AMERICAN ENERGY OUTLOOK: TECHNOLOGY, MARKET AND POLICY DRIVERS

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

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AMERICAN ENERGY OUTLOOK: TECHNOLOGY, MARKET AND POLICY DRIVERS

WEDNESDAY, FEBRUARY 13, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
Washington, D.C.

The Subcommittee met, pursuant to call, at 10:05 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Cynthia Lummis [Chairwoman of the Subcommittee] presiding.

LAMAR S. SMITH, Texas
CHAIRMAN

EDDIE BERNICE JOHNSON, Texas
RANKING MEMBER

Congress of the United States
House of Representatives

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
2321 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515-6301
(202) 225-6371
www.science.house.gov

Subcommittee on Energy

American Energy Outlook: Technology, Market and Policy Drivers

Wednesday, February 13, 2013
10:00 a.m. - 12:00 p.m.
2318 Rayburn House Office Building

Witnesses

The Honorable Adam Sieminski, Administrator, Energy Information Administration, U.S. Department of Energy

Mr. Robert McNally, President, The Rapidan Group

Ms. Lisa Jacobson, President, Business Council for Sustainable Energy

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

HEARING CHARTER

American Energy Outlook: Technology, Market and Policy Drivers

Wednesday, February 13, 2013
10:00 a.m. - 12:00 p.m.
2318 Rayburn House Office Building

PURPOSE

On Wednesday, February 13, at 10:00 a.m. in Room 2318 of the Rayburn House Office Building, the Subcommittee on Energy will hold a hearing titled, *American Energy Outlook: Technology, Market and Policy Drivers*. The Subcommittee will receive testimony regarding the current state of the U.S. energy markets, projected trends, and the impact of technology development on the U.S energy sector. The hearing will examine the impact of technology and policy on energy markets.

WITNESS LIST

- **The Honorable Adam Sieminski,** Administrator, Energy Information Administration (EIA), U.S. Department of Energy
- **Mr. Robert McNally,** President, The Rapidan Group
- **Ms. Lisa Jacobson,** President, Business Council for Sustainable Energy

BACKGROUND

Over the last decade, the United States' energy profile has undergone a profound shift, partly attributable to both increased domestic energy production and more efficient energy use. Specifically, technological advances in oil and natural gas production methods have made recovery of previously inaccessible resources, such as those in shale formations, economically recoverable. The associated increased production resulted in what some have termed a "New Energy Reality"[1] as the U.S. energy paradigm has shifted from declining oil and gas production and dependence on imports to surging production and abundant American domestic resources. These changes impact energy markets broadly, and are reflected in current and projected domestic production and consumption trends in the electricity and transportation sectors.

America's resurgence as a leading global oil and gas producer can be credited in part to the development of specific enabling technologies, particularly the combination of horizontal drilling and hydraulic fracturing. The United States currently ranks second and third in global

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[1] Yergin, Daniel, The New York Times, *America's New Energy Reality*, June 9, 2012. Accessible at: http://www.nytimes.com/2012/06/10/opinion/sunday/the-new-politics-of-energy.html

natural gas and oil production, respectively.[2] The International Energy Agency (IEA) predicts the U.S. will overtake Saudi Arabia to become the world's largest oil producer by 2020 and Russia to become the world's largest natural gas producer by 2015.[3] Increased production, coupled with reduced domestic consumption, has led to a sharp decrease in energy imports. In 2012, imports accounted for 41 percent of total domestic oil consumption, down from 60 percent in 2005.[4] Domestic natural gas production is also projected to increase substantially, due largely to an anticipated increase in shale gas production of nearly 200 percent from 2011 to 2035. See Figure 1 below.

Electric Sector Trends

In 2011, the United States consumed 3,856 billion Kilowatt-hours of electricity. Coal, natural gas and nuclear energy generate 86 percent of total electricity. See Figure 2 for further breakdown. Renewable sources of electricity account for 13 percent of total electricity generation, the majority of which is attributable to hydropower.

The impact of increased production from shale formations on America's energy outlook is striking. In the Annual Energy Outlook (AEO) for 2007, the EIA predicted that high natural gas prices would be responsible for declining use of natural gas for electricity generation by 2020, and thereafter be displaced by new coal-fired generating capacity.[5] The 2007 AEO also forecast that high natural gas prices would result in significant increases in liquefied natural gas (LNG) import capacity. By contrast, the 2013 AEO early release contemplates various LNG export scenarios, and projects U.S. natural gas prices will remain below $4 per million British Thermal Units (BTUs) through 2018.[6]

The EIA recognizes that increased production of natural gas will shape electricity markets in the long-term. According to the 2013 AEO Early Release report, natural gas is projected to account for 30 percent of total generation in 2040, up from 24 percent in 2010. Though coal remains the largest source for electricity generation throughout the 2013 outlook projection period, its share of total generation is expected to decline from 42 percent in 2011 to 35 percent in 2040.

Electricity generation capacity from non-hydro renewable technologies has increased significantly in recent years, but remains a small fraction of total U.S. electric needs. The two largest non-hydro renewable technologies, wind and solar, experienced a 117 percent and 110 percent increase in net electric generation from 2008 to 2011, respectively.[7] However, in 2011 wind and solar accounted for just three percent and one-half percent of total electricity generation, respectively. EIA projects that electricity generation from renewable energy

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[2] CIA World Factbook. Accessible at: https://www.cia.gov/library/publications/the-world-factbook/rankorder/2249rank.html

[3] International Energy Agency, World Energy Outlook 2012. Accessible at: http://www.worldenergyoutlook.org/

[4] Loder, Asjylyn, Bloomberg, *American Oil Growing Most Since First Well Signals Independence*, Dec. 18, 2012. Accessible at: http://www.bloomberg.com/news/2012-12-19/american-oil-most-since-first-well-in-1859-signals-independence.html

[5] Energy Information Administration, *Annual Energy Outlook 2007, With Projections to 2030*, February 2007.

[6] Energy Information Administration, *Annual Energy Outlook 2013 Early Release Overview*, December 5, 2012.

[7] Energy Information Administration, *Annual Energy Outlook Total Electric Power Industry Summary Statistics, 2011 and 2010* and *Electricity Net Generation from Wind and Other Renewables, 2004-2008.*

technologies, including hydropower, wind, solar, geothermal, and other renewable sources, will grow from 13 percent in 2011 to 16 percent by 2040.

Transportation Sector Trends

Petroleum is the primary transportation fuel in the U.S., accounting for 93 percent of total transportation fuels, with natural gas and renewable fuels accounting for the remaining seven percent. EIA estimates the United States will consume approximately 18.6 million barrels of oil per day (bb/d), while producing 6.4 million bb/d of crude oil daily.

U.S. consumption of petroleum and other liquid fuels peaked in 2005 at 20.8 bb/d but dropped to 18.9 bb/d in 2011, largely due to the ongoing economic downturn.[8] EIA projects energy consumption in the transportation sector to remain relatively constant out to 2020.[9]

Technology Development

Technology impacts every component of the energy system: exploration, production, transportation, delivery and end-use consumption. Technology breakthroughs in any of the system components affect the entire system. One of the most readily apparent and consequential examples of the impact of technology is hydraulic fracturing. The combination of horizontal drilling technology combined with hydraulic fracturing has transformed oil and gas exploration and production activities by making previously inaccessible resources economically recoverable. Additionally, continued advances in drilling and exploration technologies have the potential to unlock other hydrocarbon resources, such as oil shale.

Recent technology developments in other portions of the energy supply and delivery system have impacted the current energy portfolio. For example, technological improvements in nuclear power plants have increased nuclear energy generation capacity by increasing the efficiency and output of existing plants. Additionally, increased application of grid technology enables more efficient transmission of electricity and results in greater electric reliability.

Furthermore, the U.S. has experienced dramatic gains in energy efficiency and energy intensity, driven by the application of new technologies. The 2013 AEO illustrates the impact technology is having on energy intensity. From 2011 to 2040, the U.S. population is expected to grow by 29 percent; over the same time period, energy use is expected to grow by only 10 percent while energy use per capita declines by 15 percent.

Additional Reading

For additional information and background on U.S. energy use and trends, see EIA Annual Energy Outlook located at http://www.eia.gov/forecasts/aeo/er/index.cfm and IEA reports located at http://www.iea.org/countries/membercountries/unitedstates.

[8] Energy Information Administration *U.S. Product Supplied of Crude Oil and Petroleum Products,* September 27, 2012. Accessible at: http://www.eia.gov/petroleum/reports.cfm?t=164
[9] Energy Information Administration *Transportation sector key indicators and delivered energy consumption,* accessible at: http://www.eia.gov/forecasts/aeo/er/pdf/tbla7.pdf

Figure 1. U.S. dry natural gas production by source, 1990-2040 (trillion cubic feet)

Figure 3. U.S. dry natural gas production by source, 1990-2040 (trillion cubic feet)

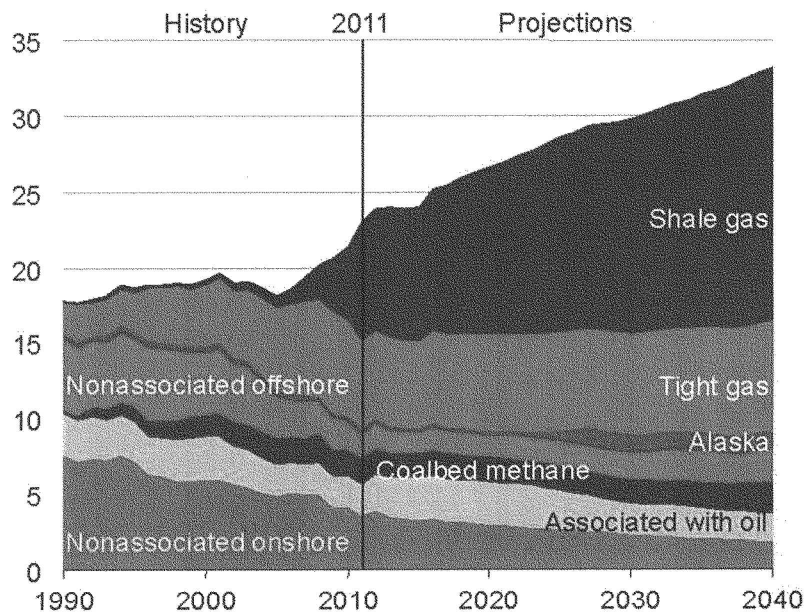
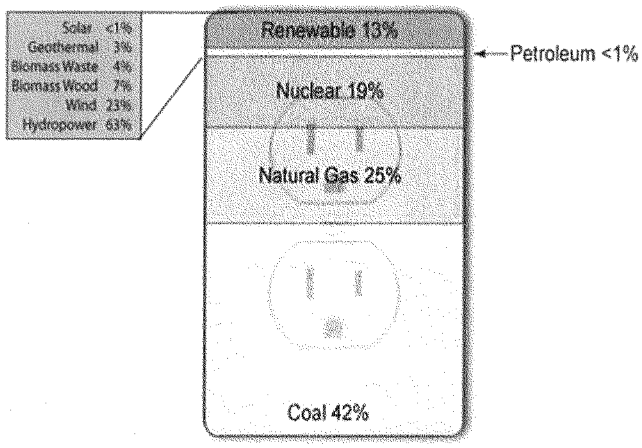


Figure 2.

Sources of Electricity Generation, 2011



Note: Includes utility-scale generation only. Excludes most customer-sited generation, for example, residential and commercial rooftop solar installations

Source: U.S. Energy Information Administration, *Electric Power Monthly* (March 2012). Percentages based on Table 1.1, preliminary 2011 data.

Figure 3.

Figure 7. U.S. primary energy consumption by fuel, 1980-2040

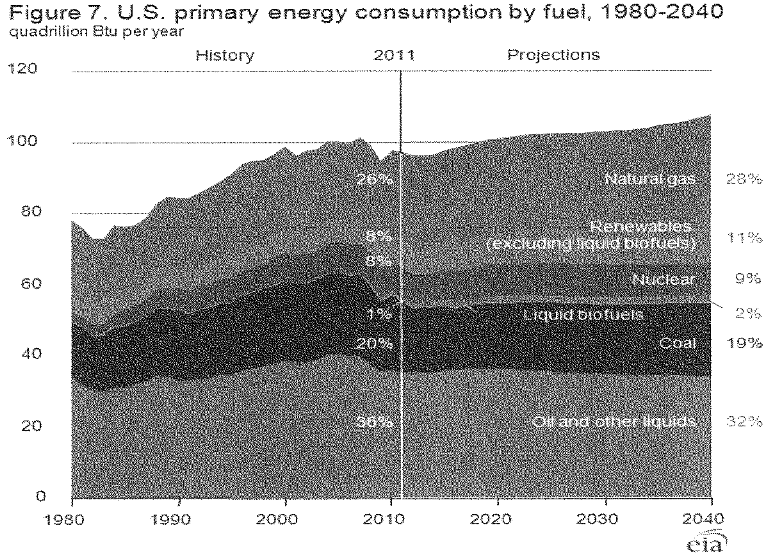


Figure 4.

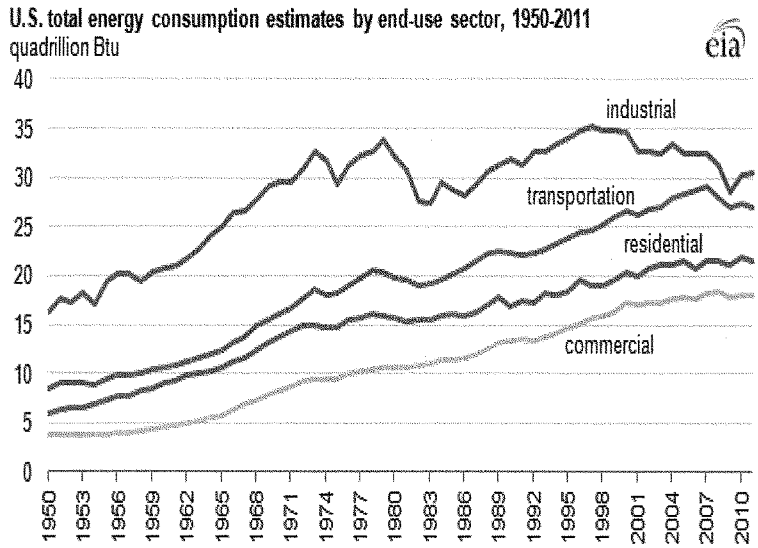
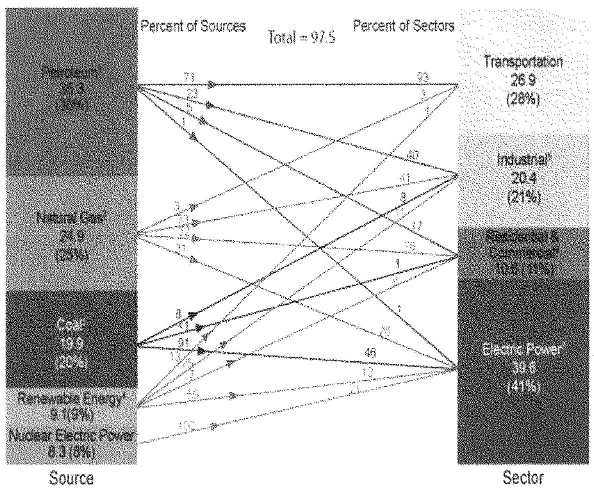

U.S. total energy consumption estimates by end-use sector, 1950-2011
quadrillion Btu
eia
40
35
30
25
20
15
10
5
0
industrial
transportation
residential
commercial
1950
1953
1956
1959
1962
1965
1968
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
2004
2007
2010

Figure 5.

Primary Energy Consumption By Source and Sector, 2011

quadrillion Btu



Endnotes.
1 Does not include biofuels that have been blended with petroleum—biofuels are included in "Renewable Energy."
2 Excludes supplemental gaseous fuels.
3 Includes less than 0.1 quadrillion Btu of coal coke net exports.
4 Conventional hydroelectric power, geothermal, solar/PV, wind, and biomass.
5 Includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.
6 Includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.
7 Electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public. Includes 0.1 quadrillion Btu of electricity net imports not shown under "Source."

Note: Primary energy in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy (for example, coal is used to generate electricity).
• Sum of components may not equal total due to independent rounding.

Sources: U.S. Energy Information Administration, Monthly Energy Review (March 2012), Tables 1.3, 2.1-2.5, **preliminary 2011 data.**

Chairwoman LUMMIS. Well, good morning. The Subcommittee on Energy will come to order. Welcome to today's hearing. It is entitled "American Energy Outlook: Technology, Market and Policy Drivers."

Now, in front of you are your packets containing the written testimony, biographies, and truth-in-testimony disclosures for today's witnesses on our panel. So we will start with opening statements. And I recognize myself for five minutes.

And I just want to again thank the witnesses this morning for joining us. I also want to congratulate Representative Swalwell on his appointment as Ranking Member of the Energy Subcommittee, and I am looking forward to working with you.

Mr. SWALWELL. Thank you, Madam Chair, and I look forward to working with you in this Committee.

Chairwoman LUMMIS. Thanks. I also want to welcome all the Members of the Subcommittee, and I look forward to having a very productive Congress together.

It is difficult to overstate the importance of energy to America's success. Abundant, affordable energy is arguably the single most important factor to enabling our prosperity, from our health and wellness to our national and economic security. Technology development impacts all components of a healthy, developed energy system, including exploration and production, transportation, and consumption. By providing the private market with the tools to innovate, our energy system can add new technologies to reliably provide affordable and abundant energy.

The jurisdiction of this Subcommittee, which includes about $8 billion in research and development at the Department of Energy, provides us a unique opportunity to help share the direction and future of energy in America. This Congress, I hope we can work together to do just that.

As a Congressman from Wyoming, I see the many benefits associated with energy production. Wyoming is the United States' second leading producer of total energy. It is the top producer of coal and uranium, third in natural gas, eighth in oil. Wyoming is also a national leader in renewable energy, generating significant energy from wind and geothermal resources as well. In fact, we are number one in wind energy resources, many of which are yet undeveloped.

I am a strong supporter of an all-of-the-above energy strategy. And now, more than ever, Congress and the President must take real steps to advance such a policy.

The timing has never been better. U.S. energy is in the early stages of a historic period of technology-driven transformation. Advancement in horizontal drilling and hydraulic fracking has unlocked vast amounts of oil and gas, so much that the International Energy Agency projects that by 2020—that is just seven years from now—the United States will overtake Russia and Saudi Arabia to lead the world in oil production. The EIA also projects that coal will be the dominant energy source globally by 2030. While domestic use of coal declined last year, the global use of coal is increasing by leaps and bounds. Coal is abundant in America, and it is the only source of energy that can meet the scale of energy demand for those billions of people worldwide who have no electricity at all.

And quite frankly, it is not our call to hold those people back by denying them the affordable resources to bring them into the 21st century.

Throughout our languishing economic recovery, expanded domestic natural gas is a bright spot in the current economy and has the potential to revitalize America's economic engine. Increased production has created sorely needed jobs, stimulated local economies, and contributed to low unemployment in States like North Dakota and Wyoming. Additionally, affordable and abundant natural gas is poised to drive a revival in the American manufacturing sector, a sector we heard about a lot last night in the State of the Union speech.

Perhaps less obvious, but equally significant, is the potential for increased energy production to help address the Nation's spiraling debt. As Wyoming's former State Treasurer, I can testify firsthand to the importance of mineral revenues to Wyoming's sovereign wealth and ability to provide quality K–12 educations, as well as roads, sewers, and the infrastructure to have a vital, vibrant society.

Last week, the Institute for Energy Research reported that increasing access to energy development would, in addition to growing GDP by $127 billion annually, increase federal revenues by $24 billion annually for the next seven years, and $86 billion per year thereafter. Most of the options we have to address the budget crisis, cutting spending and increasing taxes, are difficult to achieve. Increasing energy production should be easy to achieve.

Our great energy story here in the United States has not gone unnoticed around the world. The German Economic Minister recently expressed concern that German firms are relocating to the United States primarily due to lower energy prices. While President Obama often cites European energy policies as a model he would like to follow in the United States, statements such as these should provide a powerful reminder of the importance of affordable energy to our global economic competitiveness.

I want to thank our distinguished panel for being here today and look forward to further discussions on how we can better encourage safe and responsible domestic energy production to make newfound visions of energy independence a reality. Thank you.

And now, I would like to recognize the gentleman from California, Mr. Swalwell, for five minutes.

[The prepared statement of Mrs. Lummis follows:]

PREPARED STATEMENT OF CHAIRWOMAN CYNTHIA LUMMIS

I would first like to congratulate and welcome Representative Swalwell on his appointment as Ranking Member of the Energy Subcommittee. I look forward to working with you during the 113th Congress. I would also like to welcome all the Members of the Subcommittee and hope we have a productive Congress together.

It is difficult to overstate the importance of energy to America's success. Plentiful and affordable energy is arguably the single most important factor to enabling our prosperity—from our health and wellness to our national and economic security. Technology development impacts all components of a healthy, developed energy system, including exploration and production, transportation, and end-use consumption. By providing the private market with the tools and incentives to innovate, our energy system can continue to integrate new technologies to reliably provide affordable and abundant energy.

The jurisdiction of this Subcommittee, which includes roughly $8 billion in research and development at the Department of Energy, provides us a unique opportunity to help shape the direction and future of energy in America. This Congress, I hope we can work collaboratively to do just that.

As the Representative of the State of Wyoming, I see first-hand the widespread benefits associated with energy production. Wyoming is the United States' second leading producer of total energy. It is the top producer of coal and uranium, and ranks third and eighth in natural gas and crude oil production, respectively. In addition to being a major fossil fuel producer Wyoming is a national leader in renewable energy, generating significant energy from wind and geothermal sources as well.

Needless to say, I am a strong supporter of an "all of the above" energy strategy. And now, more than ever, it is imperative Congress and President Obama take concrete steps to advance such a policy.

The timing has never been better. The U.S. energy sector is in the early stages of an historic period of technology-driven transformation. The advancement and application of horizontal drilling and hydraulic fracturing technologies has unlocked vast amounts of oil and gas resources to economic production. So much that the International Energy Agency projects that by 2020—just seven years from now—the U.S. will overtake Russia and Saudi Arabia to lead the world in oil production. The IEA also projects that coal will be the dominant energy source globally by 2030. While domestic use of coal declined last year, the global use of coal is increasing by leaps and bounds. Coal is abundant in America, and it is the only source of energy that can meet the scale of energy demand for the billion people worldwide who live with no electricity at all.

Throughout the languishing economic recovery, expanded domestic energy production and low natural gas prices are two of the few bright spots in the current economy and have the potential to revitalize America's economic engine. Increased production has created sorely needed jobs, stimulated local economies, and contributed to low unemployment in states like Wyoming. Additionally, affordable and abundant natural gas is poised to drive a revival in the American manufacturing sector.

Perhaps less obvious but equally significant is the potential for increased energy production to help address the nation's spiraling debt. Last week, the Institute for Energy Research reported that increasing access to energy development would—in addition to growing GDP by $127 billion annually—increase Federal revenues by $24 billion annually for the next seven years, and $86 billion per year thereafter. Most of the options we have to address the budget crisis—namely, cutting spending and increasing taxes—are politically controversial and difficult to achieve. Increasing energy production shouldn't be.

Our great energy story here in the U.S. has not gone unnoticed around the world. The German economic minister recently expressed concern that German firms are relocating to the U.S. primarily due to lower energy prices. While President Obama often cites European energy policies as a model he would like the U.S. to follow, statements such as these should provide a powerful reminder of the importance of affordable energy to our global economic competitiveness.

I thank our distinguished panel for being here today, and look forward to further discussion on how we can better encourage safe and responsible domestic energy production to make newfound visions of energy independence a reality.

Thank you and I now recognize the gentleman from California, Mr. Swalwell, for five minutes.

Mr. SWALWELL. Thank you, Madam Chair. I appreciate you holding this hearing today and I look forward to working with you on energy issues on this Subcommittee. And I also want to thank our panel for appearing today and I look forward to hearing each of your testimony.

Appropriately, this hearing will serve as a stage-setter, an opportunity to get a snapshot of the current energy landscape in the United States and abroad. And we heard a little bit of that last night from our President. And I was encouraged as he talked about how our country in the last four years has started to bend the curve and the trend of other countries dominating in the clean energy industry. And I look forward to continuing to support that and U.S. innovation from this Committee.

Today, we will hear more about the shipping dynamics in the energy marketplace. Far from being stagnant and hopeless, we are now seeing an unprecedented pace of change that was unpredictable even a few years ago. For instance, renewables are penetrating at a remarkable rate with growth in wind, as the President mentioned last night, alone outpacing natural gas in 2012.

Our responsibility is to ensure that this country is prepared for whatever changes that the markets may experience. Overreliance on a limited range of technologies and finite resources is unsustainable and unreasonable. We know that the U.S. uses 20 percent of the world's oil but that we only have two percent of the world's oil reserves. Our strength will lay in our ability to transition to new, cleaner, more sustainable resources. Simply, we cannot drill our way out of this problem. However, we can innovate our way out of this problem and we can work to make our country more energy secure and help make a thriving economy.

We must be competitive and not let ourselves get behind. As Washington bickers, our competitors are pulling out all of the stops to capitalize on the booming clean energy economy. It is time for us to get serious about creating a coherent green energy policy, a national policy to enable us to compete more so globally. We should be leading the world in a search for a better, safer, more affordable energy.

The Pew Charitable Trusts estimate that between now and 2018, annual revenue from clean energy installations will grow by about eight percent globally and by about 14 percent here in the United States. These profits, if we can make sure they are generated here in the United States—that the innovation is designed and manufactured here in the United States—will create new, good, well-paying, middle-class jobs for all Americans.

Finally, we must recognize the impact that our energy choices have on public health and the global environment now and into the future. Addressing climate change—and I am glad the President talked about this also last night and in his inaugural remarks—is about global security. The ecosystems that feed us are public health and safety and our future economic well-being.

From the outside I will say that I believe there is no one-size-fits-all prescription or standardized test for the appropriate role of government in securing our energy future. In a field as complex as energy, we must be flexible and efficient when deploying taxpayer resources and rely on a mix of scientific expertise, market forces, common sense, and ways that we can identify gaps to inform our policy decisions.

The President also talked last night about working to have businesses in homes. He challenged us to reduce energy consumption that we have in our businesses and homes. And I will—I believe there is an opportunity for us to work with the business community especially and residents to bring down their own energy consumption and work with the utility companies as well to find ways that we can do that and provide incentives because that also will bring down the amount of energy we consume and also create, I believe, new jobs for clean energy providers.

Finally, we should engage our world-class scientific enterprise from universities to national laboratories to overcome fundamental scientific and technical challenges. Two national labs in particular, Lawrence Livermore National Laboratory and Sandia National Laboratory, are located in my Congressional District, and they are hard at work taking on the energy challenges of the future.

