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ENERGIZING HOUSTON: SUSTAINABILITY, TECHNOLOGICAL INNOVATION, AND GROWTH IN THE ENERGY CAPITAL OF THE WORLD

FIELD HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT

COMMITTEE ON SCIENCE AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED TENTH CONGRESS

SECOND SESSION

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ENERGIZING HOUSTON: SUSTAINABILITY, TECHNOLOGICAL INNOVATION, AND GROWTH IN THE ENERGY CAPITAL OF THE WORLD

FRIDAY, FEBRUARY 29, 2008

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND ENVIRONMENT,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Subcommittee met, pursuant to call, at 10:38 a.m. in Baker Hall, Suite 120, James A. Baker III Institute for Public Policy, 6100 Main Street, Rice University, Houston, Texas, Hon. Nick Lampson [Chairman of the Subcommittee] Presiding.

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The Subcommittee on Energy and Environment

Hearing on

Energizing Houston: Sustainability, Technological Innovation, and Growth in the Energy Capital of the World

February 29, 2007
10:30 a.m. – 12:30 p.m.
James A. Baker III Institute for Public Policy, Rice University, Houston, Texas

Witness List

Panel I

Mr. John Hofmeister
President, Shell Oil Company

Mr. Bill White
Mayor, City of Houston

Mr. Thomas Standish
President, Regulated Operations, CenterPoint Energy

Panel II

Dr. Walter Chapman
Director, Rice University Energy and Environment Systems Institute

Dr. Robert Harriss
President & CEO, Houston Advanced Research Center

Dr. Robert Hirsch
Senior Energy Advisor, Management Information Services Inc.

Mr. Michael Ming
President, Research Partnership to Secure Energy for America

FIELD HEARING CHARTER

SUBCOMMITTEE ON ENERGY AND ENVIRONMENT
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

Energizing Houston: Sustainability, Technological Innovation, and Growth in the Energy Capital of the World

FRIDAY, FEBRUARY 29, 2008
10:30 A.M.—12:30 P.M.
JAMES A. BAKER III INSTITUTE
RICE UNIVERSITY
HOUSTON, TEXAS

Purpose

On Friday, February 29, 2008 the House Committee on Science and Technology, Subcommittee on Energy and Environment will hold a hearing entitled, *"Energizing Houston: Sustainability, Technological Innovation, and Growth in the Energy Capital of the World,"* at the James A. Baker III Institute for Public Policy, Rice University, Houston Texas.

The Subcommittee's hearing will explore how the energy industry and cities like Houston are working to address challenges in areas such as energy supply and security, global climate change, and rapid economic growth.

Witnesses

Panel I:

Mr. Bill White, *Mayor of the City of Houston,* will discuss City of Houston initiatives to encourage energy conservation and clean energy technologies, while preserving the Houston region's competitiveness in an increasingly global marketplace.

Mr. John Hofmeister, *President of the Shell Oil Company,* will discuss energy challenges facing the Nation, and the major technical barriers to deploying a range of energy options including conventional and unconventional oil and gas and alternative energy resources.

Mr. Thomas Standish, *President of Regulated Operations, CenterPoint Energy,* will discuss the importance of federal funding of research and development to realize the potential of Smart Grid technologies, and other energy efficiency and emissions reductions efforts CenterPoint has underway in Houston.

Panel II:

Dr. Walter Chapman, *Director of the Energy and Environment Systems Institute, Rice University,* will describe how university-based research can provide new opportunities in conventional and unconventional oil and gas exploration, as well as renewable energy technologies. Professor Chapman will also address the funding challenges for energy research and need for education and outreach programs in energy fields.

Dr. Robert Harriss, *President & CEO, Houston Advanced Research Center,* will discuss research and technology development efforts in the Houston area to mitigate global climate change impacts of the region; to reduce energy consumption of homes; businesses and heavy industry; and encourage sustainable development.

Dr. Robert Hirsch, *Senior Energy Advisor, Management Information Services Inc.,* will discuss the economic implications of oil shortage scenarios, how government and the energy industry should address a crisis of peak oil, and the potential impact of various energy technologies.

Mr. Michael Ming, *President, Research Partnership to Secure Energy for America (RPSEA),* will discuss the potential of public-private research and development efforts to access previously unrecoverable reserves of energy in ultra-deepwater offshore and unconventional onshore oil and gas reservoirs.

Background

As the sixth largest metropolitan area in the U.S. with a population of 5.5 million, the greater Houston region continues to undergo rapid economic expansion and population growth. In every decade since 1850, the City of Houston's population has grown by at least 29 percent. This growth is due largely to Houston's proximity to raw materials, sea ports, and related infrastructure. Houston is a major port for agricultural exports and a center for oil and natural gas research, exploration, and production. However, with this rapid development come immense challenges to consumers, city planners, local energy providers, and local industries that must stay competitive in an increasingly global marketplace. Witnesses on the first panel will discuss how local initiatives in cities such as Houston can address these issues.

The challenge for all stakeholders lies in the need for the U.S. to obtain more energy from a variety of domestic sources, enhance the energy efficiency of communities and industry, become less reliant on energy sources and technologies that have an adverse effect on the environment, and to integrate these often-competing factors into policies and practices that lead to a more sustainable economy. The push for new technologies is especially urgent given the geopolitical and market forces that threaten global energy supplies and economic stability, finite fossil fuel reserves, the direct and indirect costs of energy to consumers, the looming threat of global climate change, and probable regulation of carbon dioxide emissions.

Given the magnitude and complexity of global energy use, research and development must begin to address these competing needs soon for technologies to penetrate the market and have an impact on our long-term energy and environmental goals. Complex challenges also call for a refined approach to energy R&D, one that incorporates the expertise and resources of the Nation's universities, government research labs, and private industry into cohesive efforts to overcome major technical barriers. Witnesses on the second panel will address how new models for technological innovation, including public-private research partnerships, and university-based basic research can be integrated overcome grand technical challenges in sustainable development.

Houston and Energy Technology

Houston has grown to support a number of diverse industries in sectors such as aerospace and chemicals production, yet energy remains the largest sector accounting for an estimated 48 percent of the region's employment. According to estimates by the Greater Houston Partnership, Houston's energy industry includes the headquarters for 17 Fortune 500 energy companies, more than 3,600 energy related establishments, 13 of the Nation's 20 largest natural gas transmission companies, 600 exploration and production firms, more than 170 pipeline operators and hundreds of energy-sector product manufacturers. This concentration of energy companies and expertise in the area has allowed the region to be a leader in international energy technology markets, beyond its role as a producer of oil and gas from the Gulf of Mexico. Houston has evolved into a global oil-technology development and distribution center, providing advanced oil and gas technologies for development of oil fields in the Middle East, the North Sea, Malaysia, Indonesia, South America and West Africa.

While it will continue to be a center for the petroleum industry in the U.S. Houston, along with the rest of the state of Texas, is rapidly becoming a focal point for renewable energy and energy efficiency technology development. Wind energy is one of the most promising and commercially viable renewable resources. The wind industry in Texas grew substantially after a 1999 State law that required a base percentage of electricity sold by utilities in the state to be generated from renewable sources. Since then, Texas has surpassed the rest of the country in installing wind capacity, allowing cities like Dallas (40 percent) and Houston (20 percent) to acquire a significant portion of their purchased electricity from renewable sources. The utilization of renewables and end-use energy efficiency measures will be further optimized by the deployment of "Smart Grid" technologies that integrate new communications and control functions into the electricity distribution grid. Located at the center of a nationwide fuel distribution and agricultural transportation network, Houston is also quickly becoming a hub for the biofuels industry with several of the country's major biofuels firms located in the region.

The City of Houston has also encouraged the use of renewable energy technologies and energy efficiency at the local level. The City has integrated renewable energy

technologies into local infrastructure. For example, school crosswalks use solar energy and in 2005, Mayor Bill White announced plans to convert a substantial portion of the City's fleet of cars, pickup trucks and sport utility vehicles to hybrids by the year 2010. Houston also hosted the first conference on Carbon Emissions Trading with the British Consulate-General and the Greater Houston Partnership in January 2007.

Ultra-Deepwater Research and Development

The hearing will also examine efforts underway to increase our domestic production of natural gas and other petroleum resources in ultra-deep offshore waters and in unconventional onshore formations. As offshore production declines in the shallow waters of the Gulf of Mexico, industry is looking to produce from oil and gas resources in deep-water (depths of 200–1,500 meters) and ultra-deepwater (depths greater than 1,500 meters). According to the Minerals Management Service, untapped fields on the outer continental shelf could account for 86 billion barrels of oil and 420 trillion cubic feet of gas.

Establishing wells at these depths, however, presents significant technological challenges. Simply characterizing these reservoirs requires improved exploration and depth imaging technologies. Drilling under these extreme conditions will be a more daunting challenge. As it will require extensive seafloor infrastructure, more research is needed in new production materials and architectures, and the integration of multiple systems including power distribution and data communication.

In May 2006, the Research Partnership to Secure Energy for America (RPSEA) located in Sugar Land was selected to administer R&D contracts for the Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Program established in Section 999 of the *Energy Policy Act of 2005.* The law mandated new oil and gas research and development program with funding totaling near $500 million for ten years derived from royalties, rents, and bonuses from federal onshore and offshore oil and gas leases.

Chairman LAMPSON. This hearing of the Energy and Environment Subcommittee will now come to order, and I wish all of you a good morning.

It's with a great deal of pleasure that I welcome my fellow Committee Members, Congressman Hall, Congressman Bartlett, and we have others that are going to be joining us, also Congressional colleagues who are not on the Committee who will be coming, and our distinguished panel of experts.

I welcome you all here to Rice University for what will undoubtedly be a lively and engaging conversation about the grand challenges that we face in energy. We have the pleasure of welcoming some Members here who are not on the Science Committee; and as they come, I will let you know who they are. I do ask unanimous consent that our colleagues be permitted to join us on the dais and participate in the hearing. Without objection, it is so ordered.

I would like to offer my sincere thanks to Rice University President Leebron and to the James A. Baker, III, Institute for Public Policy for offering this very impressive facility to the Committee for our meeting today.

So why, you might ask, is the United States House Committee on Science and Technology holding a hearing in Houston, Texas? Well, for one, my colleagues and I have ample opportunities in Washington, D.C. to hear from a myriad of experts, lobbyists, and interest groups; but the real way to gauge the importance of an issue and the impacts of our policies is to step away from Washington, D.C. and talk to folks in the field—consumers, government and energy leaders, researchers, and the general public. This is our chance to take our show on the road and to hear from local leaders and experts who just happen to be the international authorities in their fields, and then to get these important perspectives on the Congressional record for the benefit of Congress as we continue what will be an endless effort to craft good energy policies.

While I may be a little biased, I can't imagine a better place to have an open and honest discussion about energy than in the energy capital of the world, Houston, Texas. More specifically, Houston has long been associated with the oil-and-gas energy that provides the backbone of our economy and helps to make our quality of life the envy of the world. Oil and gas will absolutely continue to play this vital role for the foreseeable future. Until we have better alternatives or, as one witness will testify to today, our global supplies simply cannot meet our growing demand, we should not be at all bashful in aggressively pursuing the cutting-edge technologies that will unlock previously unrecoverable hydrocarbon reserves. But we all must acknowledge, it is a new world, with a new range of environmental, economic, and energy-related challenges that threaten our very way of life.

Whether you are most concerned with skyrocketing energy costs, $100-a-barrel oil, global climate change, energy security, job security, air quality, or competition from emerging nations, the one thing that we can all agree on is that the status quo is simply not sustainable and that we must adapt to this constantly shifting energy landscape. The world will not stand still for us. Our future will be determined by our ability to implement sound but aggressive policies accompanied by robust government and private invest-

ment in developing the entire range of advanced technologies and deploying them in the marketplace.

The city leaders in Houston are well aware of the difficulties of balancing often competing priorities in energy, economy, and sustainability. Our local economy, more than any in the country, is dependent on the wellbeing of the thousands of energy-related firms located here; but the demands we face as a community are really not unique. Just as any healthy company will adapt to changing market needs and regulatory pressures, so, too, must the region look at this new energy paradigm and find opportunity in these changes, and strength in our unparalleled capacity for innovation.

Houston has a good foundation to work from, as Texas happens to have some of the country's most progressive requirements for renewable electricity generation, allowing to us install more wind energy than all the other states combined. In fact, the American Wind Energy Association predicts that two thirds of the growth in U.S. wind energy will happen in Texas. There is also no shortage of sunlight in Texas to take advantage of solar energy as it becomes cost-competitive. Texas is not only leading the country in production in growth of wind energy but our production of biofuels and other biobased products, most especially biodiesel, will solidify our leadership role in diversifying the Nation's supply of cleaner energy and greener raw materials. In fact, after this hearing, some of us will get on a bus and travel to Oakridge North, where we'll see firsthand the Nation's first electric generation plant to run entirely on biodiesel. It may be one plant and one technology, but it represents a critical step in revolutionizing how we think about, use, and produce energy in the United States.

There are probably no three people more qualified than this first panel to speak to the issues that Houston and, for that matter, the Nation faces in reconciling our energy needs with our economic foundation and environmental health. The President of Shell Oil Company and the former head of the Greater Houston Partnership, Mr. John Hofmeister, knows, as well as anyone, the realities of the world's grand energy challenges and how the magnitude of these challenges should not excuse us from taking aggressive action here at home. We're honored and privilege to have Mayor Bill White to discuss initiatives that the City of Houston is pushing to make our homes, businesses, and industries more efficient, and to encourage innovation to keep Houston competitive in the global marketplace. Mr. Tom Standish's long and distinguished career at CenterPoint Energy can provide us the kind of nuts-and-bolts perspective on the technology needs to optimize the electricity grid as we continue to experience unprecedented growth in energy demands. We look forward to your testimony and to that of our second panel of distinguished experts.

With that, I will turn it over to the Ranking Member of the Science and Technology Committee, Congressman Ralph Hall from Rockwall, Texas. Thank you for joining us.

[The prepared statement of Chairman Lampson follows:]

PREPARED STATEMENT OF CHAIRMAN NICK LAMPSON

This hearing of the Energy and Environment Subcommittee will now come to order.

Good morning. It is with great pleasure that I welcome my fellow Committee Members, my Congressional colleagues from the Houston area, and our distinguished panel of experts to Rice University for what will undoubtedly be a lively and engaging conversation about the grand challenges we face in energy and the exciting research being explored to meet these challenges.

I would like to offer my sincere thanks to Rice University President Leebron, and to the James A. Baker III Institute for Public Policy for offering this impressive facility to the Committee.

So, why, you might ask, is the U.S. House Committee on Science and Technology holding a hearing in Houston, Texas?

While I may be a little biased, I cannot imagine a better place to have an open and honest discussion about energy than in the "Energy Capital of the World," Houston. But that is not the only reason.

My colleagues and I have ample opportunities in Washington to hear from a myriad of experts, lobbyists, and interest groups. But, each of us realize the best way to gauge the importance of an issue, and the impacts of our policies, is to step away from D.C. and talk to folks on the frontlines—consumers, government and industry leaders, researchers, and the general public. This is our chance to take our show on the road and hear from the local leaders and experts who just happen to be international authorities in their fields, and then record these important perspectives in the Congressional Record for the benefit of the country as we continue what will be an endless effort to craft good energy policies.

Texas, and more specifically Houston, has long been associated with the oil and gas industry. This industry, which directly and indirectly employs 1.3 million Texans, or 10.5 percent of the workforce, provides the backbone of our economy and helps make our quality of life the envy of the world.

Oil and gas will absolutely continue to play this vital role for the foreseeable future. We may someday have better alternatives or, as one witness will testify to today, we may find that our global supplies cannot meet our growing demand. Until then we should not be at all bashful in aggressively pursuing the cutting-edge technologies that will unlock previously unrecoverable hydrocarbon reserves. At the same time we must embrace new technologies that can make our use of fossil fuels cleaner and more efficient.

But, as we all must acknowledge, it is a new world with a new range of environmental, economic and energy related challenges that threaten our very way of life. Whether you are most concerned with skyrocketing energy costs, $100 oil, global climate change, energy security, job security, air quality, or competition from emerging nations, the one thing we can all agree on is that the status quo is simply not sustainable, and that we must adapt to this constantly shifting energy landscape. The world will not stand still for us. Our future will be determined by our ability to implement sound but aggressive policies accompanied by robust government and private investment in developing the entire range of advanced energy technologies, and then deploying them in the marketplace.

The city leaders in Houston are well aware of the difficulties of balancing often competing priorities in energy, economy, and sustainability. Our local economy, more than any in the country, is dependent on the wellbeing of the thousands of energy-related firms located here. But the demands we face as a community are really not unique. Just like any healthy company will adapt to changing market needs and regulatory pressures, so too must the region look at this new energy paradigm and find opportunity in these changes, and strength in our unparalleled capacity for innovation.

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In fact, after this hearing some of us will get on a bus and travel to Oak Ridge North, where we will see first-hand the Nation's first electric generation plant to run entirely on biodiesel. It may be one plant, and one technology, but it represents a critical step in revolutionizing how we think about, use, and produce energy in the U.S.

We look forward to the testimony of our witnesses and with that, I will turn it over to the Ranking Member of the Science and Technology Committee, Mr. Ralph Hall.

Mr. HALL. Mr. Chairman, thank you. It's your good luck and my good luck, too, that I can just barely speak. I'm honored to be here with Mayor Bill.

(To Mayor White) You were a page, you know, when I first met you; and my how you've grown. Both of you. And the Chairman always has the right to speak as long—you notice he didn't yield himself so long. He just started talking. When he said it all, there wasn't really any reason for me to say hardly anything; and I will be brief.

I'll start out by telling you I'm the oldest guy in the United States Congress. I'm 84. I ran three miles before I left Rockwall this morning. I do it every morning. (Applause).

You know, God gives everybody something. He gives women beauty and good intelligence. He gives men handsome features and ranches and things. He gave me stamina, and I guess that's good to have.

When I turned 80, the President gave me a party, over in the Oval Office; and all he did was tell old man jokes. I didn't like that at all.

[Laughter.]

He told one story about a fellow that was 93 and he was a great golfer and he could knock that ball a mile but he got to where he couldn't see where it went. He told his wife he had to quit golfing. She didn't want him to quit golfing, and he didn't want to. She said, "You know, my brother-in-law, Orville, is 98 and he can't play golf, doesn't play golf, but he likes exercise and he has the best vision of anybody I know. He can still see like he did when he was 35 or 40 years old. Why don't you take him with you and let him watch where the ball goes when you hit it."

He did, and the very first day, he hit a ball that went up way high in the air and soared. He was standing there. "Orville do you see it."

"Yeah."

"You watching it."

"Yeah."

"Has it landed yet."

"Yes. It's just landed."

He said, "Where did it go."

"I don't remember."

Those are the kind of jokes I have to tolerate all the time, but I am glad to be here and honored to be here. My voice will play out in just no time, but I thank you for having the hearing here in Houston and in Harris County, in this area.

I think, like you, it's important to highlight the very vital role that your city, the city of Houston, the State of Texas as a whole, one of ten states that produces energy for all the rest of them, the position we play in the world of energy. Our state's always been known as an oil- and gas-producing state, and I'm proud of what we've contributed to the Nation's energy supply and the leadership we've shown in renewable energy as well.

I'd be remiss if I didn't point out something that many of you know better than I do. There's a war on energy today. A war exists out there on energy. It's in vogue to knock energy. It's in vogue to knock fossil fuels, and some do it for different reasons. Some are sincere. Others, in my opinion, their elevator just doesn't go quite to the top. There are others, you know, who want to write a book or make a buck writing a piece or making a speech for somebody. Some want a Nobel Peace Prize, but it's a shame because we have to rely on fossil fuels for a long, long time. It makes sense to; and if we don't wise up pretty soon and start drilling in ANWR and start drilling offshore and pay attention to the ultra-deep legislation that Nick helped passed, and know that we have to rely on fossil fuels for a while—of course, we have to keep seeking technology to make them less destructive—and that's something that we all have to do and we will do. But there is that war and right now, because of that war, China's allowed to be unfettered in their search off the coast of Florida, with the help of Cuba; and we can't drill there. There's just something wrong with that.

If we don't start drilling in ANWR—and they say protect beautiful, perfect little ANWR. I heard it said that to say that is—and we want to drill on 2,000 acres. It's equivalent to saying that if you put a dollar bill in the end of Texas stadium, it will ruin the whole stadium. That's how ridiculous it is. We need to be doing that. It might keep our kids out of a war.

That's a tangent I'm off on; but in addition to that that you want us to talk about today, efficiency and conservation, I've always believed in the importance of a reliable domestic supply of oil and gas. Therefore, I have always been a proponent of research and development that will secure that for our country. It's for this reason that I'm especially looking forward to the testimony of Michael Ming of Research Partnership to Secure Energy for America.

