ENERGY DEMAND IN THE 21ST CENTURY: ARE CONGRESS AND THE EXECUTIVE BRANCH MEETING THE CHALLENGE?

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND RESOURCES

OF THE

COMMITTEE ON
GOVERNMENT REFORM

HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

MARCH 16, 2005

Serial No. 109–12

Printed for the use of the Committee on Government Reform

Available via the World Wide Web: http://www.gpo.gov/congress/house
http://www.house.gov/reform

U.S. GOVERNMENT PRINTING OFFICE

20–471 PDF WASHINGTON : 2005

For sale by the Superintendent of Documents, U.S. Government Printing Office
Internet: bookstore.gpo.gov Phone: toll free (866) 512–1800; DC area (202) 512–1800
Fax: (202) 512–2250 Mail: Stop SSOP, Washington, DC 20402–0001

CONTENTS

ENERGY DEMAND IN THE 21ST CENTURY: ARE CONGRESS AND THE EXECUTIVE BRANCH MEETING THE CHALLENGE?

WEDNESDAY, MARCH 16, 2005

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY RESOURCES,
COMMITTEE ON GOVERNMENT REFORM,
Washington, DC.

The subcommittee met, pursuant to notice, at 2 p.m., in room 2203, Rayburn House Office Building, Hon. Darrell Issa (chairman of the subcommittee) presiding.

Present: Representatives Issa, Westmoreland, Watson, Higgins.

Staff present: Larry Brady, staff director; Sarah D'Orsie, full committee deputy clerk; Dave Solan, Ph.D. and Steve Solan, professional staff members; Krista Boyd and Alexandra Teitz, minority counsels; Richard Butcher, minority professional staff member; and Jean Gosa, minority assistant clerk.

Mr. ISSA. Well, my script, of course, says "a quorum being present." We will waive a quorum being present. I will make an opening statement, and presumably Ranking Member Watson will be here by the time I get through.

I would like to apologize for being late. We are marking up for the eighth time the same bankruptcy bill, and some people had said it four times, five times, six times. But if you have not said it eight times, there is no point in waiving.

Energy drives and ensures our Nation's security. It determines our quality of life. The current volatility in fuel prices and supplies has raised real questions as to whether the current energy policy framework has failed the U.S. consumers.

U.S. oil demand is soaring, as is Chinese oil demand. Local domestic supplies are dwindling, forcing the United States to rely 60 percent on imported oil.

U.S. energy demand continues to increase. The U.S. Department of Energy has projected the total energy consumption from 2003 to 2025 will increase by 36 percent. Petroleum demand will increase by 39 percent, and national gas demand will increase by 40 percent. Overall, energy consumption will increase by more than 45 percent.

Growing U.S. energy demand must be viewed in the context of international demand for energy. The United States is now competing for a world commodity that will see dramatically increased rates of demand; demand from China and India will continue to exert pressure in the world's energy markets.

World demand for crude oil typically grows annually at about 1 million barrels a day. In 2004, it grew 2.7 million barrels a day. This begins to approach the total world production capacity. Electricity demand in the developing world is also increasing rapidly. In 2003, Chinese electricity consumption increased by 15.3 percent.

How the United States meets its growing demand and ensures its domestic supply of energy will require a full range of energy resources from proven sources like oil, coal, natural gas and nuclear to more renewables and development of new technologies like the recent hydrogen incentives.

This hearing today is intended to focus on the key issues confronting the United States. The subcommittee will attempt to determine whether Congress is asking the right questions, and whether the Federal Government's agencies are taking the right actions to meet this growing demand, and to ensure our domestic supplies.

How does the domestic supply situation and the increasing international demand for energy effect the United States? How can the United States continue to meet its domestic demand for energy, while ensuring the future reliability, affordability, and sustainability of the energy supply?

What factors contribute to the current volatility in the fuel prices? Are Federal Government agencies taking the right actions to meet the U.S. requirement in the 21st century? What issues or policies should Congress be looking at, as a way of meeting the energy challenge in the future?

We look forward to hearing from our three witnesses today, as this is the first hearing on these important issues. I am still not seeing the ranking member. I would be pleased to introduce Mr. Jim Wells, Director of Natural Resources and Environment at the U.S. Government Accountability Office. I have said "GAO" for so many years that saying it the long way is always difficult.

He has over 35 years of Government-related experience in energy, natural resources, and environmental issues. Thank you for being here today, Mr. Wells.

Also with us is Mr. Guy Caruso, Administrator of the Energy Information Administration at the U.S. Department of Energy. Mr. Caruso has over 30 years of energy experience, with particular emphasis on issues related to energy markets, policy, and security. Thank you for being here today, Mr. Caruso.

Dr. Paul Portney is president of Resources for the Future, an independent research and education organization, and I assume this is a think tank, specializing in natural resources and the environment. Thank you for being here, Dr. Portney.

We are now in that unique position that I am delighted to see you, but we have to be patient.

Counsel advises that we can go forward. If each of you would raise your right hand for the oath. Also, anyone else who expects to advise or potentially speak, would you also rise to take the oath.

[Witnesses sworn.]

Mr. ISSA. The witnesses have all affirmed to the oath. As a result, Mr. Wells, you are first up, and I look forward to hearing your testimony.

STATEMENT OF JIM WELLS, DIRECTOR, NATURAL RESOURCES AND ENVIRONMENT, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. WELLS. Thank you, Mr. Chairman, and "GAO" works. I will know when to respond.

We are pleased to be here today. It is an understatement to say that energy is important. To say it is critical, and we cannot live without it is perhaps more accurate. It is almost a daunting challenge, Mr. Chairman, to sit and talk energy to someone who lives in California, because you know what it means to you, living in the State of California, with some of the problems you have experienced.

Before I summarize our GAO work, I want to set the stage. The United States has built a strong energy delivery system, and our consumers have a standard of living, second to none. We drive the car or the truck that we want. Maybe we do complain about high gasoline prices. The lights almost always come on when we flip the switch.

We have a vast pipeline and transmission infrastructure. Energy markets are working, and energy is considered by many standards to be reasonably cheap. Having said that, we did lose power for 50 million people in the 2003 blackout. The power was returned in 3 days to most people. The gasoline price volatility of today is certainly raising questions, and our financial markets are speculating on where and how much the next barrel of oil will cost.

These events clearly are pointing to an energy system that is showing signs of strain and instability. While we have a robust energy system today, the topic of your hearing, Mr. Chairman, can we maintain it and can we meet the needs of the 21st century, is timely. I want to start my testimony and I want to finish with timely. GAO is accepting the challenge to explain U.S. energy in 120 minutes. I know it is a challenge.

Mr. ISSA. Mr. Wells.

Mr. WELLS. Yes.

Mr. ISSA. Not only is it a challenge, since we have to vote in 15 minutes, you really do have 10 minutes. [Laughter.]

Mr. WELLS. OK; we are a Nation that accounts for 5 percent of the world's population, yet we consume 25 percent of the energy used worldwide. In 2003, each man, woman, and child consumed in energy the equivalent of 790 billion gallons of gasoline, or roughly 2,800 gallons per person. As EIA will testify to today, this demand is looking like it is going to increase another 25 or 30 percent, or even higher. I will let Guy talk to that.

To meet this consumption, we have old 20th century policy solutions in place. We have increased our production by increasing drilling for oil and gas. We have increased output from our nuclear power plants, and we have achieved small increases in traditional renewable energy sources, such as wind power.

We have tried to use more fuel efficient cars and the fuels that we put in them. However, supplying this energy is a joint effort of mostly private companies, with some direct involvement by creating the VPA and TVA in delivering electricity. Our energy suppliers today are mostly multi-national corporations with worldwide shareholders.

Most of the fuel is sold at prices that are determined by competitive markets excluding, of course, the Enron deals that we learned about. The Federal Government has intervened by providing billions of dollars in tax credits, tax incentives, direct subsidies, and regulatory advice, supposedly to guide and steer the marketplace for social good.

Despite these facts, Mr. Chairman, imports of fuel are rising at alarming rates. Over the last 20 years, our net imports of energy has more than doubled, reaching 32 percent of our total consumption.

Furthermore, gasoline, as you know, is rising above $2 a gallon. Refinery capacity is clearly not keeping pace with the demand. Electricity transmission constraints, which you are well aware in California, have periodically limited the flow of electricity in parts of the country. The international turmoil in the Middle East, Russia, and Venezuela, affects our energy security.

Looking into the future, there are daunting challenges that lie ahead. As you hear today from EIA, the U.S. energy demand could increase significantly over the next 20 years. While we must focus our own domestic needs as a developed country today, we cannot lose sight of the fact that energy is being demanded globally across the world, especially in the developing countries, as you mentioned, like China and India.

Clearly, we must all buy energy from this global market place. We must all, in a sense, go to the same spigot. If world supplies do not keep pace with the world demand, energy prices will continue to rise sharply.

So where does that leave us for today's hearing? It is clear that the reliable mainstay of the 20th century: cheap oil, gasoline, plentiful natural gas, and large amounts of electricity from coal, seems less guaranteed in the 21st century.

Mr. ISSA. Mr. Wells, I have been advised that they want me to run to the vote. I apologize for the nature of this. We will allow you to continue. We will stop the clock. I will be back in about 15 to 25 minutes, depending on how fast they roll the next votes.

I appreciate your indulgence. You guys are pros. You have been through our tendency to be anything but considerate to our guests. So I appreciate that, and I will be back absolutely at a dead run, as soon as the last vote is over.

Mr. WELLS. Thank you.

[Recess.]

Mr. ISSA. As promised, we are back within 15 minutes, and the ranking member is on her way.

Mr. WELLS. Thank you, Mr. Chairman, and I will make this even shorter. We offer, in our testimony to you today, three broad cutting observations to help frame the congressional efforts to develop policies with the Federal Government. That was your charter to us.

First, we would encourage you regarding demand, the amount of energy that needs to be supplied is not fate, but choice. Consumers can play an important role, a bigger role than what they currently play today, in using energy wisely, if they are given the choice, and we help educate them on how to reduce future demand.

The second thought that we would like to suggest is that all fuel sources share some form of problems, whether it be environmental

or economic constraints. This fuel is too dirty, or that technology costs too much to be competitive.

The future choices will require compromises and tradeoffs. Consequently, we will need to use all the sources that we have available to us, if we want to make ends meet, with some offsetting benefits and costs. The demand projections numbers are just so large, it is going to be very difficult to meet that demand, unless all sources are being considered.

The third cost-cutting issue that we would suggest be looked at, with whatever Federal policies are chosen and with the political will and the balance that needs to be achieved, is having the Federal Government take some leadership role, perhaps stronger than it has today and in the past, and providing clear and consistent signals to the energy markets, and energy markets will be extremely important.

Then the consumers and the suppliers and the investment community will know how to buy the new products that we are going to need, and how to invest in that future infrastructure. If we need power plants, how do they come up with the $400 million to put in a new power plant? They will need some leadership from the Federal Government to provide consistency to make that happen.

We will also need new technology. Clearly, there is no one magic source out there that is going to get us there. But clearly, as we look at research, looking at new technology, it will certainly help us get over that hump.

In conclusion, I think I want to go back to what I said earlier in my statement, that the old 20th century energy solutions may not be able to carry us into the 21st century. What we have today may not be good enough for tomorrow.

Energy is much more global and competitive than it was in the old days. I said in the beginning of the hearing that your hearings, Mr. Chairman, are very timely. The good thing is that we are thinking about what to do now. We are not in a crisis.

It has been proven, over and over again, that we can make better decisions when we are not in a crisis like we were back in the early 1970's. To meet the 21st century challenge, the demand will be that we need all energy sources that we have available to us. It is clear what the American consumers have asked us to provide. They want secure, affordable, reliable, and environmentally sound energy.

My written statement that we submitted for the record, as requested, offers a series of questions that would be available to you that may assist this committee as it seeks answers in future hearings when you talk to the industry and when you talk to the Federal Government agencies and the players. I would be happy to answer any questions that you have; thank you.

[The prepared statement of Mr. Wells follows.]

United States Government Accountability Office

GAO

Testimony

Before the Subcommittee on Energy and Resources, Committee on Government Reform, House of Representatives

For Release on Delivery
Expected at 2:00 p.m. EST
Wednesday, March 16, 2005

MEETING ENERGY DEMAND IN THE 21ST CENTURY

Many Challenges and Key Questions

Statement of Jim Wells, Director
Natural Resources and Environment

GAO-05-414T

March 16, 2005

GAO
Accountability · Integrity · Reliability
Highlights

Highlights of GAO-05-414T, a testimony to Darrell Issa, Chairman, Energy and Resources Subcommittee, Committee on Government Reform, House of Representatives

MEETING ENERGY DEMAND IN THE 21ST CENTURY

Many Challenges and Key Questions

Why GAO Did This Study

Plentiful, relatively inexpensive energy has been the backbone of much of modern America's economic prosperity and the activities that essentially define our way of life. The energy systems that have made this possible, however, are showing increasing signs of strain and instability, and the consequences of our energy choices on the natural environment are becoming more apparent. The reliable energy mainstay of the 20th century seems less guaranteed in the 21st century.

As a nation, we have witnessed profound growth in the use of energy over the past 50 years—nearly tripling our energy use in that time. Although the United States accounts for only 5 percent of the world's population, we now consume about 25 percent of the energy used each year worldwide. Looking into the future, the Energy Information Administration (EIA) estimates that U.S. energy demand could increase by about another 30 percent over the next 20 years.

To aid the subcommittee as it evaluates U.S. energy policies, GAO agreed to provide its views on energy supplies and energy demand as well as observations that have emerged from its energy work.

This testimony is based on GAO's published work in this area, conducted in accordance with generally accepted government auditing standards, and on EIA's Annual Energy Review, 2003 and its Annual Energy Outlook, 2005.

What GAO Found

America's demand for energy has, in recent decades, outpaced its ability to supply energy. As a result, the country has witnessed rapid price increases and volatility in some markets, such as gasoline, and reliability problems in others, such as electricity, where the blackout in 2003 left millions in the dark. Given these recent and sometimes persistent problems, as well as concerns about the impacts of energy consumption on air, water, and other natural resources, there is a growing sense that action is needed.

Today, fossil fuels (coal, oil, and natural gas) provide about 86 percent of our total energy consumption, with the rest coming from nonfossil sources such as nuclear (8 percent) and renewables, such as hydroelectric energy and wind power (6 percent). Overall, the majority of the nation's energy consumption is met by domestic production. However, imports of some fuels have risen. For example, over the past 20 years, imports—primarily oil and natural gas—have doubled, and in 2003 these imports comprised about one-third of total domestic energy consumption. Imports are expected to increase still further in order to meet future domestic consumption. In light of the current and expected levels of imports, the United States is, and will increasingly be, subject to global market conditions, with the transportation sector especially affected. Global markets may face future difficulties in meeting the growing energy demands of developed nations while also meeting the demands of the developing world, particularly considering the explosive growth in some economies, such as China's and India's. If world supplies for some fuels do not keep pace with world demand, energy prices could rise sharply.

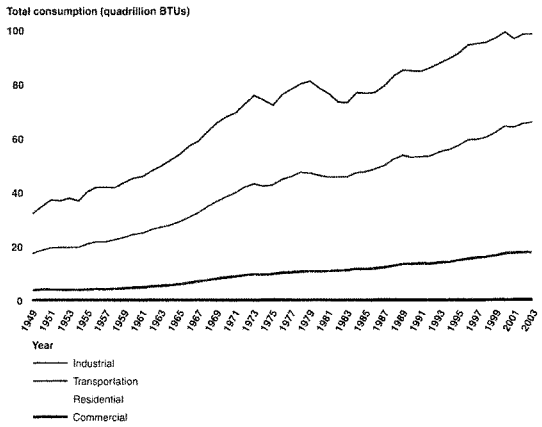
GAO believes that a fundamental reexamination of the nation's energy base and related policies is needed and that federal leadership will be important in this effort. To help frame such a reexamination, we offer three broad crosscutting observations. First, regarding demand, the amount of energy that needs to be supplied is not fate, but our choice. Consumers, whether businesses or individuals, choose to use energy because they want the services that energy provides, such as automated manufacturing and advanced computer technologies. Accordingly, consumers can play an important role in using energy wisely, if encouraged to adjust their usage in response to changes in prices or other factors. Second, all of the major fuel sources—traditional and renewable—face environmental, economic, or other constraints or trade-offs in meeting projected demand. Consequently, all energy sources will be important in meeting expected consumer demand in the next 20 years and beyond. Third, whatever federal policies are chosen, providing clear and consistent signals to energy markets, including consumers, suppliers, and the investment community, will help them succeed. Such signals help consumers to make reasoned choices about energy purchases and give energy suppliers and the investment community confidence that policies will be sustained, reducing investment risk.

Mr. Chairman and Members of the Subcommittee:

I am pleased to participate in the Subcommittee's hearing on the future direction of our nation's energy policies. Plentiful, reliable, inexpensive energy—in its various forms, including gasoline, natural gas, and electricity—has been the backbone of much of modern American economic prosperity and the activities that essentially define the American lifestyle. The United States accounts for only 5 percent of the world's population but consumes about 25 percent of the energy used each year worldwide. U.S. energy demand has increased over 25 percent since 1980, and in 2003 amounted to the equivalent of about 790 billion gallons of gasoline, or roughly 2,800 gallons for every man, woman, and child in the country.

As shown in figure 1, energy consumption in the United States has grown. While energy demand across residential, commercial, and the industrial sectors includes demand for all types of energy sources, such as oil, coal, and natural gas, demand in the transportation sector is almost completely oil dependent.

Figure 1: Energy Consumption by Sector, 1949-2003



Source: GAO analysis of data from the Energy Information Administration.

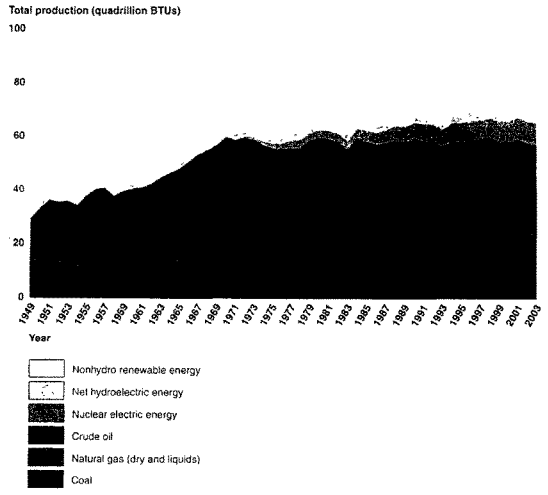
Note: BTU stands for British thermal units and is a standard unit used to measure energy consumption. In 2001, the average household in the United States consumes about 92 million BTUs per year.

Increasing demand across our economy has, at times, strained our energy system. For example, in recent years, natural gas prices have nearly tripled and crude oil prices have more than doubled, and gasoline prices now exceed $2.00 per gallon in Washington, D.C., San Francisco, and other major cities. In addition, our energy supplies have also witnessed problems, most notably in 2003 when the largest blackout in U.S. history left as many as 50 million people in the dark. Further, there have been indications that our energy infrastructure has not kept up with changes in our demand for energy as illustrated by (1) the nation's refinery capacity not keeping pace with the increasing demand for gasoline, leading to increased imports of gasoline, and (2) the electricity sector's transmission constraints periodically limiting the flow of electricity in parts of the country. Lastly, our energy dependence on other countries has increased,

raising greater concern about international turmoil in the Middle East, Russia, Venezuela, and elsewhere.

As shown in figure 2, the United States has increased production (generally through the extraction and use of oil, coal, and other fuels from the land) of a wide range of fuels over the past 50 years to help meet consumer demand. Today, fossil fuels account for about 80 percent of our total domestic energy production, with the rest coming from nonfossil sources such as nuclear electric energy, hydroelectric energy, and nonhydroelectric renewable energy sources, such as wind power. Despite the fact that the United States produces most of its energy, imports of some fuels are rising to meet growing U.S. consumption.

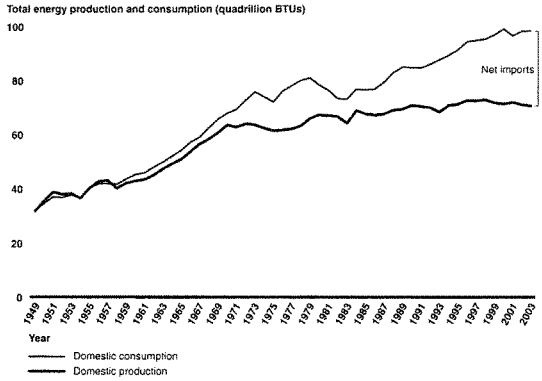
Figure 2: U.S. Energy Production, 1949-2003



Source: GAO analysis of data from the Energy Information Administration.

As shown in figure 3, over the past 50 years net imports of energy have increased. This increase has been most dramatic over the past 20 years, during which time energy net imports more than doubled, reaching 32 percent of our total consumption in 2003. The vast bulk of these imports are oil and natural gas.

Figure 3: Domestic Production and Net Imports Needed to Meet Consumption, 1949-2003



Source: GAO analysis of data from the Energy Information Administration.

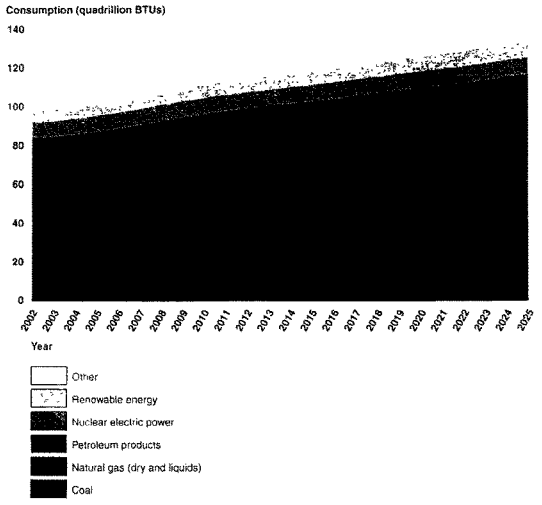
Nearly all energy is supplied by private companies that also own the energy supply infrastructure. Some of these companies are multinational corporations with worldwide shareholders, while others operate only locally. Further, most of the fuels used in the energy sector—including oil, coal, natural gas, and nuclear fuel—are sold at prices determined by competitive markets and, in some cases (such as crude oil), international markets.

Over the years, the federal government has intervened in energy markets, providing tax credits and other benefits to suppliers and consumers of traditional and renewable energy. For example, the federal government has granted tax incentives, direct subsidies, and other support to the petroleum industry, as well as tax and other benefits to the ethanol

industry, in an effort to increase U.S. energy supplies. Similarly, the federal government has also provided tax credits for the production of energy using renewable energy resources, such as wind turbines. While these tax incentives generally work to increase the production of energy, they also generally decrease revenues accruing to the U.S. Treasury.

Looking into the future, daunting challenges lie ahead. As shown in figure 4, the Energy Information Administration (EIA), within the Department of Energy (DOE), estimates that U.S. energy demand could increase by about another 30 percent over the next 20 years, if current trends hold. Meeting these projected increases could be more challenging in the natural gas and petroleum industries, because consumption of these fuels is forecast to increase by 37 percent and 33 percent, respectively, during that period. In addition, forecast imports for these two fuels are expected to rise by over 140 percent and 60 percent, respectively.

Figure 4: Forecast Energy Consumption, 2002-2025



Source: GAO analysis of data from the Energy Information Administration.

Unless changes are made, meeting the forecast increase in energy demand could further stress an already strained system. From a domestic perspective, the nation already faces energy supply constraints and higher prices for some important fuels, as well as environmental problems such as persistent air pollution in some cities. In addition, from an international perspective, the United States is increasingly subject to global markets for key energy sources, such as crude oil and, increasingly, for natural gas. Global markets may face difficulties in continuing to meet the growing energy demands of developed nations such as the United States, while also meeting the demands of the developing world, particularly in light of the explosive growth in some economies, such as China's and India's. If world supplies do not keep pace with world demand, energy prices could rise sharply.

Just last month, as part of our 21st Century Challenges report,[1] we identified two broad questions focused on reexamining the nation's energy base and related policies:

- To what extent are federal energy policies and incentive structures adequately preparing the nation to satisfy its energy needs over the long term?
- What is the appropriate balance between efforts to promote enhanced production of fossil fuels, alternative renewable energy sources, and the promotion of energy conservation?

Given the importance of energy to our nation's economy and current lifestyle choices, it is generally recognized that a secure, affordable, reliable, and environmentally sound energy supply is needed. However, the reliable energy mainstay of the 20th century seems less guaranteed in the 21st century. In the context of developing our nation's energy policies, we are providing our views on energy supply and demand based on our published work in this area, conducted in accordance with generally accepted government auditing standards. In addition, we are providing information on forthcoming work, as GAO continues to report on a range of energy activities and policies of the federal government.
In summary, based on past work and considering recent EIA forecasts, three broad crosscutting observations emerge that could help frame congressional efforts to develop the nation's energy policies:

- First, regarding demand, the amount of energy that needs to be supplied is not fate, but our choice. Consumers, whether businesses or individuals, choose to use energy because they want the services that energy provides, such as automated manufacturing, advanced computer technologies, and many high-technology household amenities. However, consumers can play an important role in using energy wisely by, among other things, choosing technologies that deliver the same services but that use less energy or reducing their energy usage when it is valuable to them to do so. For example, in electricity markets some utilities and system operators have created a variety of electricity pricing and other programs that encourage customers to adjust their usage in response to changes in prices or other factors. These "demand response" programs offer substantial benefits to participants and improve the functioning of these markets because they

[1]GAO, *21st Century Challenges: Reexamining the Base of the Federal Government*, GAO-05-325SP (Washington, D.C.: February 2005).

provide more accurate price signals to consumers and encourage more careful energy use while providing better incentives for conservation and/or energy efficiency.

- Second, all of the major fuel sources—traditional and renewable—face environmental, economic, or other constraints or trade-offs in meeting projected increases in demand. Consequently, all energy sources will be important in meeting expected consumer demand in the next 20 years and beyond. Meeting future demand will be particularly challenging for the transportation sector, where the United States is almost completely dependent on oil—more than half of which is imported. With just 5 percent of world population, the United States consumes roughly 45 percent of world gasoline. Further, the same international markets that supply U.S. needs will also need to supply countries in the developing world, such as China and India, which are experiencing increases in demand that far exceed even our own increasing thirst for oil.

- Third, whatever federal policies are chosen, providing clear and consistent signals to energy markets, including consumers, suppliers, and the investment community, will help them succeed. Energy consumers need clear and consistent signals so that they can make reasoned choices with regard to purchases of energy-consuming equipment that help to determine their long-term energy demand. Energy suppliers require clear signals regarding national policies and confidence that those policies will be sustained over time in order to undertake the substantial investment needed to support expected increases in consumption. The investment community also needs these clearly articulated policies to determine how much to invest in current and future infrastructure, new products, and new technologies.

