reliance on petroleum. Over the next several years, we will continue our deployment efforts, with a particular focus on niche markets where alternative fuel vehicles can be most competitive. The Department's Clean Cities program now has over 80 participants and 4,000 stakeholders who have voluntarily committed to the increased use of alternative fuel vehicles. In addition to public information programs, tools, and training, this past year the Clean Cities program issued grants of over $4 million for 50 projects in 35 states, focused on innovative approaches to deploy alternative fuel vehicles and infrastructure. This Federal investment leveraged over $40 million in other private and public cost-share.

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Over several years, our demonstration and deployment work has evolved from small-scale information

programs and fleet demonstrations to sophisticated web-based information dissemination and targeted demonstration and deployment projects that facilitate niche market development. For example, the purchase by the U.S. Postal Servics (USPS) of electric vehicles (EVs) is an excellent match between the clean, efficient electric technology and the short-route delivery requirements of the USPS. I understand the Postal Service is planning to order a second round of 500 EVs under its contract. We continue to work with the USPS to evaluate the benefits of using EVs.

21st Century Truck Program

The growth of petroleum use in the heavy truck sector led to the creation of a new program in 2000, the 21st Century Truck program. Like PNGV, this is designed as a partnership between the government and leading heavy vehicle and engine manufacturers to develop advanced technologies to double the fuel economy of long-haul trucks and triple the fuel economy of busses and other vehicles—while also reducing emissions and improving safety. This program is too new to show much in the way of results.

Moreover, some industry partners feel the goals are unrealistic and do not represent a true consensus. Therefore, we will reevaluate this program as well.

Conclusion

We must, as a Nation, move more aggressively to increase and diversify domestic energy supplies and radically increase vehicle fuel economy through technological advances, while maintaining vehicle safety, affordability and performance.

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Secretary Abraham has challenged the Department to "leapfrog the status quo," and to reach toward revolutionary, transformational technologies. Our ultimate goal is to achieve emission-free, carbon-free, safe and affordable personal transportation. We will reshuffle our technology portfolio toward that eventual goal. This will entail more risk, but will invite greater reward.

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BIOGRAPHY FOR DAVID K. GARMAN

Assistant Secretary, Energy Efficiency and Renewable Energy, Department of Energy

David Garman was nominated by President George W. Bush to serve as Assistant Secretary on April 30, 2001 and was confirmed unanimously by the United States Senate on May 25, 2001. He assumed the position after being sworn in by Secretary Abraham on May 31, 2001.

Assistant Secretary Garman previously served in a variety of positions on the staff of two U.S. Senators and two Senate Committees during a career spanning nearly 21 years. Most recently, Mr. Garman served as Chief of Staff to Alaska Senator Frank H. Murkowski. Mr. Garman also served on the professional staff of

the Senate Energy and Natural Resources Committee and the Senate Select Committee on Intelligence.

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Throughout his career, Mr. Garman's work has focused mainly on energy and the environment. For example, while serving on the Senate Select Committee on Intelligence, Mr. Garman worked in the newly emerging area of "environmental intelligence and security," working on issues such as global climate change, transboundary pollution, and regional environmental threats from the Former Soviet Union. While on the staff of the Energy and Natural Resources Committee, Mr. Garman's portfolio included energy research and development, science and technology, and global climate change.

Mr. Garman also served as a U.S. Senate observer at virtually all of the major negotiations under the United Nations Framework Convention on Climate Change from 1995–2000.

Mr. Garman holds a Bachelor of Arts from Duke University, and a Master of Science in Environmental Sciences from the Johns Hopkins University. He is married to Kira L. Finkler, a Counsel on the Democratic staff of the Senate Committee on Energy and Natural Resources. David and Kira reside in nearby Virginia with their daughter, Bonnie.

Chairman **BARTLETT.** Thank you very much. Mr. Dana.

STATEMENT OF GREGORY J. DANA, VICE PRESIDENT, ENVIRONMENTAL AFFAIRS, ALLIANCE OF AUTOMOBILE MANUFACTURERS

Mr. **DANA.** Good morning, Mr. Chairman, and, members of the Committee. Mr. Chairman, thank you for the opportunity to testify before you Subcommittee regarding energy security issues. I represent the Alliance of Automobile Manufacturers, a trade association of 13 car and light-truck manufacturers. Total R&D spending by the automobile industry is approximately $18.4 billion per year, with much of it in the high-tech sector.

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Auto manufacturers are working on future technologies that may lead to substantial improvements in efficiency and emissions performance without sacrificing safety, utility, and performance, features that consumers demand. Successful introduction of these technologies need cooperative efforts that bring all the key stakeholders together, including automakers, energy providers, policy makers, and, most importantly, customers.

The Alliance supports efforts to create an effective energy policy based on broad, market-oriented principles. Policies that promote research and development and deployment of advanced technologies, and which provide customer-based incentives to accelerate demand of these advanced technologies, set the foundation.

The Alliance commends the House in endorsing consumer tax credits for highly fuel efficient advanced technology and alternative fuel vehicles when it passed H.R. 4 on August 1. I would now like to address

some of these technologies.

The most promising long-term technology, fuel cells, offers breakthrough fuel economy improvements, zero emissions, and a shift away from petroleum-based fuels. Hydrogen fuel cells offer the biggest improvement in efficiency and emissions, but present major infrastructure challenges and onboard hydrogen storage also presents some issues. Gasoline infrastructure is well established, but gasoline reformers are the least developed and the most costly of reformer technology. Current sulfur content in gasoline will need further reduction to zero or near zero levels.

Hybrid-electric vehicles can offer a significant improvement in fuel economy. These products capture power through regenerative braking. Instead of losing breaking energy to the air, a decelerating hybrid vehicle can convert kinetic energy into stored energy that can be reused during the next acceleration.

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Vehicles that utilize stored energy from plug-in rechargeable batteries offer zero emissions. Battery electric vehicles continue to face weight, energy density, range, and cost challenges that limit their customer appeal and affordability.

Vehicles that are powered by advanced lean burn technology, such as clean, direct injection diesels, are faced with a significant challenge in meeting the new California and Federal exhaust emission standard. If the technology challenges can be overcome, these vehicles could provide fuel economy gains in excess of 25 percent.

Much of the discussion regarding fuel economy centers on motor vehicles. But it is important not to forget about a vital component for any vehicle—the fuel upon which it operates.

Low sulfur gasoline is vital to ensuring that vehicle pollution control devices, such as catalytic converters, work more efficiently. In 1999, new EPA rules were issues which direct oil refiners to reduce the amount of sulfur in gasoline to an average of 30 parts per million, a reduction of over 90 percent from current levels. Further improvements will be needed, especially if gasoline will be used in fuel cells.

Another promising technology is diesel engines using lean burn technology, which has gained wide acceptance in Europe and other countries. Automakers have been developing a new generation of highly fuel-efficient clean diesel vehicles, using turbo-charged direct injection engines as a way to significantly increase fuel economy and reduce greenhouse gas emissions. However, their use in the United States must be enabled by significantly cleaner diesel fuel.

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Beyond gasoline, the auto industry is working with a variety of suppliers of alternative fuels. In fact, the industry already offers more than 25 vehicles powered by alternative fuels. Approximately two million of these vehicles are on the road today and more are coming.

Today, we find vehicles that use natural gas, which reduces carbon monoxide emissions; ethanol, a renewable fuel domestically produced with the longer term potential to substantially reduce greenhouse gases; liquefied petroleum gas, or propane, the most prevalent of the alternative fuels, which reduces VOC emissions; and, for the future, hydrogen, which has the potential to emit nearly zero pollutants, depending on the feed stock. But all these are dependent on the expansion of the existing alternative fuel infrastructure.

Automobile companies, from the top executives to the lab engineers, are constantly competing for the next breakthrough in innovation. If I can leave one message with the Subcommittee today, it is to stress that all manufacturers have advanced technology programs to improve vehicle fuel efficiency, lower emissions, and increase motor vehicle safety. Thank you for the opportunity to testify before the Subcommittee today. I would be happy to answer any questions.

[The prepared statement of Mr. Dana follows:]

PREPARED STATEMENT OF GREGORY J. DANA

Mr. Chairman,

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Thank you for the opportunity to testify before your Subcommittee regarding energy security issues. I represent the Alliance of Automobile Manufacturers, a trade association of 13 car and light-truck manufacturers. Our member companies include BMW Group, DaimlerChrysler Corporation, Fiat, Ford Motor Company, General Motors Corporation, Isuzu Motors of America, Mazda, Mitsubishi, Nissan North America, Porsche, Toyota Motor North America, Volkswagen of America, and Volvo.

Alliance member companies have more than 620,000 employees in the United States, with more than 250 manufacturing facilities in 35 states. Overall, a recent University of Michigan study found that the entire automobile industry creates more than 6.6 million direct and spin-off jobs in all 50 states and produces almost $243 billion in payroll compensation annually.

Alliance R&D Focus:

The University of Michigan study also found that the total R&D spending by the industry is approximately $18.4 billion, with much of it in the high tech sector. In fact, the study stated the following: "The level of automotive R&D spending and the relatively high employment of research scientists and engineers in the U.S. auto industry has traditionally earned it a place in any U.S. government listing of high technology industries generally thought to be central to the long-term performance of the U.S. economy."

As we begin the 21st century, the auto industry is committed to developing and utilizing emerging technologies to produce cleaner, more fuel-efficient cars and light trucks. According to EPA data, fuel efficiency has increased steadily at nearly two percent per year on average from 1975 to 2001 for both cars and light trucks. The National Academy of Sciences (NAS), in a recent report to Congress, introduced their discussion of promising technologies by stating that "the 1992 NAS report outlined various automotive technologies that were either entering production at the time, or were considered "emerging" based upon

their potential and production intent. Since then, many regulatory and economic conditions have changed. In addition, automotive technology has continued to advance, especially in microelectronics, mechatronics, sensors, control systems, and manufacturing processes. Many of the technologies identified in the 1992 report as "proven" or "emerging" have already entered production."

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Auto manufacturers are working on future technologies such as hybrid and fuel cell vehicles that may lead to substantial improvements in efficiency and emissions performance without sacrificing safety, utility, and performance. Fuel cell technology also serves as a potential vehicle to move away from a petroleum dependent transportation sector. Successful introduction of these new and emerging technologies all share the need for cooperative efforts that bring all the key stakeholders together. . .including the automakers, energy providers, government policy makers and most importantly, the customers.

Key Energy Policy Initiatives:

1) Promoting Market Based Principles:

The Alliance supports efforts to create an effective energy policy based on broad, market-oriented principles. Policies that promote research and development and deployment of advanced technologies and provide customer based incentives to accelerate demand of these advanced technologies set the foundation. This focus on bringing advanced technologies to market leverages the intense competition of the automobile manufacturers worldwide. This competition drives automakers to develop and introduce breakthrough technologies to meet a variety of demands and customer needs in the marketplace.

The National Academy of Sciences summarized this diversity of demand and priorities in the marketplace when it stated that "automotive manufacturers must optimize the vehicle and its powertrain to meet the sometimes-conflicting demands of customer-desired performance, fuel economy goals, emissions standards, safety requirements and vehicle cost within the broad range of operating conditions under which the vehicle will be used. This necessitates a vehicle systems analysis. Vehicle designs trade off styling features, passenger value, trunk space and utility. These trade-offs will likewise influence vehicle weight, frontal area, drag coefficients and powertrain packaging, for example. These features together with the engine performance, torque curve, transmission characteristics, control system calibration, noise control measures, suspension characteristics and many other factors, will define the drivability, customer acceptance and marketability of the vehicle."

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This is a long way of saying that in the end, the customer is in the driver's seat. Market based incentives and approaches ultimately will help consumers overcome the initial cost barriers of advanced technologies during early market introduction and increase demand, bringing more energy efficient vehicles into the marketplace. This will also accelerate cost reduction as economies of scale are achieved in a timelier fashion.

The Alliance is pleased that Vice President Cheney's National Energy Policy report recommends and supports a tax credit for advanced technology vehicles. In addition, the report supported the broader use of alternative fuels and alternative fuel vehicles. This is consistent with the Alliance's position of supporting enactment of tax credits for consumers to help offset the initial higher costs of advanced technology and alternative fuel vehicles until more advancements and greater volumes make them less expensive to produce and purchase.

The Alliance commends the House in endorsing consumer tax credits for highly fuel efficient advanced technology vehicles when it passed H.R. 4 on August 1. The Alliance believes that the overall concepts and provisions found in the bill are the right approach and would benefit American consumers. H.R. 4 would ensure that advanced technology is used to improve fuel economy and energy independence. Performance incentives tied to improved fuel economy are incorporated into the legislation in order for a vehicle to be eligible for the tax credits. These performance incentives are added to a base credit that is provided for introducing the technologies into the marketplace.

2) Maintaining Technology Focus:

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The Alliance and its 13 member companies believe that the best approach for improved energy security and fuel efficiency gains is to aggressively promote the development of advanced technologies—through cooperative, public/private research programs and competitive development—and incentives to help pull the technologies into the marketplace as rapidly as possible.

The automobile companies are convinced that advanced technologies with the potential for major fuel economy gains are on the horizon which will allow automakers to continue offering products that consumers demand without sacrificing safety, performance or cargo features. As a nation, we need to get these technologies on the road as soon as possible in an effort to reach the national energy goals as fast and as efficiently as we can.

New Technologies. . .Promises and Challenges

Focus on Powertrain and Vehicle Technologies:

Automobile companies around the globe have dedicated substantial resources to bringing cutting-edge technologies—electric, fuel cell, and hybrid electric vehicles as well as alternative fuels and powertrain improvements—to the marketplace. Each of these technologies bring a set of unique advantages to the marketplace. At the same time, each technology has a unique set of challenges that inhibit widespread commercialization and acceptance. The internal combustion engine, fueled by relatively inexpensive gasoline, has been and continues to be, a formidable competitor against which all new technologies must compete.

For consumers sensitive to cost, fuel economy gains must be compared to the increased investment costs and risks in their new vehicle purchase decision. Assuming a fuel cost of $1.50 per gallon, a 20 percent increase in vehicle fuel efficiency offers an annual fuel savings of just over $100. This cost must be weighed against the convenience, utility and performance of the alternative. As automakers, we are keenly aware of

the importance of consumer choices and the challenges we have to deliver new technologies that meet their affordability, performance and utility needs.

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Fuel Cell Vehicles:

The most promising long-term technology offers breakthrough fuel economy improvements, zero emissions and a shift away from petroleum-based fuels. From a vehicle perspective, hydrogen-fueled fuel cells offer the biggest improvement in efficiency and emissions but at high cost and with major infrastructure challenges. On-board hydrogen storage also presents some difficulty. Gasoline infrastructure is well established, but gasoline reformers are the least developed and the most costly of reformer technology. Current sulfur content in gasoline will most likely need further reduction to zero or near zero levels.

A robust fuel cell commercialization plan incorporates breakthroughs and complementary research in stationary power units. A primary challenge in the introduction of fuel cells into America's light vehicle passenger and truck fleet are the packaging restrictions of size and weight. Experience and commercial expansion of stationary power units, relatively unconstrained by size and weight will be helpful gaining the experience necessary to meet the cost targets for commercialization in the vehicle sector.

Hybrid-Electric Vehicles:

Hybrid-electric vehicles can offer a significant improvement in fuel economy. These products capture power through regenerative braking. When decelerating an internal combustion vehicle, the brakes convert the vehicle's kinetic energy into heat, which is lost to the air. By contrast, a decelerating hybrid vehicle can convert kinetic energy into stored energy that can be reused during the next acceleration. Hybrid vehicles do not require additional investment in fuel infrastructure which helps reflect their potential for near term acceptance.

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Battery Electric Vehicles

Vehicles that utilize stored energy from "plug-in" rechargeable batteries offer zero emissions. Battery electric vehicles continue to face weight, energy density, and cost challenges that limit their customer range and affordability.

