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HIGH COSTS OF CRUDE: THE NEW CURRENCY OF FOREIGN POLICY

HEARING

BEFORE THE

COMMITTEE ON FOREIGN RELATIONS UNITED STATES SENATE

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HIGH COSTS OF CRUDE: THE NEW CURRENCY OF FOREIGN POLICY

WEDNESDAY, NOVEMBER 16, 2005

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

The committee met, pursuant to notice, at 10 a.m., in room SD–419 Dirksen Senate Office Building, Hon. Richard Lugar (chairman) presiding.

Present: Senators Lugar, Hagel, Coleman, Sununu, and Bill Nelson.

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 examine the effects of U.S. oil consumption on American foreign policy and on our wider economic and security interests. High oil prices have hurt American consumers at the gas pump, and record revenues flowing into oil producing nations are changing the world's geopolitical landscape. Increasingly, oil is the currency through which countries leverage their interests against oil dependent nations such as ours.

Oil is not just another commodity. It occupies a position of singular importance in the American economy and way of life. In 2003, each American consumed about 25 barrels of oil. That is more than double the per capita consumption in the United Kingdom, Germany, and France and more than 15 times that of China. With less than 5 percent of the world's population, the United States consumes 25 percent of its oil.

Higher oil prices have helped drive the consumer price index up 4.7 percent during the past year. Motorists felt this pinch at the pump long before the destruction of Hurricanes Katrina and Rita. This year, the United States has spent about $19 billion per month on oil imports. The cost of imported oil now accounts for approximately one-third of our trade deficit.

In the short run, our dependence on oil has created a drag on economic performance at home and troubling national security burdens overseas. In the long run, this dependence is pushing the United States toward an economic disaster that could mean diminished living standards, increased risks of war, and accelerated environmental degradation.

Up to this point, the main issues surrounding oil have been how much we have to pay for it and whether we will experience supply

disruptions. But in decades to come, the issue may be whether the world's supply of oil is abundant and accessible enough to support continued economic growth, both in the industrialized West and in large rapidly growing economies like China and India. When we reach the point where the world's oil-hungry economies are competing for insufficient supplies of energy, oil will become an even stronger magnet for conflict than it already is.

Since 1991, we have fought two major wars in the oil-rich Middle East, and oil infrastructure and shipping lanes are targets for terrorism. In addition to the enormous dollar cost we pay for the military strength to maintain our access to foreign oil, our petroleum dependence exacts a high price in terms of foreign policy and international security.

Massive infusions of oil revenue distort regional politics and can embolden leaders hostile to U.S. interests. Iran, where oil income has soared 30 percent this year, threatened last month to use oil as a weapon to protect its nuclear ambitions. At a time when the international community is attempting to persuade Iran to live up to its nonproliferation obligations, our economic leverage on Iran has declined due to its burgeoning oil revenues. Similarly, the Chavez government in Venezuela resists hemispheric calls for moderation, in part because it has been emboldened by growing oil revenues. Russia uses its gushing oil and natural gas income and reserves as leverage over new democracies in East Europe. Globally, critical international security goals, including countering nuclear weapons proliferation, supporting new democracies, and promoting sustainable development are at risk because of dependence on oil.

Diversification of our supplies of conventional and nonconventional oil, such as Canada's tar sands, is necessary and under way. Yet because the oil market is globally integrated, the impact of this diversification is limited. Our current rate of oil consumption, coupled with rapidly increasing oil demand in China, India, and elsewhere, will leave us vulnerable to events in the tumultuous Middle East and to unreliable suppliers such as Venezuela. Any solution will require much more than a diversification and expansion of our oil supply.

Despite the widening discussion of our energy vulnerability, the U.S. political system has been capable of only tentative remedial steps that have not disturbed the prevailing oil culture. The economic sacrifices imposed on Americans recently by rising oil prices have expanded our Nation's concern about oil dependence. But in the past, as oil price shocks have receded, motivations for action have also waned. Currently, policies for mediating the negative effects of oil dependence continue to be hamstrung in debate between supply-side approaches and those preferring to decrease demand. We must consider whether the political will now exists to commit to a comprehensive strategy.

Our weak response to our own energy vulnerability is all the more frustrating given that alternatives to oil do exist. Oil's importance is the result of industrial and consumption choices of the past. We now must choose a different path. Without eliminating oil imports or abandoning our cars, we can offset a significant portion of demand for oil by giving American consumers a real choice of automotive fuel. We must end oil's near monopoly on the transpor-

tation sector, which accounts for 60 percent of American oil consumption.

I believe that biofuels, combined with hybrid and other technologies, can move us away from our extreme dependence on oil. Corn-based ethanol is already providing many Midwesterners with a lower cost fuel option. Cellulosic ethanol, which is made of more abundant and less expensive biomass, is poised for a commercial takeoff. We made progress in the 2005 energy bill, which includes incentives to produce 7.5 billion gallons of renewable biofuel annually. I introduced legislation last week that would require manufacturers to install flexible-fuel technology in all new cars. This is an easy and cheap modification, which allows vehicles to run on a mixture of 85 percent ethanol and 15 percent gasoline.

We will get even greater payoffs for our investment in oil alternatives if American technological advances can be marketed to the rest of the world. Nations containing about 85 percent of the world's population depend on oil imports. These nations could reap many of the same security and economic benefits by breaking their oil import chains. Developing countries could improve their balance of payments and promote rural development by growing profitable biomass, while offering new markets for fuel technologies.

We need to think creatively about cooperating with other countries to address today's global energy challenges. For example, earlier this month I introduced S. 1950, "The United States-India Energy Security Cooperation Act of 2005." This bill would promote greater cooperation with India on clean coal technology, ethanol, and other energy sources.

I am particularly pleased to welcome two old friends, today, who will assist us in our inquiry today. Dr. James Schlesinger, former Secretary of Defense, Secretary of Energy, and Director of Central Intelligence, has seen America through oil shocks and has remained committed to improving America's energy situation. He is a keen analyst of the geopolitical consequences of oil dependence, as well as an authority on America's energy future.

Also joining us is Mr. James Woolsey, former Director of Central Intelligence. In 1999, Jim and I—and I would stress my dependance on his tutelage in this—coauthored "The New Petroleum," an article in Foreign Affairs that laid out the case for a greater role for cellulosic ethanol. He has continued to serve as a leading advocate for forward-looking reforms of our energy policy. We thank our distinguished witnesses for coming and look forward to their insights.

And let me say that after I recognize my colleagues we will ask both of you to testify. All of your statements will be made a part of the record. We will ask you to summarize, but don't summarize too much. We really want to hear from you, and hear the message this morning.

Senator Hagel, do you have a greeting for our guests?

STATEMENT OF HON. CHUCK HAGEL, U.S. SENATOR FROM NEBRASKA

Senator HAGEL. Thank you, and I, too, welcome our distinguished witnesses, and as you have appropriately noted their contributions to our country, their service, their continued service, and

we look forward to listening carefully to what they have to say this morning. Thank you.

The CHAIRMAN. Thank you Senator Hagel, Senator Sununu.

STATEMENT OF HON. JOHN E. SUNUNU, U.S. SENATOR FROM NEW HAMPSHIRE

Senator SUNUNU. Thank you Mr. Chairman, it's a pleasure to see both witnesses here today. I am interested to hear what they have to say. Clearly one of the long-term needs we have in this country, from a broad energy perspective, is to make sure we have a consistent clean reliable base load of electricity. A lot of the alternatives that are out there now, and I think that we'll hear from today, involve better use of the electric grid, off-beat power, and the like. And you know the base load that we have out there, being provided by coal, and the availability of nuclear energy is something that we need to consider, need to look at very hard today if we're going to take full advantage of these opportunities. We've been talking about oil independence in this country for literally decades but it remains a fact that the domestic price of gasoline is relatively very low. Consumers like to drive their cars, gas is relatively plentiful, very cheap compared to our peers in Europe. And as a result there isn't a great incentive right now for deploying some of these new and relatively more expensive technologies, although we hope with time the cost of these technologies will come down.

And this is despite the fact that we have spent billion of dollars in Federal resources, subsidizing the development of some of these alternatives. The Synfuels Corporation is an example of this. The partnership for next-generation vehicle is an example of this, and now the billions that we're contemplating for the subsidization of developing hydrogen technology will again come into the mix. And I have raised questions in the past, and will continue to raise questions about whether that is the best public policy, when there are some alternatives that are already out there on the market that we'll hear about from our witnesses. And to the extent that we are putting billions of dollars in certain technologies, at the Federal level, we are discriminating against, and placing at a disadvantage, other ideas and technologies that might not come in for Federal subsidy.

Finally, I think it is at least worth observing that from time to time, not only have we done things that aren't especially helpful in moving us toward oil independence, but we have done things that are counterproductive. And windfall profits tax, which has been talked about recently, is an example of this.

When it was tried in the past, it resulted in lower domestic production, and higher levels of foreign imports of oil. It was certainly well intended, the concerns that were raised then, are many of the concerns we have now, but it was an initiative that had unintended consequences. And I think it's worth underscoring that principle. We want to make sure we do things that make the situation better, and not take steps that however well intended have counterproductive impacts.

So, I welcome the witnesses and look forward to their testimony. Thank you, Mr. Chairman.

The CHAIRMAN. Well, thank you very much, Senator Sununu. Secretary Schlesinger, will you proceed with your testimony.

STATEMENT OF HON. JAMES R. SCHLESINGER, SENIOR ADVISOR, LEHMAN BROTHERS, WASHINGTON DC

Mr. SCHLESINGER. Thank you, Mr. Chairman. Thank you, Senator Hagel, Senator Sununu. I thank the committee for this invitation to discuss the quest for energy security, the implications of our heavy dependence on imported oil, the rise in oil prices, and their manifold political and economic repercussions for our Nation. In so many ways, the use of oil as our primary energy source turns out to be a two-edged sword. Actions that we take, may reduce supply or add to the resources of those who are hostile to us.

Given that reality, the ramifications are too numerous to discuss in detail. Given the necessary limitations on time, I must be selective. Therefore, I shall only touch upon several salient points.

First, Mr. Chairman, the problem of energy security is of relatively recent origin. When mankind depended upon windmills, oxen, horses, and the like, energy security was not a strategic problem. Instead, as a strategic problem it is a development of modern times and reflects most crucially the turn to fossil fuels as increasingly the source of energy. The Industrial Revolution in the 19th century, strongly reinforced by the rapid growth of oil-dependent transportation in the 20th century, unavoidably posed the question of security of supply. Imperial Germany took over Lorraine with its coal fields after the Franco-Prussian War to insure its energy security. When Britain, pushed by Churchill, converted its Navy to oil early in the 20th century, it sought a secure supply of oil under its own control in the Persian Gulf, which incidentally increased its concern for the security of the Suez Canal.

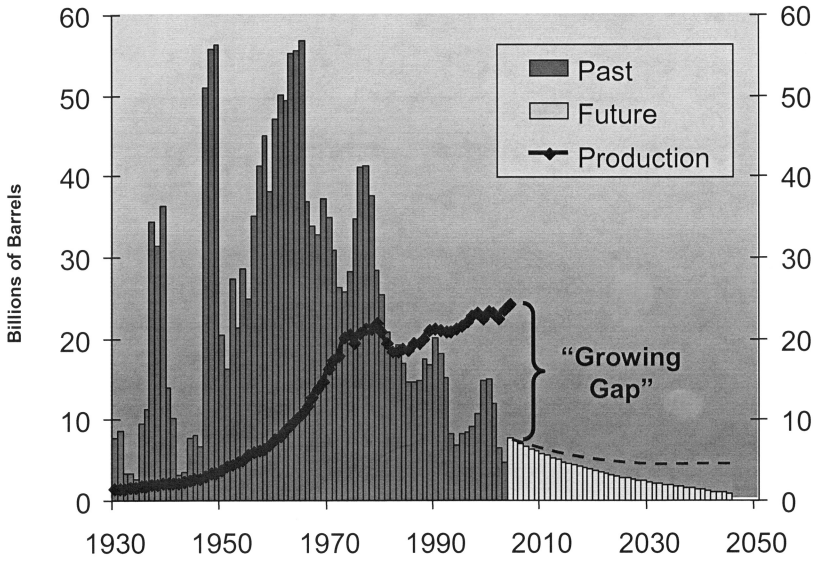
For the United States, where the production of oil had started, in 1869, and for long was primarily located, the question of security of supply did not arise until the 1960s and 1970s. Since then, we have regularly talked about and sought, by various measures, to achieve greater energy security. Such measures, limited as they were, have generally proved unsatisfactory. The Nation's dependence on imported hydrocarbons has continued to surge.

Mr. Chairman, until such time as new technologies, barely on the horizon, can wean us from our dependence on oil and gas, we shall continue to be plagued by energy insecurity. We shall not end dependence on imported oil nor, what is the hope of some, end dependence on the volatile Middle East with all the political and economic consequences that flow from that reality.

That is not to say that various measures and inventions will not, from time to time, shave our growing dependence, but we will not end it. Instead of energy security, we shall have to acknowledge, and to live with, various degrees of insecurity. To be sure, we have certain short-term problems to which I shall—which Senator Sununu has reverted to—to which I shall presently turn. More importantly, we face a fundamental, longer term problem. In the decades ahead, we do not know precisely when, we shall reach a point, a plateau or peak, beyond which we shall be unable further to increase production of conventional oil worldwide. We need to understand that problem now and to begin to prepare for that transition.

The underlying problem is that for more than three decades, our production has outrun new discoveries. Most of our giant fields were found 40 years ago and more. Even today, the bulk of our production comes from these old and aging giant fields. Ghawar in Saudi Arabia, for example, produced 7 percent of the world's petroleum all by itself. There are other examples. More recently discoveries tend to be small with high decline rates and are soon exhausted. Since the issue is crucial, and is not widely understood, I have prepared a chart which lays bare the problem.

Trends in Discoveries and Production



Mr. Chairman, and members of the committee, you can see that in the past we have had high discovery rates. Here, back in 1930, is the finding of the East Texas pool; then we opened up the Middle East, and the consequence is that we had substantial increases in reserves. For the last 30 years we have seen a downward trend in the same time that production has steadily increased with the exception, of course, of the 1970s when we saw the Arab oil embargo.

The future is somewhat unknown, some people just think that future discoveries will dwindle away but it may be that we maintain a certain level of discovery. The problem is that demand and production continue to grow and the discoveries are not matching those increases. The fact of the matter is that unless we discover oil, we will not be able to produce it over time. And we have a growing gap between our discoveries and production, which will continue to increase. The consequence is that as we look to the future, and we begin to drain off those giant fields like Ghawar, like the Burgen Field in Kuwait, we are going to be faced with an oil stringency.

Mr. Chairman, the upshot is quite simply, that as the years roll by the entire world will face a prospectively growing problem of energy supply. Moreover, we shall inevitably see a growing dependency on the Middle East, which you mentioned in your remarks, Mr. Chairman. We shall have to learn to live with degrees of insecurity—rather than that elusive security we have long sought. To be sure, some insecurity will be mitigated by the Strategic Petroleum Reserve, and other emergency measures. That will provide some protection against short-term supply disruptions, but it will not provide protection against the fundamental long-term problem.

Second, in addition to the long-term problem of the prospective limit on conventional oil production, we have a number of short-term or cyclical problems that have contributed to the current stringency and current high prices. Spare production capacity has essentially disappeared. This reflects the volatility of oil prices, which has led to a low rate of investment in new capacity, as well as an unexpected surge of demand, particularly from China and the United States. For many years, we have had excess capacity in refining. That, too, has largely disappeared, and we lack capacity to refine the heavy, sour crudes that do remain available. Here in the United States, the problem has been amplified by the battering of gulf infrastructure by Hurricanes Katrina and Rita. We have also an added, self-inflicted problem of some 17 boutique blends of gasoline, mandated by state authorities.

The insurgency in Iraq has prevented the increase in production, even to the prewar level, that many have expected. Long-term sanctions against Iraq, Iran, and Libya, both United States and international, have reduced their contributions to world supply. This has taken place against inelastic domestic production of natural gas. There are, in addition, problems of electric power generation and transmission. The point about all of these is that they are not inherent problems. In principal, they would all yield to additional investment. We must bear in mind that investment activity depends upon price signals, and that there is a long period of gestation before additional investment activity brings supply to market. Some of these problems may, however, be ameliorated by changes in law or in regulation.

By about 2010, we should see a significant increase in oil production as a result of investment activity now under way. There is a danger that any easing of the price of crude oil will, once again, dispel the recognition that there is a finite limit to conventional oil. In no way do the prospective investment decisions solve the long-term, fundamental problem of oil supply.

Let me turn now to the political and economic ramifications. Again, let me underscore that energy actions tend to be a two-edged sword. To some extent, the recent higher prices for oil reflect some of our own prior policies and actions. For example, the sanctions imposed upon various rogue regimes, by reducing world supply, have resulted in higher prices. Operation Iraqi Freedom, followed by the insurgency, has caused unrest in the Middle East. The consequence has been somewhat lower production and a significant risk premium that, again, has raised the price of oil.

The effect of higher oil prices has been significantly higher income for producers. A much higher level of income has meant that

a range of nations, including Russia, Iran, Venezuela, as well as gulf Arab nations have had their economic problems substantially eased. As a result, they have become less amenable to American policy initiatives. Perhaps more importantly, the flow of funds into the Middle East inevitably has added to the moneys that can be transferred to terrorists. As long as the motivation is there and controls remain inadequate, that means that the terrorists will continue to be adequately or amply funded. To the extent that we begin to run into supply limitations and to the extent that we all grow more dependent on the Middle East, this problem of spillover funding benefits for terrorists is not going to go away.

Fourth, there are, of course, additional problems of an economic nature. We all understand that higher oil prices can depress spending on other goods and services—and thereby cause slower growth rates and possibly a worldwide recession. The reverse side of rising receipts for producers is, of course, rising out-payments by consumer nations. This can readily augment structural imbalances. This year, the American balance-of-payments deficit looks to be almost three-quarters of a trillion dollars. As Everett Dirksen might say, a trillion here, a trillion there, and it begins to add up to real money. This is not small change. Of the well over $700 billion of that deficit, some $300 billion comes from oil and gas. It is recognized that the U.S. balance-of-payments deficit represents the locomotive that drives much of the world's economies. In performing this service—for which we get little thanks—the United States is steadily adding to its financial obligations to others. How long this process can continue is uncertain, but high oil prices add to the dilemma.

Finally, Mr. Chairman, I must point to another problem. The United States is today the preponderant military power in the world. Still, our military establishment is heavily dependent upon oil. At a minimum, the rising oil price poses a budgetary problem for the Department of Defense at a time that our national budget is increasingly strained. Moreover, in the longer run, as we face the prospect of a plateau in which we are no longer able worldwide to increase the production of oil against presumably still rising demand, the question is whether the Department of Defense will still be able to obtain the supply of oil products necessary for maintaining our military preponderance. In that prospective world, the Department of Defense will face all sorts of pressures at home and abroad to curtail its use of petroleum products, thereby endangering its overall military effectiveness.

In closing, Mr. Chairman, I trust that I have fulfilled the request in your letter of invitation to analyze "the complexity of U.S. reliance on imported energy sources, particularly oil, and the difficulties the United States faces in mediating detrimental effects of this dependency." Even in the short run, actions that we take may substantially increase the resources and reduce the economic and political pressures on states that are hostile to us. In the longer run, unless we take serious steps to prepare for the day that we can no longer increase production of conventional oil, we are faced with the possibility of a major economic shock—and the political unrest that would ensue. The United States has just over 4 percent of the world's population and uses roughly 25 percent of the world's oil

production. In a sense, that statistic, in itself, is misleading because the United States does produce roughly 20 to 25 percent of the gross world product. Nonetheless, that statistic does underscore our potential vulnerability in an era that we may no longer be able to produce additional conventional oil worldwide.

Thank you very much, Mr. Chairman. I shall be happy to answer your questions and those of any members of the committee.

[The prepared statement of Mr. Schlesinger follows:]

PREPARED STATEMENT OF HON. JAMES SCHLESINGER, SENIOR ADVISOR, LEHMAN BROTHERS, WASHINGTON, DC

Mr. Chairman, members of the committee, I thank the committee for this opportunity to discuss the quest for energy security, the implications of our heavy dependence on imported oil, the rise in oil prices, and their manifold political and economic repercussions for our Nation. In so many ways, the use of oil as our primary energy source turns out to be a two-edged sword. Given that dependence, the ramifications are too numerous to discuss in detail. Given the necessary limitations on time, I must be selective. Therefore, I shall touch only upon several salient points.

1. Mr. Chairman, the problem of energy security is of relatively recent origin. When mankind depended upon windmills, oxen, horses, etc., energy security was not a strategic problem. Instead, as a strategic problem it is a development of modem times—and reflects most crucially the turn to fossil fuels as increasingly the source of energy. The Industrial Revolution in the 19th century, strongly reinforced by the rapid growth of oil-dependent transportation in the 20th, unavoidably posed the question of security of supply. Imperial Germany took over Lorraine with its coal fields after the Franco-Prussian War—to insure its energy security. When Britain, pushed by Churchill, converted its Navy to oil early in the 20th century, it sought a secure supply of oil under its own control in the Persian Gulf—which incidentally increased its concern for the security of the Suez Canal. For the United States, where the production of oil had started and for long was primarily located, the question of security of supply did not arise until the 1960s and 1970s. Since then, we have regularly talked about—and sought by various measures—to achieve greater energy security. Such measures, limited as they were, have generally proved unsatisfactory. The Nation's dependence on imported hydrocarbons has continued to surge.

Mr. Chairman, until such time as new technologies, barely on the horizon, can wean us from our dependence on oil and gas, we shall continue to be plagued by energy insecurity. We shall not end dependence on imported oil nor, what is the hope of some, end dependence on the volatile Middle East—with all the political and economic consequences that flow from that reality. That is not to say that various measures and inventions will not, from time to time, shave our growing dependence, but we will not end it. Instead of energy security, we shall have to acknowledge and to live with various degrees of insecurity.

To be sure, we have certain short-term problems to which I shall presently turn. More importantly, we face a fundamental, longer term problem. In the decades ahead, we do not know precisely when, we shall reach a point, a plateau or peak, beyond which we shall be unable further to increase production of conventional oil worldwide. We need to understand that problem now and to begin to prepare for that transition.

The underlying problem is that for more than three decades, our production has outrun new discoveries. Most of our giant fields were found 40 years ago and more. Even today, the bulk of our production comes from these old—and aging—giant fields. More recent discoveries tend to be small with high decline rates—and are soon exhausted. Since the issue is crucial—and is not widely understood—I have prepared a chart which lays bare the problem.

Mr. Chairman, the upshot is, quite simply, that, as the years roll by, the entire world will face a prospectively growing problem of energy supply. Moreover, we shall inevitably see a growing dependency on the volatile Middle East. We shall have to learn to live with degrees of insecurity—rather than the elusive security we have long sought. To be sure, some insecurity will be mitigated by the Strategic Petroleum Reserve, and other emergency measures. That will provide some protection against (short-term) supply disruptions, but it will not provide protection against the fundamental long-term problem.

2. In addition to the long-term problem of the prospective limit on conventional oil production, we have a number of short-term or cyclical problems that have con-

tributed to the current stringency and current high prices. Spare production capacity has essentially disappeared. This reflects the volatility of oil prices, which has led to a low rate of investment in new capacity, as well as an unexpected surge of demand, particularly from China and the United States. For many years, we have had excess capacity in refining. That, too, has largely disappeared, and we lack capacity to refine the heavy, sour crudes that remain available. Here in the United States, the problem has been amplified by the battering of gulf infrastructure by Hurricanes Katrina and Rita. We also have an added, self-inflicted problem of some 17 boutique blends of gasoline, mandated by state authorities.

The insurgency in Iraq has prevented the increase in production, even to the prewar level, that many expected. Long-term sanctions against Iraq, Iran, and Libya, both United States and international, have reduced their contribution to world supply. This has taken place against inelastic domestic production of natural gas. There are, in addition, problems of electric power generation and transmission. The point about all of these is these are not inherent problems. In principal, they would all yield to additional investment. Yet, we must bear in mind that investment activity depends upon price signals, and that there is a long period of gestation before additional investment activity brings supply to market. Some of these problems may, however, be ameliorated by changes in law or in regulation.

By about 2010, we should see a significant increase in oil production as a result of investment activity now under way. There is a danger that any easing of the price of crude oil will, once again, dispel the recognition that there is a finite limit to conventional oil. In no way do the prospective investment decisions solve the long-term, fundamental problem of oil supply.

3. Let me turn now to the political and economic ramifications. Again, let me underscore that energy actions tend to be a two-edged sword. To some extent, the recent higher prices for oil reflect some of our own prior policies and actions. For example, the sanctions imposed upon various rogue nations, by reducing world supply, have resulted in higher prices. Operation Iraqi Freedom, followed by the insurgency, has caused unrest in the Middle East. The consequence has been somewhat lower production and a significant risk premium that, again, has raised the price of oil.

The effect of higher oil prices has been significantly higher incomes for producers. A much higher level of income has meant that a range of nations, including Russia, Iran, Venezuela, as well as gulf Arab nations have had their economic problems substantially eased. As a result, they have become less amenable to American policy initiatives. Perhaps more importantly, the flow of funds into the Middle East inevitably has added to the moneys that can be transferred to terrorists. As long as the motivation is there and controls remain inadequate, that means that the terrorists will continue to be adequately or amply funded. To the extent that we begin to run into supply limitations and to the extent that we all grow more dependent on the Middle East, this problem of spillover funding benefits for terrorists is not going to go away.