Specifically, our testimony presents an overall energy picture, discussing each of the major energy sources used in the United States, along with consumer demand. We end each fuel discussion with examples of key questions facing the Congress, the executive branch, states, industry, and consumers.

Oil: Our Largest Energy Source, but Mostly Imported

Oil is the largest single energy source used in the United States and remains perhaps the most visible energy source to most consumers. Oil, and the gasoline refined from it, provided the critical energy for the automobile that mobilized America. Oil remains at the center of the transportation sector and at the center of our national energy policy debate.

In 2003, oil accounted for about 40 percent of the total U.S. energy consumption and the United States consumed about 7.3 billion barrels of crude oil—about 20 million barrels per day. Most oil is used in the transportation sector as gasoline, diesel, and jet fuel, with oil-based products accounting for over 98 percent of the U.S. transportation sector's fuel consumption. In addition, oil is also used as a raw material in the manufacturing and industrial sectors; for heating in the residential and commercial sectors; and, in small amounts, for generating electric power. Although the United States accounts for about 5 percent of the world population, we consume about 25 percent of total world oil demand. Although today the United States and its industrialized counterparts currently account for the bulk of the world oil demand, demand is growing rapidly in the developing nations, especially those in Asia, such as China and India.

The United States relies on imported oil for more than half of its supply and appears likely to increase its reliance in the future. Historically, the United States produced most of the oil it consumed. However, U.S. oil production began to decline in 1970 and has dropped by about 40 percent since then. Since 1970, imports of crude oil and other products have increased 255 percent, and imports now comprise nearly 56 percent of the U.S. oil supply. Part of the reason for the rising imports is cost; it has been less costly to purchase oil produced in other countries than it has been to produce it in the United States.

Rising U.S. imports have increasingly been supplied by countries belonging to the Organization of Petroleum Exporting Countries (OPEC), which collectively provided about 42 percent of our total imports during 2003. Since about 20 percent of our imports came from the Persian Gulf region and 14 percent came from Saudi Arabia, our reliance on these imports has made the United States subject to the political instability of the Middle East witnessed in recent years. We also import a large amount of oil from our neighbors in North America; about 30 percent of our imported oil came from Canada and Mexico. Going forward, the United States will increasingly rely on imported oil because although the United States is currently the world's third largest oil producer, U.S. proven oil reserves account for only about 2 percent of total world reserves. In contrast, OPEC holds about 68 percent of total world oil reserves.

The prices of crude oil and refined petroleum products, such as gasoline and home heating oil, have been volatile over the years. Since the 1970s, the crude oil market has, at times, been heavily influenced by the OPEC cartel. Because the member countries control a large share of world

production and total reserves, these countries have been able to influence crude oil prices by limiting supply through the use of country-by-country production quotas. These quotas have, at times, served to maintain a tight balance between world supply and world demand. However, because of the relative political instability in the Middle East and some of the other OPEC countries (such as Nigeria and Venezuela), occasional oil supply disruptions and price shocks have been a fact of life for about the past 30 years and may remain an issue for the foreseeable future. Although crude oil prices play a large role in determining the prices for gasoline and other refined petroleum products, other factors also influence the volatility of gasoline prices, including limited refinery capacity, low inventory levels relative to demand, supply disruptions, and regulatory factors—such as various gasoline formulations that are used to meet federal and state environmental laws. Federal and state taxes on gasoline and other products serve to raise the level of prices, but these taxes do not fluctuate often and so do not contribute to price volatility.

Demand has pressed the limits of the production and delivery infrastructure in the oil industry in recent years. While U.S. crude oil production has fallen, rapidly rising imports have required more ocean tankers of crude oil to be off-loaded each year—forcing expansions of ocean crude oil terminals and coastal refineries. Because some refineries have closed, and no new ones have been built since 1976, there are fewer refineries available to convert crude oil into gasoline and other products. Although increases in overall output have been achieved through expanding capacity at the remaining refineries and operating those refineries at very high production levels, the nation's domestic refining capacity has lagged overall demand growth for petroleum products. Further, the network of pipelines that delivers refined petroleum products also operates at high levels of capacity, sometimes limiting the amount of fuel that can be shipped. Finally, the capacity of gasoline terminals that distribute fuel to local gas stations is also limited in some parts of the country.

Over the past 30 years, the federal government has undertaken many efforts designed to influence petroleum markets and demand for petroleum based fuels. For example, in the mid-1970s, the federal government developed the Strategic Petroleum Reserve, part of an international reserve effort designed to mitigate the economic impacts on world economies of any large, sustained disruption to the oil supply. In addition, the federal government has supported a number of research and development and regulatory efforts designed to reduce demand for petroleum fuels in transportation. For example, the federal government

supported the Partnership for a New Generation of Vehicles in order to aid U.S. automobile manufacturers in developing gas-electric hybrid vehicles. In addition, the federal government has encouraged the development and deployment of technologies focused on identifying alternatives to petroleum-based fuels, such as the recent FreedomCAR initiative—a program to help develop fuel-cell technologies for vehicles.

GAO has issued numerous reports on aspects of the petroleum sector, including gasoline markets and government efforts to reduce consumption of gasoline in vehicles among other areas. We also have reported on government efforts to improve gasoline vehicle efficiency through the use of gasoline-electric hybrid technologies and to shift vehicle fuel use to alternatives such as compressed natural gas or hydrogen-powered fuel cells. GAO has also noted that low gasoline prices do not reflect external costs associated with gasoline use, such as health and environmental impacts of air pollution or the economic cost that may result from the nation's vulnerability to oil price shocks. Consequently, low gasoline prices work to discourage energy efficiency and the use of alternative fuels. Most recently we reported on the effects of mergers and market concentration in the U.S. petroleum industry, noting that mergers and increased market concentration that occurred in the mid-to-late 1990s contributed to higher wholesale gasoline prices—averaging about 1 to 2 cents per gallon. Other factors such as changes in gasoline formulations and supply disruptions may have also contributed to higher gasoline prices during this period. Later this year, GAO will release a primer on how gasoline is made and distributed, what factors influence the price of gasoline, and why gasoline prices change, among other things. In forthcoming work requested by the Congress, GAO will report on the presence of multiple fuel formulation requirements in some parts of the country and how the expansion of these fuels have affected prices.

Key Questions:

- What are the potential implications for the United States of increased world reliance on oil supplies from politically unstable sources, such as OPEC countries?
- To what extent can the United States increase refining capacity and other delivery infrastructure to meet growing demand for petroleum products?
- What are the implications if there are further consolidations in the U.S. petroleum industry?

- Are there ways to better reflect the full societal cost of using gasoline in gasoline prices, and what are the trade-offs of doing so?

Coal: Balancing the Use of an Abundant Domestic Resource with Its Environmental Consequences

Coal has been a key energy resource in the United States for over 100 years. Over this time, the use of coal has provided low-cost electricity but has brought with it environmental consequences, such as air pollution. Choices regarding the use of coal revolve around balancing these consequences, in the light of new technologies to reduce them, with the energy benefits of using this plentiful domestic resource.

In 2003, coal accounted for about 23 percent of total U.S. energy consumption. Nearly all of the coal consumed in the United States, 92 percent, was used in the production of electricity, with almost all the remaining 8 percent used directly by industries such as steel manufacturing. Coal-fired power plants provided about half of total electricity generation in the United States in 2003, with larger shares in some parts of the country such as the mountainous West and the Midwest. Coal is expected to remain a vital element in the country's energy supply; EIA's most recent forecast indicates that coal would continue to provide about 20 percent of the country's energy needs in 2025.

The United States has substantial domestic coal resources, leading some to refer to the United States as "the Saudi Arabia of coal." Nearly all of the coal used in the country is produced domestically. In 2003, using EIA data, estimates of recoverable U.S. coal reserves could last over 250 years, based on current usage. Coal is generally extracted from either surface, or underground mines, however underground coal also contains combustible gas, called coal bed methane, that can be removed using wells and burned to produce usable energy similar to conventional natural gas. Coal reserves are located across the country, with large reserves in the West, the Midwest, and the Appalachian Mountains, but consumption of coal from the West has increased sharply in recent years. A large portion of the coal reserves are located on federal lands and are subject to direct federal controls, such as payment of royalties, limits on the amount of federal land an individual company may mine, and requirements that surface land be restored to conditions similar to natural conditions when mining ends. Partly owing to the abundance of coal and technological improvements in the mining industry, coal prices have been declining in real terms since the mid-1970s.

The production and use of coal have a variety of environmental consequences, including those related to the

pollution that is emitted when coal is burned. Surface mining has the most significant impacts on land resources, in some cases substantially altering the terrain. Both surface and underground mines can significantly affect water resources by introducing pollution or silt into groundwater or waterways. Regarding air quality, combustion of coal in power plants emits pollutants and contributors to pollutants such as nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM), and toxic chemicals, such as mercury. Although some older power plants emit high levels of these substances, significant advancements have been made in the development of new power plants, utilizing new technologies that substantially reduce emissions. In addition to these pollutants, coal plants release a substantial amount of carbon dioxide, a gas that is common in nature but has been linked with the "greenhouse effect," a greater-than-normal rise in the planet's temperature. Although some countries have agreed to attempt to reduce emissions of carbon dioxide and other "greenhouse" gases, the United States does not currently regulate the emissions of such gases. However, DOE has supported research focused on developing a zero-emission coal-fired power plant that would not emit any pollutants or carbon dioxide into the air. In 2005, according to an industry policy group, 100 or more power plants featuring advanced technologies that substantially reduce emissions of pollutants are being considered for development in the United States.

We have issued reports and testified on two primary coal related issues: technologies supported under DOE's Clean Coal Technology program and the environmental consequences of using coal in power plants. Over the past several years, we have reported on the Clean Coal Technology program, noting that while DOE has reported successes in deploying new technologies, there have been management problems with the program and that there may be important lessons that should be considered in future similar efforts, such as the value of cost-sharing agreements and federal cost-sharing limits. We have also reported (1) that coal-fired power plants that have not been required to install modern pollution reducing equipment emit higher levels of pollutants such as NOx and SOx than plants where this equipment is present, and (2) that increased electricity generation in order to meet expected growth in demand may increase emissions of certain pollutants. In forthcoming work requested by the Congress, GAO will report on the effectiveness and cost of technologies to reduce mercury emissions, a toxic element present in coal that is emitted when coal is burned.

Key Questions:

- How can the federal government balance the use of this abundant domestic energy source with its regulated and unregulated environmental consequences?
- Where will additional coal be mined, where will new power plants be located, and are additional infrastructure improvements needed?
- What is the potential role for coal bed methane, what are the trade-offs of extracting it, and what, if anything, should the federal government do to influence its development and production?
- What changes in controls, if any, should the federal government make to how coal can be mined on federal land and elsewhere?
- What role, if any, should the federal government play in providing incentives for using coal in ways that are safer for the environment?

Natural Gas: A Widely Used and Versatile Fossil Fuel

Natural gas, the fuel of choice recently, is one of the most versatile and widely used fuels—significant amounts are used as a raw material in the fertilizer, chemical, and other industries; for space heating in the industrial, commercial, and residential sectors; and for electricity generation. Until recently, prices have been low and use of natural gas for space heating and for electricity generation has expanded rapidly. Meeting the projected future growth of natural gas demand through delivering additional supply poses challenges.

Natural gas plays a vital role in meeting the country's national energy demand, accounting for about 23 percent of the total energy consumed in the United States. Use of natural gas has been growing rapidly since the mid-1980s, with consumption increasing by about 35 percent from 1986 through 2003. Natural gas demand has been the greatest in the industrial sector, accounting for about 37 percent of total demand in 2003; followed by the residential sector and electric power, each accounting for about 22 percent; then the commercial sector, at about 14 percent. The rest, about 3 percent, is used in the transportation sector, mostly as fuel for pipelines. A significant share of the increased demand in recent years has resulted from increased use of natural gas to generate electricity. This use has increased by 79 percent since the repeal of the Powerplant and Industrial Fuel Use Act in 1987, which had restricted construction of power plants using oil or natural gas as a primary fuel; natural gas is now the primary

fuel in new power plants. EIA estimates that total natural gas demand could increase 50 percent in the next 25 years.

Although natural gas prices remained low for many years, in recent years they have increased dramatically. From 1995 to 2004, average wellhead prices for natural gas increased nearly three-fold; rising from $1.55 per thousand cubic feet to $5.49 per thousand cubic feet. These higher prices for natural gas may have contributed to industrial companies reducing or ceasing U.S. operations. EIA data indicate that demand has fallen rapidly in the industrial sector, where consumption decreased by 16 percent from 1997 through 2003.

Historically, almost all the natural gas used in the United States has been produced here, but a small and growing share is imported. Most natural gas production involves extracting gas from wells drilled into underground gas reservoirs, although some natural gas is generated as a by-product of oil production. In 2003, domestic sources provided about 85 percent of total consumption. Historically, most of the country's natural gas came from Texas, Oklahoma, and Louisiana. However, the Rocky Mountain region, Alaska, and areas beneath the deeper waters of the Gulf of Mexico are becoming increasingly important in supplying natural gas. Overall, from 1994 through 2003, domestic annual production held steady at about 19 trillion cubic feet. In 2003, the United States imported about 15 percent of the total natural gas consumed, with nearly all of it coming from Canada via pipeline. However, a small share is shipped on special ocean tankers as liquefied natural gas (LNG) from countries such as Trinidad and Tobago, Nigeria, and others. Looking ahead, the Energy Information Administration estimates that U.S. consumption could increase to about 31 trillion cubic feet (TCF) by 2025, expanding the gap relative to U.S. production and requiring increasing imports to meet U.S. needs.

The United States still has substantial undeveloped natural gas resources, but some of these resources are located under federal lands, and access to some of these resources is restricted. For example, about 40 percent of the natural gas resources on federal land in the Rocky Mountain region are not available for development. Additional natural gas reserves are located in federally controlled offshore areas or other areas and are not available for development at this time. Extensive drilling for natural gas can substantially modify the surrounding landscape, and in some cases can adversely affect wildlife and its habitat, degrade air and water quality, and decrease the availability of groundwater to ranches and houses that may depend upon it. The federal government is required to consider these environmental consequences when determining if, and how, natural gas

will be extracted from federal lands. In response, the natural gas industry has and continues to use more advanced drilling methods and processes to mitigate future adverse impacts.

Meeting the sharp increases forecast for natural gas demand could also require substantial increases in infrastructure, such as new pipelines and LNG terminals. In particular, increasing natural gas supplies may require greater pipeline capacity and new pipelines. For example, over the past 20 years the federal government has considered a variety of issues with financing and building a new pipeline across federal and state lands to deliver natural gas from Alaska. The federal government is involved in the regulation and permitting of natural gas pipelines, particularly those that must traverse federal lands. To meet the need for sharply higher imports of natural gas, some experts believe that the United States may need to build more LNG terminals. To date, however, such facilities have not been built due to economic, safety, and security concerns. Consequently, it is not clear whether the United States can effectively compete with other countries for these supplies.

Over the last several years, we have issued a number of reports on natural gas, including reports on the natural gas markets and their oversight, various approaches for compensating the federal government when natural gas is removed from federal land, and the impacts of higher natural gas prices on certain industries. In 2002 and 2003, for example, we issued reports analyzing natural gas markets and their oversight. We noted that (1) prices generally increase because limited supplies have not been able to react quickly enough to changes in demand; (2) the federal government (e.g., the Federal Energy Regulatory Commission and EIA) faces significant challenges in overseeing natural gas markets and ensuring that prices are determined in a competitive and informed marketplace, minimizing unnecessary price volatility; and (3) buyers of natural gas have options to reduce their exposure to volatile prices through the use of long-term contracts and financial hedging instruments. In forthcoming work requested by the Congress, GAO will report on federal efforts to understand and manage risks associated with potential terrorist attacks on LNG shipments and other tankers.

Key Questions:

- Should the federal government encourage further development of domestic natural gas on federal lands, and can it ensure that environmental impacts are adequately mitigated?

- What are the infrastructure needs of the natural gas industry, including natural gas pipelines generally and in Alaska in particular, and what role, if any, should the government play in facilitating the development of this infrastructure?
- What are the implications for consumers (residential, commercial, industrial, and electric power) of the increasing reliance on natural gas to generate electricity?
- What are the economic and other barriers and/or trade-offs to developing an infrastructure to support increases in LNG shipments, and what role, if any, should the federal government play?
- To what extent is the federal government positioned to ensure that natural gas prices are determined competitively?

Nuclear Energy: Emission-Free Energy Source, but with Waste Storage Problems and Safety/Security Concerns

Nuclear energy was once heralded as the single answer to all of the country's energy woes, with predictions that electricity would soon be "too cheap to meter." While these enormous expectations have not been met, nuclear energy has become an important part of the country's current energy picture and may remain that way for years to come. Whether we can continue to rely on, or expand our use of, nuclear energy in the future at existing plants or at new plants based on new designs, hinges on solving the long-term waste storage problem as well as resolving concerns over safety and security.

Nuclear energy currently accounts for about 8 percent of U.S. national energy consumption. Nearly all nuclear energy is used to generate electricity, and nuclear plants are important contributors to total U.S. electricity production, providing about 20 percent in 2003. The first commercial nuclear power plant came on line in 1957, and the country witnessed a flurry of construction from the late 1960s through the 1980s. Many nuclear plants operating today were initially licensed for 40 years, and many are now approaching the end of their licenses. Since an accident at the Three Mile Island nuclear plant in 1979 raised concerns regarding the safety of nuclear plants, no new plants have been ordered in the United States, and none has been brought on line since 1996. In addition, many of the plants that were completed witnessed multibillion dollar cost overruns.

Over the past several years, a number of nuclear generating units have been retired, but because the remaining 104 units have increased their

productivity, the output actually increased by about 13 percent from 1998 through 2003. This increase in productivity has been impressive; the average annual capacity factor[2] has increased from 71 percent in 1997 to 90 percent in 2004. These increases in productivity and other improvements have led some plant operators to seek to operate some plants at somewhat higher capacity.

There appears to be renewed interest in extending the licenses of some existing plants and even building new plants. Interest in nuclear power plants has increased, in part, because they do not emit regulated air pollutants such as nitrogen oxides, sulfur dioxides, and particulate matter that can be costly to control, or carbon dioxide, a greenhouse gas, that many in the electricity industry believe might be regulated in the future. Given the improved performance, limited air emissions, and production cost advantages of nuclear power plants, some companies operating existing nuclear plants have already had them relicensed through the Nuclear Regulatory Commission (NRC) to operate for up to another 20 years, and others have started similar efforts. In addition, there have been trade industry reports that a number of utilities and other energy companies are actively considering submitting applications to build new plants. Over the past 20 years, plants have continued to be built overseas. New designs have emerged and foreign manufacturers have gained significant experience building them. Nuclear energy plays a large role in supplying energy in France, Germany, Canada, Japan, and other developed nations. Although nuclear plants remain very costly to build compared to some other plant types, they have lower fuel and other operating costs and can produce electricity at a lower cost than new plants that use fuels such as coal or natural gas—the primary energy source used in new U.S. power plants. In this country, NRC has approved new reactor designs and NRC and the Department of Energy are working to reduce the approval and construction lead times for potential new plants.

Although the United States has a large domestic supply of uranium, the nation increasingly relies on international markets to obtain the nuclear fuel used here. Historically, the fuel used at U.S. reactors has been produced here. However, several factors have combined to reduce the competitiveness and capacity to domestically supply reactor fuel, including falling prices for reactor fuel on international markets and

[2]Capacity factor is the ratio of electricity generated to the amount of energy that could have been generated if the plant ran every hour of every day in the year.

factors surrounding the 1998 privatization of the United States Enrichment Corporation (USEC). In response to the changes in the market, USEC closed the Portsmouth, Ohio, fuel plant leaving only the facility at Paducah, Kentucky, as the domestic source. Both France and Japan have advanced facilities that produce nuclear plant fuel, and these provide a large and growing share of international supplies, including those used in the United States.

Although nuclear plants do not emit pollutants, they produce radioactive waste, including the highly radioactive waste that must be stored in isolation for thousands of years. The federal government committed to develop a permanent storage facility that would receive this waste by 1998, but delays have pushed the potential opening of the facility to the 2012 to 2015 time frame. Efforts to develop the facility have focused on storing the waste deep under Yucca Mountain in the desert north of Las Vegas, Nevada. In 2002, NRC reported that about 45,000 tons of spent fuel from nuclear plants was stored in the United States. Because the permanent repository has not been completed, the highly radioactive waste remains stored at power plants and other facilities and has been the subject of several lawsuits.

Nuclear power plants have been operated safely, largely without incident. Nuclear power plants contain radioactive materials that if released could pose catastrophic risks to human health over an expansive area, but are designed and operated to avoid such an event and incorporate measures to protect the plant from attack. The Nuclear Regulatory Commission, among other things, oversees these plants, conducting periodic inspections of the plant equipment and evaluating security. However, since the terrorist attacks of September 11, 2001, nuclear plants have emerged as a key security concern and attention on these plants has increased. Industry expects that new plant designs will further reduce safety and security risks, incorporating features that, among other things, automatically cool the nuclear reaction.

We have issued a number of reports dealing with aspects of nuclear energy covering three key areas: NRC's oversight of safety issues at the existing nuclear plants; the development of a permanent storage facility for the highly radioactive waste produced by nuclear plants; and the potential vulnerability of these plants in light of the terrorist attacks of September 11. In May 2004, we issued a report on the discovery that corrosion had eaten a pineapple-sized hole in the nuclear reactor vessel head at the Davis-Besse power plant in Ohio that did not result in a radioactive release but highlighted problems with NRC's inspections and oversight. We have

issued a series of reports, spanning more than 20 years, that focus on various aspects of developing of a permanent nuclear waste storage facility. In 2002, we reported (1) that it would be premature for DOE to recommend the facility at Yucca Mountain to the President as a suitable repository for nuclear waste; (2) that DOE was unlikely to achieve its goal of opening a permanent storage repository at Yucca Mountain by 2010; and (3) that DOE did not have a reliable estimate of when, and at what cost, such a repository could be opened. We have also issued reports concerning the vulnerability of nuclear power plants to terrorist attacks. In September 2004, we testified that NRC was generally approving plants' new security plans on the basis of limited details in the plans and without visiting the plants. In forthcoming work requested by the Congress, GAO will undertake a comprehensive review of NRC's reactor oversight process and how NRC ensures that plants operate safely. GAO will continue to examine homeland security issues related to protecting commercial nuclear power plants from terrorist attacks.

Key Questions:

- What role should nuclear energy continue to play in providing the nation's energy needs in view of the aging of existing plants?
- Should new nuclear power plants be built in the United States, and can their design and construction make sense from a business standpoint while providing the safety and security assurances important to surrounding communities?
- How can existing and future nuclear waste generated by power plants be managed in an appropriate and timely manner?
- Are changes needed in how the industry and NRC ensure that plants are operated safely and securely, and is enough being done to protect nuclear plants from terrorist attacks?

Electricity: In the Midst of Change

Electricity has emerged as one of the essential elements in modern life. Today, electricity lights our homes, enables our businesses to be more productive through the use of computers, and creates the basis for our modern quality of life, providing power for everything from our morning coffee to our nightly television news. Unlike the other types of energy that we have discussed—so-called primary sources of energy—electricity is generated through the use of the other energy sources (such as when natural gas is burned in power plants to generate electricity). Encouraged

by the federal government, the electricity industry is in the midst of historic changes. Assessing that transition and determining whether the federal government can improve how electricity markets function remains a focus for federal policy.

Electricity use has grown steadily in recent years. From 1980 through 2003, the quantity of electricity sold increased by 75 percent, with the largest increases coming in the residential and commercial sectors. Electricity is used in these sectors for space heating and for cooling, lighting, and operating small appliances, such as computers and refrigerators. Industrial consumption declined slightly over this period, reflecting the contraction of manufacturing, including some large industrial users of electricity such as the aluminum and steel industries.

In 2003, over 70 percent of electricity was generated using fossil fuels, with over 50 percent coming from coal-fired power plants, about 16 percent from natural gas, and small amounts from petroleum and other fossil fuels. In recent years, new power plants have predominantly relied on natural gas. Nuclear energy provides about 20 percent of electricity generation, hydroelectric energy provides about 7 percent, and a variety of renewable resources, such as wind turbines, provide the remainder.

The federal government has a direct role in supplying electricity, through the federally controlled Power Marketing Administrations, which market electricity produced by federally owned dams and other power plants and which own an extensive transmission network to deliver that electricity. These entities initially aided in the federal mission to bring electricity to rural areas; however, most now serve major metropolitan areas, in addition to some rural customers.

Historically, electricity has been produced and delivered by local monopoly utilities within a specific area, but this has been changing. The electricity sector is restructuring to foster more competition and provide an increased role for open markets. Competition is already under way for the wholesale markets that the federal government regulates. To facilitate fair wholesale competition, the federal government has also pressed for change in what entities control transmission lines—by approving the creation of independent transmission operators to take the place of utilities in performing this function. Some states, such as California and Pennsylvania, had also moved to introduce competition to state-regulated retail markets, where most consumers obtain their electricity. Although the electricity industry is restructuring to include a greater role for competition, the federal government still oversees wholesale electricity

markets through the Federal Energy Regulatory Commission (FERC). Because federal actions have restructured wholesale markets nationwide and states have variously chosen to restructure the markets that they oversee, the national electricity market is currently a hybrid, somewhere between competitive and regulated.

Unlike the other forms of energy, the amount of electricity supplied by power plants must be balanced, on a second-to-second basis, with the amount of electricity consumed in homes and businesses. To do this, utilities or independent entities direct the production of electricity and its movement over transmission lines to avoid blackouts. In some cases, such as in California in 2000 and 2001 and more recently in the Northeast in 2003, the balance between supply and demand was disrupted and blackouts occur.

Electricity demand is projected to increase by at least 36 percent by 2025, and the industry may require significant investment in power plants and transmission lines to reach those levels. The National Energy Policy Development report estimated that the United States may need to add as many as 1,900 power plants to meet forecasted demand growth. In addition, because the existing network of power lines frequently experiences congestion, the capacity of many key transmission lines may need to be increased to move electricity from these new plants and improve the reliability of the existing system.

