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THE HIDDEN COST OF OIL

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BEFORE THE

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UNITED STATES SENATE

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THE HIDDEN COST OF OIL

THURSDAY, MARCH 30, 2006

U.S. SENATE,
COMMITTEE ON FOREIGN RELATIONS,
Washington, DC.

The committee met, pursuant to notice, at 9:40 a.m., in room SD–419, Dirksen Senate Office Building, Hon. Richard G. Lugar (chairman of the committee) presiding.

Present: Senators Lugar, Hagel, and Biden.

OPENING STATEMENT OF HON. RICHARD G. LUGAR, U.S. SENATOR FROM INDIANA

The CHAIRMAN. This hearing of the Senate Foreign Relations Committee is called to order.

The committee meets today to consider the externality costs of United States dependence on fossil fuels. The gasoline price spikes following Katrina and Rita hurricanes underscored for Americans the tenuousness of short-term energy supplies. Since these events, there is a broader understanding that gasoline and home heating prices are volatile and can rapidly spike to economically damaging levels due to natural disasters, terrorist attacks, or other world events. But, as yet, there is not a full appreciation of the hidden costs of oil dependence to our economy, our national security, our environment, and our broader international goals.

Today, with the help of experts who have thought a great deal about these issues, we'll attempt to more clearly define some of these costs. We're cognizant that this is a difficult and imprecise exercise. We're also aware that most, if not all, energy alternatives have some externality costs. But we're starting from the presumption that if we blithely ignore our dependence on foreign oil, we are inviting an economic and national security disaster.

With less than 5 percent of the world's population, the United States consumes 25 percent of its oil. If oil prices remain around $60 a barrel through 2006, we will spend approximately $320 billion on oil imports this year. Most of the world's oil is concentrated in places that are either hostile to American interests or vulnerable to political upheaval and terrorism. More than three-quarters of the world's oil reserves are controlled by national oil companies, and within 25 years the world will need 50 percent more energy than it does now.

These basic facts demand a major reorientation of U.S. policy aimed at reducing U.S. dependence on fossil fuels. Our goals must be to mitigate the short-term costs of our dependence on oil while pursuing energy alternatives that would reduce the international

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leverage of petro-superpowers, improve environmental quality, cushion potential oil price shocks, stimulate new high-tech energy industries, and ground the American economy on energy sources that will neither run out nor be cut off by a foreign supplier.

There are at least six basic threats associated with our dependence on fossil fuels:

First, oil supplies are vulnerable to natural disasters, wars and terrorist attacks that can produce price shocks and threats to national economies. This threat results in price instability and forces us to spend billions of dollars defending critical fossil fuel infrastructure and shipping choke points.

Second, over time, finite fossil fuel reserves will be stressed by the rising demand caused by explosive economic growth in China, India, and many other nations. This is creating unprecedented competition for oil and natural gas supplies that drives up prices and widens our trade deficit. Maintaining fossil fuel supplies will require trillions in new investment, much of it in unpredictable countries that are not governed by democracy and market forces.

Third, energy-rich nations are using oil and natural gas supplies as a weapon against energy-poor nations. This threatens the international economy and increases the risk of regional instability and even military conflict.

Fourth, even when energy is not used overtly as a weapon, energy imbalances are allowing oil-rich regimes to avoid democratic reforms and insulate themselves from international pressure and the aspirations of their own people. In many oil-rich nations, oil wealth has done little for the people, while ensuring less reform, less democracy, fewer free-market activities, and more enrichment of elites. It also means that the United States and other nations are transferring billions of dollars each year to some of the least accountable regimes in the world. Some of these governments are using this money to invest abroad in terrorism and instability or demagogic appeals to anti-Western populism.

Fifth, reliance on fossil fuels contributes to environmental problems, including climate change. In the long run, this could bring drought, famine, disease, and mass migration, all of which could lead to conflict and instability.

Sixth, our efforts to facilitate international development are often undercut by the high costs of energy. Developing countries are more dependent on imported oil, their industries are more energy intensive, and they use energy less efficiently. Without a diversification of energy supplies that emphasizes environmentally friendly options that are abundant in most developing countries, the national incomes of energy-poor nations will remain depressed, with negative consequences for stability, development, disease eradication, and terrorism.

Each of these threats comes with a short- and long-term cost structure, and, as a result, the price of oil dependence for the United States is far greater than the price consumers pay at the pump. Some costs, particularly those affecting the environment and public health, are attributable to oil no matter its source; others, such as costs of military resources dedicated to preserving oil supplies, stem from our dependence on oil imports. But each dollar we spend on securing oil fields, borrowing money to pay for oil im-

ports, or cleaning up an oil spill is an opportunity missed to invest in a sustainable energy future.

Certain types of costs are extremely difficult to quantify, and we understand that many national security risks are heightened by our dependence. But how, for example, would we assign a dollar figure to Iran's use of its energy exports to weaken international resolve to stop its nuclear weapons program? Yet, we should do our best to quantify the externality costs of oil so we have a clearer sense of the economic and foreign policy tradeoffs that our oil dependence imposes upon us.

As the U.S. Government and American business consider investments in energy alternatives, we must be able to compare the costs of these investments with the entire cost of oil. Public acknowledgment of the billions of dollars we spend to support what the President has called our, "oil addiction," would shed new light on investment choices related to cellulosic ethanol, hybrid cars, alternative diesel, and other forms of energy.

As we address these questions today, we'll have the benefit of a distinguished panel of experts.

Dr. Hillard Huntington is the executive director of the Energy Modeling Forum at Stanford University. He is a senior fellow and past president of the United States Association for Energy Economics. He recently coordinated two studies funded by the Department of Energy that evaluated the economic risks of oil price shocks.

Mr. Milton Copulos is the president of the National Defense Council Foundation. He has advised Secretaries of Defense, Energy, and Interior, and was a member of the National Petroleum Council. He is widely published on military affairs, and has devoted much study to the military expenditures associated with ensuring the flow of oil.

Dr. Gary Yohe is the John E. Andrus Professor of Economics at Wesleyan University. Professor Yohe is widely published on the adaptation and mitigation of climate change. He recently edited "Avoiding Dangerous Climate Change," the collection of papers on the subject that were prepared for last year's G–8 summit.

We welcome these three distinguished witnesses. We look forward to their insights.

And, first of all, I would like to recognize my colleague, Senator Hagel, for any opening thought or comment he might have this morning.

Senator HAGEL. Mr. Chairman, thank you. I do not have a statement. I look forward to listening to our witnesses.

I think your focus on this issue at this time is not only appropriate and relevant, but one of the critical challenges that faces our country and the world over the next 25 years. So, thank you for your attention to this. And I thank, as well, our witnesses for giving us their expertise and time.

Mr. Chairman, thank you.

The CHAIRMAN. Well, thank you very much, Senator Hagel.

I'll ask the witnesses to testify, starting with Mr. Copulos, then Dr. Huntington, and then Dr. Yohe.

Let me say at the outset that your full statements will be made a part of the record, so that you need not ask permission for that to occur. Please either give the statements in full or summarize, as

you wish. We will not have a rigid time limit. We've come to hear you. We want to hear your testimony, and then have opportunities to raise questions.

Mr. Copulos.

STATEMENT OF MILTON R. COPULOS, PRESIDENT, NATIONAL DEFENSE COUNCIL FOUNDATION, ALEXANDRIA, VA

Mr. COPULOS. Thank you, Mr. Chairman. Bear with me. One of the few signs of advancing age is you need more than one pair of glasses. The other is, the barber spends more time on the ears than on the top of your head. [Laughter.]

As you know, I'm Milton R. Copulos. I'm president of the National Defense Council Foundation. I would like to thank Chairman Lugar for giving me the opportunity to speak with the committee today. And I would also like to commend him for his leadership in addressing our Nation's perilous energy dependence. He "gets it." And that's important. Because what he gets is that America is rushing headlong into a disaster, a disaster that threatens to leave us with the Hobson's choice between economic calamity and world-resource war. What's worse, it's a disaster of our own design. Like Pogo said, "We have met the enemy, and they is us." More than three decades have passed since the 1973 OPEC embargo first warned us about our vulnerability to imported oil. And yet, nothing substantial has been done.

As bad as things were then, the emerging economies of China, India, and Eastern Europe are increasing competition for scarce resources, making the situation even worse. Indeed, by the year 2025, the world will need an additional 40 million barrels of oil per day. And the simple fact is, it's not there to be found from conventional resources.

But it's not just the physical shortfall that's the problem. It's also the problem of the instability of many of our sources. Out of our six top suppliers, four—Saudi Arabia, Venezuela, Nigeria, and Iraq—which supply 38.2 percent of our imports, 22.6 percent of total production, are of, at least, questionable reliability. Given the situations in these countries, it's virtually certain that sometime within the next 3 to 5 years there will be an oil supply disruption. And unlike the disruptions of the past, the consequences could be far, far more severe. We estimated that the oil supply disruptions of the 1970s cost this Nation between $2.3 and $2.5 trillion. And I should note that Oak Ridge National Lab places the estimate at $4 trillion, so, if anything, we're conservative. However, the next oil shock, because of our higher dependence, because of our higher use, could cost this Nation $8 trillion, almost two-thirds of our GDP.

And that's not the only concern that we have. One of the other most important ones is that oil, which has always been a vital military commodity, has now become much more of one. During the gulf war, a contemporary U.S. Army "heavy" division, to illustrate, used more than twice as much oil on a daily basis as an entire World War II field army. Indeed, the 582,000 people we sent to the first gulf war used more than twice as much oil every day as the entire 2-million-man Allied Expeditionary Force that liberated Europe in World War II. But, as high as that use was, it's even higher now. There's been a 20-percent increase in the amount of oil for a

deployed soldier that we now require. It now is one barrel of refined products per soldier per day. And it's going to go up further from there.

Well, these costs have long been a concern to our organization. In fact, in 2003 we published a large study, "America's Achilles' Heel: The Hidden Costs of Imported Oil," that entailed the review of hundreds of thousands of pages of documents, including the entire order of battle of the U.S. Department of Defense. We looked at historic data. We just did a massive review. And we concluded, at that point, that the hidden cost of defense and other externalities came to $304.9 billion annually. That was equivalent, at that time, to adding $3.68 to the price of a gallon of gasoline.

But much has changed since then. When we did that study, the refinery acquisition cost of a barrel of oil was $26.92. Indeed, in the base year, we spent $99 billion on oil imports, and thought that was high. Well, in 2005 we spent $251,619,000,000 on oil imports. And this year, as the chairman noted, even if prices don't go above $60 a barrel—and I suspect they could—we're going to spend at least $320 billion on imported oil.

But that's not all that's changed. In 2003, we were spending $49.1 billion annually to maintain the capability to defend the flow of oil from the Persian Gulf. And I should note, this is a commitment that is not new. We have had this commitment since 1940—since February 14, 1945, when Franklin Roosevelt met with King Abdul Aziz of Saudi Arabia and basically came to an agreement that we'd protect their oil in exchange for access to it. Every President, Republican and Democrat, since then has reaffirmed it. But now, when you add in the supplementals for Iraq—and I should say that it is foolish to suggest there's no connection to oil in our involvement there—the total comes to $132.7 billion annually.

So, what does this mean? Well, what it means is that the hidden cost in 2005 for our oil profligacy came to $779.5 billion. Now, we looked at it two ways. We amortized it over the total volume of imports, and then we also looked at the Persian Gulf separately, because so much of the defense cost is loaded there. Well, if you look at it over the total volume of oil, it's like adding $4.10 to the price of a gallon of gasoline. In terms of the Persian Gulf, it's $7.41 to the price of a gallon of gasoline, which means, at our current purchase price, you're talking—the true cost is $9.53 a gallon for 2005.

But 2005 was just the beginning, because this year we're going to spend at least $320 billion on imports, as I said. That's a $70 billion increase in just 1 year. When we look at that, it raises the hidden cost to $825.1 billion. That's almost twice the President's request for the Department of Defense authorization for FY 2006. It also means that, amortized over the total volume of oil, the premium in 2006 will be $5.04; looking at the gulf, $8.35. That means the real cost of a gallon of gasoline is about $10.86.

To put it in perspective, if you drive a family sedan, a Toyota Camry, something like that, it's really costing you $217.20 to fill your tank. If you have a large SUV, like a Ford Expedition, you're spending $325.80 to fill your tank.

Now, of course, the question is, you know, Can we do anything about it? Obviously, this is a drain on our economy we cannot af-

ford. And yet, we have had to sustain it. Well, the good news is, the answer is, yes, we can do something.

The simple truth is, our Nation does not lack energy resources. What we have lacked is the political will and public commitment to make full use of what we have. In the short term, we face one critical problem. We've got a short-term problem and a long-term problem.

The short-term is, How do you fuel the 220 million privately owned vehicles that are on our roads today? They require some sort of fuel that will burn in a conventional internal combustion engine. In the out years, we need to look at how we can make that transition. So, there are some things that we can do, short term.

First, we need to take full advantage of our offshore oil, oil in other places, where we can get at it—offshore, in particularly, because the access will be quicker. We need to expand our use of renewable fuels—alcohol and biodiesel. And that, I think we should really consider looking at opening up the Caribbean basin as a source of those fuels, lifting the tariffs that we have on fuel alcohol for that region, and let those nations gain some economic traction. There's depressed sugar prices now. Turning that sugar into alcohol would help enhance our supplies. And there's plenty to go around. It's not going to compete with domestic producers. We can use everything they have, and more.

We also should look at nonpetroleum consumption. The fact that two-thirds of—nontransportation consumption—the fact that two-thirds of our oil goes to transportation also means one-third doesn't. And, in some ways, it's easier to fix that than it is to fix the auto fleet.

For example, there's a fellow out in Moline, IL, a builder named George Bialecki. Small guy. He's building homes that are 85-percent energy efficient, that use no oil whatsoever. They use geothermal heat pumps instead. And he's building for 20 percent less than conventional builders that don't have the features his homes do. There's a new process that's been developed in Canada—they are using it; this is not R&D—that turns wood into fuel oil that can be used. There are many things like that. But to do this, we have leadership.

And, in that regard, again, I want to note that Chairman Lugar and his colleagues, Senators Chafee, Coleman, Nelson, and Obama, deserve particular praise for their sponsorship of S. 2025, the Vehicle Choices for American Security Act. It's based on the Energy Security Blueprint of the Set America Free Coalition, of which I have the honor of being one of the founding members. It's clear that this is the sort of bipartisan support for the issue that can help us avoid the Hobson's choice between economic catastrophe and global-resource war.

And one other point I really want to make sure we don't forget. Some portion of every dollar we spend on imported oil finds its way into the hands of people who would do us harm. At least $1.5 billion of it does. So, in essence, we're paying for both sides of the war on terrorism. We shouldn't have to.

But the main thing to remember is, the situation is not hopeless. We have the resources necessary to provide our energy's—our Na-

tion's energy needs. All we have to do is find the political will to do so.

[The prepared statement of Mr. Copulos follows:]

PREPARED STATEMENT OF MILTON R. COPULOS, PRESIDENT, NATIONAL DEFENSE COUNCIL FOUNDATION, ALEXANDRIA, VA

My name is Milton R. Copulos, and I am president of the National Defense Council Foundation.

I would like to thank Chairman Lugar for giving me the opportunity to speak with the committee today and I would also like to commend him for his leadership addressing our Nation's perilous energy dependence.

A HEADLONG RUSH INTO DISASTER

America is rushing headlong into disaster. What is worse, however, is that it is a disaster of our own design.

More than three decades have passed since the 1973 Arab Oil Embargo first alerted the Nation to its growing oil import vulnerability. Yet, despite this warning, we are now importing more than twice as much oil in absolute terms than we did in 1973, and the proportion of our oil supplies accounted for by imports is nearly double what it was then. What makes this dependence even more dangerous than it was three decades ago is the fact that the global market has become a far more competitive place with the emerging economies of China, India, and Eastern Europe creating burgeoning demand for increasingly scarce resources.

Indeed, over the past decade the Chinese economy has grown at a frenetic pace, officially estimated at 9.2 percent in 2005. India's growth rate for that year was 7.1 percent. In Eastern Europe, Belarus grew at 7.8 percent, the Czech Republic at 4.6 percent, and the Ukraine at 4.4 percent. This compares with 3.5 percent for the United States, 2.1 percent for Japan, and 1.7 percent for the European Union.

As a result of this explosive growth, oil consumption in the developing countries is expected to increase at a rate of 3 percent annually over the next two decades. But even this figure may severely understate the problem. Indeed, China alone has accounted for 40 percent of the total increase in world oil consumption over the past several years. Moreover China plans to add 120 million vehicles to its automobile fleet over the next decade, ultimately requiring 11.7 million barrels per day of new crude oil supplies. India, too, is expected to continue to require increasingly large amounts of oil with projected increase of 28 percent over just the next 5 years.