The ultra-deep program has been a labor of love for me. I feel strongly about its worth and its potential for recovering substantial reserves of oil and gas. I will say that I, unfortunately, have to leave the hearing early and I won't get to hear Mr. Ming probably, but I do want to welcome our other witnesses, Bill White, Mayor, it's an honor to see you and hear you. I've read the testimony, and I look forward to hearing you.

With that, Roscoe, thank you. Gene Green, thank you.

And welcome to Texas. He's my neighbor, right across the hall from me in the Rayburn Building. Thank you, Mr. Chairman. I yield back the time that you didn't yield to me. You didn't say it, but I thank you.

Chairman LAMPSON. I can only imagine how long he would have taken or what he would have said if he had all of his voice. Always great, Ralph. Thank you so much for being here.

From the State of Maryland, Congressman Roscoe Bartlett. I recognize you for the time that you will consume.

Mr. BARTLETT. Thank you very much. I'm very pleased to be here. You know, I was thinking as I rode down here in the plane this morning—I got up at 3:30 this morning to leave at 4:00 o'clock to catch a 6:00 o'clock plane, so I'm happy to be here—that we really shouldn't be coming to Houston today, the energy capital of our country, to talk about energy when oil is over $100 barrel, gold is

$970, and our dollar is probably at its lowest level in a very long time.

This saga began in Texas, interestingly enough, 52 years ago, the 6th day of March when M. King Hubbert gave a speech, that I think will shortly be recognized as the most important speech given in the last century, to a group of oil people in San Antonio, Texas. At that time the United States was king of oil—I think producing more, consuming more, exporting more than any country in the world. M. King Hubbert told the assembled group there that in about 14 years, by 1970, that the United States—and he was talking about the lower 48—would reach its maximum oil production. No matter what we did, we could produce no more oil after that.

Right on schedule in 1970, we reached our maximum oil production; and in spite of finding a lot of oil in Alaska—and I've been to Dead Horse and seen the beginning of that four-foot pipeline through which, for many years, 25 percent of our domestic oil flowed—and in spite of finding a lot of oil in the Gulf of Mexico where we have about 4,000 oil wells—which, by the way, is more than four times as in the country of Saudi Arabia—today we produce about half the oil that we produced in 1970. I noted that, in response to the Arab oil embargo of '73, that Texas stepped up its production and produced 3.4 million barrels a day. Thank you. That was a big help. Today Texas produces 934,000 barrels of oil.

Another very famous speech was given, and that will be 51 years ago, the 14th day of this May; and I would encourage you, if you haven't read this speech, to do a Google search for Rickover and energy speech, and a really interesting speech will pop up. Hyman Rickover noted that we were in the age of oil, and he had no idea at that time how long the age of oil would last. Now we know pretty much how long the age of oil will last, but he said that how long it lasted was important in only one respect, that the longer it lasted, the more time we had to plan a transition to other sources of energy.

Now, the same M. King Hubbert who predicted that we would peak in 1970, predicted that the world would be peaking about now. The question I've had in my mind for several years now is: Why, if he was right about the United States, shouldn't there have been some concern that he might just be right about the world? Shouldn't we have been doing something about that?

There have been four major studies paid for by your government and ignored by your government. The first of these studies was the big SAIC report—and Dr. Hirsch is here and will testify at our next panel—known as the Hirsch Report, published in '05. The second was the Corps of Engineers, and theirs issued, I think, in September of '05. Last year there were two reports, the Government Accountability Office and the National Petroleum Council. In different words, each of these reports said that there was a very high probability that the world was either at or would be shortly at peak oil, that the consequences could be devastating. The Hirsch Report said the world has never faced a problem like this. There is no precedent in history to prepare us for what will happen or what we should do.

Just very recently, the two major entities in the world that track the production of oil have issued a report. This is the International

Energy Agency and the Energy Information Administration, an arm of our Department of Energy. They have issued a recent report showing that oil production worldwide has been flat for at least the last 30 months. During those 30 months, oil went up from, what, about $40 a barrel to $100 a barrel.

I say that we shouldn't be here talking about this because we have now blown 28 years when we should have been anticipating this and doing something about it. By 1980, we knew darn well that M. King Hubbert was right about the United States because we had already reached Hubbert's peak and were sliding gently down the other side. If he was right about the United States, why shouldn't he be right about the world?

Now, incredibly, our solution to this problem is go out as quickly as we can, find the little bit of oil that remains out there, and then pump it dry. I have 10 kids, 16 grandkids, and two great-grandkids. If we could pump ANWR and offshore tomorrow, what would we do the day after tomorrow.

Thank you very much, Mr. Chairman, for holding this hearing. We need to have these around the country. We need to engage the people. Thank you all very much. I see you're putting up extra chairs. Thank you so much.

[Applause.]

Mr. HALL. Would the gentleman yield to one question?

Mr. BARTLETT. I'd be happy to yield, sir.

Mr. HALL. When ANWR was voted down, I had to call Boone Pickens and tell him. Do you know what his answer was?

Mr. BARTLETT. What was his answer?

Mr. HALL. It will still be there.

Mr. BARTLETT. Sir, it's like money in the bank which is yielding really huge interest. Why in the devil would you want to take it out and spend it now.

Chairman LAMPSON. Thank you, Dr. Bartlett.

Our colleague on the Energy Committee, not on this Energy Subcommittee on Science, Congressman Gene Green from Houston, Texas.

Mr. GREEN. I want to thank my friend Congressman Lampson for holding this hearing in Houston on energy. Between Congressman Lampson and Ralph Hall and I—Roscoe, we'll have an interpreter for you because we all understand Texan where we're from.

It's an honor to be here and participate in the hearing. I think it's so pertinent, considering what the House considered just this last week and, actually, four times over the last 12 months. It's no secret why Houston is known as the energy capital of the world. The energy industry is a cornerstone of our economy and our way of life. Many of the world's largest and most innovative energy companies reside in Houston, supported by a highly skilled workforce, strong partnerships between our local universities, including Rice, and businesses to help address the needs of our job base.

Understanding the importance of the energy industry to our local economy helps me better represent our district in Congress; and our district is basically east of downtown Houston, which the energy corridor, I know, is I–10 West, but I consider the refineries and energy plants that Congressman Lampson and I share in East Harris County, the energy corridor. I'm not a Member of the House

Committee on Science and Technology, but I do serve on the Committee on Energy and Commerce and with a broad jurisdiction over our nation's energy policy, and that I share with Congressman Hall.

I've always believed that a balanced national energy policy must have three basic points: Energy conservation and efficiency; research and development in new clean-energy technologies; and environmentally responsible domestic energy production.

First, the simplest and most effective way to reduce our needs for energy is to consume less energy and use it more efficiently. With new technologies, conservation does not necessarily mean doing without. Energy companies understand this fact and are working to reduce their greenhouse gas emissions by using less energy-intensive practices. Companies are employing co-generation, or combined heat and power technology, to harness the heat released by making energy products, to produce their own electricity. Advanced computer software is being utilized in refineries to optimize the energy consumption, as well as technology to reduce the wasteful flaring of gas. In fact, every time I go over the Beltway 8 bridge, or 610 bridge, or even the Fred Hartman bridge, and I see a flare, I'm worried because that's product that's being lost and also going into our air.

Second, I believe we need to invest in clean energy technologies that will wean us off our dependence on foreign fuels. Texas is a wonderful example of using this innovation to become the Nation's leader in wind energy production. Oil and gas companies need to instead be recognized as energy companies and continue investing in alternative energy sources. Wind, solar, geothermal, biofuels and other sources all deserve additional research and development by the private sector and the Federal Government to become cost-competitive in the marketplace. In fact, we need all of these sources to continue a growing economy in our country. Shell Oil, a witness at today's hearing, is breaking ground with research in hydrogen production and supply chains, a long-term but critical approach to meeting our future needs.

Lastly, I believe we must continue to responsibly develop America's energy resources. We can't increase renewable energy if we take an unrealistic approach to oil and gas. We will fail to provide Americans with adequate supplies of fuel and energy at affordable prices. Energy companies have invested heavily in technological innovation to enhance our environmental performance and capabilities. Directional drilling technology allows more wells to be drilled from a single drill rig. Infrared and laser technology can be utilized to monitor refinery emissions and to minimize releases. Global satellites and 3–D seismograph technology are helping reduce environmental disturbance and surface impact before drilling begins.

None of these strategies alone will be enough to protect our economic competitiveness and our sustainability. Through all of these efforts, the Houston energy industry has continued to fulfill the needs of our nation. That's good news because energy security is also our job. It's an issue of economic security and our national security. With that innovation and smart growth strategies, Houston will remain the energy capital of the world in years to come, and

I would hope this hearing will set the stage for Congress to be able to provide that leadership.

So thank you again for holding this hearing literally in our back yard.

Chairman LAMPSON. Thank you, Congressman Green. I appreciate it.

I would ask unanimous consent that all additional opening statements that may be submitted by other Members of the Committee be included in the record. Without objection, so ordered.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF REPRESENTATIVE ADRIAN SMITH

Thank you, Mr. Chairman. Every day, Americans and Nebraskans rely on energy in a variety of forms. We take this power for granted, but if we are to maintain an affordable and secure supply of energy we must create an environment which attracts innovators and inventors, who, like Thomas Edison, will brighten our future.

Our ultimate goal is affordable energy independence. To accomplish this we will need a diverse portfolio of energy options. We must not allow our policies to choose winners and losers in energy solutions. There is a lot of talk about energy sustainability in terms of the environment, but we also must ensure our future energy options are economically sustainable.

Energy efficiency is one means to this end. We are competing with China's and India's burgeoning demands for foreign oil, but I am encouraged by the vision of private organizations such as the X Prize Foundation which offers a monetary incentive to inspire innovation in energy efficient vehicles. When the prize is awarded to the first 100 miles per gallon vehicle, one will be able to drive across my home State of Nebraska on just 4.5 gallons of fuel.

While it is true that oil and gas companies have posted profits this year, this is good news for American investors who are the primary owners of these companies. More than 29 percent of oil company stocks are owned by mutual funds, 27 percent by pension funds, 23 percent by individual investors, and 14 percent by Individual Retirement Accounts. In other words, everyday Americans own a share of these profits. We need policies which will encourage more domestic drilling and the expansion of technologies which will facilitate recovery of oil from currently inaccessible sources.

There are myriad other technologies which need to be explored and developed including smart grids, fuel cells, solar power, wind power (including growing transmission and dealing with intermittency), biofuels (both corn and cellulosic), clean coal, coal gasification, nuclear power, hydropower, and other technologies not yet imagined.

Thank you, Mr. Chairman, and I look forward to working with you to further policies which will promote research, development, and entrepreneurship to expand technologies which empower energy consumers with more choices, more efficiency, and more affordable options.

Chairman LAMPSON. Now, as our witnesses should know, you all have five minutes for your spoken testimony. Your full written testimony will be included in the record for the hearing; and when you have completed your testimony, we will begin with questions. Each Member will have five minutes to ask questions.

Mr. Hofmeister, would you begin, please.

Panel I:

STATEMENT OF MR. JOHN HOFMEISTER, PRESIDENT, SHELL OIL COMPANY

Mr. HOFMEISTER. Good morning, Chairman Lampson, and Ranking Member Hall, Member Bartlett, and Member Green. I'm John Hofmeister. I'm President of Shell Oil Company, and I appreciate

the opportunity to speak today as part of the field hearing the Subcommittee is holding here in the energy capital.

My remarks today will focus on the short-term, medium-term, and long-term needs in the United States, how Shell anticipates the mix in the energy supply changing in the coming years and the evolving contribution Shell will make to meeting America's energy needs for decades to come.

Shell has been a part of the Houston energy industry since the mid-1960s. In the Greater Houston metropolitan area, more than 13,000 Shell and Motiva employees go to work every day to bring energy to millions of Americans. Their work includes service at nearly 500 retail stations in the Houston area and 44 Jiffy Lube locations. As one of the Houston's largest employers, Shell is a stalwart in the community.

Houston's a vibrant city with a rapidly expanding economy and population fueled by energy. The energy market in Houston reflects the worldwide energy market in many respects. We recognize the challenge here and around the world of providing enough energy to meet rising demand in an environmentally and socially responsible manner. We are committed to managing the impact of our exploration and production and conserving energy where we can.

America has a strong and growing demand for energy. Every second of every day, the United States consumes 10,000 gallons of oil—every second of every day—enough to fill a backyard swimming pool. We use 20 railcars of coal a minute in this country, and enough cubic feet of natural gas each day to build a tower to the Moon and back 25 times.

We're balanced on a razor's edge of growing demand and tightening supply. Shell wants to help provide abundant affordable energy as far into the future as we can imagine.

We consider abundant affordable energy a cornerstone of America's energy security, but we recognize that achieving this goal will require aggressive short-term, medium-term and long-term planning.

Short-term. First, I would like to outline the short-term U.S. Energy needs and the steps Shell recommends for the next decade. In the short-term, the United States will remain a fossil-fuel-based economy because very simply we cannot attain the commercial scale and infrastructure needed to meet energy needs as I've described through alternative energy. We won't have the pipeline system to pump ethanol. We won't have the transmission lines to bring hundreds of gigawatts of wind from remote, windy plains and mountains to cities. That kind of scale and infrastructure won't be available for decades to come. Largely for this reason, the International Energy Agency estimates that under a business-as-usual scenario, alternative energy will account for only 8 percent of U.S. Energy use in five years.

In the short-term, then, we need more oil and gas now to meet growing demand. We can meet that demand in two primary ways. First, we can responsibly develop the more than 100 billion barrels of technically recoverable oil and gas in this country that are currently off limits due to federal policy. Unless we intend to increase our reliance on foreign oil, we must have increased access to America's own energy resources, both onshore and on the outer conti-

nental shelf. Shell is committed to developing any resources in an environmentally sound and responsible manner.

Second, we can increase the supply of natural gas to our country by using liquefied natural gas (LNG) technology that allows us to store and ship gas safely in a liquid state. As a nation, we must put aside our resistance to building the infrastructure necessary to receive LNG, especially on the east and west coasts. In addition to these two important avenues, we must continue researching environmentally sensitive and commercially feasible ways of developing unconventional oil-and-gas resources, including the trillion barrels of oil that remain trapped in shale in Colorado, Wyoming, and Utah.

In the medium-term, Shell anticipates that in the medium-term, between the next 10 to 25 years, oil and gas will remain the primary energy sources, but biofuels and wind will play greater roles in meeting energy demands. Shell is one of the world's largest distributors of biofuels and one of the first companies to invest in second-generation biofuels that use cellulosic materials that do not compete with food crops. However, we are very concerned about the provisions of the *Energy Independence and Security Act of 2007* that mandate a more than fivefold increase in the amount of alternative fuels such as ethanol, from 7.5 billion gallons a year in 2012 to 36 billion gallons a year in 2022, to the Nation's energy supply.

Wind offers another solution to carbon dioxide emission challenges and to increasing our energy diversity. In this country, Shell Wind Energy now has interest in or operates eight wind farms in six states. Wind technology, however, is often limited by lack of transmission systems to move the wind energy from remote hills and potential offshore wind farms to connect with the electric grid. We need sound federal and State policies that support new transmission systems to enable this technology to be adopted more widely.

Also during the medium-term, Shell believes that our nation must move to clean coal technology, using our most abundant natural resource to generate electricity in a way that allows us to manage carbon dioxide emission. However, the introduction of this technology is hampered by the need for large, up-front capital investments. Public policy is needed to create the enablers to stimulate the production of clean coal technology and associated carbon capture and storage.

Over the longer-term, spanning 25 years and beyond, Shell anticipates that the U.S. economy will continue to depend on oil and gas, with an ever-growing contribution from alternative fuels. We will see a strong growth of the clean fuels mentioned in the medium-term, but we will in the long-term see more alternative fuels, that are in their infancy now, become commercially viable components of the overall energy mix. Hydrogen is an example.

Hydrogen is the world's most plentiful element, and it's part of the Shell portfolio of future low-carbon fuels. As a fuel, hydrogen offers the potential to substantially reduce emissions, reduce our reliance on fossil fuels, and increase America's energy security. There are obstacles to be overcome, but we think hydrogen could become a commercially viable transport fuel in the coming years. Shell is developing hydrogen supply chains which in the longer-

term may rely increasingly on renewable sources of energy. We partner with car manufacturers and local and national governments to coordinate the construction of hydrogen fueling stations in areas where fuel-cell vehicles are being introduced. In the United States, those include Los Angeles and the New York City metropolitan areas.

Since 2004, Shell has operated an integrated gasoline/hydrogen station in Washington, D.C., not far from Capitol Hill. Last year we opened a hydrogen station in White Plains, New York, and plan to open our first hydrogen station in Los Angeles this Spring. It will probably take a couple of decades to make hydrogen a commercially available option. However, for our grandchildren's children, it may become the standard fuel of choice.

Clearly, Shell believes that alternative energies will play an increasing role in the energy mix. We are planning for it. We invest a significant portion of our profits into developing energy technologies. We believe our commitment to technology and innovation distinguishes us from many of our competitors, but we must approach our energy challenges realistically. Because of the extensive lead time and financial commitment required to bring new technologies to market fossil fuels will remain at the core of global economies for the foreseeable future. Shell does not see that as an either/or proposition; it is a both/and proposition. The balance between conventionals and alternatives will be established by what is possible in the future. We will need all of those energy sources and others to fuel the world.

As a nation, we face tough choices to balance our energy needs, our economic well-being, our quality of life, and our respect for the environment. At Shell, we are firmly committed to bringing energy security to America and specifically to the citizens of Houston.

Thank you.

Chairman LAMPSON. Thank you, Mr. Hofmeister.

[The prepared statement of Mr. Hofmeister follows:]

PREPARED STATEMENT OF JOHN HOFMEISTER

Good morning Chairman Lampson, Ranking Member Inglis, Members of the House Science Subcommittee on Energy and Environment and other Members of the U.S. House of Representatives joining this hearing. My name is John Hofmeister. I am the President of Shell Oil Company. I appreciate the opportunity to speak today as part of the field hearing the Subcommittee is holding here in the energy capital of the world, Houston, Texas.

My remarks today will focus on the short-term, medium-term and long-term energy needs in the United States, how Shell anticipates the mix of the energy supply changing in the coming years and the evolving contribution Shell will make to meeting America's energy needs for decades to come.

Shell has been a part of the Houston energy industry since the mid-1960s. In the greater Houston metropolitan area, more than 13,000 Shell and Motiva employees go to work every day to bring energy to millions of Americans. Their work includes service at nearly 500 retail stations and 44 Jiffy Lube locations. As one of Houston's largest employers, Shell is a stalwart of this community.

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Short-term:

First, I would like to outline the short-term U.S. energy needs and the steps Shell recommends for the next decade. In the short-term, the United States will remain a fossil-fuel-based economy because, very simply, we cannot attain the commercial scale and infrastructure needed to meet energy needs through alternative energies. We won't have the pipeline system to pump ethanol. We won't have the transmission lines to bring hundreds of gigawatts of wind from remote windy plains and mountains to cities. That kind of scale and infrastructure won't be available for decades to come. Largely for this reason, the International Energy Agency estimates that under a "business-as-usual" scenario, alternative energy will account for only eight percent of U.S. energy use in five years.

In the short-term then, we need more oil and gas now to meet growing demand. We can meet that demand in two primary ways. First, we can responsibly develop the more than 100 billion barrels of technically recoverable oil and gas in this country that are currently off limits to development due to federal policy. Unless we intend to increase our reliance on foreign oil, we must have increased access to America's own energy resources both onshore and on the Outer Continental Shelf. Shell is committed to developing any resources in an environmentally sound and responsible manner.

Second, we can increase the supply of natural gas to our country by using liquefied natural gas technology that allows us to store and ship gas safely in a liquid state. As a nation, we must put aside our resistance to building the infrastructure necessary to receive LNG, especially on the East and West Coasts.

In addition to these two important avenues, we must continue researching environmentally sensitive and commercially feasible ways of developing unconventional oil and gas resources, including the trillion barrels of oil that remain trapped in shale in Colorado, Wyoming and Utah.

Medium-term:

Shell anticipates that in the medium-term—between the next 10 to 25 years—oil and gas will remain the primary energy sources, but biofuels and wind will play greater roles in meeting energy demands.

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Also during the medium-term, Shell believes that our nation must move to clean coal technology—using our most abundant natural resource to generate electricity in a way that allows us to manage carbon dioxide emissions. However, the introduction of this technology is hampered by the need for large, up-front capital investments. Public policy is needed to create the enablers to stimulate the production of clean coal technology and associated carbon capture and storage.