We have reported on the development of competition in the electricity industry and evaluated the oversight of electricity markets. For example, in one report we found that the way the market was structured in California enabled some electricity sellers to manipulate prices. We also reported on the ability to add new power plants in three states, concluding that the success of restructured markets hinged on private investment in power plants and that this investment was reduced by higher levels of perceived risk in some markets, such as in California. Further, we recently reported on the potential value of empowering consumers to manage their own electricity energy demand in order to save money and improve the functioning of these markets. Allowing consumers to see electricity prices enables them to reduce their usage when prices are high—reducing their energy bills and improving the functioning of the markets. Following the 2003 blackout, we issued a report that highlighted challenges and opportunities in the electricity industry, including whether reliability standards should be made mandatory and whether control systems critical to the electricity industry have adequate security. Regarding oversight of electricity markets, we reported that while the Federal Energy Regulatory

Commission has made progress in revising its oversight strategy, it still faced challenges in better regulating these markets. In forthcoming work requested by the Congress, GAO will assess progress in reporting electricity market transactions for use in developing market indexes and the adequacy of controls over this reporting.

Key Questions:

- To what extent does the division of regulatory authority between the federal government and the states limit the electricity industry's ability to achieve the benefits expected from the introduction of competition in electricity markets?
- What changes are necessary to federal and state monitoring and oversight of electricity markets to ensure that they are adequately overseen?
- Will FERC's actions to promote reliability be sufficient, or will additional actions be needed to improve compliance with reliability rules?
- How does continued uncertainty about how the future of electricity restructuring and electricity markets affect electricity companies, investment in new plants and transmission lines, and consumer prices?
- What role should the federal Power Marketing Administrations play in restructured electricity markets?
- To what extent are homeland security principles being integrated into new electricity infrastructure and business processes?

Renewable and Alternative Energy Sources: What Role Will They Play in the Future?

Renewable energy sources, such as hydroelectric dams, ethanol, wind turbines, and geothermal and solar applications, currently comprise a small percentage of the total energy resources consumed in the United States. Several alternative sources, such as hydrogen and fusion power, may offer potential long-term promise, but research remains at an early stage. While these renewable and alternative energy sources have a nearly unlimited domestic supply, are perceived as relatively clean, and help diversify the U.S. energy supply, technical problems and high costs relative to other options have limited their use.

According to EIA, in 2003 renewable and alternative energy sources accounted for slightly more than 6 percent of the total U.S. energy consumption. Hydropower is the largest single source in this category and

makes up over 45 percent of all renewable and alternative energy consumed. Hydropower generation, which varies due to weather conditions, has fluctuated at about the same level since the 1970s. Wood accounts for about 34 percent of total renewable energy, although its use has declined since 1989. Waste and other byproducts, such as municipal solid waste, landfill gas, and biomass, account for about 9 percent and their use has been relatively flat since the mid-1990s. Geothermal energy use has decreased slightly since it peaked in 1993 and now accounts for about 5 percent of the total. Alcohol fuels, such as ethanol, make up about 4 percent of the total, but their use has increased rapidly in recent years, almost doubling from 1999 through 2003. Wind energy accounted for about 2 percent of the total renewable energy consumed in 2003 but has witnessed substantial and persistent growth in recent years, more than tripling from 1998 through 2003. Solar energy accounts for about 1 percent of all renewable and alternative energy consumed, and its use has declined slightly but steadily since 1997, although use of some specific solar technologies such as photovoltaic solar cells that convert sunlight directly into electricity has grown in recent years.

Renewable energy technologies are increasingly becoming part of global markets and are, in some cases, owned by large multinational energy companies such as oil companies. Solar and wind energy have grown substantially in these markets, but remain at relatively low levels in the United States. Growth in wind power has benefited from improvements in wind turbine technology and the availability of government tax credits here and overseas, both of which have improved the competitiveness of wind power technologies with more traditional forms of energy. EIA estimates, however, that if the federal government removes the tax credit, the U.S. growth in the generation of wind power will almost stop. However, EIA estimates that if the government maintains the tax credit, wind power generation in the United States is expected to grow nearly seven-fold over the next 20 years. Solar technologies, especially solar cell technologies that produce electricity, have supplanted traditional technologies, such as generators for some remote applications, and sales of solar cells have expanded rapidly worldwide, albeit from a small base.

Several alternative sources may offer long-term promise, although they are not ready for widespread application. Technologies such as hydrogen power and fusion are currently being developed as new sources of energy. While these technologies have the potential to deliver large amounts of energy with fewer environmental impacts than traditional energy sources, they cannot be counted upon to deliver significant amounts of energy in the near future due to significantly higher costs and technical challenges.

To date, use of hydrogen fuel cells still requires the extraction of hydrogen from another fuel source, such as natural gas, and currently this extraction is too costly to compete with other sources of energy. In addition, the infrastructure to support hydrogen power has not been built. While fusion also may have the ability to provide an abundant and clean energy source, research on this technology remains at a very early stage.

We have issued several reports describing the viability and technical progress of several renewable and alternative energy sources supported by the federal government. A continuing theme of these reports has been that when the government invests money into research and development initiatives, it is important to keep one eye on the technical goals and one eye on the marketplace. We have noted that the success of the investment should be measured by its contribution to increasing the use and feasibility of an energy source, rather than reaching specific technical research and development goals. In forthcoming work requested by the Congress, GAO will report on the impact of wind turbines on birds and other aspects of the environment, as well as geothermal energy development in the United States.

Key Questions:

- Should the federal government establish clear and measurable goals for the development and use of renewable and alternative energy sources, and, if so, how should progress toward these goals be measured?
- What should the federal government's role be in researching and developing existing and future sources of renewable and alternative energy sources?
- What are the costs and benefits of increasing our use of renewable and alternative energy sources?
- What are the implications of renewable energy mandates for deploying renewable energy technologies and for electricity markets?

Reducing Energy Demand through Efficiency and Consumer Choice: the Often-Overlooked Energy Option

Experts have long contended that energy strategies that reduce demand can cost less, be brought on line faster, and provide greater environmental benefits compared to strategies that increase the amount of energy supplied—particularly if demand reductions decrease fossil fuel consumption and related pollution. Such strategies include improving the efficiency of energy we already use and allowing consumers to choose when it makes the most sense to conserve energy. Despite their advantages, however, opportunities to improve efficiency and consumer choice are often overlooked.

Overall, energy demand in the United States has trended steadily upward for the last 50 years. While demand has increased, the amount of energy the country uses relative to its economic output has fallen. The amount of energy used for each dollar of gross domestic product has dropped by about half from 1970 through 2003. The reduction has been even more striking when examining the industrial sector, where energy used per dollar of GDP has fallen by over 60 percent since 1970. It is not clear whether this reduction reflects a decrease in energy intensive industries, such as aluminum and steel manufacturing, improvements in energy efficiency, or some combination of the two.

The federal government has, periodically, made efforts to reduce demand, encourage energy efficiency, or both. To reduce demand, the federal government has, among other things, encouraged consumers to voluntarily limit excessive heating and cooling of homes and to reduce the number of miles that they drive. To encourage energy efficiency, the federal government has established energy efficiency standards for such things as home appliances, air conditioners, and furnaces, as well as provided incentives for purchasing energy-efficient equipment. In the transportation sector, the federal government has required automakers to meet overall efficiency standards—known as Corporate Average Fuel Economy (CAFÉ) standards—for the vehicles they sell. The federal government has also made investments to improve energy efficiency and save money on energy at its own buildings through the Federal Energy Management Program and utilizing energy savings performance contracts.

Federal efforts have met with some success. According to the American Council for an Energy Efficient Economy and the Alliance to Save Energy, energy efficiency investments made from 1973 through 2003 saved the equivalent of 40 to 50 quadrillion BTUs of energy in 2003, equal to about 40 to 50 percent of total energy consumption and more than any single fuel provided. Several organizations, including a panel of several national

laboratories, estimate that many opportunities for additional improvements in energy efficiency remain untapped.

At times, however, federal efforts to reduce energy demand and improve energy efficiency have had to compete with efforts to keep energy prices low. For example, residential and commercial sectors of the economy have until recently been somewhat protected from price volatility by regulated prices for electricity and natural gas and thus have been less likely to reduce their consumption of these sources. Moreover, inflation-adjusted energy prices have generally declined, until recently. Reducing demand when prices are falling has been difficult for several reasons. For example, because energy-consuming equipment, such as air conditioners, furnaces, and lighting systems, is generally costly to purchase and lasts many years, consumers do not want to replace it unnecessarily. In addition, consumers are often not aware of the energy inefficiency of their homes and businesses. Falling energy prices have also made it more difficult to demonstrate the cost-effectiveness of spending money to replace aging and inefficient equipment, particularly for residential and commercial customers. In contrast, when consumers face prolonged period of higher energy prices, they are more likely to identify and adopt cost-effective strategies for reducing their energy demand. For example, following prolonged supply disruptions and price increases for gasoline in the 1970s, consumers in the 1980s chose to purchase more fuel-efficient vehicles, pushing up overall fuel efficiency averages nationwide. In the late 1990s the opposite has been true; relatively low prices for gasoline have encouraged consumers to choose to purchase larger and less fuel-efficient vehicles.

GAO has examined policies designed to reduce demand in electricity markets, as well as efforts to develop more fuel-efficient automobiles. In August 2004, we issued a report finding that electricity demand programs that better link the electricity prices consumers pay with the actual cost of generating electricity offer significant financial benefits to consumers, improve the functioning of electricity markets, and benefit the federal government by lowering its utility bills. In March 2000, we reported on the Partnership for a New Generation of Vehicles (which sought to develop a family sedan that could drive about 80 miles on a gallon of fuel) and found that the vehicle being developed did not match consumer vehicle preferences and that automakers would not be manufacturing such a vehicle for U.S. markets. In forthcoming work requested by the Congress, GAO will evaluate the Department of Energy's program for setting energy efficiency standards for appliances.

Key Questions:

- What are the benefits and costs of potential federal efforts to reduce energy demand?
- Are there economic, regulatory, or other barriers preventing the adoption of cost-effective, energy-efficient technologies that could meet consumer needs?
- Are there promising energy-saving technologies that are nearly cost-effective that the federal government should consider encouraging through the use of consumer incentives?
- Are there emerging energy-efficiency technologies that are past basic research but that could benefit from federal and industry collaboration?
- Which technologies offer the greatest long-term potential for reducing demand, and should they be considered for intensive federal research?
- To what extent are retail price structures impeding the deployment of cost-effective and energy-efficiency technologies?

Conclusions

Given the increasing signs of strain on our energy systems and our growing awareness of how our energy choices impact our environment, there is a growing sense that federal leadership could provide the first step in a fundamental reexamination of our nation's energy policies. As the Congress, executive agencies, states and regions, industry, and consumers weigh such a reexamination, we believe that it makes sense to consider all energy sources together, along with options to encourage more efficient energy use and consumer choices to save energy. While a balanced energy portfolio is needed, striking that balance is difficult because of sometimes competing energy, environmental, economic, and national security needs.

Clearly none of the nation's energy options are without problems or trade-offs. Current U.S. energy supplies remain highly dependent on fossil energy sources that are either costly, imported, potentially harmful to the environment, or some combination of these three, while many renewable energy options still remain more costly than traditional options. On the other hand, past efforts to reduce energy demand appear to have lost some of their effectiveness in recent years. Striking a balance between efforts to boost supplies from these various energy sources and those focused on reducing demand presents challenges as well as opportunities.

In the end, the nation's energy policies come down to choices. Just as they did some 30 years ago in the aftermath of the major energy crises of the 1970s, congressional choices will strongly influence the direction that this country takes regarding energy issues—affecting consumer, supplier, and investor choices for years to come. Consumer choices made from today forward will determine to a great extent how much energy will be needed in the future. In the same way, energy suppliers have choices about how much of each type of energy to provide, based increasingly on their interaction with competitive domestic and sometimes global markets for energy. Choices made by consumers and suppliers will be influenced by state and local entities, along with regional stakeholders in some areas of the country, which have authority over key decisions that affect such things as the siting of generation and transmission facilities as well as access to their lands. Similarly, investors have choices regarding where to invest their money, whether in new power plants, refineries, research and development for new technologies, or outside the energy sector all together. Yet, many of these choices may be significantly influenced, or even overshadowed, by broader forces that are beyond our control, such as expected energy demand growth in the developing world.

In closing, providing the American consumer with secure, affordable, reliable, and environmentally sound energy choices will be a challenge. I would like to note that more than 30 years ago, during the first energy crisis, our nation faced many of the same choices that we are confronting today. How far have we come? Have we charted a course that can be sustained in the 21st century? In 30 years, will we again come full circle and ask ourselves these same questions about our energy future? The answer to this final question lies in our collective ability to develop and sustain a strategic plan, with supporting incentives, along with a means to measure our progress and periodically adjust our path to meet future energy challenges.

I would be pleased to respond to any questions that you, or other Members of the Subcommittee, may have at this time.

Contact and Acknowledgments

For further information about this testimony, please contact me, Jim Wells, at (202) 512-3841. Contributors to this testimony included Godwin Agbara, Dennis Carroll, Mark Gaffigan, Dan Haas, Mike Kaufman, Bill Lanouette, Jon Ludwigson, Cynthia Norris, Paul Pansini, Ilene Pollack, Melissa Roye, Frank Rusco, and Ray Smith.

Related GAO Products

Oil

Energy Markets: Effects of Mergers and Market Concentration in the U.S. Petroleum Industry. GAO-04-96. Washington, D.C. May 17, 2004.

Research and Development: Lessons Learned from Previous Research Could Benefit FreedomCAR Initiative. GAO-02-810T. Washington, D.C.: June 6, 2002.

U.S. Ethanol Market: MTBE Ban in California. GAO-02-440R. Washington, D.C.: February 27, 2002.

Motor Fuels: Gasoline Prices in the West Coast Market. GAO-01-608T. Washington, D.C.: April 25, 2001.

Motor Fuels: Gasoline Prices in Oregon. GAO-01-433R. Washington, D.C.: February 23, 2001.

Petroleum and Ethanol Fuels: Tax Incentives and Related GAO Work. RCED-00-301R. Washington, D.C.: September 25, 2000.

Cooperative Research: Results of U.S.-Industry Partnership to Develop a New Generation of Vehicles. RCED-00-81. Washington, D.C.: March 30, 2000.

Alaskan North Slope Oil: Limited Effects of Lifting Export Ban on Oil and Shipping Industries and Consumers. RCED-99-191. Washington, D.C.: July 1, 1999.

International Energy Agency: How the Agency Prepares Its World Oil Market Statistics. RCED-99-142. Washington, D.C.: May 7, 1999.

Energy Security and Policy: Analysis of the Pricing of Crude Oil and Petroleum Products. RCED-93-17. Washington, D.C.: March 19, 1993.

Energy Policy: Options to Reduce Environmental and Other Costs of Gasoline Consumption. T-RCED-92-94. Washington, D.C.: September 17, 1992.

Energy Policy: Options to Reduce Environmental and Other Costs of Gasoline Consumption. RCED-92-260. Washington, D.C.: September 17, 1992.

Alaskan Crude Oil Exports. T-RCED-90-59. Washington, D.C.: April 5, 1990.

Energy Security: An Overview of Changes in the World Oil Market. RCED-88-170. Washington, D.C.: August 31, 1988.

Coal

Clean Air Act: Observations on EPA's Cost-Benefit Analysis of Its Mercury Control Options. GAO-05-252. Washington, D.C.: February 28, 2005.

Fossil Fuel R&D: Lessons Learned in the Clean Coal Technology Program. GAO-01-854T. Washington, D.C.: June 12, 2001.

Clean Coal Technology: Status of Projects and Sales of Demonstrated Technology. RCED-00-86R. Washington, D.C.: March 9, 2000.

Natural Gas

Natural Gas: Domestic Nitrogen Fertilizer Production Depends on Natural Gas Availability and Prices. GAO-03-1148. Washington, D.C.: September 30, 2003.

Natural Gas Flaring and Venting: Opportunities to Improve Data and Reduce Emissions. GAO-04-809. Washington, D.C.: July 14, 2004.

Natural Gas: Analysis of Changes in Market Price. GAO-03-46. Washington, D.C.: December 18, 2002.

Energy Deregulation: Status of Natural Gas Customer Choice Programs. RCED-99-30. Washington, D.C.: December 15, 1998.

Nuclear

Nuclear Regulation: NRC's Assurances of Decommissioning Funding During Utility Restructuring Could Be Improved. GAO-02-48. Washington, D.C.: December 3, 2001.

Nuclear Waste: Technical, Schedule, and Cost Uncertainties of the Yucca Mountain Repository Project. GAO-02-191. Washington, D.C.: December 21, 2001.

Nuclear Nonproliferation: Implications of the U.S. Purchase of Russian Highly Enriched Uranium. GAO-01-148. Washington, D.C.: December 15, 2000.

	Nuclear Regulation: Better Oversight Needed to Ensure Accumulation of Funds to Decommission Nuclear Power Plants. RCED-99-75. Washington, D.C.: May 3, 1999. *Nuclear Waste: Impediments to Completing the Yucca Mountain Repository Project.* RCED-97-30. Washington, D.C.: January 17, 1997.
Renewable/ Alternative	*Renewable Energy: Wind Power's Contribution to Electric Power Generation and Impact on Farms and Rural Communities.* GAO-04-756. Washington, D.C.: September 3, 2004. *Geothermal Energy: Information on the Navy's Geothermal Program.* GAO-04-513. Washington, D.C.: June 4, 2004. *Department of Energy: Solar and Renewable Resources Technologies Program.* RCED-97-188. Washington, D.C.: July 11, 1997. *Energy Policy: DOE's Policy, Programs, and Issues Related to Electricity Conservation.* RCED-97-107R. Washington, D.C.: April 9, 1997.
Multiple Fuel	*Energy Markets: Additional Actions Would Help Ensure That FERC's Oversight and Enforcement Capability Is Comprehensive and Systematic.* GAO-03-845. Washington, D.C.: August 15, 2003. *Energy Markets: Concerted Actions Needed by FERC to Confront Challenges That Impede Effective Oversight.* GAO-02-656. Washington, D.C.: June 14, 2002. *Petroleum and Ethanol Fuels: Tax Incentives and Related GAO Work.* RCED-00-301R. Washington, D.C.: September 25, 2000.
Electricity	*Electricity Markets: Consumers Could Benefit from Demand Programs, but Challenges Remain.* GAO-04-844. Washington, D.C.: August 13, 2004. *Electricity Restructuring: 2003 Blackout Identifies Crisis and Opportunity for the Electricity Sector.* GAO-04-204. Washington, D.C.: November 18, 2003.

Air Pollution: Meeting Future Electricity Demand Will Increase Emission of Some Harmful Substances. GAO-03-49. Washington, D.C.: October 30, 2002.

Electricity Markets: FERC's Role in Protecting Consumers. GAO-03-726R. Washington, D.C.: June 6, 2003.

Electricity Restructuring: Action Needed to Address Emerging Gaps in Federal Information Collection. GAO-03-586. Washington, D.C.: June 30, 2003.

Lessons Learned From Electricity Restructuring: Transition to Competitive Markets Underway, but Full Benefits Will Take Time and Effort to Achieve. GAO-03-271. Washington, D.C.: December 17, 2002.

Restructured Electricity Markets: California Market Design Enabled Exercise of Market Power. GAO-02-828. Washington, D.C.: June 21, 2002.

Air Pollution: Emissions from Older Electricity Generating Units. GAO-02-709. Washington, D.C.: June 12, 2002.

Energy Markets: Concerted Actions Needed by FERC to Confront Challenges That Impede Effective Oversight. GAO-02-656. Washington, D.C.: June 14, 2002

Restructured Electricity Markets: Three States' Experiences in Adding Generating Capacity. GAO-02-427. Washington, D.C.: May 24, 2002.

California Electricity Market: Outlook for Summer 2001. GAO-01-870R. Washington, D.C.: June 29, 2001.

California Electricity Market Options for 2001: Military Generation and Private Backup Possibilities. GAO-01-865R. Washington, D.C.: June 29, 2001

Energy Markets: Results of Studies Assessing High Electricity Prices in California. GAO-01-857. Washington, D.C.: June 29, 2001.

Electric Utility Restructuring: Implications for Electricity R&D. T-RCED-98-144. Washington, D.C.: March 31, 1998.

Energy Production on Federal Lands

Mineral Revenues: A More Systematic Evaluation of the Royalty-in-Kind Pilots Is Needed. GAO-03-296. Washington, D.C.: January 9, 2003.

Alaska's North Slope: Requirements for Restoring Lands After Oil Production Ceases. GAO-02-357. Washington, D.C.: June 5, 2002.

Royalty Payments for Natural Gas From Federal Leases in the Outer-Continental Shelf. GAO-01-101R. Washington, D.C.: October 24, 2000.

Mr. ISSA. Thank you, Mr. Wells, and your entire statement and all of the other statements will be placed in the record. Mr. Caruso, please?

STATEMENT OF GUY CARUSO, ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION, U.S. DEPARTMENT OF ENERGY

Mr. CARUSO. Thank you, Mr. Chairman, it is a pleasure to be here to present the Energy Information Administration's outlook for energy markets, both for the short and the medium term.

All of EIA's outlooks are policy-neutral and rely on the existing policy's rules and regulations. So in a way, what I am going to be sharing with you today is, this is where we see the United States and global energy markets headed, if we stay on the path we are on.

I know that is the purpose of your subcommittee and your committee, to look at whether or not there are ways to change this path and what are the correct paths. I certainly applaud your interest in that.

As we sit here this afternoon, the price of crude oil on the New York Mercantile Exchange exceeded $56 a barrel. How did we get to this point? It is mainly because the fundamentals of the global oil market are extremely tightly balanced.

As mentioned earlier, world demand grew at 2.7 million barrels a day last year. We see it growing at more than 2 million barrels a day this year and next. With this kind of demand growth, it is stretching the ability to produce, store, refine, and transport oil to the limit.

So there are no longer any cushions in the market to provide pressure relief valves when there are unexpected changes in either supply or demand. So small changes can lead to large price spikes. We think our short-term outlook reflects that fact. We are now projecting, on average, $49 crude this year, and not declining much next year.

Over the longer term, we see very strong growth in United States and global energy demand. In the United States, we have about a third increase in our demand for energy projected to 2025, and domestic supplies will not keep up with demand.

Therefore, our net import position will grow from 28 percent of net imports of energy. This 28 percent will grow to 38 percent in 2025. That includes both oil and natural gas.

We are using energy more efficiently. We are getting more energy per unit of GDP. But clearly, we can do better in that, and we expect that as we look out at the next 20 years, energy efficiency will continue and technology will improve. But clearly, there is room for doing even more.

One of the issues with respect to changing our demand is that an increasing share of our energy demand is in the transportation sector, which is much less flexible than the industrial sector or even the electric power sector.

That is why, when one looks at the outlook for petroleum over the next 20 years, our import dependency will grow even more dramatically the total energy, going from 57 percent net import dependency in 2003 to almost 70 percent by 2025. That is because

our demand for oil is projected to grow by 8 million barrels a day, from about 20½ million today to about 28 million barrels a day.

Our domestic supply has been and will continue to be at a flat to declining path. Therefore, imports, and particularly those from the Persian Gulf countries, will rise dramatically. Now this outlook assumes that the high prices of oil that we are experiencing today and have been over the last year will actually come down to $25 to $30 in real terms.

Nevertheless, we recognize the great uncertainty with that referenced assumption. We have done several cases where we have assumed higher prices than those that are in our long-term outlook, which was published in February. As I mentioned, transportation will account for about 70 percent of that petroleum demand over the next 20 years.

The other area within our energy economy that reflects this increasing dependence on imports is natural gas. We expect the demand for natural gas to grow from about 22 trillion cubic feet last year to about 31 trillion cubic feet in 2025.

Once again, domestic supply will not grow nearly enough to meet that kind of a demand growth. So we will be relying on imports of gas, not only from Canada, which is our main supplier today, but increasingly on liquified natural gas [LNG], which will be coming from as far afield as Katar and Russia, as well as our traditional suppliers of Algeria, Trinidad, and Tobago.

So natural gas imports, as a share of total supply, will go from 15 percent to about 28 percent. So, again, that same pattern that we have seen in oil will be replicated in natural gas, if our projections are accurate.

On the global market, the most rapid growth will be for developing countries. As has already been mentioned, China and India are growing very strongly. Last year, China grew at almost 20 percent, in terms of its oil demand. India is growing, as well.

We think those countries will lead to growth in global energy demand over the next 20 years; not only for oil, but for natural gas, as they attempt to use more gas in electric power generation. Of course, coal will still dominate the energy economies of China and India, because they have indigenous supplies, and they use it to generate much of their electricity.

When one looks at this kind of demand for oil that we are projecting, 120 million barrels a day in our global outlook, we are often asked, will resources be sufficient to meet that kind of demand? I think the answer is, yes, the resources are there; but it represents a significant investment challenge for not only international oil companies, but national oil companies; and whether or not the proper investment incentives and the governance would be there from these countries, as I have I mentioned.

Clearly, we do recognize that prices of both oil and natural gas have been volatile in recent years. We expect that volatility to continue, because of the tightness in the fundamentals of supply and demand.

Although we do not project volatility in our models, clearly, what we do project is the tightness in the infrastructure to produce and refine oil, and to produce and consume natural gas. Given that

tightness, clearly, the expectations are that the volatility will be with us.

In conclusion, the economic growth that we have seen will lead to even higher energy demand. Fossil fuels are expected to remain the dominant sources of energy. Therefore, the United States, China, and India will become increasingly dependent on imports of both oil and natural gas.

So the questions that you have asked, I think, are the right ones. Clearly, as your hearings proceed, we would be pleased to provide any additional information that you may find useful. Mr. Chairman and members of the committee, thank you very much.

[The prepared statement of Mr. Caruso follows:]

STATEMENT OF GUY CARUSO

ADMINISTRATOR

ENERGY INFORMATION ADMINISTRATION

U.S. DEPARTMENT OF ENERGY

Before the

SUBCOMMITTEE ON ENERGY AND RESOURCES

COMMITTEE ON GOVERNMENT REFORM

U.S. HOUSE OF REPRESENTATIVES

March 16, 2005

Mr. Chairman and Members of the Committee:

I appreciate the opportunity to appear before you today. As requested in your letter of invitation, my testimony will address two main areas: the U.S. energy outlook and the recent experience with energy price volatility.

The Energy Information Administration (EIA) is an independent statistical and analytical agency within the Department of Energy. We are charged with providing objective, timely, and relevant data, analysis, and projections for the use of the Congress, the Administration, and the public. We do not take positions on policy issues, but we do produce data, analysis, and forecasts that are meant to help policy makers in their energy policy deliberations. Because we have an element of statutory independence with respect to the analyses, our views are strictly those of EIA and should not be construed as representing those of the Department of Energy or the Administration. However, EIA's baseline projections on energy trends are widely used by Government agencies, the private sector, and academia for their own energy analyses.