4. There are, of course, additional problems of an economic nature. We all understand that higher oil prices can depress spending on other goods and services—and thereby cause slower growth rates and possibly a worldwide recession. The reverse side of rising receipts for producers is, of course, rising out-payments by consumer nations. This can readily augment structural imbalances. This year, the American balance-of-payments deficit looks to be almost three-quarters of a trillion dollars. That is not small change. Of the well over $700 billion of that deficit, some $300 billion comes from oil and gas. It is recognized that the U.S. balance-of-payments deficit represents the locomotive that drives much of the world's economies. In performing this service—for which we get little thanks—the United States is steadily adding to its financial obligations to others. How long this process can continue is uncertain, but high oil prices add to the dilemma.

Finally, Mr. Chairman, I must point to another problem. The United States is today the preponderant military power in the world. Still, our military establishment is heavily dependent upon oil. At a minimum, the rising oil price poses a budgetary problem for the Department of Defense at a time that our national budget is increasingly strained. Moreover, in the longer run, as we face the prospect of a plateau in which we are no longer able, worldwide, to increase the production of oil against presumably still-rising demand, the question is whether the Department of Defense will still be able to obtain the supply of oil products necessary for maintaining our military preponderance. In that prospective world, the Department of Defense will face all sorts of pressures at home and abroad to curtail its use of petroleum products, thereby endangering its overall military effectiveness.

In closing, Mr. Chairman, I trust that I have fulfilled the request in your letter of invitation to analyze "the complexity of U.S. reliance on imported energy sources, particularly oil, and the difficulties the United States faces in mediating detrimental

effects of this dependency." Even in the short run, actions that we take may substantially increase the resources and reduce the economic and political pressures on states that are hostile to us. In the longer run, unless we take serious steps to prepare for the day that we can no longer increase production of conventional oil, we are faced with the possibility of a major economic shock—and the political unrest that would ensue. The United States has just over 4 percent of the world's population and uses roughly 25 percent of the world's oil production. In a sense, this statistic in itself is misleading, because the United States produces roughly 20 to 25 percent of the gross world product. Nonetheless, that statistic does underscore our potential vulnerability in an era that we may no longer be able to produce additional conventional crude oil worldwide.

Thank you very much, Mr. Chairman. I shall be happy to answer any questions that you or the members of the committee may have.

The CHAIRMAN. Thank you very much, Secretary Schlesinger. In response to your question, you have indeed fulfilled our expectations with a remarkable paper. And I would simply indicate that the statements that you and Dr. Woolsey have brought to us are tremendously important statements. I doubt whether any information will be more important on Capitol Hill today. I'm hopeful that there will be wide circulation of both of those papers in full, quite apart from the excellent summary that you've given us.

Mr. Woolsey.

STATEMENT OF HON. R. JAMES WOOLSEY, VICE PRESIDENT, BOOZ ALLEN HAMILTON, McLEAN, VA

Mr. WOOLSEY. Thank you, Mr. Chairman. It's always a pleasure to appear before my coauthor of several years ago and his colleagues, of course. I thank you for the work you've done on these issues, you and the other members of the committee. I want to point out that the testimony I'm presenting today is in large measure of the substance of a paper by former Secretary of State, George P. Shultz, and I. We wrote and published it on the Web site of the Committee on the Present Danger, which he and I cochair this summer.

There's a section on batteries and plug-in hybrids in the testimony that is somewhat expanded from that paper. It also—the paper—has been around for a bit of time and has been part of the basis for the "Set America Free" Coalition's legislative proposals, which are being presented this morning, I believe, by a bipartisan group in the House of Representatives, and at noon by a bipartisan group in the Senate. I believe Senator Coleman among others is a cosponsor of that legislation.

There are, Mr. Chairman, several important reasons why oil is different. I'm going to use my testimony just as talking points, essentially, if it's all right and point out why a pure market approach is something that will not work under the current circumstances.

First of all the current transportation infrastructure is committed to oil and oil-compatible products. So there's no effective short-term substitutability. One simply has to eat whatever increases in oil prices come upon us. We can't shift as we can with many other commodities.

Second, that dependance is one which operates today in such a way that the transportation fuel market and the electricity market are effectively completely separate things. In the 1970s about 20 percent of our electricity came from oil, so if one introduced nuclear power, or wind power, one was substituting them to some extent

for oil use. Today that's essentially not true anymore. Only 2 to 3 percent of our electricity comes from oil.

Whether you're a fan of nuclear power or wind or whatever, you can put windmills and nuclear reactors on every hilltop and you would have only negligible effect on our use of oil.

So the transportation fuel market and the electricity market today are very different. Secretary Shultz and I focused on the importance of proposals that could get something done soon, as Senator Sununu suggested. And in that regard let me be very blunt. We should forget about 95 percent of our effort on hydrogen fuel cells for transportation. We found on the National Energy Policy Commission that "hydrogen offers little to no potential to improve oil security and reduce climate change risks in the next 20 years." Hydrogen fuel cells have real utility in niche markets for stationary uses. But the combination of trying to get the cost of these one-to-two-million-dollar vehicles that run on hydrogen down, at the same time one coordinates a complete restructuring of the energy industry so one has hydrogen at filling stations, and does a complete restructuring of the automotive industry so one has hydrogen fuel cells, is a many decades-long undertaking.

Hydrogen fuel cells for transportation in the near term are, in my judgement, a snare and a delusion and we should stop spending the kind of money on them that we are spending now.

The second point is that the Greater Middle East will continue to be the low-cost and dominant petroleum producer for the foreseeable future. If one looks at the coming demand growth from China and India, and the relatively high cost of production elsewhere, it is still going to be the case that the gulf—Saudi Arabia in particular—is going to be the swing producer and have a dominant influence on oil prices.

If the Saudi fields are in the negative shape that Mr. Simmons and others have suggested in some of their writings it may be a bit harder for the Saudis to increase production quickly, drop the price of oil as they did in the mid-1980s, and bankrupt other approaches.

But we should, in any case, focus on approaches toward alternative fuels that are inexpensive and that have real social value, such as cleaning up waste. That is one important way to avoid having Saudi production able to be turned on and drop the price so much that it makes other sources too expensive as they did in the 1980s.

Third, the petroleum infrastructure is very vulnerable to terrorist and other attacks. My friend, Bob Baer, the former CIA officer, who wrote the recent book, "Sleeping With the Devil," opens with a scenario in which a hijacked airliner is flown into the sulfur-cleaning towers up near Ras Tanura in northeastern Saudi Arabia. That takes 6 million barrels a day or so offline for a year or more. It sends world oil prices well over $100/barrel and crashes the world's economy.

And that's not to speak of some of the vulnerabilities from attacks on shipping, from hurricane damage in the gulf and all the rest. So the infrastructure of oil worldwide is vulnerable both to accidents and certainly to terrorism. But neither Secretary Shultz nor I talk in terms of just oil imports. We don't solve anything in this

country by importing a lot less from the Middle East and importing, say, more from Canada and Mexico, and then Europe importing more from the Middle East.

To a first approximation there's one worldwide oil market, and it doesn't do anything particularly useful just to move the shipping patterns around. One needs to get at the underlying issue of oil use.

Fourth, the possibility exists, particularly under regimes that could come to power in the Greater Middle East, of embargoes or other disruptions of supply. People sometimes say, whoever is in power in Saudi Arabia, they're going to need to sell the oil in order to live. Well, they don't need to pump that much of it if they want to live in the seventh century.

Bin Laden has explicitly said that he thinks $200/barrel or more is a perfectly reasonable price for oil. And we should remember that in 1979 there was a serious coup attempt in Saudi Arabia. In this part of the world, however successful or unsuccessful, our current efforts to help bring democracy and the rule of law into that part of the world are, we are looking at a decade or two or three of chaotic change and unpredictable governmental behavior in the Middle East. And that bodes concern, at the very least, for the stability of oil supplies.

Fifth, wealth transfers from oil have been used, and continue to be used, to fund terrorism and ideological support. The old Pogo cartoon line, "We have met the enemy and he is us," is certainly true with respect to the funding of terrorism in the Middle East. For the ideological underpinnings of terrorism and the hate which is reflected in the al-Qaeda doctrine and related doctrines, we have only to look to the funding which takes place from Saudi Arabia and from wealthy individuals in that part of the world. Estimated generally at $3–$4 billion a year these funds go into teaching hatred in the madrassas of Pakistan, in the textbooks of Indonesia, in the mosques of the United States. We hear Prince Turki bin Faisal, the new Ambassador in Washington from Saudi Arabia and my former counterpart when he headed Saudi intelligence, say that we don't appreciate how much the Saudis are doing in fighting against terrorism. Well, in a sense they are. They are perfectly willing to cooperate with us in fighting al-Qaeda, but it is not because the underlying views of the Wahhabis in Saudi Arabia and those of the Salafist jihadis such as al-Qaeda are different: They are not. The underlying views are genocidal for both groups with regard to Shiite Muslims, Jews, and homosexuals and they are absolutely filled with hatred with respect to Suffi and other Muslims, Christians, those with other religious beliefs, and democracy. Both are on the side of terrible oppression of women.

The underlying views are the same, in many ways, the way the underlying views of the Stalinists and the Trotskyites were the same in the 1930s. Both were revolutionary Marxists who believed in dictatorship, but they disagreed on one major point, which was whether or not tactically one should subordinate one's revolutionary zeal to the interests of the Soviet state—that was the Stalinists—or whether one should feel free to pursue revolution anywhere and everywhere—that was the Trotskyites. That's essentially the same difference between the Wahhabis and a group like

al-Qaeda. The Wahhabis believe in subordinating the manifestations of their hatred to the interest of the Saudi state. Al-Qaeda believes in flying planes into buildings in New York and Washington.

So what is taught as a result of the oil wealth that we help fund—what is taught in the madrassas of Pakistan and elsewhere—is essentially the same hatred that is fostered by a group like al-Qaeda.

Sixth, the current account deficits for a number of countries create risks ranging from major world economic disruption to deepening poverty, and could be substantially reduced by reducing oil imports.

The United States essentially borrows about $2 billion now every day, principally from major Asian states, to finance its consumption. The single largest category of imports is the approximately $1 billion per working day that we borrow in order to finance our imported oil.

For developing nations the service of debt, for a country like Bangladesh, is a major problem that is heavily driven by having to import very expensive dollar-denominated oil. Needless to say we have a very important economic issue here in the United States. In the chairman's and my article of several years ago, we pointed out that every billion dollars of imported oil that is replaced by domestic fuel production creates something between 10,000 and 20,000 American jobs. Most of these are in rural America and areas where jobs are needed.

Seventh, global-warming gas emissions from manmade sources do create at least the risk of climate change, and one important component of potential climate change is, of course, transportation and oil.

Secretary Shultz and I suggested three proposed directions for policy in these circumstances.

The first policy is to encourage improved vehicle mileage, using technology that is now in production.

First, with modern diesel vehicles: One needs to be sure that they are clean enough with respect to emissions, but one of the main reasons that European fuel mileage is 42 miles a gallon for their fleet and ours is 24 miles a gallon, is because over half of the passenger vehicles in Europe are diesels; modern diesels.

Second, of course, hybrid gasoline-electric vehicles which have substantial advantages with respect to fuel economy, and I'll come in a minute to this new development of plug-in hybrids, which is extremely important.

Third, light weight carbon composite construction of vehicles. The Rocky Mountain Institute's publication of a year ago, "Winning the Oil Endgame" (WTOE) talks about this. This is a technology that is now in place for at least racing cars. Formula 1 racers are constructed out of carbon composites that are about 80 percent of the strength of aviation composites but about 20 percent of the cost. What that does is separate weight from safety. If one is in a light weight carbon composite vehicle like a Formula 1 racer it is extremely resistant to being crushed or damaged, many times better than steel. So having light-weight vehicles that are fuel efficient, but also strong enough that you don't have to worry that your fam-

ily's going to get crushed if they get hit by an SUV, has some real advantages. Again, this technology is being used for racing vehicles today, so it is no stranger to the automotive business.

The second policy we suggest is the commercialization of alternative transportation fuels—fuels that can be available soon, are compatible with existing infrastructure, and can be derived from waste or otherwise produced cheaply. The first is cellulosic ethanol. The chairman and I stressed it in the Foreign Affairs article that he mentioned. Ethanol of any kind can be used for up to 85 percent of the fuel in flexible-fuel vehicles. And as the chairman mentioned in his opening remarks, it is trivial to have a flexible-fuel vehicle. It means a slightly different kind of plastic in the fuel line, and a slightly different programming for the computer chip. It's a $100 cost or less for a new vehicle and there are millions on the road. Most people who have one don't even know that they have it. But by being able to use grass or straw or agricultural waste such as rice straw to produce ethanol the price can be substantially lower than would be the case for starch-based ethanol, and this also means an added crop, and added product, for farmers. If a farmer can sell not only his corn for feed grain, but also can sell the switchgrass that is mowed from the soil bank, the CRP lands, he has an added new crop. We looked in the National Energy Policy Commission at the availability of land issues and the price issues. I'd point you toward page 7 of my statement. The cost of cellulosic ethanol looks like it is headed down to well below $1 a gallon for production. Iogen is now in production with Shell Oil backing, at a cost of a bit over $1 a gallon in Canada—the first commercial cellulosic ethanol. If one focuses only on the soil bank lands, some 30 million acres are idled on farmers' property today. Two-thirds of this acreage is planted in switchgrass. If we look forward over the next 20 years, a gradual improvement in the mileage of our vehicles, up to say around 40 miles a gallon, short of where the Europeans are today, and we see a modest yield increase in prairie grass, switchgrass, its entirely plausible to have a doubling of yield, or tripling—we've had several times that increase in wheat, corn, and rice in the last 20 or so years—then one would be able, solely on the amount of land that is in the soil bank, to grow enough switchgrass to replace one-half of our gasoline. This would be essentially the gasoline that comes from the 55 percent or so of our oil that is now imported. Sometimes data bared on other assumptions make the land use requirements look huge, but that's not the way it looked to us on the National Energy Policy Commission.