Federal programs have a role to play in giving innovators, investors, and companies space to collaborate. We should do more to replicate public-private partnerships like IGATE—Innovation and Green Advanced Transportation Excellence—that harness the creativity of our best and brightest in science and business and then transfer their technologies out to the private markets.

We should also leverage equitable and innovative financing mechanisms where the market is not well structured to take on the often high technical and financial risks. Finally, where there is no tool to match the problem, we should have the courage to reinvent the way government does business. Programs like Advanced Research Projects Agency—Energy, ARPA–E and the Hubs showed us that this can be done.

With scientific research, nothing is guaranteed and so we need to be willing to take risks. I come from the Bay area, which includes Silicon Valley, where risk-taking is critical to the region's economy. Taking risks means sometimes you will not succeed, but scientific progress in our country and internationally has never been a straight line. Only by taking risks and charging forward can we ever hope to reach goals which today may seem out of reach.

The big energy challenges we face require big lead times to solve. We thus can't let bureaucratic inertia and partisan politics delay or get in the way of us making investments and encourage research, innovation, and competition. If the United States is to be the world leader in all aspects of energy, we must be willing to work together, compromise, and embrace innovation.

Again, I want to thank Chairman Lummis for holding this hearing. I look forward to engaging in a discussion of these critical energy issues facing our country. I look forward to hearing from our witnesses.

And with that, I yield back the balance of my time.

[The prepared statement of Mr. Swalwell follows:]

PREPARED STATEMENT OF RANKING MINORITY MEMBER ERIC SWALWELL

Thank you, Madam Chair. I appreciate you holding this hearing today, and I look forward to working with you on energy issues on the subcommittee.

I also would like to thank our panel for appearing today. I look forward to your testimony.

Appropriately, this hearing will serve as a stage-setter, an opportunity to get a snapshot of the current energy landscape in the U.S. and abroad.

Today we will hear more about the shifting dynamics in the energy marketplace. Far from being stagnant and hopeless, we now are seeing an unprecedented pace of change that was unpredictable even a few years ago. For instance, renewables are penetrating at a remarkable rate, with growth in wind energy alone outpacing natural gas in 2012.

Our responsibility is to ensure that this country is prepared for whatever changes the markets may experience. Overreliance on a limited range of technologies and finite resources is unreasonable. We know that the U.S. uses 20 percent of the world's oil but has only two percent of world's oil reserves. Our strength will lay in our ability to transition to new, cleaner, more sustainable resources. We cannot drill our way to energy security and a thriving economy—we need to unleash the creativity of our scientists, engineers, and entrepreneurs to unlock our energy potential.

We must be competitive and not let ourselves get left behind. As Washington bickers, our competitors are pulling out all of the stops to capitalize on the booming clean energy economy. It is time for us to get serious about creating a coherent green energy policy to enable us to compete globally. We should be leading the world in the search for better, safer, more affordable energy.

The Pew Charitable Trusts estimates that, between now and 2018, annual revenue from clean energy installations will grow by eight percent, globally, and by 14 percent in the U.S. and this will amount to almost two trillion dollars in cumulative revenues in that timeframe. These profits, if we can make sure they are generated here in the U.S., mean good, middle-class, American jobs.

Finally, we must recognize the impact that our energy choices have on public health and the global environment, now and far into the future. Addressing climate change is about global security, the ecosystems that feed us, our public health and safety, and our future economic well-being.

From the outset I will say that I believe there is no one-size-fits-all prescription or standardized test for the appropriate role of government in securing our energy future. In a field as complex as energy, we must be flexible and efficient when deploying taxpayer resources and rely on a mix of scientific expertise, market forces, and common sense to identify gaps and inform our policy decisions.

First and foremost, we should engage our world-class scientific enterprise—from universities to national labs—to overcome fundamental scientific and technical challenges. Two national labs in particular, Lawrence Livermore and Sandia, located in my congressional district, are hard at work taking on the energy challenges of the future. Federal programs have a role to play in giving innovators, investors, and companies a space to collaborate. We should do more to replicate public-private partnerships like i-GATE (Innovation for Green Advanced Transportation Excellence) that harness the creativity of our best and brightest in science and business.

We also should leverage equitable and innovative financing mechanisms where the market is not well-structured to take on the often high technical and financial risks. Finally, when there is no tool to match the problem, we should have the courage to reinvent the way government does business. Programs like Advanced Research Projects Agency-Energy (ARPA-E) and the Department of Energy's Hubs showed us it can be done.

With scientific research nothing is guaranteed, and so we need to be willing to take risks. I come from the Bay Area, which includes Silicon Valley, where risk-taking is critical to the region's economy. Taking risks means sometimes you will not succeed, but scientific progress has never been a straight line. Only by taking risks and charging forward can we ever hope to reach goals which today may seem out of reach.

The big energy challenges we face require big lead times to solve. We thus cannot let bureaucratic inertia and partisan politics delay or get in the way of us making investments that encourage research, innovation, and competition. If the U.S. is to be the world leader in all aspects of energy, we must be willing to work together, compromise, and embrace innovative ideas.

Again, I want to thank Chairman Lummis for holding this hearing. I look forward to an engaging discussion of the critical energy issues facing our country. With that, I yield back the balance of my time.

Chairwoman LUMMIS. Thank you, Mr. Swalwell.

You know, my first job out of college was in what is now your district. I worked for Flying U Rodeo Company. It was based in Marysville, California. And we did a rodeo in Livermore. And I can remember jogging around the Lawrence Livermore plant before I got to work and it was the first time I ever experienced an earthquake, and that was very memorable.

Mr. SWALWELL. Yes, and they are our largest employer in the district.

Chairwoman LUMMIS. Well, it is an enormous facility. It would be fun to go in it some time. I was just on the perimeter.

There are so many things that Democrats and Republicans agree about when it comes to energy, and I think particularly in this Committee. When we are really going to be focused on the research and the science and the technology and the innovation, we will find a lot of areas of agreement. And I really, really mean that. I want to work with both sides of the aisle to achieve something significant. I didn't come here to just conduct hearings. I really want to get the work done. So let us make that our goal.

Mr. SWALWELL. Great. And you have an ally here——

Chairwoman LUMMIS. Thank you.

Mr. SWALWELL. —that wants to do the same.

Chairwoman LUMMIS. Fabulous.

Do any Members wish to submit opening statements? If so, we will accept them now and they will be added to the record. Anyone? Okay. Well, we are good. At this point we will introduce our witnesses.

Our first witness is Hon. Adam Sieminski, Administrator for the Energy Information Administration at the U.S. Department of Energy. Mr. Sieminski is responsible for collecting, analyzing, and disseminating independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. Prior to his appointment, Mr. Sieminski was Chief Energy Economist for Deutsche Bank working with the bank's global research and forecasting energy market trends.

Our next witness is Mr. Robert McNally, President of the Rapidan Group. Did I pronounce that right? Okay. Mr. McNally has over 20 years of government and market experience as an international energy market consultant, investment strategist, and White House policy official. His background and expertise spans the convergence of energy with economic, security and environmental sectors from global oil market fundamentals to regulatory policies.

And our final witness today is Lisa Jacobson, President of the Business Council for Sustainable Energy. Ms. Jacobsen has advised states and federal policymakers on energy, tax, air quality, and climate change issues. She serves as a private sector observer to the World Bank's Climate Investment Fund and is a member of the Department of Energy's State Energy Efficiency Steering Committee.

As our witnesses should know, spoken testimony is limited to five minutes each, after which Members of the Committee will have five minutes each to ask questions. And although I am not a stickler on going over 15 seconds here or there, after that, I start getting squirmy, so just fair warning.

Now, I recognize Mr. Sieminski to present his testimony. And we are so delighted you are here. Please proceed.

STATEMENT OF THE HONORABLE ADAM SIEMINSKI, ADMINISTRATOR, ENERGY INFORMATION ADMINISTRATION (EIA), U.S. DEPARTMENT OF ENERGY

Mr. SIEMINSKI. Madam Chairman, thank you very much for that warm welcome and kind going through my background. I appreciate that.

Ranking Member Swalwell, Members of the Committee, I really appreciate the opportunity to appear before you today to provide testimony on the U.S. energy outlook.

The Energy Information Administration is the statistical and analytical agency within the U.S. Department of Energy. Our data, analyses, and forecasts are independent of the approval by any other officer or employee of the U.S. Federal Government. The views expressed in my testimony should not be construed as representing those of the Department of Energy, the Administration, or other federal agencies.

What I would like to do today is summarize some key findings from our February Short-Term Energy Outlook, just released yesterday, as well as the 2013 Annual Energy Outlook Reference case that was issued in December. At this point, I would like to highlight that our short-term analysis incorporates the extension of the production tax credit for renewables and more recent trends in oil and gas production activity here in the United States.

In the short term to 2014, the EIA expects crude oil prices to decline and gasoline and diesel fuel prices as well. Natural gas prices rise but remain below $4 a million BTU in 2013, '14. As natural gas prices rise relative to coal prices, EIA does expect a modest rise in coal-fired electricity generation. Generation from conventional hydropower will continue through the recent drought-driven decline into 2013 and then rebound slightly in 2014. Total electricity generation from renewables should increase through 2014. We expect wind generation to grow by 16 percent in 2013 and another eight percent in 2014. Solar generation is expected to grow by roughly 30 percent annually in both 2013 and 2014. Four large solar thermal plants in California, Nevada, and Arizona are expected to come online driving utility-scale solar increases 64 percent this year and another 47 percent in 2014.

Turning to the long term, as outlined in the reference case for the Annual Energy Outlook, natural gas production increases throughout the projection period out to 2040, outpacing domestic consumption by 2020 and spurring net exports of natural gas. Relatively low natural gas prices facilitated by growing shale gas production spur an increase of 16 percent in the industrial sector to 2025 and ensure continuing growth in electricity generation. Natural gas also reaches new markets as a fuel for heavy duty freight transportation and as feedstock for producing liquid fuels through gas-to-liquids technology.

Over the next three decades, electricity use is expected to continue to grow but only at a rate of less than one percent per year, as you can see in Figure 1 in my testimony. Slowing population growth, technological change, efficiency standards for equipment, and shifts in the economy towards less intensive industry are all factors. For example, just yesterday, EIA published a Today In Energy feature explaining that although newer homes are 30 percent larger, they only consume about the same amount of energy as older homes. As shown in Figure 3, energy use in the residential sector was relatively flat between 1993 and 2009 but used many more consumer electronic devices.

EIA expects the recent shift and the fuel mix for power generation to continue with natural gas plants accounting for most of the new capacity added. Strong growth in hydro renewable generation is driven by a combination of state renewable portfolio standards and federal tax incentives that spur growth in the near term, as well as the increase in fossil fuel prices that shift the competitive markets.

EIA projects no growth in transportation energy demand between 2011 and 2042 with declining light-duty vehicle energy consumption of over 1–1/2 million barrels a day out to 2040. The growth in heavy-duty vehicle demand also spurs some fuel-switching to natural gas, as I mentioned earlier. Natural gas is projected to have a significant impact on heavy-duty vehicle energy consumption in relatively high travel applications such as tractor-trailers, which account for two thirds of all heavy-duty travel.

Finally, U.S. energy-related carbon dioxide emissions remain more than five percent below their 2005 level through 2040 due to improved efficiency of energy use and a shift towards less carbon-intensive fuels.

This concludes my testimony, Madam Chairman and Members of the Committee. I would be happy to answer questions that you might have as we proceed. Thank you.

[The Statement of Mr. Sieminski follows:]

STATEMENT OF ADAM SIEMINSKI

ADMINISTRATOR

ENERGY INFORMATION ADMINISTRATION

U.S. DEPARTMENT OF ENERGY

BEFORE THE

SUBCOMMITTEE ON ENERGY

COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

FEBRUARY 13, 2013

Chairman Lummis, Ranking Member Swalwell and Members of the Committee, I appreciate the opportunity to appear before you today to provide testimony on the U.S. energy outlook.

The U.S. Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy. EIA collects, analyzes, and disseminates independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment. EIA is the Nation's premier source of energy information and, by law, its data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government. The views expressed in our reports, therefore, should not be construed as representing those of the Department of Energy, Administration, or other federal agencies.

The energy information and projections that I will discuss today are widely used by government agencies, the private sector, and academia as a starting point for their own energy analyses. EIA prepares both short-term energy outlooks, examining monthly trends over the next one to two years, and long-term outlooks, with annual projections over the next 20-to-25 years. Copies of the most recent outlooks are included as part of my testimony. I will summarize some key findings from our January *Short Term Energy Outlook* (STEO), which includes monthly forecasts through the end of 2014, and the recently released 2013 *Annual Energy Outlook* (*AEO*) Reference case. I will then provide more detail on key trends in electricity and transportation markets.

The short-term energy outlook

The February 2013 STEO forecasts for 2014 are the first to include the extension of the federal production tax credits for certain renewable energy sources. Major highlights include:

Crude oil prices projected to decline over next two years

EIA expects that the Brent crude oil spot price, which averaged $112 per barrel in 2012, will fall to an average of $109 per barrel in 2013 and $101 per barrel in 2014. The projected discount of West Texas Intermediate (WTI) crude oil to Brent, which averaged close to $18 per barrel in 2012, falls to an average closer to $17 per barrel in 2013 and $9 per barrel in 2014, as planned new pipeline capacity lowers the cost of moving mid-continent crude oil to the Gulf Coast refining centers.

Gasoline prices expected to follow crude oil prices in near-term

EIA expects that falling crude prices will help national average regular gasoline retail prices fall from an average $3.63 per gallon in 2012 to annual averages of $3.55 per gallon and $3.39 per gallon in 2013 and 2014, respectively. Diesel fuel retail prices averaged $3.97 per gallon during 2012 and are forecasted to fall to an average of $3.92 per gallon in 2013 and $3.82 per gallon in 2014.

U.S. crude oil production increases 1.4 million barrels per day between 2012 and 2014

EIA estimates U.S. total crude oil production averaged 6.4 million barrels per day (bbl/d) in 2012, an increase of 0.8 million bbl/d from the previous year. Projected domestic crude oil production increases to 7.3 million bbl/d in 2013 and 7.8 million bbl/d in 2014 which would mark the highest annual average level of production since 1988.

Total liquids consumption largely unchanged over next two years

Total U.S. liquid fuels consumption fell from an average 20.8 million bbl/d in 2005 to 18.6 million bbl/d in 2012. EIA expects total consumption to rise slowly over the next two years to an average 18.7 million bbl/d in 2014, driven by increases in distillate and liquefied petroleum gas consumption, with flat gasoline and jet fuel consumption.

Natural gas prices rise from the low levels seen in 2012

Natural gas working inventories, which reached a record-high level in early November, ended 2012 at an estimated 3.4 trillion cubic feet (Tcf), slightly below the level at the same time the previous year. EIA expects the Henry Hub natural gas spot price, which averaged $4.00 per million British thermal units (MMBtu) in 2011 and $2.75 per million MMBtu in 2012, will average $3.53 per MMBtu in 2013 and $3.84 per MMBtu in 2014.

Rising natural gas prices contribute to a modest rise in coal-fired electricity generation

EIA expects the coal share of total electricity generation to rise from 37.4 percent in 2012 to 39.1 percent in 2013 and 2014, as natural gas prices rise relative to coal prices. Lower-than-projected natural gas prices along with the industry's response to future environmental regulations could cause the coal share of total generation to fall below this forecast.

Generation from renewable sources continues to rise

EIA expects generation from conventional hydropower will decline in 2013 then rebound slightly in 2014. Other renewables, especially wind and solar, continue to grow. The amount of electricity generated from wind is expected to grow by 16 percent in 2013 and another 8 percent in 2014. Solar power generation, specifically utility scale in the electric power industry, is expected to grow by 64 percent this year and another 47 percent in 2014. All solar generation, including distributed applications, is expected to grow by roughly 30 percent annually in 2013 and 2014. Overall, EIA expects the share of total electricity generation from all renewables to increase from 12 percent in 2012 to nearly 13 percent in 2013 and 2014.

Long-term energy outlook

Annual Energy Outlook. Turning to the *Annual Energy Outlook 2013* (AEO2013): Projections in the AEO2013 Reference case focus on the factors that shape U.S. energy markets through 2040, under the assumption that current laws and regulations remain generally unchanged throughout the projection period. The trends discussed here focus on the AEO2013 Reference case, which provides the basis for examination and discussion of energy market trends and serves as a starting point for analysis of potential changes in U.S. energy policies, rules, or regulations or potential technology breakthroughs. Readers are encouraged to review the full range of cases that will be presented when the complete AEO2013 is released in early

2013, exploring key uncertainties in the Reference case. Major highlights in the AEO2013 Reference case include:

Crude oil production, particularly from tight oil plays, rises sharply over the next decade

The advent and continuing improvement of advanced crude oil production technologies continue to lift projected domestic supply. Domestic production of crude oil increases sharply in AEO2013. The growth results largely from a significant increase in onshore crude oil production, particularly from shale and other tight formations.

Natural gas production rises throughout the* AEO2013 *Reference case projection, with natural gas increasingly serving the industrial and electric power sectors, as well as an expanding export market

Relatively low natural gas prices, facilitated by growing shale gas production, spur increased use in the industrial and electric power sectors, particularly over the next 15 years. Natural gas use (excluding lease and plant fuel) in the industrial sector increases by 16 percent, from 6.8 trillion cubic feet per year in 2011 to 7.8 trillion cubic feet per year in 2025. Although natural gas also continues to capture a growing share of total electricity generation, natural gas consumption by power plants does not increase as sharply as generation because new plants are very efficient. The natural gas share of generation reaches 30 percent in 2040. Natural gas also reaches other new markets, such as exports, as a fuel for heavy-duty freight transportation (trucking), and as a feedstock for producing diesel and other fuels.

Projected motor gasoline consumption declines in* AEO2013 *reflecting the introduction of more stringent corporate average fuel economy standards; growth in diesel fuel consumption is moderated by increased use of natural gas in heavy-duty vehicles

AEO2013 incorporates the greenhouse gas (GHG) and corporate average fuel economy (CAFE) standards for light-duty vehicles (LDVs) through the 2025 model year. Motor gasoline consumption, inclusive of ethanol volumes, declines from 8.78 million barrels per day in 2011 to 8.39 million barrels per day in 2020 and 7.23 million barrels per day by 2040. Furthermore, the improved economics of liquefied natural gas (LNG) for heavy-duty vehicles results in an increase in natural gas use in heavy-duty vehicles that offsets a portion of diesel fuel consumption.

The United States exports more natural gas than projected in the AEO2012 Reference case

U.S. dry natural gas production increases throughout the projection period, outpacing domestic consumption by 2020 and spurring net exports of natural gas. Higher volumes of shale gas production in AEO2013 are central to higher total production volumes and an earlier transition to net exports than was projected in the *AEO2012* Reference case. U.S. exports of LNG from domestic sources rise to approximately 1.6 trillion cubic feet (Tcf) in 2027, almost double the 0.8 trillion cubic feet projected in *AEO2012*. U.S. net exports to Mexico via pipeline also increase steadily over the projection period, from 0.5 Tcf in 2011 to 2.4 Tcf in 2040.

Industrial production expands in response to the initial competitive advantage of low natural gas prices

Industrial production grows more rapidly in AEO2013 due to the benefit of strong growth in shale gas production and an extended period of relatively low natural gas prices, which lower the costs of both raw materials and energy, particularly through 2025. Specific industries benefit from the greater availability of natural gas at relatively low prices. For example, industrial production grows by 1.7 percent per year from 2011 to 2025 in the bulk chemicals industries—which also benefit from increased production of natural gas liquids—and by 2.8 percent per year in the primary metals industries, as compared with 1.4 percent and 1.1 percent per year, respectively, in the *AEO2012* Reference case. In the long term, growing competition from abroad in these industries limits output growth, as other nations develop and install newer, more energy-efficient facilities. The higher level of production also leads to greater industrial natural gas demand (excluding lease and plant fuel), which grows from 6.9 quadrillion Btu in 2011 to more than 8.5 quadrillion Btu in 2040 in AEO2013. Most of the increase in industrial energy demand is the result of higher output in the manufacturing sector.

Renewable fuel use grows at a much faster rate than fossil fuel use

The share of generation from renewables grows from 13 percent in 2011 to 16 percent in 2040. Electricity generation from solar and, to a lesser extent, wind energy sources grow as recent cost declines make them more economical. However, the AEO2013 projection is less optimistic than *AEO2012* about the ability of advanced biofuels to capture a rapidly growing share of the liquid fuels market.

With improved efficiency of energy use and a shift away from the most carbon-intensive fuels, U.S. energy-related carbon dioxide (CO_2) emissions remain more than 5 percent below their 2005 level through 2040

Total U.S. energy-related CO_2 emissions do not return to their 2005 level (5,997 million metric tons) by the end of the AEO2013 projection period. Emissions from motor gasoline use are reduced by the adoption of fuel economy standards, biofuel mandates, and shifts in consumer behavior. Emissions from coal use in the generation of electricity are lower as power generation shifts from coal to lower-carbon fuels, including natural gas and renewables.

Electricity Markets

Slowing demand growth (Figures 1 – 3)

As shown in Figure 1, over the next three decades electricity use is expected to continue to grow, but the rate of growth will slow over time as it has almost continuously over the last 60 years. In the 1950s, 1960s, and 1970s the use of electricity often increased more than 5 percent per year. Annual rates of increase in electricity usage then slowed to 2 to 3 percent per year in the 1980s and 1990s and, over the last decade, it has fallen to less than one percent per year.

The factors driving this trend include slowing population growth, near market saturation of key electricity-using appliances like air conditioners, water heaters, stoves, dishwashers, etc., and the improving efficiency of nearly all equipment and appliances in response to standards and technological change and a shift in the economy towards less energy intensive industry.

The dramatic changes in the residential sector are evident in the 2009 data from EIA's Residential Energy Consumption Survey (RECS) which show that the average household consumed 90 million Btu (Figure 2). Despite increases in the number and the average size of homes plus increased use of electronics, improvements in efficiency for space heating, air conditioning, and major appliances have all led to decreased consumption per household. At the same time, as shown in Figure 3, the average U.S. household uses many more consumer electronics — in particular, personal computers, televisions and related devices.
Over 45 percent of homes have at least one television with a screen size of 37 inches or larger. DVD players and Digital Video Recorders (DVR), which did not exist 20 years ago, are now widespread. As of 2009, 79 percent of homes had a DVD player, and 43 percent had a DVR. Nearly a third of all households also had at least four rechargeable electronic devices, such as cell phones, plugged in and charging at home.

While there is always uncertainty about future electricity demand, efficiency standards for lighting and other appliances that have been put in place over the past few years will continue to place downward pressure on growth as new equipment is added and existing stock is replaced. Absent a very rapid introduction of some new electricity-using device a sharp rebound in electricity demand growth is not expected.

Shifting fuel mix (Figures 4)

As shown in Figure 4, between 1990 and 2008, coal-fired power plants accounted for 50 percent or more of U.S. electricity generation each year. However, since 2008, coal's share of generation has declined each year, reaching 42 percent in 2011 and 37 percent in 2012 (preliminary data through November). The story for natural gas is almost the complete opposite. After falling to less than 10 percent of total generation in 1988, natural gas's share of generation increased to nearly 25 percent in 2011 and 31 percent in 2012 (preliminary data through November).

The decline in coal and the rise of natural gas in recent years has been driven primarily by two factors, the economy and the huge fall in natural gas prices that occurred as shale gas resources were successfully developed. The recession that began in late 2007 contributed to two year-on-year declines in electricity generation, the first time that ever occurred in the data maintained by EIA. Most of that reduction in generation was absorbed by coal. As demand for electricity started to recover in 2010, natural gas prices continued to decline. As a result, natural gas became more competitive with coal as a fuel for electricity generation.

Going forward, coal generation recovers somewhat as gas prices rise, but not enough to increase its market share. Non-hydro renewable generation actually shows the most rapid growth, as state and federal programs spur growth in the near-term and they become increasingly competitive in the long term. By 2040, EIA projects that the natural gas share of generation is at 30 percent (Figure 4).

New Capacity Additions/Retirements (Figure 5)

The relatively low natural gas prices that are projected to persist throughout most of the AEO projections cause new capacity additions to be dominated by new natural gas-fired combined cycle and combustion turbine plants. Through 2040, natural gas plants account for 64 percent of the new capacity added. Most of the remaining capacity additions are based on renewable sources. In the near term, through 2016, new renewable additions are spurred by a combination of federal tax incentives and state renewable portfolio standard (RPS) programs. Though not included in the AEO2013 Reference case, the tax credit extensions recently passed in the American Taxpayer Relief Act of 2012 (H.R. 8) would likely lead to greater near-term renewable capacity additions than are shown here. In the longer term, particularly after 2030, rising natural gas prices and falling new renewable plant costs spur further renewable capacity additions. Overall, through 2040, renewable capacity additions account for 30 percent of total additions.

Additions of other capacity types like nuclear and coal are very modest and consist of a small number of plants that are currently under construction and a small number of additional plants projected to come on after 2030 as natural gas prices rise.

Renewables (Figure 6)

The growth in non-hydro renewable generation is driven by a combination of state renewable portfolio standards and federal tax incentives that spur growth in the near-term as well as the increase in fossil fuel prices that make renewables more competitive in the long term.

Wind, biomass and solar account for the vast majority of the growth. Wind is installed primarily in utility scale facilities, while biomass generation grows in co-firing applications as a co-fuel with coal, and when electricity is produced in biofuel facilities for their own use and sale to the grid.

Growth in solar generation occurs in both utility scale and distributed applications. Among the individual fuels, solar actually shows the most rapid annual percentage growth between now and 2040, but since it starts at such a small level in 2011, its share remains modest in 2040. As more solar facilities have been installed, the costs to install solar generating plants have declined. Based on the preliminary results from a recent study of generating unit capital costs, EIA has lowered its estimate for the capital cost for new utility scale solar plants by over 20 percent. One additional point I would like to make about solar, is that we are concerned that the various data sources we use may not be capturing all of the solar capacity that is being added and we are in the process of trying to improve our solar estimates.

Technological change: improvements in generating unit efficiency (Figure 7)

While the falling price of natural gas has been a key driver in the shift in the fuels used for electricity generation, changes in technology, particularly the efficiency of new generating units have also been important. Figure 7 highlights the average heat rates of the fossil-fired electric generation fleet from 1990 through 2011. The heat rate is a measure of the thermal efficiency of an electric generating station and is commonly expressed in Btu per kilowatthour. The lower the heat rate, the more efficient the generating unit (i.e. the fewer Btu of fuel required to produce a kilowatthour of electricity). As depicted on the graph, the efficiency of the natural gas generating fleet has improved by over 20 percent.