The *Annual Energy Outlook* provides projections and analysis of domestic energy consumption, supply, prices, and energy-related carbon dioxide emissions through 2025. *Annual Energy Outlook 2005* (*AEO2005*) is based on Federal and State laws and regulations in effect on October 31, 2004. The potential impacts of pending or proposed legislation, regulations, and standards—or of sections of legislation that have been enacted but that require funds or implementing regulations that have not been provided or specified—are not reflected in the projections. *AEO2005* explicitly includes the impact of the recently enacted American Jobs Creation Act of 2004, the Military Construction Appropriations Act for Fiscal Year 2005, and the Working Families Tax Relief Act of 2004. *AEO2005* does not include the potential impact of proposed regulations such as the Environmental Protection Agency's (EPA) Clean Air Interstate and Clean Air Mercury rules.

The U.S. projections in this testimony are based on the *AEO2005*, which was released on the EIA website on February 11, 2005. The *AEO2005* is not meant to be an exact prediction of the future but represents a likely energy future, given technological and demographic trends, current laws and regulations, and consumer behavior as derived from known data. EIA recognizes that projections of energy markets are highly uncertain and subject to many random events that cannot be foreseen such as weather, political disruptions, and technological breakthroughs. In addition to these phenomena, long-term trends in technology development, demographics, economic growth, and energy resources may evolve along a different path than expected in the projections. The *AEO2005* includes a large number of alternative cases intended to examine these uncertainties. The *AEO2005* provides integrated projections of U.S. and world energy market trends for roughly the next two decades. The following discussion summarizes the highlights from *AEO2005* for the major categories of U.S. energy prices, demand, and supply and also includes the findings from some alternative cases.

U.S. Energy Prices

In the *AEO2005* reference case, the annual average world oil price[1] increases from $27.73 per barrel (2003 dollars) in 2003 ($4.64 per million Btu) to $35.00 per barrel in 2004 ($5.86 per million Btu) and then declines to $25.00 per barrel in 2010 ($4.18 per million Btu) as new supplies enter the market. It then rises slowly to $30.31 per barrel in 2025 ($5.07 per million Btu) (**Figure 1**). In nominal dollars, the average world oil price is about $52 per barrel in 2025 ($8.70 per million Btu).

There is a great deal of uncertainty about the size and availability of crude oil resources, particularly conventional resources, the adequacy of investment capital, and geopolitical trends. For example, the *AEO2005* reference case assumes that world crude oil prices will decline as growth in consumption slows and producers increase their productive capacity and output in response to current high prices; however, the October 2004 oil futures prices for West Texas Intermediate crude oil (WTI) on the New York Mercantile Exchange (NYMEX) implies that the average annual oil price in 2005 will exceed its 2004 level before declining to levels that still would be above those projected in the reference case. To evaluate this uncertainty about world crude oil prices, the *AEO2005* includes other cases based on alternative world crude oil price paths, which are designed to address the uncertainty about the market behavior of the Organization of Petroleum Exporting Countries (OPEC). They are not intended to span the full range of possible outcomes.

The alternative world oil price cases examined include:

- High A world oil price case. Prices are projected to remain at about $34 per barrel (2003 dollars) through 2015 and then increase on average by 1.4 percent per year, to more than $39 per barrel in 2025.
- High B world oil price case. Projected prices continue to increase through 2005 to $44 dollars per barrel (2003 dollars), fall to $37 in 2010, and rise to $48 dollars per barrel in 2025.
- Low world oil price case. Prices are projected to decline from their high in 2004 to $21 per barrel (2003 dollars) in 2009 and to remain at that level out to 2025.

Figure 2 provides a comparison of the reference case and the high B world oil price case. The implications of these alternative cases will be discussed later.

---

[1] World oil prices in *AEO2005* are defined based on the average refiner acquisition cost of imported oil to the United States (IRAC). The IRAC price tends to be a few dollars less than the widely-cited West Texas Intermediate (WTI) spot price and has been as much as six dollars per barrel lower than the WTI in recent months. For the first 11 months of 2004, WTI averaged $41.31 per barrel ($7.12 per million Btu), while IRAC averaged $36.94 per barrel (nominal dollars) ($6.37 per million Btu).

In the *AEO2005*, average wellhead prices for natural gas in the United States are projected to decrease from $4.98 per thousand cubic feet (2003 dollars) in 2003 ($4.84 per million Btu) to $3.64 per thousand cubic feet in 2010 ($3.54 per million Btu) as the availability of new import sources and increased drilling expand available supply. After 2010, wellhead prices are projected to increase gradually, reaching $4.79 per thousand cubic feet in 2025 ($4.67 per million Btu) (about $8.20 per thousand cubic feet or $7.95 per million Btu in nominal dollars). Growth in liquefied natural gas (LNG) imports, Alaska production, and lower-48 production from nonconventional sources is not expected to increase sufficiently to offset the impacts of resource depletion and increased demand in the lower-48 States.

In *AEO2005*, the combination of more moderate increases in coal production, expected improvements in mine productivity, and a continuing shift to low-cost coal from the Powder River Basin in Wyoming leads to a gradual decline in the average minemouth price, to approximately $17 per ton (2003 dollars) shortly after 2010 ($0.86 per million Btu). The price is projected to remain nearly constant between 2010 and 2020, increasing after 2020 as rising natural gas prices and the need for baseload generating capacity lead to the construction of many new coal-fired generating plants. By 2025, the average minemouth price is projected to be $18.26 per ton ($0.91 per million Btu). The *AEO2005* projection is equivalent to an average minemouth coal price of $31.25 per ton in nominal dollars in 2025 ($1.56 per million Btu).

Average delivered electricity prices are projected to decline from 7.4 cents per kilowatthour (2003 dollars) in 2003 ($21.68 per million Btu) to a low of 6.6 cents per kilowatthour in 2011 ($19.34 per million Btu) as a result of an increasingly competitive generation market and a decline in natural gas prices. After 2011, average real electricity prices are projected to increase, reaching 7.3 cents per kilowatthour in 2025 ($21.38 per million Btu) (equivalent to 12.5 cents per kilowatthour or $36.61 per million Btu in nominal dollars).

U.S. Energy Consumption

Total energy consumption is projected to grow at about one-half the rate (1.4 percent per year) of gross domestic product (GDP) with the strongest growth in energy consumption for electricity generation (discussed later) and transportation and commercial uses. Transportation energy demand is expected to increase from 27.1 quadrillion Btu in 2003 to 40.0 quadrillion Btu in 2025, a growth rate of 1.8 percent per year (**Figure 3**). The largest demand growth occurs in light-duty vehicles and accounts for about 60 percent of the total increase in transportation energy demand by 2025, followed by heavy truck travel (20 percent of total growth) and air travel (12 percent of total growth). Delivered commercial energy consumption is projected to grow at a more rapid average annual rate of 1.9 percent between 2003 and 2025, reaching 12.5 quadrillion Btu in 2025, consistent with growth in commercial floorspace. The most rapid increase in commercial energy demand is projected for electricity used for computers, office equipment, telecommunications, and miscellaneous small appliances.

Delivered industrial energy consumption in *AEO2005* is projected to reach 30.8 quadrillion Btu in 2025, growing at an average rate of 1.0 percent per year between 2003 and 2025, as efficiency improvements in the use of energy only partially offset the impact of growth in manufacturing output. Delivered residential energy consumption is projected to grow from 11.6 quadrillion British thermal units (Btu) in 2003 to 14.3 quadrillion Btu in 2025 (0.9 percent per year). This

growth is consistent with population growth and household formation. The most rapid growth in residential energy demand in *AEO2005* is projected to be in the demand for electricity used to power computers, electronic equipment, and appliances.

The reference case includes the effects of several policies aimed at increasing energy efficiency in both end-use technologies and supply technologies, including minimum efficiency standards and voluntary energy savings programs. However, as noted previously, the projections in *AEO2005* are based on existing Federal and State laws and regulations in effect on October 31, 2004. The impact on energy consumption of efficiency improvement could be different than what is shown in the reference case. **Figure 4** compares energy consumption in three cases to illustrate this point. The 2005 technology case assumes no increase in efficiency beyond that available in 2005. By 2025, 5 percent more energy (7.6 quadrillion Btu) is required than in the reference case. The high technology case assumes that the most-energy efficiency technologies are available earlier with lower costs and higher efficiencies. By 2025, total energy consumption is 7 quadrillion Btu lower in the high technology case when compared with the reference case.

Total petroleum demand is projected to grow at an average annual rate of 1.5 percent in the *AEO2005* reference case forecast, from 20.0 million barrels per day in 2003 to 27.9 million barrels per day in 2025 (**Figure 5**) led by growth in transportation uses, which account for 67 percent of total petroleum demand in 2003, increasing to 71 percent in 2025. Improvements in the efficiency of vehicles, planes, and ships are more than offset by growth in travel.

Total demand for natural gas is also projected to increase at an average annual rate of 1.5 percent from 2003 to 2025. About 75 percent of the growth in gas demand from 2003 to 2025 results from increased use in power generation and in industrial applications.

Total coal consumption is projected to increase from 1,095 million short tons in 2003 to 1,508 million short tons in 2025, growing by 1.5 percent per year. About 90 percent of the coal is currently used for electricity generation. Coal remains the primary fuel for generation and its share of generation is expected to remain about 50 percent between 2003 and 2025. Total coal consumption for electricity generation is projected to increase by an average of 1.6 percent per year, from 1,004 million short tons in 2003 to 1,425 million short tons in 2025.

Total electricity consumption, including both purchases from electric power producers and on-site generation, is projected to grow from 3,657 billion kilowatthours in 2003 to 5,467 billion kilowatthours in 2025, increasing at an average rate of 1.8 percent per year. Rapid growth in electricity use for computers, office equipment, and a variety of electrical appliances in the end-use sectors is partially offset in the *AEO2005* forecast by improved efficiency in these and other, more traditional electrical applications and by slower growth in electricity demand in the industrial sector.

Total marketed renewable fuel consumption, including ethanol for gasoline blending, is projected to grow by 1.5 percent per year in *AEO2005*, from 6.1 quadrillion Btu in 2003 to 8.5 quadrillion Btu in 2025, largely as a result of State mandates for renewable electricity generation and the effect of production tax credits. About 60 percent of the projected demand for renewables in 2025 is for grid-related electricity generation (including combined heat and power), and the rest is for dispersed heating and cooling, industrial uses, and fuel blending.

U.S. Energy Intensity

Energy intensity, as measured by primary energy use per dollar of GDP (2000 dollars), is projected to decline at an average annual rate of 1.6 percent in the *AEO2005*, with efficiency gains and structural shifts in the economy offsetting growth in demand for energy services (**Figure 6**). The projected rate of energy intensity decline in *AEO2005* falls between the historical averages of 2.3 percent per year from 1970 to 1986, when energy prices increased in real terms, and 0.7 percent per year from 1986 to 1992, when energy prices were generally falling. Between 1992 and 2003, energy intensity has declined on average by 1.9 percent per year. During this period, the role of energy-intensive industries in the U.S. economy fell sharply. Energy-intensive industries' share of industrial output declined 1.3 percent per year from 1992 to 2003. In the *AEO2005* forecast, the energy-intensive industries' share of total industrial output is projected to continue declining but at a slower rate of 0.8 percent per year, which leads to the projected slower annual rate of reduction in energy intensity.

Historically, energy use per person has varied over time with the level of economic growth, weather conditions, and energy prices, among many other factors. During the late 1970s and early 1980s, energy consumption per capita fell in response to high energy prices and weak economic growth. Starting in the late 1980s and lasting through the mid-1990s, energy consumption per capita increased with declining energy prices and strong economic growth. Per capita energy use is projected to increase in *AEO2005*, with growth in demand for energy services only partially offset by efficiency gains. Per capita energy use is expected to increase by an average of 0.5 percent per year between 2003 and 2025 in *AEO2005*.

U.S. Energy Production and Imports

Total energy consumption is expected to increase more rapidly than domestic energy supply through 2025. As a result, net imports of energy are projected to meet a growing share of energy demand. Net imports are expected to constitute 38 percent of total U.S. energy consumption in 2025, up from 27 percent in 2003 (**Figure 7**).

Petroleum. Projected U.S. crude oil production increases from 5.7 million barrels per day in 2003 to a peak of 6.2 million barrels per day in 2009 as a result of increased production offshore, predominantly in the deep waters of the Gulf of Mexico. Beginning in 2010, U.S. crude oil production is expected to start declining, falling to 4.7 million barrels per day in 2025. Total domestic petroleum supply (crude oil, natural gas plant liquids, refinery processing gains, and other refinery inputs) follows the same pattern as crude oil production in the *AEO2005* forecast, increasing from 9.1 million barrels per day in 2003 to a peak of 9.8 million barrels per day in 2009, then declining to 8.8 million barrels per day in 2025 (**Figure 8**).

In 2025, net petroleum imports, including both crude oil and refined products (on the basis of barrels per day), are expected to account for 68 percent of demand, up from 56 percent in 2003. Despite an expected increase in domestic refinery distillation capacity, net refined petroleum product imports account for a growing proportion of total net imports, increasing from 14 percent in 2003 to 16 percent in 2025.

In the U.S. energy markets, the transportation sector consumes about two-thirds of all petroleum products and the industrial sector about one-quarter. The remaining 10 percent is divided among the residential, commercial, and electric power sectors. With limited opportunities for fuel switching in the transportation and industrial sectors, large price-induced changes in U.S. petroleum consumption are unlikely, unless changes in petroleum prices are very large or there are significant changes in the efficiencies of petroleum-using equipment. **Figure 9** compares the impact of the *AEO2005* reference and high B world oil price cases on U.S. oil production, consumption, and imports.

Higher crude oil prices spur greater exploration and development of domestic oil supplies, reduce demand for petroleum, and slow the growth of oil imports in the high B world oil price case compared to the reference case. Total domestic petroleum supply in 2025 is projected to be 2.2 million barrels per day (24 percent) higher in the high B case than in the reference case. Production in the high B case includes 1.2 million barrels per day in 2025 of synthetic petroleum fuel produced from coal and natural gas (**Figure 10**). Total net imports in 2025, including crude oil and refined products, are reduced from 19.1 million barrels per day in the reference case to 15.2 million barrels per day in the high B case. As a result, the projected import share of total U.S. petroleum demand in 2025 is 58 percent in the high B world oil price case, compared with 68 percent in the reference case. In 2003, the import share of U.S. petroleum demand was 56 percent.

Natural Gas. Domestic natural gas production is projected to increase from 19.1 trillion cubic feet in 2003 to 21.8 trillion cubic feet in 2025 in *AEO2005* (**Figure 11**). Lower 48 onshore natural gas production is projected to increase from 13.9 trillion cubic feet in 2003 to a peak of 15.7 trillion cubic feet in 2012 before falling to 14.7 trillion cubic feet in 2025. Lower 48 offshore production, which was 4.7 trillion cubic feet in 2003, is projected to increase in the near term to 5.3 trillion cubic feet by 2014 because of the expected development of some large deepwater fields, including Mad Dog, Entrada, and Thunder Horse. After 2014, offshore production is projected to decline to about 4.9 trillion cubic feet in 2025.

Growth in U.S. natural gas supplies will depend on unconventional domestic production, natural gas from Alaska, and imports of LNG. Total nonassociated unconventional natural gas production is projected to grow from 6.6 trillion cubic feet in 2003 to 8.6 trillion cubic feet in 2025. With completion of an Alaskan natural gas pipeline in 2016, total Alaskan production is projected to increase from 0.4 trillion cubic feet in 2003 to 2.2 trillion cubic feet in 2025.

Three of the four existing U.S. LNG terminals (Cove Point, Maryland; Elba Island, Georgia; and Lake Charles, Louisiana) are all expected to expand by 2007, and additional facilities are expected to be built in the lower-48 States, serving the Gulf, Mid-Atlantic, and South Atlantic States, including a new facility in the Bahamas serving Florida via a pipeline. Another facility is projected to be built in Baja California, Mexico, serving a portion of the California market. Total net LNG imports in the United States and the Bahamas are projected to increase from 0.4 trillion cubic feet in 2003 to 6.4 trillion cubic feet in 2025.

Net Canadian imports are expected to decline from 2003 levels of 3.1 trillion cubic feet to about 2.5 trillion cubic feet by 2009. After 2010, Canadian natural gas imports in *AEO2005* increase to 3.0 trillion cubic feet in 2015 as a result of rising natural gas prices, the introduction of gas from

the Mackenzie Delta, and increased production from coalbeds. After 2015, because of reserve depletion effects and growing domestic demand in Canada, net U.S. imports are projected to decline to 2.6 trillion cubic feet in 2025.

Coal. As domestic coal demand grows in *AEO2005*, U.S. coal production is projected to increase at an average rate of 1.5 percent per year, from 1,083 million short tons in 2003 to 1,488 million short tons in 2025. Production from mines west of the Mississippi River is expected to provide the largest share of the incremental coal production. In 2025, nearly two-thirds of coal production is projected to originate from the western States (**Figure 12**).

U.S. Electricity Generation

In *AEO2005*, generation from both natural gas and coal is projected to increase through 2025 to meet growing demand for electricity. *AEO2005* projects that 1,406 billion kilowatthours of electricity (including generation in the end-use sectors) will be generated from natural gas in 2025, more than twice the 2003 level of about 630 billion kilowatthours (**Figure 13**). The natural gas share of electricity generation is projected to increase from 16 percent in 2003 to 24 percent in 2025. Generation from coal is projected to grow from about 1,970 billion kilowatthours in 2003 to 2,890 billion kilowatthours in 2025, with the share decreasing slightly from 51 percent in 2003 to 50 percent in 2025. Between 2004 and 2025, *AEO2005* projects that 87 gigawatts of new coal-fired generating capacity will be constructed.

Nuclear generating capacity in the *AEO2005* is projected to increase from 99.2 gigawatts in 2003 to 102.7 gigawatts in 2025 as a result of uprates of existing plants between 2003 and 2025. All existing nuclear plants are projected to continue to operate, but EIA projects that no new plants will become operational between 2003 and 2025. Total nuclear generation is projected to grow from 764 billion kilowatthours in 2003 to 830 billion kilowatthours in 2025 in *AEO2005*. The share of electricity generated from nuclear is projected to decline from 20 percent in 2003 to 14 percent in 2025.

The *AEO2005* reference case assumptions for the cost and performance characteristics of new nuclear technologies are based on cost estimates by Government and industry analysts, allowing for uncertainties about new, unproven designs. Two advanced nuclear cost cases analyze the sensitivity of the projections to lower costs for new nuclear power plants. The advanced nuclear cost case assumes capital and operating costs 20 percent below the reference case in 2025, reflecting a 28-percent reduction in overnight capital costs from 2005 to 2025. The vendor estimates case assumes reductions relative to the reference case of 18 percent initially and 38 percent by 2025. These costs are consistent with estimates from British Nuclear Fuels Limited for the manufacture of its advanced pressurized-water reactor (AP1000). Cost and performance characteristics for all other technologies are assumed to be the same as those in the reference case.

Projected nuclear generating costs in the advanced nuclear cost cases are competitive with the generating costs projected for new coal- and natural-gas-fired units toward the end of the projection period. In the advanced nuclear case, 7 gigawatts of new nuclear capacity are added by 2025, while the greater cost reductions in the vendor estimates case bring on 25 gigawatts by 2025 (**Figure 14**). The additional nuclear capacity displaces primarily new coal capacity.

Renewable technologies are projected to grow slowly in the *AEO2005* reference case because they are relatively capital intensive and they do not compete broadly with traditional fossil-fired generation. Where enacted, State renewable portfolio standards, which specify a minimum share of generation or sales from renewable sources, are included in the forecast. *AEO2005* includes the extension of the Federal production tax credit (PTC) for wind and biomass through December 31, 2005, as indicated in H.R. 1308, the Working Families Tax Relief Act of 2004. Total renewable generation in *AEO2005*, including combined heat and power generation, is projected to increase from 359 billion kilowatthours in 2003 to 489 billion kilowatthours in 2025, increasing 1.4 percent per year.

Current law has the PTC expiring at the end of 2005; however, since the enactment of the PTC in 1992, several previously established sunset dates have come and gone. In each instance, the credit has been extended, generally several months after expiration, with retroactive application. Thus, extension beyond the current 2005 expiration seems well within the realm of possibility. Given the uncertainty regarding the long-term fate of the PTC, EIA examined one possible outcome for an extension of the PTC. This case is not meant to represent any expectation about future policy decisions regarding the PTC, but rather to provide a useful indication of the impacts of the PTC program on future energy markets relative to the reference forecast, which assumes no extension of the PTC beyond 2005. This case is based on an "as-is" extension of the renewable electricity PTC program, as expanded by American Jobs Creation Act of 2004, to facilities placed in service by the end of 2015.

Figure 15 summarizes the impact of the extension of the PTC to 2015 in this alternative case. Wind power sees the largest projected gains, although landfill gas, geothermal, and dedicated, open-loop biomass resources all are projected to see some capacity expansion. Installed wind capacity in 2015 is almost 63 gigawatts in the PTC extension case, compared to 9.3 gigawatts in the reference case. This 580-percent increase in capacity results in a 650-percent increase in generation from the reference case projection for 2015 (206 billion kilowatthours in the PTC extension case compared to 27 billion kilowatthours in the reference case).

U.S. Carbon Dioxide Emissions

Carbon dioxide emissions from energy use are projected to increase from 5,789 million metric tons in 2003 to 8,062 million metric tons in 2025 in *AEO2005*, an average annual increase of 1.5 percent (**Figure 16**). The carbon dioxide emissions intensity of the U.S. economy is projected to fall from 558 metric tons per million dollars of GDP in 2003 to 397 metric tons per million dollars of GDP in 2025, an average decline of 1.5 percent per year. Projected increases in carbon dioxide emissions primarily result from continued reliance on coal for electricity generation and on petroleum fuels in the transportation sector.

Petroleum and Natural Gas Price Volatility

In your letter of invitation, Mr. Chairman, you also asked that we address energy price volatility. The *AEO2005*, a 20-year forecast, does not address daily or monthly swings in energy prices due to changes in the rate of economic growth, weather variation, or temporary supply disruptions. However, EIA has data as well as expertise that can be used to examine recent historical crude oil and natural gas price volatility and its most likely causes.

Petroleum Prices and Price Volatility

Recently, WTI crude oil on the NYMEX has traded at over $50 per barrel. The main reason behind the crude oil price increases seen since early 2004 is unexpected strong demand growth worldwide, which not only outstripped supply growth to tighten the world balance, but also reduced world excess crude oil production capacity to very low levels. A 2.7-million-barrel-per-day increase in global oil demand, largely due to significant growth in China and the United States, combined with only a 0.9-million-barrel increase in non-OPEC production, forced OPEC to produce very close to its capacity towards the end of 2004. This situation leaves little flexibility in the crude oil supply system. This tighter balance explains why prices have moved from the $30s to the $40s and $50s, with concerns about future supplies pushing prices higher.

While crude oil prices have more than doubled over the $20-per-barrel prices experienced in the 1990s, volatility, which is a measure of short-term price fluctuations on a percentage basis, also clearly has increased in the last 5-year period compared with the early-to-mid 1990s (**Figure 17**). Volatility, because of the way it is defined, may stay relatively constant when overall prices are increasing even though absolute price fluctuations are increasing sharply (**Figure 18**). For consumers, the magnitude of absolute price changes is of most concern. For example, 5-cent-per-gallon gasoline price fluctuations on a base price of $1.00 are equivalent in the traditional volatility sense to 10-cent-per-gallon fluctuations on a $2.00-per-gallon base price. However, in the second case, the consumer is not only paying more for the gasoline, but is also having to deal with larger price variations. **Figure 19** shows that consumers rarely saw weekly changes above 2 cents per gallon during the 1990s, but since 2000, fluctuations have increased, with occasional weekly changes over 6 cents per gallon, which were not seen during the 1990s.

Crude oil price volatility normally passes through to the markets for petroleum products, such as gasoline, diesel fuel, and heating oil. Because crude oil costs are by far the largest component of product costs, product and crude oil prices tend to move together. In addition, product markets have their own volatility over and above crude oil. As a result, gasoline price volatility is higher than crude price volatility. The tighter world petroleum market since 2000 has resulted in low product inventories as well as low crude oil inventories. When an unexpected loss of product supply or an increase in demand occurs, product prices will rise over and above crude oil prices until new supply enters the market, The longer the time for re-supply, the larger the price increase.

U.S. product markets have evolved in a way that adds to the potential for product price volatility apart from crude oil. The continued growth in domestic petroleum demand has increased U.S. refinery capacity utilization to the point that little excess refinery production capacity is available during peak demand months to help cover unexpected needs. At the same time, the delivery system has been strained both by growing demand and an increasing number of distinct fuel types being used to provide cleaner-burning fuels to consumers. Such fragmentation of the market can slow down the supply system's ability to re-supply areas that experience unexpected supply problems, such as a refinery of pipeline outage. However, to date, this does not seem to have resulted in major regional price spikes outside of California and the Midwest. The move to cleaner-burning fuels may also affect imports in a way that could add to volatility. For example, the sulfur reductions in gasoline and diesel and some States' bans on methyl tertiary butyl ether (MTBE) use in gasoline limit the number of import sources that can serve U.S. markets. While

the remaining sources have been able to meet our needs, the U.S. has fewer places to turn when unexpected supply-demand imbalances occur, which can delay supply response and create larger price swings. While the import situation will likely improve as the world continues to move to cleaner-burning fuels, today, U.S. import supply for petroleum products is more constrained than during the 1990s.

Natural Gas Prices and Price Volatility

Natural gas spot prices at the Henry Hub recently have been around $7 per thousand cubic feet, which exceeds the levels for all but a few periods since the beginning of 2000. The average monthly wellhead price for the first 2 months of 2005 has been above $5.50 per thousand cubic feet. This is almost three times the average price during the 1990s. Factors contributing to the recent relatively high prices include flat or declining U.S. natural gas production, limited growth in net imports, high petroleum prices, increasing industrial demand driven by the economic recovery, and expanding stocks of gas burning equipment in households and electric power generation. Approximately 84 percent of U.S. supplies come from domestic production. The declining productivity of new gas wells means that any need for additional supplies can be met primarily with higher cost production, if at all. This supply tightness contributes to higher prices and price volatility.

Natural gas supply has been tight since mid-2002, exhibiting a higher overall price level with periods of significant volatility (**Figure 20**). A severe cold spell and low levels of working gas in storage during the first quarter of 2003 resulted in severe price volatility. In 2003, natural gas wellhead prices rose, peaking at $6.96 per thousand cubic feet for the month of March. Since then, although prices have declined somewhat, they remain at historically high levels. Price volatility has not been as severe since. The mild summer and winter in 2004 resulted in a decline in volatility from the relatively high level experienced in 2003. However, during this time, increasing industrial demand for natural gas, shut-in natural gas production in the Gulf of Mexico, and increasing world crude oil and heating oil prices have put upward pressure on natural gas prices. With a tight natural gas demand and supply balance and limited short-term substitutability in the natural gas market, fluctuations in supply or demand owing to weather, transmission congestion, or supply disruptions create the potential for large swings in prices.