Advanced Lean Burn Technology Vehicles

Vehicles that are powered by advanced lean burn technology such as clean, direct injection diesels are faced with a significant challenge in meeting the new California and Federal exhaust emission standard. If the technology challenges can be overcome, these types of vehicles could provide fuel economy gains in excess of 25 percent above comparable conventional vehicles.

Focus on Fuels and Infrastructure

Much of the discussion regarding fuel economy centers on the vehicles of the automobile manufacturers and their role in a national energy policy. But it is important not to forget about a vital component for any vehicle—the fuel upon which it operates. As automakers looking at the competing regulatory challenges for our products—fuel efficiency, safety and emissions—and attempting to move forward with advanced technologies, we must have the best possible and cleanest fuels. EPA has begun to address gasoline quality but fuel needs to get even cleaner. This is important because gasoline will remain the prevalent fuel for years to come and may eventually be used for fuel cell technology.

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Low Sulfur Gasoline:

In 1999, new EPA rules were issued which direct oil refiners to reduce the amount of sulfur in gasoline to an average of 30 parts per million, a reduction of 90 percent over current levels. Low sulfur gasoline is vital to ensuring that vehicle pollution control devices, such as catalytic converters, work more efficiently. The so-called Tier II regulations were required under the 1990 Clean Air Act and will be phased in beginning in the 2004 model year. Further improvements will be needed especially if gasoline is to be used in fuel cells.

Low Sulfur Diesel:

In addition to alternative fuels, companies are constantly evaluating fuel-efficient technologies used in other countries to see if they can be made to comply with regulatory requirements in the United States. One such technology is diesel engines, using lean-burn technology, which has gained wide acceptance in Europe and other countries. Automakers have been developing a new generation of highly fuel-efficient clean diesel vehicles—using turbo-charged direct injection engines—as a way to significantly increase fuel economy and reduce greenhouse gas emissions. However, their use in the U.S. must be enabled by significantly cleaner diesel fuel.

Earlier this year, EPA promulgated its heavy-duty diesel rule that the Alliance supports, as far as it goes. The rule reduces the amount of sulfur in the fuel. Low sulfur diesel fuel is necessary to enable the new clean diesel technology to be used in future cars and light trucks. Providing cleaner fuels, including lowering sulfur levels in gasoline *and* diesel fuel, will provide emission benefits in existing on-road vehicles. Unless there are assurances that such fuels will be available, companies will not invest in new clean diesel technologies. Efforts to reduce sulfur content will provide environmental benefits and allow vehicles to operate more efficiently.

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Beyond gasoline, the auto industry is working with a variety of suppliers of alternative fuels. In fact, the industry already offers more than 25 vehicles powered by alternative fuels. Approximately 2 million of these vehicles are on the road today and more are coming. Today, we find vehicles that use:

Natural gas, which reduces carbon monoxide emissions;

Ethanol, a renewable fuel domestically produced with the longer term potential to substantially reduce greenhouse gases;

Liquefied petroleum gas (propane), the most prevalent of the alternative fuels, which reduces VOC emissions; and

For the future, hydrogen, which has the potential to emit nearly zero pollutants depending on feedstock.

One of the key hurdles to overcome in commercializing alternative fuel vehicles is the lack of fueling infrastructure. For nearly a century, infrastructure has focused primarily on gasoline and diesel products. Infrastructure and fuel incentives will help the distributors overcome the costs to establish the alternative fuel outlets and support distributors during initial lower sales volumes as the number of alternative fuel vehicles increases.

As you can tell, the automobile companies—from the top executives to the lab engineers—are constantly competing for the next breakthrough innovation. If I can leave one message with the Subcommittee today, it is to stress that *all manufacturers* have advanced technology programs to improve vehicle fuel efficiency, lower emissions and increase motor vehicle safety. These are not "pie in the sky" concepts on a drawing board. In fact, many companies have advanced technology vehicles in the marketplace right now or have announced production plans for the near future. That's why now is the perfect time for the enactment of tax credits to help spur consumers to purchase these new vehicles which years of research and development have made possible.

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The Alliance and its member companies would urge that public policy decisions focus on the steps that will achieve real reductions in fuel consumption and which support our national energy goals. As I mentioned earlier, the advanced technology fuel-efficient vehicles are typically more expensive than their gasoline counterparts because of the new technologies. Therefore, market penetration is a challenge. As a result, the Alliance is pleased that H.R. 4 would provide for personal and business tax incentives for the purchase of qualifying advanced technology hybrid and fuel cell powered vehicles as well as alternative fueled vehicles and infrastructure development. These tax incentives should help "jump start" the market penetration of these highly fuel efficient vehicles leading to increased sales and volumes so that the cost will come down in the long-term with positive implications for energy security.

Thank you for the opportunity to testify before the Subcommittee today. I would be happy to answer any questions you may have.

BIOGRAPHY FOR GREGORY J. DANA

Gregory J. Dana is the Vice President, Environmental Affairs for the Alliance of Automobile Manufacturers. He took this position on August 30,1999. In this role, he is responsible for all Federal and

State environmental issues that affect vehicle design and automotive production facilities.

Prior to joining the Alliance, Mr. Dana held the position of Vice President and Technical Director of the Association of International Automobile Manufacturers (AIAM). He joined AIAM in June 1986. In this position he handled environmental and vehicle safety issues for AIAM. Before that date, he was employed by the Environmental Protection Agency, Office of Mobile Sources. He worked for the Agency from 1973 to 1986. Mr. Dana worked both in the Ann Arbor Emissions Laboratory and in the Washington D.C. Headquarters for the Mobile Source Office Director.

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Mr. Dana is married and has two daughters. He resides in Fairfax Station, Virginia.

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Chairman **BARTLETT.** Thank you very much. Mr. Burnette.

STATEMENT OF ROBERT H. BURNETTE, PROJECT MANAGER, BULK POWER, DOMINION VIRGINIA POWER, ON BEHALF OF THE ELECTRIC VEHICLES ASSOCIATION OF THE AMERICAS

Mr. **BURNETTE.** Mr. Chairman, and, members of the Committee, I am Bob Burnette, Project Manager, Bulk Power, for Dominion Virginia Power. Dominion, headquartered in Richmond, Virginia, has four million electric and natural gas customers and more than 15,000 employees to serve them through a variety of subsidiaries. Dominion is the largest fully integrated electric and gas company in the United States and the third largest energy producer in the United States.

I appear today as a representative of the Electric Vehicle Association of the Americas whose membership includes international vehicle and component manufacturers, energy providers, and technology developers. I thank you for this opportunity to discuss the role that electricity can play in the transportation sector. I will focus my remarks on the important benefits that can accrue from the increased use of electric drive technologies.

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EVAA believes that reducing dependence on foreign oil demands that we transition the country's biggest consumer of this commodity, the transportation sector, to the use of other fuels. Electricity is an attractive alternative. It is clean, efficient, affordable, and is produced domestically from a variety of fuel sources. The use of electricity can greatly enhance our energy's security since today's U.S. electric generation base is less than three percent reliant on petroleum.

EVAA encourages the development and use of battery-powered vehicles, fuel cell vehicles, and hybrid-electric vehicles. My written statement details the benefits of using electric transportation and describes the changes we face in commercializing these technologies. I would like to highlight actions that both industry and government might take to assist in the transition of our transportation network to electricity.

Dominion has been promoting programs and policies that encourage the development and use of electric-drive technologies for many years through the use of EVs in our fleet and the installation of charging infrastructure. In addition, we are encouraging Virginia—we encourage Virginia to provide the existing state tax credits to purchase battery electric vehicles and to allow the use of these vehicles in high occupancy vehicles lanes.

Also, Dominion and its partners, American Maglev Technology, Lockheed Martin, the Commonwealth of Virginia, and Old Dominion University, are now building a maglev system at Old Dominion University in Norfolk, Virginia. The project is scheduled to begin transporting passengers in the summer of 2002.

With respect to the Federal Government's role, EVAA applauds the House of Representatives, and particularly this Committee, for adopting comprehensive energy legislation that includes important incentives to encourage the use of electric modes of transportation. EVAA believes that tax incentives are the single most effective means of jump-starting the market for electric and other clean fuel transportation options, and we are hopeful that the incentives, as included in H.R. 4., will be enacted into law this year.

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Also, in H.R. 4, are important programs crafted by members of this Committee and strongly supported by EVAA. Of particular note is the program proposed by Representative Jackson Lee to authorize a 3-year program to provide DOE cost share to electric utilities and others interested in demonstrating the benefits of using spent EV battery backs and stationary applications. By encouraging the development of this secondary market, we can reduce the high cost of advanced batteries.

Second, the Chairman of the House Science Committee, Sherwood Boehlert, introduced legislation to create a nationwide program that would demonstrate a variety of electric and other alternative fuel technologies. This proposal will assist in creating seamless, intermodal transportation systems in urban environments and are—that are fuel by clean alternatives, like electricity.

The AFV Acceleration Act was also incorporated into the House Energy Bill. EVAA encourages this Committee to assure that the legislation establishing and AFV Acceleration Program is enacted into law, whether as a stand-alone bill or as part of comprehensive energy legislation.

One issue that H.R. 4 does not cover is review of the Energy Policy Act Provisions that required governments and fuel provider fleets like electric and natural gas utilities, to acquire alternative fuel vehicles. The current program is failing to meet the Congressionally mandated goal of reducing transportation sector petroleum use. EVAA believes that flexibility must be built into the program in order to ensure that EPACT's future petroleum displacement goal is achieved. My written statement details specific amendments to EPACT to provide this needed flexibility.

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Finally, hydrogen fuel programs should be addressed in any legislation. Our interest in hydrogen is

simple. It is the fuel required to power fuel cell vehicles. In June, EVAA submitted written testimony to this Committee asking that any legislation recognized the need to coordinate ongoing hydrogen, fuel cell, and distributed energy R&D programs. As the Committee considers hydrogen fuel cell development and the energy needed to power a mobile society, we urge you to establish public and private partnerships to address these challenges.

That concludes my formal remarks. I thank you again for the opportunity to appear, and I will be happy to answer any questions.

[The prepared statement of Mr. Burnette follows:]

PREPARED STATEMENT OF ROBERT H. BURNETTE
On behalf of the Electric Vehicle Association of the Americas

Introduction and Overview of Statement:

This testimony is submitted on behalf of the Electric Vehicle Association *of the* Americas (EVAA), a national non-profit organization that advocates the use of electric transportation technologies, including battery, hybrid and fuel cell electric vehicles, as a means of addressing national energy security, energy efficiency *and* air quality goals. Members of the organization include international automotive and other equipment manufacturers, energy providers, national associations and government entities. (A complete membership roster is attached to, and made a part of, this testimony.)

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EVAA applauds the Energy Subcommittee's investigation to determine means by which the Federal Government might cause, or help to cause, a reduction in the use of petroleum. The statement of EVAA will be confined to addressing those options that can reduce petroleum use in the transportation sector, which is by far the greatest consumer of petroleum in the U.S., accounting for approximately 70% of our current consumption. And the consumption of energy by the transportation sector is growing at an alarming rate. By 2020, the Energy Information Administration (EIA) predicts that total energy demand for transportation in the U.S. will be 38.5 quadrillion Btu, compared with only 26.4 quadrillion Btu in 1999. Therefore, while the Committee can and should consider options for reducing petroleum use within every sector of the economy, a critical key to reducing U.S. dependence on foreign oil is to transition the transportation sector—particularly the light duty vehicle segment—to use of alternatives to gasoline and diesel fuels, like electricity and/or hydrogen. The results of inaction—continuing consumption at current trends—are alarming. EIA projects U.S. petroleum demand will grow from its 1999 level of 19.5 million barrels per day to 25.8 million in 2020.

Electric transportation represents an exciting technology solution to the energy security and environmental problems associated with the use of petroleum—electric drive systems can be powered by domestically-produced energy derived from a diverse array of feed stocks, they have little-to-no emissions in operation, and they are highly efficient in their use of energy. Electric transportation technologies are being used effectively in the transportation sector today, notably in light rail and train applications, with exciting new technologies like hybrid-electric passenger cars and hybrid-electric buses being brought to the

market. With electric modes of transportation, we have the ability to continue the high level of mobility in the U.S. without relying on petroleum products and without further degradation to our air quality. This testimony:

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highlights the important national benefits accruing from the widespread adoption of electric transportation technologies into our transportation network;

discusses the current technological, market-entry and infrastructure challenges to such widespread deployment of electric transportation technologies; and,

outlines Federal policies and programs that EVAA's members believe are critical to assuring that electric transportation technologies can be a significant segment of the U.S. transportation sector in the 21st century.

Benefits of Electric Transportation Technologies:

There is a family of electric transportation technologies being developed and/or commercialized. EVAA defines an electric vehicle as any technology that employs an electric drive system to power the vehicles. Electric transportation technologies under development and/or commercially available today include battery electric powered systems, hybrid electric powered systems (using an internal combustion engine and an electric motor) and fuel cell powered systems that create electricity on-board through a combination of hydrogen and air. And, the platforms using—or planning to use—electric drive systems include passenger and light duty vehicles, buses, trains; low-speed or neighborhood vehicles and off-road equipment such as airport equipment. Each of the technology categories—battery, hybrid-electric and fuel cell—offers significant energy security and environmental benefits, and together represents the cleanest, most advanced alternatives to conventional vehicles on the road or under development.

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Battery Electric Transportation Options:

Battery electric vehicles (BEVs) charged off the Nation's electric utility grid use "fuel" created from a variety of feedstocks, from wind to nuclear. Importantly, petroleum represents a diminimus fuel feedstock for electricity production in the U.S. Less than 3% of the current U.S. generation base relies on petroleum. Electricity is a domestically produced, relatively stably priced fuel that affords us "fuel diversity" for the transportation sector. Further, the primary charging for BEVs is expected to occur overnight, when electricity demand is at its lowest, allowing for widespread adoption of the technology without adding new capacity.

In addition to significant energy security benefits, BEVs offer the opportunity for continued personal mobility without degradation to the environment. Nearly 100 cities across the U.S. fail to meet Federal air quality standards, and approximately 62 million people live in counties where monitored data show unhealthy air for one or more of the six principal pollutants [carbon monoxide (CO), lead (Pb), nitrogen

dioxide (NO), ozone (O), particulate matter (PM), and sulfur dioxide (SO)]. For many urban areas, electric transportation can be a particularly important means to substantially reduce emissions of mobile source pollutants, including volatile organic compounds and oxides of nitrogen that are the precursors of smog. Battery electric cars and buses are truly "zero emission" transportation modes. They produce no tailpipe emissions and generate insignificant, ancillary emissions during operations. They also have the added benefit of mitigating noise pollution and using energy more efficiently than conventional modes.

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Battery electric vehicles in the market today include buses for shuttle and transit service, passenger and light duty vehicles, and low speed or "neighborhood" vehicles.

Hybrid Electric Vehicles:

Hybrid electric vehicles, which combine the benefits of electric power with conventional gas powered engines, can significantly improve the efficiency and environmental performance of vehicles, thereby reducing fuel use and contributing to improved air quality. HEVs on America's roadways today evidence the tremendous advantages that this technology provides. The Toyota Prius has a stated fuel economy of 67 mpg, and a California environmental rating of "SULEV", or "Super Ultra Low Emission Vehicle," with only about b of the carbon dioxide and 1/10 of the nitrogen oxide emissions associated with a comparable, gasoline powered vehicle; the Honda Insight is rated at 70+ mpg and meets California's "ULEV" emissions rating. All international auto manufacturers have announced plans to bring hybrid electric vehicles to the market place in the coming years.

A recent study commissioned by EPRI has indicated that the benefits of hybrid electric vehicles may be greatest through the implementation of plug-in (those that store/use electricity provided from the electric gird) hybrid electric vehicles. Results of the study indicated that such a technology configuration could provide the gasoline equivalent mileage of more than 80 mpg. The study indicated, further, that the electricity for charging such vehicles would be provided largely during offpeak—the most desirable for efficient and inexpensive generation.

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In addition to the passenger and light duty vehicles planned by the automakers, there are a growing number of hybrid-electric buses in transit and shuttle operations in major urban centers around the U.S.