Long-term:

Over the long-term, spanning 25 years and beyond, Shell anticipates that the U.S. economy will continue to depend on oil and gas with an ever-growing contribution from alternative fuels. We will see a strong growth of the clean fuels mentioned in the medium-term, but we will, in the long-term, see more alternative fuels that are in their infancy now become commercially viable components of the overall energy mix. Hydrogen is an example.

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As a nation, we face tough choices to balance our energy needs, our economic well-being, our quality of life and our respect for the environment. At Shell, we are firmly committed to bringing energy security to America—and specifically to the citizens of Houston.

Thank you.

BIOGRAPHY FOR JOHN HOFMEISTER

John Hofmeister was named President of Houston-based Shell Oil Company in March 2005. In this position, he heads the U.S. Country Leadership Team, which includes the leaders of all Shell businesses operating in the United States.

Hofmeister became President after serving as Group Human Resource Director of the Shell Group, based in The Hague, The Netherlands.

Prior to joining Shell in 1997, Hofmeister served as Vice President, International Human Resources, for AlliedSignal (now Honeywell International), based in Hong Kong. He joined AlliedSignal in 1992 as Vice President of Human Resources for its aerospace business.

From 1988 to 1992, Hofmeister was employed with Northern Telecom, where he became Vice President of Human Resources in 1990.

Hofmeister began his career in 1973 in the international marketing and sales department of the General Electric Lighting Business. During his 15-year career with GE, he held a variety of marketing, manufacturing, and human resources positions in five GE major businesses, including locomotives, telecommunications, factory automation and electric motors.

Hofmeister serves as the Chairman of the National Urban League. He is a member of the U.S. Department of Energy's Hydrogen and Fuel Cell Technical Advisory Committee and also serves on the boards of the Foreign Policy Association, the United States Energy Association, and the National Association of Manufacturers. He is a fellow of the National Academy of Human Resources, and a member of the American Petroleum Institute's Executive Committee and Policy Committee. Hofmeister also served as 2007 Chairman of the Greater Houston Partnership.

Hofmeister earned Bachelor's and Master's degrees in political science from Kansas State University.

Chairman LAMPSON. Mayor White, you are recognized for your time in the presentation.

STATEMENT OF MR. BILL WHITE, MAYOR, CITY OF HOUSTON

Mr. WHITE. Thank you, Mr. Chairman. I've submitted a written statement, and I'll just visit with you about a couple of high points

and maybe pick up on a comment, a couple of comments the Members made.

You know, too often we make the mistake of thinking that the answer in energy policy is all of one thing—like it's all on the supply or all on the demand side. Because, Mr. Chairman, you and the staff, we had such an excellent presentation on supply, I'm going to mainly talk about the demand side; but that's not posed as an alternative. I've been involved in every aspect of the energy business as a business person, and I will tell you that we need a lot of supply if we're going to accomplish our goals of trying to bring down utility bills and gasoline prices and make our nation more secure. We will have fewer emissions as we move forward, for reasons that I'll explain; but here's what we can do.

I'm going to focus on two big things on the demand side. No. 1, oil is used as a transportation fuel. Congress made a step in the right direction, a step in the right direction, with these CAFE standards that the last Congress passed.

Look, as a staff member of Congress working with Chairman Dingell in the first Subcommittee on Energy and Power, I helped write some of the first CAFE standards in 1975. If you go back—Mr. Bartlett talks about great energy speeches—go back and look at Gerald Ford's State of the Union Address in 1975 where he summoned this nation to make this a national challenge, and Congress, on a bipartisan basis, worked to craft something that was significant.

Some of the folks that are around, not many of us—I was a young kid—but Alan Greenspan was a White House staffer and George Mitchell represented the IPAA, Chairman Dingell was the first Chairman of that committee, and we did that. You know what happened when we did that? For light-duty vehicles, we almost doubled auto fuel mileage within ten years. Now, they carved out later exceptions to make sports utility vehicles; but, you know, me and my kids and my wife, we drive vehicles that get twice the miles per gallon in the city of Houston—which is not some exotic, weird city, it's a mainstream city. We're using hybrids for our civilian vehicles. We're converting our buses to hybrids, getting good fuel economy. You know what would happen if within ten years the automobile fleet of this country were able to get double the miles per gallon? You know what would happen? We would reduce the petroleum consumption by six million barrels a day from what it otherwise would be, and that would create a downward pressure on price compared to what would happen if the world was having a demand for six million barrels a day more. We all benefit from that.

So thank you, and keep your eye on that ball because there's nothing that we can do.

Mr. Bartlett, I agree with many issues involving access, but you made the point just right. I was one who was skeptical about Hubbert's speech for a long time. I've been in the business. He proved himself right, for the right reasons; and I think he's in the ballpark on the world oil demand. So we need to be anticipating this, and this is not supply versus demand because, believe me, if you don't have supply, the depletion occurs far quicker than that. If we want to maintain our standard of living, then we need to be

working on both sides and even higher auto fuel—everything else is small on transportation fuel, supply and demand, compared to what you do with automobile transportation.

Next, buildings. Buildings consume a lot of energy. In Houston, this Spring, we will adopt the most forward-looking, technically advanced, aggressive building codes in the Nation. I'm not the mayor of Aspen or Oakland. This is a city that is a working city with a diversity of views, that's very business-oriented; but we've found here in Houston that if you design buildings, using the state-of-the-art energy standards, they can consume 20 percent less. We've done it with our own city buildings for the last four years. I looked at the numbers. It doesn't cost very much more, and you save a lot of energy. Some of the companies here, without any mandate—but if you had standards from, let's say, local government and State governments, something that we all have an interest in the Nation, we could cut the growth in demand for electrical power in this nation significantly. Why? Well, you know buildings account for a substantial percentage in both our homes and our offices of our power consumed.

That has two advantages which I think the people we represent like. No. 1, as you drop demand, you reduce utility bills; and last time I checked, that is not a bad thing. It can reduce utility bills more than any tax cuts I've seen for a long time. No. 2, you will have fewer emissions. That is not a bad thing. I do not know anybody who's for emissions. At most, somebody says, well, it's a necessary price of growth. So building efficiency standards is something where we can do a lot. In Europe, sometimes they've done better than us. There's states and localities that have done better than others, but I think that Congress needs to take a look at that.

Finally, renewables. We talked about solar and wind. They have a role to play, an increasing role. They will not displace all other hydrocarbons, and I mention this, too, at the end. I think the time to act is now. I think the country's ready for this. I think it will be ready in the next session of Congress, on a bipartisan basis, to move forward for doing some things that result in real change in the way we approach energy in our country. If we do so, our economy will be stronger, there will be more American jobs, less balance-of-payments deficits, and we will have fewer emissions. Thank you.

[Applause.]

Chairman LAMPSON. Thank you, Mayor White. That was a very good presentation.

[The prepared statement of Mr. White follows:]

PREPARED STATEMENT OF MAYOR BILL WHITE

Good morning Chairman Lampson, Ranking Member Inglis, Members of the House Science Subcommittee on Energy and Environment and other Members of the U.S. House of Representatives joining this hearing. My name is Bill White. I am the Mayor of Houston, Texas, and am pleased to be speaking before the Subcommittee today.

Houston, the fourth largest city in the country, is growing and prosperous, with more than two million residents. We have added a quarter-million new jobs to our economy of the last four years and have seen our population grow in excess of five percent annually over the past several years. This includes nearly 100,000 relocations from the Katrina disaster. The Gross Area Product has also grown by 5.2 percent annually from 2004 through 2007. Houston is the Nation's No. 1 seaport in for-

eign tonnage, and No. 2 in total tonnage. Houston is home to almost two dozen Fortune 500 companies, second only to New York.

Houston is an important microcosm of the world economy as witnessed by its dramatic growth over the past five years. In order to sustain our City's prosperity as well as that of the rest of the world, we need to de-link growth from resource consumption. Not doing so will lead to dire consequences, some of which we are already seeing. Energy prices have nearly doubled over the past few years and they will not stop here. Gasoline prices have gone from $1.50 to $3.00, electric power rates have gone from 6–8 cents/kwh in the 1990s to 12–15 cents/kwh today. The supply-side trend is only going to get worse. We need to fix this problem now.

The City of Houston is aggressively addressing the issue of decoupling regional growth from energy consumption. The path forward for us is two-fold: energy efficiency and renewable energy. A watt conserved, or a gallon not used, is the lowest cost form of energy generated. We avoid $600/kwh by not building excess generation capacity and save 5.5 cents/kwh in avoided energy supply costs. Similarly, by migrating to more fuel-efficient vehicles or hybrids or eventually plug-in hybrids, we can make a real difference in our fossil fuel consumption. The complement to our energy efficiency efforts is the City's embracement of renewable energy, which is carbon free, pollutant free, and geo-politically free.

Let me give you some specific examples of what we are doing here in Houston on Energy Efficiency. We are upgrading our commercial and residential building codes to make our new buildings more energy efficient. The City already has a resolution passed in 2004 that requires all new City facilities and major renovations over 10,000 sq. ft. to be LEED certified. We are also weatherizing existing homes through a "neighborhood by neighborhood" residential energy efficiency program. So far we have done more than 2,000 homes over the past 18 months and expect to do 3,000 this year, all in low-income neighborhoods, in partnership with CenterPoint. Homeowners have seen a 10–15 percent heat-adjusted reduction in their kwh consumption with summer months as high as 20 percent.

The City of Houston has itself taken a leadership role in embracing energy efficiency and renewable energy procurement for its facilities. The City of Houston is the first Clinton Climate Initiative and C40 city to implement large-scale, energy savings performance work to retrofit 11 million square feet of city facilities including office buildings, convention center, libraries, fire stations, police stations, health service centers, and multi-service centers. We expect to see a 20–30 percent reduction in our energy consumption for these facilities. These energy efficiency efforts will be complemented with our renewable power procurement program. The City of Houston has purchased 262,800,000 kwh annually from Texas wind farms, or 20 percent of our consumption, under a fixed-price contract for delivery over the next five years. That is over 1.3 billion kwh in total, and our goal is to double that number.

The City of Houston is also leading several grass-root efforts to inspire, educate and call to action our community at large. The City, in partnership with the American Institute of Architects, is hosting the region's first "Green Consumer Expo" to showcase energy efficient products and services that are available here locally. The Expo, scheduled this April, is free and open to the public. We are also developing a Youth Job Corp program for this summer to have young people hand out over 250,000 CFLs and energy efficiency tips door to door. Last year with the Power to People Campaign we handed out 10,000 CFLs.

Finally on fuel-efficient vehicles, the City's goal is to have 50 percent of non-emergency, administrative fleet, roughly 2,800 vehicles total, to be hybrids. Currently we have 440 hybrids. Metro will purchase approximately 100 hybrid electric buses each year over the next three years, dramatically improving the fuel efficiency and emission control of our mass transit network. We are also working with our airport systems to migrate their fleets to clean fuel vehicles. For the general population here in Houston, we need help from the Federal Government to raise fuel standards even more aggressively.

BIOGRAPHY FOR MAYOR BILL WHITE

Mayor White's leadership has brought Houston together, as shown by his overwhelming re-election to a third term. He uses business practices every day at City Hall to improve service and get things done.

He has aggressively attacked our community's most difficult challenges, such as investment in neighborhood drainage, reform of municipal pensions, holding the line on property taxes with rate cuts and increased senior exemptions, attacking crime hot spots and even faster removal of stalled vehicles to reduce wrecks and traffic congestion.

Americans witnessed Mayor White's hands-on management style when he helped lead Houston's competent, compassionate response to Hurricanes Katrina and Rita.

Now in his third term, Mayor White is accelerating work to revitalize our City's most neglected neighborhoods, with foreclosure and hundreds of new housing starts on thousands of abandoned properties. He also initiated a program to weatherize thousands of homes in older neighborhoods, saving homeowners an average of 20 percent on their electricity bills.

In addition, Mayor White has aggressive programs to enforce pollution laws, reduce the flooding impact of new developments, raise high school graduation rates, and encourage more flexible working hours.

Before serving as Mayor, White built one of the region's most successful businesses. Previously he served as Deputy Secretary of Energy of the United States, where he helped diversify national energy supplies and saved taxpayers billions of dollars with management reforms. Earlier in his career, he helped build and manage one of the Nation's most successful law firms.

For decades Mayor White and his wife Andrea have helped lead numerous charitable and civic organizations. The Whites are parents of three students and attend St. Luke's United Methodist Church.

Chairman LAMPSON. I was remiss in not making a comment in two introductions. Obviously none of this would happen without the professional staff that we have. Here, representing the Minority side, is Elizabeth Stack; and on the Majority side is Chris King. I just wanted to acknowledge them and thank you for the work that you do, and your colleagues on our Committee staff, as well as the staffs of all of the Members who are here. They do a tremendous job. They do the work of our offices.

Now, Mr. Standish, you're recognized for your time.

STATEMENT OF MR. THOMAS R. STANDISH, GROUP PRESIDENT OF REGULATED OPERATIONS, CENTERPOINT ENERGY

Mr. STANDISH. Thank you, Mr. Chairman. I wish to really follow on with what the Mayor was saying and talk in a little bit of detail on the focus on the electric grid and some very remarkable convergence that's under way that I think is going to completely reshape how we make electricity and how it's consumed.

I'd like to make a comparison back from about the same time that if Orville Wright came back today and looked at a plane, he would be astounded at the progress of a modern airliner compared to the airplane he flew. If Thomas Edison came back today, he would be astounded that the electric grid he built is exactly the one that's in place today. We've essentially made no change to it.

There's a good reason why that's so. A large central plant has served us well for a long period of time, but things have changed today and the concerns of very high fuel prices, of clean air, require a very different electric grid. What we're beginning to see is the development of a digital communications system that overlays the existing electric grid, what's being called a Smart Grid, and the ability to link individual energy consumptions to the Internet will completely change the way we view our use of electricity in three ways.

For residential and commercial consumers, those consumers will be able to set consumption patterns and have this Smart Grid act to minimize their electricity consumption and their cost. In the movement that exists today towards a very large number of small sources of electricity, like plug-in hybrid cars, solar panels, and eventually fuel cells, we need some mechanism to be able to keep track of and communicate with this very large number of individual sources. It will require a massive communication network to

optimize the efficiency of these resources as well as to properly build and credit those generation sources. And third, this Smart Grid gives another ability which is to create a self-healing grid—that is, a grid that can automatically detect problems, reroute the power flows, so that, for most consumers, power outages will last a matter of seconds.

All of this technology exists today. I'm very proud to say that CenterPoint is one of the leaders in the world in developing a pilot. We currently have 10,000 very highly advanced meters deployed around the city that are capable of two-way communication and also communication within the house to allow the consumers to control devices within their home. This has been a very successful pilot. We've developed a technology center devoted to the Smart Grid. This technology center, I think, to emphasize the newness of it, is that we have conducted over 290 tours of this technology center today. By way of that, I would like to invite this committee, if you are in Houston again, to be able to come down and really see what the future of electric system operations will be.

I'd like to touch on a couple of points, too, that are happening in Houston, that the mayor touched on. We have implemented energy efficiency programs that are in some cases mandated, in some cases sponsored by the government, to over 29,000 homes in the Houston area. These energy efficiency upgrades are currently saving $12 million a year in energy costs. With the help of the City of Houston, we've deployed this to 4,700 hard-to-reach, low-income homes that are saving those individuals over a million dollars a year. The EPA Energy Star program has been very successful here. In fact, every year that that program's been in place, CenterPoint Energy has won the Energy Star award; and we are very proud to say that there are over 121,000 homes constructed in the Houston area that meet the Energy Star standard.

Finally, Mr. Chairman, I would like to make two requests of the Committee. As you know, Title XXIII of the 2007 Energy Act was directed toward Smart Grid, and in there it funded $100 million for research and development towards Smart Grid. I would ask this committee to work towards appropriating the dollars for that research and development. The ability to accelerate these funds and move forward with our research and development work will be one of the single largest keys to making energy efficiency a common event across all of this country.

To that end, my second request goes simply to technical standards, your ability of this committee to support the development of common technical standards. We currently have this very interesting convergence that's occurring. You have the electric cars coming from the automobiles. You have utilities interested in this. You have appliance manufacturers beginning to see the ability of these appliances to talk to the Internet, as well as the electrical equipment manufacturers. The ability of your committee to promote a common standard so that across the country, we'll all be plugging in the same devices the same way and communicating the same, will again accelerate the application of the Smart Grid.

Now, Mr. Chairman, the electric utility industry is not a very interesting business except when the power goes out, I guess, and it gets that way, but I think we're on the verge of changing that com-

pletely because I do believe in the next ten years or so we will see a complete renewal of our ability to use electricity and how it's consumed.

So with that, I thank you and appreciate the time to testify before your panel.

[The prepared statement of Mr. Standish follows:]

PREPARED STATEMENT OF THOMAS R. STANDISH

Good morning. My name is Tom Standish. I am Group President of Regulated Operations for CenterPoint Energy. I appreciate the opportunity to testify for the electric and gas delivery industry as we work towards improving both energy efficiency and the environment.

Today in the United States, we are in the beginning stages of the digitalization of the electric grid—a grid which is essentially unchanged since the time of Thomas Edison. A digital communications grid overlaying the electric grid—or a Smart Grid as it is often called—brings the efficiency and information of the Internet to electricity consumers as well as to the operators of the electric grid. Technology exists to allow every electricity user to have real time information about their usage and bill amounts. Consumers will be able to actively manage their usage through inexpensive smart devices that will attach to any of the appliances in the home including the thermostat. Utilities and regulators will offer real time pricing that will be automatically acted upon by the smart meters within the parameters set by the consumer. Tests conducted by the Department of Energy in the Northwest United States have shown a 15 percent reduction in energy use can be achieved by providing real time usage and billing information, real time pricing signals and the ability of the Smart Grid to cycle appliances within limits set by the consumer. Further an analysis of data in Texas indicates that a five percent reduction of electric load during the peak hours of usage will double the available reserve of generation in the state. This not only produces an enormous savings to consumers in deferred power plant construction, it also produces significant clean air benefits as the lowest efficiency power plant will operate less.

The movement away from central power stations toward a broad array of distributed generation such as solar panels, plug-in electric vehicles and, eventually, fuel cells can only be accomplished through a smart electric grid. For example, these innovations will require the grid to identify and track the billing and credits of electric vehicles that can be charged or discharged at any location, anywhere in the country. The grid must also be able to sequence these devices so that individual power lines do not become overloaded.

This same technology will also allow the utility the intelligence throughout the electric grid to allow real time monitoring which will detect failures and reroute power flows to allow the grid to become self-healing. Our studies have shown that with the addition of smart sensors and computer controlled switches, both of which exist today, power outages for most consumers will last less than a minute.

I speak with confidence about the Smart Grid because we at CenterPoint Energy are proud to be among the leaders in the world in developing advanced metering and intelligent grid technology. CenterPoint was the first utility to develop a Technology Center devoted solely to research and implementation of Smart Grid technology. We currently have ten thousand highly advanced meters deployed and have completed our pilot study of the system feasibility. To date we have conducted over two hundred and ninety tours of our Technology Center and we invite this committee to visit our Technology Center and see the state of the art in electric system design. We have worked closely with IBM on communications and software design and with ITRON on the advanced electric meters to create a system that we believe will have a broad appeal nationwide.

I would like to briefly cover other efforts that are underway in the Houston area. Over 24,000 customers participated in our Energy Efficiency programs, reducing their annual electric bills by over $12 million as a result. In conjunction with the city of Houston, we have developed programs to upgrade the energy efficiency of 4,700 hard-to-reach low income home owners resulting in annual savings of $1 million. This program has been highly successful in reducing the utility bills for those who can least afford them. Also CenterPoint ENERGY STAR New Home program one of most successful in the country having received the EPA national ENERGY STAR award for seven consecutive years. Since the program started in 2001, 121,000 ENERGY STAR homes have been constructed in Houston.

Finally, I would ask the Committee to consider two requests. First, as you well know, Title XIII of the 2007 Energy Act provides $100 million of R&D money for

Smart Grid technology. I would ask that you seek the funding of this research as soon as possible. The Research and Development money available for Smart Grid programs such as ours can greatly accelerate the understanding, practical application and deployment of these new technologies.

And second, I would ask that you work towards establishing technical standards for the Smart Grid. The greatest value will come if all participants, utilities, automobile manufacturers, appliance manufacturers and electric equipment providers are working toward the same concepts concerning which component performs which function. The CenterPoint Energy Technology Center was founded on the principle of open communication architecture that allows any equipment manufacturer to design equipment that will communicate with any other similarly design equipment. CenterPoint Energy would welcome the opportunity to participate on the Department of Energy's Advisory Council to help develop these standards.

