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OIL DEMAND

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

TO

REVIEW THE STATUS OF EXISTING FEDERAL PROGRAMS TARGETED AT REDUCING GASOLINE DEMAND IN THE NEAR TERM AND TO DISCUSS ADDITIONAL PROPOSALS FOR NEAR TERM GASOLINE DEMAND REDUCTIONS

JULY 23, 2008

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OIL DEMAND

WEDNESDAY, JULY 23, 2008

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:45 a.m. in room SD–366, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. Ok, why don't we go ahead and get started? I'm not sure of Senator Domenici's schedule this morning, but we've got Senators here and witnesses. So let's go ahead and begin at 9:45 as we indicated.

Average gas prices have been above four dollars since the beginning of June. As of June 21, gas prices averaged $4.06. I think they're higher than that today. It's about a $1.10 increase over last year at this same time.

These fuel prices have harmed our economy. They are harming our economy. They cause serious problems for many consumers.

Some believe the only way to reduce the price of gasoline is to provide more supply through additional drilling. There are also, of course, ways that we can reduce demand which will also, I believe, affect gasoline prices. Today we've gathered a panel of experts to discuss a variety of near term proposals for reducing our dependence on petroleum and hopefully lessening the pain at the pump that United States consumers are currently experiencing.

The witnesses have been selected to give us a comprehensive look at policy options in this area including relevant Federal programs; particularly those authorized in the 2005 legislation we passed, EPACT, and the 2007 legislation that the President signed last year. Another option we're hoping to look at here is increasing fuel economy and consumer response to incentives to purchase more fuel efficient vehicles, and efficient opportunities across the transportation system, the role of information technology in helping us accomplish these goals, transportation and development and policies to reduce the number of vehicle miles traveled and also advances in battery development to enable quicker electrification of our transportation system.

So, we look forward to the testimony. I thank the witnesses for being here. Let me ask if Senator Craig wishes to make an opening statement before I introduce the witnesses.

[The prepared statement of Senator Salazar follows:]

PREPARED STATEMENT OF HON. KEN SALAZAR, U.S. SENATOR FROM COLORADO

Mr. Chairman and Ranking Member Domenici, thank you for holding this hearing to discuss existing and potential federal programs to reduce gasoline consumption.

The energy crisis that we currently face is dominating the minds of many citizens. Driving up to a filling station and seeing four dollar per gallon gasoline and nearly five dollar per gallon diesel is not something that anyone can get used to. I am hearing stories from all corners about folks trying to limit their gasoline consumption. The pain of high gas prices is only the most visible symptom of a much deeper and more systemic set of problems. Today's hearing, in my mind, is about what we can do to both help consumers—especially our most vulnerable citizens—in the immediate term and what we can do to shatter our dependence on petroleum-based fuels for transportation as quickly as possible.

When we talk about encouraging reduction in gasoline consumption right now, I think it is critical to distinguish between those who have options and those who don't. Americans who live in urban areas generally have multiple options to reduce their gasoline consumption, including mass transit, bicycling, walking, and telecommuting, while those who live in rural areas typically do not have these options. Many rural Americans have to travel significant distances to their place of work or use large quantities of fuel for farm machinery. Furthermore, those in rural areas often do not have the income base to afford a transition to a hybrid vehicle; they might depend on owning a truck or other low-mileage vehicle for their livelihood. And of course many of our seniors on fixed incomes have very few options for changing vehicles or changing their transportation habits. Rising gasoline prices hit these families and individuals hardest. We've probably all heard stories of folks socking away their economic stimulus rebate check for gasoline. We need to think hard about what policies—whether it's a tax rebate or some other instrument—can help mitigate the burden on the most financially vulnerable Americans.

In the longer term, we need to escape the fundamental fact that in this country the car has a death grip on mobility and that oil has a death grip on the car. The U.S. consumes 20.7 million barrels of oil every day. 68% of this is for transportation and about half—9.2 million barrels—is consumed as gasoline by America's 235 million cars and light trucks. No matter how much we want to deny it, the truth is that OPEC and countries like China and India that subsidize artificially low gasoline prices for their citizens stack the deck against us in the global oil market. OPEC's power derives from oil's monopoly in the transportation sector.

This monopoly is bleeding our economy and American wallets. Americans are sending the staggering sum of over $700 billion a year to foreign producers. A typical family will spend about $6,000 this year on liquid fuels, natural gas, and electricity. This amount has doubled since 2000, and equates to a $300 billion tax hike on working Americans.

We have made a start in the right direction. I am proud of the work that we have done in this committee with the Energy Policy Act of 2005 and the Energy Independence and Security Act last year, which established and then expanded the renewable fuels standard.

Last year's bill also raised the CAFÉ standards for cars and light trucks by over 40 percent by 2020. And these policies are beginning to have an effect. Merrill Lynch estimates that we would be paying 15 percent higher prices at the pump today without current domestic biofuels on the market. The Energy Information Administration tells us that the 2007 energy bill will reduce U.S. oil consumption by 1.1 million barrels per day in 2020—half of what we currently import from the Persian Gulf—and by 2.5 million barrels per day by 2030. Simple arithmetic shows that the bill's 36.0 billion gallon renewable fuel standard in 2022 is equivalent to 1.6 million barrels of crude oil per day—1.6 million barrels that the U.S. will need not import.

These policies are an important start, but they are only the beginning of the radical change we need to achieve. The RFS and the increase in CAFE standards point the way forward: displacement of the roughly 14 million barrels of oil we currently import per day is eminently achievable by aggressive movement towards high-efficiency vehicles and renewable biofuels and other alternative fuels.

Yesterday I introduced legislation with Senators Brownback and Lieberman to accelerate the deployment of flex-fuel vehicles into the U.S. passenger vehicle fleet. Our bill, the Open Fuel Standard Act, will break oil's monopoly by making fuel flexibility a standard feature, ensuring that Americans have choice at the pump. There is no reason we can't do this today. At a cost of just $100 per car, FFV technology

will enable Americans to choose how to fuel their car and where to send their dollars. In Brazil today, 90% of the automobiles on the road are FFVs, and most of those are manufactured by GM and Ford. It is time our domestic automobile manufacturers produce and sell FFVs on a mass scale in this country.

FFVs will provide a platform on which alternative fuels can compete. Imagine the effect on consumption of oil and the average family's budget if, instead of filling up for $4.30 a gallon it was possible to choose alcohol fuels, which can be produced for about $2.00 a gallon, or synthetic gasoline and diesel, produced from renewable biomass, which soon will be cost-competitive with petroleum-based products. If consumers have choice at the pump, they will almost overnight send a powerful signal to the world oil markets by choosing cheaper fuels produced from abundant domestic resources. We add about 17 million new light-duty vehicles to our roads each year, and these vehicles have a lifespan of about 13 years. Increasing the number of FFVs on the roads is an investment we need to start making today and will pay lasting dividends.

In their widely publicized meeting at the White House in November 2006, the CEOs of the Big Three U.S. automakers reaffirmed their commitment to making 50% of their fleet capable of running on any mixture of alcohol and gasoline (FFVs) by 2012. Our legislation merely codifies that commitment and establishes a modest increase in that standard of 10% per year after 2012 to 80% by 2015. That trajectory matches the projected increase in supply of renewable biofuels under the 2007 renewable fuels.

Flex-fuel vehicles and alternative fuels are a big piece to the puzzle, but not the only piece. We must also pursue advanced battery technologies to "electrify" a large chunk of the transportation sector by making low-cost long-range plug-in hybrid electric vehicles a reality. We need to encourage smart transportation and smart development. We need to promote telecommuting. We need to alter our tax policies to make early adoption of plug-in hybrids more affordable and remove the few perverse provisions that actually incentivize the purchase of gas-guzzlers. We need to do all of these things to fundamentally transform the transportation sector and rid ourselves of our need for oil for good.

The key to energy security is using America's abundant natural resources to regain our strategic advantage in the world. Unlike in the case of oil, where national oil companies and countries in the Middle East control the vast majority of the resource and we have less than 2% of world oil reserves, the United States has abundant domestic coal, natural gas and biomass resources—enough to power all of America's trucks and automobiles for centuries.

I look forward to discussing these and other policy options with this distinguished panel. Thank you, Mr. Chairman.

STATEMENT OF HON. LARRY E. CRAIG, U.S. SENATOR FROM IDAHO

Senator CRAIG. Mr. Chairman, thank you very much. To all the witnesses thank you for being with us today.

We're at an interesting time in our country's history as it relates to energy. Mr. Chairman, I find it fascinating, of all of the dynamics that are out there at this moment, I was very curious over the last several years when the break point would occur. When the American consumer would finally say, we've had enough. We can't pay or we won't pay what at the pump.

It didn't happen at $2. It started appearing to happen at $3. But clearly at $4 it has occurred. We know what's going on here in Washington, a very robust debate at this moment about what we ought to do as it relates to supply and demand and can, by our public policy actions we affect it in some way.

But while that is going on, I'm fascinated by what the consumer is doing because they are doing something. We have seen the consumption in our country fall, flatten, to a point where demand is off approximately 3 percent from last year. That's directly a result of price.

As a result of that, the market is beginning to react. Yesterday crude fell $3.09, down from the high 140s to 127, I think it was yesterday. All of that, in part, is a direct result of a consumer reaction, in my opinion, in what I read, to the price.

So there is a price sensitivity out there, where we know. We hear it everyday when we go home. The American consumer can no longer afford to pay that.

Last year I found it fascinating in when we were sitting at about $3.25, in an E-news system I have out in my State of Idaho, where long distances are traveled on a very regular basis by an awful lot of our citizens. I said how many of you would pay more if you could buy a car that got $5 more to the gallon. Sixty-five percent of those who responded said we wouldn't pay a dime more, if it cost us more.

So it broke down this way. It cost a thousand dollars more to get $5 to the gallon, only 17 percent said they would pay. If it cost $3 thousand, only 11 percent said they would pay. If it cost $10 thousand only 1 percent said they would pay. In other words they weren't willing to offset in any way their reaction to that price at that time.

Today if you travel across my State that 18 mile per gallon vehicle is sitting on a lot with a for sale sign on it because the consumer has made a decision that they can no longer afford. So what we do here and what we did in EPACT 2005 and what the consumer does is a very important part of the equation to deal with it. At the same time, finding more supply certainly is also an important part of the total equation for a long term transition to the kind of opportunities I think we've put together in Energy Policy Act of 2005. Again, of course, we responded in 2007.

I hope we continue to respond as the marketplace adjusts, realigns itself. The break point has occurred. A decade from now we will look back on 2008 and 2009 as a significant shift in our attitudes toward hydrocarbons.

Thank you.

The CHAIRMAN. Thank you very much. Let me go ahead and introduce our witnesses.

First is, on the left here, is Mr. Steven Chalk, who is the Deputy Assistant Secretary for Renewable Energy. Thank you for being here.

Mr. CHALK. Thank you.

The CHAIRMAN. Dr. Greene, who has testified to us before is a Corporate Fellow with the Center of Transportation Analysis at Oak Ridge National Laboratory.

Mr. Skip Laitner is here. He is the Director of Economic Analysis for the American Council for an Energy Efficient Economy here in Washington.

Mr. Steve Winkelman, Director of Transportation and Adaptation Programs with the Center for Clean Air Policy in Port Chester, New York. Thank you for coming.

Dr. Edward Buiel, who is Vice President and Chief Technical Officer with Axion Power International in New Castle, Pennsylvania. Thank you for being here.

Why don't each of you take 5 or 6 minutes and tell us the main points you think we need to understand about this set of issues. Then we will undoubtedly have questions.

Mr. Chalk.

STATEMENT OF STEVEN G. CHALK, DEPUTY ASSISTANT SECRETARY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Mr. CHALK. Thank you, Mr. Chairman, members of the committee. Thanks for the opportunity to discuss the Department of Energy's technology development programs targeted at reducing gasoline demand and transportation-related greenhouse gases in the near term. Addressing petroleum dependency is essential to ensure national prosperity, security, and environmental stewardship.

Rising gasoline prices are having a significant impact on family budgets of many Americans and overall threatens our economic stability. Through bipartisan legislation, such as the Energy Independence and Security Act of 2007, otherwise known as EISA, we've initiated important advances in addressing this Nation's addiction to oil by increasing the renewable fuel standard, the RFS, and by increasing the corporate average fuel economy (or CAFE) of our vehicles. Durable, predictable policies like the RFS and the CAFE are crucial to industry investment in advanced technologies and infrastructure.

Today I'll discuss the near term technologies that DOE is investing in on behalf of the taxpayers. However one important point I'd like to make is that if we're going to make a more urgent effort to reduce our petroleum use, we need to accelerate the rate at which technology is introduced by turning over current assets at a faster rate. For example, it takes about 15 years for a new automotive technology to achieve full market penetration.

It's taken hybrid vehicles about 7 years just to reach 2 percent of new vehicle sales. The average lifetime a vehicle is in the inventory is 15 years. So a vehicle sold today doesn't pop out of the inventory until 2022, 2023.

Installing new infrastructure is equally daunting. It's taken 8 years to put in place over 1,400 E85 fueling stations. E85 is 85 percent ethanol, 15 percent gasoline. It's a blend. This is just 1 percent of the total number of stations that we have in the United States.

So frankly, it takes time to fully realize the benefits of new automotive technology. Right now it's measured in decades. To greatly reduce petroleum consumption in the near term we've got to act decisively and with unprecedented speed and conviction. The technology will be there, but we need to devise programs that encourage consumers, fueling station operators, vehicle manufacturers, energy providers to change over their current assets at a faster rate.

Now DOE is pursuing both short and long term technology options. Plug in hybrid vehicles (or PHEVs) are one of the most promising for the near term. These are hybrid vehicles where the battery is externally charged. The vehicle can potentially achieve 40 miles in all electric mode.

DOE recently announced a new program to accelerate the development, demonstration and commercial introduction of PHEVs.

However, the challenge to widespread plug in hybrid vehicles continues to be the battery. It's life, it's cost and it's the size of the battery pack. So our research is focused on lithium batteries that are projected to have two to four times the energy content on a volume basis or a weight basis compared to nickel metal hydride which is the type of battery that's used in today's hybrids.

Additionally, we're helping to increase the efficiency of today's gasoline diesel engines. High efficiency combustion engines are really important for all technologies, today's vehicles, hybrids and plug in hybrid vehicles.

The Department is also actively supporting advanced biofuels for basic science all the way to integration into our national fuel supply. Our goal is to make these cost competitive by 2012. Increased use of advanced biofuels such as cellulosic ethanol is going to have a very positive impact on the environment.

Now while we continue to support fuel flexible vehicles and E85 infrastructure, the use of intermediate blends of ethanol is critical to acceleration of biofuels into the marketplace. The Department is leading a testing effort right now to determine the impacts of intermediate blends on existing vehicles and non-road engines. R and D of vehicles and fuels has been very successful.

However, I want to emphasize again that the accelerated introduction of vehicle and infrastructure technologies is not only inhibited by the technology cost, performance, reliability, but also by the time it takes to introduce these technologies and replace incumbent investment. If we're to combat the economic and environmental impact of increased oil dependence in a more urgent manner, we need to evaluate programs that bring new technologies to the consumers faster and incentivize new vehicle and fuel infrastructure. This is a challenging issue because we're going to build new infrastructure, we have to look at the undue hardship we might cause to owners who have already invested in today's infrastructure.

So Mr. Chairman, thank you again for holding this important hearing and for the opportunity to address how DOE is helping reduce gasoline consumption in the near term. This concludes my prepared statement. I'd be happy to answer any questions the committee members may have.

[The prepared statement of Mr. Chalk follows:]

PREPARED STATEMENT OF STEVEN G. CHALK, DEPUTY ASSISTANT SECRETARY, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Mr. Chairman, Ranking Member Domenici, Members of the Committee, thank you for the opportunity to appear before you today to discuss the status of existing Energy Department programs targeted at reducing gasoline demand and transportation greenhouse gases in the near term.

Reducing petroleum dependency can help improve national prosperity, energy security, and environmental stewardship. Petroleum provides close to 40 percent of our total energy use, and, to date makes up about 48 percent of our trade deficit.[1] Rising gas prices present a threat to our economic stability and the link between petroleum supply and our economy is direct and precarious. Likewise, our petroleum dependence contributes to climate change and threatens our energy security, as it puts our supply at risk to unpredictable global events.

[1] The 48 percent figure was calculated as a fraction of the goods trade deficit for the first four months of 2008, http://www.eia.doe.gov/oiaf/aeo/index.html.

The transportation sector accounts for about two-thirds of U.S. petroleum use.[2] Correspondingly, transportation is also a significant contributor to climate change, accounting for 31 percent of our carbon dioxide emissions.[3] To help curb our addiction to oil, President Bush announced the "Twenty in Ten" initiative in his 2007 State of the Union address. This initiative proposed to reduce projected gasoline usage by 20 percent in 10 years, to be achieved in two ways. First, the supply of renewable and alternative fuels would be increased to displace 15% of projected gasoline use. Second, the Corporate Average Fuel Economy (CAFE) Standards for cars and light trucks would be modernized to reduce projected gasoline use by an additional 5%.

Congress responded to the Twenty in Ten initiative by passing the Energy Independence and Security Act of 2007 (EISA) that sets a mandatory renewable fuel standard (RFS) requiring fuel producers to use at least 36 billion gallons of biofuel in 2022 and set a national fuel economy standard of 35 miles per gallon by 2020. These EISA provisions will achieve substantial reductions in oil use and greenhouse gas emissions. However, there will be challenges in achieving these dramatic reductions.

New technologies must meet criteria for cost competitiveness, performance and reliability. Products must meet those criteria with a high degree of confidence because consumers will expect products to be fully warranted. However, it is also critically important to accelerate the rate in which technology is introduced so that better and more efficient technology can replace current assets. Consider that it takes approximately 15 years for a new automotive technology to achieve full market penetration,[4] it has taken hybrid vehicle technology seven years to achieve a U.S. market penetration of over 2%,[5] and the average lifetime of a new vehicle is over 15 years.[6] Placing new fueling infrastructure is equally daunting. It has taken eight years to place just over 1,400 E85 fueling stations, less than one percent of the total number of U.S. fueling stations.[7] Therefore, the time it takes to fully realize the benefits of a new automotive technology is measured in decades.

The Department of Energy is working to shorten the time between research and commercialization so Americans will be able to drive more fuel efficient vehicles while at the same time reducing greenhouse gas (GHG) emissions and criteria pollutants. As part of this plan, DOE is pursuing technologies that will significantly reduce petroleum use within five to ten years, as well as pursuing longer-term technologies. The Department continues to work with industry through its FreedomCar and Fuel partnership and 21st Century Truck Partnership. The Department and industry are on track to meet most of the FreedomCAR and Fuel 2010 technical targets.

Plug-In Hybrid Electric Vehicle Technology (PHEV)

Plug-in hybrid electric vehicles are one of the most promising technologies to decrease petroleum usage. DOE recently announced selections to accelerate the development, demonstration, and commercial introduction of Plug-In Hybrid Electric Vehicles (PHEV). Projects with Ford, General Motors, and General Electric/Chrysler, are targeted to demonstrate the technical and performance of PHEVs and result in the commercial introduction of at least three vehicle models.

DOE's Advanced Vehicle Testing Activity provides benchmark data for its research and development programs and also assists fleet managers, who are often early adopters of alternative energy vehicles, in making informed vehicle purchase, deployment and operating decisions. This testing documents the petroleum reduction potential, the infrastructure requirements, and operator use patterns. The testing to date has demonstrated very high fuel economy in mostly urban applications. The challenge to widespread PHEV production continues to be limitations in battery life, size, and cost, issues that DOE is also working to solve.

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[2] Transportation Energy Data Book, Edition 27, Table 1.13, http://cta.ornl.gov/data/tedb27/Edition27__Chapter01.pdf.

[3] "Emissions of Greenhouse Gases Report," EIA, November 28, 2007, http://www.eia.doe.gov/oiaf/1605/ggrpt/.

[4] Light-Duty Automotive Technology and Fuel Economy Trends: 1975 Through 2006, EPA420-R-011, July 2006, p. 62.

[5] Toyota Prius introduced in 2000, hybrid sales 2% of total 2007 sales. Electric Drive Transportation Association, Hybrid Sales Figures, http://www.electricdrive.org/index.php?tg=articles&topics=7.

[6] Transportation Energy Data Book, Edition 24, Tables 3.9 & 3.10, http://cta.ornl.gov/data/chapter3.shtml.

[7] "E85 Fueling Station Locations," DOE, http://www.eere.energy.gov/afdc/ethanol/ethanol__locations.html.

Battery Accomplishments

The battery research effort is supporting the development of durable and affordable advanced batteries covering the full range of vehicle applications. The higher fuel economy and reduced greenhouse gas emissions of today's hybrids (HEVs) are due in large part to the progress in battery technology resulting from the DOE's Energy Storage R&D activities.

Current DOE HEV and PHEV research is focused on lithium batteries that are projected to have two to four times the energy content, on a weight or volume basis, of nickel metal hydride batteries. The first commercial HEV to use a lithium battery is expected to be the 2009 Mercedes Benz S400 hybrid vehicle, which will use a lithium battery developed with DOE support.[8] Lithium batteries developed with DOE support are also expected to be used in the Chevy Volt PHEV that is scheduled to be introduced in 2010. The Volt is designed to achieve a driving range of 40 miles on electric power, meeting the range needs of most urban commuters.[9] With fuel economy expected to reach 120-150 mpg, PHEVs could displace million of gallons of fuel.

Combustion Engine Technology

Developing and introducing high-efficiency combustion engines in conventional, hybrid electric and plug-in hybrid electric vehicles offers the most promise to improving fuel economy in the near future. DOE is helping to develop increasingly efficient combustion engines that meet the needs of consumers and businesses.

Diesel engines are essential to trade and commerce. Over 90 percent of freight is moved by diesel-powered commercial vehicles (trucks). Unlike passenger vehicles, trucks cannot reduce their size and continue to maintain their freight capacity. Cooperative work by the Department of Energy and heavy duty diesel engine manufacturers has resulted in improvements in engine efficiency that still meet stringent EPA emissions standards.

With the help of our research, a new fuel-efficient diesel engine meeting 2010 emissions standards was introduced by diesel manufacturer Cummins, Inc., and is being sold in Dodge Ram pickup trucks. In 2010, Cummins will introduce a new diesel engine co-developed with DOE for a Chrysler light-duty pickup truck/SUV. The diesel engines in both of these applications will provide an average of 30 percent fuel savings over gasoline-powered engines for comparable vehicles. For the future heavy-duty diesel vehicles, we are targeting an additional 20 percent improvement in fuel economy through further engine optimization and novel waste heat recovery strategies.

DOE Advanced Biofuels Research, Development, and Demonstration

The Department actively supports biofuels production, from the most basic science research activities to efforts toward the integration of advanced biofuels into the national fuel supply. To help meet our long-term energy needs, the Department's biomass research and development activities are designed to make biofuels from non-food feedstocks cost competitive by 2012.

The biomass feedstocks of today include grains, as well as oilseeds from plants. Our goal is to allow future feedstocks to come from a variety of sources such as wastes and residues, and fast-growing energy crops. These future feedstocks may consist of agricultural residues like stalks and stems, as well as forest resources such as wood waste, forest thinnings, and small-diameter trees. Examples of energy crops include switchgrass, miscanthus, and hybrid poplar trees, in addition to algae and non-edible oilseeds like jatropha. Sorted municipal solid waste may also play a role.

Cellulosic ethanol is expected to improve upon the positive energy balance of today's corn ethanol by delivering four to six times as much energy as needed for production.[10] Additionally, cellulosic feedstocks can reduce life-cycle greenhouse gas emissions by 86 percent compared to gasoline.[11]

Flexible Fuel Vehicles

Currently, there are more than six million flexible-fuel vehicles (FFVs) on our roads that can utilize ethanol blended gasoline up to 85 percent ethanol and 15 percent gasoline (E85). Although this is a significant number, it is only 2.7% of the 222

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[8] "Mercedes-Benz S400 Hybrid Will Roll Out in 2009 With Breakthrough Li-Ion," Popular Mechanics, March 5, 2008, http://www.popularmechanics.com/blogs/automotive__news/4253307.html.

[9] Chevrolet—New Electric Car, http://www.chevrolet.com/electriccar/.

[10] Source: Wang et al, "Life-cycle energy and greenhouse gas emission impacts of different corn ethanol plant types," Environmental Research Letters, May 2007.

[11] Ibid.

million cars in the light duty fleet.[12] We encourage all automobile manufacturers to meet and exceed stated voluntary targets for increasing sales of FFVs. We applaud the domestic auto manufacturers for their pledge to the President to make half of their vehicles E85 compatible by 2012.[13] We are hopeful that this encouraging trend will continue and stand ready to work with the automotive industry to that end.

In order to improve the efficiency of future FFVs, the Department is partnering with industry to develop the next generation of engines for these vehicles. These projects are targeting production-ready engines optimized for use of ethanol at all blend levels. These projects seek to develop systems which can reduce or eliminate the fuel economy penalties associated with the reduced energy content of biofuels.

Intermediate Ethanol Blends

The Department realizes that achieving large near-term gains through an FFV/E85 approach is difficult due to the pace of vehicle and infrastructure deployment. While we continue to strongly support the spread of FFVs and fueling infrastructure, there are important immediate steps which may provide relief sooner. The use of intermediate blends of ethanol—those between E10 and E85—in conventional (non-flexible-fuel) vehicles is one such approach. If found to be compatible with existing infrastructure, vehicles and non-road gasoline engines, an intermediate-blends approach could accelerate the expansion of ethanol into the market. Intermediate ethanol-gasoline blends could also enable continued, uninterrupted growth in ethanol production and help to alleviate concerns about the looming "ethanol blend wall" where continued growth in ethanol production is constrained by E10 and the inability to rapidly accelerate deployment of E85.

The Department is engaged in a testing effort to determine the impacts of intermediate blends on existing vehicles and on non-road engines. The testing program is being conducted in cooperation with the Environmental Protection Agency (EPA), U.S. Department of Transportation and other partners, and has benefited from input provided by the automotive industry, the energy industry and the manufacturers of small engines.

Clean Cities

The Clean Cities deployment program supports local decisions to reduce petroleum use in transportation. To accomplish this goal, the program encourages the public and private sectors to reduce petroleum consumption by utilizing alternative fuels and increased vehicle efficiency. Specifically, it promotes the use of five major technologies: alternative fueled vehicles, hybrid electric vehicles, idle reduction technologies, fuel economy measures, and low-level fuel blends.

Clean Cities carries out its mission through 86 geographically-diverse coalitions nationwide.[14] Coalitions operate at the community level, designing projects to suit their area's needs, resources, and strengths. Clean Cities also provides a number of resources to the public, including a station locator and mapping system that allows consumers and fleet managers to find local alternative fuel stations. A trip planning tool allows drivers to plan their journey and maps refueling locations along the route. The website also provides a list of federal and state incentives for the purchase and use of alternative fueled and fuel efficient vehicles. Clean Cities, in partnership with EPA, also sponsors the publication of the annual Fuel Economy Guide.

Hydrogen Fuel Initiative

Hydrogen also continues to be an important part of DOE's balanced portfolio through the President's Hydrogen Fuel and Advanced Energy Initiatives, along with strong collaboration with Industry through the FreedomCAR and Fuel Partnership. We have made tremendous progress—doubled automotive fuel cell durability, decreased fuel cell cost by 65%, and decreased the cost of hydrogen to be competitive with gasoline—since before these initiatives.

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[12] Estimated Number of Alternative Fueled Vehicles in Use in the United States by Fuel Type, 2003-2006, http://www.eia.doe.gov/cneaf/alternate/page/atftables/afvtrans v1.xls. For total number of vehicles on the road: 2006 data from TEDB Edition 27, Table 2.12.

[13] Biofuels, GM, http://prod.gm.gmgssm.com/experience/fuel_economy/e85/index.jsp?deep=what&exist=false. Ethanol Vehicles—Flexible Fuel, Ford Motors. https://www.fleet.ford.com/Showroom/environmental_vehicles/ethnol_vehicles.asp. Ethanol / Flexible Fuel Vehicles. Chrysler. https://www.fleet.chrysler.com/fleetcda/portal?pageid=496d75dfeca67110VgnVCM100000e9261c35RCRD&sectionid=e 726cce 1 be7f5110 V gnV CM 10000091 f4e735RCRD&ptitle=E85%20-%20Flex%20Fuel.

[14] Clean Cities Coalition Locations: http://www.eere.energy.gov/cleancities/progs/coalition_locations.php.

Commercialization

Bringing these new technologies to market will take substantial capitalization. A principal purpose of the Energy Policy Act of 2005 (EPACT) Title XVII loan guarantee program is to encourage early commercial use of new or significantly improved energy technologies. This program is an excellent opportunity to help secure capital to address key challenges such as scaling battery manufacturing. In late June 2008, DOE announced solicitations totaling over $10 billion in Federal loan guarantees, including guarantees that are applicable to reducing petroleum dependency in the transportation sector.

Conclusion

Research and development of vehicles and fuels has led to new fuel saving technologies, some of which are in the marketplace today. Vehicle manufacturers continue significant research efforts to reduce fuel consumption or to replace petroleum, and investment in alternative fuels, such as biofuels remains strong. We believe that pursuit of the technology options described above has the most potential to reduce petroleum consumption in the near-term and long-term.

However, accelerated introduction of new vehicle technologies is inhibited not only by improvements still required in cost, performance and reliability of these technologies, but also by the time it takes to introduce these technologies and replace incumbent technologies. It may be beneficial to evaluate ways to bring new vehicle technologies and infrastructure to consumers faster. Any approach should minimize undue hardship or economic downturn to owners who have invested in today's installed assets.

Mr. Chairman, thank you again for holding this important hearing and for the opportunity to address how DOE is helping reduce gasoline consumption. This concludes my prepared statement, and I would be happy to answer any questions the Committee Members may have.

The CHAIRMAN. Thank you very much. Before you start, Dr. Greene, let me just see if Senator Domenici had any opening comments he wanted to make before we heard from the rest of the witnesses.

Senator DOMENICI. Senator, I think my timing is such that I am going to be with you for a while. So let's take the next one and see when I fit in.

The CHAIRMAN. Ok. Dr. Greene, go right ahead.

STATEMENT OF DAVID L. GREENE, CORPORATE FELLOW, TRANSPORTATION SCIENCE AND ENERGY DIVISION, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TN

Mr. GREENE. Thank you. Good morning, Mr. Chairman, distinguished committee members and guests. Thank you for the opportunity to comment on what can be done in the near term to reduce our demand for petroleum by increasing motor vehicle fuel economy.

Before I do that I'd like to note that the Congress has already taken several important actions to promote fuel economy. The Energy Independence and Security Act requires a 40 percent increase in fuel economy of passenger cars and light trucks by 2020. This requirement alone will save consumers about 60 billion gallons of gasoline a year in 2030, about a quarter of a trillion dollars worth at today's prices.

There are many things consumers can do themselves to improve the fuel economy of their vehicles. There are also things Congress can do to help. By combining a number of individually small improvements, consumer's gasoline bills can be reduced significantly. Some actions can be taken immediately. Others will require a few years.

With respect to immediate actions, the Department of Energy and EPA website, fueleconomy.gov itemizes and explains proven driving and maintenance tips. These tips have appeared on television, in newspapers and magazines and on the internet through programs such as the Alliance to Save Energy's Drive Smarter Challenge. Driver behavior is one of those.

After a vehicle has been built, the greatest influence on its fuel economy is its driver. Typical drivers can increase their miles per gallon by about 10 percent by diligently applying fuel economy driving tips such as curbing aggressive driving, especially at highway speeds, observing speed limits, house cleaning their vehicles to remove excess weight that's not needed, planning trips to avoid cold starts and using their most efficient vehicle when possible and avoiding unnecessary idling. Regular maintenance according to manufacturer's specifications also promotes fuel economy.

With respect to speed limits, reducing speed limits can save fuel and lives at a cost of increased travel time. For each 5 miles per hour above 55, fuel economy decreases by about 7 percent. A retrospective study of the 55 mile per hour speed limit by the National Academy of Sciences found that it probably saved just under 2 percent of total highway fuel use but also improved highway safety. Similar strategies to improve the fuel economy of heavy trucks are enumerated on the EPA's Smart Way website.

Other actions can be implemented over the next one to five years. I think the time has come to update the test procedures for determining compliance with the corporate average fuel economy standards. Several important, real world factors that affect in use fuel economy are not included in the city and highway test cycles used to determine compliance with CAFE standards.

Most accessories such as air conditioners, power steering pumps and alternators are operated little or not at all on the CAFE test cycles. So there is little incentive for manufacturers to improve their efficiency in order to meet fuel economy standards. The standards also offer no incentive to reduce cooling loads by improved insulation or specially tinted glass. It's been estimated that adoption of such off cycle fuel economy technologies could raise real world fuel economy by 10 percent or more.

Strong consideration should also be given to reporting fuel economy to consumers in terms of fuel consumption per distance rather than distance per gallon of fuel. There's evidence that consumers misinterpret miles per gallon estimates assuming that the 5 mile per gallon difference between 15 mpg and 20 mpg is the same as the five mile per gallon difference between 45 and 50. As a result fuel economy improvements tend to be undervalued for low MPG vehicles relative to higher MPG vehicles.

Drivers of most vehicles cannot see how their driving behavior affects their vehicle's fuel economy. Some vehicles provide digital displays. Research is now ongoing at the University of California at Davis to better understand how fuel economy feedback devices can improve in use fuel economy. Congress may wish to explore ways to encourage the installation of these devices in all motor vehicles.

Gasoline at $4 a gallon provides a strong economic incentive to increase fuel economy for both car makers and car buyers. Still

there are good reasons to believe that the market for automotive fuel economy is not efficient and that market outcomes could be improved by means of economic incentives to vehicle purchasers. Extending and simplifying incentives for hybrid vehicles would raise new vehicle fuel economy and encourage the transition to more efficient electric drive systems.

In the longer run, fiscal incentives for more energy efficient vehicles may be the most efficient policy. Not only for encouraging consumers to choose high fuel economy, but also for encouraging manufacturers to invent and adopt advanced fuel economy technologies. Fiscal incentives based on fuel consumption per mile can be indexed to vehicle attributes like NHTSA's footprint metric in the same way that fuel economy standards can.

In my testimony I've concentrated on actions that individuals and Congress could take to increase passenger car and light truck fuel economy and thereby reduce the burden of high gasoline prices. But we won't solve our oil dependence problem unless we address all uses of petroleum throughout the transportation sector and throughout our economy. Light duty vehicles account for less than half of total United States petroleum use. Industry consumes almost a fourth. We burn an average of a million barrels a day of distillate fuel heating homes and other buildings.

Only if we adopt a comprehensive strategy to reduce petroleum use and increase energy supply directed toward a measurable oil independence goal can we be confident of achieving energy security. Thank you very much.

[The prepared statement of Mr. Greene follows:]

PREPARED STATEMENT OF DAVID L. GREENE, CORPORATE FELLOW, TRANSPORTATION SCIENCE AND ENERGY DIVISION, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TN

NEAR TERM OPTIONS TO INCREASE FUEL ECONOMY AND DECREASE PETROLEUM DEMAND

Good morning Mr. Chairman, distinguished committee members and guests. Thank you for the opportunity to comment on what can be done in the near term to reduce our demand for petroleum by increasing motor vehicle fuel economy. Before I do that, I would first like to note the important actions Congress has already taken to promote fuel economy. The Energy Independence and Security Act (EISA) of 2007 requires a 40% increase in the fuel economy of passenger cars and light trucks by 2020. I estimate that this law alone will save consumers about 60 billion gallons of gasoline a year by 2030. The Act also calls for a study of fuel economy standards for heavy trucks, a policy that has been successfully implemented in Japan. Just as important, you are allowing energy markets to work. Market responses to higher oil prices, though painful, are an essential part of both the long and short-run solution. I believe these measures have already sent a signal to world oil markets that the United States is serious about reducing its oil consumption in the longer term.

There are many things consumers can do themselves to improve the fuel economy of their vehicles, and there are also things the Congress can do to help. By combining a number of individually small improvements consumers' gasoline bills can be reduced significantly. Some actions can be taken immediately, others will require a few years.

Improving fuel economy, by itself, will not bring oil prices back to $30 a barrel. That will require a comprehensive, long-term strategy, one that addresses both climate change and energy security simultaneously, and one that sets measurable goals for both reductions in greenhouse gases and oil dependence (Greene and Leiby, 2008).

IMMEDIATE ACTIONS TO INCREASE MILES PER GALLON

Many consumers are already aware of actions they can take to get more miles per gallon. The Department of Energy (DOE) and Environmental Protection Agency

(EPA) website, www.fueleconomy.gov, itemizes and explains a number of proven driving and maintenance tips. These tips have been publicized on television, in newspapers and magazines, and on the internet through programs such as the Alliance to Save Energy's Drive $marter Challenge at http://drivesmarterchallenge.org. However, as a provider of this information, I am well aware of its deficiencies. Often, the best information available is out of date and may not be accurate for today's automotive technology. Some of it is based on studies of a very limited number of vehicles and there are questions about how confidently it can be applied to all vehicles. Just this year, the DOE's Vehicle Technologies Program began an effort to update and validate the fuel economy information it provides to the public. I believe it is appropriate for the DOE to take on this responsibility and that the Congress should encourage it to expand and continue the effort.

Driver Behavior

After a vehicle has been designed, engineered and manufactured the driver can have the greatest influence on its fuel economy. Different driving styles are a major reason why the fuel economy label says, "your mileage will vary". What little research there is on the subject indicates that typical drivers can increase their miles per gallon by about 10% by diligently adopting the driving tips provided on fueleconomy.gov.

Curb aggressive driving—5% improvement in city driving and even more on the highway

Observe speed limits—7-8% fuel economy benefit for every 5 mph slower at highway speeds

Car "housecleaning"—remove unnecessary weight from the cargo compartment, as well as cartop carriers when not in use (2% improvement for each 100 lbs. unloaded).

Plan ahead—to combine trips to avoid cold-starts (especially in cold weather), and use your most efficient vehicle as much as possible.

Avoid unnecessary idling—idling for more than a few seconds wastes fuel versus shutting down the engine and restarting.

Vehicle Maintenance

Proper vehicle maintenance can also improve fuel economy. Keeping tires inflated to the manufacturer's recommended pressure, keeping wheels properly aligned and balanced, oil changes on manufacturers' recommended intervals with the recommended grade of fuel saving oil, replacing dirty air filters and keeping you engine in proper tune can all help maximize miles per gallon.

Speed Limits

Reducing speed limits can save fuel, but at a cost of increased travel time. For each 5 mph above 55 mph, fuel economy decreases by about 7%. For most Americans the value of their time would exceed the value of the fuel saved. A retrospective study of the 55 mph speed limit by the National Academy of Sciences (NAS) found that it saved 1-3% of highway fuel use and also improved highway safety (NAS, 1984). Because many drivers now routinely exceed the speed limit by 5 mph or more, an alternative to lowering speed limits would be to more strictly enforce those we have now.

The fact that not all vehicle travel occurs under free-flowing highway conditions limits the potential benefits of lower speed limits. According to the Federal Highway Administration (FHWA), less than 40% of all vehicle miles are traveled on interstates, freeways and expressways or principal rural roads (U.S. DOT, 2005). A substantial fraction of these miles will occur under congested conditions. Thus, a 5 mph reduction in speed limits, if strictly enforced, would reduce fuel consumption by up to 7% on the roads where it applied, and 2-3% nationwide.

Heavy Trucks

Strategies available to improve heavy truck fuel consumption include idle reduction (up to 1,000 gallons per truck per year), improved aerodynamics (up to 600 gallons per truck per year), wide base tires, automatic tire inflation systems, and hybrid powertrains (EPA $martway, www.epa.gov/smartway/smartway__fleets__strategies.htm).

NEAR-TERM (1-5 YEARS) OPTIONS

Low Rolling Resistance Tires

Americans spend about $20 billion purchasing 200 million replacement tires each year. A recent study by the NAS concluded that it was technically and economically feasible to reduce the rolling resistance of replacement tires by 10% (NRC, 2006),

saving 1-2% or 1-2 billion gallons in fuel consumption. To encourage more widespread use of low rolling resistance tires, Congress has required the National Highway Traffic Safety Administration (NHTSA) to develop and implement an energy efficiency labeling system for replacement tires, as recommended by the NAS panel. This is yet another accomplishment of the EISA of 2007. The effectiveness of this system remains to be seen. Congress might also consider establishing rolling resistance standards (relative to original equipment tires) for replacement tires.

Driver Training

Fuel efficient driving behavior, correctly done, should also contribute to safe driving. Observing posted speed limits, avoiding aggressive driving behaviors, anticipating traffic situations and avoiding tailgating all improve fuel economy and traffic safety. A well-maintained vehicle is a more fuel efficient and safer vehicle. Unfortunately, higher fuel prices have encouraged what has been called "hypermiling" which includes some extreme and unsafe driving practices such as drafting behind other vehicles to reduce aerodynamic drag or coasting with the engine off (in a vehicle not equipped for engine-off-at-idle). Congress might seek ways to encourage the inclusion of safe, fuel efficient driving practices in standard driver training curricula.

Updating Fuel Economy Test Procedures

The time has come to update the test procedures for determining compliance with Corporate Average Fuel Economy (CAFE) Standards. Beginning with model year 2008, the Environmental Protection Agency fundamentally changed the fuel economy estimates it provides to the public on window stickers, in the Fuel Economy Guide and via www.fueleconomy.gov. These changes incorporate several important real-world factors that affect in-use fuel economy but are not included in the city and highway test cycles used to determine compliance with CAFE Standards. These factors include use of air conditioning, cold starts and aggressive high speed driving. As a result, the standards provide no incentive for the adoption of certain technologies that can improve real-world fuel economy but are of little or no benefit on the city and highway test cycles. Because most accessories, such as air conditioners, power steering pumps, and alternators, are operated little or not at all on the CAFE test cycles, there is no incentive for manufacturers to improve their efficiency in order to meet fuel economy standards. The standards also offer no incentive to reduce cooling loads by improved insulation or specially tinted glass. It has been estimated that adoption of such "off-cycle" fuel economy technologies could raise real-world fuel economy by 10% or more (Duleep, Fulton and Perkins, 2005).

Voluntary Labeling of Used Cars

While every new car bears a fuel economy label, used cars, which comprise the vast majority of sales transactions, do not. New car fuel economy ratings should be useful for used cars, since research indicates that fuel economy deteriorates very little with age for a reasonably maintained vehicle (Greene et al., 2006). The National Automobile Dealers Association is currently considering a voluntary labeling program for used cars and there may be ways in which Congress could facilitate such a program.

Individualized Fuel Economy Estimates

In the belief that it's previous fuel economy numbers were biased, the EPA recently revised its procedures for calculating the fuel economy estimates it provides to the public. Despite this, most car buyers will remain highly uncertain about the fuel economy they will actually achieve in real-world driving. This is because the EPA's estimates are intended to be an average for all American drivers and not an individualized estimate for any particular driver. Many factors affect real-world fuel economy, especially traffic conditions, driving style, trip lengths, and climate. The result is tremendous variance in real world experience around the mean estimate (Figure 1).* For the data shown in Figure 1, a confidence interval that includes 95% of motorists is a band 16 mpg wide around the mean estimate. To improve the usefulness of MPG estimates to consumers we need more accurate predictions for individuals not less biased estimates for the average driver. This means finding ways to take account of driving style, traffic conditions, climate and possibly other factors to produce an individualized estimate. I believe the internet provides a means for creating such individual fuel economy estimates. With some research effort, I believe much better (but still not perfect) fuel economy information can be provided to consumers.

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*Figures 1–2 have been retained in committee files.

Strong consideration should be given to reporting fuel economy to consumers in terms of fuel consumption per distance, rather than distance per fuel consumed. There is evidence that consumers misinterpret miles per gallon estimates, assuming that the 5 mile per gallon difference between 15 MPG and 20 MPG is the same as the 5 mile per gallon difference between 45 and 50 MPG (Larrick and Soll, 2008). Thus, fuel economy improvements tend to be undervalued for low MPG vehicles relative to higher MPG vehicles. Most of the rest of the world now reports fuel economy in terms of fuel use per distance traveled. This makes it easier for consumers to compare fuel economy among vehicles and to do such calculations as average city and highway estimates.

Fuel Economy Gauges to Provide Feedback to Drivers

Drivers of most vehicles cannot see how their driving behavior affects their vehicle's fuel economy. Some cars now provide digital displays of instantaneous fuel economy so that drivers can see how speeding or aggressive driving behaviors waste fuel. While it is virtually certain that such devices will improve in-use fuel economy, current test procedures give no credit for them. Research is now ongoing at the University of California at Davis to better understand how fuel economy feedback devices can improve in-use fuel economy. Congress may wish to explore ways to encourage the installation of fuel economy feedback devices in all motor vehicles.

Pay-at-the-Pump Minimum Liability Insurance

At a time of record high gasoline prices, it may seem strange to propose a policy that would increase the price of gasoline at the pump. However, pay-at-the-pump insurance would have no impact on the overall cost of driving. It would simply transfer the incidence of a fraction (perhaps one fourth) of the total cost of auto insurance to the cost of motor fuel. This would increase the cost of gasoline by $0.25 to $0.50 per gallon but reduce the cost of auto insurance by an equal amount. Motorists would still be required to enroll with an insurance carrier to establish coverage and to purchase any additional insurance needed. The increased cost of gasoline would encourage manufacturers to adopt more fuel efficient technologies and consumers to choose more fuel efficient vehicles and operate their vehicles more efficiently. It would also reduce the problem of uninsured motorists since everyone would be purchasing a minimal amount of liability insurance on a pay-as-you-go basis. It would also improve the economic efficiency of the insurance system by making at least a fraction of insurance payments proportionate to the amount of transportation done.

Incentives for Energy Efficient Vehicles

Gasoline at $4/gallon provides a strong economic incentive to increase fuel economy for both car makers and car buyers. Still, there are good reasons to believe that the market for automotive fuel economy is not itself efficient and that market outcomes could be improved by means of economic incentives to vehicle purchasers (Greene, German and Delucchi, 2008).

Extending and simplifying incentives for hybrid vehicles would raise new vehicle fuel economy and encourage the transition to more efficient electric drive systems (Kromer and Heywood, 2007). Incentives could be based on fuel consumption (on the quantity of fuel saved) rather than on a technical measure of degree of hybridization. For example, a hybrid pickup truck that got 18 miles per gallon instead of 12 would benefit from a larger incentive than a hybrid passenger car getting 45 mpg instead of 30 because it would save 200 gallons more in a typical year of driving (333 gallons in driving 12,000 miles instead of 133). Of course, incentives for higher fuel economy have two drawbacks. First, some car buyers would have bought a hybrid vehicle anyway, especially at today's high fuel prices. Second, the incentives will be a drain on the treasury unless they are offset by comparable increases in revenue. The first problem can be mitigated but not eliminated by announcing incentives at least two years in advance to give manufacturers time to expand production. The second problem can be eliminated by implementing disincentives for inefficient vehicles.

In the longer run, fiscal incentives for more energy efficient vehicles may be the most efficient policy not only for encouraging consumers to choose higher fuel economy but also for encouraging manufacturers to invent and adopt advanced fuel economy technologies. Feebates—fiscal incentives based on fuel consumption per mile—are a flexible market based policy for promoting fuel economy. Feebates can be indexed to vehicle attributes, such as NHTSA's footprint metric, in the same way fuel economy standards can (Greene, 2008). Feebates can be revenue neutral or can provide a net subsidy for new vehicle purchases. They can be a complement to fuel economy standards, or possibly even a substitute for them.

CONCLUDING OBSERVATIONS

In my remarks I have concentrated on actions individual motorists can take to increase fuel economy and thereby reduce the burden of high gasoline prices, or things Congress can do to promote light duty vehicle fuel economy. Yet we cannot solve our oil dependence problem unless we address all uses of petroleum throughout the transportation sector and throughout our economy. Light-duty vehicles account for less than half of total U.S. petroleum use. Other transportation vehicles account for more than one-fourth of petroleum demand. Industry consumes almost another fourth and we burn up an average of 1 million barrels per day of distillate fuel heating buildings. All of these uses must be addressed. Only through a comprehensive strategy to reduce petroleum use and increase energy supply, directed towards a measurable oil independence goal, can we be confident of achieving energy security.

The CHAIRMAN. Thank you very much.

Mr. Laitner, go right ahead.

STATEMENT OF JOHN A. "SKIP" LAITNER, DIRECTOR OF ECONOMIC ANALYSIS, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY (ACEEE)

Mr. LAITNER. Thank you and good morning, Chairman Bingaman, Vice Chairman Domenici, other distinguished members of the committee and the staff. I'm now celebrating some 38 years of working the energy policy arena. After all this time, I've never been more confident of telling this committee and Congress as a whole that the United States is never better positioned to move onto a path of sustainable energy production and consumption, one that promotes both productivity and economic prosperity, if we choose to develop it.

The underpinning of this opportunity is a huge potential for cost effective investments in energy efficiency throughout all sectors of the economy on the order of 45 to 50 billion barrels of oil equivalent between now and the year 2030. This is about two and a half times bigger than what some have suggested might be available for off shore drilling. It's about five and a half times greater than what we will get from the improved CAFE standards enacted by Congress last December.

The good news is that if we were to invoke the spirit of Leonardo da Vinci's model, Sa pare de vere, meaning to know or to learn how to see things. Then we might also see the development of that 45 to 50 billion barrels of energy efficiency could generate a significant downward pressure on oil prices. Increase both the resilience and the robustness of the American economy again, if we choose to develop it.

It is in that context I want to spend a quick minute talking not about one OPEC, but about at least two different OPECs, to talk about them in the context of the American ingenuity. Not surprisingly, yes, the first OPEC is all about that conventional commodity we call oil. I think it's fair to say without any implied commentary whatsoever that in effect the OPEC countries have us over a barrel.

Yet there are other forms of OPEC like power which might give us some added bargaining power with these oil rich nations. If the first OPEC is about oil for example a second OPEC equivalent might be information and communication technologies. For example, if we know how to see, then we might begin to imagine the

semi conductor and broadband industries as having the ability to deliver an OPEC equivalent in terms of energy efficiency.

How? Very simply. It's easier to move electrons and information than it is to transport people and goods.

This is true even when we consider the relatively small amount of energy needed to power the ICT technologies. When we consider the relatively big energy that broadband technologies can deliver us in savings. In effect we're talking about companies like Intel, AMD, Dell, Hewlett Packard, EMC, Agilent Technologies and Cisco systems.

Together with the very fast broadband now being developed by companies like Verizon, Sprint and others, we can power new broadband services which substantially reduce our dependence on transportation fuels. By way of highlighting the potential contribution of these technologies let me offer the results of a real time experiment I conducted just a moment ago. From an energy perspective it's unclear whether either of our Presidential candidates have included a complete picture of the energy efficiency resource in their campaign materials.

I confess I've not yet read any of their literature. Yet, just moments ago, I ordered a book written by each candidate and they are both now in this hearing chamber. I used no gasoline to head to the bookstore to buy them.

There were no packaging materials used in the shipping of them. Neither UPS nor FedEx used fuels to deliver them to me here today. In fact I bought them moments ago using my e-book, the Amazon Kindle.

I downloaded them within a minute time. They are now here to be read at some point where I have the leisure to do so. So there was no paper wasted in their production. No shopping trips made to purchase them. No unnecessary packaging to have them delivered.

I also saved $5 over the normal purchase price of each book. Despite my cost savings, each author now has the benefit of an additional royalty from this hearing and in my purchase of their books. That's but one small example of how information communication technologies can help reduce the cost and the use of energy.

If we had the time there are several other OPEC equivalents we could explore. But the time is short. So let me now turn to a minute to discuss the role of policy in delivering these energy cost savings.

In all of this, yes, the market does respond to direction and information. Hence policy solutions will play a pivotal role in the strengthening of the continued development, dissemination and widespread adoption of these energy efficient technologies. In that regard, ACEEE recommends at least ten policy actions to complement, actually, those that have been described previously, which might be undertaken by this Congress that might provide a near term market signal and more critically to change the direction of energy usage through energy efficiency.

Our proposals include the immediate passage of a joint resolution to affirm the energy efficiency resource directing Federal agencies to develop it at all levels with current budget and authority. They also include an emergency supplemental transit appropriation, the

creation of a crush your credit to retire older and inefficient trucks and cars and the launch of a national telecommuting and video conferencing initiative to reduce unnecessary travel. We should provide an array of incentives that parallel the automotive X prize and the freedom prize. All designed to stimulate new innovations in energy productivity.

More can be discussed, but Mr. Chairman, with these opening remarks I thank you for the opportunity to be here today. I'll be happy to answer questions.

[The prepared statement of Mr. Laitner follows:]

PREPARED STATEMENT OF JOHN A. "SKIP" LAITNER, DIRECTOR OF ECONOMIC ANALYSIS, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY (ACEEE)

SUMMARY

This testimony responds to an invitation from the Senate Energy & Natural Resources Committee to explore the economic potential of cost-effective investments in more energy-efficient technologies, especially as those investments favorably impact petroleum prices and improve the robustness of the American economy. As discussed in this testimony, there is a huge potential for cost-effective investments in energy efficiency throughout all sectors of the U.S. economy: on the order of 46 billion barrels of oil equivalent between now and 2030. This is about 2.5 times bigger than what some have suggested might be available from off-shore drilling. And it is about 5.5 times greater than what we will get from the improved CAFE standards enacted by Congress last December. That magnitude of further gains in energy efficiency could generate a significant downward pressure on oil prices, and increase both the resilience and robustness of the American and the international economies—if we choose to encourage those more productive investments.

Policy solutions will play a pivotal role in strengthening the continued development, dissemination, and widespread adoption of energy-efficient industrial and transportation technologies and systems. In that regard, ACEEE recommends 10 policy actions that might be undertaken by this Congress to immediately provide that signal, and more critically, to change the direction of energy usage through increased energy efficiency.

The set of 10 proposals offered here is intended to accomplish two specific objectives. The first is to provide an immediate catalyst by launching an effort over the next few months that can "save oil in a hurry." If undertaken with sufficient robustness, these initial proposals might generate an immediate downward pressure on oil prices to the benefit of consumers and businesses. The second is to begin the process of fundamentally restructuring our transportation infrastructure—a step that will be necessary if we are to change the energy use path that our transportation system is currently on. Many of these suggestions lay the groundwork for a shift in the larger transportation policy, an opportunity that is afforded the next Congress by next year's reauthorization of the transportation bill.

Introduction

My name is John A. "Skip" Laitner. I am the Director of Economic Analysis for the American Council for an Energy-Efficient Economy (ACEEE), a nonprofit organization dedicated to increasing energy efficiency as a means of promoting economic prosperity, energy security, and environmental protection. I am here today at the invitation of the Senate Energy & Natural Resources Committee to explore the role of productive investments in more energy-efficient technologies, as well as energy conservation behaviors, as both might positively improve the robustness of the U.S. economy. I thank you for the opportunity to testify here today. Indeed, I applaud the Committee for its willingness to more closely examine (and hopefully act on) the potential contribution of energy efficiency as it strengthens the productivity of our economy.

What might we initially conclude in this last respect? As we shall see, there is a huge potential for cost-effective investments in energy efficiency across all sectors of the economy: on the order of 46 billion barrels of oil equivalent between now and 2030. This is about 2.5 times bigger than what some have suggested might be available from off-shore drilling. And it is about 5.5 times greater than what we will get from the improved CAFE standards enacted by Congress last December. That magnitude of further gains in energy efficiency could generate a significant downward pressure on oil prices and increase both the resilience and robustness of our econ-

omy and economies around the world—if we choose to encourage those more productive investments.

Despite the potential for significant improvements in energy productivity, most current policy assessments and economic modeling exercises fail to adequately capture the many ways in which individual or business energy consumption patterns might change in response to both economic and noneconomic policies and programs. As a result, policy reviews are based on these narrowly specified assessments and models consistently overlook the large energy efficiency benefits that we can achieve by encouraging the accelerated adoption of more productive technologies and more energy-aware behaviors and preferences. Frankly, such assessments significantly underestimate the cost-effective energy savings that can be achieved, while often overestimating the costs of achieving greater gains in energy productivity.

The inaccuracy of many past and current assessments has large and important implications for both energy and climate change mitigation policies. In the remainder of my testimony here today, I will expand on these notions as I try to answer three questions in response to the Committee's invitation:

1. What is the magnitude of recent gains in energy efficiency and how do they compare to ongoing investments in conventional energy resources? Perhaps more importantly, what might be the approximate scale of both near-term and mid-term efficiency opportunities? And especially, what might we say about opportunities for immediate reductions in the demand for petroleum resources in ways that enhance overall economic productivity?
2. What are the kinds of policies that might be encouraged to shape more productive behaviors and patterns of investments in cost-effective and more energy-efficient technologies?
3. Can we say anything about the economic returns associated with the accelerated adoption of energy-efficient technologies and more energy-aware behaviors?

In responding as fully as I can to each of these questions, let me divide up my remaining testimony into five major parts. The first section following this introduction provides an energy and economic context that I hope will be helpful in responding to the Committee's request. The next three sections will deal specifically with each of the questions posed—especially in the context of our transportation system and its potentially beneficial impacts on oil prices. The last section will provide a summary and conclusions.

ENERGY CONSUMPTION IN CONTEXT

As one of the richest and more technologically advanced regions of the world, the United States has expanded its economic output by more than three-fold since 1970. Per capita incomes are also twice as large today compared to incomes in 1970. Notably, however, the demand for energy and power resources grew by only 50% during the same period.[1] This decoupling of economic growth and energy consumption is a function of increased energy productivity: in effect, the ability to generate greater economic output, but to do so with less energy. In today's testimony I would like to reaffirm the compelling evidence that suggests that even greater energy productivity gains can be achieved but also highlight the evidence suggests that there is significant room for improvement in the policies that currently shape our demand for energy. In short, we have reasons to be optimistic; but as we shall see, there is also some serious work ahead.

The Success of Energy Efficiency to Date

The members of this Committee may be surprised to learn just how big of a role that energy efficiency has already played in supporting the growth of our economy over time. In the figure shown on the following page, we examine the historical context of efficiency gains estimated through 2008 as they might compare to the development of new energy supplies since 1970. In effect, the figure compares the projected level of energy consumption in 2008 to that which might have been necessary had the economy continued to rely on 1970 technologies and market structure.[2]

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[1] These and other economic and energy-related data cited in the testimony are the author's calculations as they are drawn from various resources available from the Energy Information Administration (2008a, 2008b, 2008c, and 2008d).

[2] Strictly speaking, the term energy efficiency as used here can be more broadly defined as a reduction in energy intensity; that is, a reduction in the number of Btus needed to support a dollar of economic activity. This change results from two key drivers. This first is a change in market structure as we move away from energy intensive industries as a source of income

Continued

In 1970 Americans consumed an estimated 68 quadrillion Btus (quads) for all uses of energy—whether heating and cooling our homes, schools, and businesses; powering our many industrial processes; or transporting both people and freight to the various places they needed to go. If we converted all forms of energy consumed in 1970 to an equivalent gallon of gasoline, it turns out that the U.S. economy required about 2,700 gallons of gasoline equivalent for each man, woman, and child living in the U.S. at that time. Had the United States continued to rely on 1970 market structure and technologies to maintain its economic growth, today we would be consuming an estimated 211 quads of energy resources. In per capita terms, that would be equal to roughly 5,500 gallons of gasoline per person. But in fact, the actual level of consumption estimated for 2008 appears to be just under 104 quads of energy (in rounded numbers). Again on a per capita basis, this means that the U.S. economy still requires no more than about 2,700 gallons of gasoline per resident—the same amount as in 1970.

In examining these numbers more closely, however, several important insights deserve to be highlighted. First, although we currently enjoy a much broader set of goods and services in today's economy, we have been able to achieve this expanded level of economic output while maintaining constant levels of energy use per capita. This has been achieved through investments in energy efficiency. Second, although the same level of goods and services hypothetically could have been achieved through the consumption of 211 quads of energy per year, we have been able to achieve this level of output with less than half that amount of energy. In effect, investments in energy efficiency have allowed us to reduce total energy use by the equivalent of 107 quadrillion Btus in 2008 (relative to what our energy use would have been without those efficiency gains.) As such, energy efficiency has "fueled" roughly 75% of the new growth in energy service demands in the United States since 1970. Demand for new conventional energy resources, on the other hand, fueled just one-quarter of the new energy service demands (or about 36 Quads, as shown in the above figure). As a result, energy efficiency has been dubbed the farthest-reaching, least-polluting, and fastest-growing U.S. energy success story of the last 40 years. It is also the most invisible, the least understood, and in serious danger of being overlooked when it comes to future investments.

In a report published this past May, ACEEE noted that in 2004 the U.S. invested an estimated $300 billion in energy efficiency (Ehrhardt-Martinez and Laitner 2008). This was about three times the amount invested in traditional energy infrastructure, whether power plants or oil and gas wells. Meanwhile, those investments in energy efficiency are estimated to have generated approximately 1.7 quads of energy savings in 2004 alone—roughly the equivalent of the energy required to operate 40 mid-sized coal-fired or nuclear power plants. Despite these important contributions to our Nation's energy productivity, the analysis points out that the contributions of energy efficiency have, in large part, remained invisible and often go unrecognized. Moreover, the report indicates that efficiency resources, although proven, remain seriously underdeveloped. In other words, substantial gains in efficiency are still available if we decide to pick up the pace of efficiency investments.

The Magnitude of Future Efficiency Potential

American economist Kenneth Boulding once commented that "Images of the future are critical to choice oriented behavior." In effect, Boulding was suggesting that unless we are able to visualize future opportunities, we are less likely to realize their full potential. In that same spirit, therefore, ACEEE believes it is important to visualize the larger potential of energy efficiency to enable the development of policies and technologies that might enhance our overall energy productivity. While our preliminary assessment indicates that the efficiency market is already large, the more important questions are how large can the market ultimately be, and how rapidly can it be developed?

Notably, a recent United Nations Foundation study called energy efficiency both the largest and least expensive energy resource, suggesting that the G-8 and other Nations could double historical rates of efficiency improvement by 2030 (Expert Panel on Energy Efficiency 2007). This is true whether we are talking about buildings or industry, or whether we are talking about transportation efficiency gains.

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to higher value-added services. The second is what we typically think of as energy efficiency—more efficient lighting and consumer products, greater fuel economy in our vehicles, and more efficient power plants and industrial processes. The United States has benefited from both economic drivers; and both were made possible by a combination of behaviors, innovations, and productive technology investments. From a macroeconomic perspective the evidence suggests that anything we can do that positively reduces energy use while maintaining incomes and economic prosperity can be termed "energy efficiency." It is in that larger sense that I use the term here today.

If the United States were to follow that course—and other ACEEE studies suggest this can be a highly cost-effective policy path, total U.S. energy consumption in 2030 could be reduced to the level of energy consumed in the years 1996-1997—as a result of efficiency gains alone. Assuming that policies, market forces, and new financing mechanisms are put in place to facilitate substantial investments in energy productivity, we might have an economy in the year 2030 that is about 70% larger than it is today, but one that uses no more energy than was required in the mid-1990s.[3] That would be a clear benefit for consumers, for business, and for the global climate. But, again, will be the outcome only if we choose to develop and promote that more productive investment path. And that is the huge task ahead . . .

UNDERSTANDING THE TRANSPORTATION SYSTEM

With this hearing focusing more specifically on gasoline demand, let me first reiterate the importance of energy productivity gains in all uses of energy within our economy—whether we are talking about petroleum, coal, natural gas, or renewable fuels. I will then expand and highlight the efficiency potential within the transportation sector; and more specifically the likely implications of greater efficiency on petroleum prices.[4]

Gasoline Consumption in the Larger Energy Context

I hesitate to provide any current estimate of energy expenditures since both energy demand and prices are anything but stable or predictable. Nonetheless, and only in the spirit of helping understand the financial burden created by our current levels of energy demand and (in)efficiency, let me provide this context: in 2008 the U.S. will spend something on the order of $1.3 to $1.5 trillion for its total energy consumption. Despite only a 10% increase in overall energy consumption, the Nation's energy bill will be close to twice what we spent only a decade ago. I expect that energy expenditures will be about 10-12% of the Nation's Gross Domestic Product (GDP). More specifically, gasoline and petroleum expenditures will approach something on the order of $540 and $800 billion, respectively.[5] Ignoring the price of energy for a moment, and looking only from the perspective of physical energy quantities, gasoline will consume perhaps 44% of all petroleum used this year in the U.S. and only 17% of our Nation's total energy requirements. This suggests that we can help moderate gasoline prices by looking for efficiency improvements in all uses of petroleum, as well as exploring opportunities to lower or eliminate unnecessary gasoline consumption more directly. To that extent, then, a more meaningful set of energy policies would include an economy-wide perspective.

Transportation Energy and Efficiency Opportunities

Notwithstanding the larger set of opportunities to promote cost-effective gains in energy efficiency, there is a significant benefit in focusing on our transportation system. When we climb into our cars or other vehicles to get where we want to go, we're really climbing aboard an incredibly extensive and highly diverse transportation system. It involves the obvious things like roads, bridges, tractor trailers and shipping containers, but it also includes a much larger array of elements—each with inefficiencies that if corrected, or even changed in reasonably minor ways, can help reduce the need for gasoline and other petroleum products. Among the less obvious aspects of the transportation system are traffic signals and controls, information and enforcement activities, and the scheduling, coordination, and management of facilities, goods, and services. Perhaps even less obvious is all the freight that must be hauled—to get the food from the farm to the processing plant and then to the grocery store; to get the lumber from the forests to the mills, from the mills to the

[3] In December 2007 the Energy Information Administration's forecast, the Annual Energy Review 2008 indicated that energy consumption would increase to about 124 quads by 2030. With the passage of the Energy Bill by Congress earlier this year, EIA subsequently revised its forecast to 118 quads by 2030. Building on that trend, an additional 20% savings by 2030 would imply a total energy use in a high-efficiency scenario would be on the order of 94.4 quads. EIA data suggests that actual energy use was about 94.2 quads in 1996. The difference between those projected values (i.e., 118 quads in the reference case versus 94.6 quads in the energy productivity case) is 23.6 quads. The cumulative savings over the 2008 through 2030 time horizon would be just under 269 quads compared to the reference case consumption pattern. With each barrel of oil equal to 5.8 million Btus, this level of savings is comparable to 46 billion barrels of energy efficiency equivalent. This is the figure cited at the beginning of this testimony. This comparative scenario analysis draws on a study and modeling analysis by Laitner et al. (2006).

[4] This section of the testimony draws heavily on a report released earlier this year through the Civil Society Institute (Laitner 2007).

[5] Again, these values are highly speculative and intended only to provide a magnitude that might help this committee think about the larger economic impact of our continuing levels of demand and inefficiencies.

lumber yards, and finally to our homes and offices; or to get the clothing, medicines, books, and consumer electronics to the stores for purchase by consumers and businesses.

Adding up all the energy required by these various transportation needs, it appears that we need about 14.6 million barrels of oil (or oil equivalent) each day to maintain current levels of use (and inefficiencies). Cars and other light duty vehicles demand 9.1 million barrels per day, or about 62% of the total. While the average fuel economy for automobiles has grown from 13 miles per gallon in 1973 compared to perhaps 23 miles per gallon today[6]—a respectable 70% over that period—there are more and more cars which are driving more and more miles. The end result is that we are using more and more gasoline and other petroleum fuels. And the kinds of cars we are driving have also changed. In the mid-1970s only one out of five new light-duty vehicles sold was a pickup or other light truck. Today trucks, sport utility vehicles and minivans comprise nearly half of the total sales for new light duty vehicles (Davis and Diegel 2007). Their overall fuel economy is substantially less at 17.7 miles per gallon. As a result, all the gains in fuel efficiency have been eaten away by horsepower wars and the growing sales of less-efficient trucks, minivans, and SUVs. The result is an average fuel economy of 20.3 miles per gallon for all light-duty vehicles on the road today (EIA 2008a).

There is some good news in this. Whether we are talking about passenger cars, railroad trains, trucks, aircraft or ships, over the next twenty years the potential for technology improvements that increase the fuel efficiency of individual vehicles is significantly greater than is generally imagined or appreciated. But an even larger "system gain" in energy efficiency is possible if we make wholly achievable cost-effective improvements in system operations, in infrastructure and in land use patterns—in addition to those vehicle efficiency improvements.

The Many Efficiency Opportunities in Transportation

To gain further insight into the full opportunity for system efficiency improvements, let's start with the more familiar area of vehicle efficiency improvements. Even a cursory look at the "Best of 2008" cars makes it clear that gains in energy efficiency come from a wide range of technologies. Hybrid vehicles such as the Toyota Prius or the Honda Insight have been claiming the limelight when it comes to high miles-per-gallon vehicles, but fuel-efficient technologies are also being installed in more conventional cars as well. Intelligent engines with features such as cylinder deactivation, turbocharging, direct injection, and variable valve control; advanced transmissions, including 6-7 speed automatics or continuously variable transmissions (CVTs); and lightweight materials, engine-off-at-idle, friction reduction, and improved aerodynamic designs all do their part to help make these cars more energy-efficient. By extending these and other technologies to include more of the new car and new truck fleet (in effect, so that the best becomes the typical), there is a huge potential to improve the energy efficiency of conventional vehicle technology (IEA, 2005). A recent report of technology experts funded by the United Nations Foundation called for a 35% increase in fuel economy by 2020 and a 60% increase by 2030 for new light-duty vehicles (Expert Group on Energy Efficiency 2007).

These advanced technologies admittedly increase the manufacturing costs of vehicles but at the same time they also reduce the energy costs of operating them. DeCicco et al. (2001), for example, suggested that fuel economy standards could increase from 37 to 70% over a 15 year period with no more than a 4.5 to 6.6% increase in costs. In other words, a car that might cost an additional $1200 might also save 150 gallons of gasoline annually. With current gasoline prices in the range of $4 per gallon, this might imply a typical payback of two years. Similarly, a car that might cost an extra $3000 might save 190 gallons of gasoline which means that at $4 per gallon, the extra investment would pay for itself in about four years. Although a shorter payback period would be better, either of the technology upgrades would generate a positive return for a vehicle with an expected life of 17 years or more. Perhaps even more impressive and more recently, the California Air Resources Board estimates that meeting California tailpipe standards (which will result in vehicles that reach roughly 35 mpg in 2016) will cost on average $1000 per vehicle. At $4 per gallon of gasoline, this will save about $700 per vehicle per year, yielding a 1.5 year payback. (For other comparative estimates of costs and savings associated with vehicle efficiencies, see IEA 2006, tables 5.2 and 5.6; and Vattenfall 2007.)

[6] I might note that all of the gains in fuel economy occurred over the period 1975-1986, and that today new vehicles are still below the average reached in 1986.

At the same time, the actual fuel economy that is achieved while driving those motor vehicles can be greatly affected by how they are operated and how they are maintained. Whether in the form of speeding and aggressive driving, excessive engine idling, improper tire pressure, and even poor choice of motor oil, the behavior and maintenance decisions of drivers can also affect the on-road fuel economy. One recent study concluded that programs which promote improvements in driving style through training and technology aids could generate a 10% reduction in typical fuel consumption and therefore in greenhouse gas emissions (ECMT/IEA 2004).

Even though automobiles now use about two-thirds of the transportation fuel consumed in the United States, large savings are also possible in the movement of freight as well as the movement of passengers in business, air, and train travel. One professor of transportation logistics has suggested that heavy trucks might save 32% of energy use through a combination of improved fuel efficiencies, and better coordination to reduce empty backhauls and unnecessary travel (McKinnon 2007). Still another ACEEE study lists tractor-trailer technologies that can reduce fuel consumption by 39% across the fleet of those heavy duty vehicles. The paper as a whole shows the potential to reduce oil consumption through efficiency gains across many different sectors (See Elliott et al. 2006, especially Tables 10 and 11). Although rail transport is one of the more energy-efficient transportation modes, the IPCC suggests that substantial opportunities for further efficiency improvements remain. These include reduced aerodynamic drag, lower train weight, regenerative breaking and higher efficiency propulsion systems, all of which can make significant reductions in rail energy use. While passenger jet aircraft produced today are 70% more fuel efficient than equivalent aircraft produced 40 years ago, the IPCC notes that a 20% improvement over 1997 aircraft efficiency is likely by 2015 and "possibly 40 to 50% improvement is anticipated by 2050. Still greater efficiency gains will depend on the potential of novel designs such as the blended wing body, or propulsion systems such as the unducted turbofan" (Kahn et al. 2007).

Emergence of Information Technologies

One especially interesting opportunity that is emerging is the use of broadband and information and communication technologies (ICT) to increase transportation efficiencies by decreasing travel demands and increasing transportation system efficiencies (Laitner and Ehrhardt-Martinez 2008). A new study released just last month by the Climate Group (2008), with assistance from McKinsey and Company and on behalf of the Global e-Sustainability Initiative (GeSI), found that ICT has the potential of reducing energy-related global greenhouse gas emissions by 15% by 2020 through a combination of smart buildings and smart grids and also smart transportation and travel reduction/dematerialization.

Smart vehicle technologies, for example, provide a range of innovative means for reducing transportation-related energy consumption while maintaining the services on which we depend. Vehicles are increasingly integrating sophisticated communications and information technologies that collect and communicate information regarding vehicle performance, routes and maps, road and traffic conditions, energy consumption, and environmental variables. As more and more vehicle manufacturers integrate on-board wireless technology, smart cars will increasingly be able to communicate with regional data centers as well as other vehicles on the road to share road data, travel information, traffic conditions, and other information. Moreover, on-board display devices will make this information readily accessible to drivers through the use of networks of sensors and communications devices. Maximum energy-efficiency gains can be provided through a combination of intelligent transportation systems (ITS) and smart vehicle systems that rely on a variety of sophisticated electronic technologies including GPS, sensors, processors and on-board communications equipment. In the future, these technologies will enable automated management of traffic flows, allow drivers to avoid congested roads, and locate and map the shortest routes to specified destinations—resulting in shortened drive times, reduced energy consumption, and lower greenhouse gas emissions.

Governments and businesses are also looking to integrate high-tech supply chain logistics and warehousing technologies. Advanced logistics technologies can help companies reduce fuel use, costs, and carbon emissions through:

- Intermodal shipping strategies that utilize a variety of shipping modes including rail resulting in reduced traffic congestion and idling time and increased shipping mode flexibility allowing shippers to choose the most fuel-efficient, cost-effective, reliable and timely mode of transportation.
- Improved truck tracking and logistics management to improve scheduling the pickup and delivery of goods so as to reduce wait times, maximize the size of truck loads, and reduce the number of wasted "backhaul" of empty trailers.

- Improved routing of traffic by providing real-time information about the quickest routes to reduce travel time and idling.
- Improved tracking and management of store and warehouse inventories to improve the management and flow of goods and increase the viability of intermodal shipping opportunities.

These strategies can minimize inefficient freight operations, saving fuel, increasing revenue for trucking companies, and reducing carbon dioxide emissions. For example, according to the US Environmental Protection Agency, the use of intermodal shipping for long distance shipments (over 1000 miles) cuts fuel use and greenhouse gas emissions by 65%, relative to truck transport alone (EPA 2004).

Still another transportation option is the use of telecommuting and videoconferencing. The emergence of information and communication technologies enables high quality work to be completed from a home office location in a way that saves gasoline—even after other energy uses are considered. For example, while a telecommuter may save gasoline as a result of a net reduction in commuter travel, there is some increased energy use associated with working in the home office. But even with a full accounting of those increased uses, a new estimate by the Consumer Electronics Association indicates that the regular telecommuting of some 4 million workers is now saving an estimated 840 million gallons of gasoline equivalent. More critically, the report suggests that the potential could grow to 25 or even 50 million workers which would significant increase current levels of energy savings (TIAX LLC 2007). By the time we include other ICT-enabled services ranging from expanded videoconferencing to increased electronic banking and other retail and entertainment services, the suggestion is that "normal" transportation efficiency gains could be greatly complemented by new patterns of working and living enabled by information and communication technologies.

THE NEED FOR A NEW POLICY FRAMEWORK

Even with all this good news about the potential for greater system efficiencies, however, transportation energy use is likely to increase by another 16% between now and 2030—in the absence of additional policy intervention that might otherwise guide an optimal mix of technology improvements and new services demands.[7] This result is driven, in large part, by an increase in vehicle and air miles traveled. Despite the run up in oil prices, the Energy Information Administration estimates that travel demands may be twice as high as the rate of population growth over that same period of time (EIA 2008a). One significant downside of the continued demand for petroleum resources is that it is likely to result in further increases in energy costs for businesses and consumers. The growth in energy use will also increase the environmental burden associated with the continued emissions of greenhouse gases.

A more successful outcome, one that achieves an optimal configuration of transportation technology systems, will require smartly crafted policy solutions to overcome important social, economic and structural barriers. Yet, at a recent transportation policy forum sponsored by the U.S. General Accounting Office (described as the audit, evaluation, and investigative arm of the United States Congress), participants said that "the Nation's transportation policy has lost focus and that the Nation's overall transportation goals need to be better defined." They further noted that "the federal share of total transportation spending continues to decline" (U.S. Controller General 2007). The evidence certainly seems to point in that direction.

Despite the availability of highly cost-effective measures to substantially raise fuel economy standards for both cars and heavy trucks at least since the early 1980s, we have not done so until very late last year. The Energy Independence and Security Act (EISA) enacted by Congress in December 2007, among other things, will increase the average fuel economy of new cars and light trucks combined from 25 to 35 miles per gallon by 2020. This is a positive step that will increase the average fuel economy of our national fleet of cars and light trucks over time. Unfortunately, this modest gain in average fuel economy is unlikely to offset the growth in overall travel within the United States. A more realistic focus on both climate change and world energy policies will require a more aggressive improvement in our system-wide energy and transportation efficiencies. Hence, a meaningful set of long-term policies should address an even greater level of fuel economy improvements, as well

[7] It's worth noting that before passage of the Energy Independence and Security Act (EISA) in December 2007, the Energy Information Administration projected a 28% growth in transportation energy between 2008 and 2030. With the anticipated improvements in fuel economy under EISA, as well as a somewhat slower economy coupled with significantly higher energy prices, EIA has moderated that growth to only 16% as noted above.

as significantly reducing overall travel demands, while maintaining a higher quality of life.

Following the recommendations of the United Nations Foundation panel of experts, for instance, a longer-term focus would increase fuel economy standards for light cars, trucks and heavy duty freight vehicles by at least 60% by the year 2030. There is an emerging consensus that—with the right set of policies, and with further investment in research and development activities directed toward transportation systems—a 60% improvement is still an economically achievable target (Expert Group on Energy Efficiency 2007; and Langer 2007). At the same time there should also be an emphasis on reducing the demand for travel through a combination of funding for alternative transportation systems as well as changes in land use and economic development policies.

Initial thinking suggests that, with supportive policies, a 20% (or greater) reduction in total vehicle travel might be possible by the year 2030 (Ewing et al. 2007 and Langer 2007). Alternative transportation technologies would include rail and mass transit systems as well as a greater emphasis on improving the logistics of freight shipments. Both approaches would either reduce travel or encourage the use of more fuel efficient modes of transport (e.g., piggybacking truck shipments with rail transport). A smarter transportation policy would also embrace greater reliance on telecommuting and videconferencing in ways that reduce both automobile and air travel. Economic development and land use policies might encourage production technologies that can be located closer to where new goods and services are actually needed. In this way travel demands can be reduced even further (Laitner and Ehrhardt-Martinez 2008, and The Climate Group 2008).

Policy solutions will play a pivotal role in strengthening the continued development, dissemination, and widespread adoption of energy-efficient transportation technologies and systems. Without a sensible framework of policy objectives and targets, the unfolding of these many technologies and their efficiency gains might follow any number of less productive paths.

Specific Policy Recommendations

At a minimum, the market needs a strong, clear, and persistent signal to help it organize and direct its own efforts as well as smart investments toward a more productive pattern of economic activity. To that end, ACEEE suggests the following 10 policy actions that might be undertaken by this Congress to immediately provide that signal, and more critically, to change the direction of energy usage through increased energy efficiency. These proposals are intended to accomplish two specific objectives. The first is to create an immediate catalyst by launching an effort over the next few months which can "save oil in a hurry."[8] If undertaken with sufficient robustness, these initial proposals might generate an immediate downward pressure on oil prices to the benefit of consumers and businesses. The second is to begin the process of fundamentally restructuring and stimulating new productive investments in our transportation infrastructure—a step that will be necessary if we are change the energy use path that our transportation system is currently on. Many of these suggestions lay the groundwork for a shift in transportation policy that is afforded the next Congress by next year's reauthorization of the transportation bill.

1. Enact an Immediate Joint Resolution.

An immediate joint resolution, quickly followed by the other policy actions described below, would send a clear and strong signal to consumers, businesses, and the energy market in ways that would help organize a more productive pattern of economic activity. The resolution should affirm the Nation's energy efficiency potential across all fuels and all sectors of the economy. It should direct all agencies to immediately implement all cost-effective gains in energy efficiency—consistent with their current authority and funding. Moreover, it should emphasize a coordinated effort among all agencies.

2. Enact Emergency Transit Supplemental Funding.

Mass transit represents one of the few short-term alternatives to driving personal vehicles for many consumers, and we have seen recent surges in rider-ship since gas prices have surged. However, many transit agencies are struggling to close budget gaps created by dramatic increases in fuel, forcing them to curtail service at the time when demand is on the increase. The congress should pass an emergency fund-

[8] In fact, this phrase references a 2005 workshop convened by the International Energy Agency and a resulting book by that same name. The book identified a series of immediate measures that might save up to 1.7 million barrels of oil per day, at a cost ranging from $1 to $100 per barrel, if such measures were implemented by all members of the IEA. (2005). This perspective can provide a useful model of immediate effort for the U.S. as well.

ing supplemental to assist transit agencies with meeting their increased fuel bills, and make available funds at 80% federal match to supplement local and state investments in expanded capacity.

3. Establish a Crusher Credit for Inefficient Low-Mileage Cars.

This provision would accelerate retirement of the most fuel-inefficient and polluting light trucks when coupled with additional incentives for clean and efficient new vehicles. Under rules to be issued by the Secretary of the Treasury, owners of vehicles presented for destruction (crushing, shredding) will receive a voucher redeemable upon the purchase of a new vehicle meeting the eligibility requirements of the Alternative Motor Vehicle Credit contained in the Energy Policy Act of 2005. The recommended offset for the cost of the program is the extension of the federal "Gas Guzzler Tax", currently applicable only to passenger cars, to light trucks, at a level sufficient to fully offset anticipated program costs.

4. National Telecommuting and Videoconferencing Initiative.

Direct the appropriate agencies to immediately launch a campaign to encourage and enable immediate cost-effective telecommuting and videoconferencing. In addition, all federal agencies should be directed to establish telecommuting and videoconferencing to the maximum extent possible.

5. Develop Policies to Expand Alternative Modes of Freight Movement.

In preparation for next year's Transportation Bill reauthorization, Congress should commission a study of the potential fuel savings potential of expanding alternative modes of freight movement and identify policies that could be implemented to realize these savings

6. Co-Funding of Local Land Use Planning.

Congress should establish a program to co-fund local governments' efforts to update zoning and land use regulations in such a way as to encourage compact development compatible with transit service.

7. Study of Role of Information and Communications Technologies in Improving Transportation System Efficiency.

Direct the National Academies to undertake a study into the role that Information and Communication Technologies (ICT) could have in reducing travel delays and improving the efficiency of transportation infrastructure.

8. Establish a National Energy-Efficient Maintenance and Driver Education Program.

To improve the efficiency of new drivers, it will be critical to change behavior. Congress should direct the Department of Transportation to develop information regarding driving practices, car maintenance, and fuel efficiency that can be incorporated into driver education programs. Auto inspection programs, for example, might include fuel economy recommendations. So you not only get a 12-point safety inspection, but you can also get a 12-point efficiency inspection.

9. Direct the Collection of Energy Efficiency Data and Indicators.

The role of energy efficiency is largely invisible in the US economy. Congress should direct and fund the Department of Commerce, Department of Energy and Environmental Protection Agency (among others) to collaborate in the development of a National Energy Efficiency Data Center (NEEDC). The purpose of this new center will be to collect, organize, disseminate and archive energy efficiency and social science statistics and technology costs, particularly those related to public policies and programs.

10. Explore Other Incentive Mechanisms.

The Automotive X Prize is a $10 million inducement price and was announced in March of 2008. It is sponsored by the X Prize Foundation and Progressive Insurance. The prizes will be awarded to teams with cars that can win a staged race while maintaining a fuel efficiency rating of 100 miles per gallon and better.[9] In that same spirit Congress might direct appropriate agencies to explore ways to complement this initiative, but also to look for other inducements and prize incentives (both within and outside of government) which might encourage a more entrepreneurial and smarter use of our investment and energy resources across the many dimensions of our economy.

[9] The X PRIZE Foundation, best known for the successful $10 million Ansari X PRIZE for private suborbital spaceflight, is an educational nonprofit whose mission is to bring about radical breakthroughs for the benefit of humanity by holding $10 million dollar (or larger) competitions to solve some of the world's greatest challenges." See http://www.progressiveautoxprize.org.

A NOTE ON INVESTMENT

One of the underappreciated elements in the growth of the economy and improvements in the Nation's energy overall energy efficiency is the vital role of investment. The chart* on the following page highlights the annual percentage change in all three elements over the period from 1990 through 2008 (estimated). What's the bottom line? In the period 1992 through 2000, we had a significant period of capital deepening in which investment as a percent of GDP climbed from a typical level of about 13% to a record 17.7% in 2000. The events in 2001 had an obvious impact in market confidence in both that year and 2002. After a recovery that lasted through 2006, we had negative growth in 2007, and it appears we'll see this again in 2008.

What may not be initially apparent is the role of investment in improving our energy intensity (energy productivity). Following a robust 2.7% decline in the Nation's average energy intensity over the period 1973 through 1986, the rate of change flattened out to 0.8% through 1996. Tracking the surge of investment in 1996 through 2001 (shown in the figure above), our intensity declined 2.9% annually. The decline in energy intensity moderated at 1.6% over the years 2001 through 2006. Of immediate concern is the complete flattening in that rate of change in 2007 and 2008. I might suggest this flat improvement in our energy productivity is driven, in part, by the negative rate of investment, which significantly tightens the market with respect to energy supply. One might reasonably conclude that this is among the reasons for the higher energy prices we are seeing here today. Perhaps more to the point is that the proposals we recommend here today will stimulate more productive investment in ways that increase our energy productivity. This, in turn, is likely to generate a downward pressure on energy prices.

LIKELY ECONOMIC RETURNS

At this point we might ask how all of these energy efficiency policies, behaviors and investment decisions could reduce the economic damage of high fuel prices. Generally energy efficiency reduces the toll taken by high energy prices in two ways: first, by reducing consumption, and therefore the amount of energy for which consumers must pay; and second, by reducing prices. As but one example of the possible impacts, ACEEE estimates that the U.S. could reduce oil consumption by 9-13% by 2015 and 15-21% by 2020 through energy efficiency (Elliott et al. 2006). The measures to accomplish this are all cost-effective; that is, the efficiency improvements typically cost less than half what they save in petroleum costs. With regard to price reduction, the complex and global nature of oil and petroleum markets makes predicting price nearly impossible. We can nonetheless be confident that by giving the market a greater ability to respond to the price signal and by increasing the supply margin, energy efficiency can decidedly help relieve the run-up in prices. To the extent that speculation in futures markets is responsible for high prices, the adoption of policies that cost-effectively ease inefficient consumption in the near term will serve to combat these rising price effects.

Drawing on a broader variety of related studies and assessments, we can say that as long as such energy efficiency investments are cost-effective—in effect, investments that pay for themselves over a 3-7 year period—the economy should be strengthened. This point was reinforced by another new study released by ACEEE earlier this month (Laitner and McKinney 2008). This latest report, Positive Returns: State Energy-Efficiency Analyses Can Inform U.S. Energy Policy Assessments, concluded that energy efficiency investments are likely to stimulate a small but net positive benefit for the American economy. The report's conclusions were drawn from a review of approximately four dozen state-and regional-level efficiency potential studies that were undertaken over the past 16 years. Overall, the studies demonstrate the potential for an average of 23% efficiency gain with a nearly 2 to 1 benefit-cost ratio. Moreover, they suggest that a 20% additional gain in energy efficiency by 2030 could provide an estimated 800,000 net jobs while a 30% efficiency improvement might generate as many as 1.3 million net jobs. Finally, the report notes that efficiency-led policies that emphasize greater energy productivity are likely expand the Nation's economy (as measured by our GDP) by about 0.1% by 2030.[10]

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*The chart has been retained in the committee files.

[10] This result might make more sense when we realize that energy-related sectors of the economy contribute a significantly smaller rate of value-added per dollar of revenue received that almost all other sectors of the economy. Based on 2006 economic data for the U.S. economy, energy-related sectors contributed about 43 cents of value-added per dollar of revenue while all other sectors contributed about 54 cents per dollar of revenue. The same is also true for employ-

Continued

CONCLUSIONS

Given the full array of evidence, we can conclude that energy efficiency can provide a significantly large contribution toward stabilizing energy prices and strengthening the robustness of the U.S. economy. The good news is that there are large opportunities to promote an even greater level of productive investments in energy-efficient technologies—should we choose to develop and pursue those options. Policy solutions will play a pivotal role in strengthening the continued development, dissemination, and widespread adoption of energy-efficient transportation technologies and systems. The more quickly we act, the more quickly the benefits can accrue to both consumers and businesses.

The CHAIRMAN. Thank you very much.

Mr. Winkelman.

STATEMENT OF STEVE WINKELMAN, DIRECTOR OF TRANSPORTATION AND ADAPTATION PROGRAMS, CENTER FOR CLEAN AIR POLICY, PORT CHESTER, NY

Mr. WINKELMAN. Mr. Chairman, Ranking Member Domenici, members of the committee, thank you for the opportunity to testify today. My name is Steve Winkelman. I'm the Director of the Transportation Program at the Center for Clean Air Policy, also called CCAP, an environmental think tank based in Washington, DC. I respectfully request that my full statement be made part of the record.

The CHAIRMAN. Everyone's statement will be included in the record.

Mr. WINKELMAN. CCAP helps governments at all levels implement energy policy solutions that balance economic and environmental concerns. CCAP conducts technical analyses and facilitates dialog among stakeholders to craft practical solutions. Partners include oil and car companies, environmental groups, Federal agencies and state secretaries of transportation.

At CCAP we encourage our partners to ask the climate question. From an infrastructure development to your daily commute if you build it, fund it or do it, ask what the implications are for greenhouse gas emissions. Answering the climate question will go a long way toward addressing gasoline demand.

Petroleum demand fell by 3 percent during the first half of this year. But with limited travel choices Americans are left vulnerable to high fuel prices and hit hard in the pocketbook. Federal policies can expand travel choices for all Americans and increase our resilience to oil price shocks and protect the global climate.

During World War II, Americans rose to the challenge of constrained resources. They gathered scrap metal for recycling and planted victory gardens that produced 40 percent of all vegetables. Back then children walked to school.

Today Americans are responding to high fuel prices with creativity and common sense. As a result the number of miles driven declined 2 percent in the first quarter of this year. More people are

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ment. Energy-related sectors of the economy support less that two jobs per million dollars of revenue while all other sectors support an average of seven jobs (IMPLAN 2008). The recent run-up in oil prices greatly lessens the rate of contribution the energy-related sectors provide the Nation's economy, especially as those energy dollars pull resources away from all other sectors. By the same token, any cost-effective change in the pattern of production away from energy should strengthen the Nation's overall economy. This is particularly true to the extent that the new production recipe reduces the levels of imported energy.

riding transit, biking, combining trips, telecommuting and even planting vegetable gardens.

I am fortunate to be able to walk from home and to walk my son, Benny, to school each day. Unfortunately too many Americans find they have little choice but to drive long distances to meet their basic needs. According to the American Public Transportation Association, public transit saves four billion gallons of gasoline each year. Americans are getting on the bus and train in record numbers.

The year 2007 saw the highest ridership in 50 years and it's still growing. But while transit companies are seeing record demand for their product, high fuel prices are forcing many agencies to cut service and raise fares. It would be as if Toyota cut back production on the Prius because too many people want one.

The 2007 Energy bill set new standards for vehicles and fuels that would cut gasoline demand 20 percent below 1990 levels by 2030. However, the Energy Department forecasts a 50 percent increase in driving, sending gasoline use and CO_2 emissions to 20 percent above 1990 levels instead of 30 percent below as required for climate protection. In other words, increased driving is projected to cancel out gasoline savings from the 2007 Energy bill.

Cutting gasoline use therefore requires a comprehensive approach that includes improved travel choices. Public transit agencies are in need of emergency Federal assistance to accommodate record ridership, expand service and cope with rising fuel bills. State and local governments need Federal assistance to help expand pedestrian and bicycle facilities. Smart growth policies that encourage infield development will be critical to reducing future gasoline. Because what we build today will last for a century.

CCAP proposes a Federal climate incentive program to help state and local governments expand travel choices. We believe that there is no, one size fits all, solution. The solutions must be developed locally with the diversity of measures applicable to urban, suburban and rural areas.

Next year, Congress will have a major opportunity to ask the climate question. Will the next transportation bill reduce our petroleum dependence or aggravate the problem? Will the next $300 billion that we spend on transportation build upon the savings from the Energy bill or cancel them out?

Federal transportation funding formulas currently reward increased fuel consumption and increased driving. It's time to reverse course. The next transportation bill which we call, "Green TEA," should improve travel choices for all Americans, support smart growth planning, increase freight system efficiency. Green-TEA should provide state and local governments with the tools, data and resources they need to implement the transportation and land use policies that cut petroleum demand, reduce greenhouse gas emissions and grow the economy.

My grandmother used to tell a joke about a man who desperately wanted to win the lottery. He prayed everyday for good luck. When he was an old man he begged, please, I'm old. I'm tired. All I ask is to win the lottery. A voice rang out from the heavens and said, look buddy, meet me halfway. Buy a ticket.

If we want to inflate ourselves from oil price shocks. If we want to protect our communities from the impacts of global warming, it's time for us to buy that ticket. We must make new investments in public transportation, bike lanes and even sidewalks. If we ask the climate question, together we can develop the choices that we will need to thrive.

Thank you.

[The prepared statement of Mr. Winkelman follows:]

PREPARED STATEMENT OF STEVE WINKELMAN, DIRECTOR OF TRANSPORTATION AND ADAPTATION PROGRAMS, CENTER FOR CLEAN AIR POLICY, PORT CHESTER, NY

Mr. Chairman, Ranking Member Domenici and Members of the Committee: good morning. Thank you for the opportunity to testify before you today. My name is Steve Winkelman. I am the Director of the Transportation and Adaptation Programs at the Center for Clean Air Policy (also called CCAP), a Washington DC and Brussels-based environmental think tank.

I respectfully request that my full statement be made part of the record.

CCAP helps governments at all levels design and implement energy and climate policy solutions that balance economic and environmental concerns. CCAP conducts technical and economic analyses and facilitates dialogue among stakeholders from government, industry and environmental groups to craft practical and effective solutions.

For example, CCAP's "VMT and Climate Policy Dialogue" includes state secretaries of transportation, directors of Metropolitan Planning Organizations, local governments, federal agencies, car companies, oil companies and environmental groups who are working together to develop options for advancing smart growth in climate policy and integrating climate considerations into transportation policy.

At CCAP we encourage our partners in government and industry to "Ask the Climate Question." From manufacturing, to infrastructure development to daily commuting: if you build it, fund it, buy it or do it ask what the implications are for greenhouse gas emissions and your vulnerability to the impacts of climate change.

Answering the Climate Question will go a long way toward addressing the topic of today's hearing—reducing gasoline demand.

According to the American Petroleum Institute, petroleum demand actually fell three percent during the first half of 2008, compared to the first half of 2007. But, with limited travel choices, Americans are left vulnerable to high fuel prices; they are hit hard in the pocketbook and the national economy suffers. Federal policies can increase travel choices for all Americans, and increase our resilience to high fuel prices, while reducing greenhouse gas emissions.

Some 65 years ago, during World War II, Americans rose to the challenge of constrained resources. They gathered scrap metal for recycling and planted Victory Gardens that produced an estimated 40 percent of all vegetables consumed nationally. And back then, all children walked to school (even if it wasn't really uphill both ways).

Today, Americans are responding to high fuel prices with creativity and common sense. As a result, the number of miles Americans drive declined by two percent in the first quarter of 2008 compared to the first quarter of 2007.

More people are taking public transit, walking, biking, combining trips, carpooling, telecommuting, going to four day work weeks, shifting to online shopping and even planting vegetable gardens. In effect, they are asking the Climate Question: Do I need to make this trip? Can I combine trips? Could I walk a half mile? How can I use less of this high-priced fuel?

I am fortunate to be able to work from home and walk my son, Benny, to nursery school. Unfortunately, too many Americans find they have little choice but to drive long distances to meet their basic needs. Most children can no longer even walk to school. In 1969, half of all American school children walked or biked to school. In 2001? Only 15%. And high fuel prices are compounding the pain of the housing affordability crisis.

According to the American Public Transportation Association, public transit currently saves the equivalent of four billion gallons of gasoline each year. And Americans are getting on the bus and train in record numbers: 2007 saw the highest ridership in 50 years, and we've already seen a three percent increase in 2008. But while transit companies are enjoying record demand for their product, high fuel prices are forcing many agencies to cut service and raise fares. It would be as if

Toyota cut back production of the Prius, or Ford pulled back on the Focus because too many people want them.

Whether fuel prices remain high for an extended period, or come back down and stay there for a while, Americans need more efficient choices for getting where they need to go.

Climate Change Considerations

With the Energy Independence and Security Act of 2007, your Committee set new efficiency standards for vehicles and new greenhouse gas requirements for fuels. Together, these measures would reduce gasoline demand and transportation CO2 emissions to 20 percent below 1990 levels by the year 2030.

However, the U.S. Department of Energy forecasts a 50 percent increase in the number of miles Americans will drive through 2030. This increase in driving would cancel out the benefits from the Energy Bill's new CAFE standards and fuel requirements. Gasoline use and CO2 emissions in the year 2030 would be 20 percent above 1990 levels, instead of 30% below as required for climate protection. (I provide graphs and further technical details in the appendix of my written testimony.)

Reducing gasoline demand will therefore require a comprehensive approach that includes improving transportation choices. To do that effectively, we must focus new land use development in central locations and near transit stations to shorten vehicle trips and foster more walkable communities. As we document in the book, Growing Cooler: The Evidence on Urban Development & Climate Change, people drive fewer miles in places where things are closer together, and when they have more travel options such as walking and transit. In other words, we need to Ask the Climate Question when we make development and infrastructure decisions.

I would like to commend the Committee for your foresight in pursuing the transportation/land use connection via your direction in the 2005 Energy bill for the National Academies' Transportation Research Board to conduct a study on the issue. It is my understanding that that study will be completed next May.

How can Federal Policy Help?

Public transit agencies are in immediate need of emergency federal assistance to accommodate record numbers of riders, restore service cuts, expand service, maintain or reduce fares, and cope with rising fuel bills.

Increasing the dollar cap on fringe benefits for employee transit passes and expanding policies and incentives to promote telecommuting could provide immediate relief for many employees.

New federal grants could help state and local governments expand pedestrian and bicycle facilities to make walking and biking safer and more convenient. For example, expanding the Safe Routes to School program would improve the health of our children and save gas.

Smart growth policies that encourage infill and transit-oriented development will be critical to reducing future gasoline demand, because what we build now will last for a century—and will determine whether our children will have viable alternatives to paying high oil prices. In the short-term, Location Efficient Mortgages can help people afford homes in neighborhoods where they don't need a second car.

Climate Policy

CCAP has developed a policy proposal for a federal incentive program that requires state and local governments to develop goals to slow growth in driving and reduce transportation greenhouse gas emissions. Allowance value from a federal cap-and-trade program would be used to fund goal development and implementation.