Even conservative estimates suggest that nearly 30 million barrels per day of new oil supplies will be required by the year 2025 just to service the developing world's requirements. When Europe and the Americas are included, the requirement is closer to 40 million barrels per day. It is doubtful that new supplies sufficient to meet this skyrocketing demand will be found from conventional sources.

UNCERTAIN SUPPLIERS

Nor is it just the potential physical shortfall of resources that is a source of concern. An even greater concern lies in the instability of U.S. sources of oil imports.

The top six sources of U.S. oil imports—Canada, Mexico, Saudi Arabia, Venezuela, Nigeria, and Iraq—account for 65.1 percent of all foreign crude reaching our shores and 38.9 percent of total domestic consumption. Of these four, Saudi Arabia, Venezuela, Nigeria, and Iraq, provide 38.2 percent of oil imports and 22.6 percent of total consumption. For a variety of reasons, none of the four I just mentioned can be considered a reliable source of supply.

Venezuela's President, Hugo Chavez, is a vocal opponent of the United States who has twice threatened to cut off oil shipments to the United States.

Nigeria's production has been repeatedly disrupted by civil unrest, and some 135,000 barrels of oil per day are lost to theft.

Last month, a terrorist attack on the massive Saudi oil processing facility at Abqaiq was barely thwarted, but not before two of the terrorist's explosive-laden cars were detonated. Moreover, this was not the only instance of an attempt to disrupt the flow of Saudi oil. In the summer of 2002, Saudi Interior Ministry forces blocked an al-Qaeda plot to attack and cripple the loading dock at Ras Tanura which handles 10 percent of the world's oil supplies.

Attacks on oil facilities in Iraq are a frequent occurrence.

Nor are the attacks on U.S. oil supplies a coincidence. In December 2004, al-Qaeda issued a fatwa that said in part: "We call on the mujahideen in the Arabian Peninsula to unify their ranks and target the oil supplies that do not serve the Islamic nation but the enemies of this nation."

The fatwa went onto declare: "Be active and prevent them from getting hold of our oil and concentrate on it particularly in Iraq and the gulf."

Clearly, given the instability that characterizes four of our top six sources of oil, the question is not whether we will experience a supply disruption, but rather when. The disruption could occur as a consequence of a terrorist act, or could result from a politically motivated embargo. In the end, it doesn't really matter why a disruption occurs, because the consequences would be identical, and severe.

THE CONSEQUENCES OF DISRUPTION

The supply disruptions of the 1970s cost the U.S. economy between $2.3 trillion and $2.5 trillion. Today, such an event could carry a price tag as high as $8 trillion—a figure equal to 62.5 percent of our annual GDP or nearly $27,000 for every man, woman, and child living in America.

But there is more cause for concern over such an event than just the economic toll. A supply disruption of significant magnitude, such as would occur should Saudi supplies be interdicted, would also dramatically undermine the Nation's ability to defend itself.

Oil has long been a vital military commodity, but today has taken on even more critical importance. Several examples illustrate this point:

- A contemporary U.S. Army Heavy Division uses more than twice as much oil on a daily basis as an entire World War II field army.
- The roughly 582,000 troops dispatched to the Persian Gulf used more than twice as much oil on a daily basis as the entire 2-million-man Allied Expeditionary Force that liberated Europe in World War II.
- In Operation Iraqi Freedom, the oil requirement for our Armed Forces was 20 percent higher than in the first gulf war, Operation Desert Storm, and now amount to one barrel of refined petroleum products per day for each deployed service member.

Moreover, the military's oil requirements will be even higher in the future. Therefore, a shortage of global oil supplies not only holds the potential to devastate our economy, but could hamstring our Armed Forces as well.

THE HIDDEN COST OF IMPORTED OIL

While it is broadly acknowledged that our undue dependence on imported oil would pose a threat to the Nation's economic and military security in the event of a supply disruption, less well understood is the enormous economic toll that dependence takes on a daily basis.

The principal reason why we are not fully aware of the true economic cost of our import dependence is that it largely takes the form of what economists call "externalities," that is, costs or benefits caused by production or consumption of a specific item, but not reflected in its pricing. It is important to understand that even though external costs or benefits may not be reflected in the price of an item, they nonetheless are real.

In October 2003, my organization, the National Defense Council Foundation, issued "America's Achilles Heel: The Hidden Costs of Imported Oil," a comprehensive analysis of the external costs of imported oil. The study entailed the review of literally hundreds of thousands of pages of documents, including the entire order of battle of America's Armed Forces and more than a year of effort. Its conclusions divided the externalities into three basic categories: Direct and Indirect Economic Costs, Oil Supply Disruption Impacts, and Military Expenditures.

Taken together, these costs totaled $304.9 billion annually, the equivalent of adding $3.68 to the price of a gallon of gasoline imported from the Persian Gulf.

As high as these costs were, however, they were based on a crude oil refiner acquisition cost of $26.92. Today, crude oil prices are hovering around $60 per barrel and could easily increase significantly. Indeed, whereas, in 2003 we spent around $99 billion to purchase foreign crude oil and refined petroleum products, in 2005 we spent more than $251 billion, and this year we will spend at least $320 billion.

But skyrocketing crude oil prices were not the only factor affecting oil-related externalities. Defense expenditures also changed.

In 2003, our Armed Forces allocated $49.1 billion annually to maintaining the capability to assure the flow of oil from the Persian Gulf.

I should note that expenditures for this purpose are not new. Indeed, last year marked the 60th anniversary of the historic meeting between Saudi monarch King Abdul Aziz and U.S. President Franklin Roosevelt where he first committed our Nation to assuring the flow of Persian Gulf oil—a promise that has been reaffirmed by every succeeding President, without regard to party.

In 1983 the implicit promise to protect Persian Gulf oil supplies became an explicit element of U.S. military doctrine with the creation of the United States Central Command, CENTCOM. CENTCOM's official history makes this clear stating in part: "Today's command evolved as a practical solution to the problem of projecting U S. military power to the gulf region from halfway around the world."

I am stressing the longstanding nature of our commitment to the gulf to underscore the fact that our estimates of military expenditures there are not intended as a criticism. Quite the opposite, in fact. Without oil our economy could not function, and, therefore, protecting our sources of oil is a legitimate defense mission, and the current military operation in Iraq is part of that mission.

To date, supplemental appropriations for the Iraq war come to more than $251 billion, or an average of $83.7 billion per year. As a result, when other costs are included, the total military expenditures related to oil now total $132.7 billion annually.

So, where does that leave us?

In 2003, as noted, we estimated that the "hidden cost" of imported oil totaled $304.9 billion. When we revisited the external costs, taking into account the higher prices for crude oil and increased defense expenditures we found that the "hidden cost" had skyrocketed to $779.5 billion in 2005. That would be equivalent to adding $4.10 to the price of a gallon of gasoline if amortized over the total volume of imports. For Persian Gulf imports, because of the enormous military costs associated with the region, the "hidden cost" was equal to adding $7.41 to the price of a gallon of gasoline. When the nominal cost is combined with this figure it yields a "true" cost of $9.53 per gallon, but that is just the start.

Because the price of crude oil is expected to remain at the $60 range this year, expenditures for imports are expected to be at least $320 billion this year. That amounts to an increase of $70 billion in spending for foreign oil in just 1 year. That increase would raise the total import premium or "hidden cost" to $825.1 billion, or almost twice the President's $419.3 billion defense budget request for fiscal year 2006. If all costs are amortized over the total volume of imports, that would be equivalent to adding $5.04 to the price of a gallon of gasoline. For Persian Gulf imports, the premium would be $8.35. This would bring the "real" price of a gallon of gasoline, refined from Persian Gulf oil, to $10.86. At these prices the "real" cost of filling up a family sedan is $217.20, and filling up a large SUV, $325.80.

But, can anything be done about this enormous drain on our economy?

The answer to that question is "Yes."

SOLVING THE PROBLEM

The simple truth is that we do not suffer from a lack of energy resources. Rather, what we suffer from is a lack of the political will and public consensus to use them.

As Pogo said, "We have met the enemy and they is us."

What then can we do?

The first step is to recognize that we face a two-fold problem. The first part entails assuring adequate fuel supplies for the 220 million privately owned vehicles on the road today. These vehicles have an average lifespan of 16.8 years and the average age of our vehicle fleet is 8.5 years. Therefore, we will require conventional fuels or their analogs for at least a decade, even if every new vehicle produced from this day forth runs on some alternative.

The second part of the problem is how to affect a transition to alternatives to conventional petroleum. This transition will take much longer than a decade—perhaps a generation or more—but the longer we delay beginning to make the change, the longer it will take to accomplish.

In the near term, say the next 5 to 10 years, we essentially have two options. First, to make the greatest possible use of our readily accessible conventional domestic resources, particularly the oil and natural gas that lay off our shores. We should also consider using some of our 1,430 trillion cubic feet of domestic gas reserves as a feedstock for motor fuels produced through the Fischer-Tropsch process. Indeed, we currently have 104 trillion cubic feet of so-called "stranded" natural gas in Alaska and a pipeline with some 1.1 million barrels per day of excess capacity. Stranded gas could be converted into clean burning motor fuel and transported in the existing pipeline to the lower 48 states.

We can also expand our use of renewable fuels such as alcohol and biodiesel. A concerted program to make full use of them could significantly add to our motor fuel stocks within the stated timeframe.

We should also encourage the acquisition of advanced vehicle technologies such as flex-fuel vehicles, hybrids and plug-in hybrids and vehicles that use propane or natural gas. At the same time, we should encourage the installation of biodiesel and

E85 pumps in our Nation's filling stations so that the infrastructure for alternative fuels can keep pace with the growth of the alternative fuel vehicle fleet.

Another point is to make sure that we do not forget to address nontransportation petroleum consumption. The fact that two-thirds of our petroleum is consumed in the transportation sector means that one-third is not. The opportunities to reduce oil consumption from nontransportation are greater than you might expect.

Take residential energy use, for example. Roughly 12 percent of distillate use goes to home heating, most of it imported from the Middle East. Yet, there are alternatives readily available that could totally eliminate this use, and at the same time save consumers money. For instance, a developer in Moline, IL, is currently building homes that are between 85-percent and 90-percent energy efficient, and meet their heating and cooling requirements with geothermal energy. More important, these homes are being sold for 20 percent less than conventional housing sold in the same area. So consumers are not only saving energy, they are saving enormous amounts of money.

There is another commercial process that converts wastewood into a zero-sulfur industrial boiler fuel. Our Clean Forests Program that removes deadwood and debris from national forests to prevent fires is generating an enormous amount of such wastewood, and that is just the tip of the iceberg. Oak Ridge National Laboratory estimates that a total of 1.366 billion tons of biomass is available for energy production each year. Utilizing this process, it could be turned into 5.6 million barrels of oil, per day, or close to 27 percent of our total domestic requirements.

These, of course, are just two examples. Many more exist. The important consideration is that we have a wealth of options that could help in the near to intermediate term if we would only make use of them. To do this, however, we must have leadership.

In this regard, I should note that Chairman Lugar and his colleagues, Senators Chafee, Coleman, Nelson, and Obama, deserve particular praise for their sponsorship of S. 2025, the Vehicle and Fuel Choices for American Security Act, which is based on the Energy Security Blueprint of the Set America Free Coalition, of which I was a founding member. It is focused on reducing our dependence on foreign oil, not by compromising the American way of life, but by encouraging fuel choice, utilization of the vast array of America's domestic energy resources and accelerated deployment of advanced vehicle technologies. It is clear that this sort of bipartisan effort is exactly the kind of action that is required if we are to make any progress on this critical issue.

In the longer term, there are other domestic energy resources that can be brought into play. We have between 500 billion and 1.1 trillion barrels of oil contained in our huge oil shale resources. We have 496.1 billion tons of demonstrated coal reserves—27 percent of the world total. We also have 320,222 trillion cubic feet of natural gas in the form of methane hydrates. This is equivalent to 51.1 trillion barrels of oil. Indeed one on-shore deposit in Alaska, alone, contains 519 trillion cubic feet of natural gas. That is equal to 82.9 billion barrels of oil.

We also have 4.85 billion pounds of uranium reserves. Harnessing this vital resource to provide electricity for our cities, towns, and farms is only common sense. Moreover, it could serve to reduce the need to use natural gas for electricity generation, preserving it for higher uses.

There is one final point I want to make sure is not forgotten. Some portion of every dollar we spend on imported oil finds its way into the hands of individuals who wish to do us harm. The simple truth is that international terrorism stands on two financial pillars: Oil and the drug trade. To the extent that we reduce the revenues generated by either of these activities, we hinder the ability of terrorists to operate.

To conclude, while our Nation is in dire peril due to its excessive dependence on imported oil, the situation is far from hopeless. We have the resources necessary to provide our Nation's energy needs if we can only find the political will to do so.

The CHAIRMAN. Well, thank you very much for that testimony. A great start for our morning, and we appreciate it.

I would just make the comment, parenthetically, that the President, in his speech yesterday at the Freedom House, in an extemporaneous response to a question on energy, gave a very passionate talk in which he touched upon each of the major themes that you, as witnesses, are going to be touching today. He indicated that there are many technologies available in our country to deal with energy challenges, and a sense of urgency if needed. He admitted

that some are skeptical about his speech in the State of the Union and the "oil addiction" remark. He acknowledges that. But he says, in fact, "They're wrong. That's where I am."

So, I appreciate that. It gives me some encouragement in holding this hearing this morning with my colleagues, that we have, I think, a President now who is very much interested in this. And so, we will make your statements available to the President so that he will have the benefit, as we have, of what you are having to say this morning.

I'd like to call now upon Dr. Huntington.

STATEMENT OF DR. HILLARD HUNTINGTON, EXECUTIVE DIRECTOR, ENERGY MODELING FORUM, STANFORD UNIVERSITY, STANFORD, CA

Dr. HUNTINGTON. Thank you, Chairman Lugar and Ranking Member Biden and distinguished members of the committee. I appreciate the opportunity to discuss with you today the hidden cost of oil.

As you've mentioned, tight oil markets with minimal surplus capacity have made world oil prices jumpy. Over the last 6 months, a series of political and natural events have cascaded around the globe and left their impact on increasingly nervous oil-consuming nations. The list goes on. I have listed them in my handout, but, basically, suicide attack—thwarted suicide attack in Saudi Arabia, the Niger Delta speedboat attacks, the Venezuelan pipeline explosions, and, of course, the devastating hurricanes here in the United States. Each time, they have a sporadic nature to them, and it conveys an element of unpredictability and surprise.

I have recently coordinated several studies for the Energy Modeling Forum at Stanford University that relate directly to this issue. I'd like to share a few observations that I think summarize the perspectives of many—certainly not all, but many of the participants who were involved in the studies.

Our forum frequently brings together leading experts and advisors from Government, business, and universities and—to discuss how we can improve analysis of key problems that keep policymakers awake at night. I think this is clearly one of them.

In this particular case, the work was done primarily for the U.S. Department of Energy, but we were asked to invite those individuals we thought would be leading people on the issue. So I think it's a good cross section of people working on the topic.

Our two studies focused on two areas. One is the risk of another major oil disruption. And the second one is the economic consequences of those oil-price shocks. I am also submitting both reports that we did, and they certainly go into a lot more detail than I can remark here in my brief comments.

I'll also just spend a little time talking about a third issue that we did not look at, and that is our dependence on the oil-producing cartel.

Although these recent episodes have made oil-importing countries nervous, and have imposed some very high costs on people and infrastructure, they have yet to duplicate the kinds of shocks that we experienced during the 1970s and the early 1980s—and the early 1990s. As a result, their economic impacts have been

more tolerable than in the past. Despite recent oil price volatility, for example, we've still had very strong economic growth. GDP growth has maintained 3½ percent since the end of 2001.

A number of knowledgeable experts, however, are concerned about the very real possibility of more damaging shocks in the future. A group assembled by Stanford's forum, of which I am the director, thought that the odds of at least one very damaging shock over the next 10 years, were higher than a continuation of today's events, where we have an oil market with a lot of volatility, but without such a disruption. And, although another major oil disruption is not a certainty, its likelihood is significantly high that, I think, we have to be quite worried about it.

Basically, the way I describe our results is that your odds of drawing a club, a diamond, or a heart from a shuffled deck of playing cards are three out of four. In the EMF study that I referred to, the participants found that the odds of a foreign oil disruption happening over the next 10 years is basically that. It was actually a little higher, at 80 percent.

And the disruption events that we looked at included surprise geopolitical, military, or terrorist turmoil that would remove at least 2 million barrels per day. That's about 2.1 percent of the expected global oil production. And it could be more than that level, but it had to remove at least that amount.

Foreign disruptions of this magnitude would have more serious effects on oil prices and the economy than we have seen with Katrina and Rita. Oil prices, however, would rise more, and longer than a few months in the heating season. And, basically, we thought of these episodes as perhaps doubling the price in a 3-month period.

In the study, the experts estimated the amount of oil lost to the market is the number of barrels removed from the market by the initial disruption, minus any offsets from using excess capacity from undisrupted regions. So, if the disruption was not in Saudi Arabia, maybe they would have some extra capacity.