Owing to the short-run relative inelasticity of supply and demand, levels of natural gas in storage are a critical element in managing short-term fluctuations in demand and supply. During the period since 1993, natural gas prices have become most volatile as the level of natural gas in storage falls. As of the end of February 2005, working gas in storage was more than 25 percent above the 5-year average. This should help mitigate natural gas price volatility during the remainder of 2005. However, weather and its relation to gas-fired power generation could jeopardize the stability of gas markets during the upcoming summer months. The dependence on gas-fired power generation is heightened because of a prolonged drought in the West, which has reduced available electricity from hydroelectric generation.

Imports have continued to play a crucial role in balancing U.S. natural gas supply and demand, with net imports contributing almost 16 percent of U.S. consumption in 2004. However, continued growth of natural gas demand in Canada and maturing producing fields has dimmed

prospects for growth in imports from Canada. After 16 years of steady growth, Canadian sales to the United States declined in 2003 with only a partial recovery last year. However, imports of LNG to the continental United States have expanded dramatically in recent years, reaching 652 billion cubic feet in 2004, which is a new annual record. LNG imports to the continental United States in 2004 represented about 3.5 percent of U.S. dry production and 16 percent of total natural gas imports.

Substantial demand reductions seem unlikely in the near future as demand growth continues in the residential, commercial, and electric power sectors. Demand for natural gas traditionally has been highly seasonal, depending strongly on the weather changes. The seasonal character of natural gas demand is driven by its principal use in the residential and commercial sectors for space and water heating, causing demand peaks and price spikes during the cold weather months of the year. When severe winter weather strikes, residential and much of commercial consumption tends to be unresponsive to price increases. This demand inelasticity, in conjunction with the capacity constrained supply, often results in relatively large price changes as weather varies during the heating season.

Price volatility in the natural gas market does not appear to have changed appreciably since 1993. During this time, there have been several occasions of extreme price volatility. These periods of high volatility in the natural gas market typically occur during the heating season months when demand peaks and supplies are most constrained. Natural gas prices remain significantly volatile compared with most other commodities. Moreover, in terms of absolute price changes, variability in the natural gas market has increased since 2000 (**Figure 21**). These higher absolute price swings could pose significant challenges for consumers of natural gas in the future.

Conclusions

Continuing economic growth in the United States is expected to stimulate more energy demand, with fossil fuels remaining the dominant source of energy. Dependence on foreign sources of oil is expected to increase significantly in the United States. Petroleum imports that accounted for 56 percent of total U.S. petroleum demand in 2003 are expected to account for 68 percent of total demand by 2025 and the United States alone is expected to account for about 20 percent of the world increase in projected oil demand through 2025, with most of the increase resulting from increased consumption for transportation. This strong growth in oil consumption adds to pressure on world oil prices and can lead to increased price volatility.

Furthermore, although natural gas production in the United States is expected to increase, natural gas imports, particularly LNG, is expected to grow rapidly. Total net LNG imports in the United States and the Bahamas are projected to increase from 0.4 trillion cubic feet in 2003 to 6.4 trillion cubic feet in 2025. In the United States, reliance on domestic natural gas supply to meet demand is projected to fall from 86 percent in 2003 to 72 percent in 2025. The growing dependence on imports in the United States occurs despite efficiency improvements in both the consumption and the production of natural gas. Uncertainty about the adequacy and timing of the investment capital needed to put the infrastructure in place to allow for this level of imports adds to the uncertainty about future energy prices. Again, this can lead to increased price volatility.

This concludes my testimony, Mr. Chairman and members of the Committee. I will be happy to answer any questions you may have.

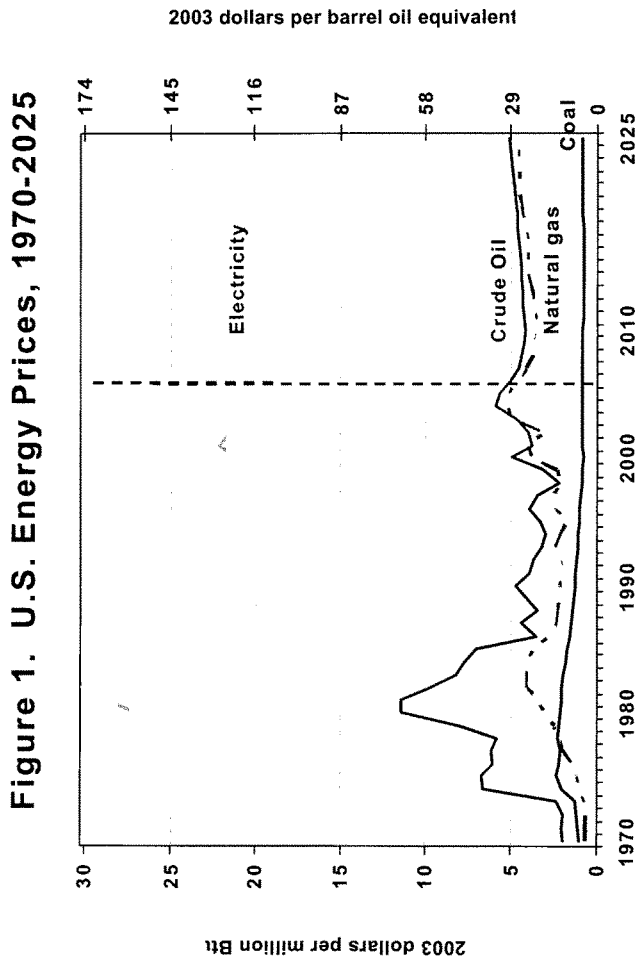
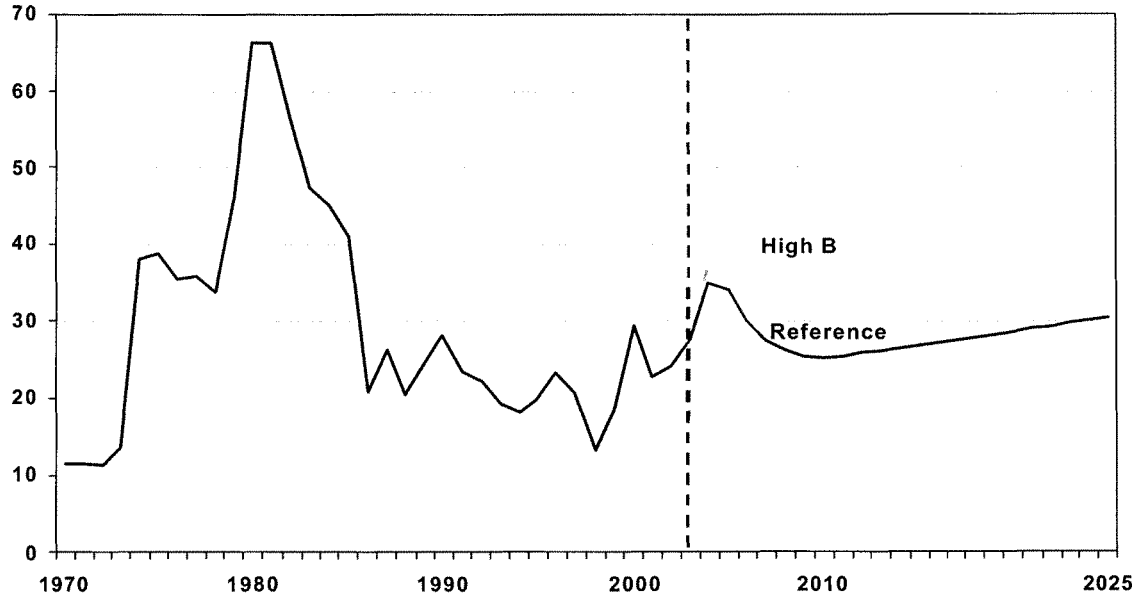


Figure 1. U.S. Energy Prices, 1970-2025
2003 dollars per barrel oil equivalent
2003 dollars per million Btu
Electricity
Crude Oil
Natural gas
Coal
174
145
116
87
58
29
0
30
25
20
15
10
5
0
1970
1980
1990
2000
2010
2025

Figure 2. World Oil Price in two cases, 1970-2025 (2003 dollars per barrel)



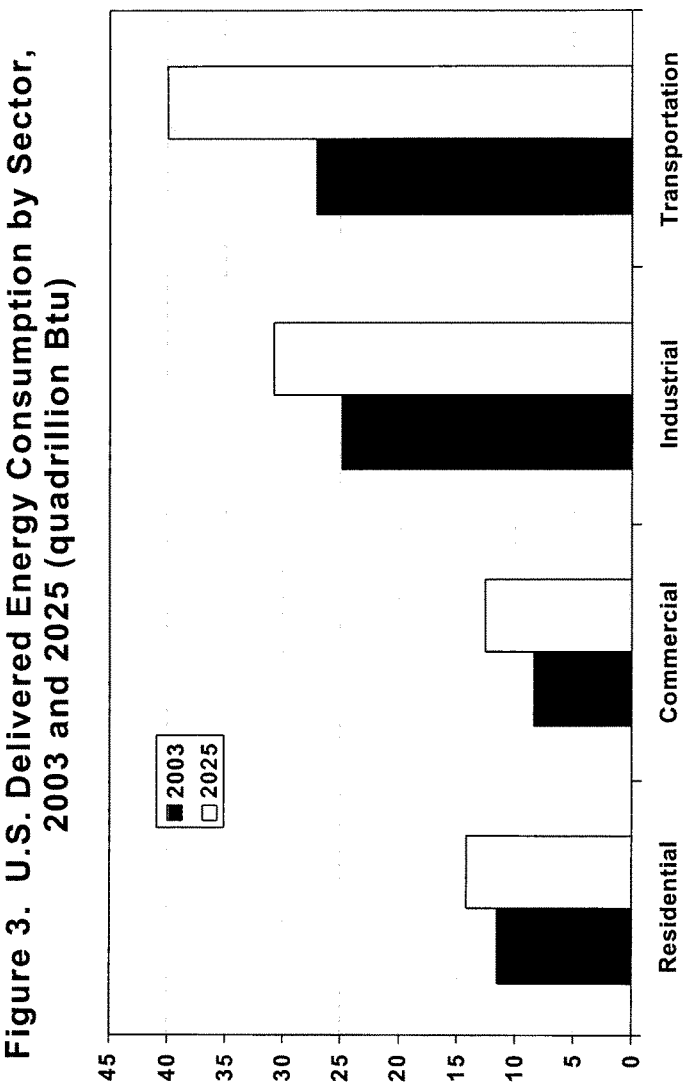


Figure 3. U.S. Delivered Energy Consumption by Sector, 2003 and 2025 (quadrillion Btu)
2003
2025
45
40
35
30
25
20
15
10
5
0
Residential
Commercial
Industrial
Transportation

Figure 4. U.S. Energy Consumption in Three Cases, 1960-2025 (quadrillion Btu)

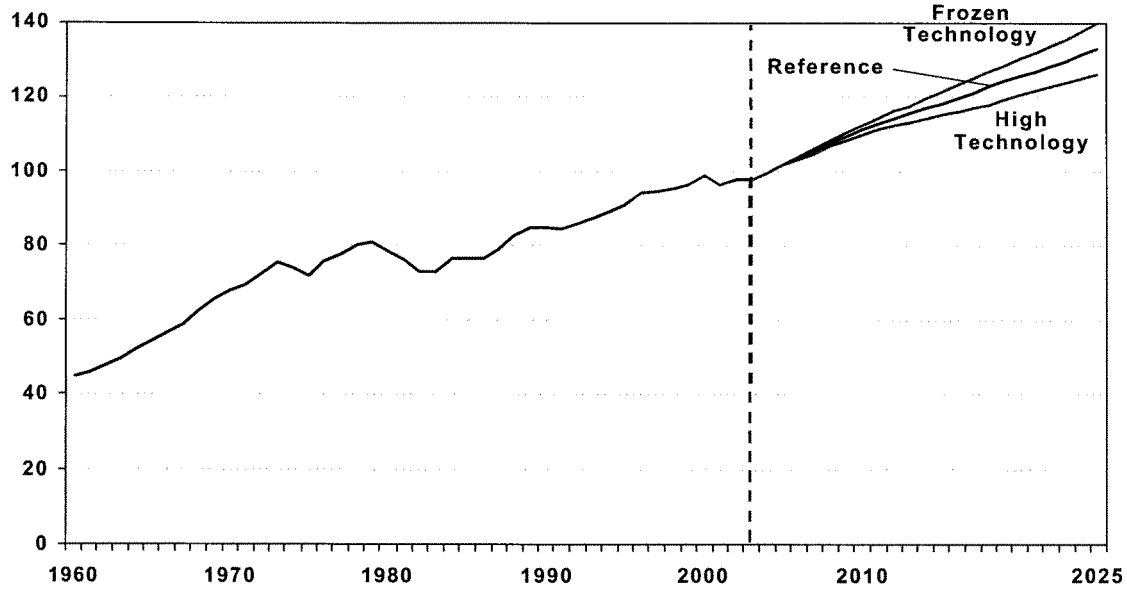


Figure 5. U.S. Energy Consumption by Fuel, 1970-2025 (quadrillion Btu)

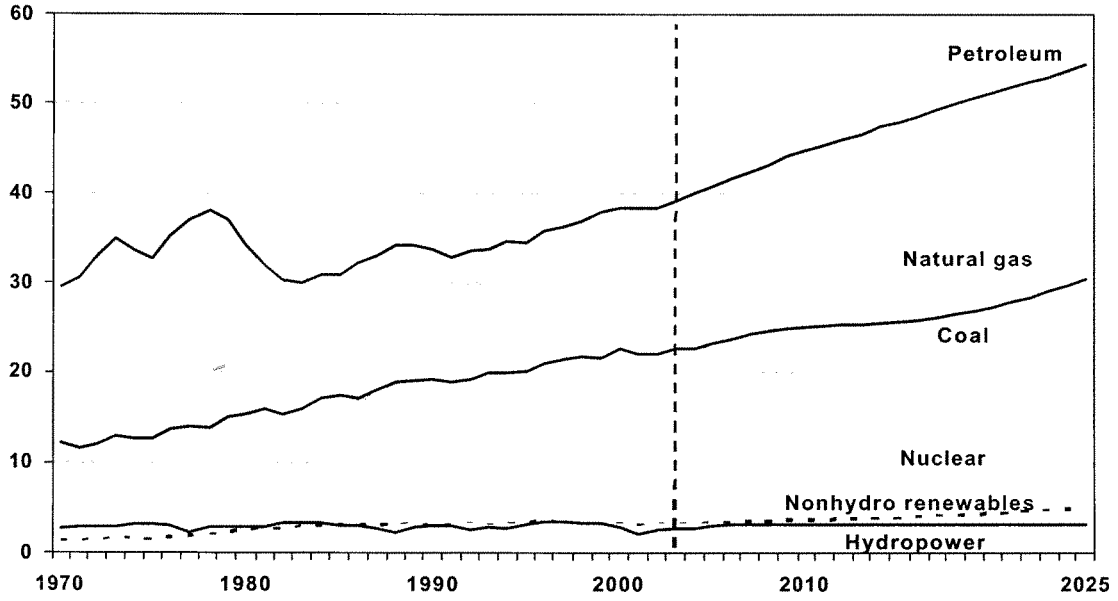


Figure 6. U.S. Energy Use per Capita and per Dollar of Gross Domestic Product, 1970-2025 (index, 1970 = 1)

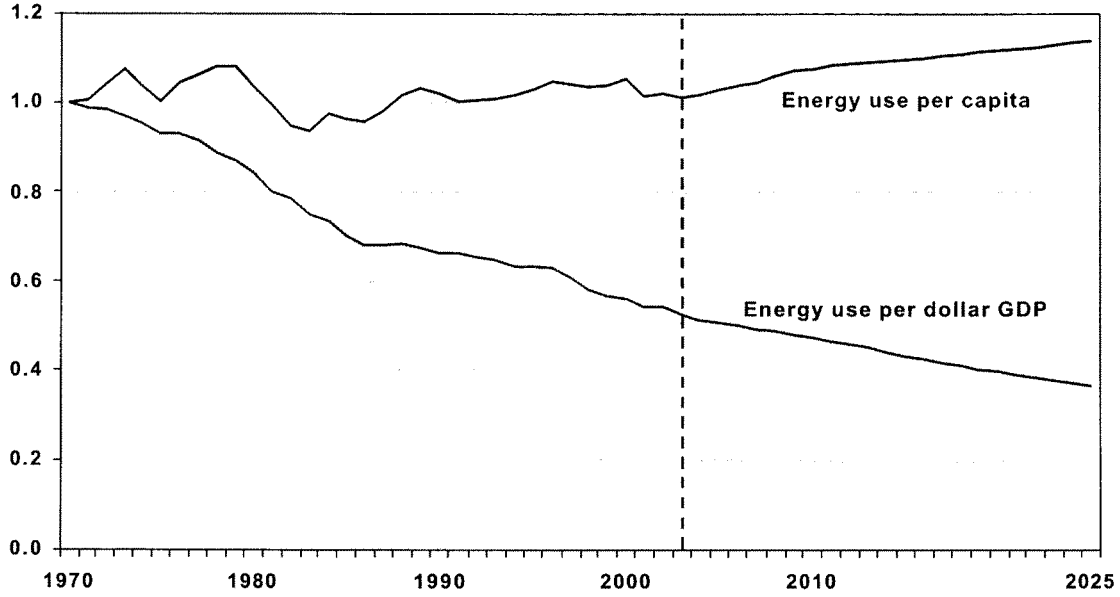


Figure 7. U.S. Energy Production, Consumption, and Net Imports, 1960-2025 (quadrillion Btu)

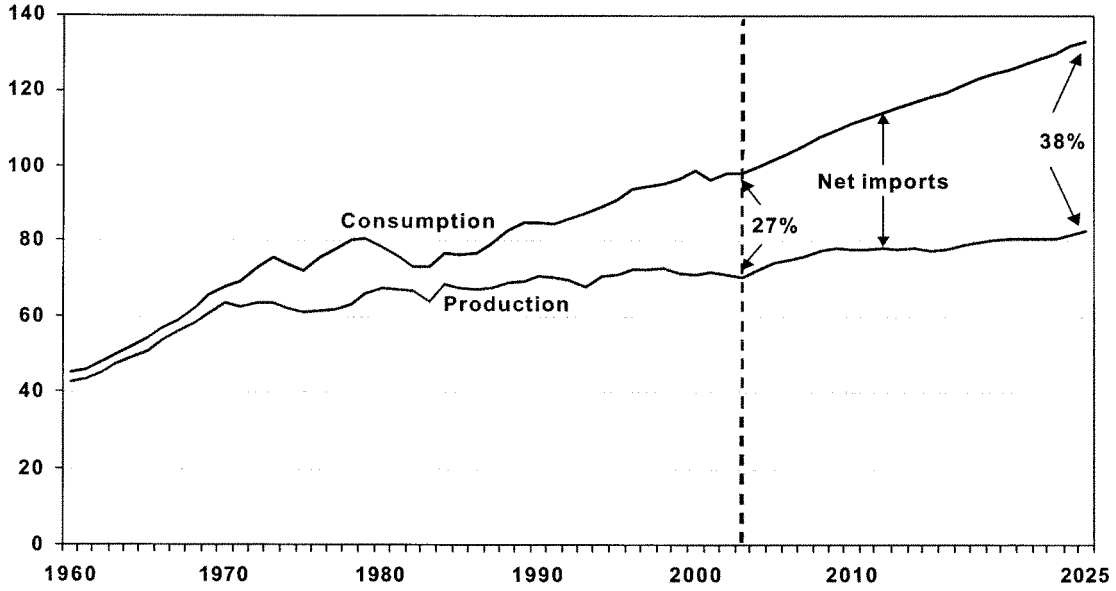


Figure 8. U.S. Petroleum Supply, Consumption, and Imports, 1970-2025 (million barrels per day)

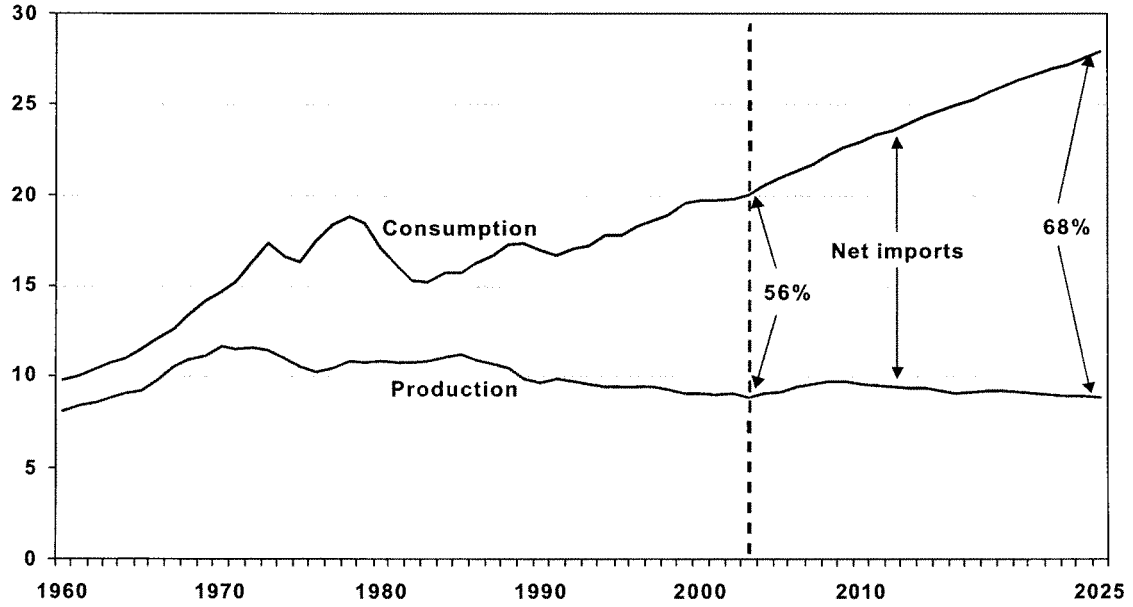
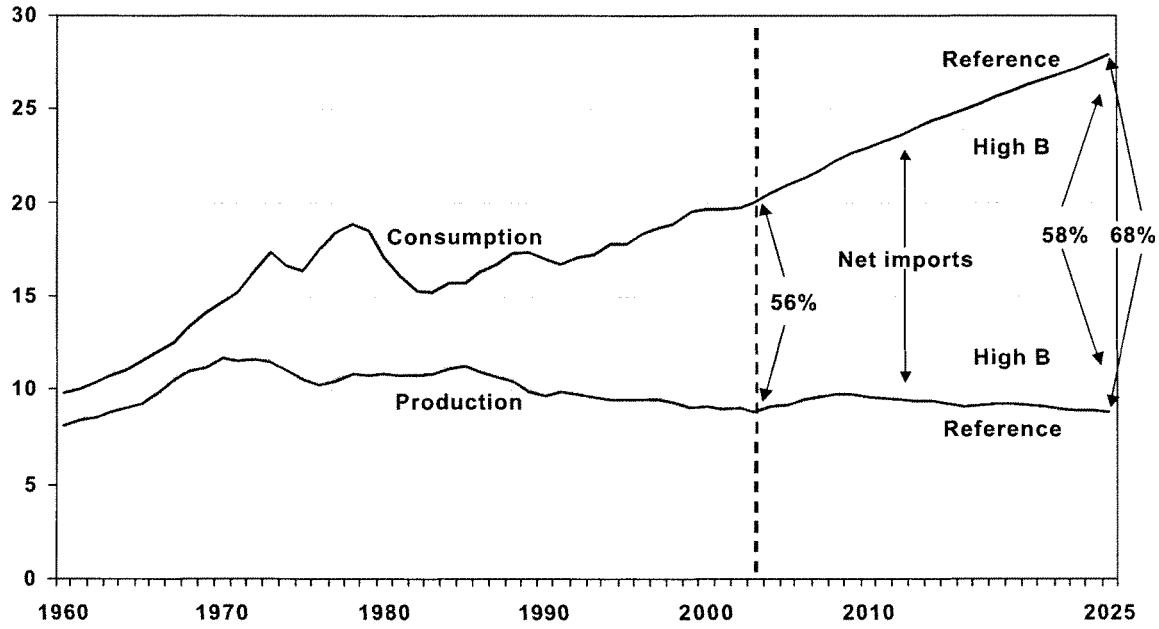
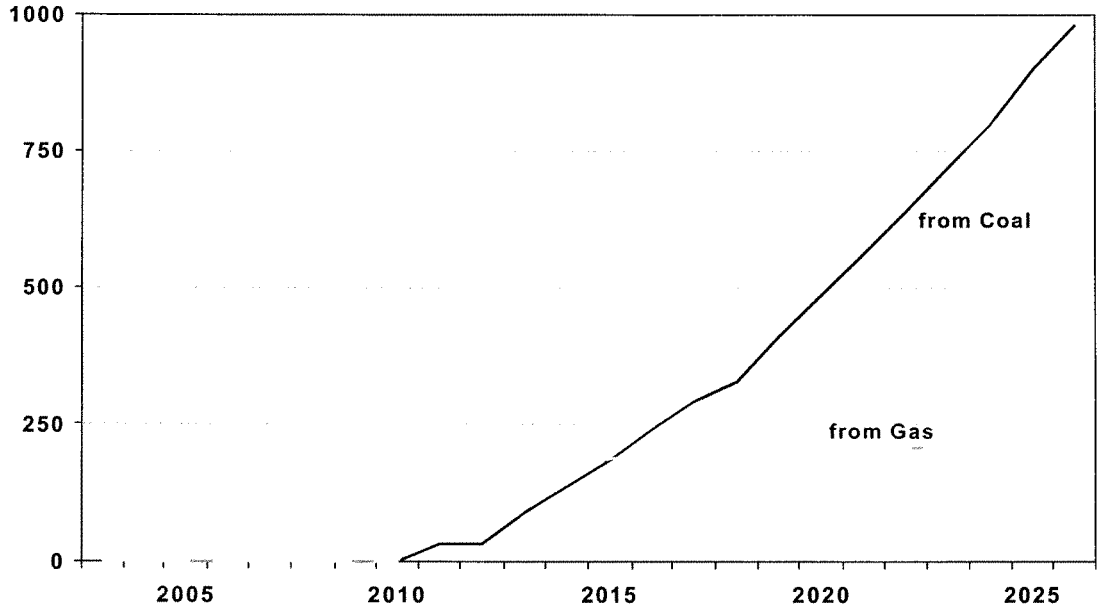


Figure 9. Petroleum Supply, Consumption, and Imports, in Two Cases 1970-2025 (million barrels per day)



67

Figure 10. Petroleum Liquids Supply from Coal and Natural Gas in the High B Case, 2003-2025 (thousand barrels per day)