Importantly, CCAP believes that there is no one-size-fits-all approach, and that solutions must be developed locally—not dictated by the federal government. We anticipate a diversity of measures applicable to urban, suburban and rural areas ranging from infill development and transit improvements, to intermodal freight. CCAP recommends a bottom-up 'discovery process' in which states and local governments conduct scenario analyses and engage stakeholders to determine goals appropriate to local conditions.

Transportation Policy

Next year, Congress will have a major opportunity to Ask the Climate Question.

- Will the next transportation bill reduce our dependence on petroleum or exacerbate it?
- Will federal transportation spending make Americans more secure or more vulnerable?

- Will the next $300 billion we spend on transportation build upon the gains from the Energy Bill, or cancel them out?

Current federal transportation funding formulas actually reward increased fuel consumption and increased driving. CCAP proposes that we reverse course.

The next federal surface transportation bill, which we have dubbed "Green-TEA," should improve travel choices for all Americans, support smart growth planning, develop truly high speed rail, expand freight rail, increase freight system efficiency. For example, Green-TEA should cover the 12-year back up in funding for "New Starts" transit projects. And transit funding guidelines should ensure that the benefits of more efficient land use, such as decreased car ownership and increased walk trips, receive appropriate credit.

Green-TEA should provide state and local governments the tools and resources to plan and implement transportation and land use policies that will cut petroleum demand, reduce greenhouse gas emissions and bolster the economy.

Finally, Green-TEA should fund substantial improvements in fuel use and travel data. In recent years key federal travel surveys have been eliminated or scaled back. If we are serious about reducing petroleum demand and greenhouse gas emissions, we will need new surveys and better data to provide accurate and timely assessment of our progress, and to evaluate policy effectiveness. To get things moving, the Committee could direct the National Academies to conduct a study on what it would take and cost to improve fuel use and travel data to at least the quality levels achieved in other industrialized countries.

Closing Thoughts

Americans are driving less. They are doing the best they can to cope with high fuel prices. Some are making the best of it, like my friend Bonnie Baker, who now walks her daughter one mile to summer camp and another mile and a half to the coffee shop on the way home. She's saving money and feeling good, and some of her neighbors have expressed interest in joining her! Many others are frustrated with long waits for the bus, or the lack of shopping within walking distance.

But you don't have to take my word for it. Over the last several years, surveys by home builders, realtors and developers indicate that at least one-third of Americans in the market for a home want to live in convenient, walkable "smart growth" neighborhoods. Communities like Portland, Oregon, Charlotte, North Carolina, Newark, New Jersey, and Arlington, Virginia, and Sacramento, California are realizing that smart growth and transit-oriented development can cut fuel costs, reduce long-term infrastructure expenditures, improve quality of life and bolster the local economy.

I'm reminded of the old joke about the man who wants more than anything to win the lottery. He spends his whole life praying to win the lottery, but never actually goes out and buys a ticket. If we want to insulate ourselves from oil price shocks, if we want to protect our communities from the impacts of global warming it's time for us to buy that ticket. We must make new investments in public transportation, in bike lanes and, yes, even in sidewalks.

Americans have shown time and again that we are innovative and resilient. If we remember to Ask the Climate Question, together we can develop the choices we will need to thrive.

Thank you for your attention.

APPENDIX: WHY HOW MUCH WE DRIVE MATTERS A LOT

Transportation Greenhouse Gas Emissions

Transportation sector CO_2 emissions account for almost one third of the US total and are growing rapidly. Transportation CO_2 emissions are a function of three factors: vehicle efficiency, fuel characteristics and the amount we drive as measured in vehicle miles traveled, or "VMT". CCAP refers to this as the three-legged stool (Figure 1)*.

Proposals for national climate legislation would set a cap on most GHG emitters, which in the case of transportation would be set at the level of petroleum refiners and importers. A GHG emissions cap could send a price signal to consumers of up to $0.50 per gallon of gasoline in 2030.[1] A price signal of that magnitude will be ineffective on its own unless there are good choices of vehicles, fuels and convenient alternatives to driving.

A number of market failures hamper provision of low-GHG travel choices. For example, consider the multitude of public and private entities involved in planning,

*Figures 1–3 have been retained in committee files.

[1] For example, see: http://www.epa.gov/climatechange/downloads/s2191__EPA__Analysis.pdf

financing and operating transportation infrastructure, and the many stakeholders engaged in land use planning, permitting and development. Therefore, complementary policies are needed to address market failures and encourage the development of more efficient vehicles, low-GHG fuels and to increase travel choices. To be clear, in a comprehensive cap-and-trade system, if the transportation sector achieves fewer reductions, other sectors will make up the difference. But placing a heavier burden on other sectors may drive up compliance costs, whereas increasing transportation choices would make it easier to meet the GHG cap, reduce consumer vulnerability to higher fuel prices and could minimize net societal costs.

CCAP analysis and experience leads us to the conclusion that it is necessary to make progress on all three legs of the stool to meet GHG reduction goals. In fact, projected improvements in vehicles and fuels are determined to be insufficient to achieve climate goals due to forecasted growth in driving (measured as VMT). This point is particularly pertinent to those industries that are typically in the crosshairs of regulation: electricity generation, petroleum refining and vehicle manufacturing—if growth in driving is not addressed, then power, oil and car companies may face stiffer regulation.

The Energy Independence and Security Act of 2007 requires new passenger vehicles to achieve at least 35 miles per gallon by 2020, which would lead to a 41 percent increase in fleet-wide fuel economy by 2030 (see Figure 2, green line).[2] The Energy Bill also sets a low GHG fuel requirement that CCAP calculates would reduce lifecycle GHG emissions by 10 percent by 2022 (see Figure 2, purple line). If we assume no growth in VMT, these measures would reduce CO_2 emissions from cars and light trucks to 20 percent below 1990 levels in 2030 (see Figure 2, dark blue line). That's just into the range of what's needed to be on path to 60 percent below 1990 levels by 2050. While other sectors would need to overcompensate if deeper GHG cuts were determined to be necessary, I submit that this would represent a rather respectable effort on the part of the transportation sector toward achieving the climate target.

Even in an aggressive case, with a 50 mpg CAFÉ standard in 2030, and an additional 10 percent reduction in fuel GHGs, passenger vehicle GHG emissions would be only four percent below 1990 levels in 2030, still well above the target range. There is a clear need to get reductions from all three legs of stool: vehicles, fuels, and VMT.

Success Stories

Residents of the New York City region drive two-thirds fewer miles each year than the national average. By accident of history, New York City had the good fortune to develop around pedestrian and transit infrastructure, but has had the economic wisdom to maintain it.

In the Portland, Oregon region, after three decades of growth management, transit-oriented development and improvements to pedestrian and cycling facilities, the amount of driving per capita decreased by six percent from 1990-2005, while national VMT per capita increased by 10 percent over the same time period.

In Arlington, Virginia, research by Dennis Leach shows that 20 years of focused development around Metro stations has resulted in no net increase in local traffic despite substantial economic and population growth. More than a third of residents take transit to work and 12 percent of households do not own cars, versus four percent for the region as a whole. Development that would have covered 14 square miles in a suburban setting, takes up only two square miles around Metro stations in Arlington. Critically, eight percent of the County land use accounts for 33 percent of real estate tax revenues—providing a crucial funding stream for enhanced transit operations and other local services.

Pre-project modeling for the Atlantic Station infill redevelopment project of an old steel mill site in downtown Atlanta projected a 30 percent reduction in driving vis-&-vis suburban locations. Actual measurements to date indicate a 75 percent reduction in daily driving per resident of the mixed-use development.

The Sacramento Area Council of Governments (SACOG) has calculated that implementation of the regional 2050 Blueprint smart growth land use plan would result in CO_2 emissions 14 percent lower than under business-as-usual trends. Importantly, SACOG calculates avoided infrastructure costs of more than $9 billion through 2050 (transportation and utility) and increased transit operating costs of $120 million per year. CCAP calculated consumer fuel cost savings of $650 million per year (at $2.50 per gallon) resulting in a net societal economic benefit. From a CO_2 perspective, CCAP calculates a negative cost (i.e., a savings) of -$200 per tonne CO_2. This net savings compares very favorably to measures such as carbon capture

[2] US DOE/EIA, Annual Energy Outlook 2008, http://www.eia.doe.gov/oiaf/aeo/index.html

and storage, which costs +$30/tonne and ethanol at +$200/tonne range. With a long backlog of deferred infrastructure maintenance, and strained public resources, polices that can reduce the need to build new infrastructure are most welcome indeed.

The CHAIRMAN. Thank you very much.

Dr. Buiel, you're the final witness. Go right ahead.

STATEMENT OF EDWARD R. BUIEL, PH.D. VICE PRESIDENT AND CHIEF TECHNICAL OFFICER, AXION POWER INTERNATIONAL, INC., NEW CASTLE, PA

Mr. BUIEL. Mr. Chairman, distinguished members of the committee and guests, thank you for inviting Axion Power to testify at this mornings hearing. We are here to talk about ways of reducing this country's dependence on oil. Axion is a manufacturer of lead acid batteries.

We are currently developing several new advanced lead acid battery technologies for a variety of applications including hybrid vehicles, plug in hybrid vehicles, battery electric vehicles and conventional retrofit programs for existing vehicles to battery electric vehicles and plug in hybrid vehicles. We're also working on batteries for military applications that include hybrid drive trains, hybrid trucks, hybrid buses, hybrid trains, energy storage for renewable power generation, such as wind and solar, truck APU systems, to prevent overnight idling of trucks, emergency back up power and various other applications.

Axion has also been working to demonstrate these new advanced lead acid battery technologies in a variety of vehicle programs. These programs again include the hybrid electric vehicle, plug in vehicle, plug in hybrid electric vehicles, battery electric vehicles and conventional vehicle retro fit programs. We are currently working with two of the largest lead acid battery manufacturers in the United States.

As we explain in more detail in our written testimony, there's about 250 million registered vehicles in the United States. They have an average life span of about 9 years. Thirty-five percent of these vehicles are 11 years of age or older.

The total world production of hybrid electric vehicles was only 500,000 in 2007. Although it is increasing rapidly, the 2007 production rate only represents 0.2 percent of the registered vehicles in the United States. Even by doubling the average fuel economy it is hard to see how hybrid electric vehicles by themselves will have an effect on United States oil consumption in the near term. More details on this are in our written testimony.

It seems appropriate that we as a Nation should consider all the available options to reduce fuel consumption. One of the programs that we are working on at Axion is a low cost battery solution that would enable the retro fitting of conventional vehicles as either electric or plug in electric vehicles. Kits are currently available from several sources to complete the retro fit of several dozen popular vehicle types.

Pick up trucks and SUVs tend to lend themselves well to the retro fit program because of their ability to carry extra weight and because they have the needed available space to house the batteries. In our more detailed testimony we describe one such pro-

gram that was completed on an S10 pick up truck. The cost of the program was $10,000.

This included $2,000 for lead acid batteries, $4,500 for the kit that included the motor controller, the motor and other necessary components, $500 for miscellaneous supplies and $3,000 in labor costs. All of these costs in this project represent retail level pricing. Only a single prototype vehicle was converted and the cost would be significantly reduced if performed on a larger volume.

The resulting vehicle had a range of approximately 40 to 50 miles depending on how the vehicle was driven. For every 1 percent of the total vehicles in the United States that are converted to electric vehicles, there is a corresponding reduction of more than 1.7 billion gallons of gasoline used per year. Pursuing advanced lead acid batteries for new electric vehicles in the future is the next step in our opinion.

Advanced lead acid batteries provide a significantly less expensive alternative for consumers than the current market options. A new electric vehicle that has a projected increased cost using nickel metal hydride or lithium ion batteries are more than $25,000. Advanced lead acid battery solutions would be less than half that number. Please reference the written testimony for more information on this specific project.

Currently the vast majority of battery R and D has focused on lithium ion. Lithium ion is the battery of choice for current, new, plug in hybrid electric vehicle and battery electric vehicle production. Lithium ion has many performance advantages over battery technologies such as lead acid.

However, several other important factors should be considered. These include safety, which has largely prevented the adoption of lithium ion in hybrid vehicles up to this point. Cost, manufacturing base in the United States, sustainability and source of raw materials, again there's much more detailed information in our written testimony that we've provided.

The written testimony that was provided also goes into a lot of these points in more detail and focuses especially on what consumers are presently willing to pay for a plug in hybrid electric vehicles and battery electric vehicles. We consider this a very important point if we're going to achieve the widespread adoption of any new vehicle technology. The report also explains why lead acid battery with their strong manufacturing base in the United States, excellent recycling and recoverability programs and the availability of the required raw materials within North America are a natural fit. We are not saying that lead acid is the only solution to move the electric fleet forward. But we are saying that it's one of the solutions and should be pursued vigorously.

Plug in HUV and/or battery electric vehicles either new or converted from conventional ICE vehicles based on lead acid batteries would also help us develop some of the needed improvements to our electrical generating and distribution infrastructure. It would also help create distributed charging systems for electric vehicles that need to become prominent in shopping centers, places of work or anywhere a vehicle is parked for a prolonged period of time. These systems would also, could also be used for lithium ion battery vehicles in the future.

Another very important concept that needs to be considered is the idea of electrified highway or the idea that we can charge our electric vehicles while driving on major highways and interstates in the United States. This by itself would have a tremendous impact on the cost of electric vehicles. Would help reduce the needed range of these vehicles and allow these vehicles to be used on long trips without frequent, multi hour stops to recharge their batteries.

It would also have a huge impact on the trucking industry where you would likely see a reduction on the cost of equipment and a decrease in operating costs. Again this is a longer term idea that is a project that Axion is currently working to develop. We'd like to see participate in a demonstration project in 2009.

In conclusion it seems prudent that with a large fleet of vehicles in the United States we should promote through research dollars and tax incentives a wide range of solutions aimed at accelerating a reduction in gasoline consumption that would result in a decrease in our oil dependence. Mr. Chairman, ranking members, thank you for allowing Axion to speak at today's hearing.

[The prepared statement of Mr. Buiel follows:]

PREPARED STATEMENT OF EDWARD R. BUIEL, PH.D., VICE PRESIDENT AND CHIEF TECHNICAL OFFICER, AXION POWER INTERNATIONAL, INC. NEW CASTLE, PA

1 OVERVIEW OF DIFFERENT VEHICLE TECHNOLOGIES

In recent years many new vehicle technologies have emerged mainly in response to rising fuel prices and environmental concerns. These new technologies include:

- HEV—Hybrid Electric Vehicles
- BEV—Battery Electric Vehicles
- FCV—Fuel Cell Vehicles
- DID—Direct-Inject Diesel/Advanced Diesel
- FFV—Flex Fuel Vehicle
- PHEV—Plug in Hybrid Electric Vehicle
- TGDI—Turbo Gasoline Direct-injection
- ICE—Internal Combustion Engine / Traditional Gasoline

A new survey taken by the global market research firm Synovate [1], found that when consumers were educated on the different available vehicle technologies, a large percentage, who would normally be expected to buy a traditional ICE vehicle decided on one of the other available technologies. Before and after education, the percentage of customers who said they would buy an ICE vehicle dropped from 76% to 45%, and for FFV the number decreased from 55% to 42%. In contrast, the decision to purchased PHEV vehicles increased dramatically from 33% to 64%, HEV from 57% to 64%, and BEV from 33% to 35%. The consumers that chose to remain with the ICE technology cited battery cost and life concerns as their main reasons for not considering BEVs and PEVs.

Additional important facts from the survey of consumers who were looking to purchase a new vehicle include [1]*:

1. 66% of consumers will chose vehicles that reduces their monthly fuel expense.
2. 75% of consumers said they would consider paying $1,500 more for a vehicle that achieves 30% better fuel economy.
3. 25% of consumers are willing to pay $2,000 or more extra for a vehicle that is significantly better for the environment.
4. 25% of consumers surveyed expressed a willingness to pay $2000 or more above the cost of an HEV to purchase a PHEV (roughly $4500 more than a normal combustion engine vehicle)

The main conclusions from this study is that consumers are willing to pay more for technologies that achieve better fuel economy and are better for the environment. However, the amount they are willing to pay is only $1500-2000 for conven-

* Figures 1–5 have been retained in committee files.

tional ICE and HEV technologies and up to $4500 (25% of consumers) for a vehicle that would spend a larger portion of time in an electric only mode of operation.

2 HYBRID VEHICLE INFLUENCE ON US FUEL CONSUMPTION

Current HEV vehicles achieve between 30-50 mpg [2]. Although this is an improvement over the current average fleet fuel economy in the US of 22 mpg (Source: 2009 Fuel Economy Guide [3]) for cars and light trucks, this will not significantly affect US dependence on oil. The three main reasons for this are dilution of this technology in a large fleet of conventional ICE vehicles, marginal improvement of fuel, and low customer adoption rates and low manufacturer production rates. Total world wide production rates for hybrid electric vehicles is growing however only about 500,000 hybrid vehicles were produced world wide in 2007 [4].

There are currently over 250,000,000 registered highway vehicles in the United States and the average vehicle life is 9.0 years and increasing, according to a report released by R. L. Polk & Co. [5] and increasing. 35% of these vehicles are 11 years or older [6]. In order to determine the effect of hybrid vehicles on gasoline consumption, we can assume that approximately 1/9th (11.1%) of the vehicles on the road are replaced each year based on the average vehicle life span and assuming that the total number of vehicles is somewhat constant. If we further assume that 10% of these vehicles will achieve double the average fuel economy of a standard passenger vehicle, then the decrease in gasoline consumption as a result of the introduction of more efficient HEV and other technologies is 1/2 x 11.1 % x 10% or 0.5%. It is difficult to see how this would have a significant effect on gasoline consumption in the near term. This also assumes that offset of conventional ICE vehicles was not offset by an increase inthe total number of vehicles which could easily over shadow the gains made by the introduction of these more efficient vehicles.

3 ASSESSMENT OF VEHICLE RETROFITTING PROGRAMS TO ACHIEVE ACCELERATED GASOLINE DEMAND REDUCTION

Further reductions in gasoline consumption can be achieved by the introduction of vehicles that can operate for prolonged periods in electric only mode. These vehicles include PHEVs, BEVs, and retrofitting existing passenger vehicles to operate as BEVs (RBEVs). The following sections have been designed to address the minimum requirements of RBEVs and an analysis PHEVs and BEVs is beyond the scope of this report. This report is not designed to promote any single technology and all technologies should be pursued vigorously in order for the cumulative efforts to accelerate the decrease in gasoline consumption.

3.1 Minimum RBEV Range Requirements

Considering the daily driving distances for US driver shown in Figure 4, 75% of US drivers drive fewer than 50 km (31 miles) per day and 90% less than 100 km (62 miles). For a RBEV, a 50-60 mile range would be sufficient for 90% of Americans daily driving needs. Such a vehicle would be considered limited compared to today's ICE vehicles however this may prove adequate for many 2-car families.

3.2 Battery Requirements for a RBEV with a 50-60 Mile Range

3.2.1 Battery Capacity

The size of the battery needed for a RBEV with a 50-60 mile driving range is dependent on many factors such as vehicle size, weight, driving conditions, etc. Data from the GM EV-1 vehicle that was produced from 1997-2000 and originally designed and displayed in the LA auto show in 1990 was used to determine vehicle range vs. battery capacity. The EV-1 Generation 1 used lead acid batteries and the EV-1 Generation 2 used NiMh batteries. Data from each generation of vehicle is shown in Table I.

Table I: General Motors EV-1 Generation 1 and Generation 2 battery specifications.

	EV-1 Generation 1	EV-1 Generation 2
Battery Type	Lead Acid VRLA	NiMh
Battery Capacity (kWh)	18.7 kWh (60 Ah)	26.4 kWh (77 Ah)
Battery Voltage (V)	312	343
Battery Weight (kg)	595	521
Vehicle Range (miles)	55 to 95*	75 to 130*
Battery Cost ($/kWh)	$150/kWh	$900/kWh **

* - Driving distances vary depending on driving style, terrain, specific route traveled, temperature and other factors.

** - Based on the current OEM cost of a 1.2 kWh battery for the Honda Civic.

Based on this data, a 20 kWh battery is sufficient to provide for a driving range of 50-60 miles based on the data for the EV-1 Generation 1.

3.2.2 Battery Cost, Safety, and Manufacturability in the US

Assuming that a 20.0 kWh battery would be sufficient to allow 90% of Americans to commute back and forth from work in an electric-only mode, the cost of different battery technologies can be estimated:

Table II: Project Cost of Different Battery Technologies Needed to Achieve a 50-60 mile range.

Battery Type	Cost for 20.0 kWh	Safety	Manufacturing Base in US
Lithium Ion (1200 $/kWh)	$24,000	Needs Improvement	Needs Improvement
Nickel Metal Hydride (900 $/kwh)	$18,000	Acceptable	Poor
Lead Acid (150 $/kWh)	$3,000	Excellent	Excellent

The cost data presented in Table II also agrees with many of the presentations that were presented at the recent AABC conference in Tampa Florida [4]. Advanced battery cost ranged from 750-2000 $/kWh based on the technology, maturity, and economy of scale.

Although Lithium ion batteries offer the best energy density resulting in the longest vehicle range, this technology also suffer from safety problems that may require further materials R&D to resolve. Honda [3] and Toyota [6] both discussed safety concerns at the recent AABC conference. Panasonic EV Energy (the joint venture between Toyota and Panasonic) announced on May 27, 2008 that they would spend $290 million on a plant to produce 100,000 NiMh batteries per year. This decision to focus on NiMh batteries instead of lithium ion is a further indication of concerns by the dominant producers of HEVs that safety is still a major concern for lithium ion batteries. Again, this technology has many merits and should continue to be pursued vigorously as a long term solution for BEVS, PHEVs, and HEVs. However, safety concerns and battery cost favor lead acid batteries and advanced lead acid batteries for near term use in RBEVs.

Manufacturability should also be a major long-term concern for the United States. In order to guard against interruptions in the supply of critical commodities, it would seem prudent to focus on US made products. As shown in Figure 5,* the majority of Lithium ion batteries are currently produced in Japan, China, and Korea. There are currently no large volume manufacturers of Lithium Ion Batteries in the United States [7] although Electro Energy and EnerDel both have manufacturing facilities in the US.

In contrast, the United States currently produces an estimated 120 million lead acid batteries per year and employs over 100,000 people in this sector (Source: Bat-

tery Council International). 99% of lead acid batteries produced in the United States are recycled back into new lead acid batteries. The recover rate for lead, plastic, and acid is currently 95-99%. In terms of sustainability, you could therefore say that lead acid batteries represent the model by which all other materials should be judged.

3.3 Case Study: Converting Existing ICE Vehicles to RBEV

A project was conducted in combination with Nord Kendal to evaluate the feasibility of converting a normal ICE vehicle to a BEV. The vehicle that was selected was a Chevrolet S-10 pickup truck. Pickup trucks and SUVs are good choices for vehicle conversion because of the availability of the necessary space for batteries, motors, controllers, and other ancillary equipment. They also typically exhibit poor fuel economy because of their larger size, poor aerodynamics, and heavier weight.

This vehicle was converted with the aid of a retrofit kit that was purchased from Wilderness-EV of Utah. A cost breakdown of what was required for the project is shown in Table III. All of these costs are at the retail pricing level and do not reflect a true manufacturing cost for a larger scale production of RBEVs.

Table III: Chevrolet S10 Pickup Truck Retrofit Costs.

Equipment	Cost
Lead Acid Batteries (10):	$2000
Conversion Kit:	$4500
Other Materials	$500
Labor	$3000
TOTAL	$10,000

The vehicle retrofit provided for 10 lead acid batteries. The ICE engine was completely removed. Three batteries were placed under the hood and a row of 7 batteries were placed in the front of the truck bed. The motor controller and the DC motor were connected directly to the transmission. Future work will focus on removing the transmission and using the DC motor to drive the drive shaft directly.

Table IV: Converted S10 Pickup BEV Specifications

Specifications	Units	Value
Number of lead acid batteries:	#	10
Total Battery Capacity	kWh	20
Vehicle Range on Full Charge	miles	50
Increase in Curb Weight	lbs	750

Vehicle conversion kits are also available for a number of other vehicles including trucks, passenger vans, delivery vehicles, and cars.

3.4 Further Considerations for RBEV Vehicles

The retrofitting of conventional ICE vehicles to RBEVs is currently being lead by small business and individuals scattered across the US. This creates significant safety concerns, pricing concerns, and reliability concerns when compared to the standard production of conventional vehicles. Many of these concerns can be addressed by better engineering and the formation of a centralized testing center similar to what is currently in place for passenger buses (i.e. The Altoona Bus Research and Testing Center). Currently the Federal Transit Authority has created minimum safety and systems requirements for passenger buses and it is believed that a similar organization should be created to address similar concerns with RBEVs.

4 Axion's Vision for Tomorrow

The development of additional technologies such as electricity infrastructures for power generation, distribution, and vehicle charge will be critical for the wide spread adoption of PHEVs, BEVs, and RBEVs. Axion has been working to develop several new ideas that pertain to distributed charging capabilities and on-the-road charging.

4.1 Distributed Charging

The need to be able to charge vehicles at work, when shopping, or whenever the vehicle is stopped, is an important consideration for increasing vehicle range. The illustration below shows how these vehicles could be charged while the driver is shopping.

Additionally, all electric vehicles will have significant range limitations due to charge time. Charge times as long as 2-3 hours and ranges of less than 200 miles will make long distance travel very difficult and subsequently will stall the adoption of electric vehicles. This limitation could be significantly improved by utilizing the concept of on-the-road-charging (OTRC). OTRC would allow the vehicles to charge and drive for prolonged periods. A vehicle with a 50-60 mile range may be all that is necessary in order to provide a driver with the needed range to drive through a city to an Interstate, to charge while driving the bulk miles of his/her journey, and then be fully charged when the vehicle leaves the interstate to travel the remaining miles to his/her destination. Such a capability would also allow for better use of heating/cooling which is a considerable challenge, especially heating in cold temperatures, for electric vehicles. The following two illustrations are designed to provide an idea on how this could work.

5 AXION'S ADVANCED LEAD ACID BATTERY TECHNOLOGIES

Even though the first generation of EV-1 vehicle was capable of meeting the cost and range requirements for 75% of Americans, Axion has made further improvements to lead acid batteries that make them more suitable for use with HEV, PHEV, and BEV vehicle technologies. These three technologies include: PbC Technology; Carbon Additive Technology; and Embossed Grid Technology.

5.1 PbC Technology

Axion's core technology is the development of a hybrid battery/supercapacitor called the PbC Technology. This technology uses a standard lead acid battery positive electrode, a new proprietary carbon negative electrode to replace the standard lead negative electrode in a lead acid battery, and the same manufacturing process as a conventional lead acid battery. In addition, the new PbC Battery uses the same case, cover, separator, acid, and other materials that are standard in conventional lead acid battery construction. This is important in order to keep the cost of this new battery technology close to the same level as conventional lead acid batteries.

As shown below,* the cells that feature the PbC negative carbon electrode are similar to the standard cell configurations.

- Longer cycle life
- Faster recharge rates
- No sulfation of the negative electrode
- Lighter weight
- Higher power capability

All of these advantages are very important for use with hybrid vehicle operation. The elimination of the problem with sulfation of the negative electrode is also critical in allowing for regenerative braking in any type of electric vehicle without greatly decrease battery life. This is the main problem prevent the use of a standard lead acid battery in HEV, BEV, PHEV, and RBEV applications.

5.2 Carbon Additive Technology

Axion has also developed a carbon additive solution for the standard negative electrode of a lead acid battery. This technology allows for much better resistance to sulfation of the negative electrode when compared to a conventional lead acid battery and may prove sufficient for several vehicle applications. Currently this technology is being developed by Axion mainly for use in hybrid train, hybrid truck, and hybrid bus applications where the cost of the batteries is the dominating factor.

Axion has developed a novel new continuous paste mixing process which allows for higher carbon loadings in paste when compared to conventional lead acid battery mixing technologies.

5.3 Embossed Grid Technology

Axion's third new lead acid battery technology was developed to improve the power, cycle life, and endurance of the positive electrode. This grid technology features a continuous sheet of lead that is embossed with a pattern to allow for the support of the active material. This technology is currently in a preproduction commercialization phase and will be used in all of the Axion vehicle demonstration batteries.

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*All pictures have been retained in committee files.

6 AXION'S ADDITIONAL HEV, PHEV, AND BEV PROJECTS

Axion is also working to demonstrate the use of Axion's three advanced lead acid battery technologies in HEVs, PHEVs, and BEVs.

6.1 HEV Project

The HEV project consists of retrofitted two Hybrid Civic vehicles with advanced lead acid batteries based on Axion PbC Technology.

This project will be completed in conjunction with Provector who has already retrofitted Honda Civic vehicles with advanced lead acid batteries in the UK. Once these vehicles are completed, they will be put through a series of drive cycle tests to 100,000 miles to demonstrate the success of the Axion new battery technology. Axion will also work to develop an aftermarket replacement battery kit for the Hybrid Civic that will be manufactured in Pennsylvania as a result of this project that will features Axion's advanced lead acid batteries.

6.2 PHEV Project

The PHEV project would consist of modifying two Toyota Prius' with an extended range advanced lead acid batteries with a capacity of around 20.0 kWh. This substantially increases the existing capacity by about 15 times (from 1.3 kWh).

This project will be completed in conjunction with Electric Transportation Applications (Phoenix, AZ) who has already retrofitted Toyota Prius vehicles as PHEV vehicles. Once these vehicles are completed, they will be put through a series of drive cycle tests to 100,000 miles to demonstrate the success of the Axion new battery technology. Axion will also work to develop an aftermarket PHEV conversion kit for the Toyota Prius that will be manufactured in Pennsylvania as a result of this project and feature Axion's advanced lead acid batteries.

6.3 BEV Project

The BEV project would consist of modifying a pure electric vehicle that was developed by Advanced Composites (Harrisburg, PA) with Axion's advanced lead acid batteries. This vehicle has already been constructed and is currently using conventional lead acid batteries. The main goal of this project is to demonstrate the versatility of Axion's advanced lead acid battery technology by, for the first time, allowing this BEV vehicle to make use of regenerative braking. Previous versions of the vehicle could not make use of regenerative braking because the high power charge/discharge resulted in sulfation of the negative electrodes and premature failure of the batteries. Using Axion's PbC and/or Axion's Carbon Additive technology, we expect to eliminate the sulfation problem and greatly enhance the performance and viability of this vehicle. Since the vehicle has already been constructed and fitted with lead acid batteries, a limited amount of time and expenses are projected for this project.

This project will be completed in conjunction with Advanced Composites. Once the vehicle is outfitted with Axion's new battery technology, it will be put through a series of test to determine range and applicability for commuter, delivery, and other vehicle applications.

7 ENERGY AND ENVIRONMENTAL BENEFITS OF PHEV AND BEV PROJECTS

7.1 Energy Benefits—Fuel conservation

Compared to other electric vehicle technologies, the PHEV, BEV, and RBEV projects could result in a dramatic decrease in gasoline/diesel fuel consumption. 90% of American's daily commuting mileage could be converted to electric only operation. This would result in a reduction of 500 gallons (approximated $2,000 per year at $4.00/gallon of fuel) per vehicle per year assuming a 22 mpg average fuel economy and 11,000 miles / year average miles driven per year. This corresponds to a reduction of 250 million gallons of fuel per year for every 500,000 vehicles that could be produced as PHEV, BEV, or RBEV. For the average consumer, charging the battery would cost roughly $3.00 (assuming $0.12/kWh and a 25% over charge). In order to cover the same distance of 75 miles in electric only mode, a standard car would consume 3.4 gallons of fuel which costs $13.60 at $4.00 / gallon. This is a reduction of 78% and an annual reduction of $1560 per consumer. In broader terms, for every 1% conversion from ICE vehicles to BEVs, PHEVs, or RBEVs there is a corresponding reduction of 1.25 billion gallons of gasoline consumption per year.

7.2 Environmental Benefits

Axion's current HEV, PHEV, BEV, and RBEV projects will be equipped with data acquisition systems that would collect and record real data from the actual "real-Axion Power International, time" use of these vehicles to determine further environmental benefits of these technologies.

HEVs would likely reduce the gasoline consumption, unburned hydrocarbons, oxides of nitrogen, and air CO_2 emmisions by 50%:

Table V: Environmental Benefits of HEV technology

Estimated Emission Reductions per 500,000 vehicles	Tons per year
Gasoline Fuel Reduction	125 million gallons
Unburned hydrocarbons (HC) and oxides of nitrogen (NO_X) (assumption: 44 kg per vehicle per year: source CARB)	12,000 tons
Air pollutant reduced per year (specify) CO_2 (assumption 19.6 lbs/gallon of gasoline: source US DOT)	1.25 million tons

PHEV, BEV, and RBEVscould eliminate the gasoline consumption, unburned hydrocarbons, oxides of nitrogen, and air CO_2 emmisions:

Table VI: Environmental Benefits of PHEV and BEV technologies.

Estimated Emission Reductions per 500,000 vehicles	Tons per year
Gasoline Fuel Reduction	250 million gallons
Unburned hydrocarbons (HC) and oxides of nitrogen (NOx) (assumption: 44 kg per vehicle per year: source CARB)	24,000 tons
Air pollutant reduced per year (specify) CO_2 (assumption 19.6 lbs/gallon of gasoline: source US DOT)	2.5 million tons

8 GOING FORWARD

Axion is not working alone in the areas we have spoken of in this report. Rather we are working with two of the three largest battery manufacturers in North America. Since we first established an MOU relationship in 2004, our vision remains the same going forward in that Axion will continue to develop technology products that can and will be manufactured on the assembly lines of much larger lead acid battery companies. In addition to our work, the entire lead acid battery industry continues to develop products of their own. Both cases would be helped by a dollar infusion for research and demonstration projects. While hundreds of millions of dollars have gone into other types of battery technologies, very, very little has gone into the enhancement of lead acid batteries.