We asked the experts to exclude any releases from the U.S. Strategic Petroleum Reserve, as these actions require separate decisions from the Government during an emergency.

The approach identified four major supply regions where disruptions are most likely. And you can imagine what those regions were. They account for roughly similar shares of total world oil production, collectively. As a group, they account for about 60 percent of total world oil production. The study lumped in one region—Algeria, Angola, Libya, Mexico, Nigeria, and Venezuela—and called that group the "West of Suez." Saudi Arabia was the second region. And other Persian States—Iran, Iraq, Kuwait, and the other Persian Gulf States—were the third region. And, finally, Russia and the Caspian States comprised the fourth region.

Of these regions, the riskiest areas were the Persian Gulf countries outside of Saudi Arabia, and several countries along the Atlantic basin, such as Nigeria and Venezuela. The least risky area, from a disruption point of view was Russia and the Caspian States. Though the participants found the possibility of disruptions was lower in Saudi Arabia than in the other regions, certainly disruptions there would tend to have larger effects, if they did happen.

In the second study, on the economic consequences of a major disruption, we sought to understand how easily the economy could absorb such a shock. And figure 1 that's shown here, as well as in my presentation, shows that oil price shocks preceded 9 out of the last 10 recessions in the United States. The solid line indicates the path of the inflation-adjusted crude oil prices since 1950. This is the line that's moving up and down on the chart. The gray bars on the slide, that are moving in a vertical direction, denote periods when the U.S. economy was experiencing recessions, as defined by the National Bureau of Economic Research. This finding was first advanced by Professor James Hamilton at the University of California at San Diego, and it's been confirmed by a number of other researchers. So, the price shocks occur before, rather than after, the recession.

If a large disruption does occur, we can expect very serious economic consequences. Large disruptions, especially if they move inflation-adjusted oil prices higher than experienced recently, will cause unemployment and excess capacity to grow in certain key sectors. Many large-scale models of the U.S. economy estimate that the level of real GDP could decline by 2 percent for a doubling of oil prices. That impact is on the level of real GDP. Since the economy is growing more rapidly than 2 percent per year, that would not mean, necessarily, a recession, but it would certainly slow down economic growth.

Other researchers in the group, however, think that these estimates underestimate the impacts, because they do not focus explicitly on sudden and scary oil price shocks, which cause a different set of results.

These other researchers think that our historical experience suggests that the level of real GDP would decline by more. And their estimate is at about 5 percent for a doubling of the oil price.

My personal view is that this second estimate is probably closer to what would happen if the world actually had a major disruption, because I think they've taken the care to sort out shocks from other types of oil price movements. But if they are correct, it clearly means we're going to have a recession if we have a major disruption of this kind.

Now, some people think that oil shocks may not be a problem, because the Federal Reserve Board could intervene and lessen the impact. I have a great deal of faith in the Federal Reserve Board. They've done a marvelous job in controlling inflation, which places the U.S. economy in a better position for offsetting oil disruptions than in previous decades. However, I'm not an expert on the Federal Reserve Board, but I am not yet convinced that they can compensate the economy for a large, devastating disruption. They would have to make some important decisions very quickly, at a time when fears were running rampant. They may also find it difficult to stimulate the economy, because the nominal interest rates are already very low, both here in this country, as well as abroad.

For this reason, I think that the United States should seriously consider other types of insurance policies that would allow the Federal Reserve Board more leeway and flexibility in controlling our inflation rates.

As a general rule, strategies that reduce our dependence on oil consumption are more effective than policies that reduce our imports. That may seem a little strange, but let me explain it this way. One should view the world oil market as one giant pool, rather than as a series of disconnected puddles. When events happen overseas anywhere in the market, they will raise prices not only there, wherever the disruption is, but also everywhere that connect to that larger pool. And since reducing our imports with our own production does not sever this link to the giant pool, disruptions will cause prices to rise for all production, including that originating in the United States. So, more domestic supplies, by themselves, do not really protect us from these price shocks. Reduction in our use tends to be more effective.

Unfortunately, insurance policies are never free. I think we all recognize this. It will cost us something to implement a strategy that reduces our risk to a major oil disruption, but it will also cost us a lot of money and jobs if we do not adopt an insurance policy and the Nation faces another major disruption.

Now, figure 2 in my presentation, which I don't have shown separately, shows that the Nation's oil use per dollar of gross domestic product can respond to oil prices. And, as a result of the 1970 oil price shock, we shifted away from oil in many sectors in the early 1980s, as shown by the top line in that chart. But that trend has slowed considerably since then.

Moreover, transportation remains strongly tied to oil use. The dependence on transportation is shown by the bottom line in that chart. The dependence on oil in transportation not only affects households directly, through higher gasoline costs, but it also raises the cost of transporting goods around the country.

Now, our most recent studies did not address a third issue that could influence the cost of using oil. And let me say a word about it. And that is that the United States could adopt policies that would try to minimize or break the oil-producing cartels' control over the market. Our forum, many years ago, addressed this issue, and, although the range of views was wide, the working group then conservatively estimated that the hidden cost of oil from this source might be something on the order of 12 cents per gallon. If you're used to thinking in terms of per barrel, it's $5 per barrel, or 12 cents per gallon.

In their review of the corporate average fuel efficiency standards of several years ago, the National Research Council used a very similar estimate. That estimate is not trivial, but it is certainly not as large as some of the estimates I've seen for gasoline's hidden cost due to pollution, congestion, and automobile accidents.

To summarize, I think the Nation is vulnerable to another major disruption, not because the economy necessarily imports oil, but because it uses a lot of oil, primarily for gasoline and jet fuel. Even if domestic production could replace all our imports, which I'm not advocating that we do, the economy would remain vulnerable to the types of disruptions discussed here. However, it is very appropriate for the committee to focus on oil, because I think it is essentially a foreign policy issue.

Oil-importing governments have committed significant political and military resources to the Middle East over a number of decades in order to provide regional stability for the world oil supplies.

Excessive exposure to our oil vulnerability risks in this country increases the cost of pursuing foreign policy. It's much—as you called—it's often used as a weapon against the oil-weak countries, I think, Senator Lugar, is the way you put it, very eloquently. And I think that's a very key concern, and it reduces our capacity to conduct the foreign policy in this way.

Unfortunately, none of the estimates that I've seen can really put a number on that figure. And yet, it may be the most important issue of all. You've actually encouraged me to think more about this issue. Maybe we can try to develop something along that line.

In sum, I would say it's a very important policy issue. I think that it's only right that you are concerned about it. And I am extremely pleased that you are concerned about it.

Thank you.

[The prepared statement of Dr. Huntington follows:]

PREPARED STATEMENT OF DR. HILLARD HUNTINGTON, EXECUTIVE DIRECTOR, ENERGY MODELING FORUM, STANFORD UNIVERSITY, STANFORD, CA

Thank you, Chairman Lugar, Ranking Member Biden, and distinguished members of the committee, for the opportunity to discuss with you today the hidden cost of oil.

Tight oil markets with minimal surplus capacity have made world oil prices particularly jumpy over recent months. In the last 6 months, a series of political and natural events have cascaded around the globe and left their impact on increasingly nervous oil-consuming nations. These developments have been extremely varied and include the following:

- A thwarted suicide attack in February at the Abqaiq oil processing facility in eastern Saudi Arabia;
- A string of turmoil in the Niger Delta highlighted by a recent speedboat attack in January by gunmen on the riverside offices of Italian oil company Agip;
- Antigovernment attempts to disrupt congressional elections in Venezuela culminating in an explosion at an oil pipeline connected to that country's largest oil refinery; and
- Devastating Hurricanes Katrina and Rita in the United States in August and September.

Their sporadic nature conveys an element of unpredictability and surprise.

I have recently coordinated several studies for the Energy Modeling Forum at Stanford University that relate directly to this issue. I would like to share a few observations that I think summarize the perspectives of many (but certainly not all) participants who were involved in the studies. Our forum frequently brings together the leading experts and advisors from government, business, and university and other research organizations to discuss how we can improve analysis of key energy problems that keep policymakers awake at night. In this particular case, the work was done primarily for the U.S. Department of Energy, but we were asked to invite individuals we thought were the leading people on this issue.

Our two studies focused on the risks of another major oil disruption and the economic consequences of oil price shocks. I am also submitting both reports that expand considerably over my brief remarks here today. I will also briefly discuss a third issue: Our dependence on the oil-producing cartel.

Although these episodes have made oil-importing countries nervous and have imposed some very high costs on people and infrastructure, they have yet to duplicate the types of oil shocks that were experienced during the 1970s and early 1990s. As a result, their economic impacts have been more tolerable than in the past. Despite recent oil price volatility, for example, real GDP in the United States has grown strongly, by 3.5 percent annually since the end of 2001.

A number of knowledgeable experts, however, are concerned about the very real possibility of much more damaging shocks in the future. A group assembled by Stanford's EMF thought that the odds of, at least, one very damaging shock over the next 10 years were higher than those of an oil market with some volatility but

without such a shock. Although another major oil disruption is not a certainty, its likelihood is significantly high enough to be worrisome.

Your odds of drawing a club, diamond, or heart from a shuffled deck of playing cards are three out of four. In the EMF study, the participants found that the odds of a foreign oil disruption happening over the next 10 years are slightly higher at 80 percent. Disruption events included surprise geopolitical, military, or terrorist turmoil that would remove at least 2 million barrels per day—an amount representing about 2.1 percent of expected global oil production. Foreign disruptions of this magnitude would have more serious effects on oil prices and the economy than we have seen with the Katrina and Rita hurricanes. Oil prices, however, would rise more and for longer than a few months or a heating season.

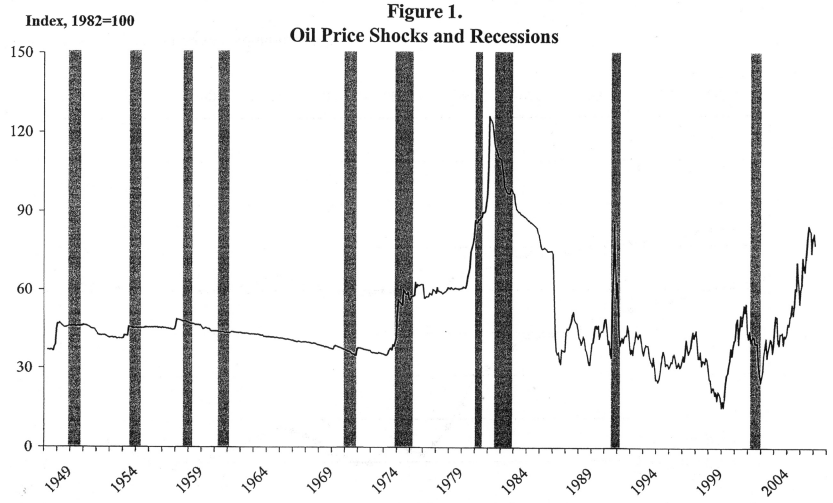
In the study, experts estimated the amount of oil lost to the market as the number of barrels removed by the initial disruption, minus any offsets from the use of excess capacity from undisrupted regions. The experts were asked to exclude any releases from the U.S. strategic petroleum reserve, as these actions require separate decisions from the government during an emergency.

The approach identified four major supply regions where disruptions are most likely. These regions account for approximately similar shares of total world oil production. Collectively, they account for about 60 percent of total world oil production. The study lumped Algeria, Angola, Libya, Mexico, Nigeria, and Venezuela as the first region, called "West of Suez." Saudi Arabia was the second region, and other Persian Gulf States—Iran, Iraq, Kuwait, Qatar, UAE, and Oman—were the third. Russia and the Caspian States comprised the fourth region.

The riskiest areas were the Persian Gulf countries outside of Saudi Arabia and several countries along the Atlantic Basin, such as Nigeria and Venezuela. The least risky area was Russia and the Caspian States. Although the participants found the possibility of disruptions was lower in Saudi Arabia than in several other vulnerable regions, disruptions there would tend to have larger effects.

In the second study on the economic consequences of a major disruption, we sought to understand how easily the economy could absorb such a shock. Figure 1 shows that oil price shocks preceded 9 of the last 10 recessions in the United States. The solid line indicates the path of inflation-adjusted crude oil prices since 1950. The gray bars denote periods when the U.S. economy was experiencing recessions as defined by the National Bureau of Economic Research (NBER). This finding was first advanced by Professor James Hamilton at University of California at San Diego and has been confirmed by numerous other researchers.

Figure 1.
Oil Price Shocks and Recessions



Source: Stephen P.A. Brown, Federal Reserve Bank of Dallas. Based upon findings of Professor James Hamilton, University of California at San Diego.

If a large disruption does occur, we can expect very serious economic consequences. Large disruptions, especially if they move inflation-adjusted oil prices higher than experienced recently, will cause unemployment and excess capacity to grow in certain key sectors. Many large-scale models of the U.S. economy estimate

that the level of real GDP could decline by 2 percent for a doubling of oil prices. Since the economy is growing more rapidly than 2 percent per year, that impact would not mean a recession.

Other researchers, however, think that these estimates underestimate the impacts, because they do not focus explicitly on sudden and scary oil price shocks. These other researchers think that our historical experience suggests that the level of real GNP would decline by more, at 5 percent for a doubling of the oil price. My personal view is that the higher estimate may be closer to what would actually happen if we had a major disruption. That would mean a recession.

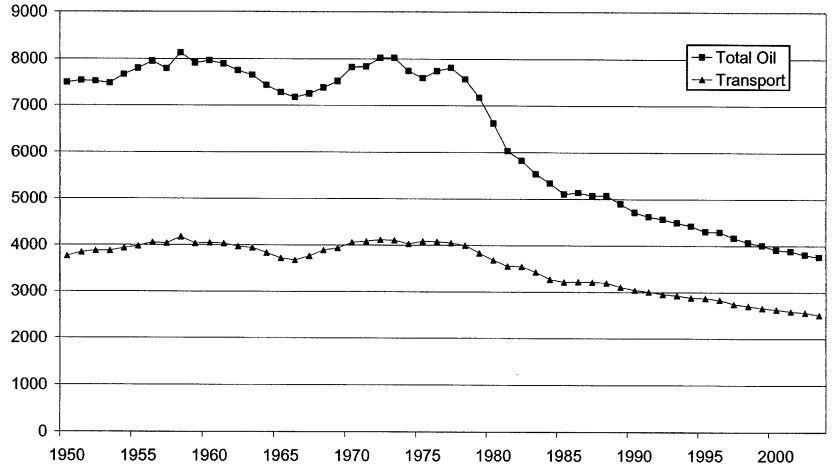
Some people think that oil shocks may not be a problem because the Federal Reserve Board could intervene and lessen the impact. I have a great deal of faith in the Federal Reserve Board. They have done a marvelous job in controlling inflation, which places the U.S. economy in a better position for offsetting oil disruptions than in previous decades. I am not yet convinced that they can compensate the economy for a large devastating disruption. They would have to make some important decisions, very quickly, at a time when fears were running rampant. They may also find it difficult to stimulate the economy because nominal interest rates are already very low, not only here but also abroad. For this reason, I think that the United States should seriously consider other types of insurance policies that would allow the Federal Reserve Board more leeway and flexibility in controlling our inflation rates.

As a general rule, strategies that reduce our dependence on oil consumption are more effective than policies that reduce our imports. One should view the world oil market as one giant pool rather than as a series of disconnected puddles. When events happen anywhere in the market, they will raise prices not only there but also everywhere that connect to that large pool. Since reducing our imports with our own production does not sever our link to that giant pool, disruptions will cause prices to rise for all production, including that originating in the United States. More domestic supplies do not protect us from these price shocks.

Unfortunately, insurance policies are never free. It will cost us something to implement a strategy that reduces our risk to another major oil disruption. But it will also cost us a lot of money and jobs if we do not adopt an insurance policy and the Nation faces another major disruption.

Figure 2 shows that the nation's oil use per dollar of Gross Domestic Product can respond to oil prices. As a result of the 1970 oil price shocks, we shifted away from oil in many sectors in the early 1980s, but that trend has slowed considerably since then. Moreover, transportation remains strongly tied to oil use. The dependence on oil in transportation not only affects households directly through higher gasoline costs but it also raises the costs of transporting goods around the country.

Figure 2. Oil & Natural Gas Intensity (Btu/$)



Source: US Energy Information Administration.

Our most recent studies did not address a third issue that could influence the costs of using oil. It is sometimes argued that the United States could adopt policies that would try to minimize or break the oil-producing cartel's control over the market. Our forum addressed this issue many years ago. Although the range of views was wide, our working group conservatively estimated that the hidden cost of oil from this source might be $5 per barrel, or 12 cents per gallon. Several years ago, the National Research Council used a very similar estimate in their review of the corporate average fuel economy standards for automobiles. That estimate is not trivial, but it is considerably smaller than various estimates for gasoline's hidden costs due to pollution, congestion, and automobile accidents.