Historical generating unit installations (Figure 8)

Figure 8 summarizes the capacity installed from 1990 through 2011. As you can see, natural gas-fired units dominated the overall generating unit installations during this time frame, representing 75 percent of the total. Roughly two-thirds of the new natural gas-fired generating capacity installed, or 186 gigawatts, were efficient combined cycle generating units. These new unit installations have contributed to the significant improvement in the overall efficiency of the electricity generating fleet.

Transportation Markets

No growth in transportation energy demand between 2011 and 2040 (Figure 9)

The transportation sector consumes 27.1 quadrillion Btu in 2040 in the AEO2013 Reference case, the same amount of energy demand in 2011. The projection of no growth in transportation energy demand differs markedly from the historical trend, which saw a 1.1 percent average annual growth between 1975 and 2011, and is due to declining light-duty vehicle (LDV) energy consumption, which offsets increases occurring in the other modes of travel (Figure 9).

Declining light-duty energy demand projected to occur due to more stringent CAFE standards (Figure 10)

Light-duty vehicle energy demand declines from 16.1 quadrillion Btu in 2011 to 13.0 quadrillion Btu in 2040, reducing its share of total transportation demand from 59 percent to 48 percent. This decline contrasts noticeably with the 0.9 percent average annual growth experienced between 1975 and 2011 and is the result of higher projections in light-duty vehicle fuel economy, which more than offsets modest growth in vehicle miles travelled. New light-duty vehicle fuel economy rises in the AEO2013 due to the joint greenhouse gas emissions and CAFE standards for model years 2012 through 2025 (Figure 10). While subsequent standards are held constant after 2025, light-duty vehicle fuel economy continues to rise.

Growing share of light-duty vehicles powered by non-gasoline sources

Light-duty vehicles that use diesel, other alternative fuels, hybrid-electric, or all-electric systems play a significant role in meeting the more stringent GHG emissions and CAFE standards and provide consumers fuel savings. Sales of hybrid-electric and all-electric vehicles that use stored electric energy for motive power grow considerably, led by gasoline- and diesel hybrid-electric vehicles, which account for 6 percent of total light-duty vehicle sales in 2040. Plug-in hybrid and plug-in all-electric vehicles account for 3 percent of sales in 2040. Diesel vehicle sales remain relatively constant over the projection period at about 3 percent of total sales.

Personal vehicle travel demand, measured as annual vehicle miles traveled (VMT) per licensed driver, grew at an average annual rate of 1 percent between 1970 and 2007 when it peaked at about 12,800 miles. Vehicle miles traveled per licensed driver remain below the 2007 level until 2029 in the AEO2013 Reference case projection before reaching 13,300 miles in 2040, growing at an average annual rate of 0.3 percent. Demographic forces moderate growth in VMT per licensed driver across the projection, as the number of vehicles per licensed driver declines. Further, unemployment remains above pre-recession levels until around 2020, tempering personal travel demand until that time. While the price of motor gasoline increases by 25 percent from 2011 to 2040, real disposable personal income climbs 95 percent. Growth in income relative to the fuel cost of driving lowers the percentage of income spent on fuel, boosting travel demand.

Rising heavy-duty energy demand with some fuel switching to natural gas (Figure 11)

Heavy-duty vehicle energy consumption, which includes tractor trailers, vocational vehicles as varied as ambulances and cement mixers, and heavy-duty pickups and vans, grows from 5.2 quadrillion Btu in 2011 to 7.6 quadrillion Btu in 2040. This represents the largest growth in the transportation sector and increases the heavy-duty vehicle share of total transportation from 19 percent to 28 percent. Heavy-duty vehicle travel grows by 82 percent between 2011 and 2040, from 240 billion miles to 438 billion miles, an average annual increase of 2.1 percent, This increase results from growth in industrial output over the projection period and an increase in the number of trucks on the road, from 9.0 million in 2011 to 13.7 million in 2040. Growth in heavy-duty vehicle energy demand is somewhat tempered by projected increases in fuel economy, which rise from 6.7 miles per gallon (mpg) in 2011 to 8.2 mpg in 2040 due to the implementation of the Heavy-Duty National Program greenhouse gas emissions and fuel efficiency standards beginning in model year 2014, along with the economic adoption of fuel saving technology.

Natural gas is projected to have a significant impact on heavy-duty vehicle energy consumption in the AEO2013, with demand rising from 0.02 quadrillion Btu in 2011 to 1.03 quadrillion Btu in 2040, an average annual growth rate of 14.6 percent. Although heavy-duty vehicles fueled by natural gas have significant incremental costs compared to their diesel-powered counterparts, the increase in natural gas consumption is due to low natural gas fuel prices compared to diesel fuel and the purchase of natural gas vehicles in relatively high travel applications such as tractor trailers. The largest heavy-duty vehicles, which include those vehicles with a Gross Vehicle Weight Rating of 26,001 pounds or greater and are primarily tractor trailers, account for about two-thirds of all heavy-duty vehicle travel and consume 91 percent of the natural gas in the heavy-duty vehicle sector by 2040. While natural gas accounts for a rapidly rising share of heavy-duty vehicle energy demand, it still amounts to only 14 percent of total heavy-duty vehicle energy demand in 2040 in the AEO2013 Reference case.

Overall, energy consumption by fuel in the transportation sector shows a marked change between 2011 and 2040 due to the key drivers discussed above. Motor gasoline consumption falls from 16.3 quadrillion Btu in 2011 to 12.6 quadrillion Btu in 2040, a decline in share from 60 percent to 47 percent, due to reduced demand by light-duty vehicles. Diesel fuel consumption grows from 5.9 quadrillion Btu in 2011 to 7.9 quadrillion Btu in 2040, an increase in share from 22 percent to 29 percent, due to growth in heavy-duty vehicle demand. Jet fuel energy consumption rises from 3.0 quadrillion Btu in 2011 to 3.4 quadrillion Btu in 2040, a growth in share from 11 percent to 13 percent. Compressed or liquefied natural gas represents the fastest growing fuel in the transportation sector, with an average annual growth rate of 11.9 percent from 2011 to 2040, reaching 1.1 quadrillion Btu by 2040, or 4 percent of total transportation energy consumption, due to increased use by heavy-duty vehicles. Pipeline fuel (3 percent), E85 (1 percent), and other fuels such as lubricants, propane, electricity, and hydrogen (4 percent) represent the remainder of transportation energy demand in 2040.

Conclusion

As I noted at the outset, while EIA does not take policy positions, its data, analyses, and projections are meant to assist policymakers in their energy deliberations. In addition to the work on baseline projections that I have reviewed this morning, EIA has often responded to requests from this Committee and others for analyses of the energy and economic impacts of energy policy proposals.

This concludes my testimony, Madam Chairman and Members of the Committee. I would be happy to answer any questions you may have.

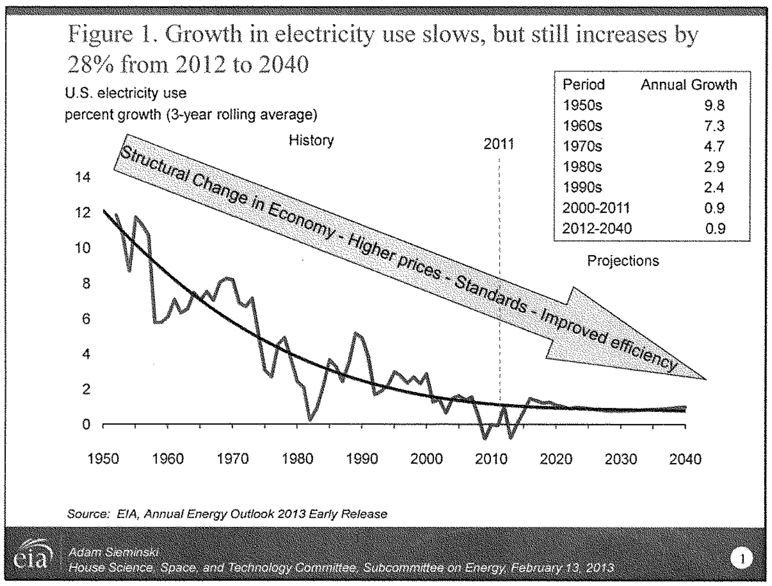
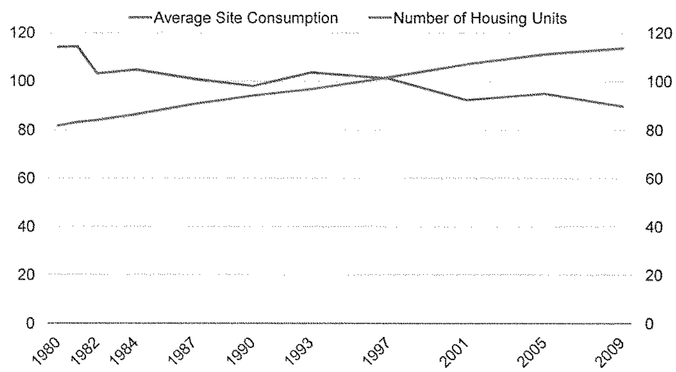


Figure 2. Average residential site consumption has steadily declined over the last 30 years

average site energy consumption per home and number of housing units, 1980 – 2009

million Btu per housing unit | million housing units

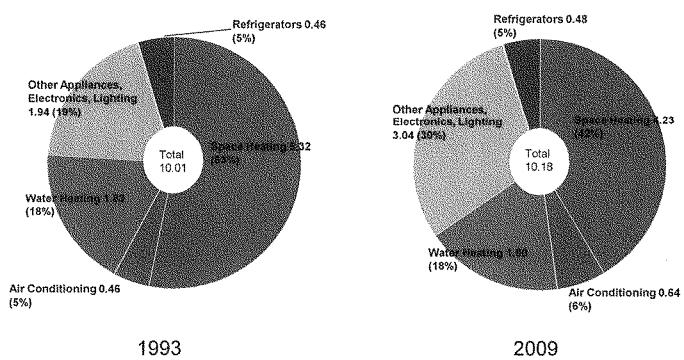


Source: EIA, Residential Energy Consumption Survey (RECS)

Figure 3. Heating and cooling no longer bulk of residential site consumption

total site energy use in homes by end use, 1993 and 2009

quadrillion Btu and percents



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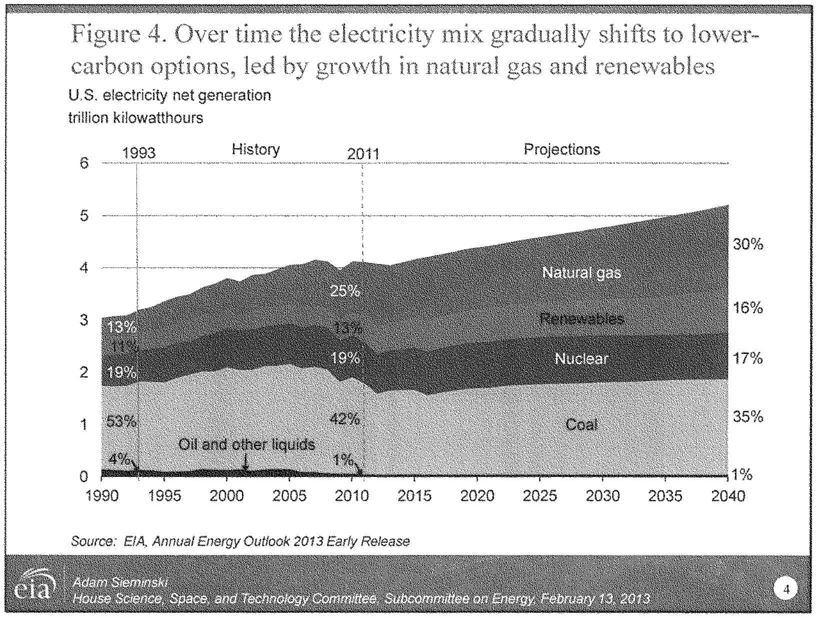
Figure 4. Over time the electricity mix gradually shifts to lower-carbon options, led by growth in natural gas and renewables
U.S. electricity net generation
trillion kilowatthours
1993
History
2011
Projections
Natural gas
Renewables
Nuclear
Coal
Oil and other liquids
25%
13%
19%
42%
1%
13%
11%
19%
53%
4%
30%
16%
17%
35%
1%
0
1
2
3
4
5
6
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
Source: EIA, Annual Energy Outlook 2013 Early Release
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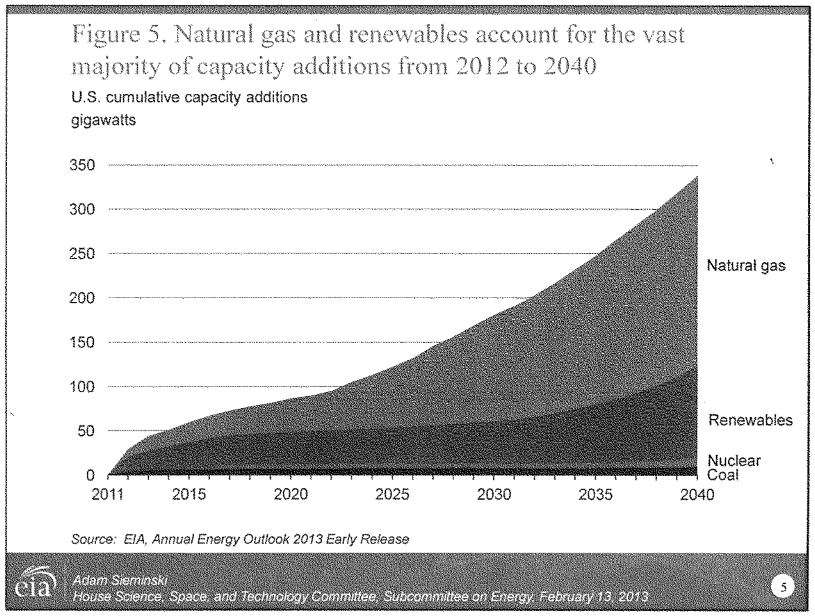
Figure 5. Natural gas and renewables account for the vast majority of capacity additions from 2012 to 2040
U.S. cumulative capacity additions
gigawatts
350
300
250
200
150
100
50
0
2011
2015
2020
2025
2030
2035
2040
Natural gas
Renewables
Nuclear
Coal
Source: EIA, Annual Energy Outlook 2013 Early Release
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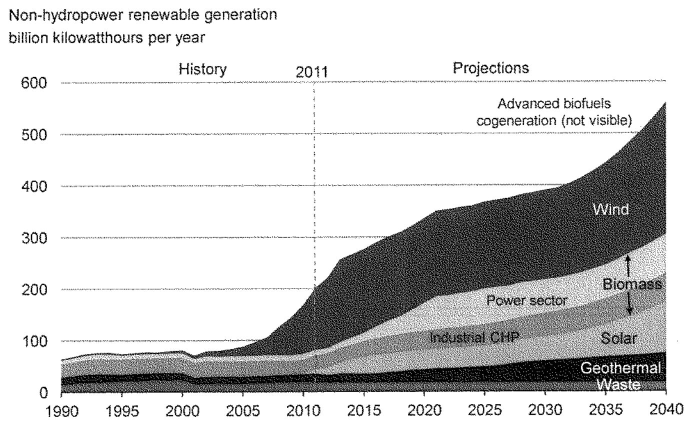
Figure 6. Non-hydro renewable generation more than doubles between 2011 and 2040



Source: EIA, Annual Energy Outlook 2013 Early Release

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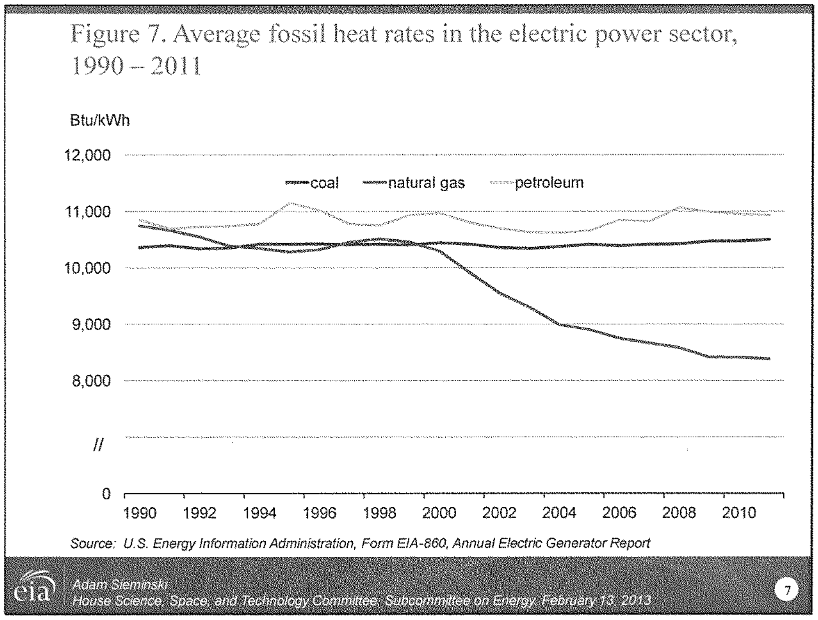
Figure 7. Average fossil heat rates in the electric power sector, 1990 – 2011
Btu/kWh
12,000
11,000
10,000
9,000
8,000
//
0
coal
natural gas
petroleum
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report
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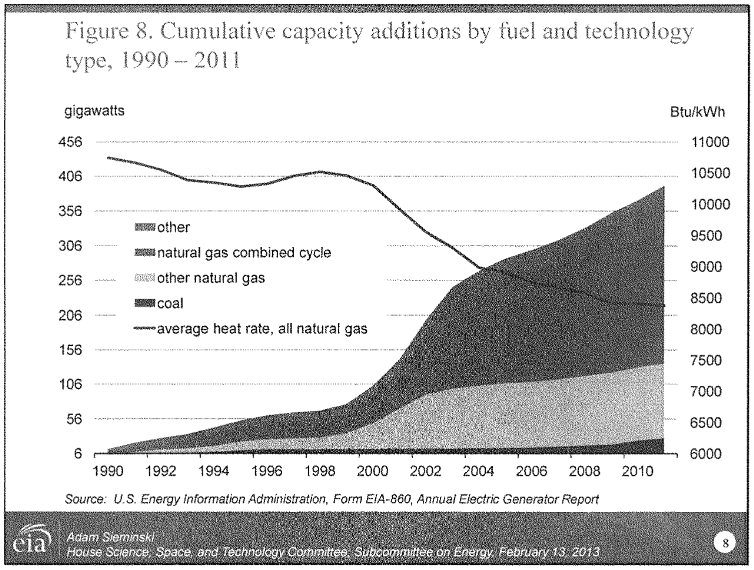
Figure 8. Cumulative capacity additions by fuel and technology type, 1990 – 2011
gigawatts
Btu/kWh
456
406
356
306
256
206
156
106
56
6
11000
10500
10000
9500
9000
8500
8000
7500
7000
6500
6000
other
natural gas combined cycle
other natural gas
coal
average heat rate, all natural gas
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
Source: U.S. Energy Information Administration, Form EIA-860, Annual Electric Generator Report
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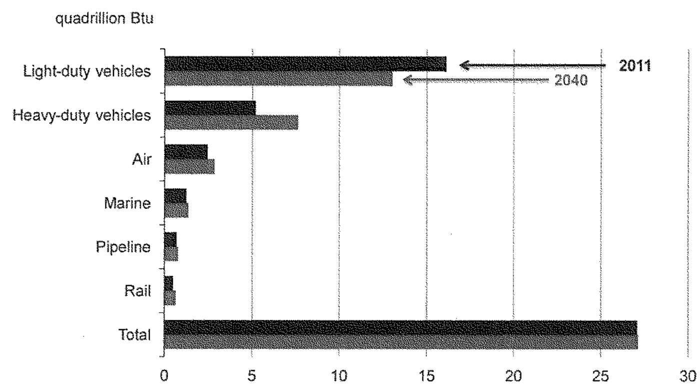
Figure 9. Transportation energy consumption remains almost flat between 2011 and 2040



Source: EIA, Annual Energy Outlook 2013 Early Release

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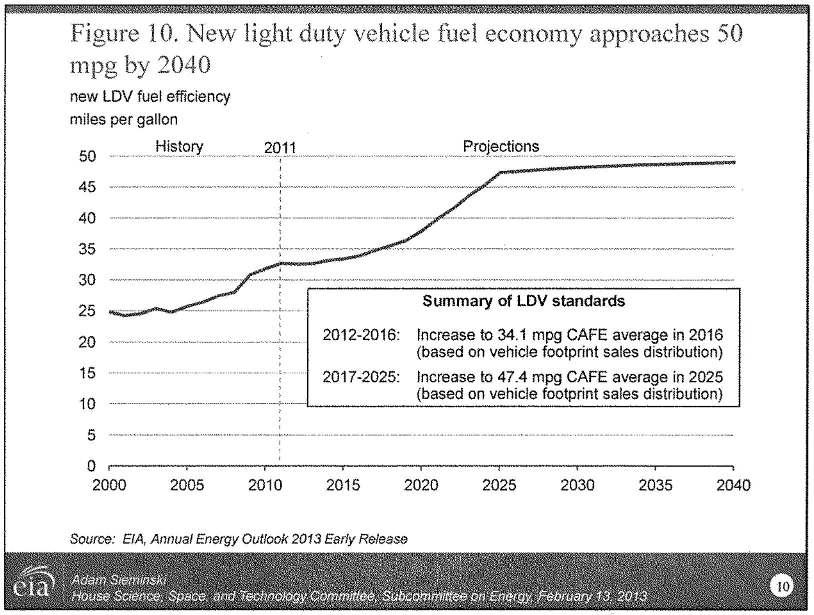
Figure 10. New light duty vehicle fuel economy approaches 50 mpg by 2040
new LDV fuel efficiency
miles per gallon
History
2011
Projections
50
45
40
35
30
25
20
15
10
5
0
2000
2005
2010
2015
2020
2025
2030
2035
2040
Summary of LDV standards
2012-2016: Increase to 34.1 mpg CAFE average in 2016 (based on vehicle footprint sales distribution)
2017-2025: Increase to 47.4 mpg CAFE average in 2025 (based on vehicle footprint sales distribution)
Source: EIA, Annual Energy Outlook 2013 Early Release
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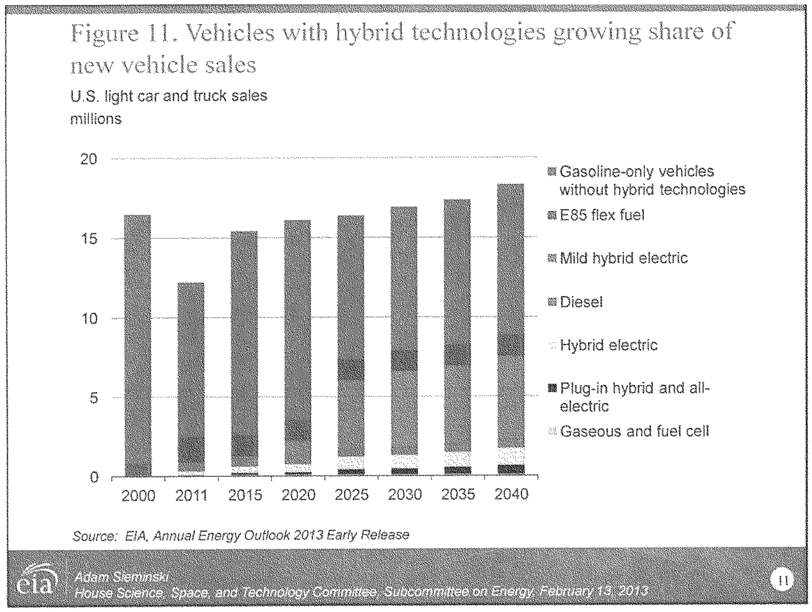
Figure 11. Vehicles with hybrid technologies growing share of new vehicle sales
U.S. light car and truck sales
millions
20
15
10
5
0
2000
2011
2015
2020
2025
2030
2035
2040
Gasoline-only vehicles without hybrid technologies
E85 flex fuel
Mild hybrid electric
Diesel
Hybrid electric
Plug-in hybrid and all-electric
Gaseous and fuel cell
Source: EIA, Annual Energy Outlook 2013 Early Release
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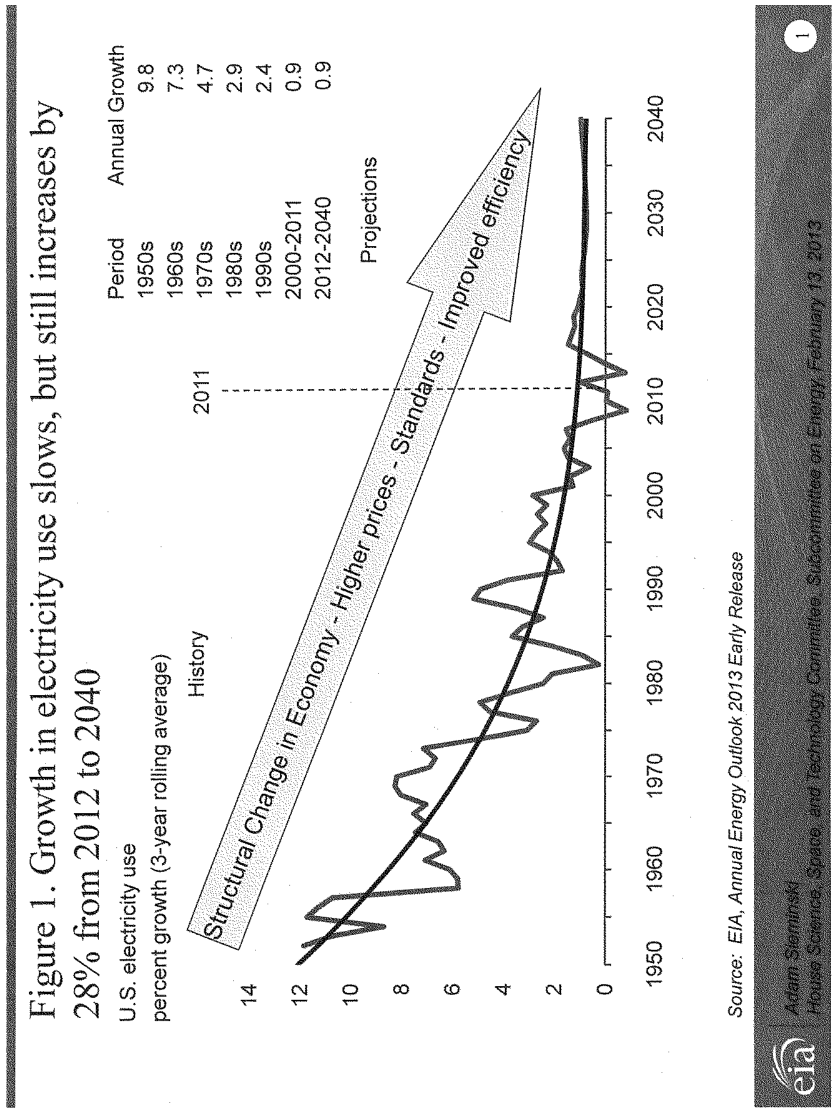
SLIDES PRESENTED DURING TESTIMONY