This is an exciting time for an industry that is rarely exciting. Ten years ago few of us envisioned how many uses would be found for the Internet. Applying the same technology to the power grid will produce unthought-of opportunities for the efficient and clean use of energy. Thank you for the opportunity to present. This concludes my testimony.

BIOGRAPHY FOR THOMAS R. STANDISH

Current Position: Group President, Regulated Operations. In this role Tom is responsible for the company's regulated electric transmission and distribution system and our regulated natural gas operations. Tom also serves as a member of the CenterPoint Energy Executive Committee.

Previous Positions: Standish began his career with the company in 1984 and served in various management positions in marketing, rates and research, regulatory relations, and engineering. He formerly served as Senior Vice President of the company's electric delivery system before he assumed the position of President of CenterPoint Energy Houston Electric in 1999.

Education and Accreditation: He earned a Bachelor's degree in electrical engineering from the University of Texas at Austin and a Master's degree in business administration from the University of St. Thomas. He is a registered professional engineer in the State of Texas.

Affiliations and Honors: Standish is a member of IEEE and is the immediate past-Chairman of the Board of Directors for the Greater Houston Area American Red Cross. He is also a current member and past-Chairman of the Salvation Army Houston Area Command. Standish serves as a member of the Board of Directors for the University of St. Thomas, and Rebuilding Together Houston (formerly PSI Homesavers). He is a past member of the Board of Directors for the Electric Reliability Council of Texas (ERCOT), the Texas Energy Coordination Council, the Edison Electric Institute (EEI) Transmission Access & Power Supply Task Force, the Association of Electric Companies of Texas' (AECT) Policy Committee, the U.S. Chamber of Commerce's Regulatory Affairs Committee, the Governor's STEPP Committee on Utilities, Strake Jesuit College Preparatory, the Saint Agnes Academy Board of Directors, and the Juvenile Diabetes Research Foundation–Houston chapter Board of Directors. He has also served on the EEI Rate Research committee and as vice chairman of the ERCOT Engineering Subcommittee. He holds two patents dealing with electronic controls.

Personal: Tom is married with three children and is a native Houstonian.

DISCUSSION

Chairman LAMPSON. Thank you very, very much for all of you for taking the time to come. We'll move into our question-and-answer period; and I yield myself the first five minutes.

THE ROLE OF THE FEDERAL GOVERNMENT

Let me start with you, Mayor White, if I may. Drawing from your former role as the U.S. Deputy Secretary of Energy, how do you think the Federal Government could better serve local and

State governments in efforts to address these grand energy challenges that we speak of.

Mr. WHITE. Well, I think, first, that there needs to be a retention of the programs such as the weatherization program that currently exists. I know some have talked about eliminating it. Personally, I know that it's a little controversial, but sometimes I think that hot-weather states may get a bit of the short end on the equity funding. I think there should be strict standards of accountability, and I think those who do it and administer it in the most cost-effective way should get a little bit more money so that it shouldn't be just sort of an entitlement allocation based on this. For example, our program, about $950 a household we're averaging, about over 10 percent annual savings, 20 percent at peak, because we do it like a manufacturing operation, not like some kind of government program. So that would be one thing that we need to retain.

The other is that you could help us and give us some flexibility on those areas where we may be preempted—and this is a technical matter—but come up with innovative standards on appliances and devices and help both State and local governments where states and local governments want to go farther than federal law permits. Often the regulated industries, with high-powered lobbyists and lawyers, try to sue to prevent local governments and State governments from taking innovative steps, by claiming that federal law preempts those actions.

Now, in some case, I'd say view it on the merits, but I would just give you an example. I'm not endorsing, but I'm just giving you an example. If we were to say that in urban areas such as Chicago, L.A., and Houston that there would be certain requirements for the railroad engines coming in here and they could use certain devices where we have emissions problems to begin with. Then if we have a standard, then we would like some help from the Federal Government, rather than always running into the industry saying, oh, you can't do that because you're preempted by federal legislation.

You know in, of course, California right now—I know it's not Congress—but the Administration is suing California to prevent them from having more aggressive rules on automobiles, where they're trying to adopt more quickly the hybrid technologies that Mr. Standish is talking about. The Federal Government is suing California, saying that we don't want you to do that because that's our game.

So thank you. Those would be some ways.

Chairman LAMPSON. Thank you very much.

HOW CAN WE MAKE OIL PRODUCTION CLEANER?

Mr. Hofmeister, what steps is Shell taking to make both production and the end use of oil cleaner and more efficient.

Mr. HOFMEISTER. Congressmen, there are a number of actions under way, and have been for almost a decade now, in which Shell has taken aggressive means to improve its own efficiency footprint. A good example would be in the recently announced expansion of the Port Arthur, Texas, Motiva refinery which, when completed, will more than double the size of an already large facility, from 300,000 to more than 600,000 barrels a day. We're operating in a way that will get every bit more molecule out of the barrel, by im-

proving the efficiency of the processing of those molecules, and at the same time reducing the emission footprint on a per-barrel basis so that with the doubling of the expansion of that facility, we will actually see a net improvement in the emissions per barrel that come out of that production process. It's mostly through efficient use of our own energy consumption to make product that we're currently able, in refineries around the world, to find a more efficient use of production of energy.

In addition to that, if the smart wells that we are developing are designed in a way to get more extraction from underground wells, enhanced oil recovery is another means by which we are improving the efficiency of the production of crude oil and natural gas from underground; but in the use of transport fuels, I think there's an interesting story to be told as well—that is, our laboratories and the chemical engineers in our laboratories are continuing to work on new and different catalyst materials which, when introduced into the gasoline or the diesel fuel, produce both more efficient use of the energy and cleaner use of the energy so that at the emissions tail pipe, you see the benefit but also in the miles per gallon, you see the benefit. We work very closely with auto manufacturers to make sure that what we're doing in the fuels is compatible with the engine design and the engine materials, but I think we can report over the last decade significant improvement—and while I'm not trying to sell the product here, if you've ever tried the Shell V Power product, which is the high-test gasoline, this is perhaps one of the most efficient fuels in the world. We can move on from there as well. For example, gas to liquids, which is a major innovation in bringing middle distillate fuel from natural gas into the diesel supply chain. It is a very, very clean and efficient use of energy in diesel engines. I think I'll stop there.

A TIMELINE FOR THE SMART GRID?

Chairman LAMPSON. Thank you very much. I have a minute, so your next entry will then be shortened. Let me ask. Potentially, the Smart Grid technology is really impressive; but the benefits will undoubtedly come in stages. So what do you see as the first step in establishing a smarter grid and how will it progress from there and what kind of time horizons do you see for wide-scale adoption of these technologies?

Mr. STANDISH. Very quickly, I think the first steps will be the introduction of this smart meter in the home. That communication, if you simply have a device that sits on the counter in the house and shows the customer how much they've spent to date in the month, by the end of the month, what their expected bill would be if you continue to consume at that rate, that price signal, I believe, is the best energy efficiency item we can introduce in the electricity business. I think that will be the first thing, and you'll see this immediate feedback—the customer will see the immediate feedback of the price signal, and that will be the first step.

Chairman LAMPSON. Can it also be connected to the Internet?

Mr. STANDISH. Yes, sir. You can do it to the home or you can do it on the Internet. You could sit in your office and control the thermostat in your home; and that step, time-wise, we expect to be in full deployment of this by January of '09, the end of this year, prob-

ably taking somewhere in a four-year time frame to deploy the two million meters that would be in this area.

Chairman LAMPSON. Thank you very much.

Mr. Hall, you're recognized. Five minutes.

ULTRA-DEEP DRILLING AND THE ENERGY POLICY ACT OF 2005

Mr. HALL. Thank you, Mr. Chairman. I can still talk a little. We've heard testimony about the Energy Policy Act of 2005, and I think most of you are well aware of Section 999 of that act that referred to the ultra-deep. I think most of you are aware of the fact that there's been some efforts on the part of the Administration to knock out those provisions that were in that act. I'd like to point out, Mr. Chairman—and I know you agree with me because you've been standing side by side with us to try to defend that act and to retain that opportunity to get, what, 60 or 70 years of gas from the ultra-deep that we can't get now, and the act itself calls for the technology to get that, and that technology to be paid for with energy that we know is there that we can't get to the top now. It's a win-win situation. No increase in taxes to the people that it will benefit. So it doesn't make sense to me to try to knock that out.

There's been two major efforts to knock it out after it's been signed by the President. Joe Bartlett and I flew out to New Mexico with him to sign that act, and since that time there's been a lot of efforts to repeal that part. So far we've fought them off. I think it makes so much sense because it doesn't cost anything. There's energy there that we won't get if we don't get the technology. The technology is paid for there with energy that we do get; and for anybody, that ought to make sense. I don't understand it, but there is an effort to knock that out and we're still fighting that. There was an effort on the floor some year ago, I guess, or eight or nine months ago; and it was turned down, I think, almost two to one.

So I guess that's the question that maybe I might have of Mr. Hofmeister. How do you feel about the likelihood of the team that's working along that line and the efforts to knock that out, when it makes very little sense to knock out something that we could use to obtain long years of gas from a system that we're not getting anything out of now to speak of?

Mr. HOFMEISTER. Congressman, the first thing I would comment upon is that ultra-deep technology and projects that move us into the ultra-deep area are long-term projects. These projects take years of engineering and design.

Mr. HALL. How many years?

Mr. HOFMEISTER. It could be anywhere from three to seven years.

Mr. HALL. That's my understanding.

Mr. HOFMEISTER. What is extraordinarily unhelpful is what would be called perhaps zigzag federal policy on support or non-support of specific laws. Once enacted, we in the industry, we take that as the governance that we should follow and then we begin to build business plans around what legal enablers there are. When we see uncertainty or when we see zigzagging in a law this year modified the following year or repealed in the subsequent year, it plays havoc with our planning process, which ultimately hurts our

energy security because we don't do anything. So if we see uncertainty, we're not going to spend hundreds of billions of dollars in pursuing something.

A project I would point to specifically which Shell is undertaking as we speak is a project called Perdido, which is very close to the Mexican border in the southern Gulf of Mexico, southern and western Gulf of Mexico. We're operating in 8,000 feet of water, which is unprecedented for normal production operations. The reservoir itself is 28,000 to 32,000 feet under the surface of the Earth once we get to it. This is a project in which Shell will spend $1 billion before producing a single gallon of crude oil—not a barrel—just a gallon of crude oil. A billion dollars sunk into this project is predicated on quite a number of financials. We believe it's a prolific region, and we have plans to expand in that region quite significantly. If, however, laws change and make this project no longer financially as viable as it once was, we'll move on to something else but America will be denied that energy in case we do.

Mr. HALL. But you do understand there's been no zigzagging in the actual thrust. There's been zigzagging in the efforts to thwart the thrust, that have failed. The reason they've failed is we've put the word "shall" in there, I think, nine times in the last paragraph. Every time someone from Department of Energy—and I'm very fond of the Secretary of Energy—I think he's a great member of the President's cabinet—but they understand what the word "shall" means and there's been no deviation from that, nor any zigzagging, and there shouldn't be and I don't think there's going to be.

So those are the things that I'm very interested in because if we're ever to rid ourselves of our problems and our fear of Saudi Arabia turning on us—they provide, what, 40 percent of the 60 percent that we have to rely on people that don't like us and we don't really trust—this would get us a long way down the road to easing that problem. I don't understand why anybody's against it, and we're going to fight our really you-know-whats off to keep that on the books. Every time a Department of Energy guy comes over there to testify about this, I read those five or six or seven shalls to him and they agree to it, that it's in the books, they're complying with it, and it's an ongoing thrust at this time.

THE DOMESTIC MANUFACTURING TAX

Now, I want to ask you a question. How would repealing the domestic manufacturing tax deduction—you're familiar with that and this is the thrust on that—affect your R&D into both conventional and alternative sources of energy like biofuels?

Mr. HOFMEISTER. Again, this is a case of a zigzag in which it now seems to have passed in Congress this past week.

Chairman LAMPSON. Only in the House.

Mr. HOFMEISTER. In the House. Sorry. Thank you. It again presents a dilemma as we look at our business-planning process. Now, having said that, it's not for Shell, as a company, to set government policy. That's not our job; that's your job. We elect you to do that, but we do try to make business plans based upon what we see and how we see it predicted.

One of the ironies of the bill that was passed in the House this week is, because it targeted only five companies by name, some of

our competitors such as PDVSA and Citgo are not excluded from the deduction. So our competitors in this country are still able to make the deduction, while the five named companies would be unable to make the deduction.

In addition, there's another little quirk, as we would call it, in the bill, which allows Hollywood producers the ability to take a manufacturing deduction in the making of movies but yet a company like Shell, which is making millions of gallons of gasoline a day, cannot take the deduction as a manufacturer. So it's an irony that we don't understand.

I think over the longer-term, Congress has to decide what they'll do, and we will comply, but we scratch our heads seriously, Congressmen, when we see this kind of policy that emanates only two years or three years after the deduction was actually created.

Mr. HALL. We thank you for your input. You know, we write those laws based on what those of you who make it happen testify; and I thank you for the testimony you've given to our committee back through the years.

Mr. Chairman, I yield back.

Chairman LAMPSON. Thank you, Mr. Hall. I think that you're somewhat a hybrid because you really created or helped create the RPSEA program when you were on the Minority side and you liked the Minority so much that you moved over and you continued to fight it.

Mr. HALL. I may move back.

Chairman LAMPSON. Well, we appreciate your effort because I, too, think it's a critically important thing.

Mr. HALL. That's what Bill White would tell us to do—and a man I admire and respect. I knew him when he was young and have seen him grow and watched him operate under a great man, Mr. Dingell. He gave us a lot of advice and guidance when you were in D.C., but we're glad to have you back in Texas.

Chairman LAMPSON. He's given us good advice and direction here as well.

Dr. Bartlett, you're recognized for five minutes.

BALANCED ON THE RAZOR'S EDGE: STRATEGIES FOR THE FUTURE

Mr. BARTLETT. Thank you. You know, in a very real sense an argument can be made that gas is too good to burn. It's a feedstock for an incredibly important petrochemical industry; and probably not one person in 50, other than our farmers, know that essentially all of our nitrogen fertilizer comes from natural gas. When natural gas is gone, nitrogen fertilizer is gone. How will we feed the world?

I want to thank Shell Oil Company for your heroic efforts in trying to exploit the oil shales. Thank you, sir, for making a good try at getting oil from this. You said a trillion barrels. It's a good deal more than that. I generally say it's probably a trillion and a half barrels there. Potentially a lot of energy, but there's a huge amount of potential energy in the tides, too. Just because it's there doesn't mean it's in your gas tank.

I'm very pleased, sir, that you have joined the chorus of voices who are warning that we're facing a supply-demand crisis. Your

words were "balanced on a razor's edge of growing demand and tightening supply." Meaning what?

Mr. HOFMEISTER. Meaning that any disruption in the supply chain is immediately felt by the consumer. The best example is the supply shortfall after Hurricanes Katrina and Rita, where 25 percent of the Nation's production capacity, both crude and natural gas and also refined product, were out of commission not just for days or weeks, but for months. During that period is when we saw such a huge spike in gasoline prices at the pump that I, for one, received letters from 48 Attorneys General suggesting that we should be investigated for price gouging, when in fact, this was a market reaction to what was a real shortage.

There was an incident, a week after Rita, where I personally called Secretary Bodman to say that our Motiva refinery in Port Arthur had the last 300,000 barrels of finished product to put into the Plantation and Colonial pipelines to feed all the way up to Washington, D.C. And that if we didn't get our generators up and running over the weekend, we couldn't pump that inventory and we would actually, for the first time in the history of the Plantation and Colonial pipelines, be literally out of gas, which would have led to panic-buying, literally from the Texas border all the way up to Washington, D.C. Across the Southeast, involving states that would have been perhaps possibly fueling panic-buying in other parts of the country. That's what I call a razor's edge. We do not have an abundance of inventory. We do not have near-term solutions for any kind of a disruption to the normal supply chain.

Mr. BARTLETT. Sir, I think your company has also said that by 2015, and perhaps before, that there will be a meaningful risk that production will not be able to meet the world's demand. That, sir, means peak oil, I think, in the terms that most people understand it; and I want to thank you very much for your voice of reason and coming out and saying that.

When you talk about the short-term, the medium-term, and the long-term, for each of those, you say that our major reliance will be on gas and oil. That, sir, is sadly true; and it's true because of the statement you made that we cannot attain the commercial scale and infrastructure needed to meet energy needs through alternative sources. That's because we've waited too darn long to start and we can't start yesterday but I sure as heck would like to start today.

I'm sure you're familiar with the Cantarell Oil Field, which was the world's second largest oil field. It has had, what, a 20 percent decline in the last two years. About three fourths of all the oil-producing countries in the world have already peaked, and it is very probable that the world has now peaked. I want to thank Shell Oil Company for being a leader in being honest with the American people and the world.

Mr. Mayor, your emphasis on conservation is exactly right. That's where it's got to begin. I led a group of nine to China over the last, not this holiday but the year before. Spent New Year's Eve in Shanghai, and the Chinese begin their discussion of energy by talking about post-oil.

We tend to think in terms of the next quarterly report here, and we in the Congress have a lot of trouble seeing beyond the next

election, but in that part of the world they tend to think in terms of generations and centuries. There will be a post-oil world. It will not last forever. There will be an age—we're about halfway through it, by the way. We're about 150 years into the age of oil. Another 150 years, ever less and less, more and more expensive, and we'll be through with the age of oil and gas and coal.

I bought the first Prius in the Congress. I bought the first Prius in Maryland. I retired from the building business a number of years ago, but I'm still the largest builder of solar homes in Frederick County. So I anticipated a long while ago that we were going to—maybe it's the scientist in me, but 40 years ago I started asking myself the question: Gee, you know, the Moon isn't made out of green cheese and the Earth isn't made out of oil and oil is not going to last forever. When do I need to start being concerned about it? Next year? Ten years? A hundred years? Maybe it's a thousand years? I had no idea, when I first started asking myself these questions, when I needed to be concerned about it. You know, it was about 30 years ago that we really needed to start being concerned about this as a world.

You know, what we have done is just so incredible. This wealth that we found under the ground, one barrel of which provides the work equivalent of 12 people working all year, each of us today enjoy a lifestyle that, if it weren't for fossil fuel energy, we'd need 300 people out there turning the cranks and waving the fan so that we could enjoy the quality of life that we have today. When we found that wealth under the ground, we should have asked ourselves the question: What can we do with this to provide the most good for the most people for the long of time?

That's sure as heck not what we did. With no more responsibility than the kids who found the cookie jar or the hog who found the feed door open, we've just been pigging out. Incredibly, that's what we want to continue to do, go out and drill as quickly as you can to get the last oil. What about my 10 kids, my 16 grandkids and my two great-grandkids?

You know, the next Congress, if age brings wisdom, you have two of the wisest people in Congress here because Mr. Hall and I are the oldest and the second-oldest people in the Congress next year.

Mr. Standish, you very correctly point to the major problem of electricity is the grid. The future for electricity is very much brighter than it is for liquid fuels. We need to be clear on that. I'm very bullish on our future for electricity. Wind and solar and more nuclear and we should do more—I see very bright friends in the Congress who are devout opponents of nuclear. Very bright young men. I can mention one of them, Mark Udall, because he told me I could mention his name. He's a very bright young man, and he understands that a reasonable alternative to nuclear might be shivering in the dark. Nuclear is not looking all that bad when shivering in the dark is an alternative to nuclear. Solar and wind and nuclear and micro hydro. We might get as much from micro hydro as we can from macro hydro, but your focus on the grid is exactly where the focus with electricity ought to be.

Thank you all very much for your testimony. I yield back, Mr. Chairman.

Mr. HALL. You know, we had a young man in the legislature that makes speeches all over about energy and he made the statement—purportedly, Mr. Waxman and Mr. Markey accused him of making a statement, "Let the Yankees freeze and starve in the dark." Wasn't that the way they came before our committee?

He came up to testify and asked me, he said, "When they finish beating me around up there on that stage, you ask me what I really said." Mr. Waxman and Mr. Markey and even Mr. Dingell worked him over. They had his statement made. He made in a speech on the West Coast. That's exactly what they were asking him about. He gave me the chance to ask him the question, "Well, what did you really say there?"

He said, "I did not say 'Let the Yankees freeze and starve in the dark.' I said, 'Let the damn, thieving Yankees freeze and starve in the dark.'" That's in the record up there. Bill, you might have been there when that happened.

Chairman LAMPSON. With that, we'll recognize Congressman Green.

THE LOW INCOME HOUSING ENERGY ASSISTANCE PROGRAM

Mr. GREEN. I guess the audiences know that Congressman Bartlett represents the district just south of the Mason-Dixon Line.