68

Figure 11. U.S. Natural Gas Production, Consumption, and Imports, 1970-2025 (trillion cubic feet)

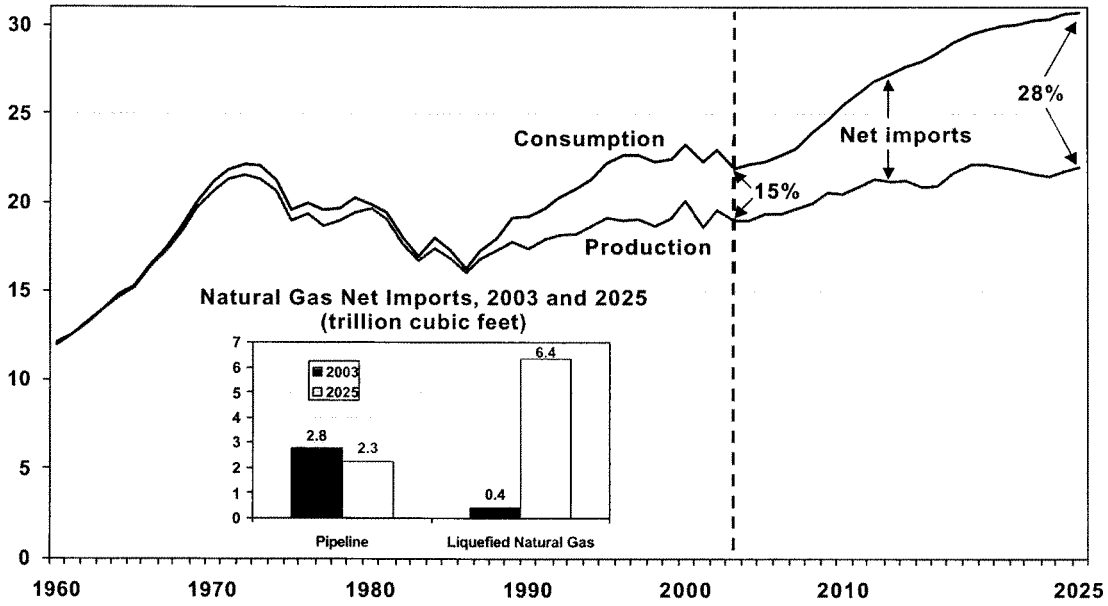


Figure 12. U.S. Coal Production by Region, 1970-2025 (million short tons)

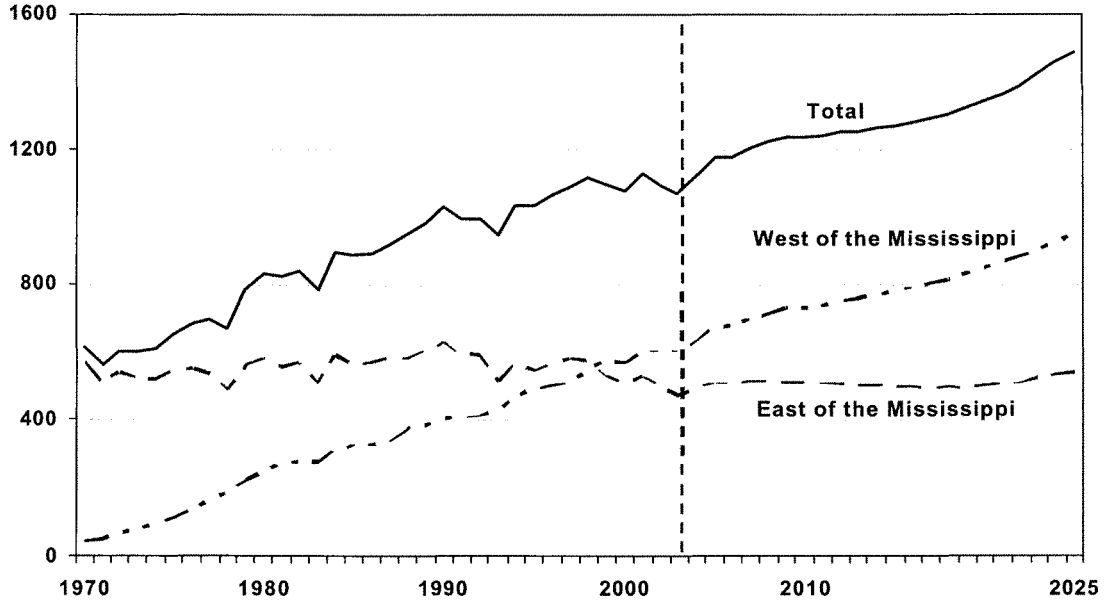
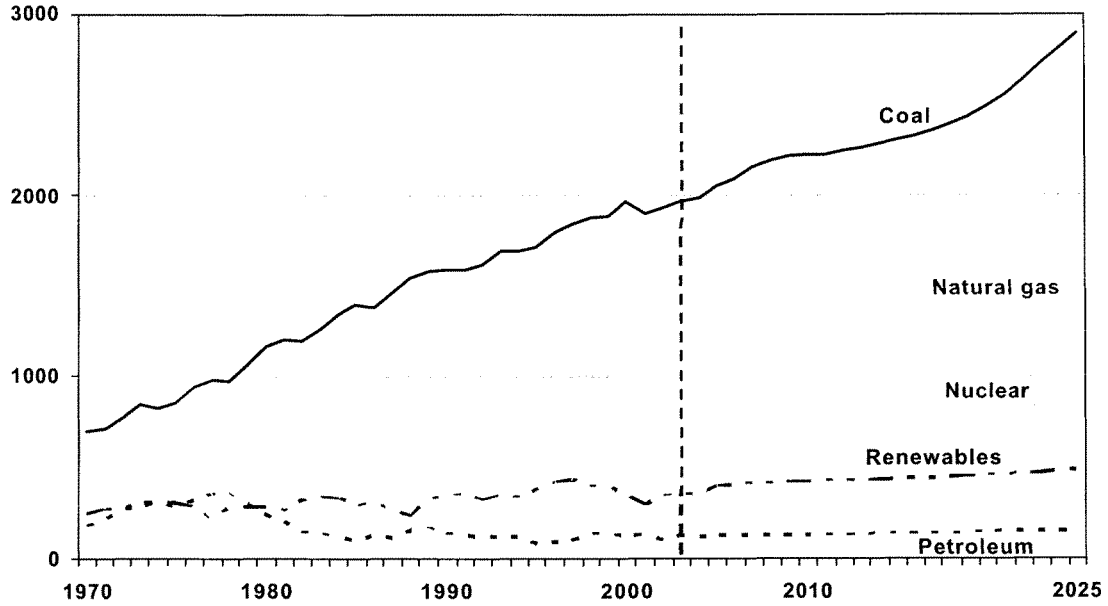


Figure 13. U.S. Electricity Generation by Fuel, 1970-2025 (billion kilowatthours)



71

Figure 14. Electricity Generation Capacity by Nuclear Power in Three Cases, 1970-2025 (gigawatts)

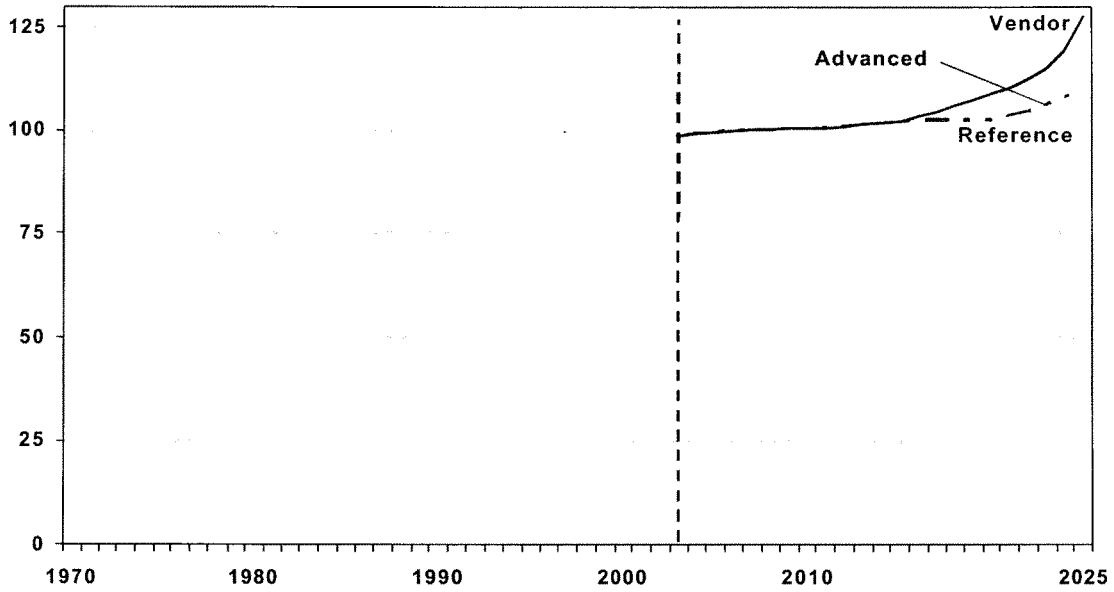


Figure 15. Renewable Electricity Generation Capacity in Two Cases, 2015 and 2025 (billion kwh)

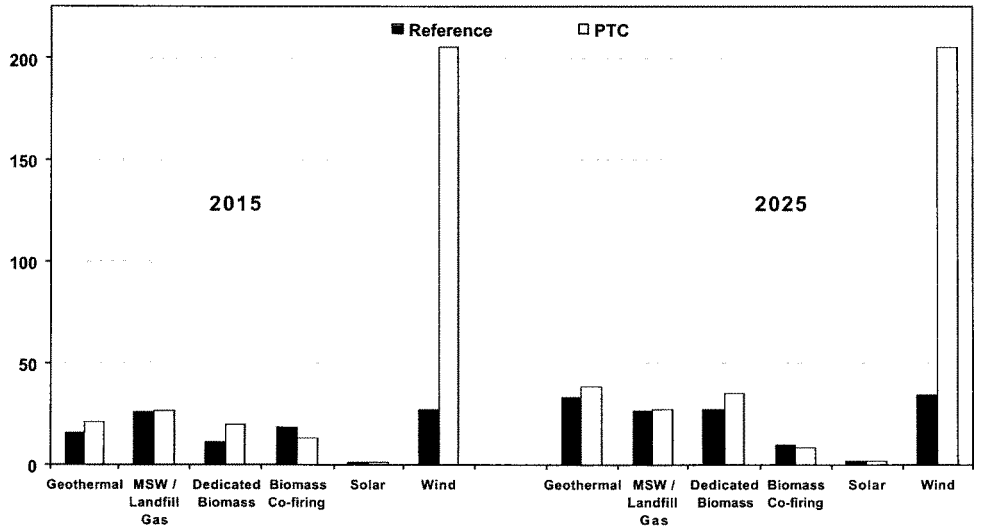


Figure 16. U.S. Carbon Dioxide Emissions by Fuel and Sector, 1970-2025 (million metric tons)

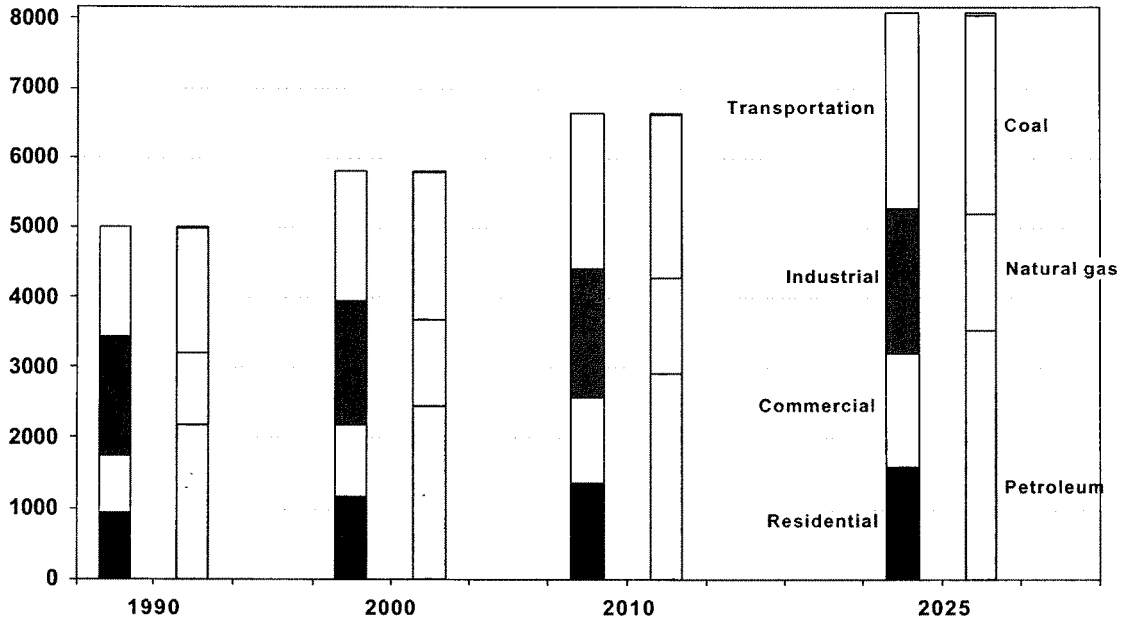
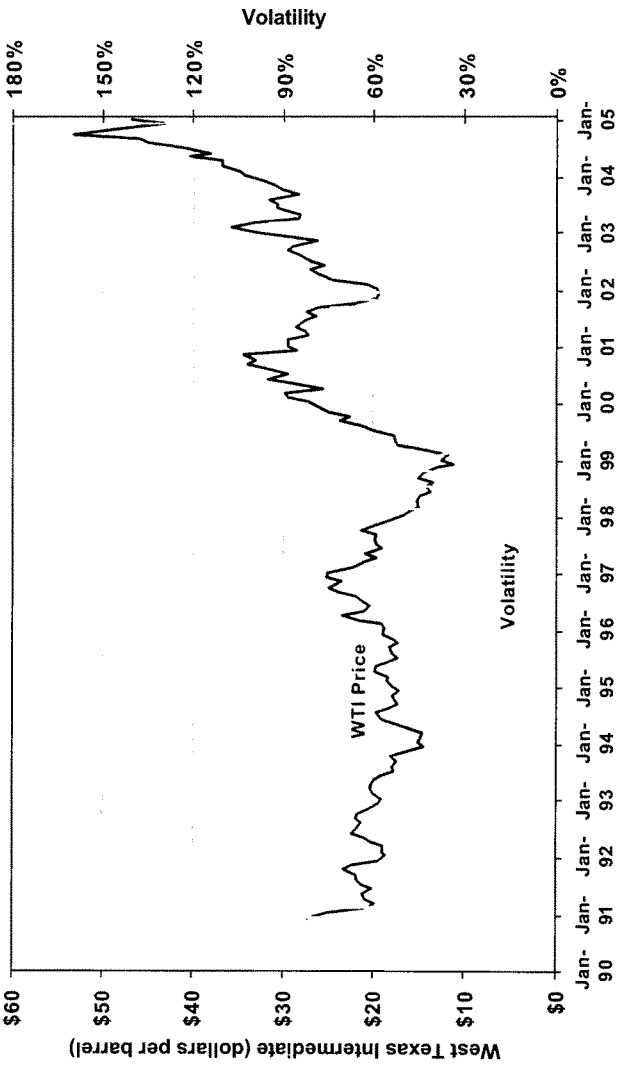


Figure 17. Monthly WTI Crude Oil Price and Volatility, January 1991 to January 2005



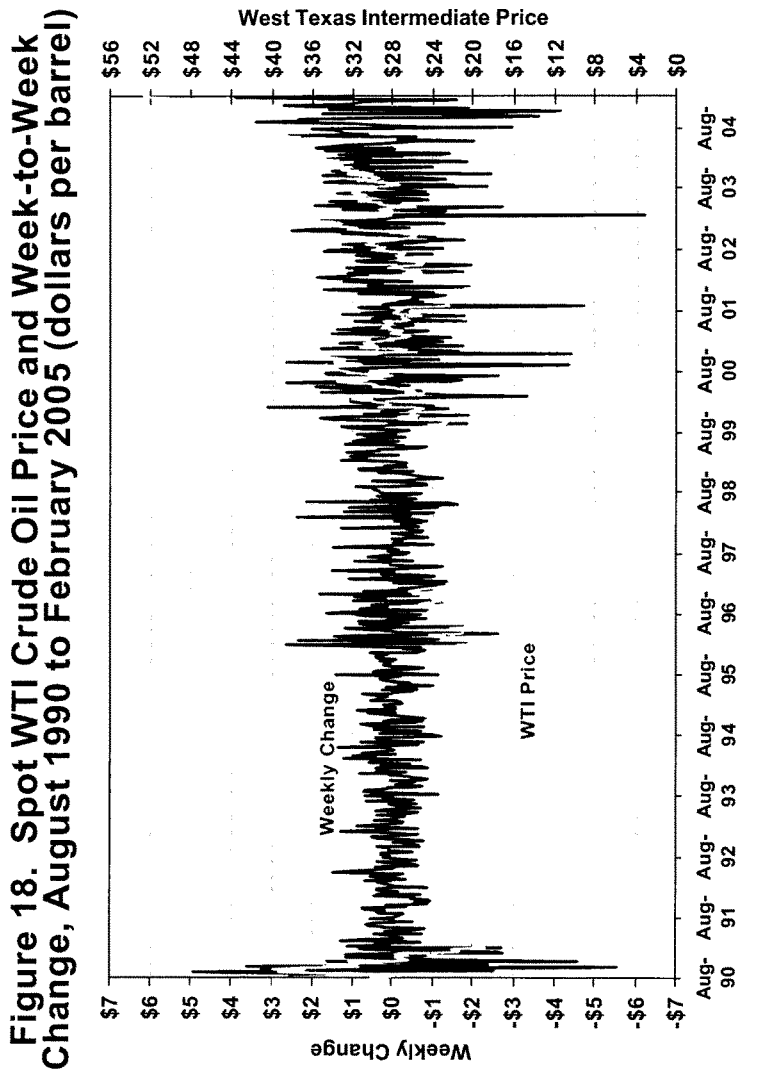


Figure 18. Spot WTI Crude Oil Price and Week-to-Week Change, August 1990 to February 2005 (dollars per barrel)

Figure 19. Retail Regular Gasoline Price and Week-to-Week Change, August 1990 to February 2005 (cents per gallon)

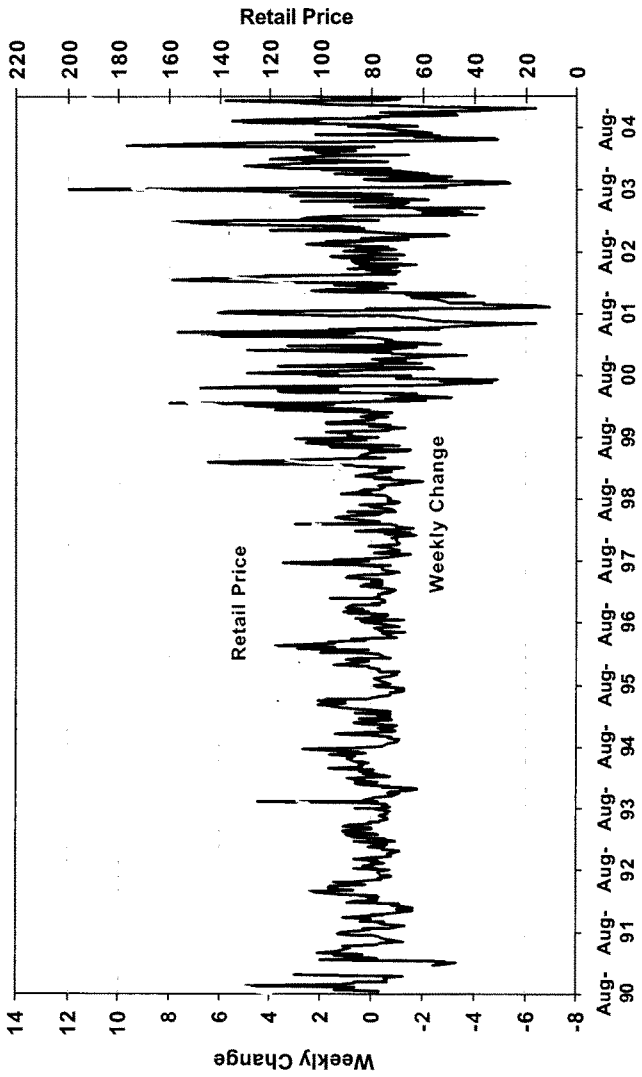


Figure 20. Monthly Natural Gas Spot Price Volatility and Wellhead Price, July 1993 to March 2005

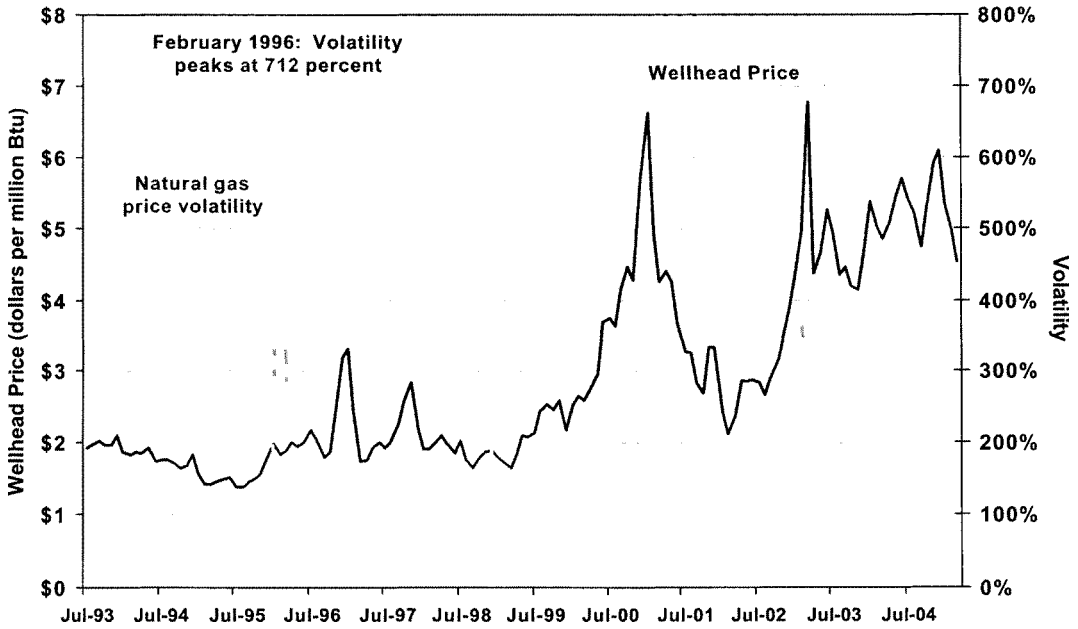
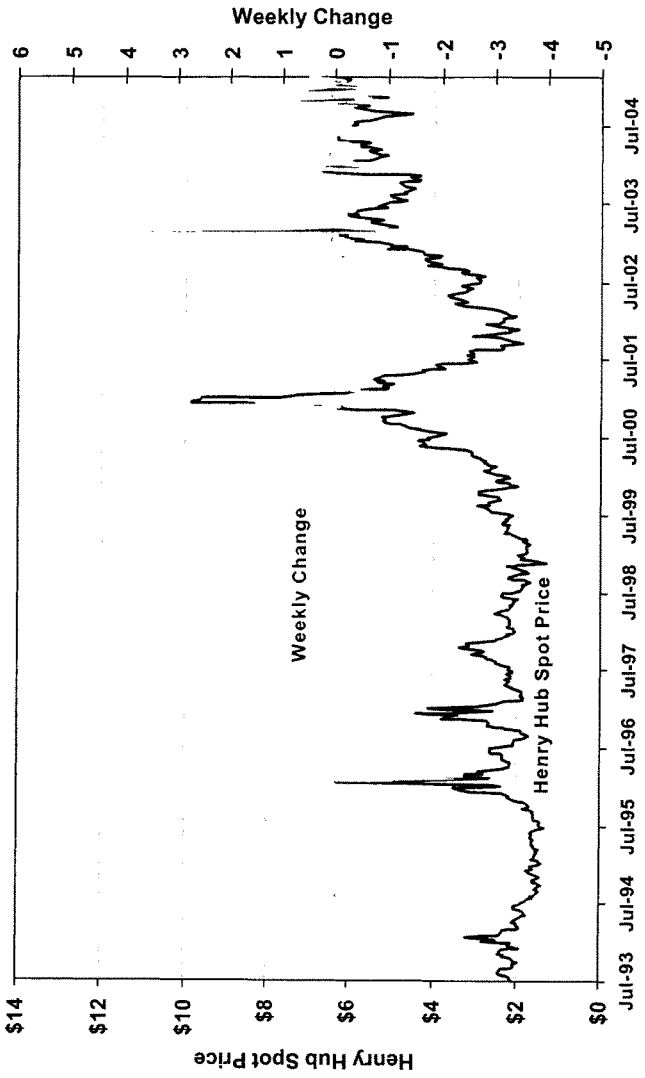


Figure 21. Henry Hub Spot Price and Week-to-Week Change, July 1993 to February 2005 (dollars per million Btu)



Charts to Accompany

Guy Caruso Oral Statement

Subcommittee on Energy and Resources

Committee on Government Reform

March 16, 2005, 2:00 p.m.