In summary, the Nation is vulnerable to another major disruption not because the economy imports oil but primarily because it uses a lot of oil, primarily for gasoline and jet fuel. Even if domestic production could replace all oil imports, which I am not advocating, the economy would remain vulnerable to the types of disruptions discussed here. However, it is very appropriate that this committee focus its energy on this issue. Oil-importing governments have committed significant political and military resources to the Middle East over a number of decades in order to provide regional stability that is critical to world oil supplies. Excessive exposure to oil vulnerability risks in this country increases these costs or reduces the capacity to pursue foreign policy objectives that are critical for mitigating nuclear proliferation, terrorism and other risks that reduce global security. I cannot provide you with an estimate for this political cost of using oil, but it is extremely important.

The CHAIRMAN. Well, thank you, Dr. Huntington, for your contribution to this discussion this morning.

We call now on Dr. Yohe.

STATEMENT OF DR. GARY W. YOHE, JOHN E. ANDRUS PROFESSOR OF ECONOMICS, WESLEYAN UNIVERSITY, MIDDLETOWN, CT

Dr. YOHE. Mr. Chairman, members of the committee, thank you very much for your invitation to present testimony today on the hidden costs of oil.

My task is to think about the hidden costs related to climate change that is buried in the background of petroleum costs that don't reflect that externality. And the idea is to try back out the share of oil to get the right order of magnitude in thinking about such things.

I'm afraid that the answer to this deceptively simple question is the same as it is to just about every economics question that I've ever seen, and that is that "it depends." And so, what I would like to do is spend a little bit of time walking you through some of the contexts of what it depends on and how much Mother Nature and scientific uncertainty plays a role in that.

I will begin with a brief review of 100 published estimates of what is termed the social cost of carbon, which can be backed down to the social cost of the carbon content of petroleum.

I will observe that those estimates vary all over the map, and offer some explanation of why.

I will also try to provide an alternative way about thinking about the hidden cost of oil, and that is the notion that the climate is changing, may, in fact, turn out to be changing abruptly. There will be times, perhaps, in the future when we begin to recognize that, and sudden adjustments in climate policy will be required. The costs of those adjustments will be much smaller if we begin to hedge against those costs. And that gets us out of the realm of thinking about the uncertainty of climate damages and into the realm—which is still uncertain, but not quite as uncertain—the realm of estimating the economic cost of energy policy, per se. It

also allows uncertainty to become a reason to do something in the near term, rather than a reason to delay, because this hedging strategy is essentially, as Hill just mentioned in another context, buying insurance, and the more risk you face and the wider the uncertainties; the more insurance you pay—the more insurance you buy at a particular premium. But uncertainty is the reason why you're doing something.

I will, finally, argue that, perhaps another hidden cost is embedded in the investment decisions that are made in the public arena and in the private arena, that ignoring the social costs, climate costs of petroleum, systematically undervalues investment projects that would provide alternative fuels, like ethanol—I've heard that mentioned two or three times this morning already—and, perhaps more of concern, it overvalues investments in projects that would actually perhaps increase our reliance and consumption of petroleum.

So, to wander through these thoughts:

Economists may disagree on the number, but they do agree on the approach to thinking about the hidden cost, the climate-change cost of carbon, and that is to think about the marginal cost of a unit of emissions at a particular point in time, as it's cast forward; and you try to track where the damages occur, and try to estimate those damages, and bring it back, to get some idea of was is the extrasocial damage created by those particular units of emission.

Economists also, oddly enough, agree on something else. That is, that this social-cost estimate will rise, over time, at 2 to 3 percent per year, as the concentrations of greenhouse gases increase.

Where they don't agree is, of course, on the estimation, per se. So, what I would like to do is provide a couple of glimpses of the sources of concern from the climate literature. On your right is a figure from the third assessment report of the Intergovernmental Panel on Climate Change. It is the summary of the lines of evidence of impacts of climate. And identified are five different reasons for concern. The color codes suggest the degree of vulnerability that systems around the world might face, even taking into account, to as much degree as possible, the ability of those systems to adapt to those external stresses. It goes from white, which is not much vulnerability, through yellow and orange, and up to red. In the red areas, it's essentially a judgment by the people who assess the literature that the capacity to adapt to these climate-related stresses may, in fact, be overwhelmed by the stresses that are there.

It's also important to notice that any one of those lines of concern, sources of vulnerability, are unevenly distributed around the globe. So, the second figure that I provided indicates two different possibilities for a picture in 2050. One calibrates vulnerability around the world to aggregate impacts, which is the second row on that particular—on the "Burning Embers" diagram from the IPCC—it suggests that developing countries are, as according to the hypothesis, perhaps more vulnerable to climate change. But the developed world doesn't get away scot free either. If you calibrate the distribution in terms of something a little bit more urgent, like the risk of extreme weather events, the portrait for 2050 again displays high vulnerabilities now in the developing world and signifi-

cant vulnerability across the developed world, including North America, which sits up there, in an orange. And if you look over there, it's sort of on its way to being something to which we could begin to worry that even our ability to respond to the external stresses of these climate events might be overwhelmed by the events themselves.

So, economists have then taken a look at these and tried to estimate them over time. I didn't have—I didn't ask that the third figure I provided be blown up, but there is a distribution indicated there of the estimates of the social cost of carbon across the hundred published estimates that are currently available, expressed both in dollars per ton of carbon emitted and also backed into dollars per barrel, based on the carbon content of petroleum.

Now, the way to read the table, at least in terms of the numbers, is to think about your old days when you took SATs, and think about percentiles. Point A, for example, indicates the estimate of zero for the social cost of carbon. It's the 14th percentile, indicating that 14 percent of these estimates actually had negative costs—i.e., benefits. How is that possible? Some of the estimates, some of the models, suggest some moderate benefit to some sectors of developed economies for very modest changes in climate. And a high discount rate that picks up very little of the downstream costs could end up with a benefit to climate. But the median estimate is point B. That's where 50 percent of the estimates are below that, at that number, and 50 percent are above that number. That comes out to about $2 a barrel. The 80th percentile is $9 a barrel. That means 80 percent are below that, but 20 percent of the estimates are above $9 a barrel. And the average across all of the estimates, because the distribution is skewed, is $11 a barrel. And to reemphasize, the notion is that those are for emissions in 2005, and that they would increase—those costs would increase at 2 or 3 percent per year.

So, how do you interpret the content of that? Richard Tol, a friend of mine who's an economist at the University of Hamburg, looks at that distribution—he's actually the one who did the meta-analysis that produced it—and said that it looks like $50 a barrel is about the maximum reasonable number for the social cost of carbon.

Tom Downing, who's a geographer at the Stockholm Environment Institute, however, looks at that distribution, and he's one that's spent a lot of time looking at vulnerabilities across Africa and developing countries, looking at the risks that peoples in those places face to changes in climate, and he thinks $50 is a threshold, as well, but he thinks it's the lower bound. He thinks the social cost of carbon is legitimately much above $50 a barrel.

How do we get such a wide range? Well, there are a lot of different reasons. I already mentioned the discount rate. There's also the possibility of equity weighting: Do you really worry about the people in Africa versus the people in a developed world? These are choices that decisionmakers get to make, parameters they get to think about as they judge the opportunity cost and the degree to which they would like to pursue polices in terms of these particular problems.

There are, however, a wide number of parameters underneath those estimates over which you do not have decisionmaker authority. These are essentially determined by Mother Nature. The major one is climate sensitivity, the degree to which the global mean temperature would increase if atmospheric concentrations were to double. The IPCC has reported that number between a degree-and-a-half and 4½ or 5½ degrees, depending on which report you read. But more recent research suggests that the historical data cannot reject the hypothesis that that climate sensitivity could be as high as 8 or 9 or 10 degrees centigrade. And if you plug those climate sensitivities into a model, even if you have high discount rates and don't worry about equity at all, you still get a high social cost of carbon. So, decisionmakers cannot get out of it with respect to that.

So, the question, I think, is: Given the range of uncertainty, and given the attempts to understand where it comes from, and recognizing that we simply don't know what Mother Nature has in store for us, how do we think about the social cost of carbon in a constructive way? And I would like to propose a second way, which, as I suggested earlier, was to think about hedging against the adjustment costs of making policy decisions in the near to medium term that would essentially have to abruptly change the way we consume energy.

What might such a thing be? Abrupt climate change—it's called "risks of large-scale discontinuities," in the jargon of the IPCC—is one place. Some work that I've done with Michael Schlesinger and some other folks suggests, for example, that if the global mean temperature were to increase another 2 degrees from 2000 levels, that there would be a 50-percent chance of the collapse of the thermohaline circulation, otherwise known as the Gulf Stream. That's—you were talking about pulling cards out of a deck—that's a flip of a coin. Heads, it shuts down; tails, it keeps going. We're not quite sure exactly how that's going to happen, but that's the best that our scientific knowledge will tell us. And should it become clear that that's happening—and that's not an experiment we'd like to try on the only planet we have—there might come a time when we need to make a policy adjustment.

So, my proposal is to think about minimizing the expected costs of making such policy adjustments. And, again, Michael Schlesinger and I and a couple of other people did a little thought exercise, in a very simple model that was actually motivated by an exercise that the Energy Modeling Forum put together 15 years ago, and came up with the notion that about $1.50 a barrel, starting now, as the reflection of a climate policy, but increasing persistently and predictably at the rate of interest over time, would be a reasonable hedge against the economic—abrupt economic costs of abrupt changes in policy. It's a very simple exercise. It only had one source of uncertainty—the climate sensitivity—so, I think that number is too low, but it's indicative of the notion that you can think about that as an insurance premium, as a hedge against something that we can predict and estimate a little bit more than climate effects. And it does, as I said before, as well, give uncertainty the reason to do something, rather than the reason not to do something.

Last, the last hidden cost that I mentioned, it strikes me that if you do not include the environmental costs of petroleum, the climate costs of petroleum, in your evaluations of what it really costs the planet for you to burn a barrel of oil, for whatever purpose, you systematically undervalue conservation projects—programs, plans, policies—projects that would look for alternative energy sources, things that are more sustainable. And that is—and makes it less likely that those projects would be undertaken. Systematically, as well, you overvalue new sources of oil, you overvalue new sources of consumption of oil, simply because the energy required to drive it is not priced appropriately.

So, if you ask me what a number would be, as I said, I think $1.50 is too low. I think $6 would be OK. That's the Downing/Tol threshold. Ten dollars might be OK. It's actually really less important what number starts the policy now. It is more important, and absolutely critical, that it increase over time at a predictable rate, like the rate of interest, which has some economic validation to it. It then becomes predictable. It's persistent, and it's incorporated in the planning and investment decisions that people would undertake.

I would encourage the second risk approach to thinking about climate policy, get out of the cost-benefit-calculator mode and begin to think about managing risks in thinking about policy portfolios, and uncertainty becomes the reason to do something in the near term, and to continue to do something at an increasing rate over the medium term.

I thank you very much for your attention.

[The prepared statement of Dr. Yohe follows:]

PREPARED STATEMENT OF DR. GARY W. YOHE, JOHN E. ANDRUS PROFESSOR OF ECONOMICS, WESLEYAN UNIVERSITY, MIDDLETOWN, CT

Mr. Chairman, Senator Biden, and members of the Committee on Foreign Relations, thank you for your invitation to present testimony on "The Hidden (Climate Change) Costs of Oil." It is indeed an honor to be here, today.

The task that I accepted when I agreed to testify involves providing some insight into the economic cost of carbon emissions so that you can "back out the share of oil to get the right order of magnitude." I am afraid, however, that this deceptively complicated question has the same answer as nearly every other question in economics: "It depends." My testimony will, therefore, be directed at providing insight into the underlying factors upon which these costs depend. I will, however, also offer some thoughts about what the underlying uncertainty means for climate policy and the hidden cost of oil.

I will begin with a brief review of the range of more than 100 published estimates of what is termed the "social cost of carbon"; this is the calculation by which we can attribute a share of cost to oil based on its carbon content (per unit energy). I will highlight why the range of these estimates is so large. I will suggest which of the factors that make the range so large can be influenced by political decision-makers, but I will also focus attention on scientific factors that are beyond their control. Thinking about how we should cope with these scientific factors will lead me to identify two fundamental sources of hidden cost that may not be immediately obvious.

I will, in particular, suggest an alternative way to calculate the hidden climate costs of oil based explicitly on hedging against the potentially severe economic costs of abrupt changes in policy. These policy adjustments may be required over the near to moderate term as we come to know more about the impacts and/or likelihoods of climate change (particularly abrupt climate change). It is important to recognize that many of these impacts have not yet been included in the direct calculation of social cost. Adopting a risk-management (hedging) approach to minimize the cost of future policy adjustments is, therefore, an appropriate, economically rational way to

think about the social cost of carbon. Moreover, it makes uncertainty a reason to act immediately rather than a reason to procrastinate.

I will, as well, argue that ignoring social costs calculated by either a tradition direct method or one derived from a risk-management approach systematically undervalues projects and programs that would reduce our consumption of petroleum (like investment in ethanol as an alternative source of energy) while it produces an symmetric overvaluation of projects and programs that would do just the opposite (like drilling in the Arctic National Wildlife Refuge).

To begin, I recall "burning ember" diagram from the Third Assessment Report (the TAR) of the Intergovernmental Panel on Climate Change (2001) in Figure 1. It duplicates Figure TS–42 from the Technical Summary of the Third Assessment Report where five Lines of Evidence" were identified. These are the five sources of concern, or indicators of vulnerability, that have captured our attention. Two are essentially economic indicators of aggregate impacts at the global and regional levels. They are dominated by estimates of the costs of the climate impacts in market-based sectors like real estate (in response to rising seas), agricultural, energy, and the like. As such, they do include evaluations of how various nations and even communities within nations might adapt to climate-related stress. It is important to recognize, of course, that these impacts are felt unevenly across the globe. Panel A of Figure 2 offers a representative portrait of a possible geographic distribution of vulnerability to climate impacts in 2050 calibrated in terms of aggregate impacts. Developing countries show up as most vulnerable, but developed countries are surely not immune to climate risk even when their superior capacities to adapt are recognized.

Figure 1: Sources of Concern and Color-Coded Indications of Vulnerability [Source: the "Burning Embers" of Figure TS-12 in IPCC (2001)]. Relative levels of vulnerability along five "Lines of Evidence" or "Sources of Concerned" and their sensitivity to increases in global mean temperature were assessed based on the literature available through the middle of 2000. Low vulnerability was indicated by a white or very pale yellow coloration. High vulnerability was highlighted by red coloration; and intermediate vulnerabilities by various shades of yellow and orange.

Figure 19-8-1: Summary of Lines of Evidence

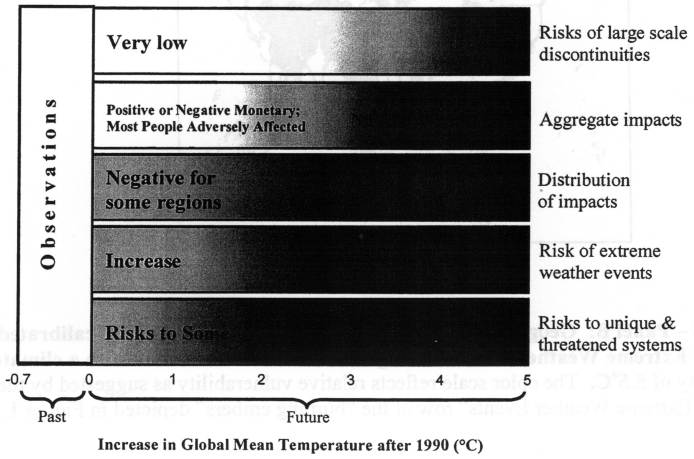


Figure 2 – Panel A: Geographical distribution of vulnerability in 2050 calibrated to "Aggregate Impacts" along an A2 emissions scenario with a climate sensitivity of 5.5°C. The color scale reflects relative vulnerability as suggested by the "Aggregate Impacts" row of the "burning embers" depicted in Figure 1.

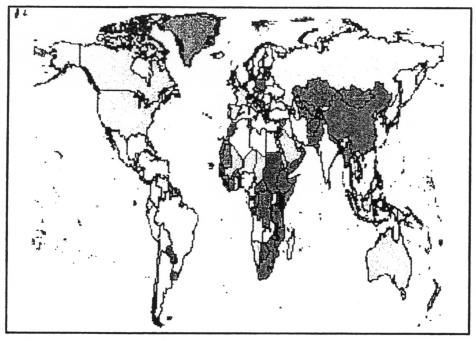
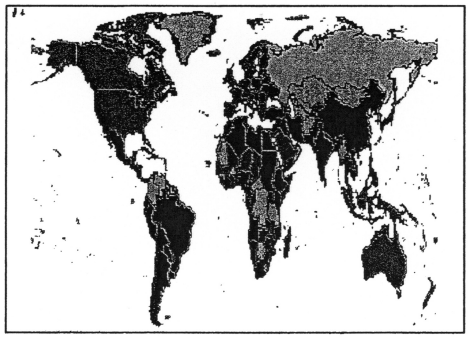


Figure 2 – Panel B: Geographical distribution of vulnerability in 2050 calibrated to "Risk to Extreme Weather Events" along an A2 emissions scenario with a climate sensitivity of 5.5°C. The color scale reflects relative vulnerability as suggested by the "Risk of Extreme Weather Events" row of the "burning embers" depicted in Figure 1.