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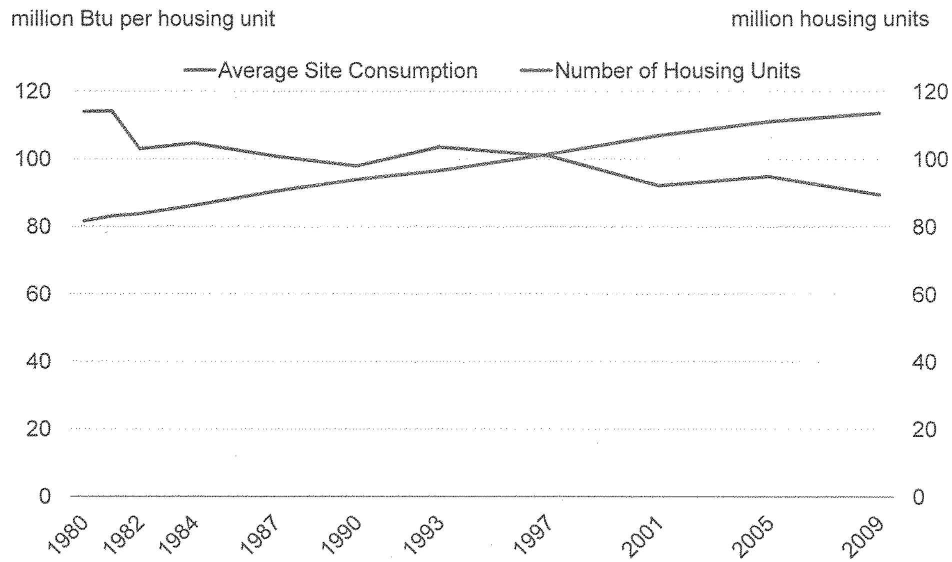

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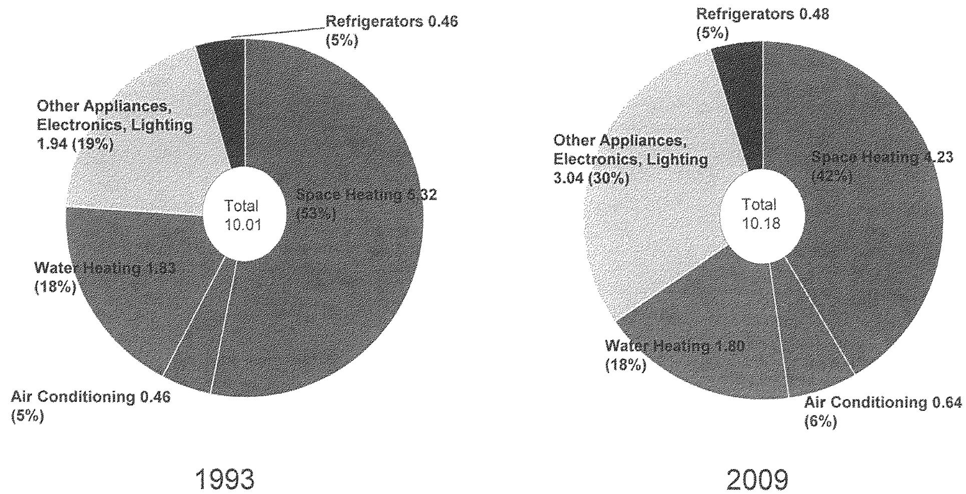

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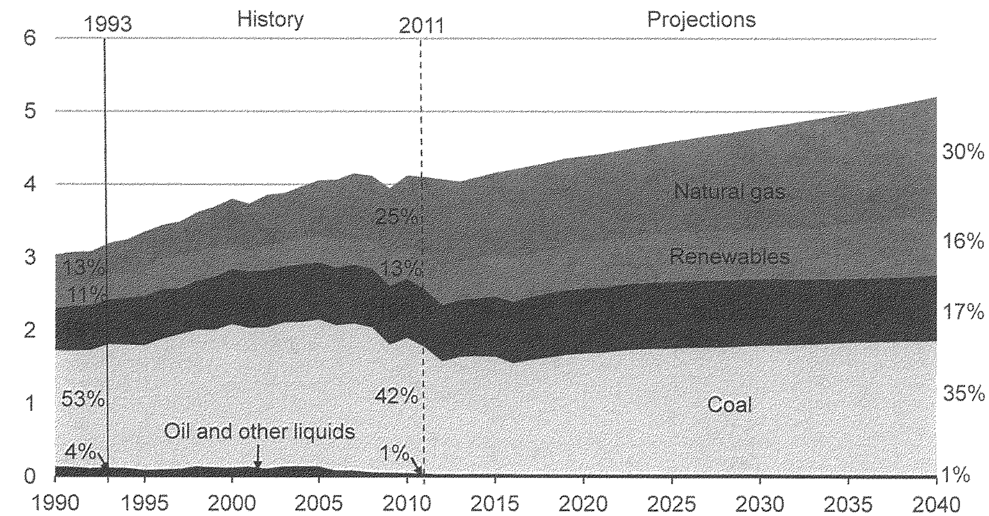
U.S. electricity net generation
trillion kilowatthours



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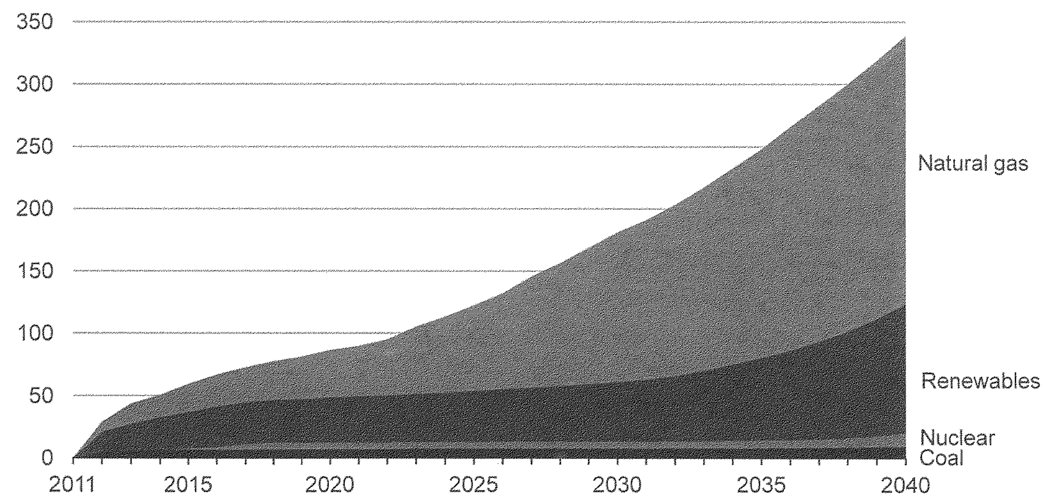
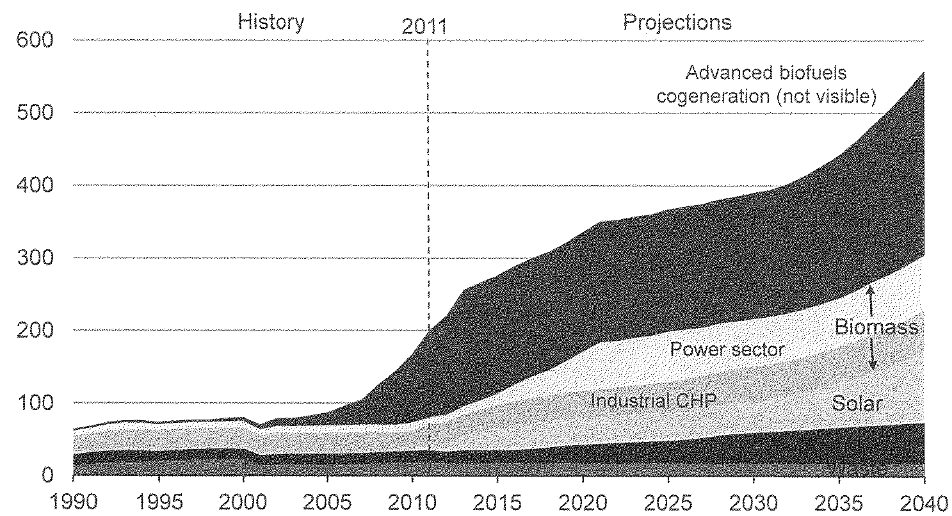
U.S. cumulative capacity additions
gigawatts



Source: EIA, Annual Energy Outlook 2013 Early Release

Figure 6. Non-hydro renewable generation more than doubles between 2011 and 2040

Non-hydropower renewable generation
billion kilowatthours per year



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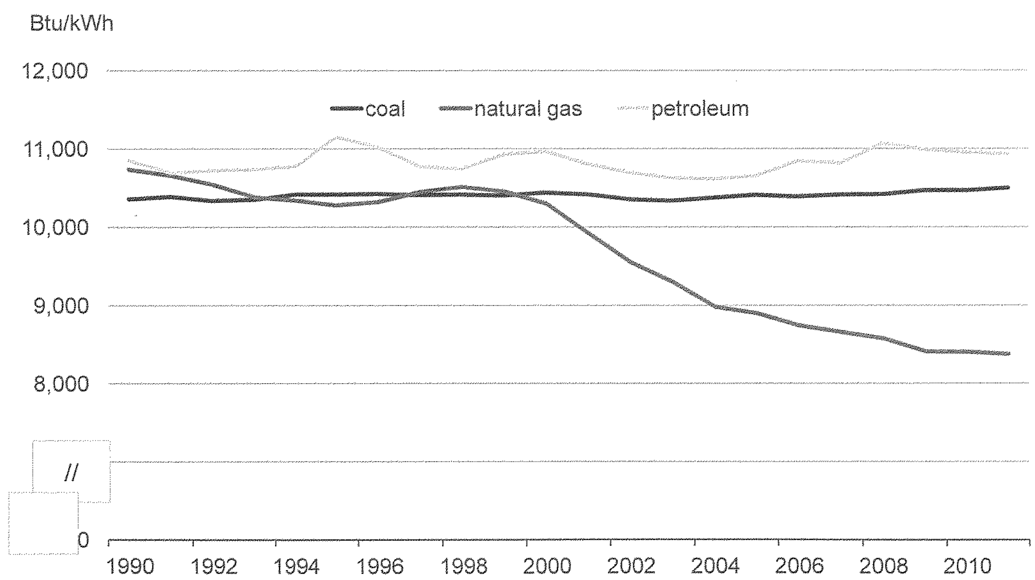

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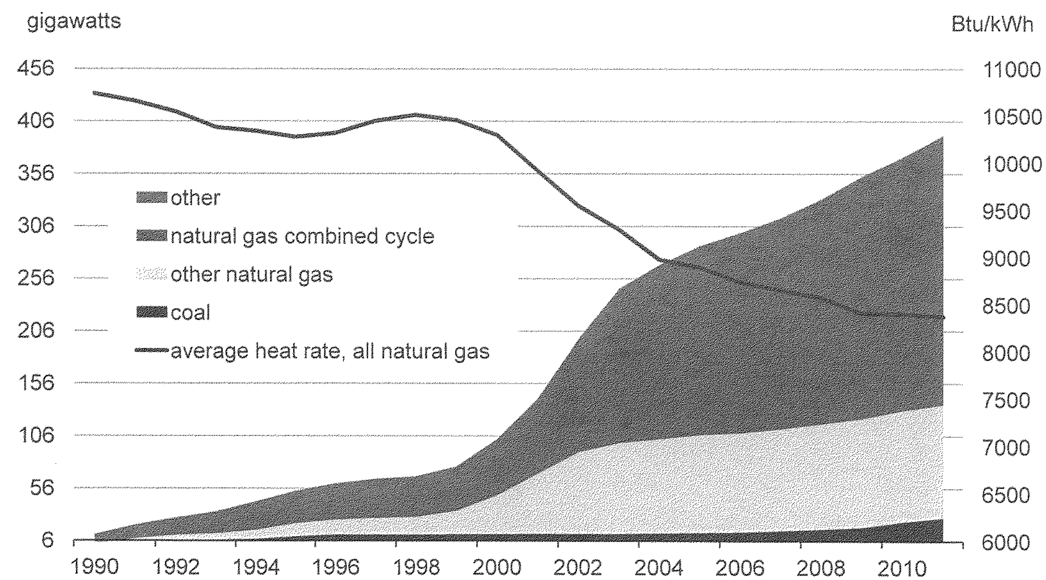

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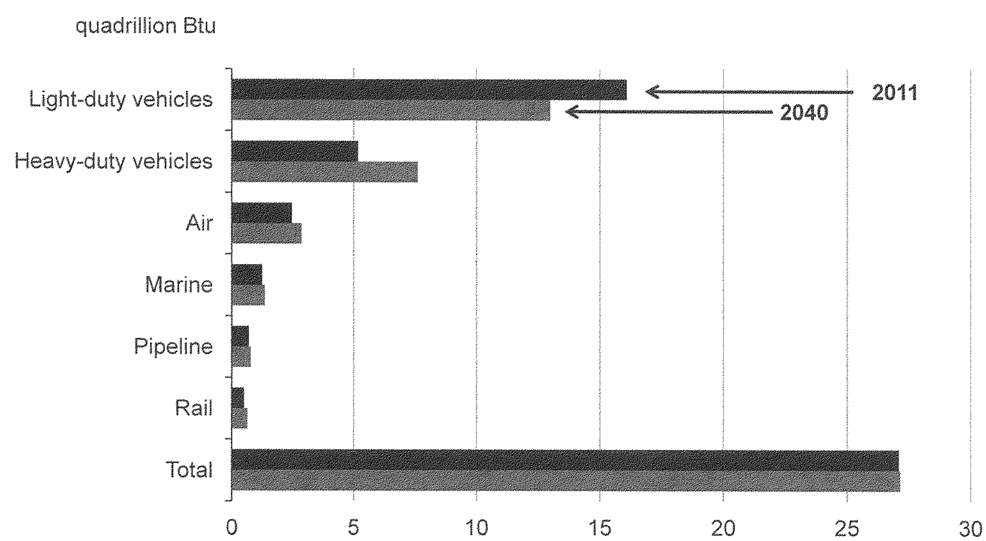

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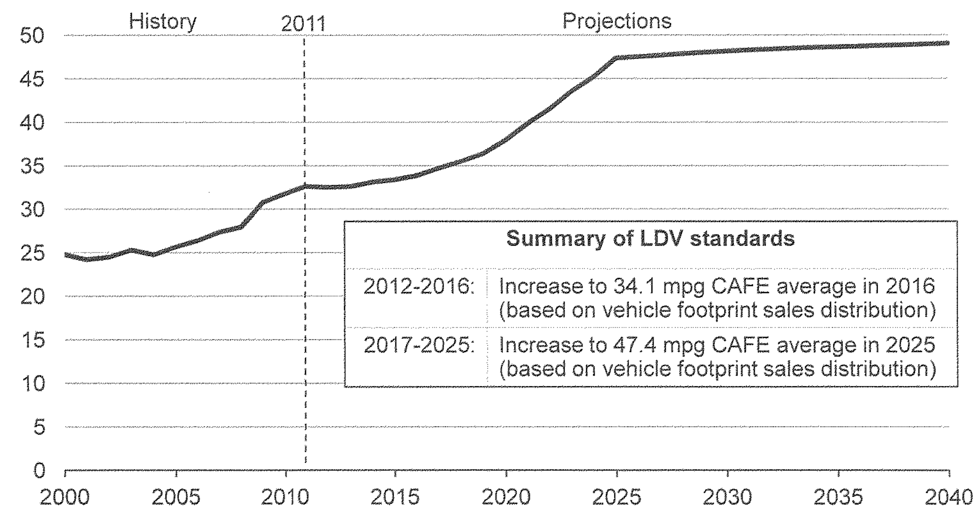
new LDV fuel efficiency
miles per gallon



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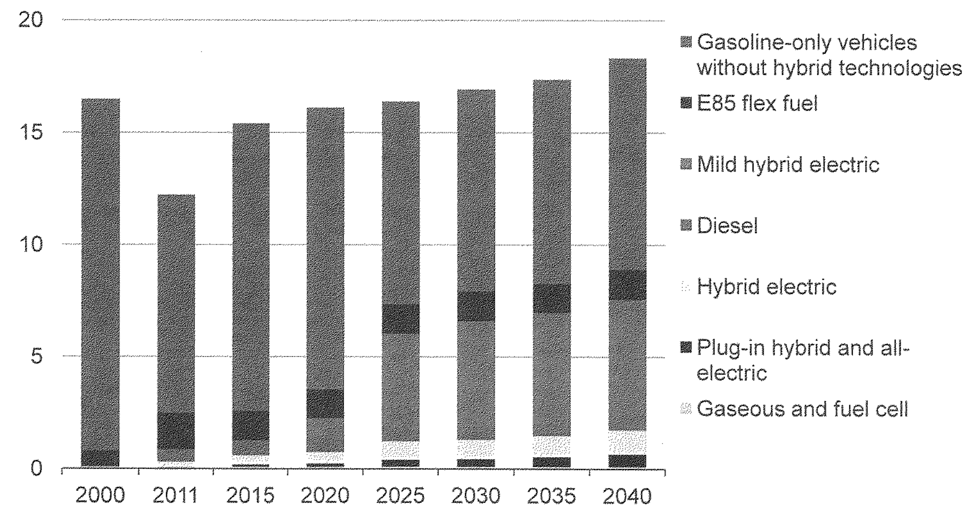
U.S. light car and truck sales
millions



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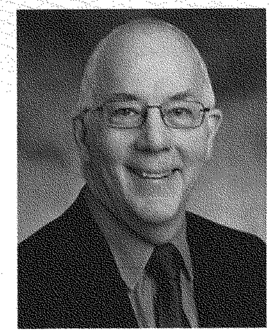
Consumption and Efficiency | www.eia.gov/consumption eia U.S. Energy Information Administration

Adam Sieminski

Administrator



Biography

Adam Sieminski was sworn in on June 4, 2012, as the eighth administrator of the U.S. Energy Information Administration (EIA). From March 2012 to May 2012, while awaiting confirmation as EIA administrator, Mr. Sieminski served as senior director for energy and environment on the staff of the National Security Council. From 2005 until March 2012, he was the chief energy economist for Deutsche Bank, working with the Bank's global research and trading units. Drawing on extensive industry, government, and academic sources, Mr. Sieminski forecasted energy market trends and wrote on a variety of topics involving energy economics, climate change, geopolitics, and commodity prices.

From 1998 to 2005, he served as the director and energy strategist for Deutsche Bank's global oil and gas equity team. Prior to that, from 1988 to 1997, Mr. Sieminski was the senior energy analyst for NatWest Securities in the United States, covering the major U.S. international integrated oil companies.

He also had acted as a senior adviser to the Energy and National Security Program at the Center for Strategic and International Studies, a nonpartisan policy think tank in Washington, DC. He is a senior fellow and former president of the U.S. Association for Energy Economics, and served as president of the National Association of Petroleum Investment Analysts.

In 2006, Secretary of Energy Samuel Bodman appointed Mr. Sieminski to the National Petroleum Council (NPC), an advisory group to the secretary of energy, where he helped author the NPC's Global Oil and Gas Study: The Hard Truths.

In addition to his affiliation with the Center for Strategic and International Studies, he was also an advisory board member of the Global Energy and Environment Initiative at Johns Hopkins University/SAIS. He had also served as chairman of the Supply-Demand Committee of the Independent Petroleum Association of America, and as an advisory member of the Strategic Energy Task Force of the Council on Foreign Relations. He is a member of the Washington, DC, investment professional society, and holds the Chartered Financial Analyst (CFA) designation. He received both an undergraduate degree in civil engineering and a master's degree in public administration from Cornell University.

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EIA is responsible for collecting, analyzing, and disseminating independent and impartial energy information to promote sound policy-making, efficient markets, and public understanding of energy and its interaction with the economy and the environment. EIA provides a wide range of information and data products covering energy production, stocks, demand, imports, exports, and prices. EIA also prepares analyses and special reports on topics of current interest.

E-mail: adam.sieminski@eia.gov

Phone: (202) 586-4361
Fax: (202) 586-0329
Room: 2H-027

Address:
U.S. Energy Information Administration, EI-1
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Chairwoman LUMMIS. Thank you, Mr. Sieminski, and we look forward to asking you some questions.

I now recognize Mr. McNally for five minutes to present his testimony.

STATEMENT OF MR. ROBERT MCNALLY, PRESIDENT, THE RAPIDAN GROUP

Mr. MCNALLY. Chairman Lummis, Ranking Member Swalwell, Members of the Committee, thank you for the opportunity to testify today on technology, market, and policy drivers of the American energy outlook. I approach the subject with 21 years of professional experience in analyzing global oil markets and energy policymaking. I am currently an independent analyst, don't represent any entity, and these views you hear today are my own.

I would like to respectfully make 5 observations and suggestions as you set about your important work. First, as you mentioned, Madam Chairman, it is hard to overstate but often overlooked how much modern civilization depends on the continuous access to substantial flows of energy from producers to consumers. "Energy," as Nobel chemist Richard Smalley noted in 2003, "is the single most important factor that impacts the prosperity of any society."

Fossil-based energy, or hydrocarbons—oil, gas, and coal—account for about 3/4 of our energy supply, and experts project that share will grow in coming decades. As a primary energy source, hydrocarbons are far superior to others, such as biomass or renewables, because they are dense, highly concentrated, abundant, and comparatively easy to transport and store. Our transportation food and electricity systems, among others, depend critically on hydrocarbon energy.

Second, many major energy transitions take a very long time, measured in decades if not generations. Recognizing the overwhelming superiority of hydrocarbons, rapidly industrializing and urbanizing countries in Asia, the Middle East, and Latin America are making enormous investments in hydrocarbon energy production, transportation, refining, distribution, and consumption systems and devices. These could not be quickly replaced in any reasonable scenario. Energy transformations are more akin to a multidecade exodus than a multiyear moon-shot. Pretending otherwise misleads citizens and distracts from serious debate about real circumstances and practical solutions.

Third, just as history has humbled energy experts who make bold predictions about future energy trends, policymakers should be cautious and restrained when setting arbitrary, unrealistic, and aggressive energy targets, much less spending tax dollars on subsidies or grants in an attempt to reach them. The historical record is littered with failed policy targets and costly attempts by government to pick winners in the marketplace. Government can play a useful role in collaborating with industry in basic core scientific research, but only private sector companies and consumers responding to market-based incentives can develop and deploy viable new energy resources and devices.

Fourth, energy can deliver unwelcome surprises with no short-term solutions. For instance, our oil production is soaring but so are our gasoline prices. They are at record levels. The combination of rising oil production and prices can be befuddling. Moreover, large gasoline price swings have become more frequent in recent years and consumers are wondering why this is the case. Pump prices at home are determined mainly by crude prices set in a global oil market. Crude oil prices are rising mainly because global supply-and-demand fundamentals are tight and geopolitical disruption risk is high. OPEC's spare production capacity—almost entirely held by Saudi Arabia and which in the past has been used as a buffer against disruptions or tight markets—is low.

As we saw with Libya in 2011 and Iran in 2012, when the market is tight and fearful, even relatively minor disruptions or risks of disruption anywhere in the world can send our gasoline prices up fast. Unfortunately, there are no effective short-term policy options to counter the short-term crude and gasoline price volatility caused by fundamentally tight and fearful global oil market. A crucial step is to increase oil supply everywhere. In a tight market, every extra barrel counts.

And this leads me to my fifth and final point. Not all surprises in energy are bad. The most pleasant surprise in energy, if not in our entire economy in the last few years, has been the ability of oil and gas producers to unlock vast previously unreachable resources through multistage hydraulic—horizontal hydraulic fracturing of domestic oil and gas reserve trapped in deep shale formations. Last week, Dan Yergin testified before your colleagues in the House Energy Committee and called the boom in unconventional oil and gas production "the most important energy innovation so far in the 21st century."

Higher U.S. and hemispheric oil and gas production is great news for our economy and energy markets. If the investment and regulatory climate allows industry to realize its full supply's potential, it will mean more jobs, billions of dollars in revenue, improved resilience to supply disruptions, and a lower trade deficit. Our companies and workers will have opportunities to take advantage of these same techniques and technology to unlock unconventional oil and gas resources globally where there appears to be much potential.

This happy surprise is just the latest in the energy industry's history of continuous improvement and innovation in technology. While we cannot predict or prescribe the future, we can be confident that our scientists and our engineers will rise to the challenge of finding and producing the abundant, affordable energy our Nation requires while protecting the environment and conserving natural resources.

Thank you.

[The prepared statement of Mr. McNally follows:]

THE RAPIDAN GROUP, LLC

American Energy Outlook: Technology, Market and Policy Drivers

Testimony of Robert McNally
President, The Rapidan Group
House Committee on Science, Space, and Technology
Subcommittee on Energy
February 13, 2013

Chairman Lummis, Ranking Member Swalwell, members of the Committee, thank you for the opportunity to provide testimony to you on the technology, market and policy drivers of the American energy outlook. I approach this subject with twenty-one years of professional experience analyzing global oil markets and energy policymaking. I also served as Special Assistant to the President for Economic Policy on the White House National Economic Council from January 2001 to June 2003 and Senior Director for International Energy on the National Security Council from January 2003 to June 2003. I am currently an independent analyst and do not represent any entity. The views expressed here are entirely my own.

I would like to respectfully make five observations and suggestions for how to think about energy technology, market and policy drivers.

1. Critical importance of ample flows of energy, mainly fossil fuels, to sustain our standard of living

It is hard to overstate but often overlooked how much modern civilization depends on continuous access to the substantial flow of fossil fuels from producers to consumers. The displacement of bioenergy with coal made the industrial era possible. Subsequent use of oil and natural gas augmented coal and enabled our modern transportation and electricity sectors to develop. Concentrated and abundant energy stores of coal, gas and oil power virtually all we do at the current state of technological development. Transportation, which is critical to food supply chains and other core systems society needs to function, today runs almost entirely on oil. Electrical generation taps a more diverse suite of fuels but much of it, too, is fossil fuel powered.

"Energy," as Nobel chemist Richard Smalley noted in 2003, "is the single most important factor that impacts the prosperity of any society." Fossil-based energy or hydrocarbons – oil, gas, and coal – are far superior to other primary energy sources because they are dense, highly concentrated, abundant, and comparatively easy to transport and store. That is the case now, and it is expected to be the case in the coming decades. The latest EIA International Energy Outlook forecasts that world energy consumption will rise by 53 percent by 2035 and fossil fuels' share of total energy consumption will rise from 74 percent to 79 percent.