Fuel Cell Electric Vehicles:

Fuel cell electric vehicles (FCEVs), which harness the chemical energy of hydrogen and oxygen to generate electricity, have the potential to change the way we think about energy. Fuel cells are more efficient than other technologies that rely on direct combustion, and they produce zero, or near zero emissions. When fueled directly by hydrogen, the only by-product of a fuel cell electric vehicle is water.

Like electricity, hydrogen does not occur naturally in a usable form on Earth; it must be generated or produced by consuming fuels or other forms of energy. Yet, also like electricity, multiple feed stocks can be

used, creating fuel diversity and thereby enhancing national energy security. Fuel processors "on-board" a vehicle can produce hydrogen from natural gas, methanol, ethanol, gasoline, or diesel. "Off-board" processors can use all of these feedstocks and can also make hydrogen from the electrolysis of water.

While fuel cell technology is not as fully developed as its sister electric drive systems, significant investment is being made in the development of a wide variety of fuel cell electric options by industry and governments around the world. Manufacturers and technology developers have shown concepts for fuel cell-powered buses, bicycles, family cars and heavy-duty trucks.

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Magnetic Levitation:

Also included in the "family" of electric transportation options is a technology that promises rapid and safe movement of large numbers of people and/or freight. Magnetic levitation technology is an electronic rail system that is projected to accommodate safe travel at speeds up to 300 mph. This technology holds the promise of dramatically reducing commute times between major cities while simultaneously reducing highway and airport congestion and pollution. Demonstrations of this technology have been undertaken successfully in Germany and Japan.

In the U.S., an exciting demonstration of the technology. is being built at the Old Dominion University in Hampton Roads, Virginia, which is intended to prove the economics and viability of using magnetic levitation systems for meeting mass transportation needs. The project, which is being sponsored by the University, the Commonwealth of Virginia and EVAA members Dominion Virginia Power and American Maglev Technology, is scheduled to begin transporting passengers from one end of the University Campus to another in the summer of 2002.

Challenges to Widespread Adoption of Electric Transportation Technologies:

Despite the significant societal benefits accruing from their use, years of research and development by companies and governments across the globe, and mandates for commercialization of such vehicles, electric transportation technologies have not yet become a meaningful part of the U.S. transportation network. Since 1996, a total of only 4,427 battery electric vehicles have been leased and/or sold in the U.S. And, while sales of HEVs are growing quickly, there still have been only 23,884 put into service to date. In addition to these light duty automotive offerings, there have been about 250 electric and hybrid-electric buses and over 6,000 low-speed, battery electric vehicles placed into service.

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While the sum of all of these vehicles—which is less than 30,000 as compared to 1999 vehicle sales in the U.S. of 16.5 million—may be insignificant statistically, they represent an enormous step toward development of along-term and sustainable market for such vehicles in the U.S. The technology—with respect to battery and hybrid electric vehicles—is proven and maturing; customer reception to the vehicles has been tremendous and sales have been constrained more by product availability than by demand; and,

incentives to encourage consumer purchase are in place and/or being considered by government at all levels. However, more must be done if these vehicles are to become an integral part of our transportation network.

Costs for immature and low-volume technologies will be higher than those of comparable, conventional vehicles. Until a supplier base can be built, the technology matured and volume production established, the incremental costs of electric transportation technologies must be addressed in order to assure consumer acceptance. Fortunately, battery, hybrid and fuel cell vehicles share a number of subsystems (e.g., power electronics, motors, regenerative brakes). Therefore establishing a supplier base for battery electric vehicles, for example, can help to lower the costs of early commercial fuel cell vehicles when they are brought forward.

Infrastructure support systems, from re-fueling and charging to service and maintenance, must be put in place to support the convenient and safe operation of electric transportation technologies. Deploying the infrastructure systems—particularly those to support a hydrogen-based economy—represents a vast and expensive undertaking.

Building markets for electric transportation will require consumer awareness and experience with the technology to establish confidence in the products.

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Finally, with respect to fuel cell electric vehicles, there is a continuing need for research and development of the subsystems and components that will allow industry to bring forward a consumer-attractive FCEV.

Role for Government in Overcoming the Technological and Market Challenges to Electric Transportation Technologies:

Consumer Tax Incentives:

Targeted tax incentives can be an effective means by which government can help assure that electric drive technologies are successfully introduced into the marketplace. EVAA members believe that such incentives should be limited in their scope and duration, and available now and in the immediate future as these new and dramatically different technologies are introduced to consumers.

EVAA members are encouraged that the House has included tax incentives for electric and other alternative fuel vehicles (AFVs) as part of its omnibus energy bill, Securing America's Future Energy Act, H. R. 4. These incentives, which were derived from the Clean Efficient Automobiles Resulting from Advanced Car Technologies Act" ("CLEAR ACT"), H.R. 1864, introduced by Congressman Dave Camp (R–MI) and others, can help drive the biggest consumer of petroleum—the transportation sector—toward use of cleaner, domestically produced alternatives. EVAA is concerned, however, that the momentum for passage of such legislation in this Congress may wane, and we ask that such incentives be considered separately, or as part of another appropriate vehicle, should a comprehensive energy plan prove unachievable. All major vehicle manufacturers are poised to bring battery, hybrid and/or fuel cell electric cars and buses to the market. Federal tax incentives, as called for in the CLEAR ACT, would allow the technology to spread quickly by lowering purchase prices and encouraging deployment of supporting infrastructure.

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We believe a very important feature of the CLEAR ACT is its recognition that vehicles which provide the greatest societal benefits in terms of environmental and efficiency performance are deserving of the most generous benefits. Also, the CLEAR ACT recognizes that fuel cell electric vehicles will be entering the market later than other electric and alternative fuel vehicles, and has provided for incentives for this category of technology to continue for a longer period of time to ensure that the market has matured sufficiently before the incentives expire.

Federal Program to Introduce Advanced Vehicle Technologies to U.S. Cities:

Cities and communities plagued with poor air quality and traffic congestion stand to be the greatest beneficiaries of the successful commercialization of electric and other alternative fuel vehicles; yet, to date, the technologies are largely unknown and "untried." Deploying electric transportation technologies, from battery-powered bikes to fuel cell electric buses, can result in the clean and efficient transport of people and goods in the urban environment.

Another provision of the omnibus energy legislation adopted by the House creates a Federal program to support the introduction of electric and other alternative fuel vehicles in linked transportation systems in up to 15 cities in the U.S. The provision, which was first introduced by the Chairman of this Committee, Mr. Boehlert (R–NY), as H.R. 2326, the "AFV Acceleration Act of 2001," provides $200 million in Federal cost-share funding to help communities deploy clean, efficient modes of transportation and to build the infrastructure that can assure the subsequent widespread adoption of these technologies. Creating these models of efficient and clean transportation will allow for transit operators, public officials and the citizens who experience the benefits of the technology in their daily lives to gain the experience and confidence necessary to transition to these radically new technologies.

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As with the tax incentives included in H.R. 4, EVAA encourages this Committee to assure that the legislation establishing an AFV Acceleration program, as envisioned in H.R. 2326, is enacted into law whether as a stand-alone bill or as part of comprehensive energy legislation. Forming partnerships and alliances between governments at the local, state and Federal levels, and leveraging Federal dollars with those of industry and other levels of government, is an effective means of introducing and deploying alternative fuel vehicles to communities and citizens across the country.

Federal Program to Assist in Making Advanced EV Batteries Economically Viable:

In addition to consumers' lack of familiarity with electric vehicles, other challenges to market penetration of the initial series of electric vehicles are high purchase prices and limited range. Manufacturers currently are not producing greater numbers of EVs, having reached conclusions that the costs are too high and the market too limited. The cycle of high costs and limited sales is broken only if costs are reduced and/or volume is increased dramatically. One of the primary contributors to the high costs of EVs is the advanced

battery necessary to provide the minimum range deemed acceptable to consumers. While it is estimated that prices for batteries begin to fall when the volume reaches 10,000 packs (i.e., enough to power 10,000 EVs) per year, auto manufacturers believe that volume alone cannot address the prohibitive costs of advanced technology batteries necessary to create consumer demand for EVs because the materials needed for such batteries (e.g., nickel) are expensive.

To assure volume sales of EVs, a dramatic reduction in the cost of batteries is required. An innovative approach to addressing this issue may be to "extend" the life—or value—of the batteries beyond vehicular use. Once the batteries have been "used" in a vehicle, there is an opportunity to refurbish, then "re-use" the batteries in a stationary application. For example, electric utilities could "re-use" EV battery packs in peak shaving, transmission deferral, back-up power and transmission quality improvement applications. If successfully demonstrated for secondary, stationary-use applications, the effective price of battery systems is projected to make EVs more competitive.

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Preliminary studies have shown that if a secondary market is created that pays $100 to $200/kWh for EV batteries, the costs of such batteries for use in the first application (i.e., the vehicle) could be reduced to $100 to $150/kWh—the price point which auto manufacturers believe is necessary to assure an affordable EV. Combining the value for using the battery in both a vehicle and then later a stationary application likely would cover the cost of producing the battery pack, even at low volume (estimated at $400/kWh).

EVAA is encouraged that this Committee, with the leadership of Representative Jackson Lee (D–TX), included a provision in H.R. 4 to establish a $15 million program within the Department of Energy to assist industry in demonstrating that "spent" EV batteries can be cost-effective and high-performing in secondary, stationary applications as part of any national energy package it develops. The program will demonstrate up to 1000 kWh of "used" batteries (approximately 33 vehicle battery packs) in a minimum of 10 stationary use applications. These "used" batteries would demonstrate electric utility stand-by, peak-shaving and transmission quality improvements and would help to validate the value of "used" batteries as a means to store electricity for purposes beyond use in EVs.

Providing Flexibility in Compliance with EPACT Fleet Requirements:

EVAA requests that this Committee examine the existing provisions of the Energy Policy Act of 1992 (EPACT), P.L. 102–486, that require state and Federal governments and the providers of alternative fuels (e. g., electric utilities, natural gas utilities, and other producers/suppliers of fuels defined as alternatives to gasoline under the Act) to convert their vehicle fleets to alternative fuel vehicles. The rationale of building volume and market demand through government fleets and the fleets of those in the business of producing, supplying and/or selling alternative fuels is sound, though the execution of the program to date has not achieved the goals of the ACT, namely to replace 10% of the petroleum used in the light duty vehicle sector by 2000, and fully 30% by the year 2010.

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While committed to building a long-term, self-sustaining market for electric vehicles, EVAA's electric utility members have found compliance with the existing EPACT alternative fuel providers' program difficult given the limited availability, high initial purchase price and limited performance of electric vehicles. These alternative fuel providers, as well as others struggling to meet the dictates of the DOE-administered program, are looking for flexibility in the program and recognition for actions taken that can help to develop the markets for electric and alternative fuel vehicles. For example, some electric utilities who are unable to incorporate so-called "full function" EVs due to limited availability, have begun to purchase and deploy low-speed electric vehicles to replace the duty cycle of a conventional vehicle; others have made investments in EV charging infrastructure to help encourage the market; and still others have begun to deploy hybrid-electric vehicles to help build demand in that segment and thereby "drive-down" the costs of components that are shared with battery and fuel cell electric vehicles. These actions, EVAA believes, should be recognized under the EPACT alternative fuel providers' program.

EVAA, in partnership with other alternative fuel interest groups, has crafted a set of modifications to the EPACT alternative fuel vehicle programs that will create flexibility in meeting the goals of the law, while assuring that the goals of the existing law, i.e., displacement of petroleum use in the transportation sector, can be achieved. The proposed modifications are attached to, and made a part hereof, this testimony. [Attachment "B"]

Integrating Federal Hydrogen and Fuel Cell Development Efforts:

The world's major automobile and heavy duty vehicle manufacturers who are engaged in efforts to commercialize fuel cell vehicles all face the same technically challenging issue: How can hydrogen be provided to the fuel cell that will power the vehicles? Whether hydrogen is produced elsewhere and then stored on-board the fuel cell vehicle or is produced on the vehicle by use of an on-board fuel processor, hydrogen is a key enabler to the success of these vehicles. And, not only can hydrogen fuel much of tomorrow's transportation systems, but its versatility could provide the clean energy needed to satisfy our electric as well as our mechanical and thermal energy needs—powering office buildings, homes, industrial complexes and shopping malls.

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The reality of the marketplace is that the role of hydrogen in the transportation sector, and to a large extent in the stationary applications sector, is coupled closely with fuel cell development. While hydrogen R&D is essential in its own right, the success of fuel cells is very dependent upon the success of hydrogen production, storage, transportation and use. The recently released report of the National Energy Policy Development Group, led by Vice President Cheney, specifically recommended that the President direct the Secretary of Energy to focus R&D efforts on *integrating* current programs regarding hydrogen, fuel cells and distributed energy.

EVAA submitted testimony to this Committee in June, as the Members considered reauthorization of the Hydrogen Future Act of 1996. We asked that any legislation reported by the Committee recognize the need to integrate on-going hydrogen, fuel cell and distributed energy research and development programs and to consider specific mechanisms and programs to insure that coordination is achieved in government and

industry efforts to pursue both hydrogen and fuel cell development.

One means for organizing public and private partnerships to address the technical challenges might be to undertake a very significant, large-scale demonstration that invites, under one tent, today's leading fuel cell and hydrogen participants to focus on maturing the technologies and deploying the infrastructure that will allow us to move to this renewable and clean energy resource as quickly as possible. An example of such a collaborative undertaking can be found in the California Fuel Cell Partnership (CaFCP), which includes participation by the Federal Government, and is organized to comprehend the infrastructure requirements within the state of California to support use of fuel cell electric vehicles.

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Conclusion:

Electric transportation technologies, whether powered by batteries, fuel cells or a combination of batteries and an internal combustion engine, collectively represent our transportation future. Transitioning to electric drive systems ensures continued mobility without reliance on insecure and often costly sources of foreign oil, and importantly, without degradation to the environment. Federal partnerships—whether in the form of consumer tax incentives, cost-share for research, development and demonstration, and/or assistance in deployment—to assist industry in bringing electric transportation technologies to the marketplace is a wise and cost-effective investment in our future energy security and in our citizens' quality of life. EVAA encourages this Committee to consider the industry's recommendations for programs and policies that can effectuate these strategic partnerships between government and industry.

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BIOGRAPHY FOR ROBERT H. BURNETTE

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Current Responsibility—Project Manager, Bulk Power, Dominion Virginia Power

Industry Experience—26 years

Qualifications

Provides comprehensive leadership and motivation to a technical sales team engaged in the development of emerging energy technologies, with emphasis in advanced distributed generation and electric transportation.

Viewed as an industry sales expert in all areas of energy delivery and energy services for applications in the industrial, commercial, governmental and residential sectors, with additional experience in the areas of power quality, call centers, and telecommunications.

Credentials

Masters in Business Administration, University of Richmond, Richmond, Virginia

Bachelors of Science in Business Administration and Economics, Virginia Commonwealth University, Richmond, Virginia

Chairman **BARTLETT.** Thank you very much. Mr. Doniger.

STATEMENT OF DAVID D. DONIGER, CLIMATE CENTER, NATURAL RESOURCES DEFENSE COUNCIL

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Mr. **DONIGER.** Thank you, Mr. Chairman. My name is David Doniger. I am the Policy Director of the Climate Center of the Natural Resources Defense Council, which has 500,000 members nationwide. I am very glad to see the focus of this hearing, recognizing that the problem we have in front of us is one of excessive demand for oil from all sources, foreign and domestic.

The first Bush Administration acknowledged this in 1991 at its National Energy Strategy, which said—and I quote, "Popular opinion aside, our vulnerability to price shocks is not determined by how much oil we import." And the report went on to say that the number one—the number one factor making us vulnerable, "how much—excuse me—how oil dependent our economy is."

I won't rehearse the arguments that you know well from our community on why the Arctic Refuge drilling is not the answer. I would only note that it would increase our share of proven world oil reserves by 3/10 of one percent and never play more than a two percent role in meeting our oil consumption needs, even after 2027, the year of its peak production.