A third row in Figure 1 focuses attention squarely on ecosystems, although the IPCC did not provide the detailed assessment of ecosystem services that was so thoroughly documented in the recently completed Millennium Ecosystem Assessment. The last two rows reflect vulnerability to two potentially more significant areas concern: "Risks from Future Large-Scale Discontinuities" and "Risks from Extreme Weather Events." Figure 2 illustrates the uneven impact point by displaying a plausible global distribution of vulnerability in 2050 calibrated to the risks of extreme weather events. Developing countries are still most vulnerable, but developed countries also face significant vulnerabilities from a more urgent "source of concern."

Economists have been trying for some time to assign currency values to the impacts of climate change identified in Figure 1 by tracking their potential trajectories along long-term scenarios of how the future might unfold. Not surprisingly, economists do not agree on what that future might hold. They do, however, agree on what

measure to use: "the social cost of carbon." What is that? It is the damage caused over time by releasing an addition unit of ton of carbon in the atmosphere discounted back to the year of its emission. That is to say, the social cost of carbon represents the "marginal cost" of emissions; alternatively, it represents the "marginal benefit" of unit of carbon emissions reduction. Most importantly for present purposes, the social cost of carbon, when modified by the carbon content of petroleum, is the hidden (climate change) cost of oil.

Figure 3 – Panel A: The Distribution of Published Estimates of the Social Cost of Carbon Emitted in 2005 (expressed in 2005$ per ton of carbon emitted). Source: Tol (2005)

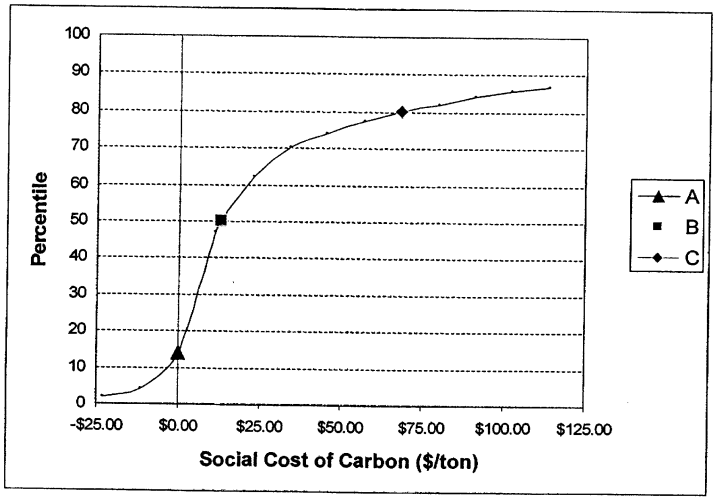


Figure 3 – Panel B: The Distribution of Published Estimates of the Social Cost of Carbon Emitted in 2005 (expressed in 2005$ per barrel of oil). Source: Tol (2005)

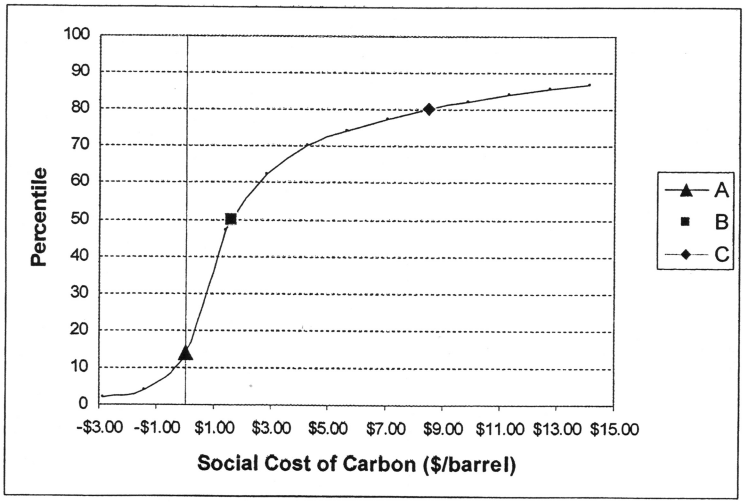


Figure 3 displays the range of more than 100 estimates currently available in the published literature; it is derived from Tol (2005). Panel A of Figure 3 displays the social cost in dollars per metric ton of carbon; Panel B tracks the estimate to the hidden cost of oil by expressing social cost in dollars per barrel of oil.

How should the data portrayed in Figure 3 be read? Percentile values are recorded up the vertical axis for cost estimates ordered from lowest to highest. So, for example, point A indicates that 12 percent of the published estimates were below $0. Point B highlights the median estimate, suggesting that 50 percent of the estimates were below $13 per ton of carbon ($2 per barrel of oil), and 50 percent of the estimate were above this benchmark. Point C shows that 20 percent of the estimates were above $73 per ton of carbon ($9 per barrel of oil). Finally, the average across all of the published estimates is $85 per ton ($11 per barrel of oil).

How should the content of Figure 3 be read, given all of the disagreement that it reveals? Richard Tol, an economist from Germany, read the data to mean that $45 per ton should be interpreted as the upper bound for a reasonable "best" estimate of the social cost of carbon; this is $6 per barrel of oil. Thomas Downing (2005), a geographer from the Stockholm Environment Institute office in the United Kingdom looked at the same distribution through the lens of enormous experience in developing countries where changes in climate produce enormous displacement effects that cannot be quantified in terms of currencies. He read the data to mean that $45 per ton or $6 per barrel of oil should be interpreted as a lower bound to the true social cost of carbon.

I have been told that presenting such a figure in a political environment would allow people, who do not think that climate is a problem, to focus on the lower part of range and people who think that climate is a large problem to focus on the upper part of the range. Productive conversations between the two sides, I have also been told, would seldom be a product of such readings.

For this, and a few other reasons, I now preach caution to all. To appropriately read Figure 3, we must work to understand what is going on behind the scenes. Why is the range so large? Which of the "Lines of Evidence" do the estimates include, and which do they miss? What combinations of underlying factors produce low or even negative estimates of social cost, and what other combinations support estimates on the high end of the scale? Answers to these questions can be enormously revealing.

The choice of discount rate and the incorporation of equity weights are extremely important, and both lie within the purview of decisionmakers. High discount rates sustain low estimates because future damages become insignificant. Conversely, low discount rates produce high estimates because future damages are important. Meanwhile, strong equity weighting across the globe support high estimates because poor developing countries are most vulnerable. Conversely, weak or no equity weighting can produce low estimates because poor developing countries do not factor heavily in the overall calculation.

It turns out, however, that several scientific parameters that decisionmakers cannot choose are even more important in explaining the variability depicted in Figure 3. Indeed, climate sensitivity (i.e., the increase in global mean temperature that would result from a doubling of greenhouse gas concentrations from preindustrial levels) is the largest source of variation. It is possible to derive high estimates for the social cost of carbon even if you assume low discount rates and almost no equity weighting. All that is required is the assumption that the climate sensitivity lies at the high range of the latest range of estimates. Andronova and Schlesinger (2001), for example, find that the historical record could easily be explained with climate sensitivities as high as 8 or 9 degrees Centigrade (even though the TAR reported an upper bound of 5.5 degrees).

Moreover, none of the estimates from which Figure 3 was drawn include the economic costs of "Risks from Extreme Climate Events" or "Risks from Future Large-Scale Discontinuities."

To offer one glimpse at the role that these sources of concern might play, I can report the results of some more recent work that focuses on what we know about when the Atlantic thermohaline circulation (the Gulf Stream when it flows close to the United States) might weaken or suddenly collapse. Schlesinger, et al. (2006) put the chance of collapse at 50 percent if the global mean temperature were to climb by another 2 degrees Centigrade. Put another way, Yohe, et al. (2006) show more than a 40-percent chance of collapse by 2105 along a "middle-of-the-road" emissions scenario. Imposing a global policy targeted at a $100 per ton social cost of carbon ($12 per barrel of oil) would reduce that likelihood to 25 percent if it were initiated immediately; but only to 35 percent if it were delayed by 30 years.

At this point, it is essential to reemphasize the point that none of these critical scientific factors can be decided by committee deliberation and popular elections.

Their values are up to nature to decide, and we simply do not know what she has in the cards for us. The bottom line is that the planet faces significant risks whose economic impacts have not yet been quantified. We have some idea of their likelihood, though, and so it is impossible to claim with certainty that they will not materialize as the future unfolds.

What should we do? We should recognize that the climate policy will be adjusted over time as we learn more, especially if all (or even one) of the really bad news scenarios begin to materialize. We should also recognize that these adjustments could significantly, and immediately, change the economic environment in which we will be living. Moreover, we should recognize that these adjustments might be required sooner rather than later.

All of this risk in the policy realm suggests an alternative method for estimating the social cost of carbon. Yohe, et al. (2004) conducted a simple "act-then-learn" experiment which showed that the expected discounted cost of global policy adjustment in 2035 could be minimized if a modest hedging policy were begun now. Their work suggests a risk-based social cost of carbon in 2005 equal to about $10 per ton ($1.50 per barrel of oil). And their approach makes uncertainty is the reason to act in the near term rather than a reason to delay.

To be clear, tacking on $1.50 to the price of a barrel of oil will not do the trick. This risk-based social cost would increase over time at the rate of interest. So it would be $3 per barrel in 2020 and $5 per barrel just after 2030. The critical component of the policy, and this estimate of social cost, is not the starting point. Consistent with the observation by Watkiss, et al. (2005) that the traditionally computed social cost of carbon increases over time, it is the persistent and predictable ratcheting-up of the effective price of carbon that would give the hedging strategy any traction at all.

This observation brings me to my last point—identifying a second potentially expensive consequence of ignoring the hidden climate cost of oil. Failing to include estimates of the social cost of the carbon content of oil simply makes projects that use more oil or provide more oil more likely to go forward. Why? Because the calculations upon which the investment decisions would be made would inappropriately underestimate true costs. They would, in other words, show exaggerated benefit-cost ratios because the denominators would be too low. Conversely, failing to include the social cost of the carbon content of oil makes projects that conserve oil or provide alternative sources of energy less likely to go forward. They would simply show deflated benefit-cost ratios because the numerators would be too low.

So, what if I had to pick a number? What would I say if asked to estimate place the hidden social cost of oil in perspective? I think that my $1.50 per barrel risk-based estimate is too low, since our analysis assumed immediate global participation in any policy response 2005 and it captured only a very limited set of possible sources of uncertainty. Given all of the impacts that are not yet part of the more traditional approaches, though, I do not think that the $6 per barrel estimate that separated Tol from Downing is too high. If pressed, I would probably say $5 per barrel for 2006, but I could be just as comfortable with $10. Indeed, I would insist only that the social cost attributed to oil for its climate impacts increase over time at the real rate of interest.

Again, thank you for the opportunity to be here today, and thank you for your attention.

The CHAIRMAN. Well, thank you very much, Dr. Yohe, for, once again, a very informative and provocative discussion.

I wanted to call upon the distinguished ranking member, Senator Biden, for an opening statement or opening comments that he might have for the hearing.

STATEMENT OF HON. JOSEPH R. BIDEN, JR., U.S. SENATOR FROM DELAWARE

Senator BIDEN. I'd just like to explain to this impressive panel that the reason I wasn't here, we have a markup in the Judiciary Committee, which I happen to be a member of, as well. And I apologize for being late.

I look forward to reading all your statements. And, when it's appropriate, I will have a few questions.

But, in the meantime, I'd put my statement in the record, rather than take the time now.

The CHAIRMAN. Thank you. The statement will be placed in the record in full.

[The prepared statement of Senator Biden follows:]

PREPARED STATEMENT OF HON. JOSEPH R. BIDEN, JR., U.S. SENATOR FROM DELAWARE

Mr. Chairman, thank you for holding this hearing on the "Hidden Costs of Oil."

For most of us, the costs of oil seem far from hidden. They are right up there on the signs at our gas stations, they are there in black and white on our heating bills.

But as our witnesses will show us today, the price at the pump, the price on our heating bills, as bad as they may be, are only part of the story. Those prices conceal the hidden tax we pay to OPEC countries who use their pricing power to charge us more than they could get in an open international market for oil.

In addition, those prices conceal the costs of the security commitments we face to protect the supply of oil from OPEC and other foreign sources. And they conceal the costs to our foreign policy, which has been handcuffed for over half a century by our dependence on oil from parts of the world with very different interests from our own.

At the same time, the rising price of oil has created a cushion that props up despotic regimes and finances their militaries or allows other countries to put off hard decisions about democratic and economic reform.

Finally, the price at the pump hides the long-term environmental damage—as well as the economic and social disruptions—that will come with global warming. The economic, social, political, and environmental costs we face today—and the costs of dealing with their repercussions in the future—will not stay hidden. There is no free lunch, as economists never tire of telling us. Somebody eventually has to pick up the tab.

When we pay too much for oil—because OPEC can use its market power—we have less money for other priorities. That artificial inflation affects both domestic and imported oil, since there is essentially just one world market for oil. In turn, we pay too much for transportation and power. We pay too much for the plastics and other products derived from oil.

That is a dead-weight loss for the entire economy. Every watt of electricity from our powerplants, every minute we run a refrigerator or air-conditioner, every trip to the store, everything shipped by truck or rail—all those parts of our everyday lives costs more than they should. That leaves us with less to spend on other priorities. It make us poorer—as individuals, as families, as a nation.

Mr. Chairman, we often speak about the costs of our foreign policy—usually we are speaking metaphorically. We may talk about trading values or prestige in one area to secure influence or leverage in another.

But there are real costs to our policies, too, of course. As hard as they may be to calculate, we must try to measure the economic costs of our reliance on oil, especially on imported oil, on oil from countries that are themselves unstable or that promote instability.

That will be important testimony for the record of this committee, Mr. Chairman.

Throwing our net a little wider, Mr. Chairman, from the quantifiable costs of oil to our economy, and the costs of our foreign entanglements to secure that oil, we come to the costs we will incur to cope with the climate change that will result from our use of oil and other fossil fuels.

You and I share a concern about all of the foreign policy implications of climate change, Mr. Chairman. Climate change will alter growing seasons, redistribute natural resources, lift sea levels, and shift other fundamental building blocks of economic, social, and political arrangements around the world. It could spark massive human migrations and new wars over resources. We will pay a price for those, too.

No other issue carries such a threat to our way of life. Putting a dollar value on that threat can show us what we are risking if we don't act now to slow global warming.

In every one of the areas we will look at today, the near term prospects are grim. The rise of the massive economies of China and India will continue to put pressure on supply, will demand tens of billions in investments, will further complicate global oil and energy politics, and will accelerate the accumulation of carbon dioxide and other greenhouse gases.

Half the world's population—3 billion people—live on $2 a day. Just to provide them with a little electricity to replace wood and kerosene for cooking, to pump

water, to light a schoolhouse—will require more than our current energy system can provide.

To meet the inevitable challenges built into our current fossil fuel economy, we must first start with the facts. Today we will learn the many ways the true costs of oil are hidden from us.

To make clear choices, we need to have the right information. Hidden costs lead consumers to make the wrong choices. They distort investment decisions—we invest too much in systems that will make our problems worse, and we invest too little in solutions.

This hearing will give us some of the facts we need to start making the right choices.

Thank you, Mr. Chairman.

The CHAIRMAN. Let me begin the questioning. We'll have a 10-minute round, and perhaps several rounds, because there is so much to talk about.

Let me begin with some topical references to what we're talking about today that I culled from the New York Times this morning. Three perspectives.

The first deals with the problems in Ukraine following the election, but really going back to January 1, when Russia cut off some gas lines and delivery to Ukraine. Ukraine citizens then took some gas from lines that were going across Ukraine to Europe. A 48-hour contretemps occurred. The article describes the very unusual organization that was formed by Russia. It starts with the rather bizarre thought that the head of this organization is in a remote house, and no one has ever heard of him.

The problem, however, is acute for the citizens of Ukraine, even as they try to form their government. In large part because the gas was shut off, it is apparent that President Yushchenko lost a great deal of authority. He lost it in two ways, one of which was that his country was cold. People were cold, physically. Their industry, which was fledgling, was stymied. I've described this, I hope in not ultradramatic ways, as waging war without sending the first troops across the line, or bombing or strafing. You can ruin, decimate a country by cutting off energy.