There are also new technologies for producing diesel encouraged in the Energy Act. It's called renewable diesel rather than biodiesel, because it focuses on waste products of all kinds as we said in the Energy Commission Report. These can be animal offal, agricultural residues, municipal solid waste, sewage, even old tires. We're talking about using waste that is organic in a chemical sense to produce diesel. In the Energy Policy Commission, we said the cost of that looked like it was headed to around 70 cents per gallon for production.

Finally, Mr. Chairman, plug-in hybrids. The Toyota Priuses that are sold in Japan and Europe have a button on them, which if you push it you can drive all electric for a kilometer or so. For some

reason those buttons are not put on the Priuses that are sold in the United States. But if one improves the capabilities of the batteries in a hybrid, and you can punch a button of that sort and drive for, let's say, 30 miles before the hybrid feature cuts in—that is the movement back and forth between gasoline power and electric power—and you have topped off the battery by plugging in the hybrid overnight, using off-peak night-time power, you are driving on the equivalent of something between 25-cent and $1-a-gallon gasoline. Most cars in the United States are driven less than 30 miles a day. So, if that's the second car in the family, the car that's used for errands and taking kids to school and so forth, you could well go weeks or months before you visited the filling station. On the average that type of a feature makes my 50-mile-a-gallon Prius into about a 125-mile-a-gallon Prius. If you make that vehicle out of carbon composites, then instead of 125 miles a gallon you would be getting around 250 miles a gallon, because halving the weight would approximately double the mileage. And then finally, if you're running that vehicle on E–85, 85 percent ethanol, because it is a flexible-fuel vehicle you're getting up in the range of 1,000 miles per gallon, of petroleum products. Now these technologies may not all work out as quickly as we might hope but just as a decent investment portfolio can make up for some shortcomings with yields in other areas, the same can happen here.

Suppose some portion of these hopes don't bear out, but others do and maybe in a few years instead of 1,000-mile-a-gallon vehicles we only have 500-mile-per-gallon vehicles, or 300-mile-per-gallon vehicles. We've nonetheless done something very, very useful and important.

And so, I would say, Mr. Chairman, there is a range of important objectives here—economic, geopolitical, environmental—that would be served by embarking on a path of encouraging these kinds of technologies, but one that is of the greatest importance is the reason Secretary Schlesinger pointed out, as did you in your opening remarks: We would be substantially more secure.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Woolsey follows:]

PREPARED STATEMENT OF HON. R. JAMES WOOLSEY, VICE PRESIDENT, BOOZ ALLEN HAMILTON, MCLEAN, VA

Mr. Chairman and members of the committee, it's a real pleasure to appear before this committee today on this issue. I am appearing solely on my own behalf and represent no organization. By way of identification I served as Director of Central Intelligence, 1993–95, one of the four Presidential appointments I have held in two Republican and two Democratic administrations; these have been interspersed in a career that has been generally in the private practice of law and now in consulting. The substantial majority of the points I will make today are drawn from an August 2005 paper by former Secretary of State, George P. Shultz, and myself, although I have updated some points due to more recent work; the two of us are cochairmen of the Committee on the Present Danger and the full paper may be found at the committee's Web site (www.fightingterror.org).

Just over 4 years ago, on the eve of 9/11, the need to reduce radically our reliance on oil was not clear to many and in any case the path of doing so seemed a long and difficult one. Today both assumptions are being undermined by the risks of the post-9/11 world, by oil prices, and by technological progress in fuel efficiency and alternative fuels.

There are at least seven major reasons why dependence on petroleum and its products for the lion's share of the world's transportation fuel creates special dangers in our time. These dangers are all driven by rigidities and potential

vulnerabilities that have become serious problems because of the geopolitical realities of the early 21st century. Those who reason about these issues solely on the basis of abstract economic models that are designed to ignore such geopolitical realities will find much to disagree with in what follows. Although such models have utility in assessing the importance of more or less purely economic factors in the long run, as Lord Keynes famously remarked: "In the long run, we are all dead."

These dangers in turn give rise to two proposed directions for government policy in order to reduce our vulnerability rapidly. In both cases it is important that existing technology should be used, i.e., technology that is already in the market or can be so in the very near future and that is compatible with the existing transportation infrastructure. To this end government policies in the United States and other oil-importing countries should: (1) Encourage a shift to substantially more fuel-efficient vehicles within the existing transportation infrastructure, including promoting both battery development and a market for existing battery types for plug-in hybrid vehicles; and (2) encourage biofuels and other alternative and renewable fuels that can be produced from inexpensive and widely available feedstocks—wherever possible from waste products.

PETROLEUM DEPENDENCE: THE DANGERS

1. The current transportation infrastructure is committed to oil and oil-compatible products

This fact substantially increases the difficulty of responding to oil price increases or disruptions in supply by substituting other fuels.

There is a range of fuels that can be used to produce electricity and heat and that can be used for other industrial uses, but petroleum and its products dominate the fuel market for vehicular transportation. With the important exception, described below, of a plug-in version of the hybrid gasoline/electric vehicle, which will allow recharging hybrids from the electricity grid, substituting other fuels for petroleum in the vehicle fleet as a whole has generally required major, time-consuming, and expensive infrastructure changes. One exception has been some use of liquid natural gas (LNG) and other fuels for fleets of buses or delivery vehicles, although not substantially for privately owned ones, and the use of corn-derived ethanol mixed with gasoline in proportions up to 10 percent ethanol ("gasohol") in some States. Neither has appreciably affected petroleum's dominance of the transportation fuel market.

Moreover, in the 1970s about 20 percent of our electricity was made from oil—so shifting electricity generation toward, say, renewables or nuclear power could save oil. But since today only about 3 percent of our electricity is oil-generated, a shift in the way we produce electricity would have almost no effect on the transportation or oil market. This could change over the long run, however, with the advent of plug-in hybrid vehicles, discussed below.

There are imaginative proposals for transitioning to other fuels for transportation, such as hydrogen to power automotive fuel cells, but this would require major infrastructure investment and restructuring. If privately owned fuel cell vehicles were to be capable of being readily refueled, this would require reformers (equipment capable of reforming, say, natural gas into hydrogen) to be located at filling stations, and would also require natural gas to be available there as a hydrogen feed-stock. So not only would fuel cell development and technology for storing hydrogen on vehicles need to be further developed, but the automobile industry's development and production of fuel cells also would need to be coordinated with the energy industry's deployment of reformers and the fuel for them.

Moving toward automotive fuel cells thus requires us to face a huge question of pace and coordination of large-scale changes by both the automotive and energy industries. This poses a sort of industrial Alphonse and Gaston dilemma: Who goes through the door first? (If, instead, it were decided that existing fuels such as gasoline were to be reformed into hydrogen on board vehicles instead of at filling stations, this would require onboard reformers to be developed and added to the fuel cell vehicles themselves—a very substantial undertaking.)

It is because of such complications that the National Commission on Energy Policy concluded in its December 2004, report "Ending The Energy Stalemate" that "hydrogen offers little to no potential to improve oil security and reduce climate change risks in the next 20 years."

To have an impact on our vulnerabilities within the next decade or two, any competitor of oil-derived fuels will need to be compatible with the existing energy infrastructure and require only modest additions or amendments to it.

2. The Greater Middle East will continue to be the low-cost and dominant petroleum producer for the foreseeable future

Home of around two-thirds of the world's proven reserves of conventional oil—45 percent of it in just Saudi Arabia, Iraq, and Iran—the Greater Middle East will inevitably have to meet a growing percentage of world oil demand. This demand is expected to increase by more than 50 percent in the next two decades, from 78 million barrels per day (bbl/d) in 2002 to 118 bbl/d in 2025, according to the Federal Energy Information Administration. Much of this will come from expected demand growth in China and India. One need not argue that world oil production has peaked to see that this puts substantial strain on the global oil system. It will mean higher prices and potential supply disruptions and will put considerable leverage in the hands of governments in the Greater Middle East as well as in those of other oil-exporting states which have not been marked recently by stability and certainty: Russia, Venezuela, and Nigeria, for example. Deep-water drilling and other opportunities for increases in supply of conventional oil may provide important increases in supply but are unlikely to change this basic picture.

Even if other production comes on line, e.g., from unconventional sources such as tar sands in Alberta or shale in the American West, their relatively high cost of production could permit low-cost producers, particularly Saudi Arabia, to increase production, drop prices for a time, and undermine the economic viability of the higher cost competitors, as occurred in the mid-1980s. For the foreseeable future, as long as vehicular transportation is dominated by oil as it is today, the Greater Middle East, and especially Saudi Arabia, will remain in the driver's seat.

3. The petroleum infrastructure is highly vulnerable to terrorist and other attacks

The radical Islamist movement, including but not exclusively al-Qaeda, has on a number of occasions explicitly called for worldwide attacks on the petroleum infrastructure and has carried some out in the Greater Middle East. A more well-planned attack than what has occurred to date—such as that set out in the opening pages of Robert Baer's recent book, "Sleeping With the Devil" (terrorists flying an aircraft into the unique sulfur-cleaning towers in northeastern Saudi Arabia), could take some 6 million barrels per day off the market for a year or more, sending petroleum prices sharply upward to well over $100/barrel and severely damaging much of the world's economy. Domestic infrastructure in the West is not immune from such disruption. U.S. refineries, for example, are concentrated in a few places, principally the gulf coast. The recent accident in the Texas City refinery—producing multiple fatalities—points out potential infrastructure vulnerabilities, as of course does this fall's hurricane damage in the gulf. The Trans-Alaska Pipeline has been subject to several amateurish attacks that have taken it briefly out of commission; a seriously planned attack on it could be far more devastating.

In view of these overall infrastructure vulnerabilities policy should not focus exclusively on petroleum imports, although such infrastructure vulnerabilities are likely to be the most severe in the Greater Middle East. It is there that terrorists have the easiest access, and the largest proportion of proven oil reserves and low-cost production are also located there. Nor is anything particularly useful accomplished by changing trade patterns. To a first approximation there is one worldwide oil market and it is not generally useful for the United States, for example, to import less from the Greater Middle East and for others then to import more from there. In effect, all of us oil-importing countries are in this together.

4. The possibility exists, particularly under regimes that could come to power in the Greater Middle East, of embargoes or other disruptions of supply

It is often said that whoever governs the oil-rich nations of the Greater Middle East will need to sell their oil. This is not true, however, if the rulers choose to try to live, for most purposes, in the seventh century. Bin Laden has advocated, for example, major reductions in oil production and oil prices of $200/barrel or more.

In 1979 there was a serious attempted coup in Saudi Arabia. Much of what the outside world saw was the seizure by Islamist fanatics of the Great Mosque in Mecca, but the effort was more widespread. Even if one is optimistic that democracy and the rule of law will spread in the Greater Middle East and that this will lead after a time to more peaceful and stable societies there, it is undeniable that there is substantial risk that for some time the region will be characterized by chaotic change and unpredictable governmental behavior. Reform, particularly if it is hesitant, has in a number of cases been trumped by radical takeovers (Jacobins, Bolsheviks). There is no reason to believe that the Greater Middle East is immune from these sorts of historic risks.

5. Wealth transfers from oil have been used, and continue to be used, to fund terrorism and its ideological support

Estimates of the amount spent by the Saudis in the last 30 years spreading Wahhabi beliefs throughout the world vary from $70 billion to $100 billion. Furthermore, some oil-rich families of the Greater Middle East fund terrorist groups directly. The spread of Wahhabi doctrine—fanatically hostile to Shiite and Suffi Muslims, Jews, Christians, women, modernity, and much else—plays a major role with respect to Islamist terrorist groups: A role similar to that played by angry German nationalism with respect to Nazism in the decades after World War I. Not all angry German nationalists became Nazis and not all those schooled in Wahhabi beliefs become terrorists, but in each case the broader doctrine of hatred has provided the soil in which the particular totalitarian movement has grown. Whether in lectures in the madrassas of Pakistan, in textbooks printed by Wahhabis for Indonesian schoolchildren, or on bookshelves of mosques in the United States, the hatred spread by Wahhabis and funded by oil is evident and influential.