There is a faster, cheaper, cleaner alternative, and this is to increase fuel economy, to make cleaner fuels from America's farms, and to make faster deployment of hybrid and fuel cell technologies. There is a lot in what I have heard from previous witnesses that we very much agree with.

Well, September 11, people say, changes everything. And this is something I wish to, even though it is not the Committee's jurisdiction, directly address the issue of fuel economy standards. And in the wake of the terror attacks and with a new appreciation of the energy security risks posed by our excessive demand for oil, we urge the House to reconsider its vote this summer on raising fuel economy standards. Closing the SUV loophole would be just a down payment. Congress should boost fuel economy standards for the

combined car and light-truck fleet, in steps every several years, to reach 40 miles per gallon by 2012 and 55 miles per gallon in 2020.

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If we had a 40-mile-per-gallon standard, we would be saving 2.2 million barrels of oil per day by 2012. That is over 9 percent of the total projected U.S. demand for oil, and 21 percent reduction in the projected demand for oil by passenger vehicles.

If the standard is flattened out at 40 and stayed there, oil savings would continue to grow as new vehicles replace old ones. They would reach 3.6 million barrels of oil per day in 2015 and 5.4 million barrels of oil per day in 2020. And by 2020, our total oil demand would be 20 percent below what it is projected to be, 43 percent below what it is projected to be just for the passenger fleet.

This would save money for the consumer, depending upon the source, between $1,000 and $5,000 over the life of the car, and it would reduce heat-trapping carbon dioxide pollution by nearly a billion tons per year in the year 2020.

We think automakers can reach a 40-mile-per-gallon standard using available technology. A 55-mile-per-gallon standard could be reached if a majority of the fleet were passenger—of the passenger fleet were hybrid vehicles, like the Toyota and Honda ones already on the market, the Ford Escape, coming next year, another hybrid Honda Civic coming within the next year or two, and this is a very promising technology. I love my Prius.

Now, let me turn to some other simple steps, some simple and some taking more vision and more investment. The simplest thing on my list would be a standard for the rolling resistance of replacement tires. Tires you buy and I buy when we go to get a second set of tires don't—well, they have more friction than the tires the automakers choose on average to put on the new cars. The automakers choose the lowest friction tires in order to help meet the CAFE standards. But there is no standard and no information to help consumers choose tires of equal quality when they get their second set. The tires of the quality that offer the low rolling resistance would cost about $2.50 to $5 extra per tire and they would return you $90 in savings over the 40,000-mile life of the tire because you would use less fuel. It would translate into about a three percent increase in the fuel economy of the total fleet if we had such a standard.

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We—the third measure—we support the tax incentives for hybrid vehicles and other—and fuel cells and other advanced technology vehicles, although in the original form, not in a watered-down form that was included in H.R. 4. But it would be a very important step to help achieve consumer acceptance, faster penetration of the hybrid vehicles.

I certainly would endorse what Mr. Woolsey said about the potential for making fuels from farm wastes. We need to make ethanol and other fuels from the farm wastes. Corn ethanol is not a long-term plus or a

long-term viable solution, nor would it ever tap the potential here. So we would endorse, for example, the support by this Committee of commercialization—excuse me—construction of commercial-scale pilot plants to make ethanol from cellulosic processes with the new technologies DOE has been working on.

Fifth, we need an "Apollo project" for fuel cells and hydrogen fuels. I am encouraged by what Assistant Secretary Garman says on the subject of fuel cells and hydrogen fuels, but the commitment is not sufficient and there are no production goals associated with it yet. There should be, articulated by this Congress, the goal of having 100,000 fuel cell vehicles minimum by 2010 and a million a year by 2020.

There is work needed also on hydrogen fuel infrastructure to make direct hydrogen, meaning the production of hydrogen outside the car, feasible and commercially feasible. We think it can be done and there are processes available with a range of fuels from agricultural and natural gas to even coal, which can be used to produce hydrogen with up to an 80 percent reduction in carbon dioxide emissions. In the case of coal, this would require sequestering the carbon dioxide underground. And this is something that is also a priority for research and development and commercialization.

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My prepared testimony mentions the importance, as well, of investing—reinvesting in public transit and in inter-city rail. We have a tremendous potential in those two areas to save fuel by giving people the opportunity, the transportation opportunities, to drive less in their own cars. Cities are expanding rail and bus systems to meet surging demand. There are nearly 1,500 miles of new light rail and heavy rail in proposal, planning, design, or construction in the year 2000, and this is a good subject for the stimulus package.

We also should—we would also recommend that this Congress support "smart growth" initiatives. The dependence on oil that we have is strongly contributed to by the suburban sprawl pattern of development since the '50's. A very interesting visualization of this in the PBS television series on the history of New York that ran in September. The road-building and development patterns established in that time are responsible for the oil consumption that we have now.

Many cities and communities are pursuing smart growth, which leads to more efficient distribution of homes and businesses in the landscape and less need for driving to get our commuting and our jobs and our recreational activities done. There are some legislative initiatives in this—mentioned in this testimony that this Congress could support to enhance smart growth.

And let me conclude by saying that our oil dependence didn't just happen. It is the result of policy choices made over many decades, and it is something we can change with smart policies such as I have outlined today. Each of these policies supports other critical environmental and economic objectives—cleaner air, reduction of carbon dioxide and other greenhouse gases, and they save consumers billions of dollars per year. There are no supply-side policy alternatives that can effectively reduce our dependence on oil and deliver these other benefits.

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The policy choices before you are not new, but the tragedies of September 11 may have changed how we will look at them. And I urge this Committee to take the lead in turning Congress in a new direction. Thank you.

[The prepared statement of Mr. Doniger follows:]

PREPARED STATEMENT OF DAVID D. DONIGER

Thank you, Mr. Chairman, for the opportunity to testify today on the importance of reducing our dependence on oil in America's transportation system. My name is David Doniger, and I serve as Policy Director for the Climate Center of the Natural Resources Defense Council. NRDC is a national, non-profit organization more than 500,000 members nationwide and a staff of scientists, lawyers and environmental specialists dedicated to protecting public health and the environment.

Since the terrorist attacks of September 11, the security of our Nation, the safety of our people, and the stability of our economy have become paramount concerns for the American public and our elected leaders. Americans are justifiably worried about energy security, especially our vulnerability to political turmoil in far-off places that could cause a disruption in oil supplies or a surge in world oil prices.

In the weeks following the attacks, some members of Congress have attempted to frame our vulnerability exclusively as a question of oil *supplies.* They argue that the answer lies in ever more domestic drilling, even in our last pristine wilderness areas such as the Arctic National Wildlife Refuge. This path, however, would not ensure our energy security or national security.

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Our dependence on oil, and our vulnerability to disruptions or price spikes, is due to our Nation's excessive *demand* for oil—from all sources, foreign and domestic. The first Bush Administration acknowledged this fact in its 1991 National Energy Strategy, which said: "Popular opinion aside, our vulnerability to price shocks is not determined by how much oil we import." The number one factor making us vulnerable: "how oil dependent our economy is."(see footnote 7)

Drilling in the Arctic Refuge would have no effect on our current situation. Americans consume 25 percent of the world's produced oil, but our nation holds only between two and three percent of the world's proven oil reserves.(see footnote 8) The amount of economically recoverable oil in the Arctic Refuge, according to U.S. Geological Survey estimates, would raise our share of proven world reserves by only 0.3 percent(see footnote 9)—not nearly enough to make a significant dent in our imports, and too little to influence petroleum prices. If we opened the area to oil development today, it would take seven to 10 years for refuge crude to begin arriving at refineries.(see footnote 10) Nor would refuge oil play a significant role in decades to come. Even at the point of its peak production rate in 2027, it would likely equal less than two percent of projected U.S. consumption for that year.(see footnote 11) And over the field's 50-year life, it would likely produce less than what our country now consumes in six months, and less than one percent of the oil we are projected to consume over those 50 years.(see footnote 12)

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There is a faster, cleaner and cheaper alternative, a path to energy security that would save many times more oil than could ever come from drilling in the Arctic Refuge or our other pristine protected places. The cornerstone of this path is to reduce demand for gasoline with better gas mileage, cleaner fuels from America's farms, and faster deployment of hybrid and fuel cell technologies.

So allow me to outline seven key energy security policies that NRDC believes would significantly reduce U.S. oil dependence starting in the next few years, and continuing for the next three decades.

1. Raise fuel economy standards to 40 mpg by 2012 and 55 mpg by 2020.

September 11, people say, changes everything. In the wake of the terror attacks and with a new appreciation of the energy security risks posed by our excessive dependence on oil, the House should reconsider its vote this summer on raising fuel economy standards. Closing the SUV loophole would be just a down payment. Congress should boost fuel economy standards for the combined car and light truck fleet in regular steps every several years, reaching 40 miles per gallon by 2012 and 55 mpg by 2020.

Passenger cars use more than 40 percent of the oil consumed in America, nearly 8 million barrels per day. Drivers spent $186 billion on fuel last year. Without vehicle fuel economy improvements, Americans' gasoline bill will rise to an estimated $260 billion in 2020.(see footnote 13)

Sadly, however, the combined average fuel economy of new cars, SUVs, and minivans is actually *falling*. Due to decades of federal inaction on standards and a surge in sales of SUVs and minivans, the fuel economy of the new vehicle fleet dropped last year to its lowest point in nearly 20 years.(see footnote 14)

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A 40 mpg standard would save about 2.2 million barrels of oil per day by 2012. That's a 9.2 percent reduction in projected U.S. oil demand and a 21 percent reduction in projected passenger vehicle fuel demand. Oil savings would continue to grow as new vehicles continue to replace old ones—reaching 3.6 million barrels per day by 2015 and 5.4 million barrels per day by 2020. By 2020, U.S. oil demand would be reduced by 20 percent—a 43 percent reduction in projected passenger vehicle fuel demand.(see footnote 15)

Over the next 50 years, a 40 mpg standard would save more than 50 billion barrels. That is more than 15 times the likely yield of economically recoverable oil from the Arctic Refuge.(see footnote 16) Raising the standard to 55 mpg in 2020 would lift that savings to more than 20 times the Arctic Refuge's likely yield over that period.(see footnote 17)

According to the Union of Concerned Scientists, a 40 mpg standard would save car owners $3,000 to $5,000 at the gas pump over the life of their cars, more than offsetting increased vehicle costs.(see footnote 18) The recent National Academy of Sciences study also concluded that, at a discount rate of five percent, consumers' fuel savings will exceed the front-end cost of meeting a 40 mpg standard by nearly $1000.(see

footnote 19) And U.S. emissions of heat-trapping carbon dioxide would be reduced by nearly 900 million tons per year by 2020.(see footnote 20)

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Automakers could reach a 40 mpg standard using available technologies to improve conventional gasoline vehicles. They could reach a 55 mpg standard if they made a majority of their passenger vehicles hybrid-electrics. Two hybrids, the Toyota Prius and Honda Insight, are already on the road. A hybrid Ford Escape and a hybrid Honda Civic will be available within the next year or two.

2. Require fuel-efficient replacement tires by 2002.

One of the simplest, quickest steps towards oil savings would be for Congress to require "after-market" replacement tires to be as fuel-efficient as original equipment tires by 2002. This simple step would save 5.4 billion barrels of oil over the next 50 years—more than one-and-a-half times the total amount of oil that is likely to be economically recoverable from the Arctic Refuge over the same time period.(see footnote 21)

Most replacement tires now on the market have more "rolling resistance"—more friction—than original equipment tires. Automakers choose low rolling resistance tires to help meet existing CAFE targets. However, there are no standards for replacement tires, and so most consumers unwittingly purchase less efficient tires when their originals wear out. Higher friction replacement tires lower fuel efficiency. A rolling resistance standard would cut the gasoline consumption of all U.S. vehicles by about three percent when fully phased in.(see footnote 22)

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The National Highway Traffic Safety Administration estimates that fuel-efficient tires would cost consumers no more than $5 per tire.(see footnote 23) Michelin has put that figure at less than $2.50 per tire. (see footnote 24) Even using the higher figure, the average driver would recoup the additional expense in fuel savings in just one year, and would save an additional $90 over the 40,000-mile life of the tires.

3. Enact tax incentives for hybrids and fuel cell vehicles.

Congress should enact tax incentives for advanced vehicle technologies, including alternative fuel vehicles, hybrid gasoline-electric vehicles and fuel cell vehicle—technologies that would enable the Nation's fleet to meet a 55 mpg standard in 2020.

Congress should pass this tax credit in the form it was originally introduced in the House and Senate, not the watered-down version included in the House energy bill. This tax incentive would greatly speed up the commercialization of hybrids. As an example, the buyer of a mid-size hybrid-electric car that gets 60 mpg (2.25 times the current class average) would receive a $3,500 rebate. As noted, Toyota and Honda already have hybrids on the road, and Ford and Honda are bringing out new hybrid models next year. The tax incentive would also give a critical boost to fuel cell vehicle technology.

4. Make fuel from farm wastes.

Congress should fund accelerated construction of commercial-scale pilot plants for making ethanol motor fuel from agricultural wastes. Tapping agricultural wastes and other renewable feedstocks to produce fuel has tremendous potential to reduce U.S. oil dependence.

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New ethanol conversion processes would greatly improve current methods of making ethanol from corn, which require substantial amounts of energy. Ethanol from corn now supplies about one percent of motor fuel. Much larger oil savings and pollution reductions are possible over the medium term by deploying these new processes. New technologies would make it economical to make ethanol from crop wastes and other woody parts of plants (called "cellulosic" biomass). Cellulosic ethanol production can start using agricultural wastes such as corn stalks, sugar cane wastes and rice hulls. Once these are fully exploited, dedicated energy crops (such as switch grass and hybrid poplars) could be planted to increase the supply.

As ethanol use increases, it will be necessary to make continued improvements in vehicle emission controls in order to achieve and maintain the public health benefits of now required of cleaner burning gasoline.

5. Launch an "Apollo Project" for fuel cells and hydrogen fuel.

Congress should set a goal of converting America's passenger transportation to fuel cell vehicles running on hydrogen, the ultimate "green" energy source whose only byproduct is water. Hydrogen fuel cell vehicles would use no gasoline and, on a full fuel-cycle basis, would emit dramatically lower levels of urban air pollutants and heat-trapping carbon dioxide.

As suggested by House Minority Leader Dick Gephardt (D–MO), Congress should create a project on the level of NASA's Apollo moon mission to accelerate the commercial feasibility of fuel cell technology. Such a program would sharply increase funding for research and development of fuel cell vehicles and hydrogen fuel distribution systems. The federal fuel cell R&D goal should be production of 100,000 fuel cell vehicles by 2010 and expanding to 1,000,000 vehicles by 2020.

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Congress should focus hydrogen fuel R&D on ways to make hydrogen with 80 percent lower emissions of carbon dioxide (on a full-fuel-cycle basis) than conventional gasoline. Promising approaches include: Using solar energy or wind power to split water; converting biomass energy crops to hydrogen or alcohol, which then is converted to hydrogen on-board the vehicle; and using natural gas or coal to produce hydrogen, electricity and steam for industrial processes, with underground carbon dioxide disposal.

6. Reinvest in public transit and inter-city railroads.

Until now, I have spoken of measures that directly affect the efficiency of passenger motor vehicles and

the fuels they use. At the same time, Congress could further reduce our oil dependence by offering states and cities more help to meet the surging demand for public transportation. Funding backlogged bus and rail transit projects, and rebuilding inter-city rail systems, would reduce U.S. oil dependence, reduce traffic congestion, and clean the air.

According to the Federal Transit Administration, starting in the early 1990s public transit saved the country 1.5 billion gallons of fuel annually—nearly 36 million barrels of oil.(see footnote 25) Cities are expanding rail and bus systems to respond to meet growing demand—nearly 1,500 miles of new light rail and heavy rail lines were in proposal, planning, design or construction phases in 2000.(see footnote 26)

Congress also should increase investments in high-speed inter-city rail transportation as a rapid, safe and energy-efficient mode of travel, providing more transportation choices for the public as well as protecting our energy security and environment. Rebuilding our rail capacity to capture a larger share of trips of 500 miles or less would save oil, and reduce congestion in the air and on our roads.