Certainly tax credits for consumers and corporations that invest in converting their vehicles from ICE to any of the electric alternatives (HEV, PHEV, BEV, or RBEV) would be a further inducement to moving the conversion process forward quickly. If we do not all act together—business, consumer and government—America will be forever mired in oil dependency.

The CHAIRMAN. Thank you very much. Thanks to all of you. Let me ask a few questions. We'll just do 5-minute rounds here. Let me start with a question to you, Mr. Chalk.

We enacted as part of the 2005 bill several different provisions that were intended to move us toward a more efficient use of petroleum and I've got that whole list here. There were Federal procurement of stationary, portable and micro fuel cells, diesel emission reduction authorizations, fuel cell school buses, railroad efficiency, clean school bus program. As far as I can tell and I haven't totally researched this, there's never been funding provided, never been funding requested by the Administration for these.

Are you familiar with this set of programs? If so, could you tell me anything now or for the record could you tell us what the Administration has done to implement any of these?

Mr. CHALK. Yes, sir, Mr. Senator. What we can do is go back and for the record go down the whole list and update you on the actions to date.

Just to pinpoint a few. The fuel cell school buses, for instance, we felt it was premature, that we don't have the reliability of fuel cells for vehicles so that we didn't want to present a safety issue

by exercising that particular one at this point in time. We'll go back and go through all of them and give you where we are as far as the status of implementing those various pieces.

The CHAIRMAN. That would be great. If you could get that to us by the time we come back into session in early September. That would be very useful.

Mr. CHALK. Ok.

The CHAIRMAN. Because this may well be a subject we're still debating then. I think it's almost certain we will be.

There have been various suggestions. Some of them we heard this morning for how we deal with this problem. Which I think you referred to, Mr. Chalk, which was the turnover of current assets in the fleet, that we have a fleet of vehicles out there.

I think you indicated that a car sold today is almost as likely to be in the fleet of cars being used in the 2022. So I guess the question is are there practical things we could look at? I know Mr. Laitner, you proposed that we have a tax credit for we provide the people for scrapping vehicles that have very poor gas mileage.

I know Andy Grove, the former head of Intel, has talked about how we should retro fit the most inefficient vehicles in our fleet. I don't know if that's a practical suggestion in terms of the cost involved. Any of you have an opinion on which of these things makes sense?

I think in each case we're talking about charging the United States taxpayer for the cost of doing this. I think we need to try to understand if the benefit would be great enough to justify that.

Mr. CHALK. Let me give an analogy maybe and then an example. An analogy might be the transition to high definition TVs. You can go out and buy a new TV or if you don't want to do that right now you can get a rebate and go to Circuit City or Best Buy and buy a converter box. That way you can convert and you can adapt to the new signal.

So we could evaluate programs. What if we made all new vehicles fuel flexible? The consideration there has to be is, if we were to do that, could the current legacy vehicles in the inventory then adapt to higher blends of ethanol and so forth.

If we really want to make a big impact in an urgent timeframe we've got to do something with those vehicles that are in the inventory. There's got to be some kind of retrofit program. Of course the challenge then is to how do you incentivize that? But it has to be in context I would say to what we're sending overseas everyday for imported oil.

The CHAIRMAN. Dr. Greene, did you have any thoughts on this?

Mr. GREENE. Yes, I think this question of accelerated scrap is to improve fuel economy and reduce oil consumption has been studied. In general does not appear to be a cost effective strategy. The variation in fuel economy across cars is perhaps on the order of two or three times, you know, for a very efficient car to a very inefficient car.

What the scrapage programs sometimes work for is pollutant emissions where the pollution created by a high polluting car may be 100 times the pollution of a very low pollution car. Sometimes accelerated scrapage is cost effective in that situation. But I've not seen a study showing that it's cost effective for improving fuel econ-

omy because the difference between a high fuel economy car and a low fuel economy car is not of that same magnitude.

The CHAIRMAN. Let me go ahead and defer to Senator Craig for his questions.

Mr. LAITNER. Might I respond to that comment very quickly because in fact——

The CHAIRMAN. Sure.

Mr. LAITNER. We've done an analysis showing that such a program can be cost effective. But it has to be smartly designed. We'll be able to provide you with more of those details at a later time.

But there are now about 90 million vehicles that would qualify as inefficient, roughly speaking, cars and light trucks on the order of less than 20 miles a gallon. So we understood that would be the pool that we might suggest a scrapage would be taken from. Then the obligation would be to buy a fuel efficient car.

We would define as 25 percent above the current CAFÉ standards in that particular year. With some other conditions I think you'll find that it can be cost effective. Not only in terms of directly but again, as among the signals that we're trying to provide the market in terms of the demand for oil and its impact on price.

The more we systematically approach a robust signal to the market provided with a series of actions, this being one of them. But others as well, including the other petroleum fuels that are used in industry and in locomotive or other types of transportation equipment. That combination will bring the prices down and it's the downward movement of the price that can add a complement to the well-being, to the benefit of the program. So not just directly, but the price impacts as well.

The CHAIRMAN. Alright. Thank you.

Senator Craig.

Senator CRAIG. Mr. Chalk, I'm going to ask you the question, but you all might wish to respond to it because I have felt for the last file while it's not wise politically to say, the bad news is gas was $4. But the good news is gas was $4. America is now rethinking, in a very aggressive way, what we can do, both short term and long term.

So let me speak short term recognizing that what we're talking about, not only in EPACT 2005, but in 2007 is more long term. Now we are faced with an immediate problem and a huge redistribution of wealth outside our country that I don't think we can take much longer as a country. The 1.2 billion a day or whatever that figure is based on 65, 70 percent dependency.

So I want to focus short term to a fleet of automobiles that transitions over a longer period of time. One of the factors that's happening in this hemisphere, but it's a product of EPACT also. As we attempted to create a world gas market, by that I mean natural gas, liquification, porting and all of that. While it is moving slowly, it is moving.

But high gas prices have also produced new technologies and a greater will to explore. That exploration is producing phenomenal results in a way that we did not anticipate it might. While gas prices are falling, interestingly enough, natural gas prices are falling faster as a percentage of total value than crude.

I've asked a variety of fuel economists, is there a short term silver bullet? While they hesitate, they do say, and in fact we have a rather prominent figure out there speaking at the moment about it, the reality of using natural gas to retro fit existing fleets for a period of time. That deals with the problem of the guzzler. That deals with the problem in my state of the need for heavy long distances vehicles, farm trucks, ranch trucks, construction trucks.

I have a growth State. We travel long distances in Idaho crushing that Ford F150 is not a very exciting idea to the average Idahoan. They want it. They feel they need it, but they can't now afford it.

Is there a way to change it? Is there a way to adjust over a periodof time while we bring on all of these other ideas and realities we're talking about without distorting the market so that we don't bring them on. That I fear almost as much as that. I am an avid, aggressive, pro-driller. I think we need to look at supplies also.

Having said that, Mr. Chalk, is it reasonable, can we, retrofit natural gas? Do we go to the average consumer? Do we go to fleets only and say to fleets you're going to retro fit?

That's going to be the law in essence. Are we distorting that gas market in a way we might damage it for a period of time, especially if we get to silly on climate change and force fuel shiftings and for electrical production? Is this a reality, a short term reality, based on rapidly increasing gas supplies and the worldization, if you will, of a gas market?

Mr. CHALK. First I would say that there's no silver bullet. We need all these options.

Senator CRAIG. I don't disagree.

Mr. CHALK. We've got to push through these more aggressively.

Senator CRAIG. You're talking short term?

Mr. CHALK. Yes. I think it's worth considering the proposal. Obviously, the specific proposal you're talking about is to replace a lot of that natural gas with wind power. That we can find a way then to use that domestic natural gas which has better well to wheel greenhouse gases for the transportation sector.

Senator CRAIG. I didn't factor in wind power. But wind power is coming on much more rapidly than many of us anticipated it might. So it could be a factor.

Mr. CHALK. Yes, my point is we can't have significant electricity generation, transportation, home heating, all on natural gas. I think we need to shift the electricity to wind and other renewable electricity resources, re-evaluate the feasibility of natural gas than for other uses like transportation, possibly replacing home heating oil. Because it's domestic and because environmentally it will perform better in terms of greenhouse gases and criteria pollutants.

So, yes, we think it's a proposal that needs closer examination.

Senator CRAIG. Reaction from the rest of the panel?

Mr. LAITNER. Yes, Senator Craig, I appreciate your question and your comment. I agree that perhaps someone in Idaho may not particularly enjoy scraping their Ford 150. The beauty of what we're proposing, first of all to put it in a context.

We're proposing a series of structured steps. Yes, the crusher credit is one, but also accelerating the ability for telecommuting,

tele-working, video conferencing. For example, I recently went to Stockholm, Sweden.

I had a very good meeting with people there by walking two blocks down in my street and had a high quality meeting with about 20 people. I saved about 180 gallons of fuel, something like that. It benefited us here by my not doing that, using teleconferencing sorts of arrangements.

If I have a colleague or friend in Illinois that wants to scrap his or her truck. That's something they can do to the benefit of your people in Idaho. The choice is there.

They are not mandated. But we're giving the opportunities so that the extent others do take advantage of these, it benefits everybody across the board. Leaves much more flexible freedom and that structured set of policies I outlined about ten of them.

David is suggesting some others. The complement would provide the market with a signal that would steady it. Then provide flexibility in the production system that would allow that market to stabilize and the price to come down to the benefit of the economy as a whole.

My point is these are things that can be done fairly quickly. We can save oil much more quickly than we imagine if we put our mind to it. But there has to be a will, a political sense that yes, this is a reality upon us. There are some steps we need to take and we should follow it.

It's in that sense that this one independent idea is among several that should be part of the solution.

Mr. WINKELMAN. Senator, petroleum is a fabulous fuel. It's very efficient. If you look at transit companies, what they've gone to are hybrid electric—hybrid diesel buses as the technology of choice in terms of delivering the power they need.

So I don't know the details in the natural gas technology. But acceleration of hybrid technologies for heavy duty diesel for agricultural and rural purposes could be quite important. Petroleum is valuable, so let's use it where it's most important to use that pick up in a rural setting and not take two tons of steel with you when you get a gallon of milk in the suburbs.

In rural areas also, if you look at a traditional rural town center, Main Street is walk able. So if we focus on redevelopment in those areas, those mom and pop shops may actually be cost effective because the long drive out to the discount center is actually a lot more expensive. Finally freight system efficiency overall, expand freight rail and efficient movement of the system benefits all in terms of safety, in terms of movement of goods and the flow of the system which will benefit folks in every area.

Mr. BUIEL. Yes, Senator.

The CHAIRMAN. Why don't you make your comments sort of quick so that we can get on to these other questioners?

Mr. BUIEL. The S10 pick up that we converted had a range of about 50 miles. It cost about $10,000 and had an ROI of 2 to 3 years. Without any incentives, any tax breaks or anything.

If you look at some of the new advanced battery technologies that feature lithium ion or nickel metal hydride, those have a ROI of 27 years. So I would say there is an option right now. It's one that we could pursue. It's one that is being pursued, mainly by individ-

uals in small companies where it's something the retro fit program is something that we should look at in a lot more detail. Thank you.

Senator CRAIG. Thank you, gentlemen.

The CHAIRMAN. Alright. Senator Barrasso.

Senator BARRASSO. Thank you very much, Mr. Chairman. Mr. Greene, I appreciate the range of the suggestions you had. You mentioned that you can raise fuel efficiency by about 10 percent by just adopting some of these issues in terms of driving. These are things people are doing voluntarily.

Before the Federal Government mandates how private citizens choose to conserve, are you aware to the extent, if there is of which any of the recommendations that you have are currently being implemented by the Federal Government for its own fleet. Is that being done?

Mr. GREENE. That I'm sorry I don't know about then.

Senator BARRASSO. Recommendations for the Federal Government on the way they ought to be doing things?

Mr. GREENE. In terms of how they're maintaining and operating——

Senator BARRASSO. In terms of being efficient. I mean, you talked about how the average person on the street can do this and is increasing their efficiency.

Mr. GREENE. I think the same recommendations apply.

Senator BARRASSO. Mr. Chalk, do you know if the Federal Government is doing any of these, taking any of these under advisement, recommending it for members of our own fleet?

Mr. CHALK. We're constantly promoting those all the time. One of the internal efforts that we have with the Department of Energy, we have about 15,000 vehicles, is to convert over time, in a couple of years, all of those over to alternative fuel vehicles and where all the DOE complexes are to have an alternative fuel station on that site or nearby that site.

Senator BARRASSO. You know, kind of following up what the Chairman had asked earlier, he talked a lot about the ideas that had come about of the 2005 Energy Policy Act. Do you feel that you're using more of a shotgun approach or are you really focused on a couple of things in terms of putting all the eggs in the same basket and watching the basket or really spreading out in terms of how efficient you're being and how effective?

Mr. CHALK. We are focused, I think, in three main areas. One is trying to take leadership through our Federal Energy Management Program to cut energy use by 30 percent, at least, by 2015 across the whole Federal Government. DOE, as I mentioned, has an internal initiative really to be the first one out of the box, be really aggressive on that. Then our role as part of the Federal Energy Management Program is to promote those practices throughout the Federal Government because the Federal Government is the biggest single energy user in the world.

Second, I think we're very, very focused on non-food, advanced biofuels. Right now biofuels, I think, are really the only mechanism that we have that are making a difference in moderating car and gasoline prices. If we didn't have the bio fuels and the current blended in current gasoline stock, we estimate that gasoline would

cost anywhere from 25 cents to 45 cents more per gallon. So that to us is critical.

Senator BARRASSO. Higher.

Mr. CHALK. The RFS is critical.

Senator BARRASSO. Higher than what it is now.

Mr. CHALK. Pardon me.

Senator BARRASSO. You said 25 to 40 percent higher——

Mr. CHALK. Higher than it is now. If we didn't have the ethanol you'd have to replace that ethanol with gasoline and you'd be paying higher prices.

Thirdly, the major emphasis right now is plug in hybrid vehicles. Again, this allows us to bring in electricity as a fuel depending on how the electricity is made we can provide extraordinary environmental benefits. Again we have lots of renewable energy.

If nuclear comes on and over the next few years we'll have other options as well as clean coal. So our electricity mix right now is very diversified. If we use that as a fuel, we can get that same diversification because right now we're 97 percent dependent on petroleum.

Senator BARRASSO. I see American families cutting back, sacrificing, conserving. I'm just not encouraged or convinced at this point that I see the same effort by the Federal Government to conserve on its use of energy.

Mr. Winkelman, I had a question for you, if I could. I appreciated your comment where you say there was no one size fits all approach. For States like North Dakota, Montana, Idaho, New Mexico, Wyoming, rural areas, we don't have the opportunity to have some of the mass transit things that you talk about.

You talk about the joy of being able to walk your son to school. That's not a possibility for many people in our part of the country. Do have some suggestions specific to rural America?

Mr. WINKELMAN. Senator, I think certainly the biggest opportunity go in the rural areas are in vehicle efficiency, in terms of short term. So using the more efficient vehicle, keeping tires inflated. Things that people are doing all over the country though, about combining trips, planning ahead, make a big difference.

The idea of expanded broadband so if you're not, if your job doesn't involve hauling things in a pick up, if you can actually telecommute some days, that can help. Shopping online as well and again, really, I go back to actually, probably I don't know in your community 50 years ago if children did walk to school if more people sort of lived closer in. We're not going to turn the clock back.

But if we look at where new development goes to the extent it revitalizes those traditional rural town centers, that means you can have that walk able downtown, so shopping and such can happen. It's an interesting fact that many don't know, only 25 percent of all miles driven relate to their work trip. Therefore shopping trips, entertainment, other trips, there's a lot of opportunities to address those.

Finally, for the State as a whole, not necessarily for individuals, but improved freight system efficiency again is critical for making sure that we're moving our goods in a way that's energy efficient. Expanded freight rail, expanded inter motor facilities, even a strategic bottleneck—strategic capacity expansion to remove bottle-

necks can help flow and improve fuel efficiency. So that set of measures can be helpful in the short term that we're all feeling the price signal.

Senator BARRASSO. Thank you, Mr. Chairman, my time's expired.

The CHAIRMAN. Senator Salazar.

Senator SALAZAR. Thank you very much, Senator Bingaman.

Mr. Chalk, I have a question for you concerning flex fuel vehicles. Let me preface it by saying that some of the work that we have done in this committee has been very helpful in moving us in the right direction. I think you'll find broad bipartisan agreement among people who are part of the Set America Free Coalition on the kinds of the things that we need to do to get rid of our dependence on foreign oil. But some of those things are long term as we make the transition over to biofuels, alternative energy and other things that are part of our portfolio.

My question has to do with respect to flex fuel vehicles. Senator Brownback and Lieberman and myself introduced legislation that would mandate that we have 50 percent of our vehicles being flex fuel by the year 2012 and 80 percent by the year 2015. What is your view on that? Does the Administration have a point of view on whether that kind of mandate would end up the transition of the national vehicle fleet system in the way that we want?

Mr. CHALK. We believe that a proposal like that which is long term and durable is really necessary. The domestic automakers have actually committed to provide half of their fleet to be fuel flexible by 2012. We would like to see that even go farther and be 100 percent.

As I mentioned earlier, we need some type of retrofit program so that we can address the legacy vehicles so they could also properly run on that fuel.

Senator SALAZAR [presiding]. In terms of new vehicles though, your position would be that we ought to go further than 50 percent and go to 100 percent by when? By 2012?

Mr. CHALK. We ought to evaluate a very strong policy for going to 100 percent.

Senator SALAZAR. Ok. Then with respect to the legacy vehicles, the position would be that we figure out ways of retrofitting them to be able to go flex fuel?

Mr. CHALK. We have to address that. I think if say E85 is not compatible in some legacy vehicles, again, the vehicles are in the fleet for 15 years. So a vehicle that was sold 12, 13 years ago, we have to make sure that it still meets emissions requirements, still performs the same.

So I think you have to address that and you have to address cars that are under warranty. Whether we hurt that warranty when we start filling it up with something different. Those issues have to be addressed. But I very much feel that we have to make bold moves like that if we're going to do something in an urgent manner.

Senator SALAZAR. Let me ask you a related question. In terms of the infrastructure and distribution system for the alternative fuels, I know that we have made some headway in terms of retail establishments out there that now provide ethanol and other kinds of biofuels. But it seems to me that we have a long ways to go there.

I would ask you the question as to whether you agree with that assessment that we still are only at the very beginning stage of that?

Then second of all if you agree with that assessment, what is it from a policy point of view that you think we could do to try to get the infrastructure and the distribution system up to where we need it to be in order to bring in this flex fuel national vehicle fleet system?

Mr. CHALK. Yes, I would suggest it's a dual strategy. E85 stations, I think we installed about 300 or 400 last year. So they're going in at a rate roughly one a day right now.

But those tend to be in the Midwest, concentrated in that area. So I would also suggest that we have a blend strategy. So right now, gasoline if you buy it an area that requires reformulated gasoline is E10. We're doing testing right now for higher blends of ethanol in gasoline.

Flex fuel vehicles would be able to take E20, 30, 50, so we can have a higher blend strategy as well as promoting fuel flex vehicles with straight E85. So I would propose that we aggressively pursue both of those.

Senator SALAZAR. So what's the timeline for you? How fast can we get this done?

Mr. CHALK. I think we have to go and evaluate that. But I think policies like the RFS and the CAFE that are in EISA are model policies to push and push them in the direction with all vehicles being fuel flexible.

Senator SALAZAR. Ok. Dr. Greene, and if there are any other comments.

Mr. GREENE. Yes, I'd just like to comment on the question of the availability of infrastructure, the E85 stations. The studies that we've done and that National Renewable Energy Laboratory have done looking at the experience of the State of Minnesota indicate that for most of the history of E85 sales in that State there's been a surplus of FFEs and a shortage of stations. So increasing the amount of stations has been the most important factor in Minnesota in increasing purchases of E85, more important than the run up in price of gasoline.

So and they are now approaching about 10 percent of the stations, so with E85 availability. So I think that getting the E85 availability is——

Senator SALAZAR. Is Minnesota an aberration to what we see happening everywhere else around the country in terms of E85 stations coming on board?

Mr. GREENE. Yes, in a sense that they've made a greater effort.

Senator SALAZAR. Is that coming from the State level as a policy initiative of the State or why is Minnesota up to the point where they have 10 percent of their stations converted?

Mr. GREENE. I think the commitment of the state is clearly important, but I couldn't say exactly how to attribute the credit let's say, for making that happen. But it's clear that the binding constraint, if you will, on E85 sales has been the availability of fuel at stations.

Mr. CHALK. There are about 1,500 stations compared to 165,000 gas stations nationwide. So you can see that that is a critical issue.

Senator SALAZAR. Thank you very much. Mr. Chairman, I know that my distinguished member/partner in this committee, Senator Menendez is waiting.

The CHAIRMAN [presiding]. So is Senator Sessions. I think Senator Sessions was here first. So we'll go to him and then Senator Menendez.

Senator SESSIONS. I know Senator Salazar and I share a concern of national security is also a big part of our need to reduce our dependence on oil. I just note today's Washington Times that Mr. Chavez from Venezuela arrived in Moscow yesterday on a billion dollar shopping list of armaments including submarines and helicopters. It's his third visit, in 2006 when he purchased $3 billion in armaments.

He doesn't know what to do with the money and a lot of these other countries don't either. It's really our money that has been extracted from us as a result of high prices. So we have a lot of reasons to take firm action.

I think that leads us in a position for bipartisan agreement, Mr. Chairman. I think there is a real possibility that if we make up our mind to do some things that work, we can do so. I certainly am willing to work with my colleagues and see what we can do.

I would just ask on ethanol, Mr. Chalk, we're using all the ethanol we produce now. President Bush, one time made the point that we don't want to transport ethanol all the way across the country at great expense of energy to have a national mandate. It should be regional.

If we produce more ethanol, presume that we'll use that. So it's not so much the E85 engines, is it? Aren't we able to use all the ethanol we can produce? Shouldn't we figure out how to produce more without impacting adversely our food prices and other things?

Mr. CHALK. That is a challenge, Senator. About 25 percent of the corn crop is devoted to ethanol. We have targets that are growing in the renewable fuel standard so we need to keep pushing our technology, accelerating it, which is based on all non-food sources and hit those targets at a faster pace with non-food based ethanol.

It's an important piece of the economy in terms of rural development and jobs.

Senator SESSIONS. I would just say that I think we are going to have a breakthrough in cellulosic. I talked to some people, an individual today, that's absolutely convinced. We're at the point, I think we'll make that breakthrough and hopefully if we have an inability to disseminate it, we need to take government action.

Dr. Greene, diesel automobiles run approximately 35 percent further on diesel fuel than a similar gasoline automobile. Diesel powered automobiles get more miles per gallon than hybrids. In addition to being fuel efficient they emit fewer CO_2 emissions than similar hybrids or gasoline engines certainly.

According to the EPA if 33 percent of American drivers switched to diesel, oil consumption in United States would be reduced by approximately 1.5 million barrels a day which would cut imports by as much as 10 percent. Based on these facts will a sustained policy to promote diesel fuel, conserve gasoline and help us be more efficient? Can Congress do more?

I know a diesel engine is more expensive, 1,500, 2,000 dollars maybe more in some cases. What are your thoughts on—I would just note that Europe has 50 percent of its automobiles are diesel. We have only 3 percent in the United States.

Mr. GREENE. Yes, I think I agree with almost everything you said about diesels. I think hybrids, full hybrids, vehicle system will emit fewer greenhouse gas emissions than a diesel. Diesel fuel has more carbon in it and so that works against the diesel in terms of greenhouse gas emissions.

But it is 30 percent or 35 percent more fuel efficient. Diesels have been held back in this country by the difficulty in meeting our NO_X emissions standards. But technical solutions are now available and we will see clean diesels in the marketplace soon.

I think we already have them, some, using this blue tech system. But I think we'll see more and more diesels. I think they in many ways are complementary to hybrid technology in the sense that hybrid technology is most effective in urban applications where there's a lot of stop and go driving. Diesels are more effective in long distance operations and for vehicles that have to do towing and carry loads.

So I think we'll see a lot of complementarity. I agree that it's appropriate for the Federal Government to encourage the market for hybrids as well as encourage the market for diesels.

Senator SESSIONS. Mr. Chalk, is there some reason that we have only 3 percent of our automobiles are diesel where Europe has 50 over us? Isn't it true that compared to a conventional gasoline engine it emits less CO_2 and less NO_X?

Mr. CHALK. Yes, sir. It's more efficient so it emits less CO_2.

Senator SESSIONS. Finally what can we do here? What should we be doing?

Mr. CHALK. I think because of the RFS and the ethanol focus that we have on cellulosic, we're focused on that because we know we can do that in a short timeframe. But it's really geared toward light duty.

I think what you're bringing up is diesel and we need to do more for heavy duty. Worldwide heavy duty is usually a much bigger energy user than light duty. This country is different, but we need to come up with a substitute for petroleum based diesel and do more for bio-based diesel.

Senator SESSIONS. What are we doing anymore? Are the things that you would recommend Congress do to, briefly, to increase diesel utilization in the——

Mr. CHALK. I think we need to evaluate whether we should have a bigger program targeted toward biodiesel. It's not sustainable to do biodiesel off soy beans, to look at other potential avenues to create a diesel-like fuel. That way alleve our or reduce our oil use in the heavy duty sector, which is growing, and again worldwide heavy duty is a much bigger issue than light duty.

I think that's the piece that we're not addressing through CAFÉ and our current focus on renewable fuel standard. There is some diesel in the renewable fuel standard, but it's not as big of an impact as the gasoline portion or the ethanol portion for light duty.

The CHAIRMAN. Senator Menendez.

Senator MENENDEZ. Thank you, Mr. Chairman. Thank you all for your testimony. Mr. Winkelman less than a year ago we finally pushed the Administration to raise CAFE standards for the first time in decades.

In April the National Highway Transportation Safety Administration proposed rules to implement this change. Now unbelievably to me, at least, they based their analysis on the assumption that gas will cost $2.26 in the year 2016. So we long for 2016.

When you model the costs and benefits for raising mileage standards using such a low price point that means that the proposed increase in CAFE standards is going to be much lower than it should be, we're facing the largest oil crisis since the 1970s. Yet it seems to me that the Bush Administration is still pursuing undermining the very essence of what the Congress tried to do. So I don't think it's realistic to see cheap gas in the year 2016, let alone in 2030.

So that's why several of us in the Senate have joined in sending a letter to the Energy Information Administration asking them to re-evaluate their forecasts which were the basis of the Administration's proposal. So first, let me ask the obvious. Do you think that gas will cost $2.26 in 2016?

Mr. WINKELMAN. Boy, if I knew the answer to that I'd be a pretty wealthy man. We did a straw poll of a meeting we held with a number of State secretaries of transportation, Federal experts and others. I think there's an expectation that at least the amount of driving will continue to grow but perhaps not at the same rate.

That's really where really I focus. I think that it assumes some higher fuel prices in the future, maybe not as high as current level.

Senator MENENDEZ. I think it's pretty safe to say thatwe're facing a little over four dollars a gallon today, that that is unlikely to happen in 2016, even with reduced demand. So if gas continues to cost four dollars a gallon what do you think is the maximum feasible fuel economy for our fleet?

Mr. WINKELMAN. In what timeframe?

Senator MENENDEZ. In the timeframe? Let's put the same timeframe, 2016.

Mr. WINKELMAN. In 2016. With fleet turnover it takes a while in the current, the new standard is 35 miles per gallon for new vehicles in 2020. But if you sort of look in that timeframe——

Senator MENENDEZ.—2020.

Mr. WINKELMAN. What's cost effective, I would expect that 40, 45 miles per gallon could be cost effective in that timeframe with these fuel prices. But I would defer to Dr. Greene, who's really the expert on that and has those numbers in his head.

Senator MENENDEZ. Do you want to extrapolate the numbers in your head, Dr. Greene?

[Laughter.]

Mr. GREENE. Could I address first the oil part of your question? I think that we had a run up similar to this in oil prices from 1979 to 1985 and prices did collapse in 1986 as a consequence of both increased supply and reduced demand worldwide. This is a question that has to do with market power of the oil producers and their ability to hold oil prices high.

If we see the oil producers having to cut back on production to keep price high then we can expect their prices will come down

sometime in the future. If they don't have to cut back production to keep prices high, then there's no telling when the prices will come down. This I think has to do with the question of whether oil supply outside of OPEC is peaking now or not.

It's a critically important question. Our supply peaked in 1970 and then in effect enabled OPEC to control the world oil market shortly thereafter. So I think this is a really important question for us to understand.

Senator MENENDEZ. But notwithstanding all of that and the other thing that we didn't have in 1970 was the incredible economies of China and India creating a huge demand. So it's fundamentally different in terms of the present timeframe, not withstanding the other elements. I mean do you see gas prices being $2.26 in the year 2016?

Mr. GREENE. I think Mr. Winkelman was correct in being hesitant in predicting that. I think it could be if oil is not peaking now. There are lots of factors that could—and how fast the world responds. How much it responds and how effectively it responds to high prices. It's possible.

On the other hand it's also possible that prices stay this high. We can make gasoline out of coal at this kind of price and make a lot of money doing it. We could make certainly, gasoline out of oil sands and heavy oil. We can make bio fuels at these prices and make money.

So there are many ways to increase supply at $130 a barrel of oil. But then there's also the question of climate change and whether things like making gasoline out of coal which doubles the carbon dioxide emissions is going to be acceptable.

Senator MENENDEZ. Dr. Greene, let me just say, 2016 is a little less than 8 years from now. To believe, especially as we are having major debates on the floor of trying to get the energy tax credits moved forward so that we can incentivize and commercialize and bring to the marketplace many of the various essences of what we're talking about as different renewable fuel sources. That's going to take its time to get.

I don't believe that anyone can sit here and tell me that in 2016 that gas prices are going to be $2.26 a gallon. I think it is purposely underestimating the amount of where gas prices will be so that in fact we have a different effort on CAFE standards than where we need to be. Because I believe, obviously, if we would look at how much oil we would save in 2016 if we set a standard based on what gasoline really costs that that would be far more significant.

I think that's what at work here. I understand nobody wants to say what the gas price is in 2016. But I've got to be honest with you. I don't believe it's going to be $2.26.

Mr. WINKELMAN. Senator, I mean, perhaps I'll stick my neck out a little bit. But you know, I think I agree it's hard to imagine that price in 2016. What's harder to imagine is that our current policies assume that price whether it's fuel economy policies or transportation infrastructure.

The way our society is built from the freight system to suburbs to transportation infrastructure assumes low cost gasoline. That's going to take some time to transition. So it's very risky whether

you look at oil security or climate change to make decisions assuming low cost gasoline.

Senator MENENDEZ. That was the essence of what I was trying to put forth. Thank you, Mr. Chairman.

Mr. GREENE. Could I just comment quickly that I'm not arguing that we shouldn't make our plans based on gasoline at $3 or $4 a gallon. There are other reasons for doing that. The price of oil may very well may be high enough to make gasoline stay at $3 or $4 a gallon over this time period.

So I'm not arguing with you on that point. All I'm saying is that it's uncertain. When we're making policies to try and drive down the price of oil we should make sure that our policies are robust in case we succeed.

Senator MENENDEZ. I would suggest and then I'll stop, Mr. Chairman. I would suggest that in fact having a more realistic gas price as the essence of the denominator by what you're going to make this determination would actually pursue the very essence of that policy.

Mr. GREENE. Yes, I certainly agree with that. So I didn't want to——

Senator MENENDEZ. Let me just say for the record I hope that gas prices are $2.26 in 2016, Mr. Chairman. I don't want anybody to confuse my insistence on that I don't think it will be that. But I certainly aspire for it to happen.

Mr. LAITNER. Senator, if I might add just one other comment. A colleague, Charlie Maxwell, who is an oil forecaster, who coined the phrase, "Energy Crisis" in 1973, 2 years ago was suggesting that our production capacity might be looking at $150 to $200 barrel oil price 2 years ago by 2020. That would seem to militate in favor of the current level of prices well above $2.16 or $2.26.

I would invite maybe a serious look at some of the work these folks are suggesting that we don't often hear about.

The CHAIRMAN. Thank you very much. I know Senator Lincoln arrived here. But she's still getting oriented.

Let me ask a couple of questions. Dr. Greene, you have in your testimony, you say the time has come to update the test procedures for determining compliance with CAFE standards. Beginning with model year 2008, the EPA fundamentally changed the fuel economy estimates it provides to the public on window stickers in the fuel economy guide.

But then you say these changes incorporate several important real world factors that effect in use fuel economy, but are not included in the city and highway test cycles used to determine compliance with CAFE standards. Could you indicate to me what—is this a problem in the legislation we passed or is this a problem with the way it's being implemented or what is the problem here? What needs to be done to get these fuel economy standards updated throughout the system?

Mr. GREENE. I think there is a legislative requirement here because the legislation specifies the test cycles that will be used and those are the city and highway cycles. Manufacturers, understandably, don't want the test cycles changed because they're accustomed to the test cycles they have. They're used to dealing with them.