On all points except allegiance to the Saudi State, Wahhabi and al-Qaeda beliefs are essentially the same. In this there is another rough parallel to the 1930s—between Wahhabis' attitudes toward al-Qaeda and like-minded Salafist jihadi groups today and Stalinists' attitude toward Trotskyites some 60 years ago. The only difference between Stalinists and Trotskyites was on the question whether allegiance to a single state was required or whether free-lance killing of enemies was permitted. But Stalinist hatred of Trotskyites and their free-lancing didn't signify disagreement about underlying objectives, only tactics, and Wahhabi/Saudi cooperation with us in the fight against al-Qaeda doesn't indicate fundamental disagreement between Wahhabis and al-Qaeda on, e.g., their common genocidal fanaticism about Shi'a, Jews, and homosexuals. So Wahhabi teaching basically supports al-Qaeda ideology.

It is sometimes contended that we should not seek substitutes for oil because disruption of the flow of funds to the Greater Middle East could further radicalize the population of some states there. The solution, however, surely lies in helping these states diversify their economies over time, not in perpetually acquiescing to the economic rent they collect from oil exports and to the uses to which these revenues are put.

6. The current account deficits for a number of countries create risks ranging from major world economic disruption to deepening poverty, and could be substantial reduced by reducing oil imports

The United States in essence borrows about $2 billion a day, every day, principally now from major Asian states, to finance its consumption. The single largest category of imports is the approximately $1 billion per working day borrowed to import oil. The accumulating debt increases the risk of a flight from the dollar or major increases in interest rates. Any such development could have major negative economic consequences for both the United States and its trading partners.

For developing nations, the service of debt is a major factor in their continued poverty. For many, debt is heavily driven by the need to import oil that at today's oil prices cannot be paid for by sales of agricultural products, textiles, and other typical developing nation exports.

If such deficits are to be reduced, however, say by domestic production of substitutes for petroleum, this should be based on recognition of real economic value such as waste cleanup, soil replenishment, or other tangible benefits.

7. Global-warming gas emissions from man-made sources create at least the risk of climate change

Although the point is not universally accepted, the weight of scientific opinion suggests that global warming gases produced by human activity form one important component of potential climate change. Oil products used in transportation provide a major share of U.S. man-made global warming gas emissions.

THREE PROPOSED DIRECTIONS FOR POLICY

The above considerations suggest that government policies with respect to the vehicular transportation market should point in the following directions:

1. Encourage improved vehicle mileage, using technology now in production

Three currently available technologies stand out to improve vehicle mileage.

Diesels

First, modern diesel vehicles are coming to be capable of meeting rigorous emission standards (such as Tier 2 standards, being introduced into the United States,

2004–08). In this context it is possible without compromising environmental standards to take advantage of diesels' substantial mileage advantage over gasoline-fueled internal combustion engines.

Substantial penetration of diesels into the private vehicle market in Europe is one major reason why the average fleet mileage of such new vehicles is 42 miles per gallon in Europe and only 24 mpg in the United States. Although the United States has, since 1981, increased vehicle weight by 24 percent and horsepower by 93 percent, it has actually somewhat lost ground with respect to mileage over that near-quarter century, In the 12 years from 1975 to 1987, however, the United States improved the mileage of new vehicles from 15 to 26 mpg.

Hybrid gasoline-electric

Second, hybrid gasoline-electric vehicles now on the market show substantial fuel savings over their conventional counterparts. The National Commission on Energy Policy found that for the four hybrids on the market in December 2004 that had exact counterpart models with conventional gasoline engines, not only were mileage advantages quite significant (10–15 mpg) for the hybrids, but in each case the horsepower of the hybrid was higher than the horsepower of the conventional vehicle.

Light-weight carbon composite construction

Third, constructing vehicles with inexpensive versions of the carbon fiber composites that have been used for years for aircraft construction can substantially reduce vehicle weight and increase fuel efficiency while at the same time making the vehicle considerably safer than with current construction materials. This is set forth thoroughly in the 2004 report of the Rocky Mountain Institute's "Winning the Oil Endgame." Aerodynamic design can have major importance as well. This breaks the traditional tie between size and safety. Much lighter vehicles, large or small, can be substantially more fuel-efficient and also safer. Such composite use has already been used for automotive construction in Formula 1 race cars and is now being adopted by BMW and other automobile companies. The goal is mass-produced vehicles with 80 percent of the performance of hand-layup aerospace composites at 20 percent of the cost. Such construction is expected to approximately double the efficiency of a normal hybrid vehicle without increasing manufacturing cost.

2. Encourage the commercialization of alternative transportation fuels that can be available soon, are compatible with existing infrastructure, and can be derived from waste or otherwise produced cheaply

Biomass (cellulosic) ethanol

The use of ethanol produced from corn in the United States and sugar cane in Brazil has given birth to the commercialization of an alternative fuel that is coming to show substantial promise, particularly as new feedstocks are developed. Some 6 million vehicles in the United States, and all new vehicles in Brazil other than those that use solely ethanol, are capable of using ethanol in mixtures of up to 85 percent ethanol and 15 percent gasoline (E–85). These are called Flexible Fuel Vehicles (FFV) and require, compared to conventional vehicles, only a somewhat different kind of material for the fuel line and a differently programmed computer chip. The cost of incorporating this feature in new vehicles is trivial. Also, there are no large-scale changes in infrastructure required for ethanol use. It may be shipped in tank cars (and, in Brazil, in pipelines), and mixing it with gasoline is a simple matter.

Although human beings have been producing ethanol, grain alcohol, from sugar and starch for millennia, it is only in recent years that the genetic engineering of biocatalysts has made possible such production from the hemicellulose and cellulose that constitute the substantial majority of the material in most plants. The genetically engineered material is in the biocatalyst only; there is no need for genetically modified plants.

These developments may be compared in importance to the invention of thermal and catalytic cracking of petroleum in the first decades of the 20th century—processes which made it possible to use a very large share of petroleum to make gasoline rather than the tiny share that was available at the beginning of the century. For example, with such genetically engineered biocatalysts it is not only grains of corn but corn cobs and most of the rest of the corn plant that may be used to make ethanol.

Such biomass, or cellulosic, ethanol is now likely to see commercial production begin first in a facility of the Canadian company, Iogen, with backing from Shell Oil, at a cost of around $1.30/gallon. The National Renewable Energy Laboratory estimates costs will drop to around $1.07/gallon over the next 5 years, and the Energy Commission estimates a drop in costs to 67–77 cents/gallon when the process is fully mature. The most common feedstocks will likely be agricultural wastes, such

as rice straw, or natural grasses such as switchgrass, a variety of prairie grass that is often planted on soil bank land to replenish the soil's fertility. There will be decided financial advantages in using as feedstocks any wastes which carry a tipping fee (a negative cost) to finance disposal—e.g., waste paper, or rice straw, which cannot be left in the fields after harvest because of its silicon content.

Old or misstated data are sometimes cited for the proposition that huge amounts of land would have to be introduced into cultivation or taken away from food production in order to have such biomass available for cellulosic ethanol production. This is incorrect. The National Commission on Energy Policy reported in December that, if fleet mileage in the United States rises to 40 mpg—somewhat below the current European Union fleet average for new vehicles of 42 mpg and well below the current Japanese average of 47 mpg—then as switchgrass yields improve modestly to around 10 tons/acre it would take only 30 million acres of land to produce sufficient cellulosic ethanol to fuel half the U.S. passenger fleet. By way of calibration, this would essentially eliminate the need for oil imports for passenger vehicle fuel and would require only the amount of land now in the soil bank (the Conservation Reserve Program (CRP) on which such soil-restoring crops as switchgrass are already being grown. Practically speaking, one would probably use for ethanol production only a little over half of the soil bank lands and add to this some portion of the plants now grown as animal feed crops (for example, on the 70 million acres that now grow soybeans for animal feed). In short, the United States and many other countries should easily find sufficient land available for enough energy crop cultivation to make a substantial dent in oil use.

There is also a common and erroneous impression that ethanol generally requires as much energy to produce as one obtains from using it and that its use does not substantially reduce global warming gas emissions. The production and use of ethanol merely recycles in a different way the CO_2 that has been fixed by plants in the photosynthesis process. It does not release carbon that would otherwise stay stored underground, as occurs with fossil fuel use, but when starch, such as corn, is used for ethanol production much energy, including fossil-fuel energy, is consumed in the process of fertilizing, plowing, and harvesting. Even starch-based ethanol, however, does reduce greenhouse gas emissions by around 30 percent. Because so little energy is required to cultivate crops such as switchgrass for cellulosic ethanol production, and because electricity can be coproduced using the residues of such cellulosic fuel production, reductions in greenhouse gas emissions for celluslosic ethanol when compared to gasoline are greater than 100 percent. The production and use of cellulosic ethanol is, in other words, a carbon sink.

Biodiesel and renewable diesel

The National Commission on Energy Policy pointed out some of the problems with most current biodiesel "produced from rapeseed, soybean, and other vegetable oils—as well as . . . used cooking oils." It said that these are "unlikely to become economic on a large scale" and that they could "cause problems when used in blends higher than 20 percent in older diesel engines." It added that "waste oil is likely to contain impurities that give rise of undesirable emissions."

The Commission notes, however, that biodiesel is generally "compatible with existing distribution infrastructure" and outlines the potential of a newer process ("thermal depolymerization") that produces renewable diesel without the above disadvantages, from "animal offal, agricultural residues, municipal solid waste, sewage, and old tires." (This has recently been designated "Renewable Diesel" in the Energy Act of this past summer.) The Commission points to the current use of this process at a Conagra turkey processing facility in Carthage, Missouri, where a "20 million commercial-scale facility" is beginning to convert turkey offal into "a variety of useful products, from fertilizer to low-sulfur diesel fuel" at a potential average cost of "about 72 cents per gallon."

Other Alternative Fuels

Progress has been made in recent years on utilizing not only coal but slag from strip mines, via gasification, for conversion into diesel fuel using a modern version of the gasified-coal-to-diesel process used in Germany during World War II.

Qatar has begun a large-scale process of converting natural gas to diesel fuel.

Outside the realm of conventional oil, the tar sands of Alberta and the oil shale of the Western United States exist in huge deposits, the exploitation of which is currently costly and accompanied by major environmental difficulties, but both definitely hold promise for a substantial increase in oil supply.

3. Plug-in hybrids and battery improvements

A modification to hybrids could permit them to become "plug-in-hybrids," drawing power from the electricity grid at night and using all electricity for short trips before

they move to operating in their gasoline-electric mode as hybrids. With a plug-in hybrid vehicle one has the advantage of an electric car, but not the disadvantage. Electric cars cannot be recharged if their batteries run down at some spot away from electric power. But since all hybrids have tanks containing liquid fuel plug-in hybrids have no such disadvantage.

The "vast majority of the most fuel-hungry trips are under 6 miles" and "well within the range" of current (nickel-metal hydride) batteries' capacity, according to Huber and Mills ("The Bottomless Well," 2005). Current Toyota Priuses sold in Japan and Europe have a button, that Toyota has removed for some reason on American vehicles, that permits all-electric driving for up to a kilometer; all that is really needed is to equip hybrids with adequate batteries so that this capability can be extended. Over half of all U.S. vehicles are driven less than 30 miles/day, so a plug-in hybrid that can obtain that range might go for many weeks without visiting the gasoline station. Other experts, however, emphasize that whether with existing nickel-metal-hydride battery types or with the more capable lithium-ion batteries now commercially available for computer and other applications, it is important that any battery used in a plug-in hybrid be capable of taking daily charging without being damaged and be capable of powering the vehicle at an adequate speed and argue that battery development will be necessary in order for this to be the case.

But the California experience with electric vehicles (EVs) in the 1990s suggests otherwise. It demonstrated that batteries used in those vehicles, particularly the nickel-metal-hydride ones that were used in later EV models (some of which are still on the road), have easily shown the capability for being charged daily for a number of years. And at U. Cal. (Davis) Professor Andy Frank has been designing and operating plug-in hybrids for years that now, with commercially available batteries, operate all electrically for 60 miles at up to 60 mph before the hybrid gasoline-electric feature needs to be used. Whether development is needed for some improvements to lithium-ion batteries or only financial incentives for mass production of them or the more mature nickel-metal-hydride batteries, such efforts should have the highest priority because plug-in hybrids promise to revolutionize transportation economics and to have a dramatic effect on the problems caused by oil dependence.

Moreover the attractiveness to the consumer of being able to use electricity from overnight charging for a substantial share of the day's driving is stunning. The average residential price of electricity in the United States is about 8.5 cents/kwh, and many utilities sell off-peak power for 2–4 cents/kwh. When one takes into consideration the different efficiencies of liquid-fueled and electric propulsion, then where the rubber meets the road the cost of powering a plug-in hybrid with average-cost residential electricity would be about 40 percent of the cost of powering the same vehicle with today's approximately $2.50/gallon gasoline, or, said another way, for the consumer to be able to buy fuel in the form of electricity at the equivalent of $1/gallon gasoline. Using off-peak power would then equate to being able to buy 25-to-50 cent/gallon gasoline. Given the burdensome cost imposed by current fuel prices on commuters and others who need to drive substantial distances, the possibility of powering one's family vehicle with fuel that can cost as little as one-tenth of today's gasoline (in the U.S. market) should solve rapidly the question whether there would be public interest in and acceptability of plug-in hybrids.

Although the use of off-peak power for plug-in hybrids should not require substantial new investments in electricity generation for some time (until millions of plug-ins are on the road), greater reliance on electricity for transportation should lead us to look particularly to the security of the electricity grid as well as the fuel we use to generate electricity. In the United States the 2002 report of the National Academies of Science, Engineering, and Medicine ("Making the Nation Safer") emphasized particularly the need to improve the security of transformers and of the Supervisory Control and Data Acquisition (SCADA) systems in the face of terrorist threats. The National Commission on Energy Policy has seconded those concerns. With or without the advent of plug-in hybrids, these electricity grid vulnerabilities require urgent attention.

CONCLUSION

The dangers from oil dependence in today's world require us both to look to ways to reduce demand for oil and to increase supply of transportation fuel by methods beyond the increase of oil production.

The realistic opportunities for reducing demand soon suggest that government policies should encourage hybrid gasoline-electric vehicles, particularly the battery work needed to bring plug-in versions thereof to the market, and modern diesel technology. The realistic opportunities for increasing supply of transportation fuel

soon suggest that government policies should encourage the commercialization of alternative fuels that can be used in the existing infrastructure: Cellulosic ethanol and biodiesel/renewable diesel. Both of these fuels could be introduced more quickly and efficiently if they achieve cost advantages from the utilization of waste products as feedstocks.

The effects of these policies are multiplicative. All should be pursued since it is impossible to predict which will be fully successful or at what pace, even though all are today either beginning commercial production or are nearly to that point. The battery development for plug-in hybrids is of substantial importance and should for the time being replace the current r&d emphasis on automotive hydrogen fuel cells.

If even one of these technologies is moved promptly into the market, the reduction in oil dependence could be substantial. If several begin to be successfully introduced into large-scale use, the reduction could be stunning. For example, a 50-mpg hybrid gasoline/electric vehicle, on the road today, if constructed from carbon composites would achieve around 100 mpg. If it were to operate on 85 percent cellulosic ethanol or a similar proportion of biodiesel or renewable diesel fuel, it would be achieving hundreds of miles per gallon of petroleum-derived fuel. If it were a plug-in version operating on either upgraded nickel-metal-hydride or newer lithium-ion batteries so that 30-mile trips or more could be undertaken on its overnight charge before it began utilizing liquid fuel at all, it could be obtaining in the range of 1,000 mpg (of petroleum).

A range of important objectives—economic, geopolitical, environmental—would be served by our embarking on such a path. Of greatest importance, we would be substantially more secure.

The CHAIRMAN. Thank you very much, Director Woolsey. We'll now have questions of the witnesses. We'll have a 10-minute round at this stage, and let me begin the questions by noting, Director Woolsey, that when we wrote the article 6 years ago, there was great enthusiasm. President Clinton came over to the U.S. Department of Agriculture. There was a celebration of a breakthrough of energy independence in our country. And I would note that I think the enthusiasm only lasted throughout that rally at USDA. Even though we tried to make the points that you've made today, 6 years later we are now sobered by war in the Middle East. And we are sobered by the fact, as you suggested, that in the future, events could make oil politically unavailable.

But all the assumptions on which our economy and our security, are based have consequences on our external affairs, over which we may not have a great deal of control. Ditto for the oil wells or lines in Iraq. Even as we try to protect them, we are not bringing more oil into the world. We are struggling to get back to the levels under Saddam, if one's looking at it from just that standpoint. And we have a situation that I outlined, and that you have amplified, both of you, that we are threatened by Venezuela. Clearly the President had a very rough reception in Latin America, not simply because of resistance to so-called globalization, but because there's a push-back factor. It's based on money. There is a whole lot of it pouring into that country. The Russians are trying to pay off all their debts in the world. They have a reservoir. Ditto for the terrorists, with the $3 or $4 billion that they have financed, even while we struggle with our defense budgets in protecting our troops.

You know, the gravity of all this has never sunk in. You mentioned today your Prius, and without blatant advertising I would say I like my Prius. You can't talk about this without thinking about how you physically can make a difference, even modest as it may be. And I'd like to have the plug-in feature. I would like to have all the features. I hope, as they come along, that they'll be available to modest persons like ourselves. But in the meanwhile,

many of our constituents want very large, heavy cars. They would say, "For my family, I want safety. I want protection, and, furthermore, I don't have the lifestyle, and I simply don't believe all of these intellectual types who come along to hearings like this and who predict doomsday. We heard that before." Even in the oil industry, until recently, people said, "this is another scare situation in which you simply go around and sound the horn."

Let me just say, I hope that we're coming to a different conclusion. Hearings like this are designed to amplify the voices of everybody who wants to talk about the subject. I appreciate your practical suggestions. The things we're talking about sometimes require almost a generational gap as we wait for them.

Current technology, current things that we have, include the harvesting of switchgrass for cellulosic fiber. There is lots of agricultural research on this, but very little followthrough. Thank goodness, finally, somebody is producing a potential gasoline for much, much less than the petroleum-based output. Even corn, an expensive product for the moment, has a lot of ethanol plants going up in Midwest States, and that will be helpful.

The E–85 business is a nobrainer, but nevertheless the legislation I produced modestly says that over the next 10 years, every car has to be so equipped for the 100 bucks that you have mentioned. I would hope that that would go by unanimous consent, but I doubt whether it will. Even the most modest sort of situation still faces resistance.

Now, I ask the two of you: What sort of shock value is required, so that we will understand the world in which we live, and so that these modest suggestions will have some hearings, some legislation? You've already made some suggestions. I'll turn to Secretary Schlesinger for his try at that issue.

Secretary SCHLESINGER. The shock value. The public does not really get interested in energy problems until such time as the price of gasoline runs up. Other than that it is indifferent. We move as a country from complacency to panic. Gasoline prices are high at the moment, they have risen and it has gotten the public's attention. Other than that, to get the understanding of the problem, you have supply interruptions so that you have gasoline lines, as we had in 1973 with the Arab oil embargo, and to some extent with the fall of the Shaw in 1979. That gets the public's attention.

Pointing to the reality that we are—have this trend ending the period of vast discoveries of elephants, so called elephants, super giant fields in the Middle East doesn't do it, until such time as there's some impact. I hesitate to mention to you, gentlemen, that politicians don't usually like to be associated with bad news. And that is bad news and it is very hard to persuade people to emulate Jimmy Carter, and go out there and say there's a problem coming.

Mr. WOOLSEY. I would think that $3-a-gallon gasoline, preceded by 15 of the 19 people who flew the planes on 9/11 coming from the world's largest oil producer, would have done it. But the only thing I can say is that one wants to make these steps as palatable as possible. Both financially and in terms of people's lifestyles. And I see no reason why we can't largely do that. A family may need a large SUV. At one time in my life when I was driving boy scouts and soccer teams around, I had a big old Chevy Suburban and

needed it. Maybe it got 12 miles to the gallon. But if that Chevy Suburban is running on 85 percent ethanol and is a hybrid, it could be a 100- to 200-mile-per-gallon vehicle and still be large and heavy. If you make it out of carbon composites it can be large but not so heavy and still protect the people who are in it and double the mileage again.

Cellulosic ethanol and renewable diesel are coming along at under a $1 a gallon production costs. Double that, as you go from production cost to retail price and it is still better than $2.50 to $3 a gallon gasoline. And electricity, my goodness, if you're using overnight power in most of the country, you are using 2–4 cent per kilowatt hour electricity. Where the rubber meets the road, that is the equivalent of 25-cent to 50-cent-a-gallon gasoline.

So, if people who are worried about the impact of $2.50 to $3 gasoline on their lifestyles, they can plug into their garage at night and be driving on power that's 10 percent essentially of that cost. That's a plus for them. And there are a number of things here that are like that. If you can tell the farmers of California and Louisiana who grow rice that you've got a way that, once they get the rice straw out of their fields, which they have to because it's toxic, they can make money by turning it into cellulosic ethanol, that's a plus for them. It's not a sacrifice.

So, I think what one wants to try to do here, is use this opportunity that's been created by the higher gasoline prices and oil prices to make institutional changes with respect to things like production credits and so forth, that will get these things intrain and point out to people that we're not asking you for a sacrifice in a sense. We're trying to do a lot to make your lives easier.

The CHAIRMAN. I think this is very, very good advice. I'm hopeful that we'll share that advice with other countries. We could be in a situation in which the Chinese, the Indians, and the European countries finally decide they are desperate. In the past, countries that were desperate often took over other people's territory. And we could say—well, we're in a small world. People are fighting world wars because they don't have energy. This could be a very unpalatable situation, even if we work out our predicament.

Mr. WOOLSEY. This is an issue on which all us oil importers are in the same fix together. I would have thought it would have been a wonderful major topic for cooperative discussion between the President and the Japanese and the Chinese, that we could work on programs like this together. We have no reason to want China to need lots of oil. We'd rather have them happy with using their grass to drive home.

The CHAIRMAN. Exactly. And each one of us who travel find hotels in African countries filled with people from India, China, as well as our own country, looking for the last acre on the preemptive possibility.

Senator Nelson.

Senator BILL NELSON. I'll go after Senator Hagel.

The CHAIRMAN. Senator Hagel.

Senator HAGEL. Mr. Chairman, thank you. Senator Nelson, thank you. Your observations based on many years of real life experience in not only the energy business but all the interconnected dynamics to this issue which you each have presented, not only

forcefully but very clearly brings us to the bigger issue here. And that is: How do we then take everything that the two of you have talked about in a way where we can address it, find solutions for it, develop the policy needed to do the things that you're talking about to avert the things that are coming down the track at us? Most of us who have any knowledge of what we're talking about this morning, through our own diligence, through our own travel, through our awareness, through our own study listening to people like you, are not unaware of the consequences that are coming, for our national security, for our international global markets, for all that each of you have laid out. We passed an energy bill this year; the President signed it into law. Neither of you mentioned that, I don't believe. I would like to have you each address it because in your opinions does it start to address, at all, what we must deal with here, and the decisions we're going to have to make in order to avert, I think, an international catastrophe that's headed straight at this country.

I wonder whether the President of the United States should lift this above where we are now, and essentially put this on the same plain as a Manhattan Project which has been mentioned before. The seriousness of this I don't think takes second place to any issue. And yet, we seem to kind of be sleepwalking through this. Yes, we passed the bill, kind of interesting, good. I voted for it, I suspect most of my colleagues voted for it. It just doesn't, in my opinion, really address what you're talking about. And it is complicated. I understand that you talked to Secretary Schlesinger about, I think, 17 different blends of gasoline that our refineries have to deal with. You talk about, Director Woolsey, the Pogo quote. Much of this, I think, is self-inflicted because we have not had the courage in this country, administrations, Congresses, to deal with this. But these hearings, as important as they are, are not going to lift this up and do what we need to do to address this impeding disaster.

So my question is: How do we then fix this? How do we address it. Maybe we start—you both start with the energy bill, whether that's really relevant to what needs to be done. Should the President come up here and sit down with the leadership of the Congress of the United States, and say now we're going to get it above this. We're going to make this a Manhattan Project, it is the focus of this country and the energy that we're going to harness, private public partnerships and get this done.

Last point I'd make. We hear a lot of talk about, especially politicians, energy independence. It's in our press releases. We're going to get this country to a point where there's energy independence. I'd like to hear from each of you whether that's possible. How do you do that. I didn't hear anything too encouraging from either one of you today, about that's going to happen. We're living in this smoke-filled political world of—I don't think that is possible, nor do I think that's particularly important. Sure domestic independence as much as we can get is, but we live in an interconnected world, underpinned by a global economy.

We need friends, we need alliances, we need relationships. I think we're destroying our forestructure in this country because of Iraq and because of overcommitments. We're destroying our budg-

ets, but yet Rome burns. And as much of that is this issue that we're dealing with today.

So, thank you again for your thoughts, and I would very much value your thoughts on my ramblings here and take any pieces of those as you would like. But I would like to hear from each of you, what we do now to fix the problem. Thank you, Mr. Secretary.

Secretary SCHLESINGER. The first point is: No, we're not going to have energy independence until such time as we move away from oil as our principal source of transportation fuel. We do not have a long-term energy problem in this country. We have a long-term liquids problem. Some of the measures that Jim has discussed would help ameliorate that dependency on fuel liquids. That goes back to the energy bill and to the comments made by Senator Sununu. The energy bill was quite useful. But it dealt essentially with shorter term problems: The failure to build our infrastructure; the difficulty in stringing out transmission lines or pipe lines; it eased a number of those problems and that was desirable. But it doesn't, as your question implies, deal with this longer term problem that for two centuries we have been dependent on the growth of our economies and on the rise of living standards of the exploitation of a finite resource which is oil.