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7. Promote "smart growth."

Not only are we overly dependent on oil; we are also overly dependent on driving. Since the 1950s, the predominant urban development pattern in the United States has been "suburban sprawl." The drivers and impacts of sprawl were strikingly illustrated recently in episodes of the PBS series on the history of New York City.

During the last decade, "smart growth" has emerged as an antidote to more of the same mindless sprawl development. Congress should reform federal transportation, housing, tax and land management policies to support, rather than undermine, state and local "smart growth" initiatives. Over the long term, "smart growth" can reduce suburban sprawl and cut the need for driving, reducing oil consumption while improving our quality of life.

By coordinating transit planning and development, Portland, Oregon, absorbed a 26 percent growth in population from the mid-1980s to the mid-1990s with only a two percent growth in traffic. Portland residents now have shorter average commute times and cleaner air. By contrast, Atlanta's traffic grew 17 percent over the same period while its population increased 32 percent. Energy consumption per capita in Portland dropped eight percent, but it increased 11 percent in Atlanta.(see footnote 27)

Congress should pass the Urban Sprawl and Smart Growth Study Act (H.R. 1739), which would add Federal impacts on suburban sprawl as part of the environmental assessment required by the National Environmental Policy Act. Congress should direct Fannie Mae to aggressively promote "Location Efficient Mortgages sm"—mortgages with favorable terms for homes located in central areas or near public transit—recognizing that homeowners with low transportation costs can carry larger mortgages. Congress should provide tax incentives and funding for transit-oriented development, urban revitalization, and rural land conservation.

Our oil dependence didn't just happen. It is the result of policy choices made over many decades. And it is something we can change, with smart policies such as I have outlined today. Each of these policies supports other critical environmental and economic objectives—they will bring cleaner air, reduce the heat-trapping pollution that is causing global warming, and save consumers billions of dollars per year. There simply are no supply-side policy alternatives that can effectively reduce our dependence on oil or deliver these other benefits.

The policy choices before this Congress are not new, but the tragedies of September 11 may have changed how we will look at them. I urge this Committee to take the lead in turning Congress in a new direction, towards a real energy security policy that actually reduces America's dangerous oil dependency.

BIOGRAPHY FOR DAVID D. DONIGER

David Doniger is policy director of the Natural Resources Defense Council's (NRDC) Climate Center. Mr. Doniger rejoined NRDC in March 2001 after serving for eight years in the Clinton administration, where he was Director of Climate Change policy at the U.S. Environmental Protection Agency and, before that, counsel to the head of the EPA's clean air program. He also served for a year at the Council on Environmental Quality. Mr. Doniger first began at NRDC in 1978 and worked on clean air issues for the next 14 years, helping to win the Montreal Protocol to stop depletion of the ozone layer and the Clean Air Act amendments of 1990.

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Chairman **BARTLETT.** Thank you very much. The bells you heard were calling for a vote, so we will need to break. We have about five minutes remaining to make the vote, and we will return as quickly as we can. I would like to note that I also drive a Prius. We have driven it now for over 25,000 miles and couldn't be more pleased with it.

I also am opposed to drilling in ANWR, probably not for the reasons that you are opposed to it. We have only two percent of the known reserves of oil in the world. I don't think that it is bright to rush out and find and pump those two percent of reserves of oil that we have. I would like to buy all the Arab oil that they will sell us and save our oil for a rainier day. We will recess now and return as quickly as we can.

[Recess]

Chairman **BARTLETT.** We will reconvene our hearing and welcome now the testimony of Dr.

MacKenzie.

STATEMENT OF DR. JAMES J. MACKENZIE, SENIOR ASSOCIATE, CLIMATE, ENERGY, AND POLLUTION PROGRAM, WORLD RESOURCES INSTITUTE

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Dr. **MACKENZIE.** Thank you, Mr. Chairman. I think you did an admirable job at the beginning of this hearing summarizing the problem, namely that the domestic production is declining, ANWR is really not the answer, that global oil production is going to peak probably 10 to 20 years from now, and, lastly, that climate considerations have to be taken into account when we deal with the problem of oil.

In my remarks this morning, I would like to give you three classifications of actions that I think we should be taking to deal with the problems, short-term, medium-term, and long-term. Is this better? Okay.

There are many things that consumers could do that would instantly reduce oil use. I was going to give a quiz, but I won't do that. But I think that most people would not know, for example, the effect of tire pressure on fuel efficiency or taking weight out of the trunk, what that would do to improve fuel efficiency, or in speeding. I will give you the answer there. If you drive 55 rather than 75, you save 30 percent of the fuel that you would otherwise use, an enormous savings, and, yet, most people don't know that. And, in fact, the Congress repealed the Federal speed limit from 55, so they made the problem worse unfortunately.

But how do you make it happen? That is the trick. And there are three tools you can use to make things happen. One is you can get the prices right. And Americans loathe that because that means taxing. But I am going to suggest that if we reduce other taxes, we can make something tax neutral and still achieve your goal. You can subsidize, which is the good, old American way, or you can regulate, which is another preferred one rather than paying the prices.

I would suggest that to deal with this consumer ignorance in the short term that we ought to mount a federally financed public relations campaign along the lines that we have done for smoking, for diet, and, well, other goals that we seek to achieve as—nationally. And that the motivation could be gotten from a gradually phased-in increase in fuel taxes that would be offset by reduction in Social Security or income taxes. I know this is a difficult one for the Congress, but I think it needs to be stressed that it is necessary, if not sufficient, to price things right if we are going to use them right. And Congress calls it internalizing.

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Medium term—you can buy more efficient cars, such as the hybrid, which you have already done, and I commend you for that, which will reduce fuel use by about 50 percent. Secondly, I think we should, as has been mentioned here already, phase in the CAFE standards for SUV's and minivans and light-duty trucks as personal-use vehicles as they are generally used. This could help meet the goals as well. So combining CAFE with price incentives and consumer information would go a long way, I think, in the medium term, to improve fuel efficiency.

Long term is the interesting one, in my view. And I think that we have to do several things. We have to change the energy source, clearly, away from fossil fuels, which are—have the burden of greenhouse gas emissions. And we need new kinds of public transit systems.

There is one which has been developed and prototyped out by Raytheon called the Personal Rapid Transit. It is—and is—it looks as though it is about 10 percent the cost of a heavy rail system. It is comprised of a electrified guideway with small electric vehicles on them, which are computer-driven so that the consumer has his or her own vehicle taking you nonstop to wherever you want to go without parking problems at the end. And I give, in my testimony, the website for the developer of this technology, which is patented and owned by the State of Minnesota, of all places.

Secondly, we need—and I think that a Federal subsidy for the construction of a quasi-commercial PRT system would really be an enormous help. It would take the load off—the burden of commuting off, off of automobiles and provide a vastly more efficient system than what we have today.

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Next, we need new fuels. We all have talked about that this morning. And not all fuels are created equal. At the end of my testimony I have a chart which shows the fuel—the carbon dioxide emissions, greenhouse gas emissions per mile for the various fuels. If you make your fuels to substitute for oil, for example, from heavy oil sands from Canada, you actually increase the greenhouse gas emissions, which is not such a great idea. If you use CNG, try to substitute CNG for gasoline, you get a very minor reduction in greenhouse gas emissions, 25 percent. And moreover, it—we don't have that much gas.

The hybrids give you a 50 percent reduction. And that is a good transition vehicle, because it introduces electro-technology that you are going to need in the electro-EV driven cars and whether it is powered by batteries or hydrogen fuel cells.

How do we make—so if you look at this chart, it turns out there are two sources that eventually give you zero emission vehicles, and, therefore, I think the long-term goals—one is battery-driven, electric vehicles, and the other one is the hydrogen fuel cell vehicles.

And the battery vehicles have the advantage that there is an infrastructure in place now. We all have wired houses and you just have to plug them in. They are pricey. That is the problem and that is a matter of purchasing large volumes, in my opinion.

The hydrogen fuel cell is great. The fuel cells are coming along. The storage, I think, compressed gas is good enough. We don't have any infrastructure though. We have no place to generate the hydrogen. And this is an area where the Federal research ought to be increased, to look at the alternative systems for creating, transmitting, and storing hydrogen so that you can have electricity at night when the wind doesn't—when the sunlight doesn't shine, for example, with photovoltaics or wind systems, as well.

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So how do we make—what should we be doing? I think that something that has not been mentioned is using the Federal purchasing power to create the marketplace, to expand production and reduce costs. For example, Congress could establish a 10-year purchasing and leasing program for as many cars and vehicles for Federal use as can meet the standards. In other words, you say you will buy all the vehicles, electric or battery or hydrogen, that will meet performance standards and cost standards. Give this—and then gradually reduce the goals to bring down costs over time.

You could also have the Congress adopt or—its own fleet of electric vehicles for use in the city here. You could have them charged in the underground garage where maybe 100 electric cars could be used for urban use, or even personal use of the Congress around town, to get you used to the technologies, and hydrogen as well.

Lastly, I think that the infrastructure needs to be examined much more thoroughly, and this is a good job for the national laboratories. Let me summarize my—the major policy recommendations that I think would achieve most of these goals over the short, medium, and long term.

Public education program on gasoline use and efficiency, along the lines that we have already seen for other nationally desired goals. Phased-in tax shift on gasoline with reduced taxes on personal income or Social Security taxes, so that the tax would be neutral, and you could call it a national security tax, if you would like. You can phase it in over time so that you get consumers used to the idea that gasoline's prices are going to be going up as they buy the new cars.

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Inclusion of light-duty trucks, minivans, and SUVs under the CAFE standard. Federal support for PRT commercial demonstration. And a subsidized fleet purchase or leasing for EVs powered by batteries or hydrogen fuel cells for the general public, and as well as for the Congress itself. And research on infrastructure design and options that will allow us to make a phased transition to these sustainable transportation systems. Thank you, Mr. Chairman.

[The prepared statement of Dr. MacKenzie follows:]

PREPARED STATEMENT OF JAMES J. MACKENZIE

Thank you, Mr. Chairman, for the opportunity to appear before the Energy Subcommittee.

I have been asked to address the issue of identifying fuels and policy measures that would lead to major oil reductions, on the order of 20 percent, in the transportation sector. In addressing such a complex and politically charged issue—everyone, after all, is an expert on cars—I think it is helpful to distinguish between short-term actions, those that can be taken within hours to a few weeks, and medium and long-term actions involving the major introduction of fundamentally new fuels, technologies, and patterns of land use development.

Although today we are necessarily focusing on the short term—achieving a 20% reduction is no simple

task—it is essential for the nation that we not ignore the long term if we are to evolve a transportation system that is truly sustainable. Our transportation system is certainly not sustainable today and it would take many decades to make it so. U.S. oil production has been declining since 1970 and global production will probably peak between 2010 and 2020. Hence we face a tightening oil situation beginning in one to two decades. Moreover, the bulk of the world's remaining oil is in the unstable Persian Gulf. Compounding the depletion problem, we must begin a shift away from fossil fuels if we are to cope with global climate change. Hence we have to meet the challenge of developing both non-oil energy sources and non-fossil as well.

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Short-Term Measures to Reduce Oil Consumption

Some of the actions that can be taken almost immediately involve minor adjustments to the car. Others involve relatively painless changes in driving behavior. The cumulative effect on U.S. oil consumption depends on how many consumers make the changes which in turn depends on how well they are informed and whether there are financial incentives. A fairly substantial amount of analysis would be required to address these issues.

The first category involves improvements in fuel economy that can be achieved by periodic tuneups and measures such as proper tire inflation and removal of heavy objects from the trunk that simply add weight and reduce fuel economy. It is estimated that for every three pounds of pressure below the recommended value, mpg declines by one percent.(see footnote 28) Carrying around an extra 100 pounds of unneeded weight can also cut mpg by about one percent.(see footnote 29)

Significant energy savings can be achieved quickly by changes in our driving habits. These involve decisions to combine trips, ride share, use of HOV lanes by single drivers (for which a toll is paid), avoiding jack rabbet starts, and—very importantly—not speeding. According to ORNL, driving at 75 mph rather than 55 mph reduces fuel efficiency (mpg) by almost 25 percent.(see footnote 30) Conversely, driving 55 mph rather than 75 mph can increase mpg by 30 percent.

One can also choose to drive the most efficient vehicle in the household at least for short trips. One hardly needs a 15 mpg SUV, minivan, or pickup truck to go to the grocery store for a quart of milk.

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Whatever actions one chooses, consumers need to be informed of the tradeoffs, which they are unlikely to be today. As a result they fail to take actions that are reasonable and economically attractive.

Medium Term

When gasoline prices rise rapidly, drivers react in the near term by simply driving less. They cut discretionary driving. If high prices persist over a period of months they may choose to buy a more efficient

vehicle either in place of or in addition to their gas guzzler. Or they may choose to move to areas where they do not have to drive as much, either to work or to other activities. These are often areas of high residential density development with shops, retail stores, and public transportation stations nearby, within walking distance. This is the way many European cities were laid out and it results in less need to drive and lower fuel consumption. It takes years to evolve this option. But one can see it beginning around some of the METRO stations in the DC area.

Long-Term

Over the long term, years, there are major opportunities to move to other fuels, which are domestically available, to other kinds of propulsion systems, such as vehicles powered by fuel cells or electric batteries, and to new forms of public transit and land use planning.

One especially attractive new form of transit is the PRT, Personal Rapid Transit, which would be powered by electricity and so would not rely on oil at all. (For more information, visit the following website: www.taxi2000.com) A prototype of such a system was built by Raytheon Company in Boston. The system is comprised of computer guided small (four seats) electric vehicles running on their own guide ways. The system has many attractive features. It provides privacy, a guaranteed seat, no parking to worry about, and non-stop travel from station to station.

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It is accessible to the young, the elderly, and the handicapped. The system can be largely built in a factory and simply site erected. Hence the time from proposal to operation can be reasonably short. The cost of a PRT system looks attractive, much less than heavy rail.

Alternative Fuels, Ranked By Their Greenhouse Emissions

In the meantime, it is important to think long-term about new fuels for vehicles. Oil poses not only a threat to national security but a threat to the global climate. Hence, in seeking a long-term substitute for oil we should seek energy systems that are also climate friendly, emitting very low or no emissions at all of carbon dioxide. Hydrogen for use in fuel cell cars where the hydrogen is made from electrolysis of water using renewable energy sources or nuclear power would be a clean, climate friendly domestically produced and sustainable form of energy. Battery powered electric vehicles would also provide similar advantages including an infrastructure of electrical distribution lines already in place.

There are many so-called alternative fuels being proposed to take the place of oil. Depending on the sources from which they are derived they can have greatly different greenhouse gas emissions (GHG). The accompanying figure shows the relative life-cycle GHG emissions of 9 kinds of fuels and/or vehicles. The lower the GHG emissions, all things being equal, the more attractive the fuel-vehicle combination from a climate perspective. Most of these results depend on work done at DOE's Argonne National Laboratory.

The top line shows emissions made from gasoline refined from Canadian oil sands. It shows that, taking the entire fuel cycle into account, this source results in 10–15 percent higher GHG emissions than from conventional gasoline from crude oil. Clearly, not an attractive substitute for conventional gasoline from a

climate viewpoint.

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The second row shows conventional gasoline whose emissions we set equal to 100%.

The third row shows emissions for CNG burned in an internal combustion engine. Emissions are about 25% below conventional gasoline. Not bad, but not the answer. U.S. natural gas production is static and Canada doesn't have enough natural gas to replace U.S. oil.

The fourth row shows emissions for a hybrid with a gasoline charger on the vehicle. An example of this would be the Toyota Prius. It has a 50% reduction in GHG. This combination is a good transition vehicle with impressive reductions in GHG and pollution emissions.

The fifth and sixth rows are hydrogen fuel cell vehicles and both achieved 60% reductions in GHG emissions. The first of these uses hydrogen made on board the vehicle by reforming methanol, wood alcohol. The methanol in turn is made at a refinery from natural gas. The other vehicle uses compressed hydrogen stored in the vehicle. The hydrogen is also made from natural gas at a refinery. Of these, the second would be considered preferable because the infrastructure changes would be smaller as a hydrogen economy is phased in.

The seventh vehicle is a battery operated vehicle with the electricity generated by a very efficient combined cycle power plant burning natural gas. Its GHG emissions are only 30% those of a conventional gasoline car.

The last two vehicles have nominally zero GHG emissions. The first is a hydrogen fuel cell vehicle with the hydrogen supplied by renewable resources such as Pvs or wind. Honda has constructed such a system in California. The 9th vehicle is battery powered with the electricity also derived from Pvs or wind. These vehicles are arguably the only long-term sustainable options that will reduce transportation climate and pollution emissions. Prototypes of this kind of vehicle have also been developed.

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The Federal Role

The Federal Government can play an important role in encouraging the changes and programs that I have outlined above. There are at least three important areas where Federal actions are warranted.

Fuel Pricing and Public Education

First the Congress can adopt tax changes that will gradually shift taxes from income and savings to the purchase prices of fossil fuels. While the net change in tax revenue would be zero, the tax shift would have the effect of giving consumers the economic signal that they must become more efficient in their transportation decision-making. We all recognize that present fuel prices are so low that they provide little

incentive to buy more efficient vehicles or to change their driving habits.

This is not to imply that higher prices, by themselves, will lead to major changes in consumer behavior. A well functioning free market also requires that consumers be informed as to the consequences of their decisions and I believe that is not the case today. I urge the Congress to authorize a nationwide public information program, much as we did for to influence eating habits, smoking, and drug use; the goal would be to educate consumers regarding energy efficiency and what they can do to save energy and money.

Federal Purchasing Power

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Second, the government can use its considerable purchasing muscle to expand the markets and reduce the costs of vehicles that are more sustainable in their use of fuels. As things stand today, the government buys mostly CNG vehicles because battery Evs and hydrogen vehicles are not available in large numbers. I urge the Congress to establish a ten-year purchasing or leasing program that would have the government offer to buy, for a given year, as many Evs or hydrogen fuel cell vehicles as meet established prices and performance goals. Each year the goals and prices would change. Over time, the prices offered for purchase (or lease) would be reduced and performance goals would increase. The net effect would be a guaranteed market for sustainable vehicles with corresponding performance and cost benefits for the American public.

The Congress could itself buy or lease a fleet of several hundred Evs and/or hydrogen vehicles for its own use. These could be refueled at special stations near the Capitol and would be available to Congressmen and Senators, at no charge, for their use in personal or official business. Such a fleet would provide first hand experience for the Congress in the practicality and performance of these rapidly improving technologies.

Infrastructure Research

Finally, there is a need for more basic research on batteries, supercapacitors, and similar electric and hydrogen storage systems. There is a particular need to understand better the tradeoffs in various possible forms of hydrogen infrastructures. Questions that need to be studied include: Where and how should the hydrogen be made? Where and how should it be stored? How transmitted? In short, what are the strategic infrastructure options available in a hydrogen economy?

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Finally, I would urge you not to support making synthetic oil from coal, shales, and other solid hydrocarbon sources. Such synthetic fuels will only compound the climate problem by increasing the GHG emissions over the levels from conventional vehicle fuels.

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Chairman **BARTLETT.** Thank you very much. I want to thank all of the witnesses for their very

excellent testimony. And let me turn now to my Ranking Member, Ms. Woolsey, for her questions and comments.

U.S. Market for Energy Efficient Vehicles

Ms. **WOOLSEY.** Well, Thank you, Mr. Chairman. While you were speaking, all of you, I keep thinking about the economy and about the auto industry and how this would go hand in hand to produce the right cars. I mean, you have to tell me, is there no market for these cars? I mean, it would be an excuse, a reason for people to invest in new automobiles and it would work all the way around. I guess, Mr. Dana, I am going to ask you—do you understand what I am asking without me going on and on and giving a speech, because I would like to ask other questions?

Mr. **DANA.** Congresswoman Woolsey, I think you are asking if we can do more in fuel efficiency.

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Ms. **WOOLSEY.** No. I want to know if there is not a way to encourage the consumer to—by having American cars that do the right thing for the economy and the environment.

Mr. **DANA.** Well, Congresswoman, there are many vehicles today that get very good mileage that are not very popular with the public. There are over 25 models that get more than 30 miles per gallon today that don't sell.

Ms. **WOOLSEY.** Well——

Mr. **DANA.** We don't—the consumers are not interested, from our surveys, in fuel economy, per se, in terms of the preferences they, you know, show us in terms of what they want to buy.

Ms. **WOOLSEY.** Okay. Well, I am going to just ask—go one more step on this then. Is there no way, in this very creative country we live in and this very hardy industry that is having some troubles, to make them interested because we provide a car that actually is interesting?

Mr. **DANA.** Congresswoman, well, we have supported H.R. 4 and the tax credits there as a way to get consumers interested in advanced technology vehicles like hybrids, like alternate-fuel vehicles, like fuel cell vehicles. We think those are the promising technologies that are available today, and the tax incentives in H. R. 4 will help involve consumers in those decisions.

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Value of PNGV Approach

Ms. **WOOLSEY.** Okay. But I don't think we are doing enough, but, okay. In Secretary Garman's statement, it was clear that, I believe, that you don't think that PNGV is going to be as effective a tool as we had hoped to increase energy efficiency. And I would like to know if the rest of the panelists—what they

think about this, starting with Mr. Woolsey.

Mr. **WOOLSEY** [continuing]. That the partnership for new generation of vehicles is not going to do enough.

Ms. **WOOLSEY.** What we had hoped.

Mr. **WOOLSEY.** I think the problem now is that we need to refocus away from fuel economy to fuel-you-worry-about economy. Let us call that FYWA, F–Y–W–A. All right. If you are using 15 percent ethanol and —15 percent gasoline and 85 percent biomass ethanol in a vehicle, a Ford Taurus that is out there on the road right now, a flexible-fuel vehicle, you are getting maybe 20 miles per gallon of fuel, but of fuel that you worry about, you are getting about 85 miles per gallon. Because this illustration is in Senator Lugar's and my article.

Ms. **WOOLSEY.** Uh-huh.

Mr. **WOOLSEY.** Because although you are using a bit more fuel, because ethanol is only 70 percent as efficient as gasoline, although it is a higher octane, you are—what you are worried about is the gasoline. The biomass ethanol does not come from the Mid-East. It does not contribute essentially anything to global warming, because with biomass ethanol you are just recycling the CO from the plant fixing the CO in photosynthesis and you turn the same CO loose. You are not digging any new CO up from underneath the ground. You are not contributing to pollution because ethanol and E–85 is much cleaner than gasoline. And furthermore, you are producing—for every billion dollars of imports you replace, you are producing ten to 20,000 jobs in the United States.

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So even though you are only getting 20 miles to the gallon maybe, in that Taurus, of fuel, you are getting 80 miles to the gallon of fuel you worry about, namely, gasoline. So part of the problem here is that we have been focusing solely on getting fuel economy, and people like to drive SUVs. All right. But if the SUV isn't running on gasoline from the Mid-East, if it is running on biomass ethanol, or, for that matter, if it is running on diesel fuel, 85 percent of which is produced from chicken manure that would have otherwise gone to pollute the Chesapeake——

Ms. **WOOLSEY.** Rivers.

Mr. **WOOLSEY** [continuing]. And otherwise turned into methane, which is 25 times worse as a global warming gas than CO—if you are doing something good with the fuel, you don't care that much whether you are getting 20 miles to the gallon or 25 miles to the gallon. You have replaced a big chunk of the fuel with fuel that you don't mind burning.

And so it seems to me what we need to do is rethink the notion of what we are trying to do and we—with different kinds of fuel we can have a much bigger impact sooner than simply focusing on getting better standards. As the standards go on, then if you are using ethanol, biomass ethanol, in a hybrid, you are using a tiny share of it, or in a fuel cell, you are doing even better. But you can do a lot——

Ms. **WOOLSEY.** Uh-huh.

Mr. **WOOLSEY** [continuing]. Just by changing the fuels.

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Ms. **WOOLSEY.** Okay. I have been given permission to ask if any of the rest of the panel would like to respond. Dr. MacKenzie. No. I mean, Mr. Doniger.

Mr. **DONIGER.** Thank you, Congresswoman. The PNGV is a good effort. It does need some refocus. We have been concerned about several things over the years. One, that there is no production commitment at the end of the rainbow. And it—for putting Federal resources into these kinds of programs, the expectation was that the automakers were going to produce these cars. And now we have come to the end when the production should start and the automakers are moving away from production promises and the Bush Administration is moving away from the production commitment. We would like to see production of these vehicles because the hybrids that are already on the road and the hybrids that are coming are a demonstration of what could be done.

And it is also not a fair criticism, in my view, to say, while the production was focusing on tourist-like vehicles, it should have been focusing on SUVs because the technologies that are being developed are applicable to anything, from the smallest cars to the biggest SUVs. And the automakers should be able to put those into production.

We have concerns to make sure that the emission standards for the targets for these vehicles are tight emission standards so we don't have any decline in air quality performance.

Ms. **WOOLSEY.** Yeah. I think——

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Mr. **DONIGER.** And the new hydrogen vehicles program should have production commitments to it.

Ms. **WOOLSEY.** All right. I have overstayed my five minutes—my—anybody else want to answer that? All right. I yield. Thank you very much, Mr. Chairman.

Chairman **BARTLETT.** Thank you. And, Mr. Smith.

Promoting Energy Efficiency

Mr. **SMITH.** Mr. Chairman, thank you. Thank our witnesses for being here, extremely important effort. As—and I am going to excuse myself after a couple of comments since I am going to an International Relations Committee—would like to introduce some guests that Mr. Ehlers and I viewed some of their suggestions and their effort. It is Paice Company that are developing the proposal for a more efficient automobile and its generation and transmission.

I guess one of my questions, and I am not sure it can take on a response, but as important as energy is, as important as our research effort in terms of increasing our efficiency and reducing our dependence on energy, it seems—it seems wrong for this to—for whatever reason, to be held up in the Senate and not move ahead with some kind of energy policy. Maybe it has generated into a question of ANWR rather than other elements of that energy policy that are going to increase the efficiency and reduce the pollution from coal and that research, and alternative energy source research, and the rest of that energy bill.

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So I would just call on all of the Panel, to the best of your ability, to encourage the Senate to move ahead, whether it is a compromised version or not, to move ahead with what this country has long needed is a solid energy policy.

I was Director of Energy for the U.S. Department of Agriculture during the Arab Oil Embargo in the early 1970's. And at that time, of course, we went to the White House with Bill Simon and met every day on how we could increase our energy supplies and reduce our dependence on foreign fuels. And that effort of conservation and expanding our research was short-lived when energy prices went down again. And then it was not only four years later that we saw OPEC increase those prices again.

So I am looking for ways that can also encourage greater efficiency, encourage the research and development, but also somewhat concerned with not leaving a total option with the American consumer on what kind of a vehicle they want to buy and what kind of fuel consumption they want to have for their particular pocketbook. So I am like Ms. Woolsey—I am looking for alternative ways for—to encourage the American consumer in their choice. And I suspect that part of that is information. And so if we can get some of that information out to the American consumer, especially at this time, it seems to me that it would result in some advantage.

Vulnerability of the Trans-Alaska Pipeline System (TAPS)

Mr. Garman, I would like to explore with you just one question on the vulnerability of the Alaskan Pipeline. And I assume that you are talking about the potential for terrorist attacks on that pipeline like we have seen in South America. I am sorry.

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Mr. **WOOLSEY.** Woolsey.

Mr. **SMITH.** Yes. Apologize. Are you talking about the——

Mr. **WOOLSEY.** Yes.

Mr. **SMITH** [continuing]. Vulnerability for attacks from terrorists or a disruption of that supply from damage to the pipeline?

Mr. **WOOLSEY.** Yes. One fellow was planning, a few years ago, to shut it down with a bomb and then take advantage of the price of oil in the stock market with his purchases. Somebody shut it down briefly with a rifle shot the other day. There is—it is—my friend, Amory Lovins, calls it a 900-mile long piece of Chapstick waiting to happen in winter. It is a very fragile thing.

And were it not for TAPS (Trans-Alaska Pipeline System), I would not have a problem personally with drilling even in the Arctic and certainly with drilling in the United States. I think domestic oil is, for national security reasons, better than oil from—imported, even though I take the Chairman's point that maybe we wouldn't want to use it right away. But having it available seems to me to be good. But having it available through the Trans-Alaska Pipeline seems to me to be a very vulnerable situation indeed.

Mr. **SMITH.** And, Mr. Chairman, I would yield—well, unless Dr. Ehlers would like me to yield him the balance of my time. Thank you, Mr. Chairman.

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Chairman **BARTLETT.** Let me turn next to Mr. Lampson, and then we will get back to Dr. Ehlers. Thank you.

Biomass Ethanol

Mr. **LAMPSON.** Thank you, Mr. Chairman. And I thank you for calling this meeting. Your testimony has been most interesting. If I can ask Mr. Woolsey first, give me a very short answer—my district in southeast Texas represents probably as much as 20 percent of the petrochemical processing capacity of the country. How do you get the oil folks to buy into your biomass ethanol?

Mr. **WOOLSEY.** I think the natural place for a lot of the processing to be done initially would be oil refineries. I think, frankly, our European friends, BP and Shell, have latched onto this far more quickly than the American oil companies. Because it seems to me that blending, processing a lot of this, can easily be done at refineries. And there is no reason why energy companies that now mainly process petroleum shouldn't regard themselves as energy companies that process a number of different types of raw material into fuel. There is plenty of time to do this. We need—I mean, this is going to be a relatively slow process even if we move as fast as possible introducing ethanol——

Mr. **LAMPSON.** What kind of education is it going to take to make it happen? Who is going to have to reach out to whom?

Mr. **WOOLSEY.** I think the science is very close to being here. I don't think this is a basic research matter. The renewable energy laboratory at Golden, Colorado, has done a lot of work in hydrolyzing cellulose, which is what we are mainly talking about here, quick ways, mainly using enzymes to break cellulose polymers down into constituent sugar molecules. And several private companies have done it as well. It is really a matter of commercialization. And I think if we gave the oil companies and refinery companies the right kind of initial incentive to move into this area, they could do a very good job of combining some of the processing of petroleum and——

Mr. **LAMPSON.** If you get other information along the way that you might be able to share, I would appreciate that——

Mr. **WOOLSEY.** Certainly.

Clean Diesel

Mr. **LAMPSON** [continuing]. And maybe we can, at some point in time, pass it on. Let me ask Mr. Dana—many in the environmental community are strongly opposed to the deployment of advanced lean-burn technologies. In fact, they seem to be opposed to all diesel engines. What assurances can you give them that these new technologies can reduce the levels and types of emissions to acceptable levels? And then, Mr. Doniger, would you comment on that, as well?

Mr. **DANA.** Well, unfortunately, I think what the view of the public in this country is they still see a lot of very old diesel busses running around the country which have a lot of black smoke coming out of the tailpipe. In Europe, manufacturers are now making what we call common-rail diesel technology—very clean, very advanced diesels that don't have a lot of noise associated with them, have much lower emissions associated with them, and no black smoke.

With the inclusion of cleaner diesel fuel in this country, which EPA has promulgated rules for 2006, we hope to be able to bring technology like that to this country. And because of the lower sulfur use after treatment technology to further reduce emissions, so that we can actually have lean burn or diesel engines in this country with very low emissions, very good fuel efficiency, and very little bit of noise or black soot emissions.

Mr. **DONIGER.** Diesel engines are coming a distance from their extremely, obviously, dirty past, but they are not yet as clean as gasoline engine technology can be. And we are concerned not to see the health standards compromised—the emission standards compromised in a way that would damage health. So if the standards are set at—on the basis, frankly, of what gasoline can do, and the diesel engines can meet that, then I think that we are there. But we need some test procedures that focus on the very, very small particles and on the toxic constituents in them. And if we have those test procedures set and the diesel technology continues to improve to meet those, then that is the objective.

New Materials for Lighter, Safer Vehicles

Mr. **LAMPSON.** So I think you are saying just treat both the same, gasoline and diesel. Let me turn to a different subject real quickly, and anyone make your comments on it. In addition to fuels, we can reduce the weight of vehicles, but, at the same time, find ways to keep them just as strong. And one of the—one advance that I am familiar with is through nanotechnology and the creation of carbon-60, or buckyballs. The

work that is being done by others in that area of creation of materials—can any of you comment on that? And it is going to play not only a role in decreasing the weight of the vehicles and helping us with fuel efficiency, but also it is going to create better means of us to create stronger, longer-lasting batteries, I think. Comments, please. And all of that needs to be put into context of policy with us—what we need to be doing. And I have run out of time, but would you at least answer?

Mr. **GARMAN.** The quick answer is that we view materials as a very, very important component of the technology portfolio. It is an easy thing to make a vehicle lighter. It is not so easy to make a vehicle lighter and crash-worthy. And that is the trick. Using advanced—we do a lot of work at Oak Ridge National Laboratory directed specifically at carbon-related materials and crash-worthiness and use of those materials in a car.

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Mr. **LAMPSON.** Thank you, Mr. Chairman.

Chairman **BARTLETT.** I am sorry. Let me turn now to Dr. Ehlers.

Alternative Fuels Issues

Mr. **EHLERS.** Thank you, Mr. Chairman. Very seldom do I throw my scientific credentials around the Congress. They really don't make that much of an impression. But I think it is worth pointing out that there are two scientists on this panel, the Chairman and myself. We both probably feel more strongly about the importance of the energy issues we are discussing today than any other two Members of Congress do. And I think that is worth noting because—and I think the factor is, first of all, we understand the laws of thermodynamics, which, I would say, the American public doesn't understand.

And it is very important to understand those if you are going to deal with this, because, first of all, you realize from the laws of thermodynamics that energy is our most basic natural resource because we can't use any other resources if we don't have energy to produce those resources. And, number two, energy is our only non-recyclable resource. It is the only resource we have that we only get to use once and then it is gone, period. No chance of recycling it in any way.

So it is incumbent upon us, I believe, to recognize those two facts. And I am afraid that most of the economic theories about energy use don't take account of that. And that once we use the energy, it is gone, period. And so we ought to be worrying about our kids and our grandkids. Economic theories don't take that into account. What we really have to be doing is using our current fossil fuels to help us develop an entire energy economy which does not depend on fossil fuels. And that is what we are not doing, at least not doing it very effectively.

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I appreciate the comments that have been made here. And I—Mr. Woolsey, your comments about ethanol, I think, are well—are right on. And we have known for years that we can produce fuels out of

biomass—we just don't do it. The ideal, in order to save refining costs and particularly refining energy, would be to have farmers refining biomass on their own property using solar energy, which would be a good way to boost farm income and make use—you don't have the transportation costs of the waste products. You don't have the energy costs going into the refining process. And it makes it much more economically competitive.

I think ethanol, as a fuel, is a good idea for a number of reasons, but I am very reluctant to see food—in other words, grains, used for that. The only basis on which I think that is a good idea is that it is better to put alcohol in the tank instead of in the driver. But other than that, it is an expensive way and there are a lot of starving people in this world who could make better use of that food.

I really think that what we are going to need is dramatic new approaches. Obviously, we have to use electric vehicles to the greatest extent possible for no other reason than they are highly efficient. There is nothing that matches the efficiency of electric vehicles. And the question is, how can we generate that electricity, whether it is in plants, which is not all that efficient, or fuel cells, which is very efficient, but, at this point, difficult and demands huge new infrastructures in terms of delivering hydrogen because that is really the best way to do it, especially if you want to reduce CO.

So we are going to need dramatic new approaches, dramatic new technologies, immense new infrastructures, in the case of hydrogen. And so my question, after all that introduction, Mr. Garman, what are you going to do about it? How—that is a very ambitious program. Is DOE really thinking seriously about this? Do you have—are you given enough responsibility and enough resources to tackle these problems? Is the DOE aware, for example, of the incredible infrastructure that is going to have to take place in this Nation if we are going to a hydrogen economy? Is DOE involved in helping the automobile companies—the PNGV program, for example, is not in the Department of Energy. What do you have to say about this?

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Mr. **GARMAN.** Well, the PNGV program is our program.

Mr. **EHLERS.** Yeah. I am sorry. I misspoke myself.

Mr. **GARMAN.** And we are working with our technology partners. And, frankly, they have issued that same challenge to us. They have told us, frankly and candidly, we would like to work with you on the hydrogen vehicles, but we need some assurances from you all that the technology, the infrastructure, will be there.

As you have pointed out, that is a daunting challenge. Hydrogen, as you know, embrittles pipelines. It is a difficult material. It has got energy density issues. We have storage issues with hydrogen. How can you carry enough hydrogen on the vehicle to give it the range that people will want? And we are working with technologies that range from carbon nanotubes to other kinds of technologies to try to store that carbon—I am sorry—to try to store that hydrogen and make it available in vehicles.

I don't—I think you are absolutely right in raising those questions. The Secretary has directed us to be

bold, and this is a bold vision and a daunting challenge. But we think that the payoff and the reward is so great that we need to start down that pathway. And I would add that money and resources alone is not the issue. We have to do some work to reorient some of our thinking, to reorient some of our programmatic shortcomings and pull it together. It is a complicated situation that not only involves vehicles, but infrastructure. How do you make the hydrogen? How do you convert it from a specialty chemical, that it is today, to a commodity chemical that is affordable and available to consumers? You are absolutely right.

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Mr. **EHLERS.** My—let me just clarify something. And I apologize for forgetting where the program was. I am on too many committees that deal with energy issues. But the real reason for government involvement and those—and that infrastructure question, is because there is not going to be time or money to let the marketplace play its normal role. We developed the gasoline stations' distribution program over many years. You know, that gradually emerged as the best fuel to use for internal combustion and so forth. We are talking about trying to get to the hydrogen economy in a decade or shortly more.

There has to be a lot of research done on all of these questions. What is the best means of transporting it? What is the best means of holding it in vehicles? Is it pressurized cylinders? Is it metal hydride? Is it some other way? Can it be done safely? What is the best way of doing all this? Immense research questions, and I just don't see the research effort being done at DOE to resolve these questions so that the private sector can pick up the ball and decide this is the way we are going to have to go. This is the infrastructure we have to build.

Mr. **GARMAN.** I don't want to mislead you, and I don't want to mislead anybody into thinking that this is a dramatic change that we are going to see in the next decade, because it is not going to come that quickly. But there are some interim technologies and things that we can think about that help us get in that direction.

Now, natural gas used in vehicles and deployment through our Clean Cities programs is one way that we can address both the biofuels issue and some of the interim gaseous technology issues that stand between us and that hydrogen vision. We have a partnership with 83 cities around the country to try to build some of the infrastructure that we need so that folks who buy the flexible fuel vehicle will have some E–85 to put into it. That is not the case everywhere today. In some cases, it is impossible to find E–85 to put in your flexible fuel vehicle.

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One of the things that we are doing there is to work with partnerships, work with cities, to encourage it is a chicken-and-egg problem. Bring the infrastructure along with the fleet. In terms of natural gas, which we also do in the context of the Clean Cities Program, it is—gas has different characteristics than hydrogen, but getting consumers used to a gaseous fuel that they can put in their car is a step that we need to address, as well, as we start to think about and move toward hydrogen.

Mr. **EHLERS.** Mr. Chairman, if I may have just one moment for another comment on this. It seems to

me that what we are going to see in the next decade, this decade we are in right now, is the rapid growth of hybrid vehicles, which will greatly reduce fuel consumption and CO production. But I see, starting about 2010, the beginning of the hydrogen economy. And the infrastructure research has to be done before that point, because that is when industry has to make huge decisions about investments for the hydrogen economy.

For fuel—if you are going to use fuel cells, which I think will start about 2010, you need—it makes sense to use hydrogen, rather than pre-fueling of other fuel. If you are going to use fuel cells you can get essentially zero CO out if you use hydrogen. If you don't, you are still going to have the CO problem. So why not go to the hydrogen economy? But that is going to take a lot of forethought by government in order to establish the ground rules under which industry will feel free and safe in making those investments.

And I totally agree with Mr. Woolsey's comment about the timing of the price of oil dramatically increasing at roughly 2015. And by then, if we don't have these things in place, the public is just going to go bonkers, because the price of gas is going to rise precipitously. Thank you.

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Chairman **BARTLETT.** Thank you very much. As Chairman, I ordinarily stand last in the queue for asking questions. And I would like to do that today also, but I do have some time constraints. And if the next —we have only two additional members who need to ask their questions. If they can reasonably limit their question period to our 5-minute clock, then I can recognize them now. And I will do that. Ms. Jackson Lee.

Energy and Homeland Security

Ms. **JACKSON LEE.** Thank you very much, Mr. Chairman, for this hearing, and I thank the Ranking Member for her leadership on these important issues and microphone that insists on not working. Let me thank the witnesses for their testimony and apologize for being in a markup at the same time of this hearing. And let me focus my questions directed toward the climate that we are in post-September 11.

I serve on the Homeland Security Task Force and even today we will be meeting. And so these issues are very front and center. They are almost—they are certainly quite different from the passage of the energy legislation out of the House that we passed this summer. It is a totally different climate.

Mr. Woolsey, what part do you believe this hearing and the focus of this hearing plays in homeland security, and what do we need to—I know that you have certainly spoken to the issue of ethanol, but let me use your expanded experience with your former affiliation to talk about briefly what we need to move to quickly as a component of homeland security dealing with our energy needs?

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And I will have a subsequent question for Mr. Garman. And let me allow you to continue to be thinking about it. And I am very interested in fuel cell research. And I may have had this question before, but my interest is the amount of investment that has gone on. You might also share with me whether Houston is one

of those 83 cities, but I am very interested in that. And then with the Department of Energy, I want to know what your role has been in the homeland security effort for the Administration, what you have done—that is Mr.—excuse me, that was Mr. Garman. And then what role the Department of Energy has played in homeland security? And what role have you been playing in dealing with 18-wheelers on the issue of energy efficiency? Mr. Dana, I want to deal with you on fuel cell research, etcetera. But, Mr. Woolsey, if you would, would you speak to me about where we need to head and how quickly we must get there?

Mr. **WOOLSEY.** Yes. Congresswoman, thank you. I touched on this in my opening statement. Let me explain it a little bit. We are a Nation of networks of all kinds and two of them have now been turned against us and used by terrorists—the air transport and the mail distribution network.

Virtually all of our networks are—have ignored, in being put together, the possibility that terrorists or people with evil intent can use them for damage. They are resilient against accidental failure. They are resilient against things like earthquakes and hurricanes, but they are not resilient against people figuring out how to read the way in which we deal with aircraft hijackings and turn that into a way to turn aircraft into giant cruise missiles to crash into buildings.

Our energy distribution network, I think, all of them, are disasters awaiting to happen. The centralized nature of power generation, the centralized nature of the control system for oil and gas pipelines, the dependence on foreign oil at entry at a few large facilities—all of that needs, over time, to get corrected. We need to think in terms of decentralization and resilience. We need to think in electricity generation in terms of small generate—a lot of small generators.

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For example, if waste from a plant can be turned partly into natural gas or fuel gas to produce electricity and also some of it into fertilizer and oil products—and there are processes that will do that—to the degree that plants are producing their own electricity, the system is more resilient. To the degree that, whether it is ethanol or some other type of biofuel, is being produced at a lot of different places in the country, rather than at a relatively few places, we have a greater degree of resilience.

There is a whole range of changes that need to made, and they will be evolutionary. These won't happen overnight. And I think they will only be made if the companies, and those who manage the infrastructure—the oil and gas companies, the refinery companies, the electricity producers, and the rest—work somehow in cooperation with the government and here's where this Committee's role and the Congress's role comes in—incentives are given. Because if you try to do this through central planning, we will mess it up.

What has to happen is that somehow the Congress and the Executive Branch have to get together with incentives that push toward renewable fuels, decentralization, and resilience, so that as these infrastructures and networks are modified over the months and years to come, they are modified in those direction. That seems to me to be the key.

Ms. **JACKSON LEE.** Thank you. I am adhering to the Chairman's admonition. I am wondering if Mr. Garman and Mr. Dana could give a one-sentence answer out of respect for the Chairman. But I really would like to hear it. Thank you very much, Mr. Woolsey. That is—energy should be dispersed—our energy

needs, and I have got it. Mr. Garman, and, Dana, are you able to give me a response on those issues that I have concern with?

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Mr. **GARMAN.** With respect to critical infrastructure, the Department of Energy is working in that. We have an aggressive distributed energy portfolio to try to distribute our resources of generation and our diversity of fuels. With respect to Houston, I had the pleasure to be in Houston a couple of weeks ago to launch a Rebuilding America Program and I have the expectation we are working with our Houston Clean Cities partners. And I will be in Houston again in a few months to—and we will contact you and your office about that to——

Ms. **JACKSON LEE.** I appreciate it. And are you involved in the homeland security effort? Is the Department of Energy part of that effort?

Mr. **GARMAN.** The Department of Energy is part of that effort. My office is not directly involved beyond that effort to work on distributed energy generation——

Ms. **JACKSON LEE.** Thank you.

Mr. **GARMAN** [continuing]. Which we think makes our network more robust.

Ms. **JACKSON LEE.** But I would like to get back with you on whoever is responsible in that department and get a briefing on their efforts. And, Dr. Dana, please.

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Mr. **DANA.** Yes. Fuel cells—right now there is an organization called the California Fuel Cell Partnership that has automakers, energy companies, the Air Resources Board in California, the Federal DOT, a lot of entities interested in transportation and changes to it, working very hard on looking both at the infrastructure of hydrogen and looking at developing the vehicles and getting them to a place where they can be afforded by the average consumer. And that is an ongoing effort today.

Ms. **JACKSON LEE.** Let me thank you, Mr. Chairman. I think there is some cross-pollination here and I didn't get to mention it, but I think energy and transportation need to get together and we all need to be funding light rail wherever we can fund it, or rail in a very efficient manner. But we have to begin to look at different modes of transportation. Thank you.

Chairman **BARTLETT.** Thank you. Mr. Gutknecht.

Issues in Setting Energy Policy

Mr. **GUTKNECHT.** I will attempt to be very brief, Mr. Chairman. Mr. Garman, I—listening to this testimony, I was both elevated and frustrated because there is, even among the panelists, and they are all distinguished esteemed members of the scientific community, but there is misunderstanding even among

them. And it is frustrating, and, I guess, as I listen to this, I am not surprised that our colleagues over on the other side of the Congress are taking no action on an energy bill.

Because what we really have is collections of experts who say, well, we want an energy policy as long as it does "X." We want energy policy as long as it doesn't do "Y." For example, I mean, we heard the comment by one of the experts today that, well, it didn't make any sense to make ethanol out of corn. Well, maybe it doesn't. And, in fact, another person said, well, it doesn't make any sense to develop the Arctic National Wildlife oil because it represents only a 6-month supply. But taken by themselves, every one of the technologies we have talked about today, represents a very, very small part of the solution.

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And, as long as we have various groups saying, well, I support an energy policy as long as you don't do this, I support an energy policy as long as you don't do that, I mean, how is the American—how are the American people to look at this and come up with a conclusion? Because at the end of the day, what the American people say, well, if we can get oil that costs $1 a barrel to produce in Saudi Arabia, why do we want to invest any money in new technologies when not even the experts will agree?

I guess my point I really want to get to—and let me just add to this to the whole story about renewable fuels—and I believe in renewable fuels and I believe in more efficient engines. I believe in fuel cell technology. I think all of these will play a role.

But I just want to make a point about renewable fuels. Currently, they represent only 7/10 of one percent of all the energy we consume, at least in the form of a liquid petroleum-type product. Now, that takes six percent of all the corn we produce. If we converted all of the corn in the United States to ethanol, it would still only represent about 12 percent. Now, some people would say, well, that is not enough to even fool with. Maybe we shouldn't mess with it. I think it is an important part of the long-term solution.

I also believe that biodiesel represents an important part of our long-term energy solution. Let me give you an example. Right now—last year—the last year we have numbers available for—and you can be helpful in this—the United States military bought approximately 248 million gallons of diesel. Now, I suspect that number is going to be considerably higher this year. But if we could get just a 20 percent blend in the fuel that the military buys, that would be 50 million barrels of biodiesel, which would consume 379 million pounds of soybean oil. And it would also, I think, keep the environment much cleaner, because the studies we have seen demonstrate that it is a very clean burning fuel.

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I guess the real question I have for you, Mr. Garman, is we have a bill that I am co-sponsoring in the House. It is H.R. 2423. The companion is Senate Bill 1006, which is sponsored by Senators Hagel and Johnson. We would like to see the Administration support that legislation. And all it really calls for is setting goals for renewable fuels, moving from about a one percent target in 2008 to a three percent target in 2011, and a five percent target in 2016. Now, with what is happening over in the other body right now, it

may be the only bill that is going to come out of this Congress this year.

So I just wanted to at least get an editorial plug in for that bill. I think it is the right direction to go. And I also want to encourage a lot of the experts to start talking to each other, listening to each other, and not being quite so parochial, saying, well, we would support an energy policy as long as it doesn't include ANWR. We include—you know, we would support energy policy as long as it doesn't include corn-based ethanol. I mean, that is the kind of thinking that is going to create the situation like was referred to in the engineer's manual of the Union Pacific Railroad Engineer's Manual a number of years ago. And that is—and I quote, "If two trains should approach each other on the same track, neither shall advance until the other is passed." And so they are sitting there looking at each other and we have no real energy policy. And you have got a tough job. I don't want to make it worse. But we would appreciate your support on 2423. Thank you.

Mr. **GARMAN.** I could very briefly respond. I don't want to take the Chairman's time. But very briefly, thank you for those astute observations. You are right. We think we have 500 million gallons a year of potential for biodiesel. And we do have DoD included in our heavy-truck program because we think that there are certain synergies—anything that will work for over-the-road highway trucks can work for DOD as well. And they are the largest fuel user in the country, the largest single fuel user, and it is very important that they are a part of the program as well. And thus far, they have been superb.

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Biomass Ethanol vs. Grain Ethanol

Mr. **WOOLSEY.** Could I just add one point? Congressman, I am not all opposed to corn-based ethanol. I—but the numbers you cited illustrate a point, which is that if all of the corn in the country can be used to replace 12 percent of our transportation fuel, the numbers from Professor Lee Lynd of Dartmouth, who has worked—gave us some of the data for Senator Lugar's and my article that you have, indicated that nearly 10 percent of the transportation fuel in the country could be replaced by processing a very small share of the country's agricultural wastes.

So as long as we are using starch, which is well under one percent of what grows to produce transportation fuel, we are going to need an awful lot of the starch in order to produce a little bit of transportation fuel. If we can not only give credits for corn-based ethanol, but enhanced credits for biomass-based ethanol, we will be able to use waste instead of what we could feed to animals or eat ourselves. And to me, that is the evolution that we want to see the ethanol companies, as well as the oil companies, move toward.

Oil Resources and Depletion

Chairman **BARTLETT.** Thank you. I want to thank the witnesses very much. First, let me just make a very brief statement, expand very briefly on what I said earlier about my position on drilling. We have only two percent of the known reserves of oil in the world. I just don't think, from the national security perspective, it makes any sense to go out and find that and pump it as quickly as possible. If we could find and pump that oil tomorrow, what would we do the day after tomorrow?

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Now, if we could, I would like to go out and drill every place that we possibly could drill in this country to find oil. Then I would like to pump none of it, relatively, and buy Arab oil as long as they will sell it to us. I am sure there will be a much rainier day than we have today when those oil reserves would be much more useful to us.

I believe with today's technology that the environmental concerns can be largely avoided. I have been to ANWR. I have seen the footprint. I have seen the roads they build in the wintertime out of crushed ice and when the spring comes, you don't even know they were there. I think, with care, there will not be a meaningful environmental impact. But from a national security viewpoint, I think that we should husband the relatively small amount of oil that we have.

There is general agreement, I gather, and I think Mr. Woolsey mentioned this in his testimony—there is something maybe a bit more, but around 1,000 gigabarrels of oil in the world. A gigabarrel is a billion. A thousand billion is a trillion. And when you get up to two trillion, you are now looking at very optimistic estimates at how much we are going to find with only a five percent probability of finding it. We may have as much as two trillion barrels out there of oil.

And, by the way, if you look at the roughly 80 million barrels a day that we use, and do some very simple arithmetic, that is 30 to—that is with no increase in consumption around the world—that is just a bit more than 30 years of oil remaining in the world.

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Mr. Woolsey, I don't believe that we are going to aggressively attack this problem, unless we perceive it as a real threat. And I would just like to spend a moment exploring our vulnerability, which you did a very good job of in your opening statement. We get now about 56, 57 percent of our oil from overseas. That is up from 34 percent at the Arab Oil Embargo. By the way, if an enemy had done this to us and made us this vulnerable, we would be out looking for him. You know, Pogo said it best, you know, "We found the enemy and he is us." It is really totally indefensible that we are in this position today. How much of that oil that we import comes from the Gulf area?

Mr. **WOOLSEY.** I think it is a relatively small share, Mr. Chairman. It is—of the 56 percent——

Chairman **BARTLETT.** My understanding it is about 20 percent.

Mr. **WOOLSEY.** Yes. It is——

Chairman **BARTLETT.** It is about 20 percent. But it is enough oil that comes from that area that if we didn't have it, our economy will essentially collapse——

Mr. **WOOLSEY.** Yeah.

Chairman **BARTLETT** [continuing]. If we don't have it. Now, how much of that oil moves through the Straits of Hormuz?

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Mr. **WOOLSEY.** Oh, a very high share——

Chairman **BARTLETT.** A very high share.

Mr. **WOOLSEY** [continuing]. Of the 20 percent that we get from the Mid-East.

Chairman **BARTLETT.** A single tanker sunk there would disrupt oil flow to our country for how long?

Mr. **WOOLSEY.** I don't know the answer to that, but it is not a real deep strait. You have got to clear it and it would—it is a—it would be a serious problem.

Chairman **BARTLETT.** It would be a very serious problem. So we are very vulnerable to any interruption of foreign oil and very vulnerable to the interruption of Arab oil. It is also my understanding that essentially every oil-producing country in the world, except OPEC, is now pumping oil about as fast as they can pump it. That is your understanding also?

Mr. **WOOLSEY.** I think that is about right. And the Mid-Eastern share of OPEC will run—start running down or will hit the halfway point, which is what is important from the point of view of cost, that production will hit the halfway point much later than most of the rest of the world. The rest of the world starts hitting the halfway point, which starts to drive up the production costs substantially before the Mid-East does.

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Chairman **BARTLETT.** By the way, we met our halfway point about 1970.

Mr. **WOOLSEY.** Yes.

Chairman **BARTLETT.** Every year since 1970, we have found less oil and pumped less oil. As a matter of fact, in 1982, we spent more energy drilling for oil than we will ever get from the oil that we found in 1982. There is—it is my understanding there is nothing we can do in this country to increase our production of oil. If we scurry around and drill hither and yon, everywhere that a number of people would like us not to drill, all that we will do is to make our downturn in oil production less steep.

Mr. **WOOLSEY.** A drop in the bucket.

Chairman **BARTLETT.** Yes, sir. It is really not much. Even Prudhoe Bay was just a little blip on the continuing downtrend of pumping oil in this country. So for those who believe that drilling under Lake Michigan and off the coast of Florida and in ANWR as a solution to our oil problem, it is not. It is—there is nothing we can do in this country to increase our production of oil. We will go down fast or faster,

depending upon what we do locally.

If the war becomes the United States against the Arab War world, and they decide to use the only real weapon they have, which is oil, and they aren't shipping us any more oil tomorrow, what do we do?

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Mr. **WOOLSEY.** The prices——

Chairman **BARTLETT.** Or if a ship is sunk, the tanker is sunk in the Straits of Hormuz, what will we do the day after tomorrow if that happens tomorrow?

Mr. **WOOLSEY.** The prices would increase substantially, both for speculative reasons and also because of supply, and people would probably finally start buying hybrids rather than SUVs, and all the rest of the things that we need to do. But it would take time and we would be behind the power curve, substantially behind the power curve.

Chairman **BARTLETT.** And isn't it true that with that diminished amount of oil, not only do we have to run our present economy, but we have to make the investment that we have not made in alternative fuels?

Mr. **WOOLSEY.** I think that is right. The key thing on a lot of these alternative fuels now really is incentives to commercialization. There is some research and development to do, but we have got a lot of scientific learning about this now. What is really needed is that—is the step, particularly given the state of the capital markets now, where very few people are willing to risk money on anything, what really is needed is incentives to commercialize some of the steps that will increase our efficiency and will increase our ability to use quickly alternative fuels.

Government Actions to Reduce Reliance on Petroleum

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Chairman **BARTLETT.** My colleague, Dr. Ehlers, made the observation and I think he is exactly right, that if we wait for our market-based economy to do these things, it is not going to happen in time. I see Mr. Woolsey shaking his head in agreement with me, that it will not happen in time. What should the government be doing now?

Mr. **WOOLSEY.** Well, I think that some of the steps, such as the renewable fuel standards that were—that the Congressman mentioned a minute ago, is credits for renewable and alternative fuels, are an excellent idea. I think production credits for the right types of alternative fuels are a great idea. I think special focus on incentives to use waste for fuels.

I would commend to the Committee the writings of Professor Lee Lynd of the Thayor School at Dartmouth, who provided a lot of the basic material for Senator Lugar and me. And Lee's focus, when he looks at a hydrogen economy versus a biomass-based fuel economy, comes out rather substantially in the direction that it is much faster and, in a lot of ways, more efficient, to move first and foremost toward

biomass as a source of different types of fuels, not only ethanol—as a source of different types of fuels and energy, and then to transition into hydrogen. That hydrogen may be ideal, but biomass will be a lot sooner and it is very well distributed around the country and around the world.

Near Term Contribution of Biomass Fuels

Chairman **BARTLETT.** Thank you for your references to energy from agricultural products. Our farmers are in trouble. We could exploit our desire to help them and also do a lot for our energy situation if we simply would focus on using products of agriculture for energy. There is the ethanol that you spoke of and the very fascinating possibility of ethanol from newspapers, from wood chips, from old desks that ordinarily go to the landfill. They will make ethanol, thank you, if you could use these little microbes to split the cellulose into glucose and then ferment the glucose.

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Mr. **WOOLSEY.** Yes. And also other types of waste to energy. And there are processes now that will produce natural gas and biofuels and fertilizer from all types of animal wastes, packing plants, used tires. There are a whole range of technologies here that are, I think, ready to be commercialized if the incentives are there.

Chairman **BARTLETT.** We are now using natural gas in most of our new electric generating plants, simply because of the environmental constraints. In a very real sense, natural gas is too good to burn. It is the raw material for most of our petrochemical industry. We live in a plastic world today and most of that is based on natural gas.

There is one other thing that is based on natural gas that most people don't know, and that is fertilizer—nitrogen fertilizer. Until we learn how to make nitrogen fertilizer from natural gas, its only source other than the barn yard, which was nowhere near adequate, was guano, from thousands of years of droppings of seabirds on some island cliffs, and that is in caves. And we mined those caves and we mined that guano, and it is gone. And it is now going to be thousands of years before there is any meaningful supply of it again.

So the food you eat is quite literally oil. It is oil because the tractors used it to till the fields. It is oil because the nitrogen fertilizer that grew the food came from gas, which is—came from the same basic source as oil originally.

I am concerned that unless America perceives that we have a real crisis here, that nothing is going to be done. Two of us ride in a car. I commute 50 miles. There are six lanes going in each direction. I am in an HOV lane going 60 miles an hour. There are five other lanes that are stopped because there is only one person per car. What do we need to do so that this kind of thing—by the way, if every car had two people in it, we would immediately reduce to only 50 percent the amount of gas used in our automobiles. What do we have to do to do this? Do we have a love affair with the car and with the freedom it gives us that is incompatible with a future where we are so vulnerable to oil?

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Mr. **WOOLSEY.** This country never really gets going until it gets scared, Mr. Chairman. And I think September 11, I hope, I trust, I believe, finally got our attention.

Chairman **BARTLETT.** I hope so. It certainly galvanized us to look at airport security and to look at how we handle our mail. But as you very appropriately mentioned in your introductory remarks, there are many, many other places that terrorists can strike. And when we developed all of these networks, these delivery systems in our country, we gave not one bit of thought to how vulnerable they were to terrorist attack, because of the very safe world that we, before 9/11, lived in.

I really want to thank all of the witnesses for their compelling testimony. Rest assured, the Committee will be following up with additional questions, and we would like your commitment that you will provide for the record answers to questions that we submit to you.

Mr. **WOOLSEY.** Absolutely.

Chairman **BARTLETT.** I know, Chairman Boehlert, in particular, has follow-up questions, and the hearing record will remain open for inclusion of their questions and your responses. The bells that you heard heralded a series of votes. And so thanking you for your testimony, we will now adjourn our hearing.

Mr. **WOOLSEY.** Thank you, Mr. Chairman.

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[Whereupon, at 12:34 p.m., the Subcommittee was adjourned.]

Appendix 1:

Additional Material for the Record

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(Footnote 1 return)
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(Footnote 2 return)
U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves: 1999 Annual Report, Energy Information Administration, Office of Oil and Gas, U.S. Department of Energy, DOE/EIA–0216(99) (Washington, DC, December 2000), p. ix. (See http://www.eia.doe.gov/pub/oil–gas/natural–gas/data–publications/ crude–oil–natural–gas–reserves/current/pdf/arr.pdf.) *According to AOE 2001,* 1999 U.S. consumption totaled about 7.1 billion barrels.

(Footnote 3 return)
http://www.ta.doc.gov/pngv/default.htm

(Footnote 4 return)
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U.S. Crude Oil, Natural Gas and Natural Gas Liquids Reserves: 1999 Annual Report, Energy Information Administration, Office of Oil and Gas, U.S. Department of Energy, DOE/EIA–0216(99) (Washington, DC, December 2000), p. ix. (See http://www.eia.doe.gov/pub/oil–gas/natural–gas/data–publications/ crude–oil–natural–gas–reserves/current/pdf/arr.pdf.) *According to AOE 2001,* 1999 U.S. consumption totaled about 21.4 trillion cubic feet.

(Footnote 6 return)
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(Footnote 7 return)
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(Footnote 9 return)
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If we opened the Arctic Refuge coastal plain to development today, seven to 10 years would pass before the first oil flowed through the Trans-Alaska Pipeline System (TAPS) to tankers and then delivered to West Coast refineries. Oil companies starting exploring for oil at the Alpine oil field west of Prudhoe Bay in 1991. Alpine oil did not start flowing through TAPS until November 2000.

(Footnote 11 return)
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(Footnote 12 return)
Lashof, Daniel and Silva, Patricio, "A Responsible Energy Policy for the 21st Century," NRDC, February 2001, p. 7.

(Footnote 13 return)
Friedman, David et al. "Drilling in Detroit: Tapping Automaker Ingenuity to Build Safe and Efficient Automobiles," Union of Concerned Scientists, June 2001, p.15, Table 4.

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(Footnote 16 return)
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(Footnote 17 return)
"Calculation using same methodology referenced in endnote 10.

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(Footnote 23 return)
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