Now, nevertheless, the world came to the rescue. Europeans said to President Putin, "You're the head of G–8. You want to talk about energy this year. Don't do this to all of us," meaning Germans, Poles, others. We had the President of Poland here testifying what it's like when the pressure goes down in your country, because it's coming across Ukraine and it's being stolen there. Now, in essence, this is for real. This is not hypothetical anymore with regard to fairly large nation-states.

However, the article points out that we're 90 days into the 6 months of the deal that only lasts for 6 months. Some Turkmenistan gas mixed together with some Russian gas, with a very strange entity somewhere based in Switzerland, rather difficult for anyone to find—for President Yushchenko, for Ms. Tymoshenko, former Prime Minister, leader of the party that came in second, or for the former Prime Minister, whose party came in first. And the people of Ukraine try to weigh, How do you do this, at this point? You have a government that might be more sympathetic to Russia. And, therefore, perhaps the next deal, July 1, works out differently. Or, do you go with Ms. Tymoshenko, for example, who says, "Down with the Russians. Independence. Investigation into all of this," and so forth?

So, the implications we're going to see played out in the next few days—and April the 7th being the first day in which a government might be formed—will be interesting on some of the relevant problems here.

At the end of the day, however, the pricing for Ukraine was $95 for the units of gas that used to cost $55. The Russians had demanded $220. They gave Belarus $47. And anyone—people talking about market forces here are up against the fact that we're talking about nationalized industries that use power plays for their advantage.

Now, I mention that, because this comes in the same paper with the headline, "Automakers Use New Technology to Beef Up Muscle, Not Mileage." And I hope I don't oversummarize by pointing out that, essentially—and the article points out as to why this is the emphasis—it says, in improving fuel economy, virtually everyone agrees that there is only one way to do it. There has to be a will. "There's no shortage of technology," said a senior analyst at Environmental Defense. However, the fact is that the automobile companies have decided the most saleable product is more zoom in the cars. If you want to, at least have something that is marketable, a car that gets off the mark faster, rather than slower, is more desirable. Some would emphasize, "After all, a large car is safer." A huge tank running down the street is probably more defensible than a small car.

So, all things considered, the technology may be there, but the market strategy is really to sell something else, which is somewhat discouraging, you know, given our parlay this morning.

Finally, there is a very interesting profile of the new president, or chief executive, of Exxon Mobil. It is flattering, in some respects, that he has indicated, for example—and I quote, "He defends Exxon's record of investing to search for alternative fuels, saying, $100 million contribution to the Global Climate and Energy Project at Stanford University focused on long-term technological changes. "However," he said, "we are looking for fundamental changes, but that is decades away. The question is, What are we going to do in the meanwhile?"

Now, his suggestion is: Explore for oil and gas. And it commends finds in Indonesia, for example, which have been significant recently. But then, it also points out in the article that it's hard even for Exxon Mobil, with all of its resources, to find enough gas or oil, day by day, to replenish that which is already being produced. In other words, the precarious political position in Qatar, which is another find recently, is a very different one from that even 2, 3, 5 years ago, for this very large company. However, the article points out, getting back to what people would say is reality, is that Exxon Mobil, in terms of its per-share earnings, has been doing better than BP and Chevron, sometimes cited by environmentalists and others as being more "with it" and taking a look at the issues we're discussing today.

In short, the Wall Street people, as the article points out, look at earnings per share, and give appropriate rewards for this situation, maybe the same way a motorist trying to get off to a fast start after a stoplight looks at the engineering that may give that kind of a boost.

So, here we are discussing, today, a subject in which, topically, there are crises in the world that are observed by some. I give a speech about Ukraine, and my visits last September with President Yushchenko or Ms. Tymoschenko, and their apprehensions about all of this. They find much of this to be news, that actually there was a cutoff, that these things happen in the world. In other words, the transmission from people who are having academic discussions, or even Foreign Relations Committee meetings about this, to the grassroots, demonstrates that we still have a long way to go. And this is why the President's statement, "We're addicted to oil, and we have to transfer 50 or 75 percent of our needs somewhere else in a while," is important, because it catches the attention of tens of millions of people all at once; whereas, we capture very few.

I would just ask this, however. You've, in your papers, given some remarkable estimates of the costs involved in this. Now, for instance, Dr. Yohe, you've suggested, even without knowing, in the climate-change situation, what any of these catastrophes may mean. What I gathered was that we should be setting aside $1.50 a gallon as, I guess, an endowment fund or some type of emergency fund for the catastrophes to come; in other words, recognizing that the probability of catastrophe is very high, or high enough to merit this kind of public policy change. Is that right, essentially? Just physically in our budget policy, what should we do, have an account, let's say, for energy or climate-change catastrophe, or however you want to characterize this, and put that aside, in the same way we would do with, say, the Social Security reserve fund or something else that has a dedicated public notice?

Dr. YOHE. It—my thought wasn't exactly that. I don't want to be flip, but I hesitate to tell Members of Congress, "This is money you can do with what you want." It is essentially sending a price signal that the economic costs on the environment need to be incorporated in the cost of petroleum. How you do that, whether or not you tax petroleum at $1.50 a barrel or $10 a barrel, or you set up carbon permits so that the targeted price is that, the critical notion is that that "rent," that's reflected in the price, increase at a rate of interest. And were it taxed, and the revenue collected, then it would make sense, it seems to me, to think about what to do with that money—to encourage alternative sources of energy. There are adaptation funds being set up by the GEF under the Framework Convention on Climate Change that begin to try to help developing countries participate.

One of the concerns in the Energy Committee is that we need broad global participation in a climate policy. Perhaps you could offer them climate insurance or climate variability insurance if they were willing to sign onto some mitigation, some best practices, in terms of their energy investments.

The CHAIRMAN. The reason I raised it in this way is—for instance, Mr. Copulos has raised the point that we will be spending $320 billion or so, as I suggested it, at the $60 level; and we already know, at least as of today, that the price has gone to $65, and who knows where from there? That's an amount of money that our country is spending somewhere else. The implications for our Federal budget that you have mentioned, Mr. Copulos, in terms of just the defense budget, go way up to $132 billion, or some such

amount. This, we have to pay. We're appropriating money for defense; and, of that money, $132 billion is involved in the expense of this oil.

Now, that's why it seems to me that if we're to get serious about this sort of thing, we could, as you say, simply put a tax on, of $1.50 or $6, whatever you've suggested, that translates into so much for a gallon, but that revenue would flow into our Treasury. It would help pay for either part of the $300 billion trade deficit or the $129 billion of domestic deficit, but really be lost in the shuffle, without any recognition that we think there's a problem here that probably, even if we don't know which of these disasters is going to occur, is going to cost us some money. For example, we've quickly cobbled together some money to help when the terrible storm came to Indonesia, because it's an emergency. People are dying. There's all sorts of difficulties there. Now, it may not have been climate change. Some would say the recurrence of some of these storms has some traces here. But it certainly would be a climate change if Bangladesh went underwater, at least 10 million people. And what do we do then? Well, we quickly appropriate an emergency appropriation, from nothing. We just simply add to the deficit.

That's why I just wanted, for the sake of argument, with this expert panel, to think, if we're serious about this, whether we try to identify, literally, an insurance policy, as you've suggested.

And maybe we change the actuarial principles as time goes on, in the same way that you do, from yellow to red. If it's getting more red, maybe the thing goes up. But, at least, at that point there is some recognition in a public-policy way. For the moment, there is not.

Essentially, without ascribing to Exxon Mobil their views on this, they are not unique in saying that, "Of course there must be a problem out there. Clearly, something is happening. But we really don't know. The science is still—not necessarily vague, but in dispute. And, therefore, to change policies while this great public dispute is going on among academics and a few politicians would not be very sound in benefiting our stockholders or any prudent person in business." So, we are back to that again.

Essentially, we're talking here about what we think is going to be catastrophe. Eventually, if any of you gentlemen are right, the catastrophe comes. Somebody will say, "Why was there no vision? Why was there no courage? Why didn't somebody rise up?" You know, this is the attempt to do that, to have hearings like this in which these questions are raised, and hopefully people who are expert, like you, inform us, who are learners and are trying very hard to see what sort of public policy ought to be adopted, or at least advocated by some of us, understanding that you have to be patient sometimes for some of these things get through two houses and be signed.

Well, with all of that, let me turn to my colleague.

Senator BIDEN. I agree. [Laughter.]

Gentlemen, there used to be a song that was popular back in the late fifties, when I was in high school, and I forget who sang it, but the lyrics were—I remember, the lyrics went "Tick-a-tick-a-tock. Timin' is the thing. Timin' is everything."

And it seems to me—and I have been of the view that there is an environmental catastrophe in the making. And I've been of the view that that's been the case for the last decade. And I don't know nearly as much as all of you know, or any one of you know. But it seems to me we may—that famous—that phrase has become—title of a book's become a phrase that everybody's beginning to digest—we're maybe heading toward a "tipping point" here.

But I don't get the sense that that has been in any way absorbed by the public. And those of us who think—the chairman being one—who think that we have got to deal, for a whole range of reasons, with the—our energy policy—environmentally, from a foreign policy standpoint, from a—from the standpoint of, in effect, developing entire new industries, if you look at it optimistically—the idea of an environmental tax is—you first have to convince people there's an environmental disaster in the making, or that they can somehow quantify, for average people—and the American people are pretty darn smart—to see the correlation between a $10-a-barrel tax, or whatever the number is, and their ability to breathe clean air or have—not have their roses grow in December in New York State.

So, when you guys talk about this—it's not your responsibility, I acknowledge here, to do this—from a public policy standpoint and the sale-ability of this, I mean, what kind of feedback do you all get when you make this case to—and I know you're usually making the cases you're making here to public policy panels and/or to other academics, but, I mean, when you have this conversation at the barbeque in the backyard with your next-door neighbor, who works for the electric company or is—you know, is a salesman for whatever, I mean, what do you—how do you talk to them about it? Or do you?

Mr. COPULOS. Perhaps I could give you some indication, because I had a recent experience that really brought that home to me. I had an—I have an article, in the current issue of the American Legion Magazine, dealing with this, and possible solutions, and I've had probably 200—it only came out last week—200 e-mails from members of the legion around the country who'd read the article and responded. And, uniformly, they have expressed concern. They kind of understand it, but the problem is, they don't know what to do about it, and that's why they're asking—that, plus some rhetoric about brain-dead people in Washington not addressing the issue. And——

Senator BIDEN. That resonates in my community.

Mr. COPULOS. Yeah. Yeah. [Laughter.]

And—but the—but it's not that people don't "get it." It's that they want to—Americans are doers. They don't—you know, they're—they don't want you to overwhelm them with some sort of rhetoric, or preach catastrophe. They know there's a problem. They're not stupid. What they say is, "OK, now, what are you going to do about it?" We're a practical people.

I, earlier, had mentioned a good example of this, which I think shows the sort of thing we have to start encouraging. There's a fellow out in Moline, IL, in Senator—where Senator Obama just opened an office, actually. He had never built a doghouse in his life, no background in construction, was providing visiting nurses

to retirement communities, and said, "You know, these people are really being taken to—these people are getting shafted. This is terrible. I—you know, they worry about locking their door. I could put my hand through the wall, it's so flimsy. They can—we can do better." So, he went out, and he looked up all sorts of environmental technologies, and he built his first development 2 years ago, homes that anyone would be proud to live in. And he built them for $130 a square foot, which is 20 percent less than the average in his area, and they're 80 to 85 percent energy efficient.

The word got out on this little—in fact, in January and February 2005, when they had a very cold winter, the average utility bill for an entire unit—2,000-square-foot unit was $98. He's got some new units he's built that are 1,750 square feet. And during that recent cold snap they had in Moline, the heating bill for an average 1,750-square-foot home was $25. In fact, he was laughing that they had to pay more in community fees and taxes and hookup fees than they were for the actual energy to heat their homes. This uses no new technology. It's not—and this is a guy who's not an engineer or a—he said, "I'm going to go out and do something about it."

And that, ultimately, is what we've got to start encouraging people to do. If we point them in the direction, if we say, "Look, you can do X, Y, and Z, and it makes real good sense"—because the American people are sensible. You say, "You know, this makes common sense. Just do these things, and you can save yourself"—geothermal heat pumps, for example, from the—day one of installation in every heating zone in this country, you save money if you use a geothermal heat pump.

Senator BIDEN. OK. Now, what would some guy say—say, "By the way, Charlie, I've just convinced the Congress to raise the price of a gallon of gasoline at the pump for you 35 cents or a dollar"? Is he going to say, "Great, I—that's right up my alley, man"?

Mr. COPULOS. He's going to say, "Who is that guy? I'm going to vote against him."

Senator BIDEN. That's right.

Mr. COPULOS. And the other thing we have to bear about—bear in mind about that is, you know, we talk about high prices for gasoline. And, as I'm sure you Senators realize—you travel outside the United States—we don't pay high prices for gasoline. As a practical rule, because we are a very wealthy nation with a high median income, you would have to raise the price of gasoline so high to have an effect on consumption that it's impractical. I mean, say, $3-a-gallon gasoline, fine, the average person uses 1,000 gallons a year. The median income of this country is $44,000-and-change, almost $45. You're talking 6 percent of gross income, maybe. And, also, against the background that 90 percent of all driving is nondiscretionary—you have to go to work, you have to go to the grocery story, you have to take kids to school—so, you're only playing without about 10 percent there, one way or the other.

Price increases, per se, are not going to change patterns of driving.

Senator BIDEN. So, the only reason for the price increase, then, justified, would be for this, in effect, insurance policy.

Dr. YOHE. Yeah, let——

Senator BIDEN. Right?

Dr. YOHE [continuing]. Let me respond to a couple of things I've just heard.

First of all, I don't agree, as an economist, that a price signal won't work. Now, I admit that it won't work in anything that would be politically viable over the near term. But, remember, I was talking about a price that was persistently increasing, predictably increasing over time, so that investment decisions that private individuals make on automobiles, that industry makes on their plant and equipment, that government makes on their infrastructures, knows that the tax was 10 cents in 2005, but it's going to be 20 cents in 2020, and 35 cents in 2025. And you build that into——

Senator BIDEN. But do you think that——

Dr. YOHE [continuing]. Into what's going on.

Senator BIDEN [continuing]. That affects—I'm not——

Dr. YOHE. I do.

Senator BIDEN [continuing]. Behavior of consumer—the average consumer? I mean, I don't know any consumer, where I live, who thinks that their gasoline prices are ever going to go back down again. I don't know anybody—I don't know anybody who thinks, "You know, Joe, we're going to get back down to, you know, 95, 85 cents a gallon." I don't know anybody who thinks we're going to get down to a dollar a gallon. And I don't—everybody that I know—now, I'm just a plain old politician now, not an economist, and I think I probably am better at this than you are at guessing what average people think they're going to do. It is presumptuous of me to say that, but I think most everybody here is. That's our living. And the fact is, I think everybody thinks the price is going to continue to go up. I don't know anybody who thinks that 10 years from now they're not going to be paying more for a gallon of gasoline than they are today, a year from now, they're not going to be paying more—and, it may go from $3 down to $2.56 or $2.36 and back up to $2.80, but it's going to go from $2.36 to $3, and next year it's going to go from $2.42 to three-two, next year it's going to go from $2.75——

I mean, so, I don't get your point that if you said to the—now, in long-term investment by, maybe a guy building a new warehouse and storage facility, I don't disagree with you. I don't—I think that will affect that kind of behavior. But the significant portion of the consumption is coming from nondiscretionary fuel costs that go into people driving automobiles, I think. And so, I'm always attracted by, I think—to take a name where—that's become a—very popularly associated with the gas tax, Tom Friedman. I have great respect for Friedman. I think he has been pretty prescient about a number of the things he has written about over the last 10–12 years. But, on the gasoline tax, I kind of come out where you do, sir. I mean, I don't see any change in behavior or consumption when gasoline went to $3 a gallon. Did it? I mean, is there anything that—did people—even though it was temporary—but did anybody—I didn't notice much.

Mr. COPULOS. Senator, there is a waiting list—I'm on it—for the Dodge Charger R/T S8.

Senator BIDEN. Yeah.

Mr. COPULOS. It's got a 454 horsepower HEMI——

Senator BIDEN. Yeah.

Dr. YOHE [continuing]. Well——

Mr. COPULOS [continuing]. Little turn 13s. You know, that's—people are not concerned—the only times that you saw a change in the purchasing of automobiles related to mileage, when people really started basing their decisions—there were only two occasions—1973 and 1979—and they both were specifically tied to an absence of energy. We had gasoline lines, and people were shooting each other. And that gets down to a very fundamental point that we have to understand. And that is that the—it is the availability of energy that drives behavior, not the price. Whatever the price of energy is, we will adjust, sooner or later. The only times prices affect—I take that—there is one time it can be a factor, and that's if it's a shocking price. In Maryland, in several other States, we see electricity prices predicted to go up 72 percent this summer. Consumers are up in arms, because they see this as a huge spike. But, I'll tell you what, 6 months after it's in effect, people will have adjusted, and they won't have changed their behavior.