Figure 1. U.S. Energy Production, Consumption, and Net Imports, 1960-2025 (quadrillion Btu)

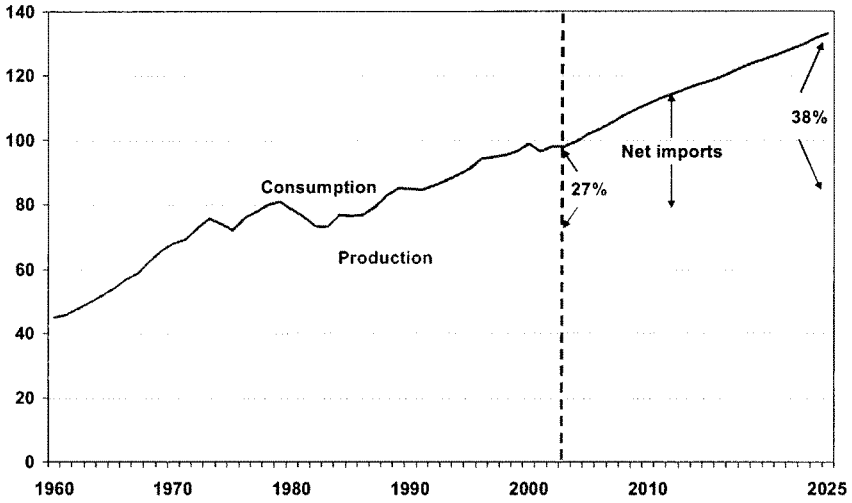


Figure 2. U.S. Petroleum Supply, Consumption, and Imports, 1970-2025 (million barrels per day)

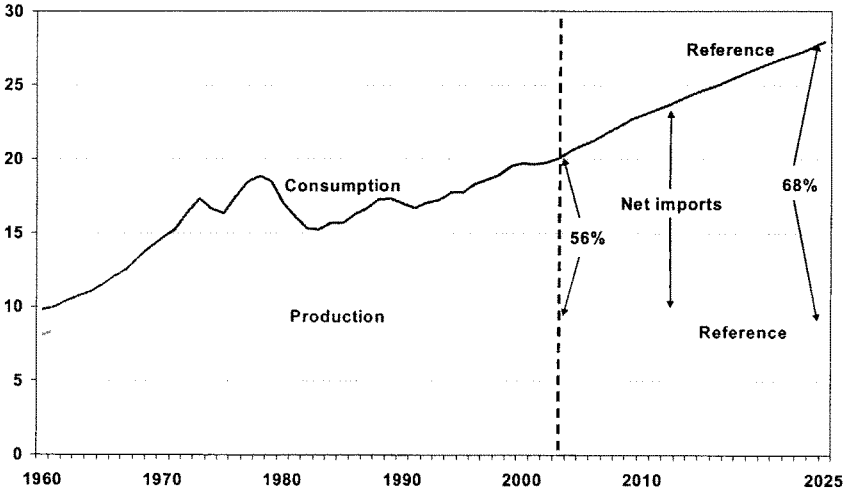


Figure 3. U.S. Natural Gas Production, Consumption, and Net Imports, 1970-2025 (trillion cubic feet)

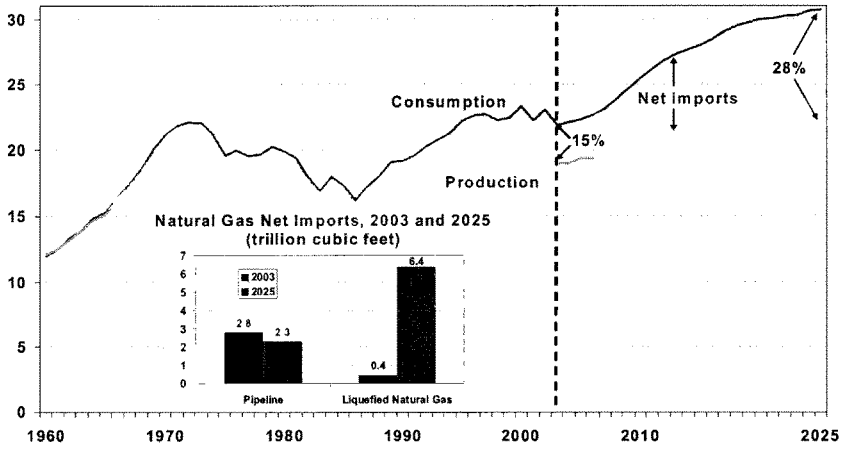


Figure 4. U.S. Electricity Generation by Fuel, 1970-2025 (billion kilowatthours)

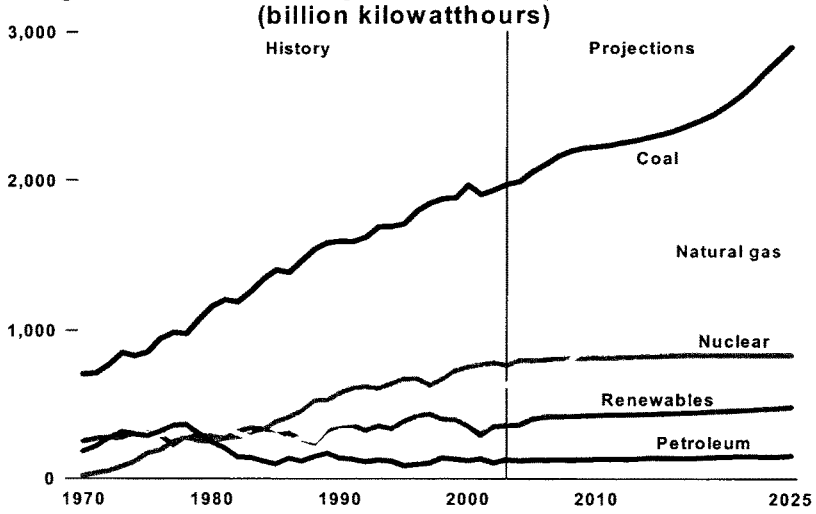


Figure 5. Monthly WTI Crude Oil Price and Volatility, January 1991 to January 2005

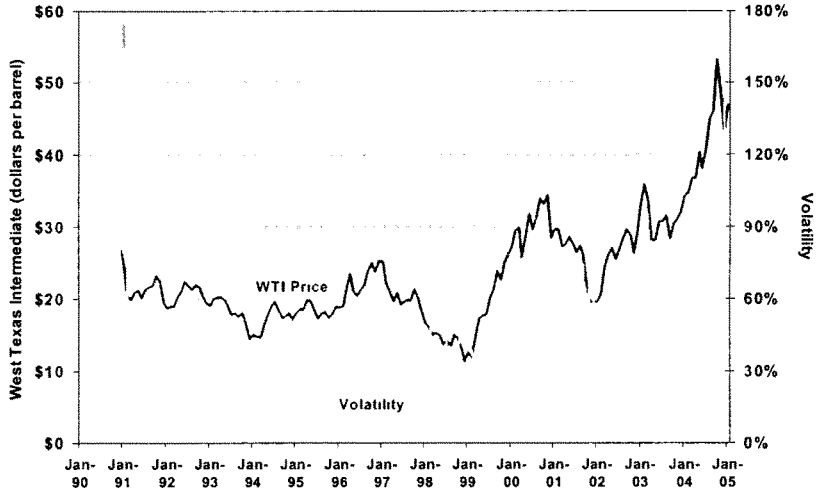
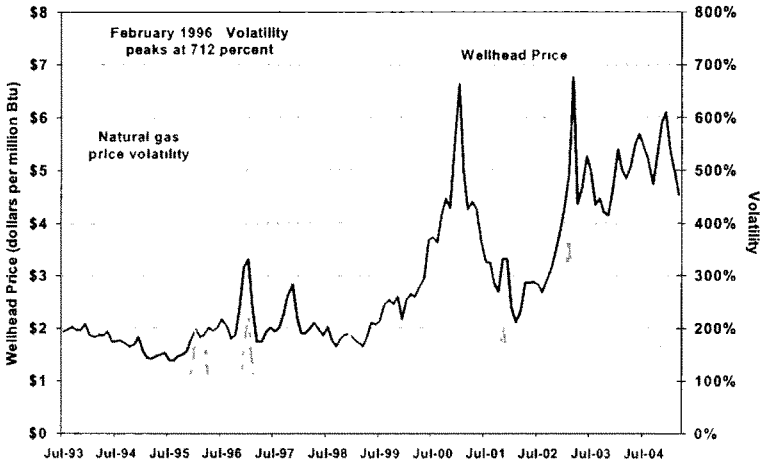


Figure 6. Monthly Natural Gas Spot Price Volatility and Wellhead Price, July 1993 to March 2005



Mr. ISSA. Thank you, Mr. Caruso; we have been joined by Mr. Brian Higgins of New York and the ranking member, Diane Watson of California. Diane, do you want to do an opening statement now, or do the final testimony and then do your opening statement and questions?

Ms. WATSON. Well, it is going to be short, so I will just do it now. Thank you so much, Mr. Chairman. I am sorry I was late. I was taking care of a little business on the floor.

Mr. ISSA. And very well, I am sure.

Ms. WATSON. I appreciate your help. This is the beginning of several days of hearings on the energy policy, and I am sure that was stated by our Chair.

Energy is almost like food and water in the American lifestyle. It keeps us warm in the winter. It gets us to and from work. It cooks our meals and it lights our way. We use it to record the memories of our children, to play our music, and to entertain us. In short, we have a desperate need for it.

It has become one of those commodities that we almost take for granted. Yet, we should not take it for granted, for many reasons. The generation and the delivery of energy is a serious challenge; a challenge of engineering, a challenge of planning, and even a challenge that evokes the most serious aspects of our foreign policy.

Energy costs represent a large and growing household expense to all Americans, and energy is a key factor in the environmental challenges we face in modern America. These issues are important to the American people, and when they stare at the gas pump, amazed at the price of gasoline, that hits people in their pocketbooks.

When their lights go out, because of deferred maintenance or even market abuses, our constituents are deeply and rightfully unhappy. When they learn that the money that they send overseas for energy imports is popping up in some despotic regimes, believe me, Americans care. When they learn that the sea level is rising and the water supplies are threatened, people then become very, very worried.

This was really brought home to the people in the State of California a few years ago, when big energy companies were allowed to run amuck. By now, many of you have heard the tape recordings of the Enron power traders laughing at how they were taking advantage of the elderly in California.

Well, it is not just Enron, and it was not just the elderly. We still have not put all the pieces back together, and California may never be compensated for the billions of dollars in overcharges that we suffered. But we must try to make things right and make sure that it never happens again.

These issues are important to the American people. They are important to Californians. They expect us to find solutions to them, and that is our job. I am glad that Chairman Issa has convened a hearing to help us do just that.

In the past, we have seen an ideological approach to energy that has resulted in a stalemate. It produced a bill that did not address our Nation's challenges, but just gave away new and larger subsidies to the big energy companies.

So in opposing this approach, and fortunately, the Senate refused to pass it, I hope we can together find new approaches. In this Congress, we have a chance to start again. We can build a bi-partisan consensus on energy policy, and steer our country through the challenges that we all face. We know it can be done.

The National Commission on Energy Policy brought together business, labor, Republicans, Democrats, and developed an approach that they agreed could work. We can do the same, and I truly hope we decide to do so. Again, Mr. Chairman, thank you for this opportunity.

[The prepared statement of Hon. Diane E. Watson follows:]

Opening Statement
Congresswoman Diane E. Watson
Subcommittee on Energy and Natural Resources - Ranking Member
Hearing: Energy Demand in the 21st Century – Are Congress and the Executive Branch Meeting the Challenge?
March 16, 2005

Mr. Chairman, thank you for convening today's hearing. I understand that today will be the first of several days of hearings on energy policy.

Energy is almost like food and water in the American lifestyle. It keeps us warm in the winter, gets us to and from work, cooks our meals and lights our way. We use it to record the memories of our children, play our music, and entertain us. In short, we need it. It has become one of those commodities that we almost take for granted.

And yet we shouldn't take it for granted for so many reasons. The generation and delivery of energy is a serious challenge – a challenge of engineering, a challenge of planning, and even a challenge that evokes the most serious aspects of our foreign policy. Energy costs represent a large and growing household expense for all Americans. And energy is a key factor in the environmental challenges we face in modern America.

These issues are important to the American people. When they stand at the gas pump amazed at the price of gasoline, that hits people in their pocketbooks. When their lights go out because of deferred maintenance or even market abuses, our constituents are deeply and rightfully unhappy. When they learn that the money they send overseas for energy imports is propping up some despotic regime, believe me, Americans care. When they learn that the sea level is rising and water supplies are threatened, people are worried.

This was really brought home to the people in my state a few years ago when big energy companies were allowed to run amuck. By now, many of you have heard the tape recordings of Enron power traders

laughing at how they were taking advantage of the elderly in California. Well it wasn't just Enron and it wasn't just the elderly. We still haven't put all the pieces back together and California may never be compensated for the billions of dollars in overcharges they suffered. But we must try to make things right and make sure that it never happens again.

These issues are important to the American people, and they expect us to find solutions to them. That is our job. I am glad that Chairman Issa has convened a hearing to help do that.

In the past we have seen an ideological approach to energy that has resulted in stalemate. It produced a bill that didn't address our nation's challenges, but just gave away new and larger subsidies to big energy companies. I opposed this approach and fortunately the Senate refused to pass it.

In this Congress, we have a chance to start again. We can build a bipartisan consensus on energy policy and steer our country through the challenges we face. We know it can be done. The National Commission on Energy Policy brought together business and labor, Republican and Democrat and developed an approach that they agreed could work. We can do the same, and I truly hope we decide to.

Mr. Chairman, thank you for convening today's hearing. I look forward to hearing the witnesses' testimony.

Mr. ISSA. Thank you, Ms. Watson.

Brian, is it all right to have yours just put in the record? OK, it will be placed in the record, and I appreciate that.

Dr. Portney, I appreciate your patience. We look forward to hearing your testimony, also. Again, your full statement will be put in the record. So summarize as best as you would like to.

STATEMENT OF PAUL PORTNEY, PRESIDENT, RESOURCES FOR THE FUTURE

Mr. PORTNEY. Terrific, I will try to be as admirably brief as my co-panelists have been here. They have set a real example for me.

First of all, I appreciate you and your fellow subcommittee members having me here today. I want to commend you all for holding hearings sort of on more general questions of whether Congress is asking the right questions and focused on the right issues in the energy debate.

Most of the time, in my time in Washington, when I have testified, it is over a particular piece of legislation. It is not often when I have had the opportunity to come up and sort of speak to a bigger picture issue. I commend you for asking a more generic set of questions here than views on a particular piece of legislation.

I want to make clear, as I did in my prepared testimony, that my comments today are my own and should not be construed as the views of Resources for Future. I will say also what an honor it is to testify on such a distinguished panel with Jim Wells and Guy Caruso.

You have asked all of us a pretty big set of questions here. Is Congress focused on the right issues? Is the executive branch taking the right set of actions?

There are a lot of ways one could attack this; probably as many ways as there are energy forms. I have chosen to focus on three issues, and I will confine my remarks today to the three issues that I have talked about, the first of which has to do with U.S. oil consumption. Both Jim and Guy Caruso have spoken to this.

Let me be even more sparing than they have been in terms of statistics. But I want to remind you that imports of oil in the United States now account for nearly 60 percent of total consumption.

We are sending $600 million each day to other countries in oil payments. That runs to about $200 billion a year in an annual total; 20 percent of which goes directly to the Persian Gulf, where at least some governments bear the United States ill will.

That $200 billion is a lot of money. You all remember former Senator Dirkson saying, "A billion here, a billion there; pretty soon you are talking about real money." Well, this is $10 billion here, $10 billion there. That is $200 billion total, and that is a significant outflow of dollars from the United States.

That $200 billion per year, at an annual rate, is about a third of the trade deficit; and a trade deficit of the size that we have now, of course, puts downward pressure on the dollar. It makes imports more expensive, and it could force interest rates up dramatically, if the foreign governments that have all of these dollars decide not to reinvest them in U.S. securities. So it is a significant economic problem.

I am not given to alarmist statements related to energy and the environment, but this is just simply a problem that we have to deal with. There is no question about that.

In addition to the amount of money that is flowing out of the United States because of oil imports, our overall level of oil consumption makes us particularly susceptible to oil price shocks. As I note in my prepared remarks, each of the last four recessions have been preceded by a run-up in oil prices.

While it would be too simplistic to say that was the only cause of the recession, there is no question about the fact that run-ups in oil prices act as taxes, slow down the rate of economic activity, and do not make recessions any better. So we need to pay attention to our oil consumption for that reason.

Another reason we need to pay attention to oil consumption is that every gallon of gasoline burned releases carbon dioxide into the atmosphere. Again, I will emphasize that I do not consider myself a Chicken Little on environmental issues, but this climate change problem is something that I think we have to continue to pay attention to.

Part of dealing with this problem lies in the electric utility sector and in the industrial sector. But part of it has to do with household consumption of gasoline.

There are only two ways that I know of to reduce the amount of gasoline that we are consuming. One is through better fuel efficiency in automobiles, as a result of Government mandates, such as the CAFE program.

I have testified before Congress on a number of occasions about CAFE, and I have said each time, and I will say again, that this is one way that you can improve automotive fuel economy.

I do not think it is the best way. I think a better way to do it is by increasing the Federal excise tax on gasoline or through a carbon tax. But I understand that this is not the most politically popular way to do this. Either through CAFE or through increases in the price of gasoline, that creates an incentive for people to buy smaller cars and pay more attention to how much they drive the cars they have.

Through some combination of these things, or one or the other, we just simply have to do something about this problem. I hope that you and your colleagues here will begin to take this even more seriously than you have in the past.

The second issue to which I want to speak has to do with natural gas. As Guy Caruso mentioned, currently, we are importing about 15 percent of it. But it will not be long before that is 20 percent and then 25 percent, and possibly even 30 percent.

Obviously, prices have risen because of the imbalance between supply and demand. Congress has taken steps to facilitate the construction of a pipeline that would bring natural gas from Alaska to the United States, although it still remains to be seen when or whether that pipeline will be built.

But I think one of the important things that Congress needs to pay attention to is the possibility that some number of years down the line, and this is something that both Jim and Guy might want to speak to, we will see a cartel of countries that produce natural

gas that will not look unlike the OPEC cartel with which we deal in the petroleum market now.

I do not know if they will be an organization of natural gas exporting countries or not. But the potential is certainly there, and as Guy has indicated, we will begin to depend more and more for our natural gas supplies on imports of liquids. If one looks at where our natural gas supplies are located around the world, the pattern looks suspiciously familiar to where petroleum is located.

If we are concerned about the sources of the petroleum that we import, we ought to be concerned somewhere down the line that we will be uncomfortably dependent on imports of natural gas, which plays a critical role in chemical and other industrial production, as well a very useful role in the United States in home heating and for other purposes.

Congress ought to begin to think now about what we can do to increase supplies in the United States and engage in conservation measures that would dampen demand, so that we are not facing two worldwide energy cartels that have the potential to squeeze us.

The third issue I will speak to is something that I think Congress probably pays some attention to. Frankly, it is much less sexy than the problems associated with petroleum and natural gas. It actually is an organizational issue.

When I talk to people, either in Washington or outside of Washington, about energy policy, people who follow it closely, they say, well, we cannot understand why the Department of Energy does not do more to solve the country's energy problems.

What I try to point out to them is that the Department of Energy has precious few levers to influence the types of fuels that we use, the conditions under which these fuels are used, etc.

If one looks at the budget of the Department of Energy, it is about $23 billion or $24 billion. By my calculations, about $20 billion of that, almost the whole enchilada so to speak, goes to weapons productions, waste clean-up associated with previous weapons productions, or basic science, a lot of which does not have very much to do with energy at all.

Who is it that does influence energy policy in the United States? Well, it is the Nuclear Regulatory Commission, the Federal Energy Regulatory Commission, the Minerals Management Service, the National Highway Traffic Safety Administration that writes fuel economy standards for light duty trucks, which comprise more than half of the new vehicles sold. More than any other agency, of course, the Environmental Protection Agency which, through standards that pertain to power plants and refineries and fuel requirements, really is the agency that drives energy policy in the United States.

That is fine, but we ought to pay attention to the fact that the laws that empower the EPA, that have given us air quality benefits and water quality benefits that are of no doubt great importance, do not direct the Environmental Protection Agency in issuing these standards to also pay attention to the impacts of these regulations on supplies of fuels and regional balances or imbalances.

So at the very least, I think we need stronger coordination within the executive branch of the activities of these five agencies and, in-

deed, other Federal agencies, which have a huge impact on the energy that we use and the way we use it.

The final thing I will say is, by way of mentioning some odds and ends here, from my standpoint, an ideal energy policy would be one that would eliminate the subsidies to all energy forms, whether nuclear, renewable, fossil fuels, etc.

That would then also internalize all of the environmental externalities, the adverse effects associated with pollution, not only from fossil fuels, but from nuclear, because you have to deal with spent waste and with renewables, because wind power has some adverse effects on wildlife and visual dis-amenities, etc. That would completely level the playing field and we could take it from there.

Now I was born at night, but not last night. So I know the chances of that happening are fairly slim. But in a sense, that would be an ideal energy policy, from my standpoint.

The other thing I would say is that because you and Congress are struggling, not only with energy problems, but also with a budget deficit and a trade deficit, an approach like that would help on both counts, a carbon tax or something like that, and would begin to produce on the order of, say, $75 billion a year in new revenues by the year 2020, depending on the level at which it was set.

That would not only create incentives to shift to cleaner fuels in the United States, but it would reduce our dependence on imported natural gas and on petroleum. It would create an incentive to move toward the hydrogen economy that President Bush, I think, has wisely committed some billions of dollars toward.

So as you think about the energy policy, you also ought to be thinking about solutions to energy problems that might also help us with the trade deficit and with the budget deficit. Because I think there are solutions out there like that. With that, I will stop, and thank you again for having me.

[The prepared statement of Mr. Portney follows:]

Energy Demand in the 21st Century: Are Congress and the Executive Branch Meeting the Challenge?

Statement of

Paul R. Portney
President, Resources for the Future

House Government Reform Subcommittee on Energy and Resources

March 16, 2005

Good afternoon, Mr. Chairman and members of the Subcommittee on Energy and Resources of the House Committee on Government Reform. I am Paul R. Portney, President of Resources for the Future (RFF), a 53 year-old research organization (or "think tank") located here in Washington, DC, that specializes in energy, environmental and natural resource issues. RFF is avowedly independent and non-partisan, and it shares the results of its economic and policy analyses with members of both parties in the executive and legislative branches of government, as well as with environmental and business advocates, academics, members of the press and interested citizens. My comments today represent my own views, it should be noted, and not those of RFF, which takes no institutional position on legislative or regulatory matters.

I am pleased to be with you here today and honored to be part of such a distinguished panel. Moreover, I commend you for asking whether Congress is focusing on the most important energy questions confronting the United States and whether the federal government agencies are taking the right actions to deal with 21st century challenges and needs. In my experience, it is unusual for a congressional committee or subcommittee to step back away from the legislative fray and look at such big-picture questions. I hope other chairmen will follow your lead.

Let me plunge directly in and speak to the question you have asked us all to address: Is Congress focusing on the key energy issues facing the United States? My blunt answer is that you are, though not with the sense of urgency I believe these issues require nor, generally, in the spirit most likely to produce effective solutions.

Key Energy Issues

The most important energy issue the United States currently faces relates to the growing amount of oil we are consuming and the ever-growing fraction of it—nearly 60 percent now--that comes from other countries. With oil prices at $50 a barrel, the United States sends nearly $600 million *each day*, (a rate of $220 billion each year) out of our country to foreign sources—often to state-owned oil companies, including some in countries that are hostile to us. A $220 billion "oil bill" would account for more than a third of the greater than $600 billion annual trade deficit we currently run, a deficit that has put downward pressure on the dollar, making imported goods more expensive for Americans and threatening much higher interest rates.

Our appetite for oil has at least two consequences of concern. First, the more oil we consume in the United States (whether produced domestically or internationally), the greater is our economic vulnerability to increases in oil prices and, perhaps more importantly, to possible significant interruptions in world oil supplies (such as might be associated with a successful terrorist attack on oil production or shipping facilities in Saudi Arabia, say).

The recessions of 1974, 1980-81, 1991 and 2002 were each preceded by a run-up in world oil prices. While it is simplistic to assign all the blame for the former to the latter, there is little doubt that oil price increases act as a tax on the economy and slow its growth. *Note that this would be the case even if we produced domestically all of the oil we use.* That oil would be priced in world markets, so even if it made sense to pursue import independence, which it does not, we would still be vulnerable to oil price shocks,

whether naturally occurring (due to cold winters, for instance, which increase demand for home heating oil) or to deliberate actions (boycotts or terrorist activities).

My second point is more controversial, but you have invited me here for my advice on the congressional energy agenda, so I intend to say what I think you should hear. Another consequence of our steadily growing oil consumption is increasing atmospheric concentrations of carbon dioxide, the most significant greenhouse gas. The United States accounts for slightly less than a quarter of global annual carbon dioxide emissions, and petroleum used for personal transportation alone accounts for about 14 percent of the U.S. total. This means that the passenger cars, minivans, pickup trucks and SUVs that take us to and from work and play here in the United States account for about one out of every thirty tons of carbon dioxide emitted everywhere in the world each year.

Though I believe President Bush was right to reject the overly ambitious targets and timetables in the Kyoto Protocol, the risks of climate change demand a much more urgent response than we have seen so far. One place to begin is by improving the fuel economy of the new-vehicle fleet in the United States, especially in view of the fact that average fuel economy has declined steadily since 1986.

Whether it is a renewed and hopefully more enlightened debate on the future of Corporate Average Fuel Economy standards or a serious discussion of measures to increase the price of gasoline through gradual increases in the federal excise tax on gasoline (a better approach to stimulate fuel economy improvements, in my view), Congress needs to address this issue immediately. As painful as these debates might be, it is far better to deal with these questions now than in the midst of a serious interruption in crude oil availability.

Congress also needs to pay more attention to another hydrocarbon—natural gas. I will say less about this because both Mr. Caruso and Mr. Wells know more about this energy source than I do, and may intend to address it themselves. What I will say is that the market for natural gas seems to be evolving in the direction of that for petroleum—i.e., toward a global market in which natural gas is transported long distances in liquefied form from places where it can be produced relatively inexpensively to places where it is in great demand. Since natural gas tends to be found in many of the same places where petroleum is abundant (e.g., the Middle East), this raises the specter of a possible future "ONGEC," an Organization of Natural Gas Exporting Countries that would have the same ability to curtail supplies, and hence drive prices up, as OPEC has in the petroleum market. Given the popularity of natural gas for residential and commercial heating, as an essential feedstock for chemical and other industrial production, and (until lately, at least) for use in turbines used to generate electricity, the possibility of an eventual global natural gas cartel is something worthy of congressional attention.

To be sure, Congress has taken steps to facilitate the construction of a pipeline to bring natural gas from Alaska to the lower 48 states. But more must be done. For instance, environmental concerns have made it difficult to open up new areas for natural gas exploration and production, both on shore and on the Outer Continental Shelf. While these concerns are quite legitimate, it behooves us to ask whether new drilling and other technologies—such as those that might be used to produce natural gas on the Outer-Continental Shelf—have developed to the point where prohibitions on exploration and production ought to be revisited.

One alternative to domestic production, of course, is the importation of natural gas in liquefied form. Ramping up LNG imports, however, will require the expansion of the four existing terminals, as well as the construction of new ones. Yet (perfectly understandable) local opposition to new terminals has stymied progress on their development. If we want to make greater use of clean-burning natural gas, however, it has to come from somewhere. One thing to which Congress should give greater consideration is ways to provide compensating benefits to localities in which natural gas (and other energy sources) is either produced (on-shore in the intermountain west, for instance, or off-shore on the OCS) or imported (LNG terminals). These inducements might take the form of new government facilities that create local jobs, preferential energy prices for those living in the vicinity of wells or LNG terminals, or favorable tax treatment. If sufficient inducements cannot be created, federal preemption in the siting of energy facilities may have to be considered.