Personally, I regard the development of fossil fuel industry on balance as an enormous blessing that has vastly enriched the conditions of human life. However, whether one regards fossil fuels as a blessing or curse, we must recognize that our standard of living is closely and inextricably linked to fossil fuels.

2. Patience about the time it takes to transform energy systems

The pace of energy transformations depends on both the availability of economical stores of energy and the development of devices that can turn those energy stores into "work" such as light, heat, and mobility. Major energy transitions take a very long time, measured in decades if not generations. The respected energy expert Vaclav Smil has written:

> "Energy transitions" encompass the time that elapses between an introduction of a new primary energy source (oil, nuclear electricity, wind captured by large turbines) and its rise to claiming a substantial share (20 percent to 30 percent) of the overall market, or even to becoming the single largest contributor or an absolute leader (with more than 50 percent) in national or global energy supply. The term also refers to gradual diffusion of new prime movers, devices that replaced animal and human muscles by converting primary energies into mechanical power that is used to rotate massive turbogenerators producing electricity or to propel fleets of vehicles, ships, and airplanes. There is one thing all energy transitions have in common: they are prolonged affairs that take decades to accomplish and the greater the scale of prevailing uses and conversions the longer the substitutions will take. The second part of this statement seems to be a truism but it is ignored as often as the first part: otherwise, we would not have all those unrealized predicted milestones for new energy sources.[1]

1 Smil, Vaclav, "Moore's Curse and the Great Energy Delusion," *The American Magazine*, November 19, 2008

The main reason why it would take many decades to transform our energy system is that our energy system is colossal. Developed countries have made, and continue to make, enormous investments in recent years in fossil energy production, transportation, refining, distribution, and consumption systems and devices that could not quickly be replaced in any reasonable scenario, even if an alternative energy source was available. Whether one regards our society's massive investment in and dependence on hydrocarbons as an addiction or a blessing, it is here to stay for many more decades.

3. Humility and restraint about predicting, much less attaining, arbitrary and aggressive energy targets

The historical record is littered with overly optimistic or scary predictions and policy targets, by experts and non-experts alike. While energy surprises can be humbling for analysts, too often leaders and observers ignore technology, geology, and economics and either predict or prescribe unachievable targets. They range from period cries of imminent peak oil, through confident predictions in the 1950s that nuclear energy would be "too cheap to meter", to President Nixon's declaration that the US would be energy independent by 1980. Widespread adoption of electric cars or deployment of renewable energy technologies has a long and sad history of failure going back over a century. Just six years ago, Congress passed a law mandating 36 billion gallons of biofuels consumption by 2022 that EIA analysts say cannot be met given economic and scientific realities. In July 2008 former Vice President Al Gore called for the US to commit to producing our entire electricity supply from renewable sources within 10 years. Though he described the goal as "achievable" and "affordable" not one energy expert I am aware of would agree this is even remotely possible.

At best, arbitrary and aggressive targets can mislead the public about the complexities and uncertainties involved in energy market transformations and at worst when such targets are married to costly mandates or subsidies, they can become expensive policy errors. Just as we in the analytical community must be cautious in making bold predictions about circumstances in energy markets even several years ahead, I would respectfully recommend policy makers abjure from basing policy on arbitrary, unrealistic targets, much less basing mandates or subsidies on them. Energy transformations are more akin to a multi-decade exodus than a mutli-year moonshot, as pretending otherwise misleads citizens and distracts from serious debate about real circumstances and solutions.

4. We live in a *global* oil market, no matter how little oil we import

Amid our jubilation over the surprising production boom, we are also reminded that energy markets can deliver unpleasant surprises. Last year, Americans paid record levels for gasoline at the pump in nominal and real terms, even though consumption was declining and production was surging. The average U.S. household spent $2,912 on gasoline in 2012, or 4 percent of its before-tax income, which is tied with 2008 as the highest household expenditure on gasoline in nearly 30 years.

The combination of rising oil production and prices can be befuddling. Moreover, large gasoline price swings have become more frequent in recent years and consumers are wondering why this is the case. As Michael Levi and I recent wrote:

> For most Americans, from the late 1970s until just a few years ago, following the price of gasoline was like riding the Disney World attraction It's a Small World: a shifting but gentle, basically unremarkable, experience. But since 2005, it has felt more like Space Mountain--unpredictable, scary, gut-wrenchingly volatile. Between January 2007 and July 2008, the price of a barrel of oil rose from $50 to more than $140; by the end of 2008, it had crashed to just over $30; less than a year later, it had breached $80 again. In early 2011, on the back of strong global demand and the political turmoil in the Middle East and North Africa, oil sold for over $120 a barrel. Today, as prices continue to swing wildly, most Americans are wondering why they are on this ride and how to get off. [2]

Crude oil prices are rising mainly because of global supply and demand fundamentals, which are tight, especially outside the United States, as well as actual and threatened geopolitical disruption risks. OPEC spare capacity, almost entirely held in Saudi Arabia and which in the past has been used to stabilize global oil prices and reassure market participants that geopolitical disruptions could be offset, has been and will likely remain too low to do so. With spare capacity tight, global crude oil prices – and therefore domestic pump prices – will inexorably rise when global demand growth exceeds net supply growth. And when there is even a relatively minor disruption or even threat of a disruption in oil supply anywhere in the world, crude and gasoline prices can shoot higher fast. We saw this in February 2011 after a disruption in Libya, and one year later, Iranian threats to close the Strait of Hormuz (where over a third of the world's waterborne oil transits) contributed to a 10 percent hike in oil prices.

Unfortunately, there are no effective short-term policy options to counter the short-term crude and gasoline price volatility caused by a fundamentally tight and fearful global oil market. There are policies that can

[2] "Crude Predicament: The Era of Volatile Oil Prices," Foreign Affairs, July/August, 2011, see attachment.

reduce future price volatility and enable our consumers to adjust to it in the medium and longer term. They range from improving the quality of data in order to reduce the uncertainty that contributes to volatility to improving the funding and focus of energy-related research and development.

A crucial step is to increase oil supply everywhere: In a tight market, and especially when spare capacity is low, every extra barrel of supply on the margin counts and can help reduce future price volatility. If North America succeeds at increasing oil supply by some 6 mb/d or more, then it would free up more Middle East oil to go to growing Asian markets or remain in spare capacity to offset a disruption.

Higher US and hemispheric oil and gas production is great news for our economy and energy markets. If the investment and regulatory climate allows industry to realize the full supply potential, it will mean more jobs, improved resilience to supply disruptions, and a lower current account deficit. Our companies and workers will have opportunities to take advantage of these same techniques and technology to unlock unconventional oil and gas resources globally, where there appears to be much potential.

However, the good news must be viewed in perspective. Even if we were entirely self-sufficient in oil, our pump prices would still move up and down with global crude oil prices. Oil is fungible, widely traded, and priced in a global market. A crude price shock anywhere is transmitted to pump price changes everywhere.

Therefore, our gasoline prices are and will remain strongly linked to trends and developments in the global oil market, not our import share. As leading oil expert Daniel Yergin wrote "[t]here is only one world oil market, so the United States – like other countries – will still be vulnerable to disruptions, and the sheer size of the oil resources in the Persian Gulf will continue to make the region strategically important for the world economy."[3]

5. Technology and innovation unlock the energy we require while protecting the environment and habitat

Not all surprises in the energy sector are unpleasant. One of the happy surprises is continuous improvement in innovation and technology that enables the energy industry to find and produce enormous reserves while protecting the environment and conserving natural resources.

Since the beginning of the hydrocarbon industry, research and development has been essential to increasing proved reserves, while increasing the efficiency and lowering the cost of production of energy resources. In fact, as the US National Petroleum Council said, the oil industry has been "supercharged by innovation and technology"[4] and has a long record of outstanding breakthroughs that has enabled our consumers and business to enjoy increasing amount of affordable energy. Early major inventions such as the rotary rig and blow out preventer greatly increased production for oil. Since the 1950s, the introduction of computer technology played an even bigger role in unlocking previously inaccessible supplies. Latest innovations include 3-D and 4-D microseismic imaging and extended reach and horizontal drilling technology reaching depths and distances measured in miles instead of feet.

As technology and innovation enabled industry chemists, geologists, and physicists to find and produce more oil and gas, production itself also become much cleaner and required a smaller footprint. A report issued by the Clinton-Gore Department of Energy in 1999 but that is still relevant today found advanced oil and gas exploration and production technologies enable the energy sector to produce energy while protecting ecology and environment, if public awareness of these benefits remained "limited."[5] The report noted[6]:

- 22,000 fewer wells are needed on an annual basis to develop the same amount of oil and gas reserves as were developed in 1985.
- Had technology remained constant since 1985, it would take two wells to produce the same amount of oil and natural gas as one 1985 well. However, advances in technology mean that one well today can produce two times as much as a single 1985 well.
- Drilling wastes have decreased by as much as 148 million barrels due to increased well productivity and fewer wells.
- The drilling footprint of well pads has decreased by as much as 70 percent due to advanced drilling technology, which is extremely useful for drilling in sensitive areas.
- By using modular drilling rigs and slimhole drilling, the size and weight of drilling rigs can be reduced by up to 75 percent over traditional drilling rigs, reducing their surface impact.

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[3] Daniel Yergin, "Oil's new world order," *Washington Post*, October 28, 2011.
[4] "Oil and Gas Technology Development," Working Document of the NPC Global Oil & Gas Study, July 18, 2007
[5] ttp://www.fe.doe.gov/programs/oilgas/publications/environ_benefits/Environmental_Benefits_Report.html
[6] Summarized here: http://www.naturalgas.org/environment/technology.asp#advances

- Had technology, and thus drilling footprints, remained at 1985 levels, today's drilling footprints would take up an additional 17,000 acres of land.
- New exploration techniques and vibrational sources mean less reliance on explosives, reducing the impact of exploration on the environment.

Innovations since that report include Measurement-While-Drilling systems that improve efficiency, accuracy and reduce odds of blowouts. Slimhole drilling, as the name implies, requires a smaller drill bit that improves efficiency while reducing environmental impact, and advances in developing improved fracturing fluids and flowback water treatment and recycling.

The most pleasant surprise in energy – if not for our entire economy in the last few years – has been the ability of oil and gas producers to unlock previously unproducible resources through multi-stage, horizontal hydraulic fracturing of oil and gas reserves trapped in deep shale rock formations. Last week Dan Yergin testified before your colleagues on the House Energy and Commerce Committee and called the boom in unconventional oil and gas production the most important energy innovation so far in the 21st century. Dr. Yergin elaborated:

> The United States is in the midst of the "unconventional revolution in oil and gas" that, it becomes increasingly apparent, goes beyond energy itself. Today, the industry supports 1.7m jobs – a considerable accomplishment given the relative newness of the technology. That number could rise to 3 million by 2020. In 2012, this revolution added $62 billion to federal and state government revenues, a number that we project could rise to about $113 billion by 2020. It is helping to stimulate a manufacturing renaissance in the United States, improving the competitive position of the United States in the global economy, and beginning to affect global geopolitics. This revolution has also engendered two debates -- about the environmental impact of shale gas development and about the role of U.S. energy exports.[7]

Looking to the future, one transformational development that is currently out of reach but in my view plausible would be to unlock scalable production of methane hydrates, which are natural gas crystals trapped in deeply buried ice formations. Globally the resource has been estimated to be as high as 700,000 trillion cubic feet[8], well over 100 times the current proven reserves. Like shale gas several years ago – we know the resource exists and we have the capability to quickly use it in our existing energy systems but have not yet discovered how to retrieve if from the earth's crust.

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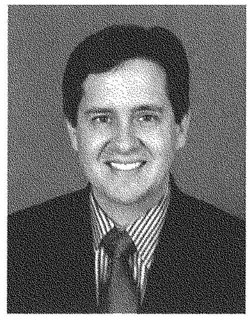
7 http://docs.house.gov/meetings/IF/IF03/20130205/100220/HHRG-113-IF03-Wstate-YerginD-20130205.pdf

8 Charles Batchelor, "Fire Ice: Gas Source is Little Understood," *Financial Times*, 1 June 2012, http://www.ft.com/intl/cms/s/0/506686c4-a4d0-11e1-9a94-00144feabdc0.html#axzz1y968sb2w.

Robert McNally



Robert McNally is the founder and President of The Rapidan Group, an independent energy consulting and market advisory firm based in the Washington DC area. Mr. McNally's clients include leading global financial and real sector energy market and industry firms. Mr. McNally's 21-year professional career includes senior financial market and official posts spanning economic, security, and environmental aspects of energy market analysis, strategy, and policymaking.

Mr. McNally started his professional career in 1991 as an oil market analyst and consultant with Energy Security Analysis, Inc. In 1994, he joined Tudor Investment Corporation, where until 2000 and between 2003 and 2009 he analyzed energy markets, macroeconomic policy, and geopolitics for Tudor portfolio managers, earning promotion to Vice President and Managing Director. From 2001 to 2003, Mr. McNally served as the top international and domestic energy adviser on the White House staff, holding the posts of Special Assistant to the President on the National Economic Council and, in 2003, Senior Director for International Energy on the National Security Council. Mr. McNally served in the Peace Corps in Senegal from 1988-1990.

Mr. McNally earned his double major BA/BS in International Relations and Political Science from American University and his MA in International Economics and American Foreign Policy from Johns Hopkins Paul H. Nitze School of Advanced International Studies (SAIS). He was co-chair for energy policy on the 2008 Romney Campaign, served on the Policy Advisory Committee for Senator Marco Rubio's 2010 campaign, and regularly advises congressional and administration officials on energy policy and markets. Mr. McNally has testified to Congress on energy markets and national security and speaks to professional conferences on energy markets, policy, and geopolitics. He has been published in *Foreign Affairs* (co-authored essay with Michael Levi, July/August 2011), *The American Interest* (co-authored essay with Matthew Kroenig, March/April 2013) and has been interviewed by CNN, *The Economist, The Financial Times, The Washington Post, National Journal, Platts Energy Week TV*, PBS' *Great Decisions in Foreign Policy* series, *Bloomberg News, Aviation Daily* and other programs and journals. Mr. McNally is married and has three children.

THE RAPIDAN GROUP, LLC
7910 Woodmont Avenue |Suite 430 |Bethesda, MD, 20814 |Telephone: +1 301 656 4480
www.rapidangroup.com

Chairwoman LUMMIS. Thank you, Mr. McNally.

And now I recognize Ms. Jacobson to present her testimony. Welcome.

STATEMENT OF MS. LISA JACOBSON, PRESIDENT, BUSINESS COUNCIL FOR SUSTAINABLE ENERGY

Ms. JACOBSON. Madam Chairman, Ranking Member Swalwell, and Subcommittee Members, thank you for the opportunity to testify today.

Over the past several years, we have seen real market penetration of a wide range of sustainable energy technologies and resources, and we have witnessed the results of policies and research and development that work. But our work is not done.

To continue the momentum of growth in these sectors and to receive their co-benefits, long-term, stable policies will be needed to level the playing field and to provide market access. We will also need to continue to invest in energy research, development, and deployment to increase the efficiency of our energy generation and use and to spur new innovations. This is important to domestic economic growth and for U.S. competitiveness in the energy sector.

I would like to share some of the findings from the recently released Sustainable Energy in America 2013 Factbook. The Factbook was researched and produced by Bloomberg New Energy Finance and commissioned by the Business Counsel for Sustainable Energy. It is a quantitative and objective report intended to be a resource for policymakers with up-to-date, accurate market information.

Some of the most significant findings from the Factbook point to the dramatic changes underway in the U.S. energy sector over the past several years. The data shows that natural gas, renewable energy, and energy efficiency are on the rise. These changes are increasing the diversity of the country's energy mix, improving our energy security, cutting energy waste, increasing our energy productivity, and reducing air pollution and greenhouse gas emissions.

In terms of the importance of policy, stable, long-term policies at state and federal levels are needed to sustain growth in clean energy sectors. Further, electricity market structures are evolving, and the U.S. power sector, long organized around large centralized systems, is considering distributed power options such as combined heat and power, waste heat-to-power, small-scale renewables, and fuel cells. Of note, ensuring ongoing grid reliability is a growing concern for electricity market operators and regulators. Dynamics contributing to this focus include changes in our energy mix, the impact of severe weather events, and increased presence of variable energy resources on the electricity grid.

Yet other changes are occurring as well, including reduced electricity demand through energy efficiency, the introduction of smart grid technologies for improved grid management, a new focus on distributed generation, and the growing role for dispatch of all resources such as natural gas plants, hydropower, and demand response. They can all help the electricity industry address these challenges.

Still, many market structures do not yet fully recognize the benefits of some of these technologies, including technologies offering new flexibility such as energy storage. Given these factors, research, development, and deployment investments are needed in the area to—this—needed in these areas to improve efficiency, demonstrate performance, and to spur the innovations that will be required to meet the evolving needs of the power grid.

With regard to federal energy investments, the Business Council strongly supports the continued funding of basic and applied research for clean energy technologies. This must be balanced with work on commercialization, market transformation, and other efforts to ensure that products do not sit on laboratory or university shelves but are transferred to the private sector to achieve the intended public benefit.

There are strong analytical findings that show the overall return on investment that have resulted from federal energy research, development, and deployment initiatives. For example, three decades of investment in extraction of natural gas from shale have led to low natural gas prices saving households and businesses money, attracting new industrial manufacturing opportunities in the United States, and helping to create U.S. jobs. In Wyoming, shale production is forecasted to bring 23,000 jobs to the State by 2020.

For energy efficiency, according to a report released last week by the Alliance to Save Energy's Commission on National Energy Efficiency Policy, private sector research and development budgets are limited in many energy efficiency sectors. In the Commission's Energy 2030 vision, it sets a goal of doubling U.S. energy productivity by 2030 and includes a call to support research, development, and deployment to meet it. Achieving the goal could save $327 billion annually and add 1.3 million jobs.

For renewables, the development of today's robust solar market and low costs in the United States can be attributed to smart investments in research and development at DOE and national laboratories over the last four decades. For wind, past investments in wind have resulted in significant improvements over the past 30 years such as increased output, improved reliability, and lower costs. Technology advances have enabled the typical modern wind turbine to produce 15 times more electricity than a typical turbine in 1990 but further improvements are needed.

The value of federal investments in research, development, and deployment is essential given current market conditions. According to Bloomberg New Energy Finance, a near-term trend is reduced private sector investment from venture capital and private equity investors in early-stage clean energy companies.

In closing, I would like to say council members look forward to working with this Committee and the Federal Government to ensure that any and all public investment in these sectors is highly leveraged, effective, and efficient in carrying out the intended policy aims of these investments. Thank you very much.

[The prepared statement of Ms. Jacobson follows:]

Lisa Jacobson

President

Business Council for Sustainable Energy

Testimony Before the Subcommittee on Energy

House Committee on Science, Space and Technology

February 13, 2013

Chairman Lummis, Ranking Member Swalwell, and Subcommittee Members, thank you for the opportunity to testify today.

My name is Lisa Jacobson, and I am the President of the Business Council for Sustainable Energy. The Council is a broad-based industry trade group representing companies and associations in the energy efficiency, natural gas and renewable energy industries. Its membership includes independent electric power producers, investor-owned utilities, public power, commercial end-users, equipment manufacturers, project developers as well as service providers for energy and environmental markets. Since 1992, the Council has been a leading industry voice advocating for policies at the state, national and international levels that increase the use of commercially-available clean energy technologies, products and services.

The Council is pleased to be able to share its views at this important hearing on the American energy outlook, focused on technology, markets and policy drivers. The Subcommittee on Energy has a significant role to play in overseeing the country's strategic energy investments, which have contributed to the development and deployment of highly valuable energy technologies and resources that underpin the U.S. economy.

Over the past several years, we have seen real market penetration of a wide range of sustainable energy technologies and resources and we have witnessed the results of policies that work. But our work is not done.

To continue the momentum of growth in these sectors, and to receive their co-benefits, long-term, stable polices will be needed to level the playing field and to provide market access to sustainable energy technologies. We will also need to continue to invest in energy research, development and deployment to increase the efficiency of our energy generation and use and to spur new innovations. This is important for domestic economic growth and for U.S. competitiveness in the energy sector.

I would like to focus my testimony on two areas. First, I would like to share some of the findings from the recently released *Sustainable Energy in America 2013 Factbook*.[1] The Factbook was researched and produced by Bloomberg New Energy Finance and commissioned by the Business Council for Sustainable Energy. It is a quantitative and objective report, intended to be a resource for policymakers with up to date, accurate market information. Its goal is to offer important benchmarks on the contributions that sustainable energy technologies are making in the U.S. energy system today. It also provides information on finance and investment trends in clean energy resources.

The second area I would like to discuss is the valuable and effective role that federal government investments in the energy sector have played, and should continue to play, in the availability of new, innovative energy technologies and practices. These investments in the form of research, development and deployment initiatives as well as federal tax incentives have expanded the energy technologies and resources available for the nation, while helping to save businesses and consumers money, and creating hundreds of thousands of U.S. jobs.

Sustainable Energy in America Factbook Findings

Some of the most significant findings from the *Sustainable Energy in America 2013 Factbook* point to the dramatic changes underway in the U.S. energy sector over the past several years. Traditional energy sources are declining, and natural gas renewable energy and energy efficiency are on the rise.

These changes are increasing the diversity of the country's energy mix, improving our energy security, cutting energy waste, increasing our energy productivity and reducing air pollution and greenhouse gas emissions.

Behind these changes are a portfolio of new energy innovations, technologies, and applications. These include: newly applied techniques for extracting natural gas from shale rock formations; lower-cost and higher-efficiency photovoltaic panels for converting sunlight to electrons; highly efficient, natural gas end-use applications; vehicles fuelled by electricity and natural gas; and 'smart meters' that allow consumers to monitor, modulate, and cut electricity consumption, among others.

The Factbook takes a broad view of sustainable energy technologies and provides data on a wide range of clean energy industries including natural gas, renewable

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[1] Business Council for Sustainable Energy, "Sustainable Energy in America 2013 Factbook," January 2013, at http://www.bcse.org/sustainableenergyfactbook.

energy sources (including solar, wind, hydropower, geothermal, and biomass – but excluding liquid biofuels), distributed power, and energy efficiency.

The Factbook also aims to fill data gaps. For example, data sources and economic models of the U.S. energy industry often fail to capture the full contribution of sectors such as distributed generation. The Factbook seeks to quantify accurately some sectors that are currently small but growing rapidly.

Recent Changes in the U.S. Energy Sector

According to preliminary 2012 EIA data, total energy use fell 6.4% between 2007 and the first nine months of 2012, driven largely by advances in energy efficiency.

Use of natural gas and renewable energy have increased, while other major energy sources such as coal and oil have experienced declines. Natural gas provided the U.S. with 27% of its total energy supply in 2012, and renewables (including hydropower) supplied 9.4%.

Further, in the electricity sector, lower- and zero-carbon power sources are growing. Natural gas-fired power plants provided 31% of U.S. electricity in 2012, up from just 22% in 2007. Renewable energy generation has meanwhile grown from 8.3% to 12.1% over that period. These technologies, which include wind, solar, geothermal and hydropower, represented the largest single source of new capacity growth in 2012, with more than 17GW added.

Market Dynamics

Low natural gas prices can both complement and conflict with other energy sources. For wind power in particular, less expensive natural gas has made it difficult to compete economically, though the one-year extension of the Production Tax Credit in 2013 has strengthened the business case for wind in the short term. Yet natural gas generators, which are inherently flexible technologies that can be easily ramped up and down to meet demand, are natural counterparts for variable resources such as wind and solar. Other options, such as combined heat and power (CHP), and fuel cell installations, which draw on natural gas for fuel, have become more competitive as natural gas prices decline.

The levelized costs of electricity for renewable technologies have fallen dramatically. For example, the cost of electricity generated by best in class large solar plant costs have dropped from $0.31 per kilowatt-hour in 2009 to $0.14 per kilowatt-hour in 2012, according to Bloomberg New Energy Finance's global benchmarking analysis based on already financed projects from around the world. Distributed solar costs have fallen dramatically as well. The investment tax credit and state incentives are clearly working. (These figures exclude the effect of tax credits and other incentives, which would bring those costs down even lower.) Over the same period, the cost of power from a typical large wind farm has fallen from $0.09 in 2009 to $0.08 per kilowatt-hour.

Energy efficiency is making its mark on the grid and in buildings. Since 1980, energy intensity of commercial buildings has decreased by over 40%, propelled by increasingly sophisticated approaches to financing for energy efficiency retrofits, as well as by standards, such as those that apply to heating and cooling units and to thermal building performance (i.e., insulation). Overall, U.S. utility budgets for energy efficiency reached $7 billion in 2011 (the latest available date for which data exists). Demand response capacity, which typically involves the curtailment of electricity consumption at times of peak usage, has grown by more than 250% between 2006 and 2011, allowing major power consumers such as manufacturers to cut their energy costs and utilities to scale back production from some of the costliest power plants. The Factbook finds that 46 million smart meters have been deployed in the U.S., while spending on smart grid roll-outs hit $4.3 billion in 2012, up from $1.3 billion in 2008.

The Impact of Policy on Renewable Energy and Energy Efficiency Growth

Stable, long-term policies at state and federal levels that provide a level playing field and enable market access, combined with targeted investments in research, development and deployment, are needed to sustain the growth in clean energy sectors.

Though the levelized costs of electricity of many renewable generation technologies have fallen drastically, most of these technologies still rely on incentives to compete. State-level mandates have been important drivers for renewable growth in the U.S., though in the case of most states, targets for the next several years have already been satisfied.

Policy measures have also helped further the cause of energy efficiency: Energy Star-certified commercial building floor space has increased by 139% from 2008 to 2012, and the stringency of building air conditioning efficiency standards has increased by up to 34% since 2005.

The value of long-term policies, coupled with public and private investments can be seen in California. California has been able to keep its per capita energy use flat over the past 30 years with a sustained commitment to energy efficiency. Energy efficiency has significant economic benefits. For example, in 2011, California investor owned utility PG&E's energy efficiency programs helped save customers more than $262 million on their energy bills.[2]

Grid Modernization, Reliability and Resiliency

Ensuring ongoing grid reliability will become a growing concern for electricity market operators and regulators. Dynamics contributing to this focus include declines in the use of coal, the impacts of severe weather events and the increased presence of variable energy resources on the electricity grid. Yet other changes are occurring – including reduced electricity demand through energy efficiency; the introduction of smart grid technologies for improved grid management; and the growing role for dispatchable resources such as natural gas plants, hydropower, and demand response – that can help the electricity industry meet these challenges. Still, many market structures do not yet fully recognize the benefits of some of the technologies offering increased flexibility, such as energy storage.