Senator BIDEN. Well, I hope that's wrong, but I'm afraid—I worry you may be right, which leads me to—look, what—I'm asking—deliberately and intentionally asking topical questions here about how—because I don't disagree with what you're asserting as what the—the extent of the problem, the need to deal with the problem, and the fact that those boneheads here in Washington aren't paying attention to this, and we're going to all say, 2, 5, 10, 12 years from now, "My God, why didn't anybody talk about this?" So, we're all on the same page on—in that regard.

But let me—one of the things that seems to sell with average people, as it relates to the notion of whether or not their behavior will be affected by anything, is that—and I mean—and by behavior to be affected by: Should we be spending more Federal tax dollars investing in alternative energy sources? Should we be doing it through incentives? Should we be doing it through direct loans? Should we be doing it by generating it ourselves? The—whose statement it was—excuse me—Mr. Huntington's statement. He said, as a general—strategies to reduce our dependence on oil are more effective than policies that reduce our imports. We should view the oil market as one giant pool, rather than a series of disconnected puddles. Whatever—when events happen anywhere in the market, they will raise prices, not only there, but also everywhere, that connect to the—that large pool. More domestic supplies will not protect us from these price shocks.

The oil companies have this nice—and others—have this nice mantra that the way in which to drive down prices, the way in which to stabilize prices, is, "We've got to go out and find more oil," and that the—the impression is, particularly if we found domestic oil—"If we found more domestic oil, then, you know, we're going to be—we're going to be, not home free, but we're going to have a lot more control. So, really, we should be, you know, investing our resources"—them—"as well as the Federal Government."

For example, we passed an energy bill—an energy bill at the time when the oil companies are having—and I'm not making the populist argument, but just a factual argument—when they're having these gigantic surpluses, in terms of profit. And we decided we needed to give them—what was it, $6 billion?

STAFF MEMBER. Two and a half, overall.

Senator BIDEN. $2½ billion? A $2½ billion incentive for them to go out and look for more oil. And people here—you know, they drank the Kool-Aid. You know, they said, "Yeah, it sounds right, you know, because we've got to get more domestic oil."

Talk to me a moment about—all three of you, if you would—about what benefit—let's assume we were able to discover and produce three times the amount of oil we are now producing domestically—and we found it overnight—that could come online over the next 4 years. We found it in—you know, in the middle of Delaware or——

[Laughter.]

Senator BIDEN [continuing]. You know, in Maine, in, you know, Washington State. I mean, we found it in unlikely places. We—boom—all of a sudden, we tripled, with essentially the same recovery cost. What would be the effect of that?

Dr. HUNTINGTON. Well, Maybe I should jump in here, since——

Senator BIDEN. Please.

Dr. HUNTINGTON [continuing]. That was the comment that you took from me. I think it's very important to emphasize that the oil market can be in a couple of different kind of situations. The kind of situation I was talking about was when there is a disruption on the market. My point there was that the price is going to rise for everything, and just having more domestic supplies is not going to protect you from that——

Senator BIDEN. Right.

Dr. HUNTINGTON [continuing]. Price rise. But now, let's take the other state of the world, the state of the world where we live in most of the time, when we don't have a disruption. More domestic supplies is going to help pull down the price of oil on the market. Just by putting that more supply on, we will help the market out that way. So, the price will be lower. And so, that would actually be beneficial. If it was economic, it would be beneficial.

The problem would come in if it was not economic. Then you're really hiding the cost, in a way. You're saying, "Yes, I'm putting on more supply, but it's really costing the taxpayers a whole lot more money somehow, because we're giving it a subsidy for it to come on."

Senator BIDEN. If I can add onto that, if—we would have to find a heck of a lot more than twice or three times what we're producing now, wouldn't we, to meet our domestic energy needs? What would we have to do to meet our domestic energy needs, in terms of being "totally self-sufficient," in—as it relates to oil and gas?

Mr. COPULOS. We'd have to roughly triple what—we use about 20.8 million barrels a day, and we import 12-and-change of that, so it's about—two-thirds of what we use is imported, so we'd have to, roughly, have three times our production.

But, I think one point we have to look at here, in terms of—the argument over domestic oil/foreign oil, kind of, in one way, misses the point, because we're going to run out of oil. That's a given. If you take a look at global demand, I don't care how much we produce. And you're—the Chinese are adding 120 million cars. You look at demand, and it—just Third World demand alone, in 2025, is going to require an additional 30 million barrels a day. When

you add in the rest of us, it's 40. And there's no "there" there. Can't be done.

What we need to do is to facilitate the transition away from a reliance on oil as a motor fuel and in other areas. But to do that, we have another problem. There are 220 million privately owned vehicles on the road today. They have an average age of 8½ years, an average life span of 16.8—actually, it's a little longer than that, in reality. So, basically, for a decade, because people are not going to junk their cars, you're going to have to do something to provide them with fuel. That means you need something that can burn in those cars.

Now, fortunately, we have some options. We've got alcohol, we've got biodiesel, which can help, to a degree. If we find—if we can find a little more natural gas, we can actually turn some of that into a motor fuel if we have to. But, in the near term—I'm talking about 5–10 years—as we make the initial start of the transition, we really need to use domestic—we need to use oil and gas; to the extent we can do it domestically, we're actually better off. In the longer term, what we need to do is understand that that's a temporary fix that gets—keeps us from having an economic calamity, and then we start bringing in all the alternatives.

Dr. YOHE. It's very——

Senator BIDEN [continuing]. Well, my time is——

Dr. YOHE [continuing]. It's—excuse me. The—both of these conversations are missing one of the fundamental points that I teach my students, that there are two sides to every market. And I think the simple answer to your question, "What happens if we tripled our supplies?" given in the context of what Hill put in his statement, is that we could join OPEC, that we would become a supplier of petroleum to the world, and that that would be something that would allow us to participate with respect to that.

The other thing that's going—sort of, going back to the price-size business and the changes in behavior—Senator Lugar was speaking about more zoom in the car. A story that I can remember from a National Academy Panel Meeting 2½ years ago, where somebody fairly high up—and I don't know his name, so—that's probably good—from Ford Motor Company, said that they could not see any way that hybrid automobiles would become popular in the United States, and that Ford had no intention of creating them or marketing them.

Senator BIDEN. I had a similar conversation with Chrysler.

Dr. YOHE. And if you look lately, they are. And why? It's because the demand side of the market has responded, so that the political—part of the political leadership that is required is to alert people of these problems and get them to understand that it's—changes in their behavior, at a pace where it is not uneconomic to do it, will help the problem a good deal. You don't have to junk your 4-year-old car, but next time it's time to buy a car, go look at a Prius until Ford gets one that looks the same and works just as well.

Senator BIDEN. Well, my time is way over. I appreciate it, Mr. Chairman. Let me conclude by recounting a similar example. 1974, I was a young Senator in a garret in this office building, number 100 in seniority, and I got a call from a fellow named Mr. Ricardo,

chairman of the board of the Chrysler Corporation, and Leonard Woodcock, the president of the AFL—of the—excuse me—the UAW, and asked if they could come to see me. And they sat in my office and jointly told me that I could not support—I had run—I was a bit of an environmentalist—I could not support the Clean Air Act, because the Clean Air Act was going to put restrictions, in some way, on tailpipe emissions of automobiles. I'll never forget Mr. Ricardo looking at me—this was 1974—and saying, "You don't understand"—and I think I'm right about the numbers—"we now have 18 percent of the large-car market. It is our plan, in the next 5 years, to get 35 percent of the large-car market." So much for management vision about how they were going to move.

Anyway, I thank you all very much. Thank you for your indulgence, Mr. Chairman.

The CHAIRMAN. Let me just pick up a little bit on the conversation that you've had with Senator Biden and further my interest in what is being offered to American motorists in this particular year.

The New York Times story that I mentioned, just to make the point, says that the 1975 Pontiac Firebird could get from zero to 60 miles per hour in 9.8 seconds. The 2005 Toyota Camry can make it in 8.1. Now, the point they're trying to make is that the developments in the last 30 years have been largely in terms of performance and the "zoom" speed, as I've described it. But, in this particular year, if we are hoping and holding our breaths that that is not where the technology is being focused, the point is that a 2006 Cadillac STS–V can reach 60 miles per hour in 5 seconds. And that——

Senator BIDEN. Helluva an engine.

The CHAIRMAN [continuing]. Unfortunately, appears to be where the competition is. In the process of this—and I quoted the President from his speech yesterday—he talked about the technologies that are out there. And they are. I saw the distinguished president of Purdue University yesterday, Martin Jischke. He's very enthusiastic, at that university, about taking on all of these technologies in a comprehensive way. But automobile companies—in fairness—have some very talented people.

Now, the dilemma here is described further in the New York Times story by someone who noted that he would like to get better gas mileage, but he's been driving, in essence, a truck for years, and he's comfortable in a truck. He doesn't want a Prius. He wants a truck. And, therefore, even though it does cost more, and he acknowledges $3 a gallon is more than he would like to pay for it—all things considered, that is sort of his habit, his comfort level, his feeling of safety. He doesn't want to zoom off at 5.1 for the first stretch after the stoplight, but he does really want to have safety and comfort.

We've been talking, "Does price at the pump influence people?" Probably, somewhat. It did, for a while, bring a waiting list, and maybe still does, for the few Prius cars that are available now, or other hybrid cars. And people are mentioning this. We've had testimony from Jim Woolsey, in our committee, that the hybrid cars that we're now driving will be obsolete. The President himself went to see the battery factory in which somebody produced the tech-

nology for the first plug-in Prius or whatever else people have, and got—and the President mentioned, yesterday, in his remarks, off the top of the head—40 miles, somebody could get in this community. I could drive from my home to the Senate Office Building and back, which is about all the driving I do in a day, and never use a drop of gas. And so, that's very attractive.

And, as you've said, about 90 percent of driving may be mandatory, anyway.

I'm trying, I suppose—and this is the purpose of the hearing—to say that all of this does not really take into consideration any of the hidden costs that you have illustrated, whether it is climate change, disruptions that are huge, or the strategic predicament that we have here.

Now, I want to zero in on one of the strategic predicaments. And this really has to do with the thoughts that you had, Mr. Copulos, on the Armed Forces.

You point out, just historically, that in 1983 the implicit promise to protect Persian Gulf oil supplies became an explicit element of U.S. military doctrine with the creation of the United States Central Command, CENTCOM. And their official history makes the point clear, you point out, and I quote, "Today's command evolved as a practical solution to the problem of projecting U.S. military power to the gulf region from halfway around the world."

Now, you point out, then, they further have refined the doctrine by saying, "Without oil, our economy could not function." And, therefore, protecting our sources of oil is a legitimate defense mission. And the current military operation in Iraq really is a part of that mission.

To date, supplemental appropriations for the Iraq war come to more than $251 billion—this is supplemental appropriations, on top of our regular military budget—an average of $83.7 billion a year. As a result, when other costs are included, the total military expenditures related to oil now are $132.7 billion annually. That is a big figure.

It's not reflected, in terms of our market economy. The automobile companies have to make their own strategy. So do the oil companies. What I've suggested from the New York Times story is a strategy to use technology for so-called performance and safety, not for what we're talking about today with regard to disruption or the oil economy or what have you. Some oil companies, but not all—I've cited just one, because it's a very large one—say, "Our job is performance for our stockholders, first of all, those who have invested in this place. And, second, it's to try to think about the future, and that is getting more of whatever we sell. We'll do a little bit of research on the side and genuflect in that direction. But that is very long term. Long term. Not this year. We are oil people."

Now, that is still, I'm afraid, the prevailing view among major players in this. What I'm trying to figure out—and I'm certain Senator Biden shares this thought—how do we get a recognition that our military doctrine, our national defense, now commits $132 billion a year to the protection of Middle East oil lines? Not just for us, but for everybody else, for that matter. I don't see this coming through. It's sort of buried in the supplemental. They don't have

an account for oil there, nor is there a mention of 1983, which is now 23 years ago.

I think you, in your paper, even go back to Franklin Roosevelt and his original meeting with the Saudi King in which, essentially, this is the assurance that came, "If you produce it, we'll protect it."

Americans have not only spent money, but they've lost a lot of lives defending all of this. And that is not reflected in the market situations that we're talking about today. And I think one of the emphasis of this, from a foreign-policy, strategic standpoint is, How do we reflect that? That was why I raised the question. Do we make an explicit foundation or endowment in which we set aside so much? Because simply to add $1.50 to the price of a barrel or a gallon or so forth may not make it. It may be that my friend, who is in the article, says, "I still want the comfort of my truck."

So, in terms of a market choice, I'm not sure we get there. Maybe some administration will come along and say, "Listen, folks, this is what our doctrine costs, $132 billion a year," explicitly, "plus whatever lives we lose, whatever risks Americans take, to keep all this going. Do you want—do you like that, or not?" As Senator Biden says, our constituents are saying, "Why don't you guys do something about $3 gas?"

Senator BIDEN. That's right.

The CHAIRMAN. "What are you—just sitting there in Washington, fiddling around?" This is the big issue out here. If I had a dollar for every Republican banquet I've attended in which people, in February, March, or whenever a crisis occurs, come to me and say, you know, "Why aren't you doing anything about that?" Whatever——

Senator BIDEN. Add a dollar for the Democratic banquets, too. We'll both get rich. [Laughter.]

The CHAIRMAN. That's the politics of the country. Now, why? Because the public recognition of this problem is at that point, that $3 at the pump. They pay it, but they're irritated. And they think that we ought to perform and get it down.

Now, we can say, theoretically, that's a part of the problem—it goes up, down. It's forgotten. People go through an upset period, but then they get over it. But, here, you're looking at climate change, which keeps it going on inexorably, you know, whether we're having this discussion or not. Or disruptions—you've illustrated those in your paper, Dr. Huntington, that are actual facts. Plus, you know, the huge problem that might have occurred in the Saudi refinery if the terrorists actually had gotten down the road and disrupted 13 percent of the oil supply that day. You've indicated we could have as much as a 5-percent loss in GNP. Well, we don't have 5 percent gain in GNP now. That takes us to a negative figure. That takes us to a huge unemployment in our country. The same motorist who wanted the comfort of his van is unemployed, and then the whole agenda of this government changes. How do we bring compensatory payments, safety nets, retraining? What in the world do we do at this particular point? And whatever is on these charts today is sort of forgotten, but it shouldn't have been, because this is the reason we got to that point.

We're looking for you not to substitute for us as politicians and to try to think through what legislation, resolution, what have you, we offer. But, as a practical matter, how do we translate the wis-

dom of this testimony into measures that give us some protection? Maybe this endowment or this insurance policy, maybe the fact that we try some element of pricing that is different from what we do, without getting into all the political hazards that Joe Biden has discussed so well, you know, namely, woe be to the person that just suggests putting a quarter on it. They'd say, "Why?" Or the thought that you do a little bit more each year, that is even worse still, because you invite a congressional candidate or a President to come along and say, "We've had enough of this kind of stuff. I'm going to reduce your taxes. And we're not going to take a look at a long-term feature."

So, can anybody give a little essay off the top of the head on this?

Dr. Huntington.

Dr. HUNTINGTON. Well, this will really be off the top of my head, but let's give it a try.

One of the ways to look at this hidden cost component is as a tax put on people's purchase of gasoline. And I actually agree with Gary that you won't see a lot of effect in the first few years. The real effect you see is in the types of vehicles that people buy eventually, later on. Consumers may not realize this effect immediately, but the people who are selling the automobiles realize that they need to be more efficient when they produce the automobile. That is the important effect.

But, step back for a minute. Let's say we've just decided that a tax is not the way we're going to go, and that we need another approach. The one way I look at this hidden cost is that it's a measure of how much you should do in an area. Suppose you want to discourage gas-guzzling vehicles in some manner, or you want to encourage a substitute fuel for gasoline. What it should tell you is that you shouldn't go above—suppose that Gary and I agree on a number, $10 a barrel, or something like this. It should tell you that you should not go above that level. If you're trying to give a subsidy you shouldn't provide a larger disincentive for people to use gasoline. You shouldn't make it more costly than whatever that hidden-cost estimate is. That's another way to look at that number.

It's not a formal account that you would have, but it should tell you that you shouldn't be looking at very large policies above that level. I don't know if that helps you thinking about the issue, but I think that's one way to think about this issue.

Senator BIDEN. Chairman, can I—not amend, but add on to your point, and maybe add this to the mix?

It seems to me that American business and industry is much more sensitive to price than the consumer at the pump is to price. If, in fact, the major businesses in my State, or small businesses in my State, realize they can add literally a penny or two pennies to their bottom line by shifting—economically shifting to another source of fuel, they'll do it, in my experience. They're much more price sensitive—even though they pass on the price, they're much more price sensitive, because they're competing, than, I think, the consumer at the pump is. But—and, again, this is above my paygrade here. That's why we're having this hearing.