I want to again thank my colleague for allowing me to sit in, as not a Member of the Science Committee but spending a lot of time on energy because of the Energy Committee and our district. Congressman Bartlett, we've had hearings in our committee with you and the cousin of Mark Udall—Tom Udall—on peak oil, last year, and the concern. I think we all share that concern.

I have a list of questions, but I really want to comment and not take up all the time of the Full Committee Members. One of the issues the mayor brought up was the Low Income Housing Energy Assistance Program (LIHEAP). The formula has been flawed. I don't know if you or your staff looked back on that, but it was drafted—and it's so out of date in today's world. We've tried to change that, and someday we tried it in the energy bill of '05 and couldn't get it done. So now we try and get above $2 billion so areas that have heat problems actually could get some equity to it. That's the frustration. So we'll continue to fight that LIHEAP battle.

I've told our northern Members that I think we need one more pre-districting, that after 2011 we'll finally have enough Members below the Mason-Dixon Line. The science is with us; more people die of heat-related than ever they do of cold-related. That's frustrating but, again, it's a political situation. Chairman Dingell is a good friend of mine, and he wrote that legislation. If I was from Michigan—I'd write the same thing—but there's going to be different Members now in the next few years.

I agree with the need for a balanced approach, and that's our biggest question and battle in Washington. The bill was passed last week, not only the 17 billion, but you know some of us agreed earlier last year for a smaller tax increase on energy that would actually do some of the things that the mayor talked about, smart building and everything else, but we're not really to that point. We don't talk about increasing production of what we're going to need

for the next 10 to 15 to 25 years. At the same time we're trying to pay for the research that we want to do for alternatives that are both cleaner. Until the House of Representatives does that balanced approach, you're going to end up with Members like Nick Lampson and I voting no on something that we'd really like to vote for, but just don't give us the number, just be part of the process because we produce energy in our area. We just don't consume it, although we do consume a lot; but that has to be the balanced approach.

Let me talk about the issue about the transmission grid that both Mr. Hofmeister and CenterPoint mentioned. The energy bill of '05 actually created the transmission corridors around the country to help with getting that power from the West that's wind power, and just last year on the House Floor we had three different attacks on trying to eliminate those transmission corridors. They were defeated in the House of Representatives, but that's one of the things in the energy bill of '05 that was really good because we have to have a national management of energy, although typically the opposition comes out of the Northeast, the area that needs those transmission corridors the most. So we'll keep fighting that, and so far we've been able to win on the House side.

The other issue—and I'm glad you mentioned about the request for funds for the technical standards. I think technical standards is actually the jurisdiction of the Science Committee and can deal with that, and on the other side the request for the R&D that was authorized in the energy bill from last year, the '07, and to see if we can get that funding in there for what we need to do. I'm glad you mentioned it. It hadn't hit my radar screen, but we'll see if we can put together some support through the appropriations process for that, to make sure we do.

SHELL'S EMISSIONS CLARIFIED

You know, like I said, Mr. Chairman, I have lots of questions. We live, some of us live every day with this issue. My last thing is I want our Shell CEO to say it again so we'll hear it, that the Motiva facility in the Beaumont/Port Arthur area, actually you're almost doubling the barrels of production and you're cutting the existing—say you're at 230,000 barrels now and you're going up to whatever, 400,000, 600,000—you're actually cutting, though, the current emissions from producing the half that you're producing now.

Mr. HOFMEISTER. I should say that more clearly, I think, Congressman. The net unit emission per barrel in total will come down; but because it's more barrels, there will be more emissions.

Mr. GREEN. There are more emissions, but the net unit per barrel. Again, there's effort being made—and again the mayor has been a leader on this, in representing a district that both has the energy industry but also has a lot of constituents who work and live around it. I want to make sure we do much better on the clear air side and still we can do the production that our country needs. We learned, as you said, in Rita and Katrina, that if we shut down the Houston Ship Channel, which it was, you know, 45 percent of our refined product comes out of this area of the Gulf of Mexico. So that's why the whole country needs it. They may not know they need it until that price will go from 3.10 or 3.50 or whatever it is

in other parts of the country to much more, because otherwise we'll let people in Pedavesa import it, which they don't have the refined product to even import.

Anyway, thank you for having the hearing here and, again, I thank the Science Committee for doing this.

Chairman LAMPSON. Thank you, Congressman Green.

That brings this panel to a close, and I want to thank the panelists for taking their time and for their good thoughts. We'll do our best to follow through with the information that you have given us.

We'll take a very short recess as we switch groups for this table and we will lose Congressman Hall.

(To Congressman Hall) We thank you very much for joining us. Thanks so much for coming.

We're in recess for just a couple of minutes.

[Recess.]

Chairman LAMPSON. I will call the meeting back into order, and I want to welcome our second panel of witnesses to provide their unique perspectives on energy from the academic and research sectors. We'll have Dr. Walter Chapman, who is the Director of the Energy and Environment Systems Institute, here at Rice University.

Mr. Michael Ming, who is President of the Research Partnership to Secure Energy for America, otherwise known as RPSEA. Dr. Robert Hirsch is the senior energy adviser for Management Information Services, Incorporated; and Dr. Robert Harriss is President and CEO of the Houston Advanced Research Center, HARC, which has done some great things around here as well.

We welcome all of you. As we said for the panel before, we ask that each of you have five minutes for your spoken testimony. Your written testimony will be included in the record for the hearing. When you all complete your testimony, we'll begin with questions. Each Member will have five minutes to question the panel.

Dr. Chapman, would you please begin.

Panel II:

STATEMENT OF DR. WALTER G. CHAPMAN, W.W. AKERS PROFESSOR; DIRECTOR, ENERGY AND ENVIRONMENT SYSTEMS INSTITUTE, RICE UNIVERSITY

Dr. CHAPMAN. Mr. Chairman and Members of the Energy and Environment Subcommittee, welcome to Rice University, a beautiful setting and one of the Nation's premier research universities. It's a great honor to address this committee on an issue of such crucial importance to the United States and the world.

Before I start, I would like to acknowledge numerous colleagues, including Amy Jaffe, Kenneth Cox, and Emil Peña, for providing input to this testimony; but the opinions I express here today are my own.

Mr. Chairman, it is fitting that you have come to Rice today because Rice takes on big challenges. Almost 50 years ago, President Kennedy came to this campus, not far from where we are seated, to challenge our Country to land a man on the Moon. The resulting investment led to one of the United States' greatest technological achievements and to unprecedented economic growth and unparal-

leled standing in the international community. We have an even larger, equally important challenge today. Energy is, as the late Richard Smalley, Nobel Prize winner and Rice University professor, told the U.S. Senate in 2004, "the single most important challenge facing humanity today." Confronting and surmounting the energy challenge is not optional; it is necessary for survival.

Compared with the space race, this challenge will involve even more advanced scientific and engineering feats, social change, and government investment. Rice University's Energy and Environmental Systems Institute envisions the challenge as being one of building the bridge to a sustainable, affordable, and secure energy future. The image of the bridge symbolizes the imperative to span the technological, economic, and political divide between the present and a sustainable future; but there is more to the symbolism. To me, this bridge is not constructed solely from technology. In fact, perhaps the most important component of the bridge is the investment in human capital.

The United States must recommit itself to science and engineering education and to funding scientists and engineers engaged in fundamental research, research that can produce innovations that will drive the economy and provide solutions to producing sustainable energy. As the U.S. Government recommits itself to the energy challenge, it's important to recognize, as I believe this committee does recognize, that you cannot legislate an energy solution. Solutions many times come from fundamental research in seemingly unrelated areas. I recommend adopting the initiatives on education and research funding in the National Academy's report, *"Rising Above the Gathering Storm, Energizing and Employing America for a Brighter Economic Future,"* that was presented to this committee in October of 2005. Among other guidelines, the report recommended significant increases in funding of basic research to secure our future.

Beyond supporting fundamental research, what else should we do? Let me approach that question by exploring a series of other questions. What do we know? What we are learning? How can we learn faster? How long will it take?

First, what do we know? We know that a transition to greater use of renewable energy sources is essential to sustainability. At the same time, as the Department of Energy points out, even with aggressive adoption of alternative energy, the U.S. demand for hydrocarbon energy sources will increase over the next two decades. Thus, the U.S. should invest more to increase the supply of fossil fuels, while simultaneously investing to replace them.

Mr. Chairman, I am very pleased that this energy portfolio approach is embodied in your bill, H.R. 5146. At Rice we have learned many things. With respect to oil and gas, familiar energy sources that have propelled the global economy for 100 years, we have learned that there is still much to learn. We still do not know all we need to know about extracting these energy sources. Roughly 70 percent of the oil discovered in the world cannot be produced by conventional technologies. Faculty members at Rice University have developed self-assembling smart fluids to better extract oil from the pores inside rocks and to expand the areas swept in an oilfield. Based on experiments and modeling studies, these tech-

nologies could double the amount of oil produced from reservoirs. Further applications of nanotechnology to existing exploration and production will enhance supplies. The newly-established Advanced Energy Consortium a privately-funded consortium of companies led by the Bureau of Economic Geology at the University of Texas, in collaboration with Rice University, is working on that possibility.

Now, beyond traditional oil and gas, we're discovering new energy opportunities and new ways to improve existing technologies. For example, we are learning how nanotechnology can inhibit corrosion, increasing safety and lower maintenance costs in energy, transportation, and other industries. According to the National Association of Corrosion Engineers, corrosion presently costs the United States, every year, $276 billion. We are learning how to create metabolically engineered bacteria and plants to convert biomass, as well as wastes from biodiesel production, into fine chemicals and fuels. We are learning how to manipulate gold coated nanoparticles to efficiently harvest energy. This could lead to more efficient solar cells.

Interestingly, the same technology has shown effectiveness in treating cancer, using light energy. We are learning how to employ, in wind turbines, new nanomaterials as blades that morph into the optimum shape in response to wind conditions and possibly also heal themselves if damaged.

In other activities, our institute is helping the Wind Energy Systems Technology Group to bring offshore wind to Texas, the first offshore wind project in the United States. We are learning within the Rick Smalley Institute at Rice how to produce, on a large scale, a quantum wire to allow transmission of electricity around the globe with near zero loss, enabling distributed energy generation on a worldwide electricity grid. This is promising and exciting research, but I have only highlighted some of the research under way, and that at Rice.

This brings me to the next question: How can we learn faster? I think the answer is twofold. First, as I noted above, we need additional research funding to advance fundamental research and to assimilate the next generation of students into the quest for solutions. Second, I recommend that the Government, presumably the Department of Energy, make available, on its website, energy-related research findings from as many sources as possible. Information technology has vastly reduced the cost of placing information in the public domain. That cost, however, has been offset by the cost of tracking the sheer volume of material available. One way to learn faster is to provide the research community and public at large a compendium of energy information. I acknowledge this is no small task, but it need not be done perfectly to make a difference.

Finally, how long will we need? We acknowledge that the odds of finding a single quick solution to the energy challenge are infinitesimally small. It will take time to develop a portfolio of solutions. At the same time, however, we have every reason to be optimistic because progress towards a secure, affordable, and sustainable energy future is certain. It is happening now. It is not a matter of whether but when. We are fortunate, as I hope I have made clear,

that there is much that this subcommittee can do to accelerate the pace toward the goal upon which our very survival depends.

Thank you very much.

Chairman LAMPSON. Thank you very much.

[The prepared statement of Dr. Chapman follows:]

PREPARED STATEMENT OF WALTER G. CHAPMAN

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As the U.S. Government re-commits itself to the energy challenge, it is important to recognize, as I believe this committee does recognize, that you cannot "legislate" an energy solution. Solutions many times come from fundamental research in seemingly unrelated areas. I recommend adopting the initiatives on education and research funding in the National Academies report *"Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future,"* presented to this committee in October, 2005. Among other guidelines, the report recommended significant increases in funding of basic research to secure our future.

Beyond supporting fundamental research, what else should we do?

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In addition, I expect that applying nano-technology to existing exploration and production will enhance supplies. The newly established Advanced Energy Consor-

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This is promising and exciting and research, but I have only highlighted some of the research underway at Rice. Which brings me to the question: How can we learn faster?

The answer to that is two-fold.

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Second, I would recommend that the government, presumably the DOE, make available on its web site a moderated wiki of energy related research findings from as many sources as possible. Information technology has vastly reduced the cost of placing information in the public domain. That cost, however, has been offset by the cost of tracking the sheer volume of material available. One way to learn faster is to provide to the research community, and the public at large, a compendium of energy research. I acknowledge this is no small task. But it need not be done perfectly to make a difference.

How long will we need? We need to acknowledge that the odds of finding a single, quick solution to the energy challenge are infinitesimally small.

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BIOGRAPHY FOR WALTER G. CHAPMAN

Professor Walter G. Chapman is the William W. Akers Professor of Chemical and Biomolecular Engineering and the Director of the Energy and Environmental Systems Institute at Rice University. Among his recognitions are multiple teaching awards and an Outstanding Young Alumni Award from Clemson University. Professor Chapman's research into properties and interfacial structure of complex fluids has applications in the energy and high performance materials industries.

Chairman LAMPSON. Mr. Ming, you're recognized for five minutes.

STATEMENT OF MR. C. MICHAEL MING, PRESIDENT, RESEARCH PARTNERSHIP TO SECURE ENERGY FOR AMERICA (RPSEA)

Mr. MING. Thank you. Good morning, Mr. Chairman. My name is Mike Ming, and I serve as the President of the Research Partnership to Secure Energy for America, known as RPSEA. While you have a copy of my written statement, I have some oral remarks to elaborate on that, somewhat shorter than my written remarks,

which in some detail describe the program Mr. Hall described from the *Energy Policy Act of 2005,* Section 999.

I appreciate the opportunity to share with you my views on what I feel is the most important issue of our time, that being energy. Its impact on productivity, our standard of living, the economy, the environment, and national and global security are indisputable. Energy plays a primary role in virtually every major challenge we face today, and if we fix the energy problem, all other problems become much more manageable.

RPSEA, a public-private research consortium headquartered in Sugar Land, Texas, focuses on abundant but technically challenging domestic unconventional natural gas in ultra-deep water resources. I especially want to thank you, Mr. Lampson, and your colleague, Mr. Hall, for your support of this program.

The U.S. is endowed with substantial natural gas and oil resources which, if developed in an environmentally responsible manner and consumed as efficiently as possible, will provide reliable and affordable energy to the American public for decades to come. Our job at RPSEA is to address those technical challenges and develop the intellectual capabilities to exploit those resources. RPSEA is a consortium comprised of 130 member entities, 25 research universities. If you include Dr. Hirsch's association with SAIC, it includes everyone on this panel, Rice University, other universities.

We are facing a fundamental shift in resource types from conventional to unconventional resources, which requires technology but leverages a much larger resource space. Contrary to popular opinion, we are not running out of energy. In fact, if we are short on anything, it is creativity and innovation on both the supply and demand ends of the pipeline.

With eight straight years of natural gas reserve growth and actually increasing production, all based on aggressive development and implementation of technology enabled by market forces and effective public policy, domestic natural gas is a bird in the hand and not two in the bush. To illustrate, 30 years ago, U.S. reserves were just over 200 trillion cubic feet, or the equivalent of ten years of remaining supply at then-current consumption rate. Today reserves are 211 trillion cubic feet and growing, despite the production of over 500 trillion cubic feet in the 30-year period in between, or two and a half times what was supposedly left in 1979. We must not let up now in our efforts to develop the energy technologies and technologists to continue this impressive progress for this clean-burning and low-carbon fuel.

Effective energy policy must address many issues and consider many options, and there is no single solution. What must occur is the development of a diverse yet integrated portfolio of technologies and policies. What I address today is primarily one component of that portfolio, technology development for natural gas and oil supply; but I would also like to comment on end-use energy efficiency because it is a critical component to the supply side of the equation.

Driven by effective public policy and appropriate market incentives, end-use energy efficiency leverages all force of supply; and this holds true for natural gas and oil more than any other fuels, if for no other reason than the sheer scale of their 66 percent con-

tribution of our nation's energy supply, an enormous enterprise by any measure. These points were eloquently stated by all the witnesses on the previous panel, Mr. Hofmeister and Mayor White, regarding energy efficiency and energy issues, and by Mr. Standish with regard to distributed generation.

With regard to the development of natural gas and oil supply technology, I will highlight three critical requirements. The first is the creation of a vehicle populated with capable participants which enables the effective creation of technology solutions. This is the RPSEA public-private partnership concept, utilizing the open innovation model which engages the full spectrum of contributors. This contrasts with the historical approach of proprietary single-breakthrough type research efforts, by integrating processes and utilizing interdisciplinary skill sets.

The second is the development and utilization of the intellectual capability necessary to solve the problems at hand. Fully engaging the academic and research community, providing real problems for them to solve, and providing incentives for the best minds to enter the research field is the best method to build this intellectual capability.

The third and final requirement is integrating supply and demand in an optimized system. The unique attributes of natural gas, for example, lend themselves to extraordinary increases in the efficiency of power generation, distribution, and end-use consumption. Legislative supplier-demand proposals, which in isolation ignore the opposite end of the pipe, don't capture this intrinsic value. In the U.S. we waste more energy than we use. So my message is that we have plenty of energy, just not plenty to waste.

All of these requirements necessitate investment with adequate funding in resources. The funding for the program described by Mr. Hall is $37.5 million per year. To put that in perspective, that's the value of less than 45 minutes worth of imported oil coming into the United States.

I urge you to take this pragmatic approach back to Washington, and I hope this message and my written testimony will assist you in developing an integrated and sustainable energy policy and portfolio that will meet the criteria of our ancestors, where effective decisions are measured seven generations out. Quoting the great Wayne Gretzky, "You miss 100 percent of the shots you don't take." Our research consortium is taking this shot and stands ready to continue our contribution to this important effort that we cannot afford to fail.

After spending a career as an independent producer from a rig floor perspective and now as a technology facilitator, I have always subscribed to the notion that I am more comfortable at proactively creating my future than reactively just trying to predict it. I hope you agree with this philosophy and continue to provide the support to enable those efforts that truly can create the sustainable energy future we all desire. I thank you for your time and the opportunity to voice these opinions.

Chairman LAMPSON. Thank you, Mr. Ming.

[The prepared statement of Mr. Ming follows:]

PREPARED STATEMENT OF C. MICHAEL MING

Thank you Mr. Chairman for this opportunity to testify before your subcommittee. The *Energy Policy Act of 2005* established a new research program to maximize the value of our domestic energy supplies through the development of new technologies titled the "Ultra-Deepwater and Unconventional Natural Gas and Other Petroleum Resources Program." This 10-year, $500 million dollar program is a public private partnership designed to benefit consumers by developing technology to increase America's domestic energy resources and is paid for from lease bonuses and production royalties from federal lands. I want to thank you and your colleague Congressman Ralph Hall for the leadership you have demonstrated with your work to see that this law was enacted and the program implemented.

The Research Partnership to Secure Energy for America ("RPSEA,"), a 501 (c) 3 not for profit corporation was selected to help manage research and development projects funded through this new program. RPSEA is an innovative public-private partnership comprised as a consortium of over 130 organizations, including 25 of the Nation's premier research universities, five national laboratories, several private research institutions, and a range of industry players. Participants in the consortium and many other people have contributed thousands of man hours and expertise to help develop a robust research plan to produce the Nation's abundant—but technically challenging—domestic natural gas and oil resources. RPSEA is headquartered in Sugar Land, Texas.

RPSEA was selected to administer 75 percent of the funds for this program in a competitive solicitation issued by the Department of Energy in November, 2005. The Federal Government maintains oversight of the program and Congress reviews our Annual Research plan. RPSEA, as the research manager, is limited to 10 percent of the total funds to administer the program. The research dollars managed by RPSEA will be awarded to research performers across the Nation. DOE's National Energy Technology Laboratory will conduct complementary research with the remaining 25 percent of the funds. Founded in 2002, RPSEA uses a collaborative approach with industry, government, non-government organizations, academia, national laboratories, Federally Funded Research Development Centers and independent research groups. Members of this consortium have invested a substantial amount of intellectual and financial resources in the start up of this new program, and initial project selections have been made in several program areas with research projects set to begin this spring.

We also appreciate the pressure that Congress faces as it seeks to allocate scarce federal resources and we appreciate how hard you have worked to resist recommendations to reduce or eliminate funding for this program—an effort that would diminish its overall effectiveness and de-value the considerable investment already made to ensure that it meets its potential for serving the American public. This new program of research and development contains a revolutionary mechanism to produce innovation and creativity unburdened by traditional constraints. Its effectiveness is based on open and transparent processes with the full engagement and support of all stakeholders in the research arena. Attempts to hamper its implementation not only diminish the value of the existing public investment but also discourage the participation of industry which is where the true leverage is created to multiply the value of the taxpayer investment.