But these test cycles don't include high speed driving. They don't include aggressive acceleration. They don't include use of air conditioning.

The EPA has recognized those problems in revising the way it reports fuel economy information to the public. But the EPA does not have the authority nor does the NTSA have the authority to change the test cycles that are used for compliance with the CAFE standards. That would require some legislation, I believe.

The CHAIRMAN. Ok. So we should change the law related to the test cycles that are used to determine CAFE, compliance with CAFE standards?

Mr. GREENE. That's my opinion, yes.

The CHAIRMAN. Ok. Let me go ahead and defer to Senator Lincoln for her questions at this point.

Senator LINCOLN. Thank you, Mr. Chairman. I appreciate all of your efforts. You've been wonderful in helping us try to find the sweet spot of where we need to be.

I come today really with the concern from someone who represents a rural state. We've got a lot of hard working families out there, low income, hard working families. Disproportionately in our rural state you have low income hard working families that live in rural areas which mean they have to travel greater distances.

Oftentimes because of the work that they do they have to use larger vehicles whether it's trucks or vans or farm equipment or what have you. So they're seeing a disproportionate share of the burden that exists right now with these prices. We've had studies that came out that were performed in May, I guess that indicated that on average working families in Arkansas are spending 8 percent of their income on fuel.

In some of the smaller, more rural counties they're spending up to 11 or 12 percent of their income just on fuel, which has taken a huge hit, particularly with the fact that they're seeing an increased cost of food and other things. So I guess I'm wanting to ask if any of you all have an idea or seeing a greater emphasis on how we deal with these issues in regard to low income families. Again, a state like mine we rank 48th in the country in terms of income which means, you know the majority of these people are hard working.

But they're low, you know, less than 25, let's see, 50 percent of the people I represent have adjusted gross incomes of less than 50 or less than 25,000 a year. Eighty percent of them have an adjusted gross income of less than 50,000. So if they're spending 8 to 12 percent of their income on fuel it's taking a real toll.

I know that in some of the testimonies that we've read here. I know Dr., is it Buiel?

Mr. BUIEL. Buiel.

Senator LINCOLN. Buiel. You cited a study that found consumers are willing to pay more for technologies that achieve better fuel economy. But the amount they're willing to pay in States like mine is sometimes unaffordable. I mean, 1,500 to 2,000 for conventional hybrid electric vehicles, up to 4,500 for plug in electric hybrid.

I guess it just concerns me that technology that's going to allow customers to achieve greater gas mileage and limit the effects on the environment are more and more expensive. One, you know, the

solutions of how we get more and more of these technologies out quicker. I know we've talked in the extenders package and others on how we can create a greater opportunity to get more of this technology out there.

It's not just the research that produces the technology. It's also the delivery mechanism. I know in visiting with a lot of our oil marketers and others, the delivery of renewable fuels.

They've upgraded their systems in many ways. They use—they've met our standards in terms of their tanks and their piping and other things like that. So we don't have the corrosion and the leaking underground storage tanks and others. But unfortunately many of those systems are put together with glues that if we increase the amount of alcohols in our fuels, it's going to erode the newer technology that they just spent all this money implementing.

So maybe you can elaborate, any of you all can elaborate on whether it's what we do in focusing on what low income, working families are faced with. How we're going to make better accessible the new vehicle technologies and the new fuels to these low income folks, getting it out there, the infrastructure that's needed out there. I don't know that you all have talked much about infrastructure today or not. I don't know. I've been watching a little bit.

Also if you could elaborate on the potential for vehicle retrofitting programs for existing passenger vehicles, whether it's electric. I saw a program, night before last on how we're seeing a lot of people that are retrofitting their existing vehicles with batteries. It seems kind of cumbersome and impractical. I don't know.

When I was growing up all the farmers in our community retrofitted their trucks to burn propane which is about half the price right now what they're seeing with diesel. You know, any options there you can enlighten us with?

Mr. WINKELMAN. Senator, if we look at this from a national security perspective, we don't think much of spending several billion dollars on national security.

Senator LINCOLN. That's right.

Mr. WINKELMAN. We think of it as a national security priority to give people that couple thousand dollars it takes to afford that more efficient pick up truck or vehicle. That could go a long way. If you look at it in terms of the amount of money it costs to save a gallon of gasoline or the perspective I come from often, the amount it costs to reduce a ton of CO_2, ethanol is about $100 to $200 a ton.

Fuel economy is negative cost per ton which means it pays back. Which means, there's net societal savings in compact development, transit. Smart growth policies also are negative cost per ton meaning there are net benefits for society.

So if we look at that and if we think of the amount of money we spend on our priorities. We make this a priority. I think there could be immediate assistance.

But there also needs to be that demand for saying we need more efficient vehicles. We are an entirely new regime with these fuel prices.

Senator LINCOLN. That's right.

Mr. WINKELMAN. Changes that we thought people would never make. People will never drive less. People will never, you know,

care about fuel economy more than they care about their cup holder or their floor mat when they buy new car. That's changing.

So all of the assumptions have changed and so the policies need to change to rise to that occasion.

Senator LINCOLN. There's no doubt that we've got to change the culture. You're exactly right. At $4, $4.50 a gallon, it's changing the culture of the way people think. Yes, sir?

Mr. LAITNER. Senator, I think you're asking an important question. One that really speaks to the need for a broad range of steps or policies that provide a signal to the marketplace. We've identified in our testimony the ability, short term, to save oil in a hurry if we have a fairly disciplined or rigorous approach at all levels. Whether it's providing immediate transit subsidy or investment to mass transit because they're overwhelmed by what the system cannot accommodate right now to what we call the crusher credit to a resolution directing and reaffirming the importance of the efficiency resource.

All of these together offer a systematic signal to the market that I think will start putting a downward pressure on price. If we achieve say a ten dollar barrel reduction fairly quickly, whether your individual voters and people can respond initially. If everybody participates at some level, a $10 drop in the barrel of oil might save us on the order of $75 to $80 billion a year right there.

So a systematic set of structured approaches. Whether a person can go out and buy a more expensive automobile, a more efficient automobile will benefit by others taking actions where they can. Whether it's the Federal Government doing its job to ferret out inefficiencies at all levels. Whether it's promoting things like video conferencing or telecommuting, those save gasoline in the short run that help stabilize and bring downward pressure on prices.

So it's the set of things together that I think at the near point in time that will help your voters in the immediate sense.

Senator LINCOLN. They definitely need some immediate assistance. That's for sure. Dr. Greene?

Mr. GREENE. Yes, Senator, if I could comment that just in my remarks I listed a number of immediate actions that can be taken by people to improve their fuel economy and save fuel.

Senator LINCOLN. Checking tires and that kind of stuff.

Mr. GREENE. Many of these things they'll already know. But some of them might not be so obvious such as trying to combine short trips. People don't realize how inefficient cold start driving is relative to driving with the engine warmed up.

But there's a whole list of these things. Each one of them is a small thing. But put together they can save perhaps 10 percent or so in fuel right now.

They can be found on fueleconomy.gov. They can be found on the EPA Smart Way site. I think we could do more to make these available and known to people than we're doing now actually. Even though a lot of these things are already known and a lot of your constituents are already practicing them.

I also want to note that I talked about incentives for efficient vehicles. One of the things I noted was that there should be greater incentives for a large pick up truck or SUV if it's used as a diesel engine or if it's converted to a hybrid system than for a small pas-

senger car. Why, because it's saving more fuel than the passenger car.

I think these kinds of things we could incorporate into our incentive systems for hybrid and diesel vehicles.

Senator LINCOLN. That's an important issue that I think a lot of times when we bring up, up here, you know it just is seen as a regional battle or regional differences. But I'm a farmer's daughter. I grew up on a farm.

There's no way that my dad could carry the equipment he needed around in the back of a compact car. You know, so it is a part of doing business. Just saying we're going to do without those vehicles.

Yet we also have an automobile parts plant in my former congressional district, the Eastern part of my State, and they've gone dormant. I mean they've, you know, temporarily shut down because the demand for pick up trucks and others has gone away. To me it makes sense that we would be looking at ways that we could still produce some of those vehicles with retrofitting or other things.

It doesn't seem like when you see these programs on television. We hear you all talk that making these shifts are that difficult. But we don't seem to be doing it. Thank you.

The CHAIRMAN. Let me call on Senator Salazar for any additional questions and then Senator Sessions.

Senator SALAZAR. Mr. Chairman, I think this hearing has been an excellent hearing. One suggestion that I would make to you and to members of the committee that the staff memorandum that was prepared by Deborah Estes and Kellie Donnelly, I think lists much of what we have been working on in a bipartisan way to get to oil savings. I think it would be a good thing for us to require a report back from the Department of Energy on where they are on each of the specific sections.

The CHAIRMAN. We did. We requested that. Mr. Chalk has agreed that they'll have that for us when we return in early September.

Senator SALAZAR. I think that will be very useful for us as we make our decisions about how we move forward. Because I think in many of these ideas we have taken through the crucible of legislation. The question is where we are relative to the status of their implementation. Then what additional things we might be able to do.

But anyway, let me ask just this very simple question. I would ask each of you to take 30 seconds or so to respond to it. Much of what we talk about in the 2005 and 2007 act is going to take some time to implement. You know, 2012, 2015. We're talking about longer term agenda.

We have a problem right now, today. We all know what it is. People are very concerned.

So if you were to form a congressional point of view and our authority require action in the United States of America immediately to reduce our consumption of gas. What would the top two things be that you would recommend to the Energy and Natural Resources Committee in the United States Senate? What would the top two things? Each of you gets two items.

So how about I start with Mr. Chalk since you've been working with us for a long time on this issue. Start with you and we'll just go right across. Take about 30 seconds.

Mr. Chalk.

Mr. CHALK. Overall, as I mentioned in my testimony, I think all of these technologies are near or are ready to enter the market. We need mechanisms that will allow faster adoption. The example I gave is that it took 7 years for hybrid vehicles to reach 2 percent.

We've really got to address that issue.

Senator SALAZAR. So expedite the adoption of many of the policies that we have. What would be your second one, like in short term? What do we do immediately?

Mr. CHALK. I think we have to take a harder look. I think we can do more for our vehicle efficiency. I think we can do more with an array of alternative fuels.

Senator SALAZAR. Ok.

Dr. Greene. Two things.

Mr. GREENE. Yes, I think the first thing is I would re-double our efforts, maybe quadruple our efforts to make sure that people understand how their driving behavior effects fuel efficiency. How maintenance and such effects fuel efficiency. I would do more to make sure that the information we're giving them is accurate and as individualized as possible.

The second thing I think is a comprehensive system of incentives for purchasing more fuel efficient vehicles as well as disincentives for purchasing less fuel efficient vehicles. I mentioned this. Sometimes it's called fee-bates.

But I think that is a complementary system to fuel economy standards.

Senator SALAZAR. So consumer education and incentives for fuel efficient vehicles. Those would be your two top priorities.

Mr. Laitner.

Mr. LAITNER. Yes, thank you. I would suggest in my policies numbers one and four. The first one is, again, a directing the Federal Government to within its current budget authority and with its ability as it stands now to determine all efficiency measures that can be implemented in ways that are not now being advanced.

I've talked with colleagues. I'm a former EPA employee. I've talked to a number of my former DOE and EPA colleagues who are just chomping at the bit waiting to be able to bring forth their own creativity and their own willingness to develop much more in the way of efficiency opportunities they can support.

Senator SALAZAR. So additional fuel efficiency measures that we have not yet put into place in policy. That's one.

Mr. LAITNER. Exactly. There are a wealth of things that can be done.

Senator SALAZAR. What else?

Mr. LAITNER. The second one would be my recommendation for a national telecommuting and teleconferencing initiative. We can do considerably more than we're seeing now in the way of allowing teleworking, telecommuting, videoconferencing in huge numbers that in effect allows ICT, Information Communication Technology, be an OPEC equivalent resource.

Senator SALAZAR. Ok.

Mr. Winkelman.

Mr. WINKELMAN. Yes, Senator. The first would be, as I proposed, emergency funding for transit. As you know the regional transit district in Denver and transit agencies around the county are either cutting service, raising fairs or faced with cutting service due to high fuel prices.

So they need immediate assistance due to state and local budget problems. They don't have the money for operations.

Senator SALAZAR. Ok. Emergency funding for transit. Second?

Mr. WINKELMAN. Second is providing resources for states and metropolitan planning organizations to develop plans to reduce fuel use and greenhouse gas emissions. In your region, Dr. Ka, at the Denver Regional Council of Governments has developed those sorts of plans so that states and local governments going forward can figure out what works in their community. Whether it's inter-motor rail in a rural area or transit in a—so a requirement in resources.

Senator SALAZAR. Thank you, Mr. Winkelman.

Dr. Buiel.

Mr. BUIEL. I think with 250 million vehicles on the road and an average lifespan of 9 years we really need to focus on anything. So the two that I'll pick are two that I think aren't being pursued right now. The first is the retrofitting of vehicles, complete with subsidies and tax incentives and also possibly financing options. So those vehicles, you know, pay back in 3 years. So with a 5-year, you know, 5-year financing that could actually directly affect people in rural states immediately.

The second thing I would look at is infrastructure. We need to start developing the distributed charging infrastructure that I talked about in my written testimony. We also need to talk about the electrified highway. Because it enables electric vehicle technologies at a much lower cost to the consumer and also provides them with much the same driving experience that they're used to.

If somebody wants to drive, you know, from New York to Florida and not have to stop every couple hours and wait 3 hours for the vehicle to charge. You're going to need to be able to charge the vehicle while it's driving on a major interstate. So those are the two that I choose.

Senator SALAZAR. Thank you, Dr. Buiel. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Sessions.

Senator SESSIONS. Mr. Chairman, I do think this is a national crisis. It's time for us to take firm action. I look forward to working in a bipartisan way to doing that.

I just have been handed a note that indicates that the majority leader, Senator Reid has propounded a unanimous consent request that we just have one vote on the Republican package and one vote on the speculation package. Which I think is a saying that we don't have time to do that before we break. I believe that's a mistake.

I think we just should stay here. Do some things. Make this work. It's also sort of an admission that nothing is going to get done of a serious nature.

This is an excellent hearing. Thank you very much for doing it. I've learned some things I did not know. I'm more confident that we can make progress than I was before this committee started.

I would just ask you, Mr. Boone Pickens is running ads saying that we ought to utilize natural gas for vehicles and replace that electric generation that we're using natural gas for today with wind. I understand that Secretary Bodman, Mr. Chalk, once said that utilizing natural gas for electric power is like taking a bath in fine scotch. I don't know if that's accurate. But it does seem to me that we are—we could use natural gas more for automobile and vehicular use, buses and fleets.

Dr. Greene, I'll just start with you. You've studied all this. How do you feel about Mr. Pickens' suggestion that we use natural gas more for vehicles?

Mr. GREENE. There are certain applications which vehicles running directly on compressed natural gas are a good choice. I don't think we will want to convert our entire vehicle fleet to compressed natural gas. It's also possible to convert natural gas to distillate fuel or gasoline. We may want to consider some of that as well.

I don't see this as the sweeping solution to everything. I also think we should do more with wind power than we're doing. But I don't see this as the silver bullet solution. I think it's, again, one of the things we can do.

Senator SESSIONS. With the pressure we tend to be placing on the electric generation industry to produce more electricity with less emissions seems to be driving them toward natural gas more and more. Mr. Chalk, is that a good direction? Should we utilize nuclear or other sources of energy more that natural gas?

Mr. CHALK. We believe we need all the options-nuclear and clean coal options as well as other renewables. Wind power is a great example. That was the second fastest growing power plant in terms of new capacity added last year, second only to natural gas.

So it's been very successful. The United States is the world leader in annual installations of wind power. We believe that it's feasible that 20 percent of our electricity can come from wind power.

So wind power can replace some of the natural gas. Again, I would agree we don't want to put all of our transportation on natural gas. But we ought to look at areas that we may not be focused on like heavy duty that we talked about before. See what domestic natural gas can do for that to replace petroleum-based diesel, much of which is imported.

So I think that's very worthy of evaluation.

Senator SESSIONS. Let me ask you directly. Isn't it a fact that if we are to significantly impact our global warming gas emissions and reduce them substantially and do so in a way that does not drive up cost dramatically in the next 20 or 30 years we need to expand nuclear power?

Mr. CHALK. We need to expand nuclear power as well as clean coal and renewable options. Yes.

Senator SESSIONS. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Lincoln.

Senator LINCOLN. Thank you, Mr. Chairman. Just a couple of final comments. First I'd like to agree with Dr. Buiel. Retro fitting vehicles and distributing infrastructure, I think are critical ways that we could have an immediate impact. I hope that we'll make some headway on that.

The last thing I'd just like to comment and see, I guess, Mr. Chalk, I guess your comments here. The famous saying, "If you build it, they will come." We have built a government fleet that's pretty amazing in terms of its consumption. Whether it's the military, whether it's the postal service, whether it's the park service, you know any of the Federal agencies out there.

We continue to look at ways to decrease our demand for energy. I'm really interested in what you think the Federal fleet's role is going to be in that equation. In section 701 of the Energy Policy Act of 2005 we encouraged Federal agencies to purchase flex fuel vehicles.

Those vehicles operate on alternative fuels exclusively unless a waiver is obtained. The Energy Independence Security Act of 2007 also included new Federal vehicle fleet requirements that new vehicles be low greenhouse gas emitting vehicles. That the fleet reduce by 20 percent its petroleum consumption and increase by 10 percent its alternative fuel.

I mean, if we move those numbers up. If these alternative fuels and the production of alternative fuel vehicles and others know they have a given marketplace. The Federal Government is going to participate in that marketplace. I mean, does that not jump start some of what we need to see jump started?

I mean, are we still just buying these vehicles and parking them on the lower 40 and not using them. I mean, what is the Federal Government doing? What can it do to really be a more useful participant in this shift from an old, you know, an old energy economy to a new energy economy?

Mr. CHALK. Yes, Senator, you're right. The Federal Government is the biggest single energy user in the world. So we can potentially be in a role of being an early adopter. Secretary Bodman has made a commitment to change all of our vehicles at DOE, 15,000 of them, over to alternative fuel vehicles. To have alternative fuel vehicle sites at all of our national laboratories and major operations.

Senator LINCOLN. By when?

Mr. CHALK. By the end of 2010, I believe. This is an internal initiative. We feel we have to be the lead because we have the Federal Energy Management Program where we're trying to coach other agencies on how to do this as well. So our timeframe is very aggressive.

Senator LINCOLN. How well are they taking that coaching? I mean what about the park service? What about the military? What about the postal service? What about?

Mr. CHALK. Very well. A lot of this is being done by private financing. So we have energy savings performance contracting where I believe a couple of years ago we more than doubled. I think a couple of years ago it was $500 million in contracting for private companies to come in, pay the first cost and they get paid back through the energy savings.

That contracting has more than doubled over the last year, year and a half. So we now have over a billion dollars of energy service performance contracting done. So it doesn't take necessarily appropriations up front to make these changes and this transformation.

If there's actual energy savings, there's utility savings. That's how you can pay back the private sector. They can do the first cost which is often a problem for many Federal agencies.

Senator LINCOLN. So if the producers of alternative energy know that there's going to be X amount of gallons or megawatts or whatever consumed and automobile manufacturers know that there's going to be X number of these purchased just by the Federal Government. I mean, is that considered a considerable help in jump starting this industry?

Mr. CHALK. That is critical help. It's just like the RFS. It goes out to 2022. It's predictable policy. You know that market is going to be there.

So maintaining those policies in place is critical for private investment.

Senator LINCOLN. So you're saying DOE will be completely retrofitted or whatever by 2010?

Mr. CHALK. That's our goal, our internal initiative, by the end of 2010.

Senator LINCOLN. Are there any other agencies that have that internal initiative?

Mr. CHALK. I don't believe so. But I can check back for the record to see if anyone else is doing that as aggressively.

Senator LINCOLN. Great. We'd appreciate that. Thank you, Mr. Chairman. Great hearing.

Mr. WINKELMAN. Senator, may I comment on that?

Senator LINCOLN. Sure, I guess. Mr. Chairman?

Mr. WINKELMAN. On the fleet issue I think the term alternative fuel has been thrown around for decades without necessarily saying—without assessing the merits in terms of costs, energy or greenhouse gases. So for example, I think on the heavy duty side whether it's pick up trucks, government fleets or long range trucks, hybrid diesels offer a lot of advantages. But DOE could look into that and compare how would converting the fleet to hybrid diesels compare to other alternative fuels out there.

Because again, I think petroleum is an efficient fuel. We have that existing infrastructure. It's about using it well and see how those compare out. When you have in niche fleets of vehicles you run into the problem of the fueling infrastructure. So that's an important issue to study.

Mr. CHALK. I guess to respond to that, what we would like to do is not necessarily compare the technologies, but set the attributes that we want in terms of impact on the environment, efficiency and be technology neutral. If any technology can achieve those attributes, that would be fine.

The CHAIRMAN. Alright. Thank you all very much. I think it's been useful testimony. That will conclude the hearing.

[Whereupon, at 11:37 a.m. the hearing was adjourned.]

APPENDIX

RESPONSES TO ADDITIONAL QUESTIONS

DEPARTMENT OF ENERGY,
Washington, DC, November 12, 2008.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: On September 23, 2008, Howard Gruenspecht, Acting Administrator, Energy Information Administration, testified regarding why diesel fuel prices have been so high, and what can be done to address the situation.

Enclosed are the answers to six questions submitted by you, Senators Domenici and Lincoln to complete the hearing record.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Lillian Owen, at (202) 586-2031.

Sincerely,

LISA E. EPIFANI,
Assistant Secretary, Congressional and Intergovernmental Affairs.

[Enclosures.]

QUESTIONS FROM SENATOR BINGAMAN

Question 1. Is the recent surge in demand for diesel for electric generation a short term or long term factor? What are alternative options for low-cost, off-grid electrification? Might this be a good application for biodiesel?

Answer. Diesel generators are often used in response to emergency situations, when commercial electricity supplies are disrupted. As a result, spikes in diesel generation are most often short-term phenomena, rather than long-term solutions to providing electricity. For instance, disruptions to coal transportation systems in China last year during particularly harsh winter weather resulted in an increase in diesel generation. Many South American countries rely on diesel generators when drought conditions lower hydroelectric supplies.

In the long-run, electricity providers seek more cost effective solutions to supplying reliable electricity generation rather than continuing to rely on diesel generators. In China, for instance, there are plans to expand nuclear, coal-fired, and renewable generation. Unfortunately, these solutions can take a long time to implement because of the need to expand the infrastructure to support the expansion of electricity, including transmission lines, railroads and highways.

It is likely that diesel generators will continue to be used as short-term solutions to emergency situations, because they can be used to quickly respond to power disruptions, so that the use of biodiesel to fuel generators would be possible. In remote areas with no access to national grids and where it is difficult and expensive to expand transmission lines, renewable energy sources—for example, micro hydroelectric facilities, wind, solar, and other off-grid renewable technologies—could also provide relatively cost-effective power solutions.

Question 2. NPRA has stated that U.S. diesel exports are not clean enough to be consumed inside the U.S. Are there export data to back up this claim? Might there be other domestic applications for some of that diesel? For instance, could it be used for heating oil?

Answer. This year's distillate exports include both low sulfur and ultra-low sulfur distillate that could be used in the U.S. EIA uses export data provided by the U.S. Bureau of the Census that does not break out ultra-low sulfur diesel from low sulfur, but we confirmed that some of the product being exported included ultra-low sulfur diesel. The high sulfur distillate market (fuel with greater than 500 ppm sulfur) includes home heating oil and fuel for electric generating use. Historically, high sulfur distillate represented more than half of total distillate exports. For example,

in 2000 high sulfur exports represented 77 percent of the exported volumes, while in 2007 they represented 51 percent. This year, high sulfur exports dropped to 13 percent of total distillate exports, both because most U.S. distillate production (88 percent) is now low or ultra-low sulfur distillate and because some of the major export areas needing distillate, such as Europe, now use low sulfur or ultra-low sulfur product.

QUESTIONS FROM SENATOR DOMENICI

Question 1. On the second page of your written testimony, I noticed that in the past year, the cost to refine a gallon of gasoline has declined, while the cost to refine a gallon of diesel has increased. According to your chart, the cost to refine gasoline dropped by 31 cents, but the cost to refine diesel increased by 18 cents. Can you explain why these numbers went in opposite directions?

Answer. Figure 1 of the testimony, presents a simplified view of price components to help explain variations in retail prices. The component labeled as the "wholesale crack" in the figure is not refining costs to produce the products shown. Rather, the wholesale crack, defined as the wholesale price of gasoline or diesel minus the cost of crude oil to the refinery is a measure of the revenue available to cover remaining refining costs and refining profits associated with gasoline or diesel production after crude costs are removed. This revenue varies in the short run as a result of basic supply and demand forces in the markets for crude and products.

Figure 2 in the testimony displays time series of wholesale diesel and gasoline crack spreads. Looking at gasoline, it shows that during 2007 the wholesale price were often much larger than crude oil costs, implying high profitability. This year. however, gasoline markets have had ample supply relative to demand as a result of declining demand, increased use of ethanol (and thus less need for crude-based gasoline), and increased availability of gasoline imports. This ample supply reduced the wholesale gasoline crack spread, and at times, pushed gasoline prices below the price of crude oil resulting in financial losses for gasoline production. At the same time, the distillate market, which includes diesel, and is distinct from gasoline market, tightened considerably worldwide as a result of growing demand, particularly in the electricity generating sector. That pulled diesel prices up relative to crude oil cost, improving refining profits from diesel production.

Since 2002, EIA has broken out the price of diesel into its component costs—refining, distribution and marketing, taxes, and crude oil. In May 2002, refining accounted for 5.1 percent of the price of diesel, but since then, and even as the price of oil has increased substantially, refining costs have consistently been much higher.

Question 2. I understand that one factor in this increase may be the decision to mandate the use of Ultra-Low Sulfur Diesel fuel. EPA initially estimated this would cost no more than 5 cents per gallon. The transition to ULSD is important to improving air quality, but has it come at a greater cost than we expected? Can you describe any other factors that may account for the substantial increase in refining as a percentage of the price of diesel??

Answer. The data represented in Figure 1 reflects the sum of refining costs and profits which varies. The "wholesale diesel crack" component will vary both as a percent of total price and as an absolute value with the changing distillate and gasoline supply-demand balances in the short run. We do not have any direct measure of how the cost of producing diesel fuel has increased over time. Both heating oil and diesel fuel tend to move together with the general distillate market tightness or looseness, so looking at the difference between diesel prices and heating oil prices over time will help to isolate the impact diesel specification changes such as the move to ultra low sulfur diesel (ULSD) may have had. Prior to 2005 and the hurricane impacts on prices, wholesale diesel prices on the Gulf Coast would normally average one to three cents above No. 2 fuel oil (heating oil). After the ULSD program began in 2006, diesel has been averaging 13-14 cents per gallon over No. 2 fuel oil. This implies that the ULSD program may be contributing about 10 cents per gallon to the price of diesel fuel.

This is relatively consistent with the studies done on ULSD production costs. For simplicity, EPA, EIA, NPC and others use single numbers to discuss cost estimates. But these costs are difficult to compare. EIA's 2001 report, Transition to Ultra-Low Sulfur Diesel explains the difficulties in comparing costs in greater detail. For example, costs will increase with the relative amount of ULSD produced compared to 500 ppm sulfur or high sulfur distillate, with the amount of "cracked stock" (distillate material that comes from fluid catalytic cracking or coking units) that needs to be desulfurized, with the scale of the units used to desulfurize the distillate, and whether new or revamped units could be used. The clean diesel program has grown,

with more of the distillate market being required to use low or ultra-low sulfur fuel, which alone would be expected to result in increasing costs.

Question 3. The military has undertaken a program aimed at providing a greater share of their energy needs with domestically produced fuel—much of this work has focused on taking greater advantage of our domestic coal reserves.

What impact do you believe coal-to-liquids fuels could have on the price of diesel?

Answer. Given the amount of coal-to-liquids distillate fuels EIA is projecting in the AE02008 reference case in 2030, approximately 137,000 barrels per day, and the amount of diesel fuel use projected in 2030, 4.871 million barrels per day, the price effect would be likely be limited. In general, adding new supply to an extremely tight market for all distillate range material should lower prices to some extent for all midrange distillate products, but EIA has not performed quantitative analysis on this topic.

QUESTION FROM SENATOR LINCOLN

The rise in both gas prices and diesel prices are especially worrisome in a rural state like Arkansas, where families have to drive long miles to work and school and the grocery store. The combination of lower incomes, high fuel prices, and the heavy dependence on pickup trucks and vans and use of farm equipment is putting an even tighter squeeze on family budgets. Rural residents do not have mass transit or grocery stores nearby and few alternative fuel options available to ease the pain at the pump.

Question 1. I do believe that most of our energy policy option will focus on the long-term, as we are not going to solve this problem overnight. However, in you expert opinions, what do you believe are Congress' most immediate options for providing relief to hard-working families and businesses which rely mostly on diesel fuel?

Answer. The Administration has pursued, as you note, significant strategies to increase both the efficiency of motor vehicles and the supply of alternative fuels for transportation use. These measures have included increased fuel economy standards for both cars and light trucks, mandates for greater use of non-petroleum fuels and incentives for their production, biofuels research, incentives for advanced hybrid vehicles, and increased access to domestic resources for increased domestic energy production. Despite these long-term initiatives, world oil prices rose to very high levels, peaking in the summer of 2008. The resulting gasoline prices of about $4.00 per gallon, and diesel prices even higher prompted widespread public concern.

Fuel prices have fallen sharply since their mid-2008 peak under the combined influence of consumer adjustments and weaker economic growth both in the United States and worldwide. These lower fuel prices provide significant relief to hard-working families and businesses. Additionally, the Department of Energy remains focused on long-term energy security through alternative fuels, increased domestic energy production and gains in energy efficiency.

RESPONSES OF DAVID L. GREENE TO QUESTIONS FROM SENATOR BINGAMAN

Question 1. Why do you believe that scrapping is not a cost-effective option for transitioning the US fleet towards higher fuel economy? Please provide data to support your answer.

Answer. Accelerated scrapping, in general, can be economically justified when there is a very large difference between the external costs caused by older versus newer vehicles. Accelerated scrappage implies retirement of a vehicle before its economically useful life is over. The cost of accelerated scrappage is therefore the destruction of this residual value. Assuming that used car markets are efficient, only when the present value of the external costs produced by the vehicle exceed its remaining value in use can accelerated scrapping be cost-effective.

Four factors mitigate against a large reduction in greenhouse gases from accelerated scrappage of used vehicles. First, older vehicles have a limited life expectancy. For example, based on estimated survival rates for passenger cars, a 25-year-old (1982 model year) vehicle has a remaining life expectancy of 4 years (Davis, Diegel and Boundy, 2008, table 8.10). Second, older vehicles tend to be driven less. Whereas a brand new vehicle will on average be driven 14,500 to 15,500 miles in its first year, a 25-year-old vehicle will on average be driven only about 5,000 to 6,000 miles (Davis, Diegel and Boundy, 2008, table 8.10). Third, the average fuel economy of new vehicles has changed very little in 25 years. When new, the per-mile greenhouse gas emissions of an average 25-year-old vehicle were quite close to those of an average new vehicle. According to the EPA (2007, table 1), a new 2007 passenger car got 23.4 miles per gallon (adjusted EPA combined estimate) whereas a 1982 ve-

hicle got 22.2 miles per gallon. This implies a difference of only 0.0023 gallons per mile or 0.02 kg CO_2 per mile. Fourth, fuel economy, unlike pollutant emissions, deteriorates very little with vehicle age. One recent study estimated an average deterioration rate of 0.0723 miles per gallon per year (Greene et al., 2006). Thus, a 25-year-old vehicle would lose 1.8 miles per gallon from its EPA estimate when new.

Using data from the sources cited above, I estimate that an average functioning 25 year-old vehicle, scrapped in 2007 would have burned 140 gallons more gasoline and emitted fewer than 1.5 metric tons more CO_2 over its 4 remaining years of life than it would have if it had the same fuel economy as a new 2007 model year vehicle of the same type. At $1 per gallon, the energy security externality would be worth $140. At $50/t CO_2, the greenhouse gas emission reduction would be worth less than $75. Unless the vehicle's market value were less than $215, scrapping it on the basis of the petroleum and greenhouse gas reduction benefits would not be cost-effective.

Of course, the younger the used vehicle, the longer its remaining expected lifetime. For example, according to the same data sources, a 16-year-old vehicle would have 6-7 years of remaining life expectancy. Its annual usage would be more like 8,000 miles per year, but its fuel economy would be closer to that of the 2007 model year vehicle.

Accelerated scrappage can sometimes be cost-effective for avoiding pollutant emissions, since rates of pollutant emissions for very old vehicles can be an order of magnitude or more greater than new vehicles (OTA, 1992). Thus, there may be additional factors that could make accelerated scrappage cost-effective. However, it is highly unlikely that it could be cost-effective on the basis of petroleum savings or CO_2 emissions alone.

Question 2. Can you submit for the record any analysis you've done of the effects on consumer behavior of feebates or how such a system might be structured? In particular, are you aware of any analysis of how such a system may be structured to enhance the effects of the newly reformed CAFE system?

Answer. Yes, I can submit a study I completed that has been accepted for future publication in the peer-reviewed journal, Transportation Research D—Environment (Greene, 2008). This paper analyzes the functioning of a feebate system based on the same attribute used in the reformed CAFE system, vehicle footprint. The paper also discusses how such a system could be phased in over time, beginning as a net subsidy for new vehicle purchases and gradually achieving revenue neutrality as manufacturers have the opportunity to redesign all their makes and models.

Question 3. All of you have given us a number of proposals to help reduce demand for oil over the short term. Can you submit for the record any analysis you have that would give us a basis for comparing the oil savings and potential costs, both to the taxpayer and the consumer, of each?

Answer. I can submit an analysis conducted for the International Energy Agency (Duleep et al., 2004) that quantifies the oil savings potential of various options for improving the in-use fuel economy of light-duty vehicles. I can also point to rigorous analyses by the National Research Council on the overall cost and benefits of lower speed limits (TRB, 1984) and improved tire inflation (TRB, 2006). To the best of my knowledge, most of the proposals have not been subjected to rigorous cost-benefit analysis.

Responses of David L. Greene to Questions From Senator Domenici

Question 1. In your opinion, what is the single most important action we can take in the near-term to decrease our Nation's demand for gasoline?

In my opinion, the single most important action that can be taken in the near term to decrease out Nation's demand for gasoline is to allow markets to respond to the high price of petroleum. After that, I think that a comprehensive system of financial incentives for inventing and adopting energy-efficient vehicle technologies could have the greatest impact in the near and longer term. In my opinion, markets undervalue fuel economy due to a combination of uncertainty about future fuel savings and consumer loss aversion. Feebates are an example of an incentive system that solves this problem by shifting the incidence of the incentive to increase fuel economy to the purchase price of the vehicle. In the very near term (1-2 years), feebates would serve mainly to encourage consumers to make more fuel-efficient choices. In the longer run, feebates encourage manufacturers to devote R&D resources to inventing fuel economy technology and to implementing that technology for increasing fuel economy rather than horsepower.

Question 2. Please describe the deficiencies in providing accurate fuel economy information. Is there a plan to improve the usefulness of miles per gallon estimates?

Answer. There is no single fuel economy number for any car that is accurate for all driving conditions and driving styles. Fuel economy is not a measure, like vehicle mass or length, that can be assigned a single number and will be accurate under all conditions. It varies with speed, driving style, traffic conditions, and trip length, among other factors. The EPA's fuel economy numbers may therefore be good estimators of the average fuel economy of a large number of motorists but poor predictors of the fuel economy of any specific individual (Greene et al., 2006). The key to developing more useful fuel economy estimates lies not in making them higher or lower but rather in doing a better job of predicting what any individual can expect to achieve. This will require collecting data on real-world fuel economy that includes relevant factors such as traffic conditions, driving style, temperature, and trip length. Data voluntarily supplied to the DOE/EPA website www.fueleconomy.gov may be adequate to accomplish this analysis, but it is not a statistically random sample and additional data collection may be required. It will require developing simple ways of eliciting information on these factors from anyone desiring a more accurate fuel economy estimate, and then a method for calculating that estimate and providing it to the customer. The internet provides the technology to do this. How many consumers would be interested enough to use it remains to be seen.

There is also a need for more up-to-date information on how driving behavior and maintenance affect fuel economy. Little rigorous measurement has been done in this area over the past twenty years. Much of the information on how speed affects fuel economy, for example, is more than 10 years old. While the basic physics don't change, cars' aerodynamics, horsepower and gear ratios do. Here too there is a need for more specific information since not all vehicles have the same speed v. fuel economy profiles. Studies of how such things as dirty air filters or air conditioner use affect fuel economy are also out of date. Earlier this year, the Department of Energy began a small effort to fill some of these gaps in knowledge and to validate the fuel economy tips it is providing to the public. At the current level of effort, it will be at least 5 years or more before all of the driving and maintenance information is reasonably up to date.

Question 3. From the list of options referenced in your testimony that could improve energy efficiency, which are the least expensive to initiate? What options require the most investment?

Answer. The least expensive options are those that consist of educating or providing improved information to the public. Driving and maintenance tips, individualized fuel economy estimates, and voluntary fuel economy labels for used vehicles would likely cost on the order of 10 million dollars for public service advertising, research and analysis, and implementation (this is not a precise estimate but is given to indicate my opinion of the order of magnitude). On the other hand, many motorists are well aware of these opportunities to increase fuel economy. The Department of Energy and Environmental Protection Agency have made these tips available via the internet for almost a decade, and the information has been featured by the news media on the internet, in magazines, on television and even on gas pumps. Still, many consumers are not aware of all of their options for improving fuel economy, and what little research has been done on the subject indicates that the knowledge needs to be refreshed and reinforced to be effective over time.

Intermediate in cost, in my opinion, would be changing the test procedures used to certify CAFE numbers for light-duty vehicles. There would be some cost to the government to validate the test procedures and to do a rulemaking. However, the work that EPA has already done to develop new numbers for reporting to consumers will be very useful in developing new CAFE test procedures. Most of the cost would be borne by vehicle manufacturers and suppliers who would have to develop a new understanding of how their vehicles would perform over the new test cycles and how different technological options would change that performance. If the new cycles involved more than two tests, certification costs would also increase somewhat. These costs could be reduced by making use of the test cycles EPA has already developed for air conditioner use, aggressive driving and cold start, since manufacturers are already familiar with these test cycles.

Question 4. What financial incentives do you believe are necessary to encourage manufacturers to invent and adopt advanced fuel economy technologies?

Answer. In my opinion, the real-world operation of the market for fuel economy prevents it from reaching the optimal level of fuel economy, as defined by the maximum expected net value of fuel savings to consumers. The reason is that future fuel savings can be very uncertain and consumers are known to be loss averse. I believe this phenomenon is often expressed in terms of short payback periods on the order of two to four years. One way to get around this market deficiency is to shift the incidence of future fuel costs to the purchase price of the vehicle. Feebates are a potentially efficient way to do this (Greene, et al., 2005). Feebates on the order

of $1,000 to $2,000 per gallon per 100 miles (a 25 MPG vehicle consumes 4 gallons per 100 miles) would provide a powerful incentive for manufacturers to invent and adopt fuel efficient technologies. Feebates generally offer a rebate to vehicles with fuel consumption rates below a reference gallons-per-mile point and levy fees on those with high rates of fuel consumption. However, there is enormous flexibility in how reference points can be defined. For example, in the paper on feebates* cited above in response to Senator Bingaman's question #2, I show how feebates reference points can be made a function of a vehicle's footprint (track width times wheelbase).

Economic analysis indicates that rebates applying to only a few types of vehicles or gas-guzzler taxes without comparable rebates are far less efficient incentives for fuel economy improvement via advanced technology than a complete feebate system applying to all vehicles.

RESPONSES OF EDWARD R. BUIEL TO QUESTIONS FROM SENATOR BINGAMAN

Question 1. How soon would you be able to scale up production of advanced lead acid batteries to integrate into new plug-in hybrid electric vehicles?

Answer. We have several technologies currently in production and we are working with 2 of the largest lead acid battery manufacturers in the United States. All of the technologies that we are working on are designed to be produced on conventional lead acid battery production lines with conventional equipment.

Question 2. What would be a ballpark estimate of the cost for such a vehicle?

Answer. The current retail level pricing cost to retrofit a single vehicle is $10,000. We expect that this could be reduced 25-40% with larger scale production.

Question 3a. Considering a possible vehicle retrofit program using advanced lead acid batteries, how would such a program be structured?

Answer. There are already several companies producing retrofit kits for vehicles for many different vehicle models. Some of the companies are working to educate performance racing shops and other repair centers all over the United States to complete the retrofits. This would allow small, medium, and large businesses to build the retrofit kits that could be installed all over the country.

Question 3b. How do you plan to address the numerous safety, pricing, and reliability concerns?

Answer. Lead acid batteries currently have very few safety concerns when compared to other battery advanced technologies. The main concern is an inadvertent shorting of the terminals of the higher voltage battery and much of this can be addressed with the design of suitable connectors and electronic isolation of the batteries when the vehicle is not in operation.

Retrofitted vehicles would also benefit from a federal testing and certification program similar to what has been established for buses. The Pennsylvania Transportation Institute at Penn State currently oversees the operation of the Federal Transit Administrations new model bus testing program. We envision that any company planning to build and sell more than 50 electric vehicle retrofit kits would be required to provide a vehicle for safety and reliability testing to a similar testing facility that would oversee the certification of the vehicle and systems.

Lead acid batteries are currently the cheapest battery technology available for EVs. A 20 kWh battery which is required for to provide a driving range of 50-60 miles would cost about $2000 for lead acid batteries. Possibly as high as $3000 for advanced lead acid batteries. Lithium ion and NiMH batteries will cost approximately $1000/kWh when all of the necessary engineering and module costs are included which results in a cost of at least $20,000.

Conventional deep cycle lead acid batteries for golf carts and other motive applications typically achieve 600 deep cycles. These batteries come with a 3-year prorated warrantee. If the average consumer where to drive 50-60 miles at least 200 times per year, this would result in about a 3 year life. As explained in our testimony, this would be more than adequate to provide a significant return on investment to the consumer (initial cost was $10,000). Replacing the battery for $2000 would pay for itself in just a few months and again last for another 3 years. Lead acid batteries are also recycled and the lead, plastic, and acid can be reused to make new lead acid batteries. Currently 99% of the lead acid batteries used in this country are recycled making lead acid batteries an excellent sustainable technology for vehicle use. The opposite is true for other advanced battery technologies.

Question 4. All of you have given us a number of proposals to help reduce demand for oil over the short term. Can you submit for the record any analysis you have

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* Document has been retained in committee files.

that would give us a basis for comparing the oil savings and potential costs, both to the taxpayer and the consumer, of each?

Answer. Axion's testimony includes detailed information on fuel savings, CO_2 reductions, and NO_2 reductions for every 500,000 vehicles that are retrofitted in the United States.

RESPONSES OF EDWARD R. BUIEL TO QUESTIONS FROM SENATOR DOMENICI

Question 1. In your opinion, what is the single most important action we can take in the near-term to decrease our Nation's demand for gasoline? Also, what is the most inexpensive action we can take immediately to reduce demand?

Answer. In our opinion, the cost, performance, and current and forecast production rates of hybrid, plug-in hybrid, and electric vehicles will take decades to reach double digit reductions in this Nation's demand for gasoline. With over 250 million vehicles registered in the United States, any solution must not only focus on new technologies for the future but also on cost effective retrofitted programs for existing vehicles. These programs are currently being developed mainly by small and medium sized businesses that would greatly benefit from federal funding.

Question 2. Please describe the pros and cons of the different types of rechargeable batteries (ie. lead-acid battery, nickel metal hydride, lithium-ion battery, etc) available today in the market. In addition, please describe the different uses for these batteries.

Answer. We have developed the following table to include a variety of the important performance attributes of batteries.

Battery Type	Energy Density	Weight	Power Density Low Temp.	Safety	Ability to be Recycled into New Batteries	Cost	Availability and Cost of Raw Materials In the US	Manufacturing Base in the US
PbC Battery	0	−	+	+	++	+	++	++
Lithium Ion	++	+	− −	−	− −	−	− −	− −
NiMH	+	0	− −	+	− −	−	−	−

− − Very Poor
− Poor
0 Neutral
+ Good
++ Excellent

Question 3. How can Axion's work with lead-carbon based battery technology help with intermittent wind and solar technologies? Also, how can it assist with grid buffering and hybrid electric vehicle markets?

Answer. Axion is currently working to install a grid based energy storage system in conjunction with NYSERDA (New York State Energy and Resource Development Authority). We believe that as the United States becomes more dependent on wind and solar power generation that energy storage is going to play a very crucial in order to maintain the stability of the grid. Axion is currently also working on demonstrated both the economic and performance benefits of advanced lead acid batteries in these applications.

Question 4. What is the current market for retrofitting traditional gasoline vehicles to battery electric vehicles?

Answer. The current market is very small with only a few companies supplying retrofit kits for about 30-50 vehicles however this could easily grow to a large number using existing repair garages, performance shops, and service centers. Better engineered and more cost effective retrofit kits need to be developed and training programs need to be established for installers. Axion is currently working with several other companies, national labs, universities, and other organizations to promote these ideas.

RESPONSES OF JOHN A. "SKIP" LAITNER TO QUESTIONS FROM SENATOR BINGAMAN

Introduction

This memorandum responds to a set of questions posed by Senators Jeff Bingaman and Pete Domenici following testimony I was asked to provide to the Senate Energy Committee on July 23, 2008. In preparing a full set of responses, I will first recap my testimony to provide an appropriate context for understanding the thrust of both the questions and their answers. I will then respond, in subsequent fashion, first to questions asked by Senator Bingaman and then to ones asked by Senator Domenici. Following this full set of responses, I will offer a set of conclusions based on this full memorandum.

The Energy Efficiency Potential

In my original testimony I noted the huge potential for cost-effective investments in energy efficiency throughout all sectors of the U.S. economy: on the order of 46 billion barrels of oil equivalent between now and 2030. This is about 2.5 times bigger than what some have suggested might be available from off-shore drilling. And it is about 5.5 times greater than what we will get from the improved CAFE standards enacted by Congress last December. That magnitude of further gains in energy efficiency could generate a significant downward pressure on oil prices, and increase both the resilience and robustness of the American and the international economies—if we choose to encourage those more productive energy efficiency investments.

Policy solutions will play a pivotal role in strengthening the continued development, dissemination, and widespread adoption of energy-efficient industrial and transportation technologies and systems. In that regard, ACEEE continues to recommend the set of 10 near-term policy actions described in my original testimony. If they are undertaken with sufficient robustness, this set of policy proposals can "save oil in a hurry" (IEA 2005). By this I mean we can take actions which lead to significant savings within a year to 18 months compared to normal reference case forecasts or projections. These near-term policy initiatives would likely generate an immediate downward pressure on oil prices to the benefit of consumers and businesses. Many of these suggestions lay the groundwork for a shift in the larger transportation policy, an opportunity that is afforded the next Congress by next year's reauthorization of the transportation bill. They also have significant implications for other uses of energy as well.

While we did not provide a proposal-by-proposal estimate of specific cost-effectiveness in the original testimony, I noted that the full set of efficiency gains—again, as much as 46 billion barrels of oil equivalent potentially available through 2030, if we should choose to make the appropriate investments—would be fully cost-effective. By cost-effective, I mean that such investments would more than pay for themselves over their effective lifetimes. Building on this initial background, I now turn to answer the specific questions posed following the hearing on July 23, 2008.

Question 1. Can you please expand on the opportunities that you mentioned for IT and communication technology to reduce energy demand?

Answer. As noted in my oral comments during the hearing, it is much easier and much less energy intensive to move information and electrons around than it is to

transport people and goods. This is true even when we consider the relatively small amount energy needed to power ICT and broadband technologies compared to the significant energy use they avoid. Hence, any time we can transmit data and information in a way that substitutes for the physical movement or processing of commodities, goods, and services, there is a very strong likelihood for net gains in energy efficiency. The example I demonstrated in the hearing underscored this potential. Yes, there was a very small amount of electricity used to order and download two different books onto my AmazonKindle, and then to electronically bill my account. Yet, there was no paper wasted in their production of the books, no shopping trips made to purchase them, and no unnecessary packaging or petroleum resources to have them delivered. And I saved about five dollars over the normal purchase price of each book. Despite my own cost and energy savings, each author now has the benefit of an additional royalty from my purchase of their book. That is but one small example of how information and communication technologies can help reduce the cost and use of energy.

The most immediate impact for reducing energy, and especially for reducing the use of petroleum fuels, is likely to be through telecommuting, teleworking, and videoconferencing. As one example, an analysis for the Consumer Electronics Association indicates that the regular telecommuting of some 4 million workers is now saving an estimated 840 million gallons of gasoline equivalent. More critically, the report suggests that the potential could grow to 25 or even 50 million workers (TIAX LLC 2007). If the relationships were to hold and we encouraged, say, 40 million workers, to move to a telecommuting work style, that 840 million gallons of savings would grow to about 8.4 billion gallons. How big is that? Translating that level of energy productivity gains would suggest a daily savings of more than 500,000 barrels of oil—or about 2.5 percent of current consumption. This is about what we now import from either Ecuador or Columbia.

Still there is more to be saved if we begin to think about other forms of working, especially if we better understand the opportunities associated with Videoconferencing. Cisco Systems "TelePresence" and HP's Halo Video Exchange Network both offer smart new opportunities for a greater than an order of magnitude of energy savings compared to normal business travel. So if we use one gallon of gasoline equivalent in the form of electricity, then we might avoid anywhere from 10-60 gallons of gasoline equivalent. To get an idea of this opportunity, I encourage the committee to look at an online video of this emerging technology (see, for example, http://www.youtube.com/watch?v=akzNWS5dygQ&feature=related), and then to also download a paper by Howard Lichtman (2006) describing the potential larger productivity benefits of this possibility (see, http://www.hp.com/halo/pdf/Telepresence—Paper.pdf). More broadly, anything that can be done with system optimization and the use of real-time data is likely to save energy through the enhanced and accelerated use of information and communication technologies, (see, Laitner and Ehrhardt-Martinez 2008, and the Climate Group 2008). For a broader overview of the potential economic impacts of the digital economy, see Atkinson and McKay (2007).

Question 2. Can you provide any studies or data on the potential of information and communication technologies to produce efficiencies and reduce demand?

Answer. This was generally answered in the response to the question above. Let me expand on one critical area that has not really been highlighted to this point: Investment in traffic signal operations and intelligent transportation systems.

Intelligent Transportation Systems (ITS) is the coordination and continued study of traffic flow patterns within a given city or metropolitan area. Traffic signals are linked via a centralized monitoring center to optimize the flow of traffic. In some more advance systems, the monitoring center receives data regarding pavement temperature to improve traffic flow and safety in icy conditions. ITS also has the benefit of reducing the number and severity of crashes. More immediately, however, improved traffic signal operations can reduce idling and waiting times, and they can save energy.

Our system of an estimated 272,000 traffic lights nationwide has recently been given a performance grade of D (NTOC 2007). If we improved that to a grade level A, we would see significant benefits in quality of life and protection of the environment. Among these benefits would be a reduction in traffic delays and travel time on the order of a 25 percent from current levels. For typical households, improved traffic signal timing might save them more than 100 hours per year in avoided car time. More to the point of this Committee, however, we might also see reductions in fuel consumption of up to 10 percent (NTOC 2007). For example, if a typical household now uses one tank of gasoline per week, it might save five full tanks or about 75 gallons of gasoline per year. Nationwide this amounts to a savings of almost 17 billion gallons of motor fuels per year. And, of course, there would be con-

comitant reductions in harmful emissions of carbon monoxide, nitrogen oxides, and volatile organic compounds. And there would also be a huge reduction in carbon dioxide emissions.

Based on 2001 data, we spend about $110.5 billion in federal, state and local funds for highway transportation. When we approach the issue of traffic signal operations from a performance-based decision-making perspective, the National Transportation Operations Commission (NTOC) views improved traffic signal operations as a strategy that has a 40:1 benefit-cost ratio. Spending less than 1 percent of the current funds allocated to highway transportation amount on traffic signal operations would create a customer benefit benefits of as much as $45 billion per year. This is a benefit equivalent to 41 percent of the total expenditure on highway transportation. This corresponds to a price of less than $3 per U.S. household with resulting benefits of $100 per household (NTOC 2007). This level of savings, about 1 million barrels per day, is about what we import from the country of Qatar on an annual basis.

Question 3. What sectors would have the greatest benefits from implementing communication and information technologies?

Answer. As suggested in the response to the first question above, the service, education, and government sectors would more immediately benefit as they incorporate new practices and methods of telecommuting, teleworking, and videoconferencing. But there are also substantial potential savings in improved logistics associated with the movement of both freight and passengers. And as noted in the answer to the question above, there are large potential savings associated with intelligent transportation systems and improved traffic signal operations (NTOC 2007). Over the next several years, the electricity sector would clearly benefit through smart grid applications (see, for example, Kannberg, L. D. and D. P. Chassin, et al. 2003, and IBM Corporation 2007, and with a further discussion in Laitner and Ehrhardt-Martinez 2008). Finally, there are developments in the world of materials science, which together with new production processes and information technologies, are now beginning to benefit the manufacturing sectors in some surprising ways. Although perhaps more longer-term, an emerging technology known as selective laser sintering, together with other digital or instant manufacturing technologies (also known as on-demand manufacturing), can generate significant productivity gains (Amato 2003). There have been some preliminary descriptions and technology characterizations of this opportunity, but there have been little analysis in the way of understanding the short-term productivity benefits. We hope to have a more detailed look at such technologies by early next year and, of course, we would be happy to share our findings with the Committee and its staff.

Question 4. What is the role of the federal government in encouraging the use of these technologies?

Answer. The most critical role of the federal government is two-fold. First, the expertise within government can help assess the full efficiency opportunity and develop the metrics to gauge overall economic performance of an agency or a private business. Second, a critical role of government is to encourage the development, use, and deployment of these productive new technologies as we've described them elsewhere.

Question 5. All of you have given us a number of proposals to help reduce demand for oil over the short term. Can you submit for the record any analysis you have that would give us a basis for comparing the oil savings and potential costs, both to the taxpayer and the consumer, of each?

Answer. The measures to accomplish this are all shown generally to be cost-effective; that is, the efficiency improvements typically cost less than what they save in petroleum or other energy costs. In the case of measures designed to "save oil in a hurry" (referencing a 2005 workshop convened by the International Energy Agency) the IEA identified a series of immediate measures that might save up to 1.7 million barrels of oil per day in developed countries at a cost ranging from $1 to $100 per barrel, if such measures were implemented by all members of the IEA. (2005). Drawing from the available literature, we can generally say with confidence that there are significant savings available literature with a benefit cost-ratio on the order of 2 to 1. That is, policies which stimulate productive investments in more energy-efficient technologies over perhaps a 15-20 year period will return $2 in energy savings for every dollar of investment and policy and program expenditure (Laitner and McKinney 2008).

At the same time, we might ask the question of what we've lost by failing to act more quickly on this issue. For example, in 2001 my ACEEE colleague Steven Nadel and Howard Geller published a report which identified nine specific policy recommendations that could have "a substantial impact on the demand for energy in the United States while also providing positive economic returns to American con-

sumers and businesses (Nadel and Geller 2001). For the most part we've failed to act on those policies. In a separate analysis I've estimated that since 2001 our Nation has foregone an energy bill savings approaching $260 billion through July 2008 as a result of not acting on those efficiency investment opportunities.

At the same time, we can offer examples of how the policies we suggested in my original testimony might look from a cost standpoint. For example, one of the programs we suggested is the development of a "Crusher Credit." We envision this as a federal incentive for the voluntary retirement of fuel-inefficient vehicles (primarily older cars and light trucks) registered to private and commercial owners in the United States. It is intended to operate for four years, 2009-2012, and to incent the early retirement of one million vehicles per year. As this policy initiative stimulates the investment in new vehicles, we anticipate fuel savings to reach the equivalent of about 80,000 barrels per day (ACEEE 2008). If we assume the average credit is about $5,000 per vehicle to save perhaps 250 gallons of gasoline per year, this implies an effective $2.18 per gallon of gasoline equivalent (assuming a vehicle life of about 15 years at a 7 percent discount rate). In some respects this may be one of the more expensive policies that we recommend, but it is still shown to be highly cost-effective. And to the extent that the collective set of policies which we describe might reduce the price of oil by as little as $10 per barrel, our Nation may save on the order of about $70 billion per year. As we might imagine, a greater drop in the price of oil would have an even larger positive economic impact.

RESPONSES OF JOHN A. "SKIP" LAITNER TO QUESTIONS FROM SENATOR DOMENICI

Question 1. In your opinion, what is the single most important action we can take in the near-term to decrease our Nation's demand for gasoline? Also, what is the most inexpensive action we can take immediately to reduce demand?

Answer. This is a difficult question to answer since there is no single magic bullet. Rather, it is a coherent, integrated, and consistent set of energy efficiency policies that are most likely to generate the optimal set of benefit for the American economy. But within that context, I would have to say that the largest immediate source of savings might be provided by a serious commitment to telecommuting and videoconferencing initiatives, together with investments in logistics management and traffic flow operations.

Question 2. Your policy recommendations include enacting a Joint Resolution directing agencies to immediately implement all forms of energy efficiency. Both the 2005 Energy Policy Act and last year's energy bill directed the agencies to undertake numerous energy efficiency activities, including the obligation to decrease the energy consumption in federal buildings annually by certain percentages to reach a 30% reduction by the year 2015. What additional cost-effective policies can the agencies undertake?

Answer. Both the 2005 Energy Policy Act and last year's energy bill are important initiatives. And a 30 percent reduction in federal building energy use is an ambitious but a cost-effective and important target. But there is more that can be done. I might highlight several steps in this regard. First, I might recommend that, just as federal employees were expected to do with respect of security measures following 9/11, we might expand the education of all federal workers and ask them to take an online course, followed by an online test to earn a required certification. In this way we can promote a greater energy awareness not only within our federal operations, but in our personal lives and in learning how to encourage a greater collaboration with members of the public, as well as the many partners and stakeholders who now participate in a wide variety of governmental programs. In effect, this kind of effort would be directed to stimulate greater internal and external energy productivity gains at all levels of the American economy. Second, we might ask each agency to re-examine the overall energy intensity per employee and see what might be done to enlarge that savings opportunity through public outreach (as perhaps an offset against their own energy use within the federal government), through expanded use of teleworking, telecommuting, and videoconferencing initiatives, and through improved fleet management and the management of an agency's total transportation needs. Finally, they might also examine ways to positively impact energy efficiency savings through the purchase and leasing of all durable and non-durable goods required by the federal government.

Question 3. You note in your written testimony that the U.S. has expanded its economic output by more than three-fold since 1970. However, the demand for energy and power resources grew by only 50% during the same period.

Answer. Yes, and that reduced demand for energy was made possible by on-going investments in more energy-efficient technologies and operations since 1970. In effect, there has been an invisible investment boom in energy efficiency at all levels

of the economy. Our suggestion is that we make routine efficiency gains much more visible, that learn from them, and we then identify the larger benefits that are still available should we choose to pursue them (Ehrhardt-Martinez and Laitner 2008). By one estimate there are still on the order of 46 billion barrels of energy efficiency which are recoverable for a net positive benefit to the economy. Again, this is about 2.5 times greater than some have suggested might be recoverable through off-shore drilling. More to the point, these efficiency gains can be made available more quickly than most new supply-side opportunities—if we choose to make those more productive investments.

Question 4. In your opinion, was energy demand reduced mainly because of market forces or government-led energy efficiency requirements?

Answer. The market is hugely dynamic system that produces and delivers an amazing variety of goods and services. Most recently, a process of capital deepening—especially in the period 1996 though about 2001, generated a significant level of efficiency improvements within the U.S. But there have been a wide variety of programs and incentives which have also enabled those productivity gains. It is hard to disentangle the mix of market forces and government policies. The critical point is that if we are to full optimize our more efficient use of all resources, it will take a smart blend of both market forces and energy policies to achieve the net benefits we describe throughout my original testimony.

Question 5. What successful energy efficiency practices has the business community undertaken?

Answer. In a Google search there were 850,000 references to the terms energy efficiency and best practices. This suggests a significant array of best practices are now identified and implemented. These range from the use of teleworking, telecommuting and videoconferencing practices to the use of better metrics to assess overall performance. Even with the encouragement of "best practices," however, the economy continues to underperform with respect to the potential gains from large-scale energy productivity investments and best practices. The reasons might be two-fold. The first is the lack of access to immediate expertise in a timely fashion. A typical business has a difficult enough time to focus on its core expertise. For the most part maintaining a working and timely knowledge of efficiency improvements may be beyond the capabilities of routine production operations. This is especially true for small to medium sized firms. In fact, there is a critical need for improved engineering, logistical, and financial skills that are specifically directed toward energy productivity gains in ways that can immediately benefit an industrial site or operation. The second reason is that efficiency gains remain largely invisible. Efficiency is the cost-effective investment in the energy we don't use to produce goods and services. In many ways efficiency is not an obvious opportunity. Hence, there is a critical need to make these investments and best practices more obvious and more real in order for the private sector to take real advantage of such opportunities.

Final Comments and Conclusions

Given the full array of evidence, we can conclude that energy efficiency can provide a significantly large contribution toward stabilizing energy prices and strengthening the robustness of the U.S. economy. The good news is that there are large opportunities to promote an even greater level of productive investments in energy-efficient technologies—should we choose to develop and pursue those options. Policy solutions will play a pivotal role in strengthening the continued development, dissemination, and widespread adoption of energy-efficient transportation technologies and systems. The more quickly we act, the more quickly the benefits can accrue to both consumers and businesses.

RESPONSE OF STEVE WINKELMAN TO QUESTION FROM SENATOR BINGAMAN

Question 1. All of you have given us a number of proposals to help reduce demand for oil over the short term. Can you submit for the record any analysis you have that would give us a basis for comparing the oil savings and potential costs, both to the taxpayer and the consumer, of each?

Answer. My primary recommendation is to provide emergency federal assistance to help public transit agencies accommodate record numbers of riders, restore service cuts, expand service, maintain or reduce fares, and cope with rising fuel bills.

According to the American Public Transportation Association (APTA), public transit currently saves the equivalent of four billion gallons of gasoline each year.[1] At the current $3.75 a gallon, saving four billion gallons of gasoline would save consumers some $15 billion per year. A 10 percent increase in ridership could save consumers another $1.5 billion per year. Another APTA study concludes that an individual can save more than $8,000 per year by using public transportation instead of driving.[2] These savings come from a combination of direct substitution of private car for transit vehicles, as well as shorter trips, and more walk trips accommodated by transit-oriented development patterns.

According to a recent APTA survey, diesel costs are about $1.00 higher in 2008 than in 2007, costing transit agencies about $750 million per year.[3] As transit agencies face growing and record ridership and high fuel prices, emergency federal assistance to transit agencies could help accommodate new riders and keep fares down, which also helps attract new passengers.

The exact relationship between emergency federal support for transit funding and oil demand reduction will depend upon location-specific factors such as current ridership capacity and local land use patterns.

An example I included in my written testimony illustrates the longer-term costs and savings from comprehensive smart growth policies such as compact and pedestrian-friendly development patterns, transit expansion and transit oriented development. The Sacramento Area Council of Governments (SACOG) has calculated that implementation of the regional 2050 Blueprint smart growth land use plan would result in avoided infrastructure costs of more than $9 billion through 2050 and increased transit operating costs of $120 million per year. CCAP calculated consumer fuel cost savings of $650 million per year (at $2.50 per gallon) resulting in a net societal economic benefit. With a long backlog of deferred infrastructure maintenance, and strained public resources, polices that can reduce the need to build new infrastructure are most welcome indeed.

A recent book, Street Smart, edited by Reconnecting America and sponsored by APTA and the Community Streetcar Coalition, estimates the private investment in local development leveraged by public investments in transit. According to the book, initial public investment of $73 million in the Portland Streetcar, helped attract $2.3 billion in private investments within two blocks of the line, a more than 30-fold return on investment.[4] Similarly a $20 million public investment in the Little Rock Streetcar helped leverage $200 million in private investment, and a $60 million public investment in the Tampa TECO Streetcar helped leverage $1 billion in private investment. The authors are careful to note that streetcar investments don't directly cause private developers to make invest in development, but streetcars can make the market much more attractive for developers, especially when coupled with policy changes (e.g., zoning, permitting) that support transit-oriented development.

RESPONSES OF STEVE WINKELMAN TO QUESTIONS FROM SENATOR DOMENICI

Question 1. In your opinion, what is the single most important action we can take in the near-term to decrease our Nation's demand for gasoline? Also, what is the most inexpensive action we can take immediately to reduce demand?

Answer. My primary recommendation is to provide emergency federal assistance to help public transit agencies accommodate record numbers of riders, restore service cuts, expand service, maintain or reduce fares, and cope with rising fuel bills.

The most inexpensive action we can take to immediately reduce gasoline demand could be employer and federal support for employee telecommuting and compressed work weeks. Commute trips to and from work accounts for about 25% of household travel. Thus, telecommuting one day per week could immediately cut household travel by 5%.

Question 2. In your testimony, you reference several localities that have implemented smart-growth strategies that have helped them reduce energy demand. What financial mechanisms have these communities used to finance these initiatives?

Answer. Implementation of smart growth polices typically requires partnerships across different levels of government and with the private sector. Financial mechanisms include local sales taxes, tax increment financing, and value capture ap-

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[1] APTA, "Public Transportation Reduces Greenhouse Gases and Conserves Energy," February 2008. http://www.apta.com/research/info/online/greenhouse brochure.cfm

[2] APTA, "Public Transit Users Avoid High Gas Prices: Save Over $8,000 Per Household Annually," July 2008. http://www.apta.com/media/releases/080731 transit savings.cfm

[3] APTA, "Impact of Rising Fuel Costs on Transit Services__Survey Results," May 2008. http://www.apta.com/research/info/online/fuel survey.cfm

[4] G. Ohland and Poticha (eds), Street Smart, Reconnecting America, 2006, pp. 3–4.

proaches such as joint development and equity participation.[5] In addition to financing policies and projects, a critical government role is to help create favorable conditions for smart growth, infill and transit-oriented development. Public funding for transportation and land use planning, alternatives analyses and 'visioning' processes is a key starting point for identifying, generating support for and implementing smart growth policies.