Given these factors, research, development and deployment investments are needed in this area to improve efficiency, demonstrate performance and to spur the new innovations that will be required to meet the evolving needs of the power grid. For example, investment being made in smarter and more efficient technologies such as voltage sensors and distribution circuits can help utilities better pinpoint what is happening on the grid and speed power restoration efforts when outages occur.[3]

Federal Investments in Research, Development and Deployment Foster U.S. Competitiveness, Energy Security

With regard to federal energy investments, BCSE strongly supports the continued funding of basic and applied research and development for clean energy technologies. This must be balanced with work on commercialization, market transformation and other efforts to ensure that products do not sit on laboratory or university shelves, but are transferred to the private sector to achieve the intended public benefit of the research and development.

While the U.S. Department of Energy (DOE) is primarily a research and development institution, it is uniquely positioned to address barriers in the marketplace that

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[2] PG&E Corporation, "Customer Energy Efficiency," at http://www.pgecorp.com/corp_responsibility/reports/2011/co04_ee.jsp.

[3] PG&E Corporation, "Fewer Outages for PG&E Customers with Help from High Tech Upgrades," December 2012, at http://www.pgecurrents.com/2012/12/14/thanks-to-technology-and-electric-system-upgrades-pge-customers-are-seeing-fewer-outages/

inhibit the successful deployment of clean energy technologies and should dedicate significant resources to these market efforts, especially for technologies that are ready to progress out of the "innovators" area of the technology adoption cycle and into "early majority" stage.

There are strong analytical findings that show the overall return on investment that has resulted in federal energy research, development and deployment (RD&D) investments. Such investments jumpstart private sector innovation critical to our long-term economic growth, energy security, and international competitiveness. DOE has supported effective programs, many in partnership with the private sector, that have resulted in the availability of new, more efficient energy technologies.

As part of a comprehensive review that was released in 2001, the National Research Council's Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy found that "DOE's RD&D programs in these areas have yielded significant benefits (economic, environmental, and national security-related), important technological options for potential application in a different (but possible) economic, political, and/or environmental setting, and important additions to the stock of engineering and scientific knowledge in a number of fields."[4]

Although the committee was not always able to distinguish the DOE contribution from that of others, the net realized economic benefits in the programs studied were viewed to be substantially larger than the DOE investment. Energy R&D is also being undertaken by NASA and DOD, and there is solid collaboration between the efforts of DOD and DOE in the area of renewable energy.

The value of federal investments in RD&D is especially important given current market conditions. According to Bloomberg New Energy Finance, the near term trend is reduced private sector investment from venture capital and private equity investors in early stage clean energy companies. This is due to challenges with fundraising and difficulties in taking private firms onto public stock exchanges. This is a troubling development given the importance of innovation in the energy sector.

Venture capital and private equity investment shrank by a third in 2012 to $5.8 billion from $8.7 billion in 2011. The third and fourth quarter 2012 figures were the lowest since 2006. Down also is the number of venture financings. Bloomberg New

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[4] Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy, Commission on Engineering and Technical Systems, National Research Council. "Executive Summary." *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000.* Washington, DC: The National Academies Press, 2001.

Energy Finance tracked 421 investments made in early-stage companies in 2012, down 22% from the 543 in 2011.

Finally, in our current constrained budgetary environment, support for energy RD&D might be questioned. In response, I would argue that the energy sector, like the transportation sector for example, involves technologies that have been transformed over the course of a century. Just as the government should not stop investing in automotive R&D – improving fuel efficiency and economy, safety, incorporating new materials, etc., it is critical that the U.S. government continue to investment in advancements in the energy sector.

Sustainable Energy RD&D Investments

Natural Gas

The technological advances allowing for the low cost extraction of natural gas from shale occurred due to more than three decades of federal government and Gas Research Institute investment in research, demonstration, and production. According to a 2011 Breakthrough Institute report, both directly and indirectly, the government supported critical moments and tools in the shale gas revolution - massive hydraulic fracking (MHF), 3-D mapping, horizontal drilling, and horizontal wells.[5] These technological advancements offers the potential for stable natural gas prices in the $4 to $6.50 per million BTU range.[6] According to the American Gas Association, at these price ranges, the country's natural gas resource base can support significant expanded use of natural gas during the next decade and beyond. This provides the potential for natural gas to provide an abundant, clean and domestic fuel source for direct use applications, transportation and power generation at affordable prices.

This will also have a major impact for U.S. job creation, for instance, in Wyoming gas shale development is expected to support about 23,000 jobs in the state by 2020.[7]

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[5] Michael Shellenberger et al., "Where the Shale Gas Revolution Came From: Government's Role in the Development of Hydraulic Fracturing in Shale," Breakthrough Institute, May 23, 2012, at http://thebreakthrough.org/index.php/programs/energy-and-climate/where-the-shale-gas-revolution-came-from.

[6] American Gas Association, *Rethinking Natural Gas, A Future for Natural Gas in the U.S. Economy* (Washington, DC: 2012), p. 6.

[7] *Casper Star-Tribune.* "Wyoming Shale Gas to Support 23K Jobs by 2020," December 23, 2012, at http://trib.com/business/energy/report-wyoming-shale-gas-to-support-k-jobs-by/article_09b5f2e4-bf68-5953-90e4-fbc94c19d81e.html

In terms of private sector research, the Gas Research Institute (GRI) developed the world's first high efficiency fully condensing natural gas furnace in 1983. This product now has 50 percent of the furnace market and 90 percent of the new furnaces purchased in places like Wisconsin. GRI estimates that this sped up the introduction of the high efficiency furnace by at least ten years.

To help realize this potential, DOE should consider undertaking more RD&D into efficient natural gas technology, ensuring that businesses and consumers utilize natural gas wisely and efficiently. Specific technology areas for increased focus would include: fuel cells, micro combined heat and power, natural gas fired cooling and heat pumps, solar/gas hybrid systems, gas water heaters and natural gas vehicles.

Further, in 2011, the American Gas Association, Gas Technology Institute and Navigant consulting released a white paper that offered a vision of a smart energy infrastructure integrating natural gas with electricity from multiple sources, including renewable energy. To achieve this vision, several RD&D areas were recommended. I note a few below.

- Include natural gas in advanced metering infrastructure development to optimize common infrastructure, interoperability and cross-compensation among all utility infrastructures including electricity and water;

- Ensure that future federal funding programs including Smart Grid encourage and allow the use of funding for dedicated natural gas projects and combined electric/natural gas projects; and

- Increase governmental funding for basic as well as applied research in natural gas safety and reliability and smart energy infrastructure technology.[8]

Hydropower

The DOE Water Power Program is growing the nation's global position by funding cutting-edge research to produce the next generation of conventional hydropower and marine and hydrokinetic (MHK) technologies, and by accelerating the development of markets for those technologies. The main objectives of the Water Power Program are to improve hydropower technologies and to gather critical industry, operational and environmental impact data.

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[8] Gas Technology Institute and Navigant Consulting, Inc., *Natural Gas in a Smart Energy Future* (Des Plaines, IL: 2011), at http://www.gasfoundation.org/ResearchStudies/natural-gas-smart-energy-future.htm.

Currently, the conventional hydropower industry employs more than 300,000 workers in the U.S., making it the largest renewable electricity production workforce in the nation. With the Water Power Program's goal for water power technologies to provide 15% of the nation's energy by 2030, hydropower can provide hundreds of thousands of new jobs and economic development benefits for communities.[9]

Further, increasing hydropower generation provides more clean energy megawatts to the grid, and also increases the amount of grid reliability, stability and integrations services to enhance the penetration of variable energy resources. While hydropower and pumped storage projects can provide regional and grid-scale energy storage and other ancillary services, doing so will require projects to operate in new ways and modes, and in some cases, utilize new technologies. This makes continued federal research investments vitally important.

Energy Efficiency

On February 7, 2013, the Alliance Commission on National Energy Efficiency Policy, convened by the Alliance to Save Energy released at its Energy2030 vision. The Commission's report includes a goal of doubling U.S. energy productivity by 2030 and a set of recommendations to achieve this goal, which includes continued support of energy productivity RD&D. Achieving the goal could save $327 billion annually and add 1.3 million jobs.[10]

The Commission noted that private sector R&D budgets are limited in many energy efficiency sectors. Market barriers also prevent adoption and commercialization of new innovations. Thus government support both for R&D and for a wide range of deployment programs has been critical to advances in energy productivity. Looking forward, the Commission recommends increased federal investment in basic and applied research, development, demonstration, deployment, and technical assistance at DOE, the Environmental Protection Agency, and other agencies. The federal government should also encourage private R&D through other policy approaches such as public-private consortia, the R&D tax credit, and supporting challenges or contests.

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[9] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, "Water Power for a Clean Energy Future," at http://www1.eere.energy.gov/water/pdfs/wp_accomplishments_brochure.pdf.

[10] Alliance to Save Energy, "Energy2030: Doubling U.S. Energy Productivity by 2030," at http://ase.org/programs/ee-commission.

Solar

The development of today's robust solar market in the U.S. can be attributed to smart investments in R&D at DOE and national laboratories over the last four decades. Between 1975 and 2008, researchers in industry, academia, and DOE's national laboratories received financial and technical support to hasten the development and market introduction of higher quality, longer lived, and lower cost PV modules. Specifically, PV technologies have benefited from long-term DOE investment that has supported core cell and module technology R&D, manufacturing process development, and the technology infrastructure supporting that R&D. Today, the market is driving most of the cost reductions through economies of scale, manufacturing efficiencies, and innovation throughout the supply chain – but all of this is possible only because of the role of federal R&D in solar to create today's modern solar technologies.

In 2010, DOE released an analysis of these investments over the 1975 to 2008 time period and found important economic, environmental and health, emissions, national security and knowledge benefits. In terms of economic benefits, the study found that $18,734.8 million (2008$) in economic benefits over the period from 1975 to 2008 were quantified, encompassing

- $11,319 million in benefits for PV systems installed in the United States between 1976 and 2008. These benefits included cost savings as well as increases in PV modules' guaranteed useful life.

- $6,773 million in production cost savings for PV companies producing modules destined for non-U.S. markets.

- $630 million from the development of advanced silicon refining processes.

- $12 million from accelerated adoption of wire saw technology by the semiconductor industry for slicing silicon ingots into wafers.[11]

Today, the DOE is continuing its work on solar R&D – both PV and concentrating solar power. The investment in the former is strong, but in the latter it is weak and could use improvement. The three areas that the DOE Solar Program focuses its work are as follows:

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[11] "Retrospective Benefit-Cost Evaluation of DOE Investment in Photovoltaic Energy Systems," Department of Energy, Office of Energy Efficiency and Renewable Energy, August 2010, http://www1.eere.energy.gov/analysis/pdfs/solar_pv.pdf

- Solar Technologies—projects that reduce costs related to photovoltaic and concentrating solar power technologies.
- Systems Integration—projects that reduce the costs of connecting high penetrations of solar electricity onto the grid, related to balance of systems, power electronics, and smart grid.
- Balance of Systems Costs—projects that remove market barriers, specifically related to fostering a skilled workforce and standardized permitting and interconnection.

All three of these areas are critical for continued innovation and leadership by the U.S. in the area of solar energy. Although I and the solar industry support work in all three areas, much of the technological cost reduction targeted in the first item will be incremental engineering work supported by companies competing for deployment market share—some in collaboration with federal programs. The second item could be rephrased as preparing our grid for the impending solar success in providing massive amounts of electricity. The third area, although lower in percentage of work that could be called R&D, may be most critical in meeting the policy goals of the last several Administrations and of Congress in its last several major energy bills, in deploying large amounts of solar for national security, environmental, and other policy reasons.

Wind

Past investments in wind have resulted in significant improvements over the past 30 years, such as increased output, improved reliability, and lower costs. Despite this dramatic decrease, there is still plenty of room for further reductions that will be critical for wind energy to compete in an environment of very low electricity costs.

Wind energy is now cost competitive with virtually every other energy source and technology advancements can drive the cost down even more. Already, these technology advances have enabled a typical modern wind turbine to produce 15 times more electricity than the typical turbine in 1990, but further improvements are needed to meet the 20% goal by 2030 as outlined in the DOE's *20% Wind Energy by 2030* report in 2008.

Conclusion

The Sustainable Energy in America Factbook shows with a mix of research, development and deployment initiatives supported by policies and incentives at the state and federal level, the U.S. has experienced a rise in market penetration of a broad range of sustainable energy technologies. The data shows that the policies that have been adopted have worked but the work is not done. To ensure secure, clean, reliable, affordable energy sources in the U.S. we must continue the federal government's partnership in research, development and deployment programs. Council members have specific views on programs that have been effective for their industries and look forward to working with this Committee to identify effective programs that bring a strong rate of return to tax payers while unlocking the vast domestic potential for sustainable energy technologies. Private industry stands ready to work with the federal government to ensure that any and all public investment in these sectors is highly leveraged, effective, and efficient in carrying out the intended policy aims of the investments.

BIOGRAPHY FOR LISA JACOBSON

Lisa Jacobson serves as the President of the Business Council for Sustainable Energy – a policy advocacy coalition of energy efficiency, natural gas and renewable energy industries.

Ms. Jacobson has advised policymakers on energy, tax, air quality and climate change issues. She is a private sector observer to the World Bank's Climate Investment Fund and is a member of the Department of Energy's State Energy Efficiency Action steering committee. Ms. Jacobson has testified before Congress and the United Nations Framework Convention on Climate Change.

Prior to her position with the Council, Ms. Jacobson was a legislative aide to the U.S. Congress; and has a Masters in International Relations from the London School of Economics and a Bachelors degree in Political Science from the University of Vermont.

Chairwoman LUMMIS. Well, I would like to thank all of our witnesses for your testimony and for staying around so we can ask some questions of you. Before we do that, I want to acknowledge that we have been joined by Committee Chairman Lamar Smith of Texas. He is the Chairman of the Full Committee.

Mr. Chairman, thank you so much for joining us.

And the Chairman Emeritus of this Committee, Mr. Ralph Hall, also of Texas. So I would like to welcome these two very distinguished Members.

And I further want to remind Members that Committee rules limit questions to five minutes. And the Chair will at this point open the round of questions. So I recognize myself for five minutes.

Mr. Sieminski, I would like to talk a little bit about coal and the technology improvements in that sector sometimes are overlooked. And I would like to ask—slide up. They knew I was going to ask some questions about this slide or make some points about this slide. If you look at the two gigantic dots in red, those are China and India and those are proposed global coal-fired plants. And then the United States' dot is on the far left in the middle of the screen, obviously, way smaller than what we are seeing in China and India, also smaller than what we are seeing in Vietnam, in Turkey.

And so global demand and global growth in coal-fired power plants is going to, I believe, necessitate continued research and development of increasingly clean coal. And so I want to kind of focus on that for a minute.

Mr. Sieminski, what are EIA's projections on coal export trends to meet this growing global demand? As you know, coal consumption in China grew more than nine percent, and I know you recently reported that China consumes nearly as much coal as the rest of the world combined. So going forward with China and India installing over 500,000 megawatts of coal generation, more than 25 times what is planned for the United States, we have got this huge coal resource available for export to those countries and we can also export our technology for them to burn it cleaner and more efficiently. So what do you see is the global demand and what does this mean for jobs and the economy? I also want to know what you see as barriers to increase in coal exports.

Mr. SIEMINSKI. Madam Chairman, we have coal demand growing very rapidly outside of the developed countries, so outside of the OECD. This accounts for, I think, the largest portion of growth in energy on a global basis. A lot of that, as you point out on your slide, is in China and India. For the United States, because we have electricity growth only increasing at less than one percent a year, .9 percent per year, the opportunities for almost any fuel going into the electricity markets are going to be somewhat limited in the United States. And the competition between natural gas and coal basically on a price basis has been moving more natural gas into electricity generation.

In EIA's forecast out to 2040, we have the use of coal in the United States actually going up slightly in terms of tons. Although coal's market share is reduced somewhat as natural gas and renewables increase their market share, the actual amount of coal being used grows slightly. And the reason that we see that in the United States is that there are a number of relatively new cleaner plants that are running at below their maximum capacity utilization factors. And even with retirement of our older plants, we will see those utilization factors, if we are correct in our assumption that natural gas prices rise over time, creating a better competitive atmosphere for coal.

As you said, Madam Chairman, the opportunity then for the United States to export coal does exist. We have been doing that. U.S. coal has been moving into European markets, for example, as those countries have higher natural gas prices than we do and some countries, including Germany, have talked about lowering the amount of nuclear-generated electricity that they have.

On the R&D side, that is not really something that EIA has looked at, but I would be happy to provide to you for the record our detailed forecasts on all these numbers. We will be publishing the International Energy Outlook this summer and we will have, I think, some fairly decent data for you, Madam Chairman.

Chairwoman LUMMIS. Well, thank you, Mr. Sieminski. And we would be most interested in having those figures for the record.

I want to make sure that everybody gets a chance to ask questions of our witnesses, so at this point I would like to recognize Mr. Swalwell for five minutes.

Mr. SWALWELL. Thank you, Chairman Lummis. And I did want to go back to—as I mentioned in my opening remarks, I was interested by the President's challenge last night when he referred to how we can cut in half our energy consumption in our homes and our businesses. And before coming to Congress, I was a local city councilman and I worked very closely in local economic development projects. And I know that many commercial buildings—that the business owners did want to take measures to make their buildings more energy efficient so they could reduce their own costs and also help make the earth more healthy and our country less dependent on foreign sources of oil. But it would always have to pencil out. It would always have to make sense financially. And often times, not just in my district, but across the country, I have heard that commercial buildings and even homeowners have had a tough time connecting to the grid and working with public utilities.

In the United States there are approximately 5 million commercial buildings, approximately 72 billion square feet of commercial buildings. And commercial buildings consume about 19 percent of all energy in the United States. So my first question—and I will ask Mr. Sieminski—is there an opportunity for us to have commercial buildings working better with public utilities to connect to the grid where we can install clean energy-type technology on these buildings to make them more energy efficient, reduce their consumption, and also create more made-in-America jobs? So how do we approach that challenge? Is it something we should be considering as a national energy policy rather than region-by-region, state-by-state if our President is issuing sort of this national challenge?

Mr. SIEMINSKI. I think there are lots of opportunities in the building sector for improvements in energy efficiency. And I like to think of it that way because it is something that consumers can do for themselves in terms of saving money on their energy purchases.

The opportunities for improvements in the efficiency of heating and air-conditioning equipment is something that EIA has tried to build into our forecasts.

Mr. Swalwell, we have a number of surveys that we do and EIA is the only group that is seriously undertaking to survey commercial buildings, residential buildings, and manufacturing facilities for their energy use. The Commercial Building Energy Survey that we are working on right now, and will be sending people out into the field in the next few months, will provide a baseline to be able to answer some of these questions that you have raised.

It is a rather expensive part of what EIA's budget represents, but it is supported by numerous people in the private sector, including electric utilities and the commercial building owners themselves because they like to see how their numbers stack up against the averages. I think there are tremendous opportunities. Not just EIA but virtually every other research group that has ever looked at the opportunities finds that now that we have moved as rapidly as we have on light-duty vehicles, the next best place to find energy efficiency savings in the United States is likely in the buildings area.

Mr. SWALWELL. Great. And Ms. Jacobson, do you care to weigh in on this? I bet you could——

Ms. JACOBSON. Sure.

Mr. SWALWELL. —also inform us.

Ms. JACOBSON. Well, first of all, thank you for the excellent question. And I think data on commercial buildings is essential. And there is an initiative called the Better Buildings Initiative, which brings all of the players together, including utilities, building owners, financiers to come together to both increase awareness, discuss financing models, and try to overcome some of the barriers—the split incentives you are describing—that exist between building owners and building users.

But I would like to point out that we have had some success due to increased building codes and standards both at the state level and federal action as well. ENERGY STAR's certified commercial building floor space has increased by 137 percent from 2008 to 2012. And the stringency of building air-conditioning efficiency standards has increased by 34 percent since 2005. I mean clearly, there is more that we can do, but as you have said, there is tremendous potential here. And I think there is a real partnership between utilities, building owners, government, and data providers, as well as financiers to really unlock that potential.

Mr. SWALWELL. Great. And I believe not just to make us more energy efficient, which I think is our primary goal, but also to create local good-paying jobs in clean energy.

Ms. JACOBSON. Well, very much so. When you are talking about energy efficiency—I know people have used this saying—but these jobs can't be outsourced——

Mr. SWALWELL. Right.

Ms. JACOBSON. —and a lot of the equipment is—we have an innovative edge and the United States on a lot of the building management technology, a lot of the equipment and significant insulation that is a manufactured here in the United States. So I mean the opportunities are abound.

Mr. SWALWELL. Great. Thank you.

Chairwoman LUMMIS. Thank you so much, Ms. Jacobson. And thank you, Mr. Swalwell.

I will now recognize the gentleman from Texas, Mr. Weber.

Mr. WEBER. Thank you, Madam Chair.

Mr. Sieminski, a question for you. You have done a lot of calculations, a lot of discussion about coal. Has EIA done any calculations with improving clean coal technology? Have you factored out going into the future what the reduction in emmissions from those new clean coal technology plants?

Mr. SIEMINSKI. We have incorporated that into our estimates of energy use and including the numbers that we do on carbon dioxide emissions. We try to build in not leapfrogs in technology but the trends so that we are capturing the likely continuous improvement that we are seeing in areas like that, yes, sir.

Mr. WEBER. Second question would be, this may be above your pay grade to use a previous term, have you done any calculations when the Federal Government invests money in renewable technology, including, for example, the 500 million I think it was to Solyndra, what are we getting on a return in investment? In other words, we are investing a lot of money, but exactly how much is that increasing solar contributions to the grid? Have you calculated that out?

Mr. SIEMINSKI. EIA has not done such calculations. I am sorry.

Mr. WEBER. Right. I was afraid you would say that. The reason I ask is because, obviously, if you have building owners, and I was encouraged to hear Ms. Jacobson say that we have an innovative edge in. For example, I am an air-conditioning contractor, so ENERGY STAR means something to me in power requirements. I am glad to hear we have an innovative edge, but I am also mindful that business owners should be able to take those energy savings and plow them back into another property, invest in more jobs and into the economy. That kind of return on investment I would be interested in hearing. I don't know who to ask. If the money that the Federal Government is spending in subsidies, what are we getting? How much bang for the buck? And then we would have to equate that, too, if private entrepreneurs took that money and reinvested it, it would mean more purchases of real estate, more jobs in their local economies. So I think we would want to look at that.

That is just more of a statement than a question. And then finally for Mr. McNally, I did not see a footnote on the 2003 quote by Richard Smalley. What is that source?

Mr. MCNALLY. Congressman Weber, that is an article he wrote called the "Terawatt Challenge." And I would be happy to send that to you. I apologize.

Mr. WEBER. Yeah.

Mr. MCNALLY. I should have footnoted that.

Mr. WEBER. Yeah.

Mr. MCNALLY. I will send that to you——

Mr. WEBER. Would you send that to my office?

Mr. MCNALLY. Yes, sir.

Mr. WEBER. Thank you very much.

And I yield back the balance of my time that I don't have.

Chairwoman LUMMIS. Thank you, Mr. Weber.

I will now recognize the gentleman from Massachusetts, Mr. Kennedy.

Mr. KENNEDY. Thank you, Madam Chair. And to our Committee Chairman as well, thank you, and our Chairman Emeritus, and the Ranking Member Mr. Swalwell, thank you for holding this hearing. To our witnesses, thank you very much for coming to testify.

To begin, Ms. Jacobson, I was hoping you could just build a little bit on some of your comments about residential efficiency that we can build upon. I am from the Northeast. I lived in an apartment where in the winter I did not pay for heat. It was heated by the management company. It was so hot that I would often keep a window open throughout the entire course of the winter and often had a fan in the window because it would be about 85 degrees in the apartment. Many apartment buildings in the Northeast, old buildings, they don't have insulation. Do you have any idea of how many—the figures about energy loss that we are losing and how—some strategies, either state or federal, that we can start to implement that would help?

Ms. JACOBSON. Thank you very much for the question. Clearly, retrofitting buildings in the residential sector, as well as you are talking about apartments, are a significant challenge. In some ways, we are doing a little bit better with new construction because we can upgrade the codes and standards. But with the majority of our buildings living 30 to 50 years or more, we have significant challenges to face.

I don't have specific statistics on residential and efficiency across the board, an aggregate. Perhaps some of the other panelists would. But I can get it for you. I point you to one of our board Members, the Alliance to Save Energy, but I will take it upon myself to get you whatever data is available, either from the Alliance to Save Energy or the American Council on Energy Efficiency. They are really the key resources on data for energy efficiency.

But I think your experience is so telling and I appreciate you mentioning it because that is kind of the real world reality that we are in. But you know, with more public awareness and by innovative actions by states through revolving funds to help support residential energy efficiency or the PACE program you might have heard of, which is facing some challenges, but those types of innovative models will get in front of more customers to help retrofit homes.

Mr. KENNEDY. I appreciate that.

Mr. McNally, I had a quick question for you as well, sir. I represent a city called Fall River in southeastern Massachusetts, and there is a company there called TPI Composites that manufactures wind turbines along with other military and transportation equipment in their product lines. I spoke just last week with the CEO of TPI Composites and he expressed obviously the importance of the production tax credit for their business model and for facilities that continue to invest in wind energy despite loaded upfront costs that should thus bring an additional element of diversification to our American energy portfolio.

So if we know that clean energy technology manufacturing can create high-quality jobs in Fall River, and we know that minimizing uncertainty about our federal investment can create a dependable landscape that encourages further private sector investment in these technologies, but we also recognize that renewable energy alternatives like wind are not yet priced competitive with other existing technologies and traditional fossil fuels, what, then, would your path forward be that you suggest? You testified a bit about the market-based incentives and the need to make energy security policy a priority. While fossil fuels are deeply entwined in our current way of life and our standard of living, federal investments like the production tax credit are industry-wide, that you are not picking individual winners and losers, I think have a value for adding renewables and other clean energy sources to the mix. I would appreciate your comments on this if you can, sir.

Mr. MCNALLY. Thank you, Congressman Kennedy, for that question. As I said in my remarks, in my view in general, and particularly during these times of stretched fiscal resources and difficult budget questions and constraints, the proper role for Federal Government is in the basic research area. I would rather shut down the production tax credit, which is really helping mature but uneconomic renewable energies, and take some of that money and maybe hire some more scientists to figure out how to produce batteries that can store and discharge electricity better than they can now with the idea being if they can figure that out, they may then—those findings can translate down into the commercial sector that are without a production tax credit or distorting mechanisms of any kind. Industry can take and deploy that.

So again, I guess I would say in general but certainly in stretched budget times, let us focus the government's role in basic research—Ms. Jacobson said and I agree with very much—stable, long-term investments in basic research would be my preference, sir.

Mr. KENNEDY. Thank you. I yield back.

Chairwoman LUMMIS. Thank you.

Our next questioner is the gentleman from Texas, Mr. Hall.

Mr. HALL. And I do thank you, Madam Chairman.

The hearing today is entitled "American Energy Outlook," and I think that is one of the most important outlooks, besides prayer, energy is probably the most important word in the dictionary. The youngsters that are graduating from high school and going into college, they will be affected by how we treat and how we work with the energy people and people who are producing energy. Being from Texas, of course, I am sure Mr. Weber is a supporter of fossil fuels and coal and all of the above. And I am pleased to see young Kennedy on this Committee because of the Kennedy family, not just a famous family, but supporters of energy and invested in energy for our country, so I think he will be a a very good Member of this Committee.

We ought to be selling energy and not buying energy. We have tried for years to drill on ANWR. We have certain groups here that any time you talk about drilling on ANWR they say oh, don't drill on little ANWR. We want to drill on about about 2,000 acres up there out of 19 million acres. I doubt seriously that that would ruin little ANWR. And we have had previous bills, 22 bills at one time, that we sent to the Senate to drill ANWR particularly, and one got through. And President Clinton had some reason—maybe a good reason—to veto that particular bill.

But the other bills never got through because we had a person running the Senate then who was a Republican, and Republicans had charge of the House, Senate, and the President, and he felt like a businessman. And when they would pull up one of those energy bills, some of those fellows would get up over there to filibuster and he would pull it down because he didn't want to waste the Senate's time. And those 20 bills languishing over there, any of the 20 could help us for 60 years of energy from there.

Those are the things that I am interested in. And I guess I might ask Ms. Jacobson. There have been a lot of actions by the EPA onto their efforts to regulate or restrain production from hydraulic fracturing, and I would just like to ask you, in their effort to regulate or restrain production from hydraulic fracturing impact, does that impact not just energy production but our economy as a whole?

Ms. JACOBSON. Chairman Emeritus Hall, thank you very much for the thoughtful question. First, I would say our coalition, which is natural gas, renewable energy, and energy efficiency, believes in the abundancy and the need to tap into this unprecedented development we have had with natural gas in this country. And the key to that is public confidence and making sure that we have the regulatory frameworks in place so it is done in an environmentally sound fashion. And we believe that is very possible.

I think what is interesting is what is happening at the state level. There is discussion over at the Senate Energy Committee yesterday from the Governor of Colorado about the models that they are taking into account with regards to regulation of shale production.

So with regard to the Environmental Protection Agency or a state or other federal actions, I think we need to be careful and cautious and get the right data and make sure that the American public is confident so we can benefit from all the benefits that shale development can provide us.

Mr. HALL. Yeah, their decisions ought to be a little more game on scientific background more so we think then they have done. The next gentleman to speak, Mr. Rohrabacher, is very knowledgeable on fracturing. And we have had a lot of hearings along that line. And I think that we need desperately, and I was here when we passed the Clean Air and Clean Water bills, and we kind of didn't create the EPA but I was in favor of the EPA being there. And being from Texas and of the oil and gas industry, I thought they needed some regulation and some support. And I thought the EPA was fine. I don't think they are so fine today.

And the election didn't come out just exactly like I had hoped it would, but we might be doing something about that.

But I thank all three of you and I know you know the importance of energy. It is a national defense issue for us. And I thank you for your answer. I might have one other question I want to ask you if I can find it here for Mr. McNally.

Let me ask you this. In the last ten years, U.S. energy outlook has been transformed from what some refer to as an energy renaissance or revolution. Can you explain how various technological developments and advancements such as widespread adoption of the hydraulic fracturing have revolutionized the U.S. energy outlook?

Mr. MCNALLY. Thank you, Congressman Hall, for that question. Yes, I think you put your finger on the main one, and that is really in innovation and technology and the industry figuring out in the late 1980s in Texas and Oklahoma how to get at resources that are vast and that we have known are there. Now, we have known that there are vast amounts of oil and gas trapped in rock 10,000 feet below the ground for decades. And we haven't figured out how to get it.

We have been using hydraulic fracturing some say since the Civil War throwing dynamite down a hole. The Federal Government reportedly looked at nuclear explosions underneath the ocean floor to stimulate wells by fracturing. But the real innovation came with going after the shale deposits and using hydraulic fracturing. And that turned what we call resources, which is the oil that we think is in the ground but we don't know how to get out, into reserves, producible by our companies. And we are having continuous improvement and how to frack those wells, how to do so more efficiently, to go horizontally and in multi-stages, not just one straw into the ground.

So really, it is a remarkable story of industry progress with some government involvement mainly at the core, basic research level we should note. But it is brought to us by the industry and it has smoothed out our supply curve not only for natural gas but also for oil to the point where, according to some forecasts, we will surpass in the near future Saudi Arabia in production.

Mr. HALL. I thank you. I yield back.

I am sorry, Madam Chairman. I took him over.

Chairwoman LUMMIS. Thank you both, Mr. McNally and Mr. Hall.

And I would like to next recognize Mr. Veasey. And Mr. Veasey, did I pronounce that correctly?

Mr. VEASEY. Veasey.

Chairwoman LUMMIS. Veasey. It is Veasey.

Mr. VEASEY. Yes, ma'am.

Chairwoman LUMMIS. And you are also a gentleman from Texas?

Mr. VEASEY. Yes, I am from Texas. Yes.

Chairwoman LUMMIS. Well——

Mr. VEASEY. From almost the same area where Mr. Hall lives. I am a little bit west.

Chairwoman LUMMIS. Could you name for our benefit a couple of communities in your district so we can help——

Mr. VEASEY. Yes.

Chairwoman LUMMIS. —put you in a place?

Mr. VEASEY. Yes. I live in Ft. Worth——

Chairwoman LUMMIS. Okay.

Mr. VEASEY. —and I also represent the City of Arlington and the City of Dallas.

Chairwoman LUMMIS. Well, you are recognized and welcome.

Mr. VEASEY. Thank you very much. I appreciate that, Madam Chair.

And I wanted to ask Mr. Sieminski specifically about a concern that I have with the flaring of natural gas. As you know in the

Bakken, they are producing a lot of oil but I also know they do not have the pipeline capacity and so they are flaring quite a bit of natural gas. The Texas Railroad Commission does a really good job in Texas of keeping up with the number of permits that are given to operators, but I know in the Eagle Ford in particular and even some in my area, in the Barnett Shale, that there is some flaring going.

I know you specifically talked a little bit earlier about the rising cost of natural gas as it goes worldwide particularly. If the Department of Energy decides to export liquefied natural gas, or LNG, is there any technology on the horizon that would make it where we wouldn't have to flare so much natural gas so we would have more in quantity? I mean I think that that should be one real environmental concern that we have, particularly when you start talking about drilling in remote places like Alaska where there would be a lot of associated gas produced with oil production that would have to be flared off.

Mr. SIEMINSKI. Congressman Veasey, thank you very much. Just to put some numbers on the flaring, although there is a significant amount of flaring taking place in the Bakken formation right now, I think the latest statistics from North Dakota suggest that it is actually coming down. It had been as high as 35 or 36 percent of the gas. It is now down slightly below 30 percent. This is usually indicative of infrastructure build-out needed in a new area. And the gas is associated with the oil production in North Dakota. I suspect that over time the pipeline networks will be built out in North Dakota and those numbers will come down even further.

Although it seems like a lot of gas when you just look at the percentage in North Dakota, the amount in North Dakota is less than 1/3 of one percent, so less than 1/3 of one percent of total U.S. gas production. So it is actually a very small number. And you are correct, sir, that there actually has been some flaring in the Eagle Ford essentially for the same reason. Eagle Ford is in a part of Texas that is not heavily populated. It does not have the same pipeline infrastructure that you see in other parts of Texas. And it will just take a little bit of time—companies are working on that on the technology side. There has been an effort to look into small LNG liquefaction facilities that might be put in place in some of these remote areas where you could turn that natural gas that is being flared into a liquid, which would be easier to transport.

So I think that there is a lot of thinking going on in the industry. And although those satellite pictures showing the sky at night and the amount of light being given off in some of these new producing areas seem startling, it is I think a relatively small proportion. It is fairly normal in the course of development in new areas.

Very quickly, in Alaska there is a lot of gas that comes up in Alaska with the oil, but it is re-injected back into the formation. And so there is very little flaring taking place in Alaska.

Mr. VEASEY. And one more question about the rising prices, particularly if we end up exporting LNG. I know that some of our manufacturers and some of our plants of that are dependent upon the use of natural gas are concerned about those rising prices as they built them into their business models. Where do you see the appetite, particularly in Europe, for the production of natural gas, particularly as it pertains to fracturing and some of the other environmental things that we have talked about earlier? Because, as you know, particularly in my area in the Barnett Shale to where, you know, I mean I think that we have a gas lease on one of our properties literally in a single family setting I have a frack pond, pipelines like in the middle of Ft. Worth, you know, 700,000 people.

What do you see as far as the future is concerned, Europe's appetite for developing any formations? Because I would think that would be interesting. I don't know if they are even to a certain extent—can sometimes be even more environmentally sensitive to things than we are.

Mr. SIEMINSKI. There are a number of countries in Europe that are taking hydraulic fracturing very seriously. Poland, for example, Romania, the Ukraine, there is activity underway by industry there. The main thing that makes U.S. LNG exports so attractive to some companies and consumers in Europe, and in Asia as well, is that in most of the rest of the world, LNG prices are matched one-for-one to oil prices. In the United States it is a separate market. The models that we have run at EIA do incorporate the existing already-permitted facility in Louisiana that is going to export LNG, and we think that exports of LNG from the West Coast of Canada and possibly even Alaska into Asia would make economic sense, but there are policy issues, obviously, involved in making that decision.

Chairwoman LUMMIS. Thank you, Mr. Veasey.

I would like to now acknowledge—since the Bakken came up—the gentleman from North Dakota, Mr. Cramer.

Mr. CRAMER. Thank you, Madam Chair, and Ranking Member. And thank you to all of the witnesses. This is quite enlightening and it has been hard for me to sit here and not answer half of these questions, quite honestly. But your answer was right on with regard to——

Mr. SIEMINSKI. I would welcome your testimony.

Mr. CRAMER. No, I spent the last ten years as a public utilities regulator in North Dakota prior to coming to Congress, and one of the things that oftentimes gets overlooked is that while North Dakota is in fact the second-leading producer of oil, largest producer of gas, we mine 30 million tons of coal, generate about 5,000 megawatts of electricity with that coal, export it to many States and provinces, we also enjoyed the lowest natural gas residential retail rates in the country.

And I love, by the way, Mr. Sieminski, your service. I use it a lot. I always did use it a lot. And I am looking right now at the average retail price of electricity to ultimate customer users by end-use sector—that is one of my more common tables that I look up—and see that North Dakota continues to be among the three for lowest-priced electricity States in the country.

And so when I hear, frankly, Ms. Jacobson, somebody talk about leveling the playing field for all forms of energy, what I really hear is manipulating the playing field to create an advantage where one doesn't exist when the playing field is level. And so I would be interested in public policy thoughts as to how we would properly incent the marketplace. My definition, of course, properly might not be the same as yours. But it truly creates the level as opposed to manipulation.

The other thing, and then I will let Mr. Sieminski perhaps answer this question first and then we can get into the other stuff, but with regard to electricity prices and the use of the shift by policy from coal to natural gas, realizing that even in my short term on the Public Utilities Commission in North Dakota, the Public Service Commission, that I saw gas at $12 and I saw gas at $2 and everywhere in between. Do we run the risk of tightening this demand-and-supply curve of natural gas even in this abundance to a point where we make ourselves dependent on a fuel source that is so volatile? How much of that do you consider when you consider the price and the outlook going forward?

Mr. SIEMINSKI. We try to take that into account by looking at the reserve base and ultimate resource base for the different fuels. We are fairly confident that the resource base for natural gas will allow for continuing increases in production in the United States, all the way out to 2040 with shale gas currently accounting for about one third of U.S. production reaching half of U.S. production by 2040. We think that the coal resource base is also pretty strong, and although the deepest research on that was done quite some time ago, one of the reasons that it hasn't been updated is because the resource base is actually so vast that it didn't make as much sense to concentrate on that.

On the oil side, EIA does believe that there are some questions— and we do have tight oil production rising fairly sharply, reaching almost 8 million barrels a day by 2014, probably continuing to increase into 2020, but possibly coming back down again. What we would love to have, sir, is another two or three years worth of that on the oil side comparable to what we now have on the gas side to let us make a better judgment about the extent of the resource base therefore tight oil.

Mr. CRAMER. Thank you. You do a great job by the way.

Mr. SIEMINSKI. Thank you.

Mr. CRAMER. I appreciate the data.

Mr. SIEMINSKI. And we would be happy to work with your staff to show you some of the newer things that we are doing, including state mapping where any of you can go down to your Congressional District level and look at the energy infrastructure, including resources, power plant facilities, pipelines, and electric transmission lines and so on. It is a very useful thing, I think, for the entire Congress.

Mr. CRAMER. I want to allow Ms. Jacobson to respond to my comments earlier.

Ms. JACOBSEN. Mr. Cramer, thank you very much. And my organization supports a diverse energy mix, and all-of-the-above strategy. Just let me start with that. But as you know very well, given your experiences, there are a range of decisions that go into energy procurement. Some of them interact with state and federal policy, some deal with technology, some deal with price. And clearly, the credits that have been given for energy efficiency or various renewable energy sources are attempts to lower the cost and make more competitive these resources for a range of reasons, whether they be economic, environmental, or technology innovation-related.

As you know as well, very well, looking at the history of government involvement in energy policy, it is a century deep. And I think that when we look at energy efficiency or renewable energy, or energy storage, or we could go down the line. There are times when strategic investments, whether it be on incentives, for purchase, or lowering the cost for consumers and businesses are in play, or opportunities to entice the private sector through new investments that they might make. I mean I think what we are looking for is balance and ensuring that all these technologies will be available in the future.

So though certain incentives may be temporary versus permanent, we think all of them should be looked at critically to make sure that they are leveraging private sector investment, that they make sense for the public good, and that they are driving the objectives of this Committee and other Members of Congress.

Mr. CRAMER. Thank you. I yield back.

Chairwoman LUMMIS. Thank you, Ms. Jacobson. Thank you, Mr. Cramer.

We will go next to Mr. Lipinski. Before we do, Mr. Swalwell has had to leave for a Homeland Security meeting. He thanks the witnesses for your time and expertise this morning.

So next, I will recognize the gentleman from Illinois, Mr. Lipinski.

Mr. LIPINSKI. Thank you, Chairwoman Lummis. Thank you for holding this hearing today. Obviously, it is critical to get this overview right now and I look forward to the work that we are going to be doing on the Committee on this issue.

I want to start out with a question for Mr. Sieminski. EIA projections have nuclear production increasing by—increasing 15 percent by 2025, and by 2040, production is still projected to be up 14 percent. Now, these projections are made despite the relatively few orders for expansions of existing nuclear plants. I know that nuclear plant operations have made great improvements in the past to keep plants operating more efficiently and producing more electricity. But I want to ask, what is the source of these increases in projections? Is EIA projecting that most of these plants will have their operating licenses extended and that efficiency gains will continue? Or are these projected increases due to new production possibly from next-generation technologies?

Mr. SIEMINSKI. Thank you, Congressman Lipinski. We have a couple of new power plants built into the projections. There are several under construction right now. In addition to that, we are assuming some further efficiency gains in the industry. They call it up-rating where you get more power out of the individual plants. And on—the reason that the numbers do begin to trail off at the end of the time is that we are assuming that there will be some retirements, but in general, I think we have built in extensions of licenses in a number of cases for relicensing.

The overall numbers that we have for the type of fuels used in generating electricity, the fastest growth that we see is in solar, percentagewise, as well as wind. The biggest from a standpoint of not the annual percent increases but the absolute numbers is in natural gas, and that comes back more to the continuing strong price competition that we see between natural gas and coal.

Mr. LIPINSKI. Okay. I wanted to continue on a little bit on nuclear technology and how much might be gained from additional R&D into our nuclear energy. I just wanted to ask Mr. Sieminski but if you have additional comments here also. Do you think advanced concepts like small modular reactors and fast breeder reactors could change the conversation about nuclear to make it safer and easier to build while also helping to solve the waste issue? Or at a minimum, could it help extend the life of existing reactors with greater safety? Because what we are focused on here in this Committee is the R&D. So what do you think we can get from nuclear R&D? And what is the future for nuclear?

Mr. SIEMINSKI. I would be happy to come back to you for the record and provide you some background on the assumptions that we are making in that area.

In general, as I said, our overall forecast generally assumes trend improvement and technologies but not major breakthroughs. We try not to predict changes in regulation, legislation, or huge changes in technology. The role that technology has played recently has been very strong. In Mr. Swalwell's district, the labs—Lawrence Livermore and Sandia—as Mr. McNally said earlier, these labs played a strong role in providing research, particularly in 3–D seismic technology and in horizontal drilling that was instrumental in the Barnett Shale breakthroughs that took place back in the 1990s.

Interestingly, there was also a Section 29 tax credit for shale gas—type gas at that time that also spurred things. I think that one of the more interesting aspects of that tax credit is is that it expired and it was allowed to expire so that we got the benefits of the R&D, little help from a tax credit that ultimately was no longer necessary once the industry was on its feet.

Mr. LIPINSKI. My time is almost up. Does anyone else have any comments on nuclear R&D? All right. Thank you very much.

I yield back.

Chairwoman LUMMIS. Well, thank you, Mr. Lipinski.

And I would note that Mr. Lipinski, Mr. Rohrabacher, and Ms. Lummis all have an interest in this issue. And so we may want to pursue that further with you, the notion of modular nuclear reactors, small nuclear reactors, very small-scale electricity production, in Texas, too. So I think that you are going to find that there is a spark on this Committee for that subject.

Thank you.

Thanks, Mr. Lipinski.

Next, we will go to Mr. Hultgren. I might just for planning purposes tell you that, Mr. Hultgren, you are next. Mr. Rohrabacher, who has joined us as a Member of the Full Committee, will then have an opportunity to ask some questions. I want to recognize that Mr. Veasey has joined us in a capacity as Ranking Member. And then after that, Chairman Smith has asked me to ask a question on his behalf.

Then, unless there is a burning desire on anyone's behalf to have a second round, which would be sort of an abbreviated, one-question-per-person round, if that is not the case, we will conclude the hearing. But I do want to put out the opportunity for Members to ask a second question. That preparation having been laid, I now yield to the gentleman from Illinois, Mr. Hultgren.

Mr. HULTGREN. Thank you, Madam Chair. Thank you all for being here as well.

Our national competitiveness, our investment in basic research, and the critical role that each plays in enhancing the other, as well as the energy security of our Nation are very important to me and my constituents in Illinois.

Mr. McNally, you have said in your testimony that too often, leaders and observers predict or prescribe unachievable targets when it comes to the energy future in this country. In his State of the Union address last night, President Obama made frequent references to research and development, something I find ironic coming from the President that cut high-energy physics, nuclear physics, manned spaceflight, and planetary science. I wondered, Mr. McNally, in your opinion, is the Administration's focus on cutting basic research in order to subsidize favorable companies in the alternative energy market going to speed up or delay our eventual adoption of cleaner technology in the future?

Mr. MCNALLY. Thank you for that question, Congressman Hultgren. In the interest of bipartisan open-mindedness, let me say that our energy predictions, our policymakers, are becoming more realistic. President Nixon kicked things off in 1973 by predicting we would be oil-import-free by 1980. President Carter said we would never consume more of a drop than we did in 1979. We are getting at least a little more realistic in our productions and prescriptions.

But to your question, no, in my view it is not consistent with my testimony or my beliefs were we to shut down investments in basic, core research that then can be deployed by the private sector in a viable way that adds to wealth and adds to productivity without continual government support, that would be a mistake to end those kinds of activities and shift them towards the type of activities that, again, as I said in my testimony, there is a long record of failure. So that would not be my preference, sir.

Mr. HULTGREN. Well, I appreciated, as I was stepping out, I have got another Committee going on at the same time, so I apologize. Kind of jumping back and forth, but I had heard you mention a little bit earlier, again, of how important basic scientific research is and the fear of really undercutting that, of how that puts us at a disadvantage. The President seems to think that asking us to spend more money on these short-term items is really the only way to achieve clean energy future. He seems to have this sense that we can just buy an immediate change in our economy. My sense is that it is going to take maybe 20 years or even longer of long-term, basic research in the very subjects he is cutting—high energy physics, nuclear physics—in order to produce a change and really change our fundamental ability to produce energy in a cleaner and cheaper way.

Again, Mr. McNally, I wondered if you could talk—what do you think the best use of limited resources at a time like this would be in order to best affect that?

Mr. MCNALLY. Well, thank you for the opportunity to respond to that, Congressman. I wanted to connect a dot. I don't think I did clearly enough with Representative Kennedy's question. The reason I thought that we would want to maybe invest in some research into batteries is because the reason—one of the main reasons wind is not economical is because you cannot store electricity. The wind blows in places where we don't need it and electricity, unlike oil and coal, cannot be stored. So if we can figure out ways to store and discharge electricity, we will make all renewable forms of electricity, solar and wind, more economic. And that is an example, I think, of the potential benefit of core research.

Another one—and again, my wife calls me Mr. Worst-case-scenario, so I am not known for flowery predictions about wonderful transformations, but I will say, as I said in my testimony, if you ask me what plausible transformative change is out there that could happen in our lifetimes that could completely upend in a positive way our energy outlook, and I would think that is—that we figure out how to get methane hydrate out of the Earth's crust. Like shale gas and shale oil of the day, we know it is there. We know the resources are enormous. Some estimates say there is 6 trillion TCF in the Gulf of Mexico. That is equal to total proved reserves in the world, conventional reserves. But we have not figured out yet—and we and the Japanese and others are working on it and DOE is doing some good work here—is to get that methane hydrate out of the crust in a safe way that doesn't create methane burps if you will and emissions.

So those are the kind of problems that humans can solve. We don't have to figure out how to make algae go into gasoline. We know how to use methane. We just have to figure out how to get it out of the crust. We did it with shale gas and shale oil. I think we can do it with the government's help in the core basic research area with methane hydrates.

Mr. HULTGREN. My time is winding down, but again, I really do appreciate each one of you being here. This is an important discussion to have. I do think, especially at a time like this where budgets are tight, resources are limited, we have got to focus where doing the work that only government can do, and I think that is basic scientific research. We have seen that industry can step in and apply what is discovered, but there are certain things that only we can do. So thanks for being here.

Thank you, Madam Chairwoman. I yield back.

Chairwoman LUMMIS. Go ahead, Mr. Weber.

Mr. WEBER. Well, thank you. In the absence of the Chairwoman—oh, I see she is back.

I do want to very quickly say, though, Mr. McNally, you can store direct-current electricity and maybe our tack needs to be at producing more appliances that actually operate off of DC as opposed to alternating current AC. But thank you for that.

And Mr. Rohrabacher, the esteemed gentleman from California, you are recognized.

Mr. ROHRABACHER. It seems the lady is away just for a second and the guys have already taken over. What is going on here?

Well, first of all, let me suggest that Madam Chairwoman is absolutely correct when she says that there is a keen interest in small modular reactors and new types of nuclear power, approaches to nuclear power. Let me note also that the Department of Energy is moving forward in building light water reactors, which is 60-year-old technology as part of their step forward in the research. I have been disappointed many times in my 24 years here when government research projects end up focusing on, because the companies that get involved in that research make a profit on what they already know rather than trying to push the envelope. I remember when they tried to get $500 million from us in research money in order to compete with the Japanese on high definition TV. And we ended up financing the development of high definition TV based on analog technology rather than digital technology. So I mean it is just examples.

The human genome, which we also with this Committee financed, I will never forget it was going to take 20 years, and halfway through it, a private company said look, we can do this cheaper and we can get this done years in advance. Just give us the right to own this technology or this approach into the years that we are going to save it from when the government when it is going to be done. And it was a big debate about that.

So I am hoping that if we do provide money for energy research, it is not for like light water reactors or analog, that we are literally pushing the envelope. And that is in terms of our, of course, science that is aimed at breaking new ground. Applied science and applied research I think that business could do pretty much on their own. Let us get to that.

First of all, I would like to ask, a few years ago we were gloom and doom about peak oil and how we are going to be energy-wise, things are going to get worse and worse. What about peak oil and gas? Is that just a false alarm?

Mr. SIEMINSKI. Thank you, Congressman.

The problem that I saw as an energy economist, the problem that I always had with the peak oil hypothesis was that it was entirely geology-based. The view assumes that the resource base is completely known, and once you produce half of it that you inevitably are on a downturn. I think that this Committee particularly understands that there is a role for both prices and technology to dramatically change our understanding of the resource base. And that is what we have seen.

Mr. ROHRABACHER. When you talk about price, which is one thing, we heard it earlier about the importance of efficiency. Well, assuming that mandates and regulations are what causes efficiency as compared to price, and when you allow the price to go up, there is going to be a great deal more efficiency. People will turn off their lights. Actually, we found that out in California. If indeed the price of electricity goes up, again, we go back to market-based solutions. Rather than having the government step in to try to mandate what direction we go, quite often, the market-based solutions actually get the job done better.

Let me ask about fracking now. I understand that the fracking that has given us so much more energy and thus more national security, that this is mainly on private land. Has there been some type of stifling of fracking on public lands?

Mr. SIEMINSKI. There is hydraulic fracturing that takes place on federal lands. The Bureau of Land Management actually has issued some rules on hydraulic fracturing and how that should proceed. For the most case, the vast majority of what we see geologically as the type of flight oil and shale gas resource base is on private lands, and I believe that that is one of the main reasons the bulk of the development so far has been on private——

Mr. ROHRABACHER. But you wouldn't say that it is being stifled on public land? That is not an accurate charge then?

Mr. SIEMINSKI. That sounds like a policy question and I think I am going to stay away from policy questions.

If the Chairwoman would allow me 30 seconds, some of the changes that we are seeing in technology are going to dramatically shift the public's concept of hydraulic fracturing. Right now, in Pennsylvania, for example, most of the water—produced water from hydraulic fracturing is being recycled and being used again. And the companies involved in the fracturing activity are finding ways to target the areas that they fracture so that, rather than fracturing the entire length of a horizontal wellbore, they are using 3–D seismic technology to pick where they want to fracture, which then reduces the amount of water and chemicals and the impacts that come from hydraulic fracturing. And I think it is technological breakthroughs like that that offer a tremendous opportunity for the public to be reassured that hydraulic fracturing can be done in a sound, safe manner.

Mr. ROHRABACHER. Thank you very much, Madam Chairman. And let me thank the Chairwoman for holding this hearing.

Chairwoman LUMMIS. Thank you, Mr. Rohrabacher.And Mr. Weber had a question. Who developed that technology you were just talking about?

Mr. SIEMINSKI. That technology was developed in the private sector by a number of the companies active in oil services activity. A gentleman that I spoke to about the developments taking place comes from Schlumberger.

Chairwoman LUMMIS. Does that track with what you recall?

Mr. WEBER. It does.

Chairwoman LUMMIS. All right.