How do we deal with that? I would hope that we can focus the national attention on this longer term problem and begin to prepare now to get through that transition that we face, 20 years out, 25 years out, I don't know what the date is. That depends, of course, on Presidential leadership and the need to focus on the realities of that future and possibly to develop a number of what I'll call "mini Manhattan Projects" because there are a range of developments that can help. Hybrid cars, plug-ins, look most promising. But that is not going to happen unless we are prepared to contravene to some extent, at least, the decisions of the marketplace. Senator Sununu's concerns about electric power supply are appropriate. But once again until we can link up electric power and the transportation sector, we are not going to deal with the larger oil problem.

Senator HAGEL. And I appreciate that. And I don't know if there is an answer here. But we seem to be stuck here and understanding what you're saying, Mr. Secretary, and I agree with it. But then, what do you do to get it out of neutral, and take it up somewhere where we can start to put all these pieces together, bring some leadership, resources, harness, focus policy, that's—I think that's the real issue and we may be here in 5 years, and hearing the same kind of testimony and say, well, one of these days, we'll get at it. And maybe the answer is, you said it earlier in your remarks, there has to be some crisis. A big crisis. And I think the margins of error today in the world are so much different than they were when you were Secretary of Energy, to recover from such a crisis, that is a very frightening prospect if we don't get serious about this, and I think both political parties, the Congress, and the President, have this as its greatest responsibility.

Secretary SCHLESINGER. That is absolutely right, Senator. We need to have a chorus of all political, almost all political figures, in Washington and throughout the country, Governors as well, pointing to this problem, that is something that we must address.

And if we don't have that, we are not going to get on with these major adjustments that are necessary. We must remember and this is—we must remember that our societies have difficulty facing distant threats.

We saw that in the case of Hurricane Katrina. For over a century we've known that sooner or later a CAT 4 or CAT 5 would hit a city that was below sea level. But it wasn't today's problem. Somebody has commented, it's like the fella who plays Russian roulette, and he spins five or six times, nothing happens, and he puts the revolver aside and says that's not dangerous. Well, we've been to two or three of those occasions, starting—possibly starting with the Suez crisis in 1956 and then, of course, with 1973 and 1979 and we've recovered from them and the reaction is like that fella with the revolver and Russian roulette.

Senator HAGEL. May I ask the indulgence of the committee if Director Woolsey would care to comment, and I appreciate that, Senator Nelson, since it's your time.

Mr. WOOLSEY. I'll be very brief, Senator Hagel. I agree very much with what Jim said with respect to the energy bill. Energy independence is really the wrong phrase. We're not bothered by importing natural gas from Canada for example. The problem is oil, as Jim suggested. And it seems to me that with respect to oil, although there are other things that can be done, this "Set America Free" coalition bill that Senator Coleman is a cosponsor of, that's going to be announced at the Senate press conference today at noon, has a lot of very attractive features in it. Most of the things I detailed here today are encouraged in the Senate version of the bill. There's a House bill that's a little bit less ambitious with respect to targeted reductions. But the Senate bill calls for a 10-million-barrel-a-day reduction over the course of the next 20 years. That's approximately half of our oil use today. So given the likely growth in our oil use, that would not get us completely off imported oil, but it would certainly have a very substantial effect.

So, I would think encouraging these alternative fuels of the sort that I've described, and encouraging things like plug-in hybrids as that proposal does, would get us well started. Not every bill is going to be perfect, but that's a good beginning.

Secretary SCHLESINGER. Encouraging is fine. But we must remember that we are working against the grain of the price mechanism, or the market economy. And that we are working against the predilections of the public and that's what makes it hard.

The CHAIRMAN. Thank you, Senator Hagel. And let me mention that we have promised Director Woolsey that his participation will end at about 11 o'clock. We want to honor that. That will be ample time for questions, which may very well conclude our hearing.

Senator Nelson.

Senator BILL NELSON. Thank you, Mr. Chairman. I thank Mr. Secretary and Mr. Director for your public service. I wanted to follow up, Mr. Director, on one of your comments. You said everything doesn't have to work perfectly, but some of these things can work, and we are suddenly at a position that we're using half of the gasoline that we are using now. By a combination of all the things that you have very articulately laid out. Realistically, in what period of time would that be?

Mr. WOOLSEY. Well, a lot would have to do with how fast the fleet of passenger vehicles turns over. I think the average American passenger vehicle is—stays in service for double digit years, I don't remember whether it's 10 years or 12 years or whatever. If you go to Japan all the cars look new. The reason is, they are because the tax system in Japan encourages people to get a new vehicle every 3 or 4 years. Changes like plug-in hybrids, and even adding flexible fuel vehicle capability at low cost generally require a new vehicle. Not a new kind of vehicle radically, not new factories but a new vehicle.

So, I think basically, that for these changes the technology is here. For everything I've described, the technology is either here and being built in prototype, or in several cases beginning to come into the market. Take the alternative fuels. They're beginning to come into the market. So, it's not as if we need a Manhattan Project in the sense of inventing something. You would need that if you wanted to transition to a hydrogen economy. But for these steps that I've described, it's more a matter of encouraging via the tax system or otherwise some process whereby people who had older vehicles got some sort of a break in terms of turning them in. Most of them are gas guzzlers anyway. There is a social good here of trying to make it easier financially for people to move into new types of vehicles. There are things called feebates, for example. The concept is zero net income to the government, but requiring higher prices for low-mileage vehicles and lower prices for high-mileage vehicles—balancing it out. Some of these types of policies can incline the market toward faster turnover and toward fuel efficiency, while still doing everything one can to make vehicles comfortable for people; the kinds of vehicles they want to drive.

Some people need SUVs. The problem isn't SUVs, if they're driving with 85 percent ethanol, and they are plug-in hybrids. They're going to be getting hundreds of miles a gallon in their big SUV. That's fine. If they need an SUV they should drive an SUV. So I think what we ought to do is try to figure out how we can accommodate people's needs, encourage financially the introduction of this new technology, and encourage relatively rapid turnover of the fleet of passenger vehicles. To me that would be the combination of policies that would help the most. And that moves you in these directions in a few years as distinct from 20, 30 years, I think.

Senator BILL NELSON. And I will define a few years. If we really put our mind to it and if we had the Presidential leadership, that could be accomplished over the course of 5 to 10 years.

Mr. WOOLSEY. Single digit years, rather than double digit years.

Senator BILL NELSON. And, as a result of that we would be, if at the end of that period of time, however long it is. We would be almost not dependent on foreign oil, and the question is: Are we going to be well on our way to that goal, or achieving that goal before the crisis comes that you mentioned, Senator Hagel? Because the crisis is coming. We just don't know how it's going to come. It may be that a terrorist sinks a supertanker in the Strait of Hormuz, or they blow up a refinery, or some other—maybe another major hurricane. And why we can't get the American public and the American leadership focused on this is beyond me. Now, I have spoken till I am blue in the face, and I have clearly been influenced

by you, Mr. Woolsey, because you have shared these ideas before with this Senator. You and I come from—all three of us Senators come from agricultural States. What a benefit to farmers. You don't have to be a corn farmer just to think that you're going to benefit from ethanol, because you might be a corn farmer who's also participating in the land bank, and, therefore, make that unproductive land suddenly productive, not only for your own individual financial means, but for the good of the country. Then you've got a win/win situation.

We've got a big timber industry in Florida, all throughout the southeastern United States. They go in and harvest the trees, but they're cutting off all the limbs. And they stay and they decompose right there in the forest. Well, you can use that now. You can use the animal waste, and you could go on and on and on. And why we are not recognizing this, for the life of me, I don't understand. I know it's what they've testified. That we have been seduced on cheap oil. And now it is so omni present in our system of distribution of energy that it's hard to change it, and it's going to take the crisis. It's going to force us to change. And that's sad. Now this Senator's going to continue to speak out, and I assume my colleague on the basis of your leadership, Mr. Chairman, are going to continue to speak out and let's see if we can influence whoever's occupying the White House for the next 3 years, and for the next years after that, whoever the new administration is, to see if we can break this stranglehold that we're in. I don't know what else to say.

Mr. WOOLSEY. I think that says it, Senator.

Senator BILL NELSON. I'm getting by the way, also—I have on order a hybrid. They're not easy to get, I might say. And isn't that an interesting commentary. That there is a waiting list a mile long. Why aren't the American Automobile Distributors supplying the marketplace with the demands of the marketplace. And so forth and so forth.

The CHAIRMAN. Thank you very much, Senator Nelson. This committee is declaring intellectual independence, even if we can't declare energy independence. Let me just parenthetically try to conclude, although I would yield to my colleague. He has the final comments. I visited Ukraine in early September. That country has lots of possibilities. And we have all been excited about the revolution in Ukraine that brought democracy. We have been troubled by the fact that its government has been in conflict about how reforms occur, and how to maintain unity in that country of 50 million people. It is a very important country.

But let me just say, the thing that all segments of Ukraine politics pointed to, were maps. They drew all sorts of oil lines to various countries, or gas, because of a sense of their independence conceivably being lost. The people who have the spigots and could turn them off could create a cause of war. They could create financial chaos in the meanwhile, a physical torture of the country. In other words, fortunately we are not in that condition. We are talking about a situation down the trail, but if you are in that condition as are many countries, either Ukraine or those coming to that point in this world. I stress again the international implications of our conversation today.

Even as we get our own acts straightened out, and I think that we will, we must exude optimism. We must try to work with other countries, so that they do not face this crushing sense of dependence. This is critical, or we are going to be involved, I fear, in military conflict elsewhere in the world, trying to mediate either wars or disputes among others who did not work things out.

And that is a very serious problem. For the moment, we're talking about competition with the Chinese, the Indians, everybody grasping for the last barrel, with the understanding that if they don't get it, and the dynamics of their public demand a good for their country, they may take means to get it. We have a strong need for diplomacy. I don't see it, and this is one reason for holding a hearing in this committee on a subject that others have talked about, and talked about brilliantly.

I'm very indebted to both of you for remarkable papers, as well as for your testimony and for your leadership. And we hope to stay closely in touch. Senator Hagel, do you have a final comment?

Senator HAGEL. Only that I would say, Mr. Chairman, that you have clearly and succinctly framed the issue in the larger context of the international scope of this and I think you are exactly right in what you say, and I know our two distinguished guests here, this morning, understand what we're talking about and how you have said it. So thank you, Mr. Chairman. Thank you.

The CHAIRMAN. So saying, the hearing is adjourned.

[Whereupon, at 11:03 a.m., the hearing was adjourned]

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD

PREPARED STATEMENT OF SENATOR RUSSELL D. FEINGOLD, U.S. SENATOR FROM WISCONSIN

I thank the chairman for holding today's hearing to consider the interplay between our country's energy policy and our foreign policy. As I have said many times, we must move away from our dependence on oil, most of which comes from foreign soil, if we are to truly meet our responsibility to future generations. I would like to thank today's witnesses, James Woolsey and James Schlesinger, for appearing before the committee. Given their active role in bringing attention to the concerns surrounding dependency on foreign oil, I look forward to hearing their ideas for avoiding future policy crises through an intelligent, well-informed nonfossil-fuel-based energy policy.

[From The National Interest, Winter 2005/06]

THINKING SERIOUSLY—ABOUT ENERGY AND OIL'S FUTURE

(By James R. Schlesinger)

The run-up in gasoline and other energy prices—with its impact on consumers' purchasing power—has captured the public's attention after two decades of relative quiescence. Though energy mavens argue energy issues endlessly, it is only a sharp rise in price that captures the public's attention. A perfect storm—a combination of the near-exhaustion of OPEC's spare capacity, serious infrastructure problems, most notably insufficient refining capacity, and the battering that Hurricanes Katrina and Rita inflicted on the Gulf Coast have driven up the prices of oil and oil products beyond what OPEC can control—and beyond what responsible members of the cartel prefer. They, too, see the potential for worldwide recession and recognize that it runs counter to their interests. But the impact is not limited to economic effects. Those rising domestic energy prices and the costs of fixing the damage caused by Katrina have weakened public support for the task of stabilizing Iraq, thereby potentially having a major impact on our foreign policy.

What is the cause of the run-up in energy prices? Is the cause short term (cyclical) or long term? Though the debate continues, the answer is both.

Clearly there have been substantial cyclical elements and "contradictions" at work. For several decades, there has been spare capacity in both oil production and refining. Volatile prices for oil and low margins in refining have discouraged investment. The International Energy Agency, which expresses confidence in the adequacy of oil reserves, urges substantially increased investment in new production capacity and has recently warned that, in the absence of such investment, oil prices will increase sharply.[1] Such an increase in investment clearly would be desirable, but it is more easily said than done.