Public policies and investments can leverage major new private investments by improving conditions for developers to conduct infill and transit-oriented development. A recent book, Street Smart, edited by Reconnecting America and sponsored by APTA and the Community Streetcar Coalition, estimates the private investment in local development leveraged by public investments in transit. According to the book, initial public investment of $73 million in the Portland Streetcar, helped attract $2.3 billion in private investments within two blocks of the line, a more than 30-fold return on investment.[6] Similarly a $20 million public investment in the Little Rock Streetcar helped leverage $200 million in private investment, and a $60 million public investment in the Tampa TECO Streetcar helped leverage $1 billion in private investment. The authors are careful to note that streetcar investments don't directly cause private developers to make invest in development, but streetcars can make the market much more attractive for developers, especially when coupled with policy changes (e.g., zoning, permitting) that support transit-oriented development.

Below I provide some examples of public support and finance mechanisms for smart growth policies and projects.

Albuquerque, New Mexico

According to a recent book, The New Transit Town, edited by Hank Dittmar and Gloria Ohland, transit agencies are experimenting with equity participation to improve private investor appeal and to share in project returns. For example,

> The City of Albuquerque is an equity investor in a 500,000 square foot commercial and residential development in downtown Albuquerque. In return for contributing the land, building a 635-space public parking garage, and providing the project with tax abatements, the city will receive 25 percent of the cash flow after expenses and debt service in years six to twelve and 50 percent in years twelve to twenty or until 125 percent of its investment is returned, in addition to any other public revenues the project generates for the city.[7]

Arlington, Virginia[8]

As I noted in my written testimony of July 23, 2008, over the past decades Arlington, Virginia has pursued policies to focus new development around Metro stations, resulting in no net increase in local traffic despite substantial economic and population growth. As a result of this compact, transit-oriented development, eight percent of the County land use accounts for 33 percent of real estate tax revenue. The increased tax revenue from the mixed use development in the Metro corridors has enabled the County to provide substantial funding for a wide range of community services including expanded transit and reinvestment in the community's aging infrastructure.

Arlington County has created a general land use plan that identifies development use and densities that would be acceptable in exchange for appropriate community benefits, with the highest potential densities around transit. The community benefits list includes: undergrounding utilities, upgrading pedestrian, bike and transit facilities, public art, affordable housing, etc.

As a result of its location, policies and investments, Arlington has a large, stable, and diverse tax base. However, the County is challenged with funding the next generation of transportation infrastructure investments needed to support community development.

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[5] J. Parzen and A. Sigal, "Financing Transit-Oriented Development," in H. Dittmar and G. Ohland (eds.), The New Transit Town, Island Press, 2004, Chapter 5.

[6] G. Ohland and Poticha (eds), Street Smart, Reconnecting America, 2006, pp. 3-–4.

[7] Parzen and. Sigal, op cit., pp. 92–93.

[8] This discussion of Arlington, Virginia is based on information provided by Dennis Leach, the County Director of Transportation.

Charlotte, North Carolina

Funding for Charlotte's new Lynx light rail system came from federal, state and a local sales tax.[9] The City also provided zoning flexibility to support private investment in transit-oriented development. The planned Center City Streetcar is a key element of Charlotte's 2025 Transit System Plan aimed at creating an integrated transportation system that fosters local economic development.

Chattanooga, Tennessee

The Eastgate Mall was built on farmland eight miles from downtown Chattanooga in the early 1960s. In 1986 the Hamilton Place Mall opened and many stores left Eastgate. By the early 1990s, Eastgate had a vacancy rate higher than 70 percent. The City of Chattanooga, the County Planning Agency and private developers have developed and pursued a plan to convert the dying mall site to a new mixed-use town center with offices, shops and restaurants along with educational and civic organizations. The site has attracted thousands of jobs within walking distance of shopping, services and institutions such as the YMCA which moved to the Eastgate Town Center, helping to revitalize the Brainerd neighborhood.[10] Public investment in planning has leveraged private development and has helped make walking a more convenient and realistic travel option.

Little Rock, Arkansas

The Little Rock Streetcar started service in 2004 and was financed primarily with $16 million in federal funding and $4 million in local funding, helping to leverage some $200 million in private development. The initial project connects the River Market District (created via a 1994 local sales-tax measure) with other downtown destinations and North Little Rock.[11] A recent extension connected the streetcar to the Clinton Library and Heifer International.

New Jersey

A recent New Jersey state law established the Urban Transit Hub Tax Credit Program, which provides tax incentives to developers building near transit hubs in a few key urban centers.

> New Jersey recently introduced a new initiative designed to encourage investment and job growth around urban transit hubs, which are defined as heavy rail stations in nine urban municipalities—Camden, East Orange, Elizabeth, Hoboken, Jersey City, Newark, New Brunswick, Paterson, and Trenton. The Urban Transit Hub Tax Credit Program provides tax credits equal to 80 percent to 100 percent of the qualified capital investments made within an eight-year period. Taxpayers may apply 10 percent of the total credit amount per year over a ten -year period against their corporate business tax, insurance premiums tax, or gross income tax liability.[12]

The New Jersey Department of Transportation's (NJDOT) Transit Village Program provides $3 million a year in grants for transit-oriented development efforts.[13] NJDOT is also working with cities and towns to assess how smart growth land use planning can increase travel choices and minimize transportation infrastructure investments.

Portland, Oregon

Portland's success with transit-oriented development has its roots in the statewide planning program adopted in the early 1970s, which included a requirement for cities to develop urban growth boundaries. In the 1990s, Portland's Land Use, Transportation and Air Quality (LUTRAQ) planning effort provided the framework and quantitative analysis for assessing how smart growth and transit-oriented development can reduce energy consumption, air pollution and greenhouse gas emissions. Portland has employed a broad variety of policies to increase travel choices, including transit system expansion, plans and regulations to encourage transit-oriented development, and improvements to bicycle and pedestrian facilities. Finance mechanisms for Portland's streetcar projects have included increased parking rates, a local-improvement district, tax-increment financing, sponsorship and advertising.[14]

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[9] Ohland ands. Poticha, op cit., p. 40. A. Marshall, "More than just a train," Governing, June 2008. http://www.governing.com/articles/0806trans.htm.
[10] Benfield et al., Solving Sprawl, NRDC 2001, p. 100.
[11] Ohland ands. Poticha, op cit., pp. 51 0952.
[12] http://www.state.nj.us/njbusiness/financing/geographic/urban transit.shtml
[13] http://www.state.nj.us/transportation/community/village/
[14] Ohland ands. Poticha, op cit., pp. 4–7.

Rock Hill, South Carolina

The Bank of America Historic Tax Credit Fund, which provides equity to developers, invested $1 million in the Dalton Building a mixed-use housing and office property on Rock Hill's main street.[15] This is an example of private equity helping developers make use of public tax credits through reuse of old buildings in older communities that are already pedestrian accessible.

Sacramento, California[16]

The Sacramento Area Council of Governments (SACOG) has undertaken a state-of-the art "Blueprint" regional land use planning process. The Blueprint laid the ground work for the region's Master Transportation Plan, making possible fuel use and greenhouse gas emissions savings from integrated transportation infrastructure and land development patterns.

The Blueprint planning process was financially supported through a number of revenue sources. By far the largest funding source was by prioritizing existing federal and state planning funds to this purpose. State grants helped with travel model improvements and economic analysis. Additional federal and private foundation support helped with the project's citizen outreach effort. Local business and development organizations funded housing market research and some of the costs of the large regional conference at the end of the process. Planning and citizen engagement activities to implement the Blueprint have been funded through existing federal and state planning funds, the State of California Blueprint grant program, a federal earmark, and a grant from US EPA.

Tampa, Florida

A $60 million public investment in the Tampa TECO Streetcar helped leverage $1 billion in private investment within three blocks of the streetcar line. This was achieved via partnership among the city, the regional transit authority, the metropolitan planning organization, the state DOT and the Federal Transit Administration. Operating funds are supported by a tax-assessment district along the streetcar route, sales of station naming rights, advertising and fares.[17]

Question 3. In the early 70s, it was anticipated that our energy demand would be much higher than it currently is today. In your opinion, why did these projections generally overestimate actual demand?

Answer. I have not analyzed the energy demand projections from the early 1970's, so am unable to comment in any depth on this question. It is likely that actual energy end-use efficiency improvements exceeded expectations at the time. I would also expect that shifts from a manufacturing toward a more service-oriented economy played some role, as well as export of energy-intensive manufacturing to other countries.

I recommend that current federal energy demand forecasts be adjusted to reflect recent consumer travel and vehicle purchase behavior. Even though oil prices have come down somewhat since the July hearing, if gasoline remains above $3.00 per gallon, I expect that consumers will remember the high prices and think twice before purchasing inefficient vehicles, making nonessential trips and will consider the travel cost implications of residence and employment locations.

Question 4. What immediate and near-term steps can suburban or rural areas take to reduce gasoline demands?

Answer. In the near-term, residents of suburban and rural areas can combine trips, eliminate non-essential trips and maximize use of internet based shopping and work. In addition they can employ a host of measures to improve vehicle efficiency including tire inflation and moderate driving practices (e.g., reduce high acceleration events).

Suburban and rural areas can also take steps now to increase the walkability of their town or village centers so that, for example, some shopping and recreational trips can be taken by foot. Pursuing development and zoning policies that encourage compact, centralized development can shorten vehicle trips, enhance the practicality of walk trips and bolster local businesses that may be becoming more competitive vis-à-vis distant discount centers due to high motor fuel costs.

Question 5. You noted in previous Senate testimony that a July 2007 report from the American Association of State Highway and Transportation Officials (AASHTO) set a goal of cutting Vehicle Miles Travelled growth in half by 2055. What steps is the AASHTO taking to meet this ambitious goal?

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[15] Parzen and. Sigal, op cit., p. 107.
[16] Based on input from Mike McKeever, Executive Director of SACOG.
[17] Ohland ands. Poticha, op cit., pp. 48–50.

Answer. I forwarded your question to AASHTO for their response, which I have attached in a separate document.

ATTACHMENT

Question 1. You noted in previous Senate testimony that a July 2007 report from the American Association of State Highway and Transportation Officials (AASHTO) set a goal of cutting Vehicle Miles Traveled growth in half by 2055. What steps is AASHTO taking to meet this ambitious goal?

Answer. The origin of the AASHTO goal cited by Senator Domenici was a report titled A New Vision for the 21st Century, which was approved by AASHTO's Executive Committee in July, 2007. That report came about through a national conference AASHTO convened in Maryland. In May, 2007 AASHTO brought together transportation experts from across the Nation, representing users, builders and providers of our transportation system for a three-day Transportation Vision and Strategies for the 21st Century Summit. The resulting report, A New Vision for the 21st Century, recognized that to make a positive contribution to the issue of global climate change, transportation policies need to reduce dependence on foreign oil, reduce energy consumption, and reduce travel demand, relative to current trends. To achieve these goals AASHTO called for:

- Supporting the President's goal to reduce oil consumption by 20 percent in 10 years,
- Doubling the fuel efficiency of new passenger cars and light trucks by 2020, the entire fleet by 2030,
- Reducing the projected growth in vehicle miles traveled-from three trillion in 2006 to five trillion, rather than seven trillion, by 2055, and
- Reducing the percentage of commuters who drive alone to 1980 levels, and
- Increasing the percentage of those who ride transit, car pool, walk, bike, or work at home.

To achieve the proposed reduction in VMT growth, AASHTO proposed:

- Doubling transit ridership by 2030,
- Significantly expanding the market share of passengers and freight moved by rail rather than trucks,
- Reducing the percentage of commuters who drive alone to 1980 levels, and
- Increasing the percentage of those who ride transit, carpool, walk, bike and work at home.

This year AASHTO and its members have been working diligently to be part of the climate change solution. AASHTO has undertaken a number of climate change activities, including:

- Publishing, in April 2008, a Primer on Transportation and Climate Change,
- Developing a Climate Change Technical Assistance Program to supply AASHTO members with timely information, tools and technical assistance to assist them in meeting the difficult challenges that arise related to climate change, and
- Organizing a Transportation Vision Conference in Spring, 2007 which included discussions regarding sustainability and climate change.

The states are proactive on climate change; thirty-six governors have developed aggressive plans to reduce greenhouse gas emissions from electric energy generation, industry, and transportation. To reduce GHG emissions from the transportation sector, changes will be needed in four areas: (1) improving fuel economy of vehicles; (2) developing new, lower-carbon fuels; (3) reducing the growth in transportation demand, as measured in vehicle miles traveled (VMT), and (4) improving system efficiency.

Evidence shows that VMT growth trends have been tapering off for decades, most dramatically in recent years. The following is VMT growth rates by decade from the 1950's to the 2000's:

- 1950's: 4.8%
- 1960's: 4.3%
- 1970's: 3.8%
- 1980's: 3.2%
- 1990's: 2.5%
- 2000's: 1.4%

Rather than growing at the predicted rate of 2% or more annually, VMT has been increasing at approximately one-half of a percent since 2004. And in the past year, VMT has actually declined in response to sharply higher gasoline prices. The recent

VMT trends suggest that VMT growth is abating on its own, in response to market forces, lessening the need for any regulatory intervention by the federal government.

In tandem with efforts to develop cleaner vehicles and fuels and to reduce growth in VMT, it also is possible to reduce greenhouse gas emissions by improving system efficiency. Traffic congestion contributes to greenhouse gas emissions because vehicle engines operate less efficiently—and therefore produce higher emissions per mile—when they are driven at low speeds in stop-and-go traffic. In 2002, traffic congestion wasted 5.7 billion gallons of fuel. The optimal speed for motor vehicles with internal combustion engines is about 45 mph. At lower speeds, CO_2 emissions per-mile are several times higher than at 45 mph. At higher speeds, CO_2 emissions per mile increase as well, but somewhat less sharply. As such, congestion relief can play a role in reducing greenhouse gas emissions. If we can reduce the amount of fuel burned by vehicles stalled in traffic that is a gain. If we can improve the flow of traffic so fuel is burned at more optimal efficiency rates then that will also produce a gain.

All four of these areas are important, but ultimately, we need zero carbon fuels. A breakthrough in vehicle and fuel technology is essential for the world as a whole to achieve the necessary reductions in GHG emissions. Reducing GHG emissions in the U.S. alone would accomplish very little, if emissions elsewhere continue to rise at their current rates. Developing countries in particular are experiencing rapid increases in automobile ownership, economic growth, and personal incomes. Developing countries will only be able to reduce their GHG emissions if they have access to much cleaner vehicles. The U.S. should be leading the way toward the development of these new technologies, both to reduce U.S. emissions and to reduce emissions worldwide.

A policy recommendation prepared for action by AASHTO's Board of Directors proposes that the Nation establish a major national R&D initiative to transition the entire transportation vehicle fleet to zero-carbon fuels. The goal by 2050 should be to transition our vehicle fleet from internal combustion engines powered by petroleum to new engines powered by electricity generated from renewable sources. Before then, we must continue to make major improvements in the fuel economy of existing engines and broaden the availability of highly efficient gasoline/electric hybrid engines, including plug-in hybrids.

DEPARTMENT OF ENERGY,
Washington, DC, October 24, 2008.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources, U.S. Senate Washington, DC.

DEAR SENATOR BINGAMAN: On July 23, 2008, Steven Chalk, Deputy Assistant Secretary, Office of Energy Efficiency and Renewable Energy, testified regarding the status of existing federal programs targeted at reducing gasoline demand in the near term and to discuss additional proposals for short term gasoline demand reductions.

Enclosed are the answers to five questions submitted by you and Senator Domenici for the hearing record. The remaining answers are being prepared and will be forwarded to you as soon as possible.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Lillian Owen, at (202) 586-2031.

Sincerely,

LISA E. EPIFANI,
Assistant Secretary Congressional and Intergovernmental Affairs.

[Enclosures.]

QUESTIONS FROM SENATOR BINGAMAN

Question 1. Is the recent surge in demand for diesel for electric generation a short term or long term factor? What are alternative options for low-cost, off-grid electrification? Might this be a good application for biodiesel?

Answer. Diesel generators are often used in response to emergency situations, when commercial electricity supplies are disrupted. As a result, spikes in diesel generation are most often short-term phenomena, rather than long-term solutions to providing electricity. For instance, disruptions to coal transportation systems in China last year during particularly harsh winter weather resulted in an increase in diesel generation. Many South American countries rely on diesel generators when drought conditions lower hydroelectric supplies.

In the long-run, electricity providers seek more cost effective solutions to supplying reliable electricity generation rather than continuing to rely on diesel generators. In China, for instance, there are plans to expand nuclear, coal-fired, and renewable generation. Unfortunately, these solutions can take a long time to implement because of the need to expand the infrastructure to support the expansion of electricity, including transmission lines, railroads and highways.

It is likely that diesel generators will continue to be used as short-term solutions to emergency situations, because they can be used to quickly respond to power disruptions, so that the use of biodiesel to fuel generators would be possible. In remote areas with no access to national grids and where it is difficult and expensive to expand transmission lines, renewable energy sources—for example, micro hydroelectric facilities, wind, solar, and other off-grid renewable technologies—could also provide relatively cost-effective power solutions.

Question 2. NPRA has stated that U.S. diesel exports are not clean enough to be consumed inside the U.S. Are there export data to back up this claim? Might there be other domestic applications for some of that diesel? For instance, could it be used for heating oil?

Answer. This year's distillate exports include both low sulfur and ultra-low sulfur distillate that could be used in the U.S. EIA uses export data provided by the U.S. Bureau of the Census that does not break out ultra-low sulfur diesel from low sulfur, but we confirmed that some of the product being exported included ultra-low sulfur diesel. The high sulfur distillate market (fuel with greater than 500 ppm sulfur) includes home hearting oil and fuel for electric generating use. Historically, high sulfur distillate represented more than half of total distillate exports. For example, in 2000 high sulfur exports represented 77 percent of the exported volumes, while in 2007 they represented 51 percent. This year, high sulfur exports dropped to 13 percent of total distillate exports, both because most U.S. distillate production (88 percent) is now low or ultra-low sulfur distillate and because some of the major export areas needing distillate, such as Europe, now use low sulfur or ultra-low sulfur product.

Question 3. When will testing be completed on the use of intermediate blends of ethanol in conventional vehicles (between El0 and E85). Is it possible to approve the use of E12 at this time, or is further testing required?

Answer. DOE has completed the first set of tests of intermediate ethanol blends on vehicles and small non-road engines. An interim report that summarizes data available to date has been peer reviewed and will be released publicly in early Fall 2008. A number of additional studies that consider the effects of blends on materials, durability, drivability, and emissions are underway or planned. These individual studies have a variety of end dates, with completion of the longest-term study on catalyst durability expected in 2010. DOE will issue reports in the interim as results become available from the various tests, with a final report expected upon completion of the durability testing in 2010.

EPA has the authority to determine whether a particular fuel is substantially similar to gasoline and therefore can be used in conventional vehicles. DOE cannot comment nor make a determination on the acceptability of E12 or any other intermediate ethanol blend at this time.

QUESTION FROM SENATOR LINCOLN

The rise in both gas prices and diesel prices are especially worrisome in a rural state like Arkansas, where families have to drive long miles to work and school and the grocery store. The combination of lower incomes, high fuel prices, and the heavy dependence on pickup trucks and vans and use of farm equipment is putting an even tighter squeeze on family budgets. Rural residents do not have mass transit or grocery stores nearby and few alternative fuel options available to ease the pain at the pump.

Question 1. I do believe that most of our energy policy option will focus on he long-term, as we are not going to solve this problem overnight. However, in your expert opinions, what do you believe are Congress' most immediate options for providing relief to hard-working families and businesses which rely mostly on diesel fuel?

Answer. The Administration has pursued, as you note, significant strategies to increase both the efficiency of motor vehicles and the supply of alternative fuels for transportation use. These measures have included fuel economy standards for both cars and light trucks, mandates for greater use of non-petroleum fuels and incentives for their production, biofuels research, incentives for advanced hybrid vehicles, and increased access to domestic resources for increased domestic energy production. Despite these long-term initiatives, world oil prices rose to very high levels,

peaking in the summer of 2008. The resulting gasoline prices of about $4.00 per gallon, and diesel prices even higher prompted widespread public concern.

Fuel prices have fallen sharply since their mid-2008 peak under the combined influence of consumer adjustments and weaker economic growth both in the United States and worldwide. These lower fuel prices provide significant relief to hard-working families and businesses. Additionally, the Department of Energy remains focused on long-term energy security through alternative fuels, increased domestic energy production and gains in energy efficiency.

QUESTIONS FROM SENATOR DOMENICI

Question 1. On the second page of your written testimony, I noticed that in the past year, the cost to refine a gallon of gasoline has declined, while the cost to refine a gallon of diesel has increased. According to your chart, the cost to refine gasoline dropped by 31 cents, but the cost to refine diesel increased by 18 cents. Can you explain why these numbers went in opposite directions?

Answer. Figure 1 of the testimony, presents a simplified view of price components to help explain variations in retail prices. The component labeled as the "wholesale crack" in the figure is not refining costs to produce the products shown. Rather, the wholesale crack, defined as the wholesale price of gasoline or diesel minus the cost of crude oil to the refinery is a measure of the revenue available to cover remaining refining costs and refining profits associated with gasoline or diesel production after crude costs are removed. This revenue varies in the short run as a result of basic supply and demand forces in the markets for crude and products.

Figure 2 in the testimony displays time series of wholesale diesel and gasoline crack spreads. Looking at gasoline, it shows that during 2007 the wholesale price were often much larger than crude oil costs, implying high profitability. This year, however, gasoline markets have had ample supply relative to demand as a result of declining demand, increased use of ethanol (and thus less need for crude-based gasoline), and increased availability of gasoline imports. This ample supply reduced the wholesale gasoline crack spread, and at times, pushed gasoline prices below the price of crude oil resulting in financial losses for gasoline production. At the same time, the distillate market, which includes diesel, and is distinct from gasoline market, tightened considerably worldwide as a result of growing demand, particularly in the electricity generating sector. That pulled diesel prices up relative to crude oil cost, improving refining profits from diesel production.

Question 2. Since 2002, EIA has broken out the price of diesel into its component costs-refining, distribution and marketing, taxes, and crude oil. In May 2002, refining accounted for 5.1 percent of the price of diesel, but since then, and even as the price of oil has increased substantially, refining costs have consistently been much higher.

I understand that one factor in this increase may be the decision to mandate the use of Ultra-Low Sulfur Diesel fuel. EPA initially estimated this would cost no more than 5 cents per gallon. The transition to ULSD is important to improving air quality, but has it come at a greater cost than we expected? Can you describe any other factors that may account for the substantial increase in refining as a percentage of the price of diesel?

Answer. The data represented in Figure 1 reflects the sum of refining costs and profits which varies. The "wholesale diesel crack" component will vary both as a percent of total price and as an absolute value with the changing distillate and gasoline supply-demand balances in the short run. We do not have any direct measure of how the cost of producing diesel fuel has increased over time. Both heating oil and diesel fuel tend to move together with the general distillate market tightness or looseness, so looking at the difference between diesel prices and heating oil prices over time will help to isolate the impact diesel specification changes such as the move to ultra low sulfur diesel (ULSD) may have had. Prior to 2005 and the hurricane impacts on prices, wholesale diesel prices on the Gulf Coast would normally average one to three cents above No. 2 fuel oil (heating oil). After the ULSD program began in 2006, diesel has been averaging 13-14 cents per gallon over No. 2 fuel oil. This implies that the ULSD program may be contributing about 10 cents per gallon to the price of diesel fuel.

This is relatively consistent with the studies done on ULSD production costs. For simplicity, EPA, EIA, NPC and others use single numbers to discuss cost estimates. But these costs are difficult to compare. EIA's 2001 report, Transition to Ultra-Low Sulfur diesel explains the difficulties in comparing costs in greater detail. For example, costs will increase with the relative amount of ULSD produced compared to 500 ppm sulfur or high sulfur distillate, with the amount of "cracked stock" (distillate material that comes from fluid catalytic cracking or coking units) that needs to be

desulfurized, with the scale of the units used to desulfurize the distillate, and whether new or revamped units could be used. The clean diesel program has grown, with moe of the distillate market being required to use low or ultra-low sulfur fuel, which alone would be expected to result in increasing costs.

Question 3. The military has undertaken a program aimed at providing a greater share of their energy needs with domestically produced fuel—much of this work has focused on taking greater advantage of our domestic coal reserves.

What impact do you believe coal-to-liquids fuels could have on the price of diesel?

Answer. Given the amount of coal-to-liquids distillate fuels EIA is projecting in the AEO2008 reference case in 2030, approximately 137,000 barrels per day, and the amount of diesel fuel use projected in 2030, 4.871 million barrels per day, the price effect would be likely be limited. In general, adding new supply to an extremely tight market for all distillate range material should lower prices to some extent for all midrane distillate products, but EIA has not performed quantitative analysis on this topic.

Question 4. Plug-in vehicles hold great promise in our ongoing efforts to lessen our dependence on foreign sources of oil. However, U.S. transmission infrastructure has increased by only 6.8% since 1996. In last year's energy bill, Congress encouraged the modernization of the electricity grid in "Smart Grid" provisions that include the deployment and integration of plug-in electric and hybrid electric vehicles.

What kind of infrastructure improvements must we undertake to accommodate the eventual use of plug-in vehicles?

Answer. The total amount of generating capacity (power) may not need to grow at the same rate that electricity generation (energy) will increase to charge the vehicles. This assumes that many plug-in vehicles are charged at off-peak times (mostly at nighttime) when capacity demand is down. In November 2007, Pacific Northwest National Laboratory published a study that found, "The existing electricity grid has sufficient capacity to fuel 73% of the Nation's cars, pickup trucks, and SUVs for a daily average drive of 33 miles."[1]

Other related infrastructure needs will include case-by-case decisions to upgrade power distribution networks and residential sites. For example, the local utility may need to implement smart chargers to encourage consumers to recharge their vehicles overnight to take advantage of off-peak electricity and time-of-day pricing. Special infrastructure such as smart metering and smart charging devices will be needed if PHEVs are used in a vehicle-to-grid mode to help with grid voltage regulation and reduce grid congestion during peak use periods.

Question 5. Although there are 240 million light duty vehicles in the U.S., there are only 6 million flexible-fuel vehicles that can use a blend of 85% ethanol and 15% gasoline on the road.

I understand that the domestic auto manufacturers have pledged to make half of their vehicles E85 compatible by the year 2012. Have we made any progress there? Also, how limited are we by the current distribution and fueling infrastructure for E85?

Answer. The domestic car companies assert that they are committed to delivering on their promise to make half of their vehicles E85 compatible by 2012. None of the foreign car companies have made such a pledge. Flexible fuel vehicles (FFVs) in 2007 represented 14% of total domestic vehicle sales, up substantially from 5% in 2005.[1] General Motors is leading in this area and has increased its FFV production from 395,010 to 764,465 between 2006 and 2007. That is approximately 19% of their 2007 North American sales. Note that some of the original equipment manufacturers (OEMs) have also included the use of biodiesel in their vehicles with diesel engines in their strategy to achieve the 50% production goal. (The chart below was produce by National Renewable Energy Laboratory (NREL) with data extracted from R.L. Polk and other information provided directly from OEMs).

[1] http://www.pnl.gov/energvieedietd/pdfs/phev__feasibility__analysis__combined.pdf.

[1] R.L. Polk data

Manufacturer	Year	FFV % of Total Sales	Diesel % of Total Sales	Diesel + FFV % of Total Sales
Chrysler	2005	0%	4%	4%
	2006	1%	7%	8%
	2007	6%	3%	9%
Ford	2005	10%	7%	17%
	2006	7%	9%	16%
	2007	10%	4%	14%
GM	2005	5%	3%	8%
	2006	11%	3%	14%
	2007	19%	3%	22%

The U.S. is very limited in E85 infrastructure to support the fleet of E85 vehicles. There are a total of 168,000 fueling stations in the U.S. and slightly more than 1,500 E85 capable stations (less than 1% of the total).[2],[3] These E85 fueling stations serve just eight percent of the total U.S. population. The U.S. is also limited in its ability to move ethanol in large quantities to terminals where it can be shipped to fueling stations, primarily because ethanol is not compatible with the existing pipeline infrastructure. DOE is also investigating the use of intermediate blends of ethanol (e.g., E15, E20). The infrastructure requirements for these blends would likely be significantly reduced. Since it is envisioned that intermediate blends could be introduced to the entire existing fleet of vehicles, the Vehicle Technologies Program is primarily focused on determining whether existing vehicles are adversely affected by various blend levels.

Question 6. In fiscal years 2007 and 2008, DOE allocated $14.6 million to test the impacts of intermediate blends on existing systems. What is the status of that ongoing research?

Answer. DOE has completed the first set of tests of intermediate ethanol blends on vehicles and small non-road engines. An interim report that summarizes data available to date has been peer reviewed and will be released publicly in September 2008. This report will include emissions and temperature data for 13 vehicles as well as emissions, temperature, and durability data for a variety of small non-road engines. Additional vehicle studies assessing the impacts of intermediate ethanol blends on drivability, emissions, materials, and durability are underway or planned. DOE also plans to undertake studies that will consider the impacts of these fuels on other specialty engines, such as marine and motorcycle engines. DOE will continue to issue new reports as data from ongoing studies becomes available and is peer reviewed.

Question 7. Is the Hydrogen Fuel Initiative meeting its goals? If so, can you tell us how?

Answer. The Department's Hydrogen Program continues to make significant progress toward meeting its goals. Through the accelerated research and development enabled by the Hydrogen Fuel Initiative, the Program has accomplished the following:

- Developed fuel cell components with improved performance and durability that have been demonstrated in fuel cell stacks which were build by industry and which doubled the lifetime from 1,000 hours in 2003 to 2,000 hours in 2006; on track towards meeting the target of 5,000 hours, equivalent to 150,000 miles.[1] Developed a fuel cell membrane electrode assembly and achieved more than 7,000 hours durability, exceeding the 2010 membrane target of 5,000 hours.[2]
- Reduced the projected high volume cost of fuel cells by 65%—from $275 per kilowatt in 2002 to $94 per kilowatt today—on track towards meeting the target of $30 per kilowatt in 2015.[3],[4]

[2] See http://wwwl.eere.energy.gov/vehiclesandfuels/facts/2004/fcvt__fotx344.html
[3] http://www.eere.energy.gov/afdc/fuels/stations__counts.html
[1] http://www.hydrogen.energy.gov/pdfs/5036fuel__cell__stack__durability.pdf
[2] http://www.hydrogen.energy.gov/pdfs/review08/fc__l__debe.pdf
[3] http://www.hydrogen.energy.gov/pdfs/review08/fc__7__james.pdf
[4] http://www.hydrogen.energy.gov/pdfs/5005__fuel__cell__cost.pdf

- Lowered the cost (untaxed) of producing hydrogen at a fueling station using natural gas from $5 per kilogram in 2003 to $3 per kilogram (projected for high volumes), demonstrating that hydrogen can be cost competitive with gasoline.[5]
- Developed a hydrogen purification membrane that meets 2010 targets for sulfur tolerance, predicted economic life, and operating conditions and surpassed targets for hydrogen production rate, product purity, and cost, to enable hydrogen production from coal gasification.[6]
- Initiated operation of an integrated lab scale system with peak hydrogen production of 2,000 liters per hour, on track towards enabling hydrogen production using nuclear power.[7]
- Through Centers of Excellence (collaborative teams of research groups, selected through a competitive solicitation process, each working on specific types of hydrogen storage materials) and independent projects, identified potential materials for low-pressure vehicular hydrogen storage with 50% improvement in capacity compared to 2004.[8]
- Through basic science research, expanded understanding of how hydrogen interacts with metal surfaces and developed a bacterial enzyme that catalyzes hydrogen production, with a high tolerance for oxygen and increased robustness for producing hydrogen under non-biological conditions."[9,10]
- Produced several resources to share important safety and permitting information with communities, including a "Technical Reference for Hydrogen Compatibility of Materials" and a "Permitting Compendium for Hydrogen Fueling Stations and Stationary Installations." [11,12]
- Developed educational materials and conducted workshops for various key target audiences including teachers, safety and code officials, state and local government officials, potential early adopters, and the public. Among the resources developed is an online training tool to introduce first-responders (primarily fire fighters but also law enforcement and emergency medical personnel) to hydrogen, its properties as compared to other commonly used fuels, and initial emergency response actions; to date more than 6,000 users have accessed the course.[13]
- Through the DOE Hydrogen Technology Program's Technology Validation efforts and 50-50 industry cost shared projects, demonstrated 122 vehicles and 16 fueling stations, achieving a fuel cell system efficiency of more than twice that of gasoline vehicles, a projected durability of 1,900 hours (equivalent to 57,000 miles), and a driving range of up to 190 miles.[14,15]

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[5] http://www.nrel.govklocs/fy07osti/40382.pdf
[6] http://www.hydrogen.energy.gov/pdfs/review08/pd__39__jack.pdf
[7] http://www.hydrogen.energy.gov/pdfs/review08/pd__25__pickard.pdf
[8] http://www.hydrogen.energy.gov/pdfs/5037__h2storage.pdf
[9] http://www.hydrogen.energy.gov/pdfs/review07/pl__0__kung.pdf
[10] Paul W. King, Drazenka Svedruzic, Jordi Cohen, Klaus Schulten, Michael Seibert, and Maria L. Ghirardi, Proc. SPIE Vol. 6340, 63400Y (2006)
[11] http://www.ca.sandia.gov/matIsTechRef/
[12] http://www.hydrogen.energy.gov/permitting/
[13] http://www1.eere.energy.gov/hydrogenandfuelcells/education
[14] http://www1.eere.energy.gov/hydrogenandfuelcells/tech__validation/fleet__demonstration.html
[15] http://www.nrel.gov/hydrogen/cdp__topic.html