Mr. WEBER. Thank you, sir.

Chairwoman LUMMIS. There is a little company in Wyoming called Well Dog that also was dropping computers down wellbores and gathering all kinds of information about whether there were commercial quantities recoverable in that wellbore, where they were. And so before they even case the well, they had all kinds of data. And so these technologies, even in the traditional oil and gas business, as you have pointed out, are just improving dramatically every year. So that will be a fun subject for this Committee to explore further in the months ahead.

I do, with your indulgence, have a question from Chairman Lamar Smith for Mr. Sieminski. The Energy Information Administration's 2008 report called "FederalFinancial Interventions and Subsidies in Energy Markets 2007" included two very useful tables listing federal subsidies by energy source, as well as the amount of subsidy per unit of energy produced. Now, this information was not included in the EIA's updated report in 2011. Chairman Smith would like to request that EIA update the information contained in both tables and provide this to the Committee. Can you do this for me, Mr. Sieminski, so I can pass that information on to the Chairman?

Mr. SIEMINSKI. I understand that we have actually looked into that. We will come back with—to the best of our ability with some updates. What we found, Madam Chairman, is that the assumptions that you have to use to get to the useful comparable answers on which of our fuels are being subsidized in one extent or another are extremely complex. But we will come back to you with some numbers. Thank you.

Chairwoman LUMMIS. Well, thanks, Mr. Sieminski. And we expect the information you give us will include appropriate caveats and an explanation of the complexity of the calculation. But we would like to see those basic facts on subsidies and energy production for the Committee.

I would like to close. Mr. Weber, do you have any additional questions? Okay. This is great. Hey, I want to thank the witnesses for their valuable testimony, and I want to thank all the Members for their questions.

Members of the Committee may have additional questions for you, and we will ask you to respond to those in writing. The record will remain open for two weeks for additional comments and written questions from the Members.

With our great thanks, the witnesses are excused and this hearing is adjourned.

[Whereupon, at 11:40 a.m., the Subcommittee was adjourned.]

Appendix I

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by The Honorable Adam Sieminski

QUESTIONS FROM REPRESENTATIVE LUMMIS

Q1. In 2010, EIA released its U.S. Uranium Reserves Estimates, which included 2008 uranium reserve data. According to EIA's website, the summary was expected to be updated in 2012. Is EIA currently in the process of updating this report? If so, please provide the estimated release date. If not, please do so with the most recently available data and provide to the Subcommittee.

A1. The 2008 "U.S. Uranium Reserves Estimate" report is the most current data available on our website. These data were not collected by an EIA survey but assembled from publicly available company information.

EIA began collecting uranium reserves data via its Form EIA-851A, "Domestic Uranium Production Report." EIA plans to include the most recent data, i.e., data for 2012, in its "2012 Domestic Uranium Production Report," which is scheduled to be released in late June 2013.

QUESTIONS FROM REPRESENTATIVE NEUGEBAUER

Q1. It was recently announced that wind was the largest source of installed capacity during 2012, and the wind industry regularly touts significant growth in installed capacity as a sign of the technology's growing competitiveness. Secretary Chu has similarly noted that wind generation is a mature technology. However, in the recent "Fiscal Cliff" deal, the Production Tax Credit (PTC), the primary subsidy for wind energy, was extended for another year and expanded to include facilities that begin construction in 2013.

1. Do you consider wind generation a mature technology?
2. Is wind cost-competitive without the PTC? If not, when –if ever – will it be?
3. How have projections of low natural gas prices impacted the competitiveness of alternative power sources such as wind and solar?

A1. For purposes of evaluating the learning-induced capital cost reduction potential of on-shore wind power technologies, EIA considers wind as a relatively mature technology, with 60 GW of installed capacity in the U.S. by the end of 2012. However, while well-established on a commercial basis in the U.S. and other countries, wind is still a relatively new generation resource and still comprises a relatively small percentage of U.S. electricity generation (3.5% in 2012). Because of wind's unique generating characteristics and its potential to affect broader grid operations at higher penetration levels, there is still much to learn about wind's overall impact on and value to the electrical grid.

EIA has recently prepared an Annual Energy Outlook 2013 case which assumes that the PTC is available for wind projects under construction by the end of 2013 as provided for in legislation enacted after the 2013 Reference case was issued. In that case, no significant additions of wind capacity are projected between 2017, when the incentive effectively expires (based on an assumed 3-year development lead time for wind projects) and 2030. While about 20 GW of new capacity are added through 2016, less than 1 GW of wind capacity is added from 2016 through

2030 out of over 90 GW of total capacity additions in the utility sector during this period. After 2030, EIA projects that wind will be among several generation resources that will be competitive for new capacity additions to the U.S. grid. In the period 2030 through 2040, we project the addition of almost 22 GW of wind out of 135 GW of total additions without the PTC in place. Much of this projected growth after 2030 is market-driven, as wind and other renewables are projected to be built in excess of state-level requirements for new renewable generation sources.

Because of its key role in determining wholesale electricity prices in much of the U.S., low natural gas prices will generally tend to reduce the potential revenue available to resources like wind and solar power. This can be seen in projections prepared for the Annual Energy Outlook 2013 which assume high natural gas resource extraction (low prices) and low natural gas resource extraction (high prices). In the AEO 2013 Reference case, wind is projected to grow at an annual average rate 1.5 percent, but with lower natural gas prices, that projected growth drops to 0.2 percent per year, and with higher natural gas prices increases to 2.9 percent per year. Lower natural gas prices have eroded the competitive position of wind energy over the past several years by reducing the avoided cost of generation displaced by the wind.

QUESTIONS FROM REPRESENTATIVE GRAYSON

Q1. To what extent is the reduction in US greenhouse gas emissions the result of increased greenhouse gas emissions in China to make products for import to the US?

A1. EIA is not able to answer this question definitively. There are significant uncertainties about the degree to which changing output in one country might be replacing production formerly supplied by another country. For example, the U.S. primary steel industry has been contracting, while the Chinese steel industry has been growing. However, a large portion of the change in China is clearly due to the rapid growth in infrastructure that is occurring there and the needs for steel that grows with it.

Overall, the U.S. industrial sector was responsible for 1,695 million metric tons of carbon dioxide in 1990 and 1,496 million metric tons in 2011. Some of this change may be due to shifting production from the U.S. to China, but the changes are modest when compared to total emissions growth in China over the same period. Furthermore, there are other sectors of the U.S. economy, such as electric power, transportation and residential and commercial buildings that are largely unaffected by these types of shifts.

QUESTIONS FROM REPRESENTATIVE VEASEY

Q1. While the outlook for U.S. production of conventional fuels suggests continued growth over the short and medium term, much more could be done to support sustained increases in domestic energy production over the long term. Can you provide further details regarding recent initiatives by the Department of Energy and the private sector to advance algae-derived biofuels, and efforts to collaborate with the Department of Defense regarding development of domestically produced, drop-in, advanced biofuels for transportation?

A1. As the independent statistical and analytical agency within the Department of Energy, EIA is not involved in the Department's technology development initiatives. The Department's Office of Energy Efficiency and Renewable Energy would be best able to provide a thorough answer.

Responses by Mr. Robert McNally

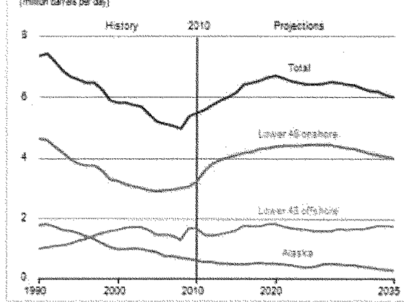
Hearing Questions for the Record
The Honorable Randy Neugebauer

Question 1: In the last ten years, the US energy outlook has been transformed in what some refer to as an energy revolution or renaissance. Can you explain how various technology developments and advancements, such as widespread adoption of hydraulic fracturing, have revolutionized the US energy outlook?

Answer: The widespread application of hydraulic fracturing and horizontal drilling into US oil and natural gas fields has been the most dramatic development in the energy sector over the past 10 years. Hydraulic fracturing is a technology that has existed in some form for several decades. Well stimulation techniques have been utilized by energy companies ever since the earliest oil drillers discovered dropping sticks of dynamite into well bores would loosen up the "rock oil" they were producing in shallow formations in Pennsylvania. It is the unlocking of horizontal drilling technology and its marriage with hydraulic fracturing that has led to the burst of production from unconventional shale gas and oil formations.

This technological achievement has allowed energy companies to produce oil and gas in massive quantities in places where for decades it was impossible to do so. Certain geological formations containing shale, limestone, and dolostone, among others, can hold oil and natural gas molecules within the rocks themselves on a microscopic level. Unlike conventional oil and gas reservoirs, where the hydrocarbons can flow freely to a nearby well, "tight" oil and gas formations need to be horizontally drilled because of the orientation of their strata and hydraulically fractured to free the oil or gas from the rocks.

Figure 112. Domestic crude oil production by source, 1990-2035
(million barrels per day)



Fortunately for the US, there are numerous tight oil and gas formations that we are now able to access. In many cases geologists and petroleum engineers have known of these fields for some time but have never possessed the technology to explore them. That has changed and as a result the US has reversed its decline in oil and natural gas production. The Energy Information Administration estimates 33 percent of US onshore oil production comes from tight oil with that figure increasing to 51 percent by 2040. Similarly, shale gas now accounts for 23 percent of total gas production but will grow to 49 percent by 2035.

Question 2: The current growth in energy production underway in the Bakken, Marcellus, and Eagle Ford shales is well known. Are there significant new shale plays that could deliver similar production in the coming years and if so where are they located?

Answer: As a caveat, the Rapidan Group analyzes market trends and developments and is not specialized in the geology or technical aspects of oil and gas production. We do, however, keep track of prospective developments and how they can influence energy prices and industry performance.

In general, as natural gas prices remain below $4.00/mcf, production companies are less attracted to "dry" natural gas fields where no crude oil or natural gas liquids can be produced. In fact, in the Bakken formation, natural gas that comes up with crude oil for now is being flared as the economics do not currently justify separate and massive gas pipeline infrastructure construction. Producers and midstream developers are working, albeit slowly, to correct this. But until natural gas prices rebound, gas-heavy plays will not be developed as rapidly as the liquid-rich plays like the Bakken and Eagle Ford.

Other prospective plays exist and are currently in the very early stages of development. The Lower Smackover Brown Dense in Louisiana and Arkansas has great liquid potential, and some early surveys of the Monterey formation in California show it being twice as large as the Bakken and Eagle Ford combined. California is in the process of updating its regulations for hydraulic fracturing and until they are complete, it is unknown how much production we will actually see from the Monterey.

Responses by Ms. Lisa Jacobson

Lisa Jacobson, President
Business Council for Sustainable Energy

Responses to questions for the record regarding hearing on "American Energy Outlook: Technology, Market and Policy Drivers"

Responses to questions for the record from the Honorable Randy Nuegebauer

Question 1

It was recently announced that wind was the largest source of installed capacity during 2012, and the wind industry regularly touts significant growth in installed capacity as a sign of the technology's growing competitiveness. Secretary Chu has similarly noted that wind generation is a mature technology. However, in the recent "Fiscal Cliff" deal the Production Tax Credit (PTC), the primary subsidy for wind energy, was extended for another year and expanded to include facilities that begin construction in 2013.

1. Do you consider wind generation a mature technology?
2. Is wind cost-competitive without the PTC? If not, when—if ever—will it be?
3. How have projections of low natural gas prices impacted the competitiveness of alternative power sources such as wind and solar?

1) Currently, wind energy only generates 3.5% of our nation's electricity, compared to 37% for coal, 31% for natural gas, and 19% for nuclear. In 2005, the Department of Energy issued the *20% Wind Energy by 2030* report finding that wind energy could provide 20% of our nation's electricity generating capacity by 2030. Wind energy's development is on a similar growth trajectory compared to earlier growth trajectories of other energy sources, such as nuclear energy.

2) Like other electricity generating technologies, the competitiveness of wind varies widely across regions of the country. In most areas of the country, wind would not be cost-competitive without the Production Tax Credit (PTC) compared to existing natural gas generation. The wind industry has publicly stated that it will not need the PTC forever, but determining exactly when the PTC will not be needed is a difficult exercise that depends on a lot of variables. This calculation depends on energy prices, wind energy costs and development cycles, and other market conditions. These market conditions, in turn, are influenced by policy developments at the state and federal level. In that sense, the ongoing availability of other energy-specific incentives, some of which have been in place for many decades, also affects the competitiveness of wind energy.

3) As noted in the Sustainable Energy in America 2013 Factbook[1] that was released on January 31, 2013, lower- and zero-carbon power sources are growing in the electricity sector. Natural gas-fired power plants provided 31% of US electricity in 2012 – up from just 22% in 2007. Meanwhile renewable energy generation has grown from 8.3% to 12.1% over that period.

[1] "Sustainable Energy in America 2013 Factbook," January 2013, http://www.bcse.org/sustainableenergyfactbook. The Factbook was researched and produced by Bloomberg New Energy Finance and commissioned by the Business Council for Sustainable Energy. It is a quantitative and objective report, intended to be a resource for policymakers with up to date, accurate market information. Its goal is to offer important benchmarks on the contributions that sustainable energy technologies are making in the U.S. energy system today. It also provides information on finance and investment trends in clean energy resources.

Fuel-price economics and supply-demand characteristics of the electricity markets explain natural gas's expanded share. In situations of excess capacity, different fuels compete against each other, especially when short-term substitution is possible. In the US electricity sector, this substitution is made possible by two phenomena:

- Reserve margins – the amount of total available generating capacity over and above annual peak demand – are currently quite high across most of the US. High reserve margins mean that electricity markets rarely utilize their full portfolio of generation supply.
- US electricity demand is highly seasonal, with a large summer peak, a smaller winter peak and two 'shoulder' seasons where demand drops to very low levels (intraday demand is also highly variable). This separates power plants into three broad classes: baseload generators, which run for more than 70% of the year; intermediate generators, which run between 15% and 70% of the year; and peakers, which only run during peak hours.

With sufficient supply to meet demand, markets choose which plants to run; naturally, the lowest-cost plant is selected to provide electricity. Because of relatively low natural gas prices, combined-cycle gas plants (CCGTs) have become more competitive and increased their run hours.

Of note, wind generation is nearly cost competitive with natural gas given recent cost reductions, but more reductions can be achieved with stability. Wind was the largest new source of electric generating capacity installed during 2012, followed by natural gas. Further, renewable energy and natural gas together made up the majority of new installations over the past 5 years. These dynamics show that renewables are increasingly competitive with low-priced natural gas, while helping hedge against any overexposure to any single sources of energy.

Figure 1: US electricity generation by fuel type, 2007-12 (%)

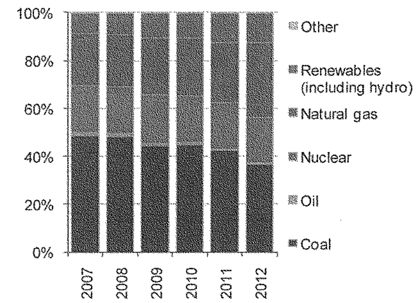
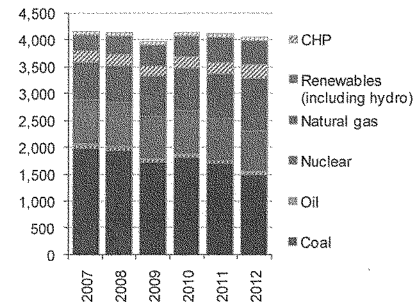


Figure 2: US electricity generation by fuel type, 2007-12 (TWh)



Source: Bloomberg New Energy Finance, EIA Notes: In Figure 1, contribution from 'Other' is minimal and consists of miscellaneous technologies including hydrogen and non-renewable waste. In Figure 2, contribution from CHP is indicated by a 'shaded' bar in the columns. Values for 2012 are projected, accounting for seasonality, based on latest monthly values from EIA (actual data available through October 2012).

Figure 3: US capacity build by fuel type, 1990-2011 (GW)

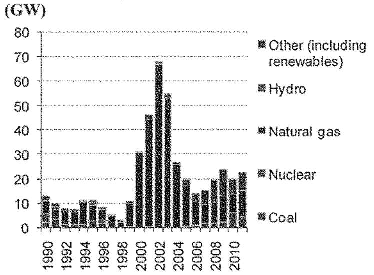
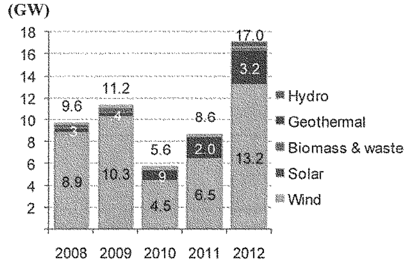


Figure 4: US renewable capacity build by technology, 2008-12 (GW)



Source: Bloomberg New Energy Finance, EIA, FERC Note: Figures for official capacity additions for later years not yet available. New natural gas build also includes oil generating capacity; the EIA does not differentiate between the two, but the vast majority of new natural gas/oil capacity is devoted to natural gas generation. In 2012, new biomass and waste capacity totalled 218MW, new geothermal capacity totalled 147MW, and new hydropower capacity totalled 19MW.

The end of 2012 finished with 86GW of operating renewable capacity (Figure 5). Cumulative installed renewable capacity nearly doubled between 2008 (44GW) and 2012 (86GW) (Figure 6). Over the same period, renewable generation increased from 126TWh in 2008 to 217TWh in 2012 (375TWh in 2008 and 488TWh in 2012 including hydropower)

Figure 7: US renewable generation by technology (including hydropower), 2008-12 (TWh)

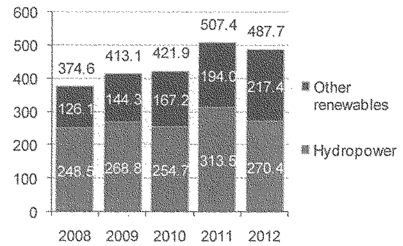
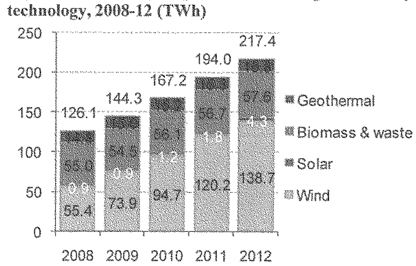


Figure 8: US non-hydropower renewable generation by technology, 2008-12 (TWh)



Source: Bloomberg New Energy Finance, EIA Note: Includes net energy consumption by pumped hydropower storage projects.

Figure 5: US cumulative renewable capacity by technology (including hydropower), 2008-12 (GW)

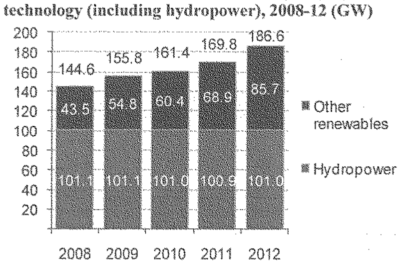
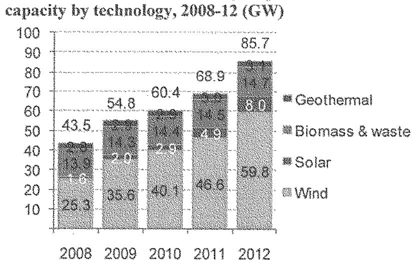


Figure 6: US cumulative non-hydropower renewable capacity by technology, 2008-12 (GW)



Source: Bloomberg New Energy Finance, EIA Note: Hydropower capacity includes pumped storage

Responses to questions for the record from The Honorable Eric Swalwell.

Question 2

1. Over the last few years we have seen costs for renewable generation decrease rapidly. What has driven down the cost of renewables; what can we expect these cost curves to do in the near-to-mid-term; and what are some factors that might cause those trends to change?

2. The U.S. economy today is markedly more efficient than it was even a few short years ago. What is driving the overall decrease in energy-intensity of the U.S. economy? For example, can we attribute it to more stringent appliance and fuel economy standards, a downturn in the economy, or the basic incentive for consumers and industry to save money?

3. If across-the-board cuts are made at the Department of Energy and other federal agencies, how will it affect our nation's capacity to innovate and deploy new cleaner energy technologies?

1) Over the past several years, we have seen real market penetration and cost reductions in a wide range of sustainable energy technologies and resources, including renewable energy technologies.

According to the Sustainable Energy in America 2013 Factbook[2] that was released on January 31, 2013, the levelized costs of electricity for renewable technologies have plummeted. For example, the cost of electricity generated by average large solar power plants has fallen from $0.31 per kilowatt-hour in 2009 to $0.14 per kilowatt-hour in 2012, according to Bloomberg New Energy Finance's global benchmarking analysis based on already financed projects from around the world. (These figures exclude the effect of tax credits and other incentives, which would bring those costs down even lower.) Over the same period, the cost of power from a typical large wind farm has fallen from $0.09 in 2009 to $0.08 per kilowatt-hour.

The Business Council for Sustainable Energy and the Sustainable Energy in America Factbook do not make forward-looking forecasts on pricing, but generally, to continue the momentum of growth in these sectors, and to receive their co-benefits, long-term, stable polices will be needed to level the playing field and to provide market access to new technologies. We will also need to continue to invest in energy research, development and deployment to increase the efficiency of our energy generation and use and to spur new innovations. This is important for domestic economic growth and for U.S. competitiveness in the energy sector.

2) The Sustainable Energy in America Factbook shows how energy efficiency is making its mark on the grid and on buildings. Total energy use fell 6.4% between 2007 and 2012, according to preliminary estimates, driven largely by advances in energy efficiency. This decrease occurred in spite of a 3.0% increase in GDP over the same period. It is fair to attribute this to a range of factors including economic dynamics, policy and financing and technology innovations.
It is important to note that much of the overall energy reduction has come from sectors outside electricity. Over 1991-2011, while total energy consumption grew by a compound annual growth rate (CAGR) of

[2] "Sustainable Energy in America 2013 Factbook," January 2013, http://www.bcse.org/sustainableenergyfactbook. The Factbook was researched and produced by Bloomberg New Energy Finance and commissioned by the Business Council for Sustainable Energy. It is a quantitative and objective report, intended to be a resource for policymakers with up to date, accurate market information. Its goal is to offer important benchmarks on the contributions that sustainable energy technologies are making in the U.S. energy system today. It also provides information on finance and investment trends in clean energy resources.

just 0.7%, electricity demand grew twice as quickly at 1.5%. Non-electricity energy demand has slowed or fallen due to factors including increased vehicle fuel economy, which has reduced oil consumption since 2005, and more efficient heating systems and buildings, which have kept residential and commercial natural gas consumption flat.

Further, since 1980, energy intensity of commercial buildings has decreased by over 40%, propelled by increasingly sophisticated approaches to financing for energy efficiency retrofits, as well as by standards, such as those that apply to heating and cooling units and to thermal performance (ie, insulation). For example, Energy Star-certified commercial building floor space has increased by 139% from 2008 to 2012, and the stringency of building air conditioning efficiency standards has increased by up to 34% since 2005.

Overall, US utility budgets for energy efficiency reached $7bn in 2011 (the latest available date for which data exists). Demand response capacity, which typically involves the curtailment of electricity consumption at times of peak usage, has grown by more than 250% between 2006 and 2011, allowing major power consumers such as manufacturers to cut their energy costs and utilities to scale back production from some of the costliest power plants. Some 46m smart meters have been deployed in the US, while spending on smart grid roll-outs hit $4.3bn in 2012, up from $1.3bn in 2008.

3) BCSE strongly supports the continued funding of basic and applied research and development for clean energy technologies. This must be balanced with work on commercialization, market transformation and other efforts to ensure that products do not sit on laboratory or university shelves, but are transferred to the private sector to achieve the intended public benefit of the research and development. BCSE is concerned with the significant cuts that may be imposed on a range of energy sector investments.

In this year's economic and budget environment it is clear that Congress will be forced to make difficult choices in appropriating federal dollars. In light of this, the Business Council for Sustainable Energy offers some areas for consideration during the FY2014 budget cycle in order to maximize the value to American taxpayers and spur economic recovery.

The Council believes that continued funding for programs under the Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) is in the best interest of American taxpayers and supports a well-reasoned national energy strategy that improves our economic conditions at home and strengthens America's competitiveness in the global marketplace. The Council encourages Congress to maintain stable and consistent funding in the following areas:

- Congress should continue to support funding of energy efficiency, including better building technologies, building codes and standards, industrial technologies, vehicles, and advanced manufacturing, in order to drive economic growth, promote the competiveness of U.S. industries, and save consumers money. Congress should also strive to save taxpayers money by providing funding for the Federal Energy Management Program (FEMP) to improve efficiency in federal buildings.

- Congress should support net zero energy building research, development and deployment that optimizes and combines the best high-value energy efficiency and on-site renewable and distributed energy applications in order to lower costs, emissions, and water use, and to compensate for deteriorating electric grid reliability and power quality. Congress should also support smart grid software and hardware RD&D as well as modular, inter-operable renewable and distributed energy (and hybrid systems) for electric grid interface as well as to harden critical infrastructure.

- Unlocking the vast hydropower potential of our rivers, oceans, tides and conduits requires funding the research and development initiatives that make innovative ideas a reality. The Department of Energy's Water Power Program is an important source of support for the researchers, scientists and developers working to grow hydropower's contribution to our country's clean energy resources. Continued investment in this program across all technologies is crucial to ensuring that the nation is on a path to reduce carbon emissions.

- Maintaining a commitment to fund the SunShot Initiative is a necessity to meet its goal of making solar energy cost-competitive with other sources of electricity by 2020. The SunShot Initiative focuses on cost reductions in all parts of the value chain, from materials research and manufacturing processes to permitting times and installation best practices and has helped the industry have its best year ever in 201s while reducing the installed cost of solar by 20 percent.

- Continued investments in wind energy research and development are delivering value for taxpayers by fostering the development of a domestic energy source that strengthens our national security, provides rural economic development, spurs new high-tech jobs, and protects the environment. For these reasons we urge Congress to continue funding wind energy research and development through the DOE Wind Energy Program.

- Considering the growing use of natural gas in our energy economy the Department of Energy can play a substantial role in supporting research that will ensure natural gas is used, wisely, safely and efficiently. Therefore, the Council supports funding to be directed towards research and development for natural gas technology development and improvement.

- Fuel cell and hydrogen technologies produce jobs in domestic and export markets and promote energy independence and environmental stewardship. The Council encourages Congress to continue to support the fuel cell and hydrogen program managed by the Office of Energy Efficiency and Renewable Energy and the Office of Fossil Energy to build upon the substantial progress made by these programs in cost reduction; the Council also encourages Congress to fully provide funding for the successful public-private partnerships to continue the industry's transition to market. In particular, the Council supports funding technology validation for hydrogen fueling infrastructure and fuel cell electric vehicles, as well as market transformation for stationary and backup power, material handling, refrigerated trucks, auxiliary power units, and the associated hydrogen infrastructure.