All reasonable forecasts indicate that natural gas and petroleum will remain essential sources of energy in this country for decades as we transition to a sustainable energy future. The United States has 75 years of natural gas supply, with most of it on lands that are not subject to access restrictions; they are, however, "technically" restricted. New technologies will enable less expensive, more efficient, and more environmentally-friendly domestic natural gas and other petroleum production. Natural gas and oil provide two-third's of our nation's primary energy, and will do so for the next several decades as we transition to a new energy future. This collaborative research program will ensure the continued development of America's intellectual capital and skilled workforce to effect this transition, enhance our energy security and provide new technologies to produce affordable domestic energy supplies in environmentally-sound ways.

Our nation is not short on resources, in fact identified technically recoverable unconventional resources are growing, and it is this fundamental shift from historical conventional resources to a virtually unlimited unconventional resource base that makes this investment so beneficial. Developing cutting edge technologies to bring reliable sources of clean-burning, environmentally friendly, domestic natural gas to American consumers is exactly the kind of investment that the United States should be making today, especially in light of sharply rising energy costs. RPSEA funds research projects conducted across the country that are designed to enhance domestic

energy production, mitigate its environmental impacts and help develop the next generation of energy technologies and technologists. We need to re-establish the United States global leadership role in energy technology and intellectual capital.

This national effort will engage the best minds in the country—from inside and outside of the industry—to develop the new technologies that will take us to new levels of energy self-sufficiency. The work of RPSEA benefits the public directly because the technology that is developed through RPSEA funded research is non-proprietary. The purpose of this Department of Energy program is to fund research—using federal oil and gas royalties and industry matching funds—that will reduce America's dependence on foreign energy sources.

Quoting Congressman Ralph Hall to Energy Secretary Samuel Bodman, "the energy supply and demand situation in this country will not improve without the concerted and expeditious effort of every person that has the capacity to make a contribution. Production in difficult regions such as the ultra-deepwater requires new technologies, a point that has been recently highlighted by the recent large Chevron and Devon find in the Gulf of Mexico. Exploration wells have indicated there is significant resource available in that region; however, actual production and delivery to market could take five to seven years." This program and the technologies and partnerships envisioned could help accelerate that production and lower its cost. The technologies that are developed will likely have crosscutting applications for deep drilling and production for unconventional onshore production as well. Chevron and Devon are two of the over 130 members of RPSEA.

Further, two natural gas resources—coal bed methane and the Barnett Shale—have been unlocked in recent years as the result of collaborative research jointly funded by the Federal Government, the energy industry and private not-for-profit research organizations. Today, the Barnett Shale and many basins containing coal bed methane are significant contributors to our nation's natural gas supply. The Energy Information Administration recently announced that natural gas reserves rose for the eighth straight year. Texas led the Nation in gas reserve additions in 2005 thanks largely to sharp increases in the Barnett Shale. Coal bed methane reserves now account for approximately 10 percent of overall domestic gas reserves. Much new technology remains to be developed to tap the 1,525 trillion cubic feet of technically recoverable natural gas resource estimated by the Potential Gas Committee. This program will help to ensure that our citizen's collective knowledge and ingenuity will continue to be used aggressively to unlock many more natural gas and oil resources through technology advancement.

The members of our consortium are confident that this program will enable the broad sharing of R&D results, done at sites all across the country, to address the public's interest in developing abundant, clean, affordable and secure supplies. RPSEA will administer a program across four elements of research, development, demonstration and commercial application of technologies. The actual R&D activity is conducted by recipients of awards that are selected through a competitive proposal process.

The time for action is now. Investing in the development of domestic energy resources will make us less dependent on supplies from unreliable overseas supplies. And investments in R&D today will increase the energy supplies of tomorrow. This means lower prices, increased competitiveness, and greater security. This program will give the American consumer a seat at the head of the table: directing the Nation's energy research agenda with public, not corporate, interests serving as its primary guideposts.

BIOGRAPHY FOR C. MICHAEL MING

C. Michael Ming currently serves as the President of the Research Partnership to Secure Energy for America, RPSEA. Mr. Ming formerly served as an independent oil & gas producer as a Managing Member of K. Stewart Energy Group, LLC and as a principal, Director, and VP of Engineering at K. Stewart Petroleum Corp. He holds a BS degree with distinction in Petroleum Engineering and an MS degree in Engineering Management, both from Stanford University, and is a Registered Professional Engineer in Oklahoma. Mr. Ming is an emeritus member of the Petroleum Investments Committee at Stanford University and is a past Chairman. He is actively involved in the University's energy programs, co-sponsored the MAP/Ming Visiting Professorship on Energy and the Environment, and currently serves on the School of Earth Sciences Dean's Advisory Board. He has served as an adjunct professor in Energy Management at the University of Oklahoma and as an oil & gas strategic planning advisor to the Department of Energy.

Chairman LAMPSON. Dr. Hirsch, you're recognized for five minutes.

STATEMENT OF DR. ROBERT L. HIRSCH, SENIOR ENERGY ADVISOR, MANAGEMENT INFORMATION SERVICES, INC.

Dr. HIRSCH. Mr. Chairman, Dr. Bartlett, and staff, if it hasn't already, world oil production is about to reach a maximum, after which it will go into decline. When decline begins, world oil prices will leap upwards and oil shortages will worsen year after year.

The oil interruptions of 1973 and 1979 sparked recession, inflation, growing unemployment, and high interest rates. The peaking of world oil production will be much more damaging and could well last much longer than a decade, in spite of the very best of human efforts. Oil prices have risen by more than a factor of five since the 1990s, as you know. For the last three and a half years, world liquid fuel production has stagnated, which means that production has fluctuated within a relatively narrow volatility band. Such a long plateau in world oil production hasn't happened in the last 50 years.

A growing chorus of influential individuals and organizations has warned of impending world oil shortages. Included are the International Energy Agency, Chevron, Shell, Total Oil, Statoil, Hess Oil, the Chinese Petroleum Institute, the Corps of Engineers, Volvo Trucks, and a number of retired senior oil company geologists, and such American notables as James Schlesinger, Boone Pickens, Matt Simmons, and Charlie Maxwell. Some sugar-coat their warnings with phrases like "supply will no longer be able to meet demand," while others warn specifically of growing world oil shortages.

Consider statements by executives of the International Energy Agency when they released their 2006 world energy outlook: "This energy future is not only unsustainable, it is doomed to failure. We are on a course for an energy system that will evolve from crisis to crisis." The IEA chief economist opined that he expects the oil industry's production capacity to slightly outstrip demand through the end of this decade—not far from now—if all oil projects worldwide see the light of day, which he said is not likely.

Charlie Maxwell is often called "the dean of world oil analysts." He tells us to expect gasoline at twelve to fifteen dollars per gallon within a few years. Twelve to fifteen dollars within a few years. Others specifically speak of oil shortages that will increase year after year. Think of what oil shortages will mean to our economy with our everyday mobility requirements, extensive world trade, oil-based agriculture, just-in-time manufacturing, and long commutes to work.

In 2005, the Department of Energy released a study that colleagues and I prepared, on mitigating the impacts of peak oil. We analyzed a worldwide crash program because that represents the best that would be humanly possible. We found that a crash program started 20 years before world oil peaking could avoid economic disaster. On the other hand, waiting for peaking to become obvious—the course we are presently following—means much more than a decade of dire economic consequences. During the time of our study, we took no position on when peaking might occur because it was much less clear then than it is now. Our primary con-

clusion was that growing world oil shortages will almost certainly outrun the best human efforts, assuming that we wait until the problem is obvious.

The fact is that there will be no quick fixes, absolutely no quick fixes, because of the enormity of the lost oil production. That enormity means that rapid activity, the best that we can possibly do, will not be sufficient. Today credible forecasts indicate that oil declines will occur either right after the current production stagnation or after a few more years of production fluctuations, but a few more years either way is not significant when viewed from the point of view of what will have to be a worldwide, multi-decade crash program.

Peak oil could, indeed, be another perfect storm. This is because the world, as you well know, is increasingly focused—some might say fixated—on manmade contributions to global climate change. While some energy efficiency options may be similar for the two problems, other peak oil mitigation methods are not. So some wrenching value readjustments are going to be necessary. Which problem is more urgent is a matter for debate. To me, the worst kind of disaster is hordes of people out of work, out of their homes, and desperate, which is what world oil shortages will deliver.

Peak oil could burst into active public consciousness at any time. There's a lot in the literature now, in television and newspapers and so forth; but in reality hasn't crashed past the threshold into open public consciousness. When it does, reactions are likely to resemble those of 1973 and 1979 oil shocks—namely, public panic, early hoarding, induced shortages, and major negative reactions on Wall Street.

Those problems arose in the past, and they are almost certain to happen again.

Difficult compromises and decisive action will be needed. There will be no single solution. Multiple mitigation options will be required. Large-scale deployment—and let me repeat the word "deployment"—of appropriate technologies will be essential, and government-facilitated industrial crash programs will be a must. Research and development will be required—and I'm a research and development person and feel very strongly about such things—but make no mistake: R&D alone will have little impact in the near-term. R&D in big problems like this takes times to implement under the best of conditions. Large-scale deployment is the only thing that can make a difference.

Thank you for the opportunity to be heard. I have compressed my comments here, quite obviously. This is a horrendous problem. The task ahead will be unprecedented.

Chairman LAMPSON. That's a lot to think of, but I think you're right and that's why we're here. Thank you, Dr. Hirsch.

[The prepared statement of Dr. Hirsch follows:]

PREPARED STATEMENT OF ROBERT L. HIRSCH

If it hasn't already, world oil production is about to reach a maximum, after which it will go into decline. When decline begins, world oil prices will leap much higher, and oil shortages will worsen year-after-year. The brief oil interruptions of 1973 and 1979 sparked recession, inflation, growing unemployment, and high interest rates. The peaking of world oil production will be much more damaging and could well last much longer than a decade in spite of our best efforts.

Oil prices have risen by more than a factor of five since the late 1990s. For the last three and a half years, world liquid fuel production has stagnated, which means that production has fluctuated within a relatively narrow volatility band. Such a long plateau in world oil production hasn't happened in the last 50 years.

A growing chorus of influential individuals and organizations has warned of impending oil shortages. Included are the International Energy Agency (IEA), Chevron, Shell, Total Oil, Statoil, Hess Oil, The Chinese Petroleum Institute, The Corps of Engineers, Volvo Trucks, a number of retired senior oil company geologists, and such American notables as James Schlesinger, Boone Pickens, Matt Simmons, and Charlie Maxwell. Some sugarcoat their warnings with phrases like "supply will no longer be able to meet demand," while others warn specifically of growing oil shortages.

Consider statements by the Executive Director and Chief Economist of the International Energy Agency (IEA) associated with the release of their 2006 World Energy Outlook: "This energy future is not only unsustainable, it is doomed to failure. . ." ". . .we are on course for an energy system that will evolve from crisis to crisis." The IEA chief economist opined that he expects the oil industry's production capacity to "slightly outstrip demand" through the end of this decade, if all oil projects worldwide see the light of day, which he said was not likely.

Charlie Maxwell is often called the dean of world oil analysts. He tells us to expect gasoline at $12–$15 per gallon within a few years. Others warn of world oil shortages that increase each year. Think about what oil shortages will mean to our economy with our everyday mobility requirements, extensive world trade, oil-based agriculture, just-in-time manufacturing, and long commutes to work.

Some deny that the problem is imminent and tell us not to worry. Included are OPEC, DOE EIA, CERA, ExxonMobil, and fewer and fewer others. OPEC asks us to trust that it can and will act in our best interests. The OPEC countries tell us to believe their secret, unaudited oil reserves claims, in spite of disturbing evidence they have been less-than-truthful in the past.

CERA has been consistently optimistic, but they have been wrong on many resource and price forecasts in the past. They too ask us to trust them.

In early 2005 the Department of Energy released a study that colleagues and I prepared on mitigating the impacts of peak oil. We analyzed a worldwide crash program, because it represents the best that would be humanly possible. We found that a crash program started 20 years before world oil peaking could avoid economic disaster. On the other hand, waiting for peaking to become obvious—the course we are presently following—means much more than a decade of dire economic circumstances. At the time of our study, we took no position on when peaking might occur, because it was much less clear than it is now. Our primary conclusion was that growing world oil shortages will almost certainly outrun our very best human efforts, assuming that we wait until the problem is obvious. The fact is that there will be no quick fixes, because the enormity of lost oil production means that rapid mitigation is impossible.

Today, credible forecasts indicate that oil declines will occur either immediately after the current production stagnation or after a few more years of production fluctuations. But a matter of a few years is not significant when viewed in the context of a multi-decade crash program.

Peak oil could indeed be another "Perfect Storm." This is because the world is increasingly focused, some say fixated, on man-made contributions to global climate change. While some energy efficiency options may be similar for the two problems, other peak oil mitigation methods are not, so some wrenching value adjustments will be called for. Which problem is more urgent is a matter for debate. To me, the worst kind of disaster is hoards of people out of work, out of their homes, and desperate, which is what world oil shortages will deliver.

Energy experts know that it will take something like half a century for the world to meaningfully transition toward a more sustainable energy future. In the meantime, world oil supply shortages will require other sources of liquid fuels to power the huge worldwide fleets of automobiles, trucks, airplanes, ships, and farm equipment.

Most renewables won't help because they produce electricity, which will be of no value in existing liquid fuel-consuming machinery. Corn-based ethanol produces a fuel that can replace oil, but its energy efficiency is near zero; its climate impact is now believed to be negative; and it has already lead to higher food prices. Oil peaking will force us to be much more pragmatic about our energy choices and to stop betting on seemingly wonderful technologies that cannot significantly contribute to the toughest energy challenge we've ever faced.

Thinking about peak oil is extremely uncomfortable because it quickly conjures a cascade of events that lead to a major recession that deepens with time.

How could peak oil happen? It's because oil is a finite resource, which the world is consuming at an ever-increasing rate. Oil production peaking has occurred in countries all over the world. The Royal Swedish Academy tells us that 54 of the 65 most important oil-producing countries are already past their peak oil production. In the U.S. lower 48 states, our production peaked in 1970 and has been declining ever since. This happened in spite of dramatically improved technology and increased oil prices.

The Royal Swedish Academy also tells us that the rate of discoveries of new oil reserves is less than a third of the present rate of oil consumption. Some believe the number to be higher. It's not hard to comprehend that we've got a problem.

Keep in mind that seemingly small numbers have very large impacts when it comes to oil. For example, the five percent decrease in U.S. oil supplies associated with the 1973 Arab oil embargo was accompanied by a damaging economic recession. A one percent change in current world oil production equates to over 800,000 barrels per day (bpd), which represents a huge volume. To save that level of consumption through improvements in the efficiency of the world's light duty vehicle fleet would require more than a decade, assuming crash program implementation. The production of 800,000 bpd of substitute liquid fuels would require coal-to-liquids (CTL) plants costing $50–100 billion and more than a decade under the best of conditions, which don't now exist. The bottom line is that small decreases in world oil supply can have large economic impacts and necessitate unprecedented levels of mitigation hardware and investment.

An exercise called Oil Shockwave a couple of years ago concluded "It only requires a relatively small amount of oil to be taken out of the system to have huge economic and security implications." Robert Gates made that statement prior to his current job as Secretary of Defense. Among other Oil Shockwave conclusions was that a four percent global shortfall in daily oil supply would result in an oil price increase of nearly a factor of three and a severe recession in the U.S.

And our whipping boys must change. We can no longer blame the major oil companies, including the public's favorite villain, ExxonMobil. That's because the majors now control only a small fraction of world oil. Expropriations over recent years mean that National Oil Companies dominate world oil, and many of them are much more interested in near-term revenues than servicing the world's thirst for oil. Indeed, it can be argued that it is in their best interests to hold back production.

The peak oil issue is percolating up the public awareness ladder. There are growing numbers of related articles in the media. The Administration gives indications that it recognizes the problem but isn't speaking out directly. More and more people on Wall Street are talking about the problem. Last time I Googled "peak oil," there were over four million items, including serious studies, newspaper stories, documentaries and blogs.

Peak oil could burst into active public consciousness at any time. When it does, reactions are likely to resemble those of the 1973 and 1979 oil shocks: Public panic, early hoarding-induced shortages, and major negative reactions on Wall Street. These problems occurred before, and they are almost certain to happen again.

Difficult compromises and decisive action will be needed. There will be no single solution; multiple mitigation options will be required. Large-scale deployment of appropriate technologies will be essential, and government-facilitated industrial crash programs will be a must. Research and development will be required at much higher levels, but make no mistake, R&D alone will have little impact in the near-term. Large-scale technology deployment is the only thing that can make a difference.

Thank you for the opportunity to be heard. I hope that these compressed thoughts will help to motivate greater attention to this horrendous problem. The task ahead will be unprecedented.

BIOGRAPHY FOR ROBERT L. HIRSCH

Dr. Hirsch is a Senior Energy Advisor at MISI and has been involved in virtually all aspects of energy technology in industry and government for over 40 years. He is a past Chairman of the Board on Energy and Environmental Systems at the National Academies.

Chairman LAMPSON. Dr. Harriss, you're recognized for five minutes.

STATEMENT OF DR. ROBERT C. HARRISS, PRESIDENT AND CEO, HOUSTON ADVANCED RESEARCH CENTER

Dr. HARRISS. Thank you, Mr. Chairman, and thank you for inviting me to testify. This is an honor to be here with such a distinguished panel, and I want to first say that I'm used to be at the end of the line because I grew up down in South Texas, in Cameron County, and one of the most transforming things in my life was to get off the ranch and come to Houston, Texas, to go to Rice University. I was lucky to be here at a time when there was an amazing and inspiring speech in this football stadium by John F. Kennedy, and it was one of the things that changed my life and has inspired me for the last 43 years, and I hope for many more, to work for a more sustainable future for our nation. NASA and the space program have resulted in radical innovation in so many ways, from robots on Mars to better products on our markets today, that it's a model that I would like to talk about today for other things that we do in the energy area.

I'm also pleased to represent the Houston Advanced Research Center, a nonprofit organization founded by the visionaries George and Cynthia Mitchell. We are dedicated to city and regional sustainability. George Mitchell was a pioneer in natural gas, continues to worry every day about issues of sustainability and the need for more visionary thinking. He often calls me up and says, "Bob, well, if we're not doing well at sustaining Houston with six million people, what are we going to do when three more million people get here? You've got to get to work." So he's relentless in trying to say, "How do we come up with solutions? There's plenty of people talking about problems. I'd like to see some solutions."

I agree with him. I get weary when I turn on my computer in the morning to look at the news and see ongoing discussion about climate change and oil wars and the spread of nuclear weapons, because they're all looking at the problems and I say it's time for us to choose none of those topics but to look for solutions and look forward with a vision that will inspire young people to go out and engage in the science, the engineering, and the policy that's necessary to move us forward.

Now, I do totally agree with the previous statements that in the near-term, the next 20 to 50 years, we're going to require a very efficient and effective use of fossil fuel. However, I think we need to look beyond that. We need to do everything we can to make that bridge, to look beyond that and, in doing so, to focus on thinking about how we live in a different world today. It's an urban age. We're really transitioning out of the industrial age into the urban age. Cities are essential sources of opportunities for social advancement and the creation of wealth, globalization, and creativity; but they are also large consumers of resources, they're reservoirs of poverty, and concentrated sources of solution. We've talked about severe air pollution. We've talked about the vulnerability of our urban areas to hurricanes. Those are just two examples of the metrics which suggest that we have a big challenge ahead.

Now, I do think the Houston metro area reflects the complexity, opportunities, and challenges that we face in the urban age on a worldwide scale. It is the face of the future.

I'd like to comment on what I think is a very exciting opportunity in urban sustainability, which is actually a new and emerging field that considers primarily use-inspired research. We do a lot of good, basic, fundamental research in our university community and in our federal laboratories, but we need to also focus on what I will talk about as use-inspired work. That's meeting the needs of the consumers in this nation with the products that will be fitting to the solutions they expect for their culture, for their local setting, for their environment. One size simply doesn't fit all. It's urgent that we think seriously through a vision, a design, and a deployment of a whole array of regional and local solutions to our problem with supplying energy for the future.

I'm going to comment very briefly on something that builds on Mr. Standish's testimony, and that is the opportunity that Texas has to lead the world in terms of displaying the first smart super-grid based entirely on renewable energy. Before I do that, I would like to emphasize that all of these systems that we are talking about in terms of energy supply and demand, are what we call sociotechnical systems—that is, the social dimension is every bit as important as the technological dimension. We can produce a lot of gadgets, but if there's not a consumer demand for those and a desire for the consumer to buy those, we're not going to make a bit of difference, and yet often we ignore the social sciences as an incredibly important part of the future.