There is another aspect of energy policymaking that Congress might usefully consider: the way the federal government is organized to conduct such policy. I co-authored a paper several years ago with my then-colleague Howard Gruenspecht. We noted then that the Department of Energy (which people assume is the focal point for energy policy making in the Executive Branch) actually has very few "levers" with which to influence the types of energy we use in the United states, how and where these energy forms are used and how the energy mix should change over time.

Truth be told, the Federal Energy Regulatory Commission, the Nuclear Regulatory Commission, the Minerals Management Service, the National Highway Traffic Safety Administration and especially the Environmental Protection Agency all

have a much greater influence on energy use than does the Department of Energy. After all, one or another of these agencies make decisions that effectively determine what fuels will be used to generate electricity in the United States, what fuel economy targets the new light-duty truck fleet has to meet, what "recipes" must be used for gasoline sold in the metropolitan areas around the country, and where oil and natural gas can be produced—among other things.

It probably makes little sense to recommend a substantial reorganization of the federal government for the purposes of improved energy policymaking at a time when we are still trying to "digest" the Department of Homeland Security. But better coordination of the various actions of the Department of Energy and the five agencies mentioned immediately above—possibly through a strong and permanent Cabinet Council on Energy—would be a step in the right direction.

There are a host of other energy issues on which I would like to see Congress focus more attention. One is better internalizing the environmental "externalities" (adverse effects) associated both with fossil fuels and other forms of energy, preferably through such things as taxes on carbon or other pollutant emissions, or cap-and-trade programs. Another is working to eliminate subsidies that both distort energy decisionmaking and also cost the treasury much-needed tax receipts. A third is an expansion and rationalization of this country's energy R&D programs.

It bears brief mention that taxes on carbon dioxide or other pollutant emissions, or a cap-and-trade system in which at least some of the pollution allowances are auctioned off by the government, would not only improve the environment but also raise revenues that can be used for deficit reduction. They would also advance the cause of non-

polluting fuels such as renewables and nuclear power (though these, too, have externalities that would have to be accounted for).

Thank you very much, Mr. Chairman and Subcommittee members. That concludes my written statement and I would be happy to answer any questions you might have.

Mr. ISSA. Thank you, Doctor; we have also now been joined by the gentleman from Georgia, Mr. Westmoreland. If you would put your opening statement into the record, and then you can summarize your opening statement and your questions as we go through. With that, I would like to recognize the ranking member for the first round of questions.

Ms. WATSON. I want to thank all the panelists. I think you have described the issue quite well. I keep going back in my mind to climate change. We saw the effects of it in Los Angeles, where we had a record rainfall. We almost broke the record, 33 inches. That is more than we get in 6 years.

Our electricity went off. We had floods. We had potholes, and so on. It all goes back to energy. So I want to ask the three of you, and I think Dr. Portney has already touched on some of this. But what do you think we can do about taking climate change into consideration and its relativity to energy sources, and our need for energy in the future?

I understand that now we are competing with the Chinese for oil. Everyone is driving a car. When I first went there, they were on bicycles or walking. So how are you relating the climate change to the sources of fuel, and what can we do? I know that is a big question, but try your best.

Mr. CARUSO. Well, the one thing I can say about the greenhouse gas emissions is, if you look out over the 20 year forecast that I have presented the highlights of this afternoon, a significant amount of the CO_2 emissions over the next 20 years will be coming from the developing Asian countries of China, India and elsewhere.

So because so much of their electricity is generated by coal, whatever we choose to do on an international basis, because I do not think we can look at this just from our own domestic perspective, we do need to bring in a broader array of countries to deal with this.

So I think that is the thing that just jumps out at you, when you look at the projections in our model; that there is so much growth in greenhouse gas emissions coming from developing Asian countries, that we need to do this on as broad a collaborative basis as possible.

Mr. WELLS. I think I would start and respond domestically to pick up a little bit on what Paul was saying. We, as an audit agency, have an opportunity to look at the actions that are being taken by Federal agencies. For instance, I will go to EPA. We have ongoing work and PASS work looking at, for instance, mercury emissions from the power plants.

What we are finding when we look at and ask questions about how EPA is designing and coming up with their rulemaking, we challenge some of their methodologies and some of their economic analysis that are being used as being missing items.

One of the things that we tend to notice, it is not only in mercury emissions, but we have noticed it in the gasoline marketplace, where EPA has a responsibility to approve and grant the permission for localities to use special fuels.

What we are seeing is that the total analysis being done are missing things that involve energy impacts. So our recommendation to much of the Federal Government would be to, when you

make these rules, you need to consider, from a climate change standpoint, all the factors and the consequences that are derived from those factors. For gasoline, they were missing factors in terms of the impact to the energy market, as well as mercury emissions.

Ms. WATSON. Thank you; Dr. Portney.

Mr. PORTNEY. Thank you very much; I guess, in my view, there are three pieces to dealing with this climate change problem. One is, as Guy Caruso said, I think we need to re-negotiate an international agreement that would eventually at least begin to bring the developing countries in. Because as he pointed out, it will not be too long before CO_2 emissions from the developing world account for more than half of the total, between developed countries and developing countries.

I will also say though that I do think it makes sense for the United States and the other developed countries to go first in beginning to reduce greenhouse gas emissions, since the stock of carbon dioxide in the atmosphere is mostly ours. I do not think it is inappropriate that we take the first steps.

In terms of how we go about reducing greenhouse gas emissions, I think there are two parts to this puzzle. One is to invest in new technologies. The hydrogen initiative is one part of this, but I think we need to invest more in energy efficiency and in renewables. Hydrogen, as I say, is an important component to that.

The third leg of the stool is the one that is politically more unpalatable. But the way you get people to consume less carbon-intensive fuels is to increase the price. That means electricity that derives from coal. It means higher prices for petroleum and higher prices for natural gas. I think we have to do that very, very gradually, and that will not be politically popular. I understand that.

But if we do that in such a way, through a carbon tax, for instance, that is at least spending off revenues and reducing the deficit and dampening the trade deficit, then I think people will understand that we are at least getting something else for that sacrifice, in addition to investing in a better environment.

Ms. WATSON. If I have another minute, Mr. Chairman, global warming is something that has been looked at most often. I think that we have not really put enough research into looking at the impact.

We can see the net results, and we have to really change them. You can comment on this statement I am making, or not. I think what we really have to do is do much more in depth research as to all the factors causing this and the results, and we have to chance the demand, and I think you alluded to it.

That means educating our people, starting in school, on how to conserve, and looking for alternative technologies and so on. Those that are politically unpopular are the ones that we really need to get on top of.

I am so sure that our Chair is going to look into it and have our committee hold additional hearings. You have already started. I want to commend you for that, because I see a really serious problem for the United States. But you did mention that we needed to look globally and have an alliance as we tackle the climate changes. I think that is the only way that our hearings are going to be meaningful, if we end up doing that.

So if you would like to comment, fine; but I wanted to make that statement, Mr. Chair.

Mr. ISSA. Well, thank you, and in keeping with our bi-partisan efforts that you and I, as Californians, are committed to, we will be looking at those issues to the full extent of the committee's jurisdiction.

I do very much believe that your points are valid; that we have to take where we have come from to where we are going, and do it to that next step. To that extent, I am not going to ask a round of questions, yet. But I just want to put a little point into the record, which I think sets the principle of where we have been and where we are, and Ms. Watson says it very well, where we need to go.

Since 1970, the U.S. aggregate emissions of the six pollutants recognized in the Clean Air Act has been cut by 48 percent. At the same time, the U.S. GDP increased by 164 percent.

Energy consumption increased by only 42 percent, meaning more money per BTU, so to speak. We have increased fuel consumption, as I said, by 42 percent. But vehicular travel has increased by 155 percent. If you think the Chinese are driving; boy, are we driving.

It is exactly that trend, that we have to do the good part of it; cut emissions by another 48 percent. But we also have to do a much better job of using our fuel per GDP dollar more wisely. With your indulgence, to my ranking member, I now call on Vice Chair Westmoreland, please, for 5 minutes.

Mr. WESTMORELAND. Thank you, Mr. Chairman, and I want to thank you for having these hearings. When I was at home last week and had a couple of Social Security meetings, all that people wanted to talk about was the price of gasoline. So I think these are very timely hearings.

Let me start out by asking you, I know that there are different formulas of gasoline that burn in different parts of the country, due to the Clean Air Act. Do any of you know how many types of reformulated gas are being used across the country today? Are they just used during certain times of the year, in certain parts of the country? What is the total number of reformulated fuels that we actually have?

Mr. WELLS. Congressman, the Government Accountability Office has some ongoing work looking at the status of reformulated fuels in use in the country. We hope to have that worked out in several months. But the numbers are in the ballpark of starting at a number around a dozen fuels that are special fuels.

If you were to look at the seasonality of the fuels, you get into the neighborhood of a 30 range. I am talking about winter gasoline, summer gasoline. If you were to talk in terms of the multiple grades of octane, you are over 100.

The upcoming work that GAO will be publishing will address how difficult it has been for the industry to deal with these special formulations. It is not that the special formulations are bad. I mean, they are being driven by the Clean Air Act rules and requirements. But they do have price consequences, and they have cost and benefits, and that is in the ballpark range of what we are seeing in the gasoline marketplace.

Mr. WESTMORELAND. Could I have a followup question, please?

Mr. ISSA. Of course.

Mr. WESTMORELAND. Has there been a cost benefit analysis of what it costs us to do this reformulating of gasoline, compared to how clean it is actually making our air; and what is the end gain on clean air? I mean, I think if I asked in this room who all wants to have clean air, I think we would all raise our hands.

But I guess my question to the panel is, how clean is clean? Where are we trying to go with this, and how much further do you think that we are from being there? What price is it going to cost us, and is it going to cause us to have to develop more formulas of gas?

Mr. WELLS. The quality of the type of studies you are asking, do they exist, are hard to find, particularly if you want to try to do a cost/benefit and if you try to include health impacts.

We hope to have a compilation of everything that exists. I think they will fall short of the answer that the American public is probably asking for. Perhaps some of the other panelists are aware of some of these studies.

Mr. PORTNEY. If I could, very briefly, you have asked, I think, a very interesting and important question. In other words, I will rephrase it as, how many different recipes for gasoline are there?

The reason we began to get a proliferation of recipes that makes sense, is that we do not want to have one size fits all. In others words, we needed a type of gasoline that was low in certain additives to deal with the Denver problem. So you do not necessarily want to make everybody in the country use the same type of gasoline because you have a problem in one city.

But I do think that what has happened is, we have almost gotten to the point where we have now designer blends for almost every part of the country. The difficulty that it creates is that if a refinery that produces one of those designer blends goes down, you cannot easily ship gasoline from an adjacent city or State.

So while the basic motive of trying to tailor the gasoline to the local conditions originally, I think, made sense, I think we have probably gotten to a point now where it probably makes sense, from an overall national standpoint, to have fewer blends, so that if we have shortages in one area, we can ship gasoline from California or Nevada or something, and not be in a position where they go, well, I am sorry, that is not the recipe we use here. It think that is what you are driving at, and I think we have a problem on that count now.

Mr. WESTMORELAND. I have just one further question, and this will be my last one. I know that in some situations in Georgia, we had some pipeline issues of getting a certain amount of gasoline in the pipeline. They were actually having to lower it into tankers.

We were just putting a lot more trucks on the road than was necessary. If we had only been using one single formulation of gas, you know, trying to save on the one hand was costing us dearly on the other hand.

Mr. CARUSO. I have a couple comments. I agree with both of my colleagues. Clearly, the infrastructure problem that we have in this country, particularly on oil, is related to the point you have made. That is, it has increased the inflexibility to deal with unexpected

changes in supply or demand, which is exactly the point you are making about the pipeline.

But one thing to remember is, Georgia, for example, has the lowest priced gasoline in the country and California has the highest. Part of it is because of the different emission standards. Specifications in California were compared with Georgia. So that is another very sensitive issue. I agree with Paul, we need to do something to improve the flexibility to deal with unexpected changes. By there would be, of course, a cost to it.

Mr. WESTMORELAND. Well, is there an answer to it? Do you all have an answer of what that might be, that this committee could look at, so we could start working toward something?

Mr. WELLS. I would suggest that there may be an issue to look at the proliferation of these specials fuels; and where in the Federal Government, and perhaps at the Environmental Protection level, that are granting approval for these special fuels, what type of approval process they use; what criteria do they use; and are they, in fact, factoring in the various infrastructure needs and consequences of approving these special fuels?

I mentioned 12, 30, 100 different fuels. If we continue to allow approvals for these multiple fuels, we are talking about multiplying the price impact and the infrastructure consequences of trying to deliver those fuels.

So one needs to look at, you know, are we perhaps better off regionalizing some of these special blends, as opposed to allowing every city in the country to design their own fuel?

The best example I can give is Kansas City. Right down the middle, you have a Missouri blend and you have a Kansas blend, and it is the same city. A truck has to roll through the city to the other side of the city to deliver. That is an inefficient way to deliver gasoline products.

Mr. ISSA. Thank you; Mr. Higgins, do you have any questions?

Mr. HIGGINS. Thank you, I am new to the committee and new to Congress. But obviously, I have a strong interest in energy issues, particularly coming from New York State.

One of the problems I think we have in New York State is particularly high energy costs, which undermines our economic development efforts, particularly in a globalized economy.

My understanding was that deregulation of energy was to provide more competition, which would result in a cost-cutting stimulus. But in New York State, our problem is, I believe, a situation where our demand is approximately 31,000 megawatts a day and the supply is about 35,000 megawatts on any given day.

I think this creates a situation where there is not enough supply to create the cost cutting stimulus that should come from competition. As you may know, the price for electricity each day is determined by this reverse auction type of scheme, which is administered by the independent system operator.

So in trying to address the Nation's energy demand moving forward, and particularly with respect to New York State, can you offer any insight as to the particular problems in New York State, beyond which I have described, relative to creating the cost cutting influence that should come from competition?

Ms. WELLS. Let me start. The decision you are talking about was the decision the country made to restructure the electricity industry, and to restructure it in the wholesale marketplace to achieve benefits that hopefully would be derived from lower prices from the electricity, by bringing in private marketeer to deliver energy and take energy out of the realm of being delivered locally, but across the Nation.

The situation we are now in is, unfortunately, we are sort of halfway into it. There is sort of a hybrid that exists. Many of the States went for restructuring and worked, in terms of starting that process. Some of the States chose not to start with restructuring, and have continued to deliver electricity the old way.

So I think FERC has its hands full right now, trying to oversee a marketplace that we are sort of in the middle of this design to go for restructuring electricity. So the verdict is still out, in terms of the benefits and costs and what can be derived from a true restructured marketplace.

I think this gets back to what we are talking about, in terms of where we need to be in the future, in terms of a partnership.

Truly, it is going to take more than FERC. It is going to take more than the country and the Federal Government saying, we are going to restructure, because we have to bring in the local communities and the individual States, and we have to figure out a way to make delivery of electricity in the best efficient possible way.

We are just not there, yet. I think the country is struggling a little bit in the electricity delivery marketplace.

Mr. HIGGINS. Could I ask one more question, then? This is more localized to the western New York area. There are two hydro-electric plants in New York State, which produce about 10 percent of the State's electricity supply.

With the Federal Energy Regulatory Commission, I am particularly concerned about the Niagara Power Project in western New York. It generates about 2.4 million kilowatts of power.

The Federal Energy Regulatory Commission issued to the New York Power Authority a license to own and operate that plant for 50 years in the year 1957. It was part of the Niagara Redevelopment Act, which was an act of Congress.

That license is set to expire to in 2007. That resource, hydro-electricity, could have a profound impact on the economy of western New York, if the power was taken from the New York Power Authority and put into job-creating businesses in that area.

I am just wondering, what specifically do you understand the role of the Federal Energy Regulatory Commission to be, relative to the mandating of where that power is allocated?

Mr. WELLS. I am not familiar with that at all.

Mr. HIGGINS. OK, thanks.

Ms. WELLS. I am sorry.

Mr. HIGGINS. That is not a problem.

Mr. ISSA. OK, we have time for a second round; Mr. Westmoreland.

Mr. WESTMORELAND. I am going to ask all three of these at one time. Getting back to the reformulated gas, what percentage of the gas price would you say is caused by the different formulas, No. 1;

and what effect on price do you think we could expect if we came to a conclusion to regionalize or cut down on the otique gases.

Mr. WELLS. Otique.

Mr. WESTMORELAND. Yes, I mean, in the supply and demand part of it, is there more demand for some of these different types of gases in different cities than it is capable for these refineries to try to refine and still keep the supply going to other parts that they are responsible for supplying the fuel to?

Mr. ISSA. If I could help perhaps, with the gentleman's approval, with the refinery question a little bit more? I might suggest that you simply look at California, where every air quality board is allowed to independently and has independently made decisions leading to the greatest single number of boutiques of similar cities. It is just a suggestion to look at what I believe is described as the worst case in any one State.

Mr. WESTMORELAND. Right.

Mr. WELLS. Mr. Congressman, I have some constraints in that the information that is available to us, as we have ongoing study, is not published, yet. It is not final. I can tell you that there is a price differential that is being added because of these blends.

Our GAO report, when released, will talk to a range. That range will be from single digit pennies to double digit pennies per gallon. There is a consequence of doing special blends; and yes, there are refinery capacity issues in terms of price impact, in terms of the quantity that is being requested versus the quantity that can be delivered on a consistent basis on any given day.

Therefore, we talk to the consumer and give an explanation of the price volatility and why the pump is jumping 5 cents up 1 day, 10 cents up the next day, 5 cents down the next day. It does cause price volatility. It is a problem that someone is going to need to take a look at, in terms of, there are some efficiencies.

You know, I think that is the direction that the committee and the Congress and the people that are regulating boutique fuels need to be aware of when they approve future boutique fuels.

Mr. WESTMORELAND. How long have you been working on this report?

Mr. WELLS. The actual audit work is completed. The report draft is being put together now. We are probably 30 days away from it being publicly released. That work belongs to the clients in the Congress that asked for that work. So that is why I am a little cagey with the actual numbers.

Mr. ISSA. Is that the Energy and Commerce Committee?

Mr. WELLS. I believe it is over on the Senate side that we are doing that work.

Mr. WESTMORELAND. But how long have you actually been working on this report?

Mr. WELLS. We have about 4 months worth of audit work done in that area.

Mr. WESTMORELAND. OK, but this has been going on for a lot longer than 4 months.

Mr. WELLS. Oh, absolutely.

Mr. WESTMORELAND. I mean, why did we just decide all of a sudden that it was time to do a report on it?

Mr. WELLS. We work for the Congress, and the client came to us and asked for an investigation audit of this issue, and we agreed to accept that study. We are just about wrapping up that study and hope to have it published within the next 30 to 45 days.

Mr. WESTMORELAND. Thank you.

Mr. ISSA. Thank you, and I will do some additional questions, and then if you have any more, that would be just great.

Regarding the role of coal, here in the Congress, we speak in flowery terms like, clean coal. Cleaning up coal does not sound as good as clean coal. So I think we speak in less exact terms than the reality that it is a dirty fuel, that we are making ever cleaner. But at best, coal is only going to be as clean as, in a perfect world, natural gas, I suppose, is today.

Having said that, and with the recognition that as we burn fossil fuels, ultimately, we have a carbon monoxide and carbon dioxide component coming out of any of our processes for burning fossil fuels.

I would leave this to each of you, but I think particularly for Mr. Caruso, where do you see nuclear/other zero emission fuels, you know, like solar, wind, and we speak of those a lot, but they are relatively small parts of the equation.

But where do you see nuclear, particularly in light of the prediction that there will not be a new nuclear facility coming on line, at least until 2025? By that time, every single nuclear power plant on line today, if it is still on line, will be on multiple extensions. So how would you view nuclear, in the component of those fuels that you mentioned that we had to do all of?

Mr. CARUSO. Yes, nuclear is about 20 percent of our electricity generation, as we speak. We, in our long-term outlook, do not expect, or the model does not project, any new nuclear power plants being added to the fleet. But at the same time, we assume all existing plants are relicensed and continue operating through the 2025 timeframe.

There will be some improvements in efficiency and upgrading, so that the actual amount of electricity generated by nuclear power would increase. It will lose market share under our projections, mainly to natural gas. The coal, we expect, would stay about the same, 50 or 51 percent.

The reason we are projecting no new nuclear power plants is that the capital cost of building a new nuclear power plant is higher than either combined cycled natural gas plants or pulverized coal. So when the model searches out where the next new electric power plant will be built and what fuel it will use, it chooses the less costly, in terms of capital costs, plant. That is how we come up with this.

Our best estimate of what it would take to build a new nuclear power plant, since we have not built one from scratch for more than 30 years, is about $1,900 per kilowatt. Now coal and natural gas can be built much cheaper than that. But, of course, there is a fuel component to it. But still, both coal and natural gas, at this time, the existing technologies are more efficient.

Now we have been criticized by the Nuclear Energy Institute and nuclear vendors that our cost estimates are too high and that they can do better.

So what we have done is run two other cases in this year's outlook. One is using a $1,450 capital cost; and the lower one is what you would call the advanced technology case. Then we have taken the vendor cost estimates from Westinghouse and others, which are around $1,100.

If you use those assumptions, $1,450 or $1,100, you do get some new nuclear power plants built in this country, particularly in the period between 2015 and 2025. At $1,100, you get a substantial amount of new nuclear power plants. So this is a matter of the economics and technology, in our view.

Mr. ISSA. Let me have one followup question here. It is one that I do not expect you to be able to easily answer today; but if you could followup, if that can be done without specific authorization.

If one were to take nuclear as a category, and the U.S. Government were to absorb all extraordinary liability questions and all extraordinary lawsuit questions in the citing; basically, we defend all the claims that come, every time you want to build a nuclear plant, and we take the extraordinary risk of insurance completely for zero cost to the vendor, leaving the remainder of the costs there, what would be the per kilowatt, from the industry, that they believe they would deliver for?

I would like it, if possible, in two bases; one, with fuel prices in the estimate, and then based on the fact that next generation nuclear can literally burn weapons, plutonium, which we have an excess of that we have been trying to get rid of, literally 10,000 years worth of fuel that, at some point, we are not going to want to keep sitting post-silo, and then at a zero cost.

If you could give us your best estimates of that, so that at least when we are having these discussions, and I agree with you, Mr. Caruso, they do not pencil out today, but taking out particularly those extraordinary costs that come when someone says, I want to build a nuclear versus alternate, where we would end up?

Then, as somebody who wants to see, if you will, the swords turned into plow shears and the burning of plutonium, once and for all, and getting rid of as much of the weapons stockpiles as we can, that analysis, both of those are personally important to me, and I would like to know the cost benefit on them.

With that, I do not want to monopolize the questions. Are there any last rounds of questions?

[The information referred to follows:]

COMMITTEE: HOUSE COMMITTEE ON GOVERNMENT REFORM, SUBCOMMITTE ON ENERGY RESOURCES

DATE: MARCH 16, 2005

WITNESS: GUY F. CARUSO
PAGE: 53, LINE: 1198

INSERT FOR THE RECORD

If one were to take nuclear as a category, and the United States Government were to absorb all extraordinary liability questions and all extraordinary lawsuit questions in the citing: basically, we defend all the claims that come every time you want to build a nuclear plant, and we take the extraordinary risk of insurance completely for zero cost to the vendor, leaving the remainder if the costs there, what would be the per kilowatt, from the industry, that they believe they would deliver for?

I would like it, if possible, in two bases; one, with fuel prices in the estimate, and then based on the fact that next generation nuclear can literally burn weapons, plutonium, which we have an excess of that we have been trying to get rid of, literally 10,000 years worth of fuel that, at some point, we are not going to want to keep sitting post-silo, and then at zero cost.

It has been over 25 years since a new nuclear plant was ordered in the United States. During that time, changes have been made in the proposed design of new plants and the regulatory process for reviewing and approving them. However,

since none of these new designs has been built anywhere in the world and the new regulatory process has not been tested, there is great uncertainty about the cost of building a new nuclear plant in the United States. For this reason, EIA's *Annual Energy Outlook 2005* includes three cases with different assumptions about the cost of new nuclear plants. The overnight costs of building new nuclear plants to come on line in 2015 range from $1,854 per kilowatt in the reference case to $1,435 per kilowatt in the Vendor Estimates case, with the Advanced Nuclear case costs falling in between at $1,679 per kilowatt. In the reference case, the per kilowatthour cost of building and operating a new nuclear plant that comes on line in 2015 is 6.3 cents. Approximately 0.5 cents per kilowatthour of this cost is the fuel cost. In the Vendor Estimates case, the per kilowatthour cost in 2015 is 5.4 cents. Again, approximately 0.5 cents per kilowatthour of the cost is for the fuel. Thus, with fuel costs, the costs of building and operating a new nuclear plant range from 5.4 cents per kilowatthour to 6.3 cents per kilowatthour in 2015. Without fuel costs, this range falls to between 4.9 cents per kilowatthour and 5.8 cents per kilowatthour.

Jim Wells Insert for the Record Follow-Up to Chairman Issa's Question:

Mr. Chairman, the short answer is that we do not know what those numbers might be. As you know the United States government already provides protection from some of the liability aspects of operating a commercial nuclear plant through the Price-Anderson Act. This Act created in 1957 and amended over the years, has ensured that funds would be available for at least a portion of the damages suffered by the public in the event of an incident at a U. S. nuclear power plant. The current requirements for both primary and secondary insurance are around $10 billion to the industry. As mentioned in your question and several recent statements by the administration, there have been proposals to expand the protections provided to companies wishing to build and, or, operate nuclear power plants. We have not been asked to review such proposals; therefore we do not have any per kilowatt estimates.

Mr. WESTMORELAND. I do have a closing statement.

Mr. ISSA. OK, then with your indulgence, we will have the closing statement, please.

Mr. WESTMORELAND. Well, I would just like to thank you again, Mr. Chairman, for doing this. I know I am a freshman, but I understand in the last two Congresses, there has been two or three attempts to get an energy bill passed.

I think, from all the testimony today, it is quite evident that we need an energy bill. It is something that we need to have as a road map to where we have to go with our energy policy, and also be able to put some of these guidelines in that we have talked about today.

So I hope that this committee will encourage the Energy Committee to pass that along. Because I think that is something that is very critical right now; not only to our economy, but to our national security, that we have a good energy policy in tact and on the laws of this land. So that is all I really had to say, Mr. Chairman; thank you.

Mr. ISSA. With that, I would like to thank our panel for their testimony and obviously for your candid answers. I would also like to thank the majority and minority staff, because without them, this would not have happened. They have done a great deal of work here for all of us.

Without objection, we will hold open the record for 2 weeks from this date, so that anyone can make submissions, including from the witnesses and from the members of the committee. If that will not be sufficient for any questions, please let my staff know and we will extend that date. With that, I thank you once again, and this hearing is adjourned.

[Whereupon, at 3:50 p.m., the subcommittee was adjourned.]