If that's true, and even though that's a smaller percentage of the market that's—consumes energy in America, has anybody thought about strategies that deal with that smaller percent of the market,

where you won't get as big a bang for the buck, but there—will be more likely to embrace the change that takes place—the incentive offered, or the disincentive?

And I know that's not how we think about it, but has there been any studies done? Have you fellows looked at that?

And the last piece is that it seems this hidden cost that the chairman is—in putting together this hearing to have you all speaking about, breaks—my staff just pointed out the DuPont companies recently saved $2 billion in energy by cleaning up climate emissions for them. I mean, to them, it's a big deal.

But, at any rate, the other—in the hidden costs, there seems to be two hidden costs that fall—they fall in two categories that the American public could understand. One is the hidden costs relating to environmental costs. The other hidden costs is—are relating to defense costs. It seems to me we are much—the public is much more attuned and believes that the defense costs are more real, apparent, and immediate than the environmental costs, even though I think they know, and they think, that there are environmental costs. But one of the things we all say, in one form or another—I won't put words in the chairman's mouth, but obviously I would say—does anybody think we would be in the Middle East if, in fact, we were energy independent? Does anyone—would there be any American out there willing to, you know, give their son or daughter's life out there if, in fact, we, in fact, thought that we didn't need anything that the oil oligarchs had to offer? They get that pretty quickly. They get that pretty quickly.

So, as you think through the things that we can, or should, be doing—and the point you just made, Dr. Huntington, that whatever we do, the price of accomplishing this independent—not independence—greater flexibility can't be so high as to discourage that effort—what about focusing on the smaller end of the consumption continuum here—that is, industry? And what about a strategy relating to making the defense piece a more palatable or understandable argument as an incentive to change behavior?

Dr. YOHE. I don't—I'll leave it to folks to talk about the expense stuff. And I'm—don't know how—the defense stuff. And I don't have specific references with respect to your business question.

But it—the notion of providing the appropriate incentives for businesses to take a longer term view of what their energy costs are going to look like is the part of the persistent and increasing business. And if you look in my statement, there's a sentence that said, "almost doesn't matter where you start it." You can actually even separate it from the social cost of carbon. What you need to do is get it in there, get the train out of the station so that people, as they make these decisions, begin to take it into account.

With respect to its being small, over the long term it might not be to the degree that it influences infrastructure decisions and long—large capital decisions that businesses and governments take, that we will define the energy structure of the United States through 2060 by 2025. We will determine the energy structure of the United States by the—through the end of the century by 2050.

Senator BIDEN. Right.

Dr. YOHE. We are locked in. And so, if we haven't——

Senator BIDEN. Right. That's why——

Dr. YOHE [continuing]. If we haven't fiddled on that margin, we're stuck for a very long time.

Senator BIDEN. What are some of the things you could do to "fiddle on the margin"?

Dr. YOHE. Let me think about that. [Laughter.]

Senator BIDEN. Well, that's what we have to do.

Dr. YOHE. Yeah.

Senator BIDEN. See? I mean——

Dr. YOHE. No, I mean——

Senator BIDEN [continuing]. When it gets down to it, we have to come up with concrete, specific ways to fiddle. I mean, you know, it is—it's not like—we can't generically talk about this. Assuming the Federal Government has any role to play in affecting this behavior.

Dr. YOHE. The bill that's being discussed in the Energy Committee, which has this sort of ratcheting permit price idea that was vetted last spring, I think—and I think they're talking about it again—is an attractive idea. And, frankly, the $5 or $7, or whatever they're picking out for a ton of carbon, isn't going to—you know, isn't fixing the climate problem, but that it goes up at—I don't think it goes up fast enough, but it goes up at a nominal rate of interest, and there's a ceiling that's a little bit too low, and things like that, in terms of incentives that you want to create, but maybe the fiddling is in the specifications of how that evolves over time to make sure that it's persistent, predictable, and maybe invulnerable to political manipulation every 4 years.

The CHAIRMAN. Let me just say, picking up on the word "fiddling" that my colleague used, a couple of provisions in one bill that I and several others have offered says that all the cars produced in America ought to be flexible-fuel cars within a 10-year period of time. I don't know why it really couldn't be within a 2-year period of time. That's about a $100 adjustment, in terms of the cost of the car. But it does, at least, give American motorists the same options Brazilian motorists now have, and have had for several years, as a matter of fact. And it does make possible, then, the practical notion of some amount of ethanol, whether it be corn-based, sugar-based, or cellulosic or however one wants to get along with those projects.

The other thing, which probably is our bailiwick and difficult to do is, is to find somebody close to the President—because we think this is a prime emergency—that coordinates all the missing pieces of this. And without going into laborious detail, for instance, in my State—and I suspect that's true in Delaware—there, we are encouraging people to produce ethanol—right now, from corn. And we have got one place that started up in 1983, in South Bend. There'll be two more places that will be producing ethanol, hopefully, in November, if the construction season goes well, and about five more the following year. And there are now 27 places, single tanks, in Indiana where you could use E85—that is 85 percent ethanol, 15 percent petroleum. This is out of several thousand tanks.

Now, the dilemma here is that suddenly life is never simple. The demand for ethanol has increased so much that USA Today points out in many places that it's higher than petroleum-based. And you say, "Well, how can this be? It's supposed to be 50 cents lower. This

is the incentive." Well, it can be, because MTBE is being substituted by people in California and New England, a long distance away from Indiana. But suddenly at the very moment that we think about making these substitutions and trying to get flexible cars built fast enough—Ford's pledged 250,000; General Motors, likewise, 250,000—suddenly we're not sure there is any ethanol to buy.

And my point is that—and when I go back to my State, I say, "Well, who is managing this whole thing?" Well, it turns out it's some volunteer organizations——

Senator BIDEN. Right.

The CHAIRMAN. One lady, working out of her living room in Mooresville, IN, has more control over this than the Governor of the State or the President of the United States, in large part because we don't take it seriously. There is not really any leadership focus in all of this, despite all the pledges for people to do something.

So, when I'm talking about "fiddling at the margins," as opposed to the big picture, we're really thinking on the ground now, with some things that have some small alleviation.

And I pick up your point, Mr.—I think you made it, Mr. Copulos—that we ought to begin thinking, in a foreign policy way, about our hemisphere. The Brazilian Ambassador came to visit me the other day. He's probably visited with Senator Biden and others. And he said, "Now, we could furnish a lot of ethanol to you right now." The President, just to be provocative, told a small group of Senators this in the White House, you know, "How about"—Well, my goodness, here you have people on the Agriculture Committee, and I've served on that distinguished committee, and they say, "Not on your life," you know——

Senator BIDEN. Yeah.

The CHAIRMAN [continuing]. "We have a sugar policy. There will be no amendment to the farm bill through 2007. As a matter of fact, we're not sure we want to see a change in 2008–09." You know, in other words, leaving aside the emergency we're talking about today—Americans sacrificing their lives—sugar comes first, or whatever it happens to be, in terms of our vested interest.

This is the niggling business that we're dealing with. But it's very serious. And this is why the big picture you present is helpful to us for people who do take this seriously, which I think most of our colleagues do, when they are confronted with this.

But I'm still back to Senator Biden's plea to you for suggestions for legislation, enactments, speeches, you know, action steps that may come from this conference today.

Mr. COPULOS. Well——

The CHAIRMAN. Yes, sir.

Mr. COPULOS [continuing]. We've given a lot of thought to that, and actually have been very involved. We put together the first Alternative Fuel Vehicle Program at the Department of Defense in 1990, so—and I have done some work with the Tank-Automotive and Armor Command up in Detroit—actually, Warrenville, Michigan. But there are some things we can do. And what we need to do, first of all, is to understand and recognize that the American

people are practical. If you say, you know, "Go do this. It'll do X, Y, or Z," they'll go do it.

And there are some real simple things. I think your suggestion on having all new vehicles be flex fuel is excellent. There's no reason they can't do that next year. All you're doing is changing one chip and some fuel lines. It costs $100 in the factory. You could even—I would even go so far as to say give a tax credit to let people retrofit it. But when you do, you've got to make sure that Detroit doesn't turn around and void their warranties, because what's been happening is that people who might want to use more, they'll say, "Well, that's fine, but under our warranty, if you use more than 15 percent or 20 percent"—it varies by manufacturer—"your warranty is voided. And if your engines goes bad, it's all on you."

A second thing that we can do—the Department of Defense has this 21st-century-base program. The idea is to make bases sustainable, in terms of their own energy. Now, one of the things I've suggested is, under the Energy Policy Act rules, Federal vehicles are supposed to be, by now, 80 percent alternative fuels. They've managed to get around that by buying the flex fuel vehicle and not using flex fuels. But we need to solve that. But one of the other things is, why not put E85 pumps—since they're supposed to be using it anyway in their civilian vehicles—in military installations, post offices, to fuel the Government vehicles, but then have them available to the public.

One of the problems you've got now is infrastructure. If you want to use E85 or—where do you find it? Well, there's—there are military and Government installations that have fuel depots in every city in every region of this country. You could very quickly begin to do that.

Now, once you did that, what's going to happen is, the Exxons and BPs of this world are going to go, "Well, wait a minute now, I don't want them buying that from the Government." [Laughter.]

You know, "God help us there." So, you're going to see those cropping up at regular filling—it's the same thing that happened with diesel in 1973. You couldn't find a diesel pump, to save your life, in 1973. Along came the boycott. All—they had to literally give out books with, "This is where the pumps are, these truckstops." Every gas station you pull into today has a diesel pump.

The CHAIRMAN. Let me just interrupt by saying that we've tried to—in a statesmanlike way—to write letters to all the major oil companies——

[Laughter.]

The CHAIRMAN [continuing]. Suggesting that they might want to put E85 pumps on the premises of stations that they have in our country. The letters that I receive back usually point out that, you know, "Understand I'm well motivated," and, you know, there's some salutary——

Senator BIDEN. You're a good man.

The CHAIRMAN [continuing]. Remarks.

Senator BIDEN. You're a good man.

The CHAIRMAN. Genial, or whatever, but——

[Laughter.]

The CHAIRMAN [continuing]. At the same time, "Let's get real. There are impurities with E85. To mix that stuff with what we're

doing would just be terribly disruptive, to say the least." And, furthermore, those who are the most negative on it are not really sure that this alternative fuel business is not just a fad, "It's almost like the spike to $3, but we'll get over it." So, therefore, to get serious about this, they're not prepared to do that. I have yet to get a single favorable response from any oil company that would put a single tank out there.

I went out to Terre Haute, IN, last July to see the very first tank put aside two alternatives, with a sign in the middle of the road that showed that the ethanol would be $1.50, or something of that variety, as opposed to $2 at the tank that was next to it. And there was a speedway race driver there, who said, "We're going to use that at the speedway." And so, that was helpful. And 200 people and the mayor. It was big—for one gas tank. But that doesn't mean that it's spread like wildfire. The 27 I'm talking about are not on major oil-company lots. They are mom-and-pop variety stores, that, as a matter of patriotism, have decided to do this. And many are losing money, for the reasons that I suggested; the ethanol is going to California to solve MTBE. And the number of flexible-fuel cars coming in Indiana, we can trace by the hundreds per month, not by the thousands. That's the real-life dilemma that——

Senator BIDEN. Right.

The CHAIRMAN [continuing]. You know, we face out here in these sort of situations.

As you write more about this—and I hope that you all will—and reflect, if you can, how we solve the political problem—I think, you know, clearly, we have some opportunities, and we'll write to the oil companies again. And Senator Biden and I hope to be more persuasive as we do that.

Senator BIDEN. Thirty seconds to reinforce your point. Our colleague, Senator Carper, when he was Governor, shifted all State vehicles to alternative fuels, made the farmers in my State very happy. They thought that was a good idea. People thought that was a good idea, too, but they can't go anywhere to get it, except to go to a government-sponsored facility, and they're not able to do that, to the best of my knowledge, now. So, you——

The CHAIRMAN. Why can't they do that?

Senator BIDEN. Well, I think it's—the answer is, I don't know. I don't know whether it's insurance or they're not—availability or the physical access. I'm not sure what the reason is, to be honest with you, until it was raised a moment ago. I mean, I don't know what the—I don't think it's a policy prescription, but I think it's just—I simply don't know, to be honest with you.

Mr. COPULOS. The answer is really pretty—that's why we say put it on the fenceline—the answer is really pretty simple. After 9/11, they restricted access to military bases to people with an ID card, retired or active. I happen to have an ID card, so I can get on. If you can't, you can't get on——

Senator BIDEN. This is State-owned. It's not a military——

Mr. COPULOS. Oh, OK.

Senator BIDEN [continuing]. Facility.

Mr. COPULOS. Well, a lot of times——

Senator BIDEN. Yeah, but——

Mr. COPULOS [continuing]. States all go——

Senator BIDEN [continuing]. State—similar, yeah.

Mr. COPULOS [continuing]. They'll restrict——

Senator BIDEN. I assume that's the reason. It relates to—and the argument about, you know, access to, you know, insurance, covering anything that happened to citizen—I don't know. I truly don't know. But it's worth my finding out, now that I've raised it and acknowledged I don't know.

Mr. COPULOS. Well, that's amenable to a legislative fix, just like the warranty issue, but——

Senator BIDEN. Yeah.

Mr. COPULOS [continuing]. Getting back, if I can, for a second, to the base point, I had said in my testimony that the fact that two-thirds of our oil is used in the transportation sector means one-third isn't, and we really need to look at that. And, yeah, there are couple of things. For example, there is a—several—but one technology I'm aware of, because I've looked at recently, it takes waste wood, turns it into a fuel oil that's perfect for—a perfect replacement for number 6—zero sulphur, zero knocks, and so on. This is a company that is Canadian. Right now they're taking all of the dead wood from the pine bark beetle infestation. They're getting ready to convert that into oil substitute up—it is an oil, actually.

We have a Clean Forest Program. We're taking enormous amounts of dead wood out of the forests and we're piling it up. And guess what? It's a fire hazard. Instead of piling it up, you could take that, all of that, and convert it into oil. And the nice thing about this particular unit is, it'll handle 400 tons a day economically—it's economic in that size—which means that you can put a lot of little ones around our public forests, take all that oil, which right—all that wood, which, right now, we're paying $20 a ton to haul away, and I don't know what we're paying to get rid of it after that, or at least have it in dumps, and turn that into a boiler fuel that's so good that Alcoa, in Canada, has agreed to buy every bit of this they can get, because they had environmental problems with their stacks and their smelters, and this is going to lower emissions enough that they can meet Canadian standards.

The CHAIRMAN. Yes, sir.

Dr. HUNTINGTON. This issue that we've been talking about for most of the morning really comes down to whether people have the perception that these problems are real or not. And, actually, that's an issue that people at Stanford are beginning to look at—not myself, but other people who are trained and thinking of people's psychology and how do they learn about these problems. And so, hopefully this research will come out with some interesting, useful information.

As I think about the problem—and I admit, it's a very simplistic way of thinking about it, it seems that we were successful in putting in fees on sulphur dioxide emissions, a number of years ago. What's different about that, as compared to higher gasoline prices or a gasoline tax, is, that the consumer sees the gasoline tax directly, but does not see sulphur dioxide emissions fees. The utilities squabble about them but they basically make the adjustment, and then they pay the higher cost. They charge the higher electricity price to the consumer, and the consumer pays the bill without carefully checking the bill. They're not as aware of the additional costs.

And so, following up on this point—suppose you took Gary's suggestion of a very small tax, initially, that would rise gradually. If you put a fee in there that wasn't so visible, but did affect prices paid by anyone who used fossil fuels, perhaps as a fee that was based on the carbon content, you could almost make that work, much like the sulphur dioxide emissions fees, and it wouldn't be quite as a direct charge, that people wouldn't be coming up to you at cocktail parties and saying, "Why did you raise my fee?"

In the automobile sector, the one thing we have done is the corporate automobile efficiency standards or CAFE. I think that measure also works in a similar way. It forces automobile companies to make more expensive automobiles, perhaps, than they want to, if—particularly on the vehicles which have to meet those standards. If you combine CAFE standards with a little more flexibility, as proposed previously by the National Academy of Sciences, you could allow the trading of credits that would allow people to focus their attention on those vehicles that really could meet the standards less costly than others. Again, it wouldn't look like a direct tax to people. It has the nice advantage of being flexible. These kinds of policies are, more or less, ways of not hitting the consumer full on and saying, "You are going to pay a higher tax." Such policies perhaps could be done for gasoline. They certainly have been done on other types of problems.

The CHAIRMAN. Well, we thank all three of you for your very thoughtful papers and the facts that you have included, which will be a part of this record, and which we will try to transmit to our colleagues. We ask for your help in responding to additional questions that we have, and those of other members who were not able to attend, so that we may have as complete a hearing record as possible for those who are interested in this subject. And we hope that many are. I thank each one of you for your preparation and for being so forthcoming in your responses.

Senator BIDEN. Gentlemen, thank you very much.

The hearing is adjourned.

[Whereupon, at 11:49 a.m., the hearing was adjourned.]

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