In the preceding period of low activity, both the personnel and the physical capacity in the oil service industry have diminished—and it will take time to recruit and train personnel, to restore capacity and to produce equipment. It is interesting to note that the capacity of OPEC itself has shrunk in this last quarter-century from 38 million barrels per day (BPD) to 31 million BPD. The bulk of the shrinkage occurred in Iran, Iraq, and Libya, which have been the targets of both U.S. and international sanctions. Though knowledgeable people were aware of the shrinkage of spare capacity, it was still thought to be adequate—until the recent surge of demand, especially from China and the United States, brought us to the point that it was insufficient to satisfy the growing demand at prevailing prices.

Two additional points should be kept in mind. First, crude oil production capacity has not been wholly exhausted. The minister of petroleum of Saudi Arabia, Ali Naimi, points to the unutilized 1.5 million BPD in his country and states that he stands ready to serve additional buyers. The minister is making something of a rhetorical point: For the moment, that additional crude oil production capacity is unusable. There is a mismatch between the types of crude available and what refiners are able to process. For many decades there has been a marked excess of refining capacity—and very low margins in refining. There has been only a modest incentive to invest in additional capacity. With sufficient light crude apparently available, there has been little incentive to invest in capacity to process the heavy, sour crudes of the sort still available in Saudi Arabia. That is not to say, however, that there has been no investment. Here in the United States, far too much of the investment has been channeled into the capacity to produce the numerous boutique blends of gasoline, some thirty at last count—a foolishness mandated by the different state regulatory bodies.

Second, it is the international oil companies (IOCs) that have lots of cash. Their inclination has been to invest in new production capacity, counting only on prices being in the range of $20 to $30 per barrel—and not necessarily expecting the current high prices to be sustained. But while the IOCs have the cash, it is basically the national oil companies (NOCs) that have the reserves. The IOCs seek equity oil, and for the most part, equity investment in reserves controlled by NOCs has not been permitted. So, there exists another mismatch between those who have the resources to invest and the availability of suitable places to invest.

One additional point needs to be made. When gasoline prices are rising, public anger rises at least correspondingly. Public anger immediately draws the attention of politicians—and here in the United States it elicits a special type of political syndrome: Wishful thinking. It is notable that in the last election both candidates talked about "energy independence," a phrase that traces back to the presidency of Richard Nixon and to the reaction to the Arab oil embargo. One should not be beguiled by this forlorn hope—and this brings us to the real problem for the foreseeable future. What is the prospect for oil production in the long term? How does it bear on the prospects for "energy independence"?

THE DAY OF RECKONING DRAWS NIGH

At the end of World War II came the period of the opening-up and rapid development of Middle East oil production, notably in the Arabian Peninsula. Both Europe and the United States embraced the shift from coal to oil as their principal energy source. The beginning of flush production in the Middle East coincided with and fostered the tremendous expansion of world oil consumption. In the 1950s and 1960s, oil production and consumption more than doubled in each decade. Annual growth rates in consumption of 8, 9 or 10 percent were typical.

By contrast, no one, not even the most optimistic observers, expects a doubling of production in the decades ahead. The present expectation is markedly different. In increasing numbers, now approaching a consensus, knowledgeable analysts believe that the world will, over the next several decades, reach a peak—or plateau—

[1] See World Energy Outlook 2005 (International Energy Agency, 2005).

in conventional oil production.[2] Timing varies among these observers, but generally there is agreement on the outcome.[3]

The implication is clear. Even present trends are unsustainable. Sometime in the decades ahead, the world will no longer be able to accommodate rising energy demand with increased production of conventional oil.

It should be emphasized that that would pose not a general "crisis in energy," but instead a "liquids crisis." Problems in energy other than oil are infrastructure problems, solvable through appropriate investment. To talk of a general "energy crisis" aside from oil is to divert attention from the central long-term problem. Advocating the construction of nuclear plants, for example, may be desirable, but it does not confront the critical issue of the liquids crisis. Basically, there is no inherent problem in generating and transmitting electric power, for which the resources are available. The intractable problem lies in liquid fuel for land, sea and air transportation.

We get clear indications regarding oil's future from those in the industry. Though the United States and other consuming nations seem to believe that Saudi Arabia can and should increase production as demand rises, when he was asked at a recent conference whether oil production would peak, Ali Naimi, the long-time head of Saudi Aramco, responded that it would reach a plateau. It is quite telling that when, in 2004, the Energy Information Administration (EIA) projected Saudi production in 2025 of some 25 million BPD to satisfy world demand, the Saudis demurred—and quite politely indicated that such figures were "unrealistic." The Saudis have never discussed a figure higher than 15 million BPD.

This is why David O'Reilly, CEO of Chevron has stated that the "era of easy oil is over." Projections by Shell and by BP put that plateau several decades out. BP now says that its initials stand for "Beyond Petroleum." Others, more pessimistic, suggest that the peak is much closer at hand—in the next decade. It is interesting to note, in light of the recent discussion of Chinese ambitions in acquiring oil assets, that the Chinese seem to believe that world production will reach a peak around 2012.[4] So any indication of relative optimism is greeted with sighs of relief: The peak is not that near. For example, when Daniel Yergin of Cambridge Energy Research Associates recently stated that the peak will not come until after 2020, it was greeted with something approaching cries of elation: The threat is not that immediate!

What lies behind this now-changed view? In brief, most of the giant fields were found forty years or more ago. Only a few have been found since 1975. Even today the bulk of production comes from these old and now aging giant fields. The Ghawar oilfield in Saudi Arabia, discovered in the 1940s, is by itself still producing 7 percent of the world's oil. Would that there were more Ghawars, but, alas, that is probably not to be.

Moreover, the announcement by the Kuwait Oil Company in November that its Burgan field, the world's second largest, is now past its peak output caused considerable consternation. The field's optimal rate is now calculated at 1.7 million BPD, not the two million that had been forecast for decades ahead. In addition, that announcement has called into question the EIA's estimate in its reference case that Kuwait would be able to produce five million BPD; it now appears likely that the emirate will not be able to produce over three million BPD.

Recent discoveries have typically been relatively small with high decline rates—and have been exhausted relatively quickly. With respect to the United States, it has been observed: "In the old days, we found elephants—now we find prairie dogs."

A growing consensus accepts that the peak is not that far off. It was a geologist, M. King Hubbert, who outlined the theory of peaking in the middle of the last century, basing it on the experience that as an oilfield passes the halfway point in ex-

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[2] See, inter alia, Robert L. Hirsch, "The Inevitable Peaking of World Oil Production," (Atlantic Council of the United States, October 2005), which includes a range of different estimates for the peak year. For a more comprehensive analysis, see Robert L. Hirsch, Roger Bezdek and Robert Wendling, "Peaking of World Oil Production: Impacts, Mitigation and Risk Management" (National Energy Technology Laboratory, February 2005).

[3] One exception is a different view of oil's origins developed by Soviet scientists. Contrary to the standard view that oil, like coal, was laid down long ago and there is a finite amount available, the Russians argue that oil is a primordial product continuously produced deep in the earth's mantle. It comes to the surface when it can find a route to do so. Thus, there may be more oil to be found outside sedimentary basins. The theory remains highly conjectural. While this alternative view needs to be explored, it is notable that even the Russian Oil Ministry pays little attention to it in developing projections of Russian production.

[4] See Pang Xiongqi, et al., "The Challenge Brought by the Shortage of Oil and Gas in China and their Countermeasures," a presentation at an international seminar in Lisbon, 2004. One may assume that such presentations do not depart significantly from the views of the Chinese government.

tracting its reserves, its production goes into decline. Hubbert correctly predicted that production in the United States itself would peak out around 1970. Dissenting from that view are the economists, who have a deep (and touching) faith in the market mechanism—and a belief that over time market forces can adequately cope with any limits on oil supply.[5] In the extreme, some economists have regarded oil supplies as almost inexhaustible.

The optimistic view is held by the Energy Information Administration of the Department of Energy, as well as the International Energy Agency. What lies behind it? While it is conceded that we have not been finding many new giants, it is contended that "additions and extensions" of existing fields will sustain growth. There is some truth in that contention—in that new technologies have been the basis of much of the additions to existing fields—and the hope is always there that we can increase overall recovery from the already discovered fields.

Optimists are buttressed in their views and are fond of pointing to the many earlier statements about "running out of oil." Perhaps the most notable example was one by the director of the U.S. Geological Survey, George Otis Smith, who suggested in 1920 that we had already used up 40 percent of the oil to be found here in this country. That was a decade before the discovery in 1930 of the vast East Texas field, a bonanza that made oil supply so available that it drove oil prices below a dollar a barrel during the 1930s. A recent Chevron advertisement makes this substantive point quite dramatically: "It took us 125 years to use the first trillion barrels of oil. We'll use the next trillion in 30."

Such past failed predictions are far less comforting than the journalists who cite them believe. The future may actually be different from the past. The optimists, mostly non-experts, seem unable to think quantitatively. Things are different now. In 1919 the world consumed a modest 386 million barrels of oil. Today the world is consuming some thirty billion barrels of oil each year. Statements like that of Director Smith were made before we had something approaching a billion automobiles worldwide, before we had aircraft and air transportation, before agriculture depended upon oil-powered farm machinery.

Hubbert's peaking theory, based on observation of individual oil fields, was static in that it abstracted from improvements in technology. It also dealt strictly with conventional oil supplies. One notes that today those who are challenging Hubbert's Peak are changing the rules of the game. They rightly point to dramatic improvements in technology, most notably deep-sea drilling. Somewhat less legitimately, they include in their projections all sorts of unconventional oil, like the Canadian tar sands and the prospects for shale oil. For example, of late, estimates of Canadian oil reserves have jumped by 180 billion barrels, now including the tar sands of Alberta. This is not a refutation of Hubbert's theory (though it is frequently treated as such); it is simply a change in the rules that does not gainsay the fear that we will reach a plateau in conventional oil production.

We must bear in mind that earlier estimates suggested that there were some two trillion barrels of conventional oil in the earth's crust. Now the estimate has grown to around three trillion. We have now consumed over a trillion barrels of oil. As indicated, we are consuming oil at the rate of thirty billion barrels a year. If one accepts Department of Energy projections, worldwide we would be consuming forty billion barrels of oil by 2025.

At such rates of consumption, the world will soon have reached the halfway point—with all that that implies—of all the conventional oil in the earth's crust. At that point, the plateau or the peak will be near. And such calculations presuppose what cannot be assumed, that all the nations with substantial oil reserves will be willing to develop those reserves and exploit them at the maximum efficient rate. Both the Russian Federation and Saudi Arabia seem to intend to reach a plateau that they can sustain for a long time—the Russians at around ten million BPD, the Saudis up to but no more than 15 million BPD.

In thinking about the problem, we need not more rhetoric but, instead, quantitative reasoning. We also need to add political wisdom. The inability readily to expand the supply of oil, given rising demand, will in the future impose a severe economic shock. Inevitably, such a shock will cause political unrest—and could impact

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[5] Many economists take great comfort from the conviction that there is always a price at which markets will clear, and that the outcome determined by supply and demand is not only inevitable, but is also politically workable and acceptable. An outcome in which the price of a crucial commodity like oil rises to a level causing widespread economic disruption, along with the political consequences that flow from such disruption, turns out to be a secondary consideration, if considered at all. One is reminded of the phrase used by Wesley Clair Mitchell and Arthur F. Burns in their classic, Measuring Business Cycles (1946), when they spoke scornfully of the "Dreamland of Equilibrium."

political systems. To be sure, we cannot anticipate with any precision the year or even the decade that we will reach that plateau. Yet, as Justice Potter Stuart suggested, in seeking to define pornography, we shall know it when we see it.

That brings us to the question of the transition away from conventional oil as the principal source of energy for raising living standards of the world's population. That transition will be the greatest challenge this country and the world will face—outside of war. The longer we delay, the greater will be the subsequent trauma. For this country, with its 4 percent of the world's population, using 25 percent of the world's oil, it will be especially severe.[6] The Day of Reckoning is coming, and we need to take measures earlier to cushion the shock. To reduce the shock, measures to ameliorate it should start ten years earlier at a minimum, given the length of time required to adjust the capital stock—and preferably much longer. The longer we delay, the greater the subsequent pain.

Both people and nations find it hard to deal with the inevitable. Even though it was long recognized that a Category 4 or Category 5 hurricane would inevitably strike New Orleans, a city substantially below sea level, Hurricane Katrina reminds us that political systems do not allocate much effort to dealing with distant threats—even when those threats have a probability of 100 percent.

We should heed a lesson from ancient Rome. In the towns of Pompeii and Herculaneum, scant attention was paid to that neighboring volcano, Vesuvius, smoking so near to them. It had always been there. Till then, it had caused little harm. The possibility of more terrible consequences was ignored—until those communities were buried in ten feet of ash.

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[6] The high percentage of world production consumed in the United States is used by critics to point to our presumed wastefulness. It is, however, misleading in that the United States also produces between 20 and 25 percent of the gross world product. Nonetheless, it does appropriately point to our greater vulnerability to a future period of oil stringency.