Now, one of the things I think we could do to start to make important headway is to think about setting up a network of urban sustainability centers. In one sense, I think of the fact that Congress has taken action before that did a very similar thing when they set up the land grant college system. We were an agricultural nation. We needed to get out and work with the farmers on a regional basis and to figure out how to innovate in a way that was suitable for the local culture and the local conditions, including the environmental conditions. Now, regional sustainability centers would catalyze, facilitate, and support the integration process necessary to creating use-inspired solutions to the grand challenges facing American cities.

They are: Shaping the transition to a renewable energy future, adapting to climate change, sustaining biodiversity in ecosystems, and reducing vulnerabilities, especially vulnerabilities that many of our citizens in Houston face to pollution and natural disasters. These centers would be, I think, a major contribution to going from a one-size-fits-all model to the customized model that will meet the needs of citizens across the Nation, in our metros, where they live and under the conditions and cultural settings in which they live. As America's energy capital, Houston would be the ideal setting to assemble the necessary expertise to do a demonstration or at least to think through a design of what these regional sustainability centers might look like.

Finally, I want to come back to this notion that Mr. Standish talked about, of a super-grid or of a Smart Grid; and I want to say that because Texas is fortunate to have a relatively independent electrical grid—there are small interconnections, but for the most part, being a big state with six climate zones, we have our own grid—and it offers a model for the Nation and the world because

of the variety of local and regional environments we have. Now, we can, I am convinced, produce the most affordable electricity our nation has ever experienced, with renewable energy that will only require a backup of natural gas as a reserve for surprises that may come as a result of global warming or some other factor; but I think it will be easy for us over the next 20 years to demonstrate that we can jump-start the world in moving towards a Smart Grid and a super-grid here in Texas and using available technologies. I want to emphasize that not only do we not have the funding, we don't have the institutions to make that happen now. There are too many variables.

Finally, I would point out that in terms of energy R&D in our nation, the energy area and related environmental science have been flat for several decades now and it's time for us to, I think, invest in a way that's far beyond $100 million in terms of this grid technology, probably more like $100 billion, and really inspire our young people to see that as the most exciting challenge they can take on in their future careers.

Thank you very much, sir.

Chairman LAMPSON. Thank you very much.

[The prepared statement of Dr. Harriss follows:]

PREPARED STATEMENT OF ROBERT C. HARRISS

Mr. Chairman, Thank you for inviting me to testify. My name is Robert Harriss and I am President of the Houston Advanced Research Center (HARC), a nonprofit organization dedicated to moving knowledge to action to improve human well-being and the environment at the regional scale. As an institution, HARC does not take positions nor engage in advocacy, so the opinions expressed here are my own.

For the record, I have been involved with energy, environment, and related sustainability issues as researcher, educator, and science administrator serving universities, NSF, NASA, the National Center for Atmospheric Research, and the Houston Advanced Research Center for the past 43 years of my professional career.

My testimony today draws heavily on the work of the Board on Sustainability and Sustainability Roundtable at the National Academy of Sciences/National Research Council. The National Academy Press publication titled *"Our Common Journey: A Transition Toward Sustainability,"* published in 1999, provided a new foundation for thinking about pathways to more sustainable futures. The continuing leadership of Robert W. Kates, recipient of the National Medal of Science, William C. Clarke of Harvard University, William Merrell at Texas A&M–Galveston, and many others, continues to reveal and refine new insights and pathways for advancing the well-being of both our nation and the global environment.

THE URBAN AGE

The Greater Houston and Upper Texas Coast region, our nation, and Planet Earth are nearing critical tipping points that will result in declining economic prosperity, dramatic environmental degradation, and other serious threats to human well-being. Prospects for today's children, and especially our region's vulnerable populations, hinge upon more aggressive and effective leadership in advancing the science, engineering, and policies necessary to achieving more sustainable futures.

The United States has demonstrated an extraordinarily successful capacity for discovery and innovation in developing new technologies, innovation processes, and public policies that serve commercial and national security purposes. In little more than a century our nation has moved from an agricultural, to an industrial, to an urban age. Remarkably, today our top 100 metropolitan areas take up only 12 percent of the land in the United States, but account for 68 percent of our population and 75 percent of the U.S. Gross Domestic Product. The urbanization of America and other advanced nations, combined with the increasing role of cyberspace as the primary infrastructure stimulating economic globalization, positions cities as the primary platforms for addressing the major challenges facing the world today.

Cities are essential sources of opportunities for social advancement and the creation of wealth, globalization, and creativity. But many cities are also dysfunctional both environmentally and socially. They are large consumers of resources, reservoirs

of poverty, and concentrated sources of pollution. The Houston metro area reflects the complexity, opportunities, and challenges that we face in the urban age.

URBAN SUSTAINABILITY: AN EMERGING FIELD OF "USE-INSPIRED" RESEARCH, EDUCATION, AND INNOVATION

Sustainability science is a new paradigm that aspires to integrate research and knowledge from the natural, social, medical, engineering, and policy sciences and to inform decision-making and stimulate innovation. It is defined by the practical problems it addresses, specifically the problems of sustainable development. It is focused on scientific understanding of strongly interacting human and environmental systems. Sustainability science is generally place-based; at metropolitan and regional scales where complexity is comprehensible and integration is possible, innovation and management happen, and local culture is understood.

Present systems for governing and implementing R&D encourage good research that is anchored in single (or closely related) disciplines and is either fundamental (e.g., university R&D) or specific to commercial products (e.g., industrial R&D). The essence of sustainability science, engineering, and policy is synthesis and integration of knowledge and treating policies and projects as opportunities to learn. Relative to conventional science less emphasis is needed on elite researchers making discoveries and more on connecting diverse stakeholders in a sustained collaborative dialogue on an important shared problem. The outcome of a sustainability process and project is to increase stakeholder options and make choices among them. HARC is committed to the goal of being an effective, trusted bridging organization dedicated to solving sustainability issues in the Greater Houston and Upper Texas Coast region.

THE NEED FOR A NATIONAL NETWORK OF URBAN SUSTAINABILITY CENTERS

America has several times solved complex issues through the implementation of a distributed network of centers that could facilitate a knowledge dialogue aimed at use-inspired research and education. The development of industrial age agriculture benefited from the Land Grant College program. NASA's network of regional research and engineering centers has been successful at integrating university and private sector researchers into national space technology R&D programs. There is an urgent need to provide an institutional framework appropriate to solving the many sustainability issues facing the major metropolitan regions of this nation. Regional urban sustainability centers would catalyze, facilitate, and support the integration process necessary to creating use-inspired solutions to the grand challenges facing American cities—shaping the transition to a renewable energy future, adaptation to climate change, sustaining biodiversity and ecosystems services, reducing vulnerabilities to pollution and natural disasters, etc.

A TRANSITION TOWARDS SUSTAINABLE ENERGY SERVICES

Long-term sustainable development must be based on clean, affordable, and renewable energy services. Today's most critical sustainability issues like global climate change, energy security, and urban air quality can be directly connected to energy systems. Current efforts to design a transition towards future sustainable energy services will fail because many of the objectives related to public goods (e.g., national security) and externalities (e.g., air pollution) that are not currently priced in markets. A fundamental transition in energy systems would also be subject to "market failures" derived from abuse of monopoly power, lack of information, perverse incentives, short-term planning horizons, and other factors.

A transition beyond business-as-usual toward energy systems that support socially, environmentally, and economically sustainable energy is possible. Many technologies and scenarios are available that could meet the requirements of lower costs of delivering energy services, lower energy intensity of economic activity, lower emissions intensity of economic activity, and enhanced resilience to climate surprise. Conventional R&D is necessary but not sufficient to achieve the goal of sustainable energy services. Creating usable knowledge that informs the design of sustainable energy services requires solution-driven research and innovation and must consider the place and scale of operation. Regional urban sustainability centers would catalyze, facilitate, and integrate the dialogue between stakeholders in civil society, business, and government through which scientists and engineers learn what users need and users learn what scientists and engineers can offer. As America's energy capital, Houston would be the ideal setting to assemble the expertise necessary to develop the goals and institutional framework for a national network of regional urban sustainability centers focused initially on the transition towards sustainable energy services.

THE NEED TO MOVE QUICKLY TO SCALE

Energy will be our most important technological and social challenge in the 21st century. America's metropolitan regions are likely to grow by a further 100 million people in this century. By 2030, fully half of the American built infrastructure in place will have been constructed since 2000. Our current federal technology and environment R&D programs will not drive a transformational change in the design process or implementation of a transition to sustainable energy services. There is an urgent need to move quickly to scale and to maintain a long-term commitment to funding sustainable energy programs by both public and private sectors. This commitment is essential, given the long lead times required for transformational changes in both technology and human capital.

In summary, I suggest that urban centers are the focus of our sustainability problem and they should be the source of innovative solutions. We should employ models of innovation based on collaboration and facilitated by organizations capable of bridging from basic research to application. The first challenge to be addressed by this network of urban sustainability centers should be development of systems for sustainable energy services.

BIOGRAPHY FOR ROBERT C. HARRISS

Robert Harriss is President and CEO of the Houston Advanced Research Center. He was formerly Senior Scientist and Director of the Institute for the Study of Society and the Environment of the National Center for Atmospheric Research, Boulder, CO. Current adjunct appointments include Professor, Department of Marine Sciences, Texas A&M University at Galveston; and Principal Scientist, The Institute for Oceans and Coasts.

Previous appointments include a Harvard University postdoctoral fellowship and faculty appointments at McMaster University (Canada), Florida State University, the University of New Hampshire, and Texas A&M University. He also served as a Senior Scientist at the NASA Langley Research Center and as Science Director of the Mission to Planet Earth Program at NASA Headquarters. Dr. Harriss obtained a B.S. in Geology from Florida State University and a Ph.D. in Geochemistry from Rice University and has primary professional interests in sustainability science, engineering, and policy.

DISCUSSION

Chairman LAMPSON. I think that all of our panelists are to be commended for the words that you've given us, and you've given us a lot of food for thought. I will now move into our question-and-answer period, and I will yield myself the first five minutes of our discussion.

I want to tell everyone that when we finish this particular section of our hearing this morning, we'll adjourn the formal hearing. We will step into a room on the other side of this wall, and we'll ask you to come in and we'll have a period of questions and answers, statements that might be made by the public. So I just encourage you to stick around when we are finished here.

TECHNOLOGY COMMERCIALIZATION CHALLENGES

Let me begin, Dr. Chapman, with you. The real prize, I guess, in research and development is the commercialization and the adoption of technologies. Obviously, it's a long road from the laboratory shelf of the marketplace.

How is Rice University providing an environment to connect innovative technologies with entrepreneurs?

Dr. CHAPMAN. Rice has an organization called the Rice Alliance that's built up in the Jones School of Management here at Rice. The Rice Alliance is a, I have here "the mission is to support the creation of technology-based companies and commercialization of

new technologies in the Houston community and the Southwest." And what's really fascinating about this is since its inception, it's assisted in launching 205 new technology companies. What they do is they bring together the entrepreneurs with the companies, the startup companies that develop new technology, along with the researchers, in addition bring in the companies that will apply the technology. By bringing these organizations together, it's provided the infrastructure, at least in the Houston area, to develop new innovations, new companies, and get the technologies to the marketplace. It's really become, I believe, a model for technology commercialization that can be used in other parts of the country.

Chairman LAMPSON. I think the comments of both you and Dr. Harriss made about how challenges of this country—I guess maybe all of you alluded to it—the challenges of this country pull along education and change the activities that we do here. It's that inspiration and follow-up with the inspiration that has to be done—not just offer a challenge, put something in place, and then don't talk about it anymore or not fund it. It's going to take the active effort; and when we do, I think that we have the ability in this nation to rise to the challenge and to make our dreams become realties. It's just providing the wherewithal to make it happen; and it can't help but grow our economy, grow our position of technology leadership in the world.

H.R. 5146, INVEST IN ENERGY SECURITY ACT

Mr. Ming, I think that you know that Congressman Chet Edwards and I have introduced a resolution, a bill in the House, HR 5146. We call it the Invest in Energy Security Act. Our legislation is intended to increase funding this year for important energy research-and-development programs that have already been authorized by Congress but are not fully funded.

One of the things that the bill would do is to increase, by $50 million, funding for the program that RPSEA manages.

If we're successful in getting that bill enacted, how would you expect to apply those funds to research projects?

Mr. MING. Well, first of all, I'd like to applaud you for that proposed legislation, not only for that component but the rest of the integrated component as I described in my remarks because I think it's the integrated approach that really extracts the true value.

What we have done at RPSEA now over the last years is embark on the solicitation of research proposals from the entire research community, and just the initial rounds of those proposals have produced over 90 quality research proposals. Right now, with the available funding of the basic $50 million, we estimate we'll be able to fund about one in three of those proposals. The legislation that you proposed would allow us to fund more of the proposals. It would allow us to get back to a more historical norm in terms of research-and-development funding levels from the Federal Government that produce the results that, for example, are technologies now being deployed that have enabled the Barnett Shale play in the Dallas-Fort Worth area and coal bed methane production which now comprises almost 10 percent of the Nation's production.

So the increase in funding would really just bring us back to the level that we need to be in order to continue the impressive

progress to exploit this transition from the conventional to the unconventional fuels. If you take the 1525 trillion cubic feet of technically recoverable reserve resources estimated by the Potential Gas Committee, that resource base has a value well in excess of $10 trillion. If you take royalties and severance taxes that are derived from the production of that resource base, it amounts to billions of dollars per year that go to states, individuals, and the Federal Government. That money can be used to develop the next generation of energy technologies and energy technologists.

Chairman LAMPSON. Thank you very much.

BENEFIT OF R&D IN PEAK OIL SCENARIO

Dr. Hirsch, I don't understand why a crash program of mitigation won't keep us out of serious economic trouble. So why is that, and why won't more research and development be beneficial?

Dr. HIRSCH. More research and development, of course, will be beneficial; it just won't pay off quickly. That's all. Because you have to deploy technologies in order to make up for the loss of oil, the loss that will increase year after year.

The numbers are relatively small, seemingly small. Two to five percent per year is what people believe the decline in world oil production will be; but when you translate that to times 85 million barrels a day, you come up with enormous numbers. One percent is 800,000 barrels a day. It would take much more than a decade of crash program change in fuel-efficient vehicles in order to begin to make a dent, come close to that 800,000 barrels a day of savings. The reason is that there are something like 240 million vehicles in this country and they have a long lifetime, which we're happy with because they last a long time and we don't have to buy new ones every few years. That same lifetime means that it takes a long time for things to change.

Eight hundred thousand barrels a day—if, for instance, you wanted to produce it by making liquid fuels out of coal, would require over $100 billion of investment and require over a decade of effort in order to bring enough plants on to save that much liquids. It's the scale of things. The scale is absolutely unbelievable, and that's why the word "deployment" is key in this whole thing.

PEAK OIL AND CLIMATE CHANGE

Chairman LAMPSON. Let me ask about reconciling our concerns for manmade global climate change with peak oil mitigation. How do we go about that reconciliation?

Dr. HIRSCH. Well, I think it's going to be very difficult because the focus in the public for quite some time has been on manmade contributions to global climate change.

So people are fixated on that and I think the mule is going to have to get hit by the two-by-four of significant growing recession and people really being hurt. I know they're being hurt now with what's going on, but it's nothing compared to what's almost certain to happen when peak oil hits and shortages begin. That's when people will recognize that they have to change their thinking, they've got to alter their priorities and have to make some compromises. When in life didn't we have to make some compromises?

Compromises are going to be necessary here; and the thing, the squeaky wheel that gets the most attention are people in pain.

Chairman LAMPSON. Thank you.

THE CHANGING ROLE OF GOVERNMENT RESEARCH

Dr. Harriss, energy research and development is extremely expensive, and getting more so every day. I also know that we have cut, for example, the research money in the Department of Energy over the last 25 or so years by more than 85 percent; but federal research and development program budgets are just continuing to get squeezed down, as that one certainly has. We can't expect just the Department of Energy to tackle all the world's energy problems, particularly with the smaller and smaller amount of money that we're giving them. So how do we see the role of government research and development changing in the future and what can we in Congress do to enhance that role, with increasingly limited funds?

Dr. HARRISS. I think there are several lines of hope that we could explore in addressing that. One is certainly to try to create opportunities to stimulate more radical innovation. When funding is tight in the science sector, our wonderful peer-review system, which I have great respect for and have worked on at NASA and NSF, gets more and more conservative. It's just human nature. You've got less money; you give it to things you're most confident will work. So we do need new institutional ways of thinking about, in times where we're limited in funding, how we can continue to really push the frontiers of creativity and innovation. I think the notion of this ARPA–E, modeled after DARPA, which was focused on defense, radical innovation for defense, is a very interesting notion and one that needs to be considered further. I applaud the Congress for taking this forward and putting it on the table. I think it is crucial that it not be buried under DOE bureaucracy and have as much autonomy as possible and have adequate funding to really go out and do some exciting things.

The second line that I'm particularly interested in is that we do a much better job of forming partnerships. We need a continuing sustained dialogue between business, government, independent scientists, and civil society. This dialogue really has to be one in which scientists and engineers learn what users need, and users learn what scientists and engineers have to offer. That has to be a continuing dialogue; and out of that, hopefully, we will be able to narrow down the domain in terms of our focus and be more efficient in the use of our R&D dollars.

Chairman LAMPSON. Where and how does that take place?

Dr. HARRISS. I think that dialogue takes place at particularly the metropolitan regional scale because our metro areas have very different needs in terms of the types of technologies that will best supply them. That's why I was calling for these regional urban sustainability centers.

Those would be basically neutral, non-advocacy organizations that could facilitate, in hopefully a trusted and absolutely superb way, this partnership.

Again, if I can relate back to my youth in Houston, Texas, one of the reasons I came to school here was not only because Rice was

a wonderful institution but because at that time the Shell Development Center was a world-famous center for basic research and applications in geology and geophysics. I could go walk into that organization anytime I wanted to, talk to the scientists about the research. It was sort of an open environment, that simply doesn't exist anymore. I'm not expert at talking about all the institutional and other reasons for that, but we need to stimulate more of that again, to get that dialogue between all that wonderful brainpower that is in our energy industry, all of the exciting new developments at places like Rice and other universities, and people out there who are the consumers, because we should not produce things that we don't first sort of understand whether they're going to meet consumer needs. So I think that's a really important discussion for us to have, but it does have to be an ongoing process.

Chairman LAMPSON. Thank you very much.

Dr. Bartlett, I recognize you for the time that you may consume.

STRATEGIES: WILL CONSERVATION WORK?

Mr. BARTLETT. Thank you very much.

Dr. Chapman, I would like to thank you for your observation that solutions many times come from fundamental research into seemingly unrelated areas. When I came to Congress 15 years ago, Congress was going to really do the right thing with our taxpayers' money. We were going to fund only basic research that was going to have a societal payoff. I said, "Pray tell me how you're going to know which basic research is going to have a societal payoff." I can't imagine that Madame Curie had any notion of the implication of her early discoveries of radiation.

So thank you for recognizing what we really need to do is to put enough money in basic research and in the education of the people to do that basic research, and we will get benefits from that. I can't tell you ahead of time where those benefits will come; but I can assure you that the more money we put into basic research, the more the benefits will be.

I have a lot of farmers in my district and not one of them is dumb enough to eat their seed corn, but that's exactly what we do in the Government. Every year we cut basic research. That's the equivalent of eating your seed corn. (Applause) Nobody said Congress was very bright, did they?

Near the end of your presentation, sir, you made some really great comments: "We need to acknowledge that the odds of finding a single quick solution to the energy challenge are infinitesimally small." If you believe, sir, that there is a silver bullet out there, you probably also believe you're going to solve your personal economic problems by winning the lottery. I think the odds are about the same.

You also say that we need to accelerate the pace toward a goal upon which our very survival depends. I think that Dr. Hirsch would agree with you. Then earlier in your text, you quote from the Department of Energy, the Energy Information Administration. I would caution that if you're quoting from their assessment of the amount of oil that we have used, you can be pretty sanguine that you can have some confidence in that. If you're quoting from their assessment of how much oil will be there in the future, I think you

ought to be very cautious. They're economists and they come to my office and they say that's USGS. The USGS has the strangest way of providing their prognostications of future oil. They do a lot of computer simulations and they take the mean of those computer simulations and they say that's how much oil is going to be there. That's a 50 percent of probability, is what the Energy Information Administration said. So be very careful.

You quoted their comments that just don't square with reality: "The hydrocarbon energy sources will increase over the next two decades." Sir, there isn't even a prayer that that's going to happen. That just isn't going to happen.

Then they say the thing we ought to be doing is increasing the supply of fossil fuels. That's exactly the thing we ought not be doing. We need to be husbanding the small, readily available reserves of fossil fuels we have for really, really critical needs; but going out there now and harvesting those things as quickly as we can is exactly the wrong thing to do.

So thank you for your words of wisdom at the end of the article, and be very careful in noting our Energy Information Administration and what they say. They're very nice people. They've been in my office and they say we just use USGS data. And maybe Dr. Hirsch will tell us more about the USGS data.

Mr. Ming, we need to be very careful in what we say, that we aren't lolling our people. People just love to hear nice, soothing words. My wife tells me I ought not to be talking about these things. She said, "Don't you remember in ancient Greece they killed the messenger that brought bad news," and I have to stand for election every two years. On the average, every year I have a primary and then a general. You know, I tell her, "Gee, this is a good news story because the good news is, if we start today, the ride will be less bumpy than if we start tomorrow."

It's good news in another respect. You know, we spend far too much effort, many of us in our country, you know, seeing dirty movies and smoking marijuana; and we need other things to challenge us. We're the most creative, innovative society in the world; and, properly challenged, we're up to this task of seeing us through this really, really critical time. There's no exhilaration like the exhilaration of meeting and overcoming a big challenge; and, boy, this is a big, big challenge.

We ought to be careful, sir, in saying things like we're going to have all the gas and all we need for the foreseeable future and we're not running out of energy. That's right. We're not running out of oil. There's as much more oil to be pumped as all the oil we have ever pumped. What we are running out of is our ability to produce that oil as fast as we would like to use it. Our world comes unglued if we cannot grow. In the United States, two percent growth is considered too small and the stock market goes into panic.

By the way, a session for another day, we're going to have to change the way we look at these things. Ultimately, sir, for the finite world, there's no such thing as sustainable growth unless that growth is coming from increased efficiency, which we really need to be focusing on. Thank you very much.

Dr. Hirsch, you mentioned scale; and when you mentioned that, I was thinking of our corn ethanol debacle. The National Academy of Sciences says that if we converted all of our corn to ethanol, every bit of it to ethanol, and just discounted it for fossil fueling, but which is big—some people think it's bigger than what you get out of it, but it's big—it would displace 2.4 percent of our gasoline. They wisely mention—now, this isn't Roscoe Bartlett saying this or Bob Hirsch; this is the National Academy of Sciences saying this—if you tuned up your car and put air in the tires, you would save as much gas as using all of our corn for ethanol. They further say if we turned all of our soybeans into soy diesel, it would displace 2.9 percent of our diesel requirement.

What we have done with corn ethanol—and I voted against the last energy bill because it doubled this silly mandate—this ethanol corn mandate doubled the price of corn. So our farmers diverted land from soybeans and wheat to corn. So then the price of soybeans and wheat went up—so did the world demand go up. So now there are people all over the world—three of the basic four food necessities, we drastically increased the price of them and did essentially nothing to displace our need for foreign oil.

One of the officials in the U.N. said what we have done is a crime against humanity, and now we're doubling that thing in this new bill? I wanted to vote for that bill because there's some very good things in there about renewables; but with that, I couldn't vote for it.

Dr. Hirsch, the one thing that we might do is a really aggressive program on conservation, which, by the way, was the No. 1 point in the Chinese five-point program. Matt Simmons says that we might buy a couple of decades and free up some energy to invest in alternatives. Now we have run out of time because we totally ignored the warnings of M. King Hubbert and the reality that we peaked in 1970, and there's no surplus oil. If there's any surplus oil to invest in alternatives, it will take a huge investment in these alternatives, of time—we won't worry about money. We just borrow that from our kids and our grandkids—not with my vote—but borrow from our kids and our grandkids, without their permission. You can't borrow time from them, and you can't borrow energy from them. Do you agree with him that with a really aggressive conservation program that we might buy a couple of decades and free up some energy to invest in alternatives?

Dr. HIRSCH. As you know, one of the things that we've talked about—and it's part of my testimony and part of our reports in the past—is that there is no single answer to any of these things. We've got to do a number of things simultaneously. If we make the mistake of picking one thing and relying on that, we have made a fundamental error. Conservation clearly is something that is important and will be important, no matter how you see the world. Indeed, there are significant opportunities out there to be more efficient and to conserve.

I see the term "energy efficiency" different than conservation. I see conservation as something that is voluntary. As a number of us have talked about, if people understand that, by God, they need to do some things differently, they will voluntarily do those things differently, at least for a while; but then the history also is that after

a while of doing things and things being all right, people tend to lapse back into where they were and do what they've been doing previously.

So conservation is a wonderful idea. I think people will respond, but I think there also needs to be teeth in that. How you do that, how you do that in such a way as to, on the one hand, inspire but, on the other hand, be sure that there are negative consequences for people that don't fall in line and don't do what they could be doing? That's very important and that's going to be up to you folks to figure out. That is not going to be easy.

The scale is enormous. There are opportunities here in light-duty vehicles, particularly in the United States.

We're all well aware of the SUVs, and I don't want to be negative about soccer moms because we had soccer kids when I was a kid also and I was a younger person. People want what they can have; and if they can have it easily, they take it, particularly when they can afford it. Driving around huge pieces of metal in order for a 150- or 200-pound person to get from Point A to Point B just simply does not make sense. To get people to change is going to be very, very difficult. That's where the two-by-four is going to have to come in, because my standing up and saying that this is a waste is not going to influence a lot of people. How we do these things, very important.

We also have got these huge fleets of airplanes that I flew in on and you flew in on. The cars that are out on the street here, an enormous amount of them, they're not going to go away overnight. We can't replace them overnight. We can't afford to replace them overnight. We will make them more efficient over time. We do that, hopefully, on a crash-program basis. It will not happen quickly. That has to happen, though. Airplanes already have incentive to be more fuel-efficient. I don't know how much more capability there is to make them much more fuel-efficient. I think probably what will happen is much less airplane travel. Railroads are a very efficient way of doing things, and doing much more with railroads rather than trucks and airplanes makes sense.

The point here, I'm going on and on because, in fact, you can go on and on and there are many different dimensions to this whole thing. They've got to be looked at in a hard way, they've got to be looked at in a creative way, and they've got to be looked at in a practical way. Part of what we're doing today is looking to the sustainable future and we want to go from where we are now to this beautiful future. I can conceive of a beautiful future, everybody up here can consider a more beautiful future, but we've got to get from here to there and that is an enormous task.

Mr. BARTLETT. It is, indeed. The fifth point of the Chinese five-point program is international cooperation; and what I would hope that we might have is an international cooperation and competition. Rather than competing to see how much of the oil we can use, I'd like to have a challenge to sustainability. Ultimately, we will have sustainability; it is inescapable. We will go from fossil fuels to renewables. In 150 years, the age of oil will be over and we will be making it on renewables. What will that world look like?

Sir, the soccer moms are right and if they know that more of their kids die in SUVs because they turn over and kill—and that

is the statistic—then they'll drive something smaller. Conservation is two people getting into a car; efficiency is getting into a Prius.

Dr. HIRSCH. I drive a Prius, sir.

Mr. BARTLETT. Okay. Well, we're on our second. I bought the first one, as I mentioned, in Congress and the first one in Maryland.

I want to thank you, sir, very much for the contribution that you have made. You and I first started talking about this how many years ago? When I first started talking about this, by the way, we spent, in my office, quite some time trying to decide whether we were going to talk about the great roll over Hubbert's peak or were we going to call it peak oil. Finally decided to call it peak oil. That's how little discussion there was about this at that time. So thank you very much.

Dr. Harriss, you make a statement which I couldn't agree more with. Planet Earth, you started with Houston, and upper Texas coast region, our nation and planet Earth, we're all in the same boat, aren't we? On our way to the Moon, we looked back and we saw, boy, that's just a little spaceship, isn't it? And we're going to have to make do with what's on that spaceship.

When I thought about that, I thought Apollo 13, your statement here that nearing critical tipping points that will result in declining economic prosperity, dramatic environmental degradation, and other serious threats to human well-being. I thought of Apollo 13. They were on a little spaceship, and they only had so much. Don't you think that's a pretty reasonable model for where we are today, to take another look at what we've got and what we have to do if we're going to make it? I think there's a fairly narrow window of opportunity which is closing, if we're going to make it through.

By the way, one of the greatest authorities in this area, Kenneth Deffeyes, says that the least bad outcome of this is a deep worldwide recession that may make the Thirties look like good times. Then he says if you don't like that, try the four horsemen of the Apocalypse—war, famine, pestilence, and death. If you have a chance to invite him to a hearing, he's really a very bright and very entertaining guy. Someone asked him what the odds were that we were going to have a happy outcome in this challenge, and so what he showed them was a little picture his granddaughter had colored. It was a snowball in hell.

I want to thank you, Mr. Chairman, very much. I want to thank the witnesses. I take every opportunity I can. I'll go halfway around the Earth to talk about energy because I agree—which one of you said it—it is the transcending, overarching issue of the 21st century. That it will be.

Thank you. Thank you very much.

You know, we talk about a lot of things now that it won't even matter if we don't have this energy. One of the first casualties of an energy-deficient world are going to be all these social programs that we spend most of our time talking about. This really is a huge, huge problem we face.

Let me just close by saying that your government, sir, has paid for four studies, all of them saying essentially the same thing in different words. Peaking is near or present, with potentially devastating consequences. Why are we totally ignoring that?

We're not. You're here. So thank you very much for not ignoring. Thank you for having this hearing, and I want to thank our witnesses. I yield back.

Chairman LAMPSON. Thank you very, very much. (Applause).

Dr. Bartlett, in my opinion, is one of the most thoughtful and, in my opinion, one of the brightest guys in the House of Representatives. He's a real scientist that's come to serve in this body, and it's an honor to be able to serve with you.

We do have work to do. It seems like that all of these things, it's easier for us to come up with more of the problems than we do the solutions. It's easier to talk about the problems and we've got to find ways to change the commitment and get down to the level of where we can make the changes. That's going to be in our schools and inspiring our kids to grow up knowing different things than what we know and react differently than what we react to.

None of this is going to be very easy to achieve, and we don't seem to be making the right kind of commitment. We don't seem to have had the right kind of leadership for an awfully long time to bring these issues to a head, where we can actually get them adequately addressed. That is why we are here, and I thank all of you for taking the time to come and to share your concern. Hopefully, more than the folks that are here in this room today who are here at this meeting. Hopefully there will be many, many more meetings.

Recently I had something that we called an economic development summit. We got folks from across the community to come and talk to us about what kind of smart growth and what kind of planning we're going to be doing. We seem to concentrate too much on looking at what's going to be happening to us in the next 10 to 20 years rather than looking at what's going to be happening to us generationally. Every decision that we make today is having a greater and greater impact and making it harder for those future generations to be able to make the kinds of decisions that we are making. I think that through our shortsightedness, we are just taking so much away from our children and our grandchildren that we should be ashamed of ourselves. Hopefully, that will begin to change; and obviously, as you heard from our panels today, we don't have much time within which to change it.

I hope that all of you will do everything that you probably can to continue to talk about these issues, continue to push Members of Congress. There's not a lot of pushing you can do on us or the others that you have here this morning, but there are plenty of Members of Congress that need to understand that we have to change what we have been doing.

I want to also mention to you that all of the materials that have been generated today will be on the website, which is www.science.house.gov, for those of you who want access to it. I would encourage you to go there and use that as well to keep in touch with our Science Committee and other Members of Congress through that website.

At this time, I want to thank all of you for appearing before the Subcommittee today. I think it's been a very interesting discussion. There's been suggestions that hopefully will indeed turn into legislation that will help change some of these things. I must say that

under the rules of this committee, the record will be held open for two weeks for Members to submit additional statements and any additional questions that they might have for the witnesses. At this time I will adjourn this hearing, and I thank all of you for participating.

[Whereupon, at 1:17 p.m., the Subcommittee was adjourned.]

Appendix:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by John Hofmeister, President, Shell Oil Company

Questions submitted by Representative Adrian Smith

Q1. What technological advances are needed to develop the domestic oil and gas resources of the United States?

A1. An assortment of technologies will be needed to responsibly and sustainably recover the vast resources of the United States. Which technologies will prove to be best is yet to become clear. The following highlights some of what will be required:

1. Access to all potential hydrocarbon basins in the U.S. onshore and offshore so energy companies can apply and finish development of our new technologies and learn about new settings, reservoirs and hydrocarbon opportunities.
2. All reservoirs are getting small, low pressure, viscous, corrosive or all combinations of the aforementioned. Even giant income cannot pay the technology and development cost to do these economically.
3. The cost of doing business has outstripped the oil price. Only technology breakthroughs can make many projects feasible.
4. Much of the U.S. infrastructure has aged. The cost to sustain this infrastructure is often prohibitive without technology breakthroughs.
5. Despite overall top performance, we do not have a social and government environment encouraging domestic energy and fuel development from oil and gas. New technologies must be developed to allow economically possible environmental performance in these more challenging projects. This must be coupled with support by and confidence in the technology and our ability to sustainably do our job.
6. Tight rock, deep formations, deepwater, low hydrocarbon saturations, small compartmentalized accumulations, new hydrocarbon and rock types are all conspiring to dramatically increase risk and uncertainty in exploration. Only big technology breakthroughs will deliver most of the reservoirs of the future.
7. Complexity in the business is growing rapidly at the same time we are having difficulty getting information from our existing tools. This is made worse because, in many places, we are limited by cost or legislation on the number of wells (information points) we can drill. Ability to gather, analyze and take action on the analysis results must greatly increase in information volume and speed while accommodating the increasingly limited pool of skilled and experienced workers.
8. We must both improve recovery and have new recovery mechanisms and techniques since the remaining U.S. capacity is oil left in old fields or new, more difficult crude in new areas. These have to be sustainable and economical under much more difficult conditions than in the past.
9. Related to the above is the need for technologies that will speed up development, allow phased and reusable/movable production systems, faster and lower cost drilling, and also reduce our carbon footprint.

Q2. What impact will the loss of tax credits have on the U.S. oil and gas industry?

A2. At a time when we need energy companies to continue the record level of investment in developing our energy resources, it is unfortunate that some in Congress are pursuing tax policies that will discourage this needed investment. These policies include proposals such as the repeal of the domestic manufacturing deduction for select U.S. oil and gas companies, which would reduce domestic oil and gas production and negatively affect our nation's energy security. Energy companies invest significant amounts in new technologies, new production, refining and product distribution infrastructure and environmental improvements, and make such investments considering long-term commitments. Continued and sustained capital expenditures are required each year to find and develop energy resources, despite the cyclical nature of the business and risks involved. Given the industry's long-term capital allocation models in a global and free marketplace, it is important to have stable and consistent tax policy in order to meet all of the challenges ahead.

Q3. In what way could federal policies level the playing field for all energy solutions, thereby promoting research and development in a broad range of energy solutions which will survive in the marketplace?

A3. Federal policies should not pick winners and losers among possible technology solutions. Fair and equal opportunities promoting research and development for a broad array of innovative solutions to our energy needs should include a wide range of applications, since we cannot currently predict which ones will survive in the marketplace. Government policies can and do play a role. Policies currently limit access to domestic resources, which is not reasonable. Research and development can be incentivized through federal funding, tax policy and other innovative programs.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Thomas R. Standish, Group President of Regulated Operations, CenterPoint Energy

Questions submitted by Representative Adrian Smith

Q1. What technological advances are needed to develop the domestic oil and gas resources of the United States?

A1. In the power sector it's becoming obvious that gas-fueled generation will be the short-term bridge in transitioning from fossil-fired generation to renewable technology such as wind and solar as well as nuclear and cleaner coal technology. Hence, with respect to gas resources, existing exploration efforts need to continue to evolve through the development of more efficient tools while alternative or unconventional discovery efforts need to also be encouraged. These alternative efforts would include the enhanced exploration of "tight sand" gas, shale, coal bed methane, and methane hydrates.

Q2. What impact will the loss of tax credits have on the U.S. oil and gas industry?

A2. Tax credits were granted to help encourage research and development of new technologies and offset the cost of exploration in areas that otherwise would not be economical to explore when energy prices were low (e.g., shale, tight sands, and coal seam formations). In today's market of high oil and gas costs, one might expect that energy companies would be able to cover the cost of exploration and production in those formerly uneconomic areas. For example, once natural gas prices rose above $5 per MMBtu the U.S. experienced a proliferation of drilling in the various shale formations throughout the mid-continent area. Without tax credits, one could expect the energy companies might reduce exploration in areas where their cost are highest.

Q3. In what way could federal policies level the playing field for all energy solutions, thereby promoting research and development in a broad range of energy solutions which will survive the marketplace?

A3. With respect to the power industry federal policies should promote research and development of historically uneconomical and underutilized energy sources such as renewable energy sources (e.g., solar, wind, biofuels made or recovered from waste, etc.) and also encourage the development of demand response to time of use and real-time prices. This might call for research grants or new tax credits to companies that would develop renewable energy technologies and demand-side sources so that they can quickly be brought to market while also maintaining current tax credits for existing gas and oil exploration.

Policies and incentives for cleaner coal, nuclear generation as well as the development of technologies that would create more efficient use of oil and gas should also be sought.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Walter G. Chapman, W.W. Akers Professor; Director, Energy and Environment Systems Institute, Rice University

Questions submitted by Representative Adrian Smith

Q1. What technological advances are needed to develop the domestic oil and gas resources of the United States?

A1. Many technological advances are needed to maximize recovery of domestic oil and gas. One example where advances are needed is in more efficient oil recovery. Conventional oil recovery technologies produce only about one third of the oil originally in place—leaving behind approximately two thirds of the oil in a reservoir. Advances in enhanced oil recovery can potentially recover two thirds or more of the oil originally in place. Although enhanced oil recovery shows great promise, DOE funding of university research for enhanced oil recovery essentially ended in the 1990's. The lack of funding results in a lack of new knowledge, but it also results in a lack of new scientists and engineers available to more the technology forward.

In the area of natural gas, the organization, Research Partnership to Secure Energy for America (*www.RPSEA.org <http://www.rpsea.org/>*) has received funding through the Department of Energy based on the Energy Act of 2005 to determine the technology gaps and to fund research and development in this area. Still, RPSEA is limited by law and funding in its scope.

But technological advances alone are only part of the answer. The oil and gas industry, as well as other high technology industries, need a steady supply of educated workers. To maintain economic leadership in all high technology industries, the United States must commit itself to encouraging students to study science and engineering and invest in improved science and engineering education programs. One of the most beneficial ways to invest is to increase funding for basic and applied research. The United States needs the equivalent of Apollo level funding in research to regain our technological leadership in the world.

Q2. What impact will the loss of tax credits have on the U.S. oil and gas industry?

A2. Since this question is outside of my area of expertise, I cannot answer.

Q3. In what way could federal policies level the playing field for all energy solutions, thereby promoting research and development in a broad range of energy solutions which will survive in the marketplace?

A3. In my testimony, I stated that a portfolio of energy solutions will be needed. The next breakthrough in energy cannot be "legislated." Research funding must be increased across the range of energy technologies as well as by significantly increasing funding for basic research. I suggest at least doubling the U.S. investment in fundamental research and increasing investment in science and engineering education. I support the guidelines listed in the National Academies report *"Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future."*

ANSWERS TO POST-HEARING QUESTIONS

Responses by Robert L. Hirsch, Senior Energy Advisor, Management Information Services, Inc.

Questions submitted by Representative Adrian Smith

Q1. What technological advances are needed to develop the domestic oil and gas resources of the United States?

A1. None would make a large difference. The issues are almost all human—primarily restricted access to potentially attractive areas for exploration and production.

Q2. What impact will the loss of tax credits have on the U.S. oil and gas industry?

A2. I'm not qualified to provide a meaningful answer.

Q3. In what way could federal policies level the playing field for all energy solutions, thereby promoting research and development in a broad range of energy solutions which will survive in the marketplace?

A3. The Federal Government needs to stop picking winners and losers and let the marketplace do it. The corn-ethanol mandates are a disaster because of marginal energy benefits and serious negative environmental impacts. Mandates for renewables such as wind and photovoltaics are unfortunate because those technologies cannot provide large-scale electric power because of their inherent intermittence. The public demands electric power-on-demand, not when the wind blows or the sun shines. Helping new technologies with temporary tax subsidies or benefits can be both legitimate and beneficial, but "temporary" too often becomes permanent, which distorts the marketplace and hinders attempts to build more practical, more reliable power systems.

All energy sources have strengths and weaknesses, and too often people are mesmerized by "the new thing" that promises to be better than what is currently satisfying our power needs. Too often "the new thing" turns out to have "warts" that can be worse than what currently serves us. Since it is not politically correct to criticize renewables, politicians are not being told the inherent practical limits of these "wonder technologies" and are thus not getting the kind of straight talk that is needed to implement optimal energy policies.

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