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AMERICAN ENERGY SECURITY AND INNOVATION: AN ASSESSMENT OF NORTH AMERICA'S ENERGY RESOURCES

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY AND POWER

OF THE

COMMITTEE ON ENERGY AND COMMERCE
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRTEENTH CONGRESS

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AMERICAN ENERGY SECURITY AND INNOVATION: AN ASSESSMENT OF NORTH AMERICA'S ENERGY RESOURCES

TUESDAY, FEBRUARY 5, 2013

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON ENERGY AND POWER,
COMMITTEE ON ENERGY AND COMMERCE,
Washington, DC.

The subcommittee met, pursuant to call, at 10:08 a.m., in room 2322 of the Rayburn House Office Building, the Honorable Ed Whitfield (chairman of the subcommittee) presiding.

Members present: Representatives Whitfield, Scalise, Shimkus, Pitts, Terry, Burgess, Latta, Cassidy, Olson, McKinley, Gardner, Pompeo, Kinzinger, Griffith, Barton, Upton (ex officio), Rush, Tonko, Markey, Engel, Green, Capps, Doyle, Barrow, Matsui, Christensen, Castor, and Waxman (ex officio).

Staff present: Nick Abraham, Legislative Clerk; Gary Andres, Staff Director; Charlotte Baker, Press Secretary; Mike Bloomquist, General Counsel; Sean Bonyun, Communications Director; Matt Bravo, Professional Staff Member; Allison Busbee, Policy Coordinator, Energy and Power; Patrick Currier, Counsel, Energy and Power; Tom Hassenboehler, Chief Counsel, Energy and Power; Heidi King, Chief Economist; Ben Lieberman, Counsel, Energy and Power; Jason Knox, Counsel, Energy and Power; David McCarthy, Chief Counsel, Environment/Economy; Gib Mullan, Chief Counsel, Commerce, Manufacturing, and Trade; Mary Neumayr, Senior Energy Counsel; Andrew Powaleny, Deputy Press Secretary; Krista Rosenthall, Counsel to Chairman Emeritus; Chris Sarley, Policy Coordinator, Environment and Economy; Phil Barnett, Democratic Staff Director; Alison Cassady, Democratic Senior Professional Staff Member; Greg Dotson, Democratic Energy and Environment Staff Director; Kristina Friedman, EPA Detailee; Caitlin Haberman, Democratic Policy Analyst; and Alexandra Teitz, Democrat Senior Counsel, Energy and Environment.

OPENING STATEMENT OF HON. ED WHITFIELD, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF KENTUCKY

Mr. WHITFIELD. I would like to call this hearing to order this morning, and I certainly want to welcome our panel of witnesses and also I want to welcome all the members back on the subcommittee. I look forward to another 2 years with the ranking member, Mr. Rush. And also, we are really excited to have three new members on the Republican side joining our subcommittee for

the first time, Mr. Latta of Ohio and Mr. Cassidy of Louisiana and also Mr. Kinzinger of Illinois. We are delighted that they are on this subcommittee and look forward to working with them on important issues facing our Nation in the energy sector as well as all the members of the subcommittee, Democrat and Republican.

The title of today's hearing is "American Energy Security and Innovation," and we are going to focus on an assessment of North America's energy resources. I think all of us agree that we have many problems facing our country today but one of the primary ones that we have is a sluggish economy and we want to be sure that we take every action possible to stimulate the economy and create more jobs. Certainly, we are very much aware in the last quarter our GDP decreased by .1 percent. Our unemployment has ticked up from 7.8 to 7.9 percent, and so we all face this challenge of adopting policies and taking actions that can help stimulate the economy.

Certainly, one of the primary factors that affects the economy is energy policy, and certainly there are other factors as well but that plays a vital role. I was reminded as I read the testimony last night that it wasn't too many years ago when people throughout the country, experts and otherwise, were talking about the United States fossil fuels, for example, their resources were being depleted. We were running out of oil, we were running out of natural gas and we were going to have to be importing more. As a matter of fact, in January 2007, a CEO of one of our largest utility companies made the comment that we were running out of natural gas, production was declining and demand growing so he expected that imports would go from 3 percent of our national needs to 24 percent in 2020. And then of course, we know what has happened. We have had all sorts of new discoveries—the Bakken field, the Eagle Ford, developments in Colorado—and most of these shale fields have been discovered on private lands, and even though the number of permits on public lands has gone down, the production on private lands has increased dramatically.

So this is a real game changer, the possibility of a game changer in America. We have heard the term for many, many years, we have the opportunity to be energy independent, and that is actually the reality today, and I tell you what, people around the world are focused on it too because some of our witnesses today attended the World Economic Forum in Davos, and we know that many Europeans are expressing great concern about the abundance of energy that we have in America and their ability to compete in the global marketplace because their energy costs are going up in Europe and we have the opportunity to decrease our energy costs because of this abundance of fossil fuels that we have.

Now, we all recognize that we have renewable that can play a role as well, but I am not going to be an alarmist about the increased use of fossil fuel because our carbon dioxide emissions today are lower than they have been in America in 20 years, which shows that the marketplace can continue to play a vital role, our expertise in technology continues to improve and so in oil, in natural gas and in coal, we have abundant resources that can meet the needs of this country on the electricity side and the transportation side for years and years to come.

So we have a unique opportunity and the policies that we adopt at the government level will determine whether or not we are going to be successful in America, and some of the policies, there is a lot of disagreement on this committee about aggressive EPA should be. I was reading some court decisions over the last couple of weeks. There were a total of eight of them in which the court language was very strong in chastising EPA for being overly aggressive and exceeding their legal authority, and yet they have had good policies as well and America does not have to take a back seat to anyone, to any country for our enforcement of environmental laws. But our objective is, we want a balanced approach. We don't want to be an alarmist on climate change, for example, but we want to protect our environment and we want to fully explore the natural resources that we have which can go a long way toward stimulating our economy and creating jobs for Americans.

[The prepared statement of Mr. Whitfield follows:]

PREPARED STATEMENT OF HON. ED WHITFIELD

Today, we are going to kick off the subcommittee's activities, and we are going to do so with a hearing on what many of us consider to be the most significant energy story to emerge in a long time—the potential to truly be more energy secure as a nation. We have long known that we possess an abundance of coal, but the news on oil and natural gas has been a very pleasant surprise.

We have seen increases in domestic oil production since 2007 and natural gas production since 2006, according to the Energy Information Administration. And EIA predicts that these upward trends will continue for years to come.

At the same time, Canadian oil production is growing so fast that we will need the Keystone XL pipeline expansion project to bring the additional output to American refineries in the Midwest and Gulf Coast.

In fact, the news is so promising that some analysts are talking about the possibility of achieving North American energy independence by the end of the decade.

Of course, experts may disagree as to just how much energy potential is out there, but none would have claimed just a few years ago that our nation would reverse course and have the potential to become a true global energy supplier and powerhouse. A quantitative assessment of the resource base is the topic of today's hearing and what we will hear today shows how the impacts are profound and only beginning to be understood.

I might add that we are seeing a truly dramatic shift away from long-held beliefs about domestic oil and natural gas supplies. So much of our existing legislation is rooted in the assumption of domestic energy scarcity, not energy abundance. Needless to say, a wholesale rethinking of energy policy is in order, and today's hearing is the first step in that process.

This domestic energy wealth brings with it many issues that will need to be addressed by this subcommittee in the months and years ahead. After all, an abundance of energy alone means little without the right policies in place. Just look at the nation's abundance of coal, which in my view is being squandered thanks to a long and growing list of anti-coal regulations from the EPA.

As we will soon hear from one of our witnesses, Mary Hutzler of the Institute for Energy Research, America possesses nearly half of the entire world's coal reserves. This is enough coal to continue its use at current rates for 500 years. We should be making good use of this gift instead of strangling it in red tape.

We want policies that enable our resources to be utilized for the benefit the American people. If we do this right, we can lower energy prices, create jobs, and strengthen national security.

There will be issues related to access, issues related to infrastructure, and issues related to export, among other things that will need to be sorted out. But today, we will focus on the threshold question of how much potential is out there and how this knowledge can help shape the difficult, but remarkable choices we will have to make as a country on how best to use it all.

This includes ensuring a diverse mix of our resources: coal, oil, gas, and renewables, continue to power America. But these and other policy considerations will be the subject of future hearings. We are pleased to welcome the EIA and all of our witnesses today.

The good news is that a future of plentiful, affordable, and reliable supplies of North American energy is no longer just a dream. With today's effort to gain an accurate assessment of the resource base, we are taking the first step in what I hope will be a bipartisan initiative to help turn that dream into a reality.

# # #

Mr. WHITFIELD. With that, at this time I would like to recognize the gentleman from Illinois, Mr. Rush, for 5 minutes.

OPENING STATEMENT OF HON. BOBBY L. RUSH, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF ILLINOIS

Mr. RUSH. I certainly want to thank you, Mr. Chairman, and Mr. Chairman, I also want to join you in welcoming all the new members of the subcommittee and those who are returning, and I want to especially welcome the new members on the Democratic side, Mr. McNerney, Mr. Tom Cole, and Mr. Barrow; Ms. Matsui and Ms. Christensen to this subcommittee.

Mr. Chairman, I want to thank you for holding today's hearing assessing North America's energy resources. As we begin the subcommittee's work for the 113th Congress, I would submit that it is critical for us as policymakers to understand the changing landscape of our Nation's energy supplies, not only as we move away from policies guided by scarcity but also so that we can develop a comprehensive energy plan for moving this Nation forward.

This subcommittee needs to get down to the serious business of enacting an energy blueprint that will move this country towards a truly all-of-the-above strategy that will follow four basic principles: one, to provide safe, reliable and affordable energy to all Americans; two, to provide additional jobs and economic opportunities to all segments of our population; three, a plan that will address the dire consequences of climate change that scientists have been warning us about for years now and which we have been seeing more and more firsthand evidence of across this Nation; and fourth, to set a path that would help us become self-sufficient and energy independent over the next few decades.

Mr. Chairman, today we will hear from our expert witnesses that domestic crude oil production has increased significantly over the past few years with the EIA reporting that U.S. crude oil production has increased from 5.1 million barrels per day in 2007 to 6.4 million barrels per day in 2012, the highest level since 1997. The EIA reports that in 2005, the United States imported 60 percent of the petroleum it consumed, and by 2012, that number had dropped to about 41 percent, the lowest level in decades. This decline can be attributed primarily to increased domestic oil production, the additional use of biofuels as well as the adoption of higher fuel efficiency standards for vehicles. The EIA also projects that the United States will reduce its reliance on imported oil to less than 30 percent of consumption by 2035, and U.S. natural gas production will increase by 44 percent by 2040 due primarily to the projected growth in shale gas production.

However, Mr. Chairman, in order to reach all the necessary objectives of providing reliable energy, creating new jobs, addressing climate change and also becoming energy independent, it is imperative for this subcommittee to also promote and to encourage re-

newable energy resources. The NREL estimates that we could supply 80 percent of total U.S. electricity generation from renewable energy generation through technologies that are commercially available by the year 2005.

Mr. Chairman, I welcome today's hearing, and we move legislatively, I will urge this subcommittee to promote a truly all-of-the-above energy policy that includes renewables and clean energy sources as well as traditional carbon-intensive fossil fuels before the time is too late, Mr. Chairman, too late to act.

I thank you, and I really look forward to hearing from today's witnesses and I yield back the balance of my time.

Mr. WHITFIELD. Thank you, Mr. Rush. We appreciate that opening statement.

At this time I recognize the chairman of the full committee, the gentleman from Michigan, Mr. Upton, for 5 minutes.

OPENING STATEMENT OF HON. FRED UPTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MICHIGAN

Mr. UPTON. Well, thank you, Mr. Chairman.

Certainly, this hearing is a welcome one to examine the positive developments resulting from advancements in innovation and technology, the game-changing potential for North American energy independence. What was once believed to be unthinkable is certainly now within our grasp.

For 3 decades, 30 years, the American people have been told that we are a Nation of declining resources at the mercy of OPEC. The story was nearly as gloomy with natural gas with forecasts of dwindling domestic supplies, higher prices, and rising imports from the Middle East. In fact, in this committee, many may remember when we crafted a new title in the Energy Policy Act of 2005 to facilitate what we thought would be the new norm: pending reliance on imported gas from geopolitically unstable regions of the world, to add to our growing reliance on OPEC oil. What a bad thing.

But thanks to American ingenuity and advanced technologies, the trends in domestic oil and natural gas production have in fact been turned upside down. In fact, the United States is now the world's leading producer of natural gas, and the IEA is predicting that by 2020, U.S. oil production will exceed Saudi Arabia. 2020, let me repeat that, we are going to exceed the production in Saudi Arabia.

Our overall energy landscape has changed dramatically in just a short period of time, and it is not only rewriting the economic outlook that we have as a Nation, but also beginning to change the geopolitical nature of global energy economics.

Today, this subcommittee is launching a series of hearings on energy security and innovation to hear from experts who are working with the current realities. It is up to us to ensure that our federal laws are not continuing to introduce roadblock after roadblock to enhanced energy security. We have got to remain steadfast in our support for efforts to improve the infrastructure necessary to maximize use of these resources, including the Keystone XL pipeline. These issues are too important for our Nation to be looked at in a vacuum, and if we don't take advantage of our energy abundance,

other nations are eagerly waiting to step in and use North American energy to fuel their own growth.

The benefits of our emerging energy abundance are many, boosting our economy and creating jobs across the nation, a bright spot in the economic downturn. We have got to build upon that progress. Once we have a more accurate sense of North America's energy potential, we can start the process of ensuring we have the proper vision for the future.

I yield the balance of my time to—anybody? Mr. Barton.

[The prepared statement of Mr. Upton follows:]

PREPARED STATEMENT OF HON. FRED UPTON

Today's hearing is a welcome one to examine the positive developments resulting from advancements in innovation and technology—the game changing potential for North American energy independence. What was once believed to be unthinkable is now within our grasp.

For over 3 decades, the American people have been told that we are a nation of declining resources at the mercy of OPEC. The story was nearly as gloomy with natural gas—with forecasts of dwindling domestic supplies, higher prices, and rising imports from the Middle East. In fact, in this committee, many may remember when we crafted a title in the Energy Policy Act of 2005 to facilitate what we thought would be the new norm: Pending reliance on imported gas from geopolitically unstable regions of the world, to add to our growing reliance on OPEC oil.

But thanks to American ingenuity and advanced technologies, the trends in domestic oil and natural gas production have been turned upside down. In fact, the U.S. is now the world's leading producer of natural gas and the IEA is predicting that by 2020, U.S. oil production will exceed Saudi Arabia's. Let me repeat that—by 2020, U.S. oil production will exceed Saudi Arabia. A remarkable turn of events.

Our overall energy landscape has changed dramatically in just a short period of time, and it is not only rewriting the economic outlook that we have as a nation, but also beginning to change the geopoliticalnature of global energy economics.

Today, this subcommittee is launching a series of hearings on American Energy Security and Innovation to hear from experts who are working with the current realities of this energy transformation. It is up to us to ensure that our federal laws are not continuing to introduce roadblock after roadblock to enhanced energy security.

We must remain steadfast in our support for efforts to improve the infrastructure necessary to maximize use of these resources, including the Keystone XL pipeline. These issues are too important for our nationto be looked at in a vacuum, and if we don't take advantage of our energy abundance, other nations are eagerly waiting to step in and use North American energy to fuel their own growth.

The benefits of our emerging energy abundance are many, boosting our economy and creating jobs in Michigan and across the nation, a bright spot in the economic downturn. We must build upon our progress.

Once we have a more accurate sense of North America's energy potential, we can start the process of ensuring we have the proper vision for the future. I welcome our esteemed panel of experts here today, including Dr. Daniel Yergin. The domestic energy boom is good news—but only if we are wise enough to let it happen.

# # #

OPENING STATEMENT OF HON. JOE BARTON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF TEXAS

Mr. BARTON. Well, thank you, Mr. Chairman.

I want the record to show that I have my iPad and I am trying to do this electronically, so I am at least trying.

I want to welcome our witnesses. I see former Congressman Martin Frost out in the audience. He knows a little bit about energy. We are glad to have you here, Martin.

Today is an important hearing, Mr. Chairman. I represent a Congressional district in Texas that at one time had it been a nation would have been the fifth largest oil-producing nation in the world. The first oil field west of the Mississippi was discovered in my Congressional district at Corsicana in 1895. As we speak today, in the Barnett shale, which is not totally in my Congressional district, there are over 16,000 producing natural gas wells, and last year they produced in the neighborhood of 2 trillion cubic feet of natural gas in that one field.

With the miracle of hydraulic fracturing, we have unleashed a drilling and production revolution in this country, not only in natural gas but now that technology is being used in oil, and the State of North Dakota, which less than 10 years ago had probably fewer than 200 or 300 oil wells, is on track in that one State to produce over a million barrels of oil in the very near future, possibly this year. We can be energy independent if we want to. It is not a question of can we. It is a question of, is it in our economic and political self-interest to do so.

So today's hearing is an important hearing for the American people to see the energy abundance that our Lord blessed us with and the policymakers in this room and in this city can decide what we want to do with it.

With that, Mr. Chairman, I yield back to you or any other person.

Mr. WHITFIELD. Thank you, Mr. Chairman.

At this time I would like to recognize the ranking member of the full committee, Mr. Waxman of California, for 5 minutes.

OPENING STATEMENT OF HON. HENRY A. WAXMAN, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. WAXMAN. Thank you, Mr. Chairman. I appreciate that we are holding this hearing on North America's energy resources. We are going to hear testimony about fossil and renewable energy supplies in the United States, Canada and Mexico.

We are dramatically improving the efficiency of our use of oil, so we are using less of it. At the same time, we are producing more domestic oil, which means we are importing less oil from dangerous parts of the world.

We are unlocking new reserves of natural gas, which is helping to limit the use of polluting coal, and to increase the competitiveness of our domestic industries. We have doubled our capacity to generate renewable electricity from wind and solar in just 4 years, which has cut our pollution and invigorated clean energy manufacturing.

These are all positive developments. The question we must ask is whether we are on a sustainable course for the years to come.

In his inaugural address, President Obama said that we must transition to a sustainable energy future. He said we must respond to climate change, because to do otherwise would "betray our children and future generations."

As we debate our energy future, this committee has a choice. It is an energy choice and a climate policy choice, and ultimately it is a moral choice.

The biggest energy challenge we face as a country is carbon pollution. We can't have a conversation about America's energy policy without also having a conversation about climate change. We have a rapidly diminishing window of time to act to reduce our carbon pollution before the catastrophic impacts of climate change are irreversible.

In November, the International Energy Agency published its World Energy Outlook. IEA concluded that our current global energy system is "unsustainable." The International Energy Agency found that "the climate goal of limiting warming to 2 degrees Celsius is becoming more difficult and more costly with each year that passes." The International Energy Agency also concluded that if the world does not take action to reduce carbon pollution before 2017, then "all the allowable CO_2 emissions would be locked in by energy infrastructure existing at that time.

That means that the energy policy decisions we make today will have a real and direct impact on whether we can limit climate change in the future. Every decision to build a new fossil fuel-fired power plant, or construct a pipeline to transport tar sands, or drill for more oil off our Nation's coasts has climate risks. We need to understand and weigh those risks before we lock in infrastructure that will produce carbon pollution for decades to come.

There is an appeal to the energy resources we are discovering. We are stronger when we produce oil in the United States than when we import it from Saudi Arabia. We are better off when we produce our own natural gas than when we import LNG.

But we also must recognize that the world has far more proven reserves of oil, gas and coal than we can ever safely use. The atmosphere has a rapidly shrinking capacity to safely absorb carbon. In fact, if we want to have a reasonable chance of limiting average global warming to 2 degrees Centigrade, or 3.6 degrees Fahrenheit, there is an estimated five times more carbon in proven fossil fuel reserves than we can release into the atmosphere. If we burn all the known reserves of fossil fuel without new technologies to sequester the carbon, the damage to the planet would be immense.

The future will belong to the country that leads the inevitable transition to the clean energy economy of tomorrow. It is our responsibility to figure out how we make sure our Nation is in the forefront of this change.

Mr. Chairman, this is a new Congress. I want to begin it by offering to work with you as we grapple with these incredibly serious challenges. I look forward to this hearing and future hearings on this subject and to our cooperation to deal with these problems in a bipartisan and a balanced way.

Thank you. I yield back the time.

Mr. WHITFIELD. Thank you, Mr. Waxman. We appreciate your opening statement.

I also want to welcome Joe Pitts of Pennsylvania, who is a new member of this subcommittee. As many of you know, he is the chairman of the Health Subcommittee, and we are delighted to have him on the Energy and Power Subcommittee as well. We do have a new vice chairman also, Steve Scalise, who was here but I think stepped out for just a moment.

Right now I would like to get our witnesses. We are thrilled with the panel that we have today. Each one of them are real experts in various fields of energy and we genuinely appreciate your testimony that you have prepared and that you are about to give, and I know that everyone will have questions for you, and at this time I would like to introduce our panel of witnesses. First we have Adam Sieminski, who has been here a number of times. He is the Administrator for the United States Energy Information Administration, and we welcome you. Dr. Daniel Yergin is Vice Chairman of IHS, and many of you know Mr. Yergin also because he wrote a book called The Prize, which won the Pulitzer Prize, so we are delighted that he is here. We have Jennifer Morgan, who is the Director of the Climate and Energy Program at the World Resources Institute, and we look forward to your testimony, Ms. Morgan. We have Mary Hutzler, who is a Distinguished Senior Fellow at the Institute for Energy Research. I read her testimony as well, and she has some great things to tell us today. And then we have Mr. Harry Vidas, who is Vice President for ICF International, and we appreciate your thoughtful testimony as well, Mr. Vidas.

So each one of you will be given 5 minutes for your opening statement, and there are a couple of little boxes with lights, and when it is green that means go, and when it is red, it means stop, but we will give you some leeway because we do respect your being here and appreciate your expertise.

So Mr. Sieminski, I will recognize you for 5 minutes for your opening statement.

STATEMENTS OF HON. ADAM SIEMINSKI, ADMINISTRATOR, U.S. ENERGY INFORMATION ADMINISTRATION; DANIEL YERGIN, VICE CHAIRMAN, IHS; JENNIFER MORGAN, DIRECTOR, CLIMATE AND ENERGY PROGRAM, WORLD RESOURCES INSTITUTE; MARY J. HUTZLER, DISTINGUISHED SENIOR FELLOW, INSTITUTE FOR ENERGY RESEARCH; AND E. HARRY VIDAS, VICE PRESIDENT, ICF INTERNATIONAL

STATEMENT OF ADAM SIEMINSKI

Mr. SIEMINSKI. Thank you, Mr. Chairman and members of the subcommittee. I appreciate the opportunity to appear before you today to discuss American energy security and innovation. EIA is the statistical and analytical agency within the U.S. Department of Energy. By law, its data, analyses and forecast are independent of approval by any officer or employee of the U.S. government.

My statement today summarizes recent trends in production and draws on EIA's January short-term energy outlook, and also, I am going to talk about resource estimates for oil, gas, coal and renewables for the United States.

As I discuss the different sectors, though, it is useful to keep in mind that the methodologies for developing reserve and resource estimates differ across the fuels. EIA estimates that U.S. total crude oil production averaged 6.4 million barrels a day in 2012, an increase of .8 million barrels a day. This is the largest annual increase since Colonel Drake drilled the first commercial crude oil well up in Titusville, Pennsylvania back in 1859. This growth is driven largely by tight oil production—that is in figure one of my

written statement. Drilling in tight oil plays in North Dakota, Montana, and Texas are expected to account for the bulk of the forecast production growth over the next 2 years. U.S. crude oil production could reach 8 million barrels a day in 2014, and with some very strong assumptions about how drilling could proceed and other factors, could get as high as 10 million barrels a day but that is not currently in our reference case.

U.S. dry natural gas production has increased consistently since 2005, mainly because of the production of shale gas resources. Total marketed production averaged about 69 billion cubic feet in 2012, and EIA expects production will remain close to that level this year and next year.

Crude oil and natural gas proved reserve additions in 2010 were the highest recorded since EIA began publishing those numbers in 1977. Crude oil proved reserves increased by 12.8 percent, almost 3 billion barrels, during 2010 to end the year at over 25 billion barrels. U.S. proved reserves of wet natural gas increased by almost 12 percent, or 34 trillion cubic feet, during 2010, ending that year at well over 300 trillion cubic feet.

Next, I want to speak to the issue of oil and natural gas resources. Estimates of technically recoverable resources, while inherently uncertain, are a common measure of the long-term viability of U.S. domestic production. U.S. crude oil and lease condensate resources in non-prohibited areas are estimated at 223 billion barrels in the Annual Energy Outlook that we just published in December up from EIA's estimate of 140 billion barrels back in the year 2000. That is despite cumulative production since the year 2000 of over 26 billion barrels of oil. U.S. total dry natural gas resources, 2,327 trillion cubic feet in the AEO2013 are up from our 2000 estimate of nearly 1,600, maybe I should say only 1,600 trillion cubic feet, despite cumulative production between those years of 260 trillion cubic feet. The shale gas resource in the AEO2013 is about 13 percent higher than what we estimated in 2012.

Moving on to coal, domestic production decreased by 12 percent by over 1,000 million short tons between 2008 and 2012, half of this decline between 2011 and 2012, as electric utilities and the industrial sector cut back their purchases. EIA estimates that coal consumption in electric power in 2012 will total 829 million short tons, the lowest since 1992, due largely to competition from low natural gas prices. Coal exports in 2012 partially offset that decline in consumption.

The largest category of coal resources, the demonstrated reserve base, represents coal in the ground, this resource base was originally estimated back in 1974 by the Bureau of Mines as part of the last comprehensive assessment. On January 1, 2012, the resource base was estimated to contain 483 billion short tons. That is a huge amount. Limited resources at EIA have prevented us from doing a full national reassessment but we have updated some of the regions.

Finally, I would like to highlight developments in renewable resources. EIA estimates that production of renewables, most renewables, grew significantly in 2012, especially wind and solar. Hydropower production fell because of the drought. Even so, the overall growth in renewable energy consumption from 2010 to 2012 was

over 10 percent. Drought in the Midwest caused fuel ethanol production to fall by about 80,000 barrels a day in the second half of 2012. We expect that production will pick back up again as the drought recedes and we will get back to pre-drought levels of about 870,000 barrels a day of ethanol production. Biodiesel production averaged a billion gallons in 2012 and it is expected to meet the RFS requirements of 1.28 billion gallons that have been set for 2013.

That concludes my testimony. Thank you again, Mr. Chairman, for the opportunity to be here.

[The prepared statement of Mr. Sieminski follows:]

Summary of Statement of Adam Sieminski, Administrator, EIA,

February 5, 2013

EIA estimates that 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 driven largely by growth in tight oil production. Crude oil production is expected to increase to 7.9 million bbl/d EIA 2014 led by drilling in tight oil plays in North Dakota, Montana, and Texas.

In 2012, U.S. natural gas production increased, primarily due to shale gas, to an average of 69.2 billion cubic feet per day . EIA expects U.S. natural gas production to remain close to its 2012 level in both 2013 and 2014.

EIA's most recent published crude oil and natural gas reserves report, as of year-end 2010, showed the highest year on year recorded increase since EIA began publishing proved reserves estimates in 1977.

In its FY2013 budget, EIA has proposed to increase the timeliness and accuracy of both oil and natural gas production data by expanding the current natural gas collection to more states and adding collection of oil production.

Between 2008 and 2012, domestic coal production decreased by 12 percent to 1,027 million short tons; over half of this decline occurred between 2011 and 2012. Lower natural gas prices led to a significant increase in the share of natural gas-fired power generation in 2012. Record coal exports partially offset declines in consumption in the power sector.

The demonstrated reserve base (DRB), which represents coal reserves in the ground that have been identified to specified levels of accuracy and are in thickness ranges and at depths that are considered minable is estimated **to contain 483 billion short tons. As of January 1, 2012,** recoverable reserves at producing mines, which are reported to EIA annually by mine operators, stood at 19 billion short tons.

In 2012, EIA expects the consumption of most renewable energy forms including wind, solar, and biofuels to have grown, wind by 17 percent and solar by 32 percent. EIA expects hydropower production will have fallen nearly 14 percent from the unusually high levels seen in 2011. Renewable energy consumption grew 10.3 percent from 2010 to 2012. In October of 2012, electricity generation from non-hydro renewables surpassed conventional hydroelectricity generation for the first time.

EIA expects ethanol production will remain near current levels through mid-2013 before recovering to pre-drought production levels in 2014.

STATEMENT OF ADAM SIEMINSKI

ADMINISTRATOR

ENERGY INFORMATION ADMINISTRATION

U.S. DEPARTMENT OF ENERGY

before the

SUBCOMMITTEE ON ENERGY AND POWER COMMITTEE ON ENERGY AND COMMERCE

U. S. HOUSE OF REPRESENTATIVES

FEBRUARY 5, 2013

Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to appear before you today at this hearing on American Energy Security and Innovation: An Assessment of North America's Energy Resources.

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 herein should therefore not be construed as representing those of the Department of Energy or any other Federal agency.

EIA provides a wide range of information and data products covering energy production, stocks, demand, imports, exports, and prices; and prepares analyses and special reports on topics of current interest. 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.

While my testimony will be focusing primarily on the most recent production and resource information and the short term energy outlook, I would like to briefly point to some key results from the Annual Energy Outlook 2013 (AEO2013). The Reference case discussed in this testimony was released in December and is intended to represent an energy future through 2040 based on given market, technological, and demographic trends; current laws and regulations; and consumer behavior. EIA recognizes that projections of energy markets are highly uncertain and subject to geopolitical disruptions, technological breakthroughs, and other unforeseeable events. In addition, long-term trends in technology development, demographics, economic growth, and energy resources may evolve along a

different path than represented in the projections. The complete AEO2013, which EIA will release this spring, will include a number of alternative cases intended to examine these uncertainties as well as changes in law since the reference case was released.

In the AEO2013, the application of technology innovation has a notable effect on the productivity and development cost of certain areas across the energy resource base. Domestic production of crude oil, particularly from shale and other tight formations, increases sharply. Cumulative production of dry natural gas from 2011 through 2035 in the AEO2013 Reference case is about 8 percent higher than in AEO2012, primarily reflecting continued increases in shale gas production that result from the dual application of horizontal drilling and hydraulic fracturing. The share of electricity 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 grows as 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. Domestic coal production increases at an average rate of only 0.2 percent per year, from 22.2 quadrillion British thermal units (Btu) (1,096 million short tons) in 2011 to 23.5 quadrillion Btu (1,167 million short tons) in 2040. Before I discuss the different resource sectors, I would like to clarify that the methodologies for developing reserve and resource estimates differ across fuels. For example, "estimated recoverable reserves" for coal reflect a different concept than "proved reserves" for oil and natural gas. The EIA and the USGS both have a role with regard to oil, natural gas and coal. The renewable assessments are developed by the National Renewable Energy Laboratory. The data and forecasts in the rest of my testimony are largely from EIA's most January Short Term Energy Outlook (STEO) which does not reflect the impact of the recent extension of various energy tax incentives.

TRENDS IN U.S. CRUDE OIL AND NATURAL GAS PRODUCTION

Crude Oil. EIA estimates that U.S. total crude oil production (which includes lease condensates) averaged 6.4 million barrels per day (bbl/d) in 2012, an increase of 0.8 million bbl/d from the previous year driven largely by growth in tight oil production (Figures 1 and 2). This increase in U.S. annual production is the largest since Colonel Drake drilled the first crude oil well in Pennsylvania in 1859. EIA forecasts that another record increase in production will occur this year, with domestic crude oil production expected to increase to 7.3 million bbl/d in 2013. The 7.9 million bbl/d EIA currently forecasts for 2014 would mark the highest annual average level of production since 1988. Central to this projected growth will be ongoing development activity in key onshore basins. Drilling in tight oil plays in the Williston Basin's Bakken formation in North Dakota and Montana, the Western Gulf Basin's Eagle Ford formation, and the Permian Basin in Texas is expected to account for the bulk of forecast production growth over the next two years.

Natural Gas. U.S. dry natural gas production has increased since 2005 mainly because of production of shale gas resources (Figure 3). That upward growth trend has been a little bumpy reflecting economic factors affecting natural gas prices and weather events. Declining production from less-profitable "dry" natural gas plays such as the Haynesville Shale has been offset by growth in production from liquids-rich natural gas production areas such as the Eagle Ford and wet areas of the Marcellus Shale as well as associated gas from the growth in domestic oil production. Total marketed production averaged 69.2 Bcf/d in 2012. EIA expects overall U.S. natural gas production to remain close to its 2012 level in both 2013 and 2014.

CRUDE OIL AND NATURAL GAS PROVED RESERVES

EIA's most recent published crude oil and natural gas reserves report is as of year-end 2010. For each fuel, net additions to proved reserves, which reflect the volume of reserves added during 2010 after subtracting the year's production, were – by a large margin – the highest ever recorded since EIA began publishing proved reserves estimates in 1977. I testified before this Subcommittee in some detail last August right after the report was released, but given the dramatic change in the U.S. crude oil and natural gas reserve profile, I am repeating some of that information here for new members of the Subcommittee. EIA is catching up on the reserves reporting following the 2011 budget cuts that delayed the program. The year end 2011 proved reserves will be published in the coming months.

Proved reserves are estimates of hydrocarbons that geologic and engineering data demonstrate with reasonable certainty can be recoverable from identified fields under existing economic and operating conditions. The data and estimates we develop and disseminate reflect a combination of survey data collected directly from operators and information provided by other Federal agencies and the states.

Crude oil (includes lease condensate) proved reserves increased by 2.9 billion barrels (12.8 percent) during 2010, ending that year at 25.2 billion barrels (Figure 4). Texas, North Dakota, and the Gulf of Mexico Federal Offshore had the largest increases in oil proved reserves in 2010 (Figure 5). An increase in the oil price boosted oil reserves in states with large producing oil fields.

U.S. proved reserves of wet natural gas increased by 33.8 trillion cubic feet (Tcf) (11.9 percent) during 2010, ending that year at 317.6 Tcf (Figure 6). Texas, Louisiana, and Pennsylvania had the largest increases (Figure 7).

CRUDE OIL AND NATURAL GAS RESOURCES

Next, I want to speak to the issue of resources. Technically recoverable resources, also known as TRR, are an estimate of hydrocarbons that are producible using currently available technologies and industry practices from both discovered resources and estimated potential resources without regard to economic considerations. Estimates of technically recoverable resources, while inherently uncertain, are a common measure of the long-term viability of U.S. domestic oil and natural gas as an energy source and are an important input to EIA's energy projections. TRR estimates are a "work in progress," changing as more production experience becomes available and as new production technologies are applied to these resources.

EIA's energy supply projections address the timing of economic production of oil and natural gas resources, which depend upon the production profile of individual wells over time, the cost of drilling and operating those wells, and the revenues generated by those wells based on projected oil and natural gas prices. For these reasons EIA is primarily concerned with determining well drilling and operating costs, production decline curves, and other economic parameters, such as tax, depreciation, and royalty rates. Although TRR estimates provide a context for the size of the potentially available resource, this aggregate number says nothing about whether a large or small portion of the resource will be economic to produce in the foreseeable future.

The EIA relies heavily on the expertise of the United States Geologic Survey (USGS) to develop many of the resource production characteristics and parameters that generate TRR estimates. The USGS estimates of TRR represent a snapshot of resource recoverability based on the wells drilled and technologies deployed prior to the assessment. The USGS re-estimates a formation's TRR, typically updating its estimates every 5 to 10 years, whereas EIA re-estimates initial production rates and production decline curves, and in turn, estimated ultimate recovery (EUR) per well and TRR for every

Annual Energy Outlook. In EIA's annual re-estimation process, EIA emphasizes current well productivity data, which inherently incorporates the latest technology. EIA also develops estimates for those formations that have recently gone into production, but for which the USGS has not yet developed a resource estimate.

Although each TRR parameter has some degree of uncertainty associated with it, the greatest uncertainty is associated with the determination of a formation's average initial production rate and production decline curve, which specifies a well's estimated ultimate recovery (EUR).

EIA will continue to solicit input from geologists, petroleum engineers, statisticians, and other experts to improve the methodology for developing estimates of TRR and to determine specific key assumptions. The ultimate goal is to establish a TRR methodology that is practical, reasonable, defendable, and uses the best available production data. Even so, EIA recognizes that even the best methodology and data will still result in highly uncertain TRRs that will change over time as more information becomes available and as management practices and technology evolve.

DATA COLLECTION FOR CRUDE OIL AND NATURAL GAS PRODUCTION

Finally, I want to raise an issue of importance to this subcommittee which has jurisdiction over EIA. As just discussed, the quality and timeliness of the data has become more important. EIA estimates for non-Federal oil production are based on monthly oil production data from state Government agencies and purchased third party data. Many of the states collect production data largely for revenue purposes, though some data are collected in order to regulate crude oil and natural gas production. Different data are collected by each state, and definitions vary from state to state on the most basic of questions and the lag from production to final reporting varies enormously. EIA currently collects monthly data on natural gas production from about 230 to 240 operators in five key states: Texas,

Louisiana, Oklahoma, New Mexico, and Wyoming. EIA started direct collection of this data in 2005, because of the growing importance of timely and accurate monthly natural gas production data. Though more accurate than the oil production estimates, the current natural gas monthly production survey does not collect data for Federal lands or data on natural gas shale production, and it has not been expanded to identify and track major changes in natural gas production, such as the rise in shale gas production in Pennsylvania and Arkansas.

In its FY2013 budget, EIA has proposed spending an additional $550,000 per year to increase the timeliness and accuracy of both oil and natural gas production data. Additional funds would allow EIA to expand the natural gas collection to 15 producing states and to add collection of oil production. (For the federal offshore EIA would continue to cooperate closely with the Department of the Interior.) The proposal would improve data quality as well as enable EIA to identify and report on trends sooner.

COAL PRODUCTION, MARKETS AND RESOURCES

After reaching 1,172 million short tons in 2008, domestic coal production decreased by 12 percent to 1,027 million short tons by 2012; over half of this decline occurred between 2011 and 2012. In 2012, coal production decreased in the two top producing regions, Central Appalachia and the Powder River Basin (PRB), by 16 percent and 9 percent respectively. In contrast, 2012 coal production volumes in the Illinois Basin rose above its five-year range, up 9 percent from 2011. Illinois Basin coal has become more competitive as additional coal-fired power plants have installed scrubbers capable of reducing sulfur emissions by 90 percent or more. The increasing costs of mining Central Appalachian coal and the location advantages relative to PRB coal have had a positive impact as well. Regional coal production patterns from 2007 are illustrated in Figure 8.

The decline in domestic production corresponds to a significant reduction in coal consumption by electric utilities. EIA estimates coal consumption in the electric power sector will total 829 million short tons in 2012, the lowest since 1992, and 21percent lower than in 2007. Domestic coal use outside of the electric power sector is estimated at 65 million short tons in 2012, also a 21 percent decline since 2007.

Coal's general competitiveness has also been affected by a steady increase in the delivered cost of coal over time, reaching a national average of $2.40 per million Btu in 2012. A key driver of delivered coal prices is the rail transportation cost. More than 70 percent of coal shipments to power plants are by rail. These costs increased by approximately 50 percent from 2001 to 2010 and account for approximately 40percent of the total delivered coal price on average. However, delivered price increases are moderating in response to the reduction in demand since 2008 affecting both transportation and commodity prices.

Lower natural gas prices led to a significant increase in the share of natural gas-fired power generation in 2012. Wholesale (spot) coal prices across all basins fell during the first half of 2012 before stabilizing in the latter half of the year. Competition between natural gas and coal for electric power generation drove price declines in the Appalachian and Powder River Basins (PRB), two key sources for thermal coal, through the summer. Also, mild temperatures in the winter and high stockpiles at electric power plants limited demand for more purchases of coal in the second half of 2012. Spot prices represent a fraction of coal sales to power plants but do influence the setting of longer-term coal contracts, gradually affecting the delivered price of coal as coal supply contracts are renegotiated.

Record coal exports and slowing coal imports led to a 20 million short ton increase in net exports, partially offsetting declines in consumption in the power sector. Export volumes are volatile from year to year and depend on world coal market conditions which favored increasing coal exports over the past

few years. While the majority of U.S. exports are metallurgical coal, growing steam coal demand for power generation is also fueling 2012 exports to an all-time high.

U.S. coal exports are largely concentrated in a few facilities, with the leading seven ports accounting for 93 percent of U.S. exports. Despite growing demand in Asia, the United States exports more coal to Europe (55 percent) than it sends to the rest of the world combined. About 82 percent of U.S. coal exports were shipped to Europe and Asia in the first eleven months of 2012. U.S. coal exports to Europe are primarily serviced out of the East Coast via Norfolk, Virginia (the largest coal export facility in the United States) and Baltimore, Maryland (the third largest). Exports to Asia originate mostly from the East Coast as well, primarily out of Baltimore. Among the top export facilities, only New Orleans and Seattle primarily export steam coal. Figure 9 shows the distribution of export shipments by region of the world and the U.S. port of origin. (These changes in coal production and markets have been reported in *Today in Energy*, a relatively new EIA series of short analytical pieces posted daily on the EIA website.)

There are three types of coal resource and reserves data at EIA: the demonstrated reserve base, estimated recoverable reserves, and recoverable reserves at producing mines.

Demonstrated Reserve Base. The largest category of reserves is the demonstrated reserve base (DRB), which represents coal reserves in the ground that have been identified to specified levels of accuracy and are in thickness ranges and at depths that are considered minable. As of January 1, 2012, the demonstrated reserve base was estimated to contain 483 billion short tons. The DRB was originally estimated in 1974 by the U.S. Bureau of Mines as part of the last comprehensive assessment of U.S. coal resources and reserves. Because of higher priority needs, EIA has not completed a full national reassessment of the DRB, although it has made several new regional assessments over the years.

Estimated Recoverable Reserves. The actual proportion of coal reserves that can be produced from undisturbed deposits varies from less than 40 percent in some underground mines to more than 90 percent at some surface mines. Because of property rights, land use conflicts, and physical and environmental restrictions, EIA has estimated that only about 50 percent of the DRB may be available or accessible for mining. Thus, EIA estimated that the remaining U.S. estimate recoverable reserves totaled 259 billion short tons.

Recoverable Reserves at Producing Mines. The smallest category of reserves is recoverable reserves at producing mines, which are reported to EIA annually by mine operators. These reserves essentially reflect the working inventory at producing mines. As of January 1, 2012, they were estimated at 19 billion short tons.

TRENDS IN RENEWABLE RESOURCE USE IN ELECTRICITY AND LIQUID FUELS

In 2012, the consumption of most renewable energy forms including wind, solar, and biofuels are projected by EIA to have grown. EIA expects hydropower production will have fallen 13.7 percent from the unusually high levels seen in 2011, leading to an overall decline of 2.5percent in renewable energy consumption. Even so, the overall growth in renewable energy consumption from 2010 to 2012 was 10.3percent. In October of 2012, electricity generation from *Other Renewables* (wood, black liquor, other wood waste, biogenic municipal solid waste, landfill gas, sludge waste, agriculture byproducts, other biomass, geothermal, solar thermal, photovoltaic energy, and wind) surpassed conventional hydroelectricity generation (Figure 10) for the first time.
EIA projects that wind-powered generation grew by 17 percent in 2012. According to a recent analysis by the National Renewable Energy Laboratory (NREL), the estimated annual domestic resource potential for wind (onshore as well as offshore) is 49,700 TWh. Onshore wind accounts for 32,700 TWh of the estimated resource potential, and is present in nearly every state, being largest in the western and

central Great Plains and lowest in the southeastern United States. Technical estimated potential for offshore wind power is 17,000 TWh, and is present in significant quantities in all offshore regions of the United States.

Solar energy continues robust growth and is projected to grow by 32 percent in 2012. According to NREL, the estimated annual resource potential is 399,700 TWh, with the largest potential coming from rural utility scale PV (280,600 TWh). Concentrating solar power technologies also comprise a substantial segment of the total solar resource potential with an estimated annual potential of 116,100 TWh.

Enhanced geothermal systems (EGS) have an estimated annual domestic resource potential of 31,300 TWh. The vast majority of the geothermal potential for EGS within the contiguous United States is located in the westernmost portion of the country. The Rocky Mountain states, and the Great Basin particularly, contain the most favorable resource (17,400 TWh).

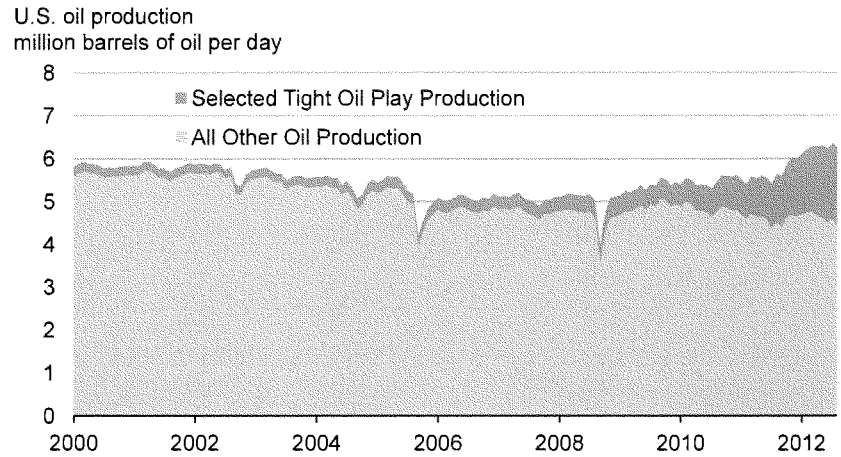
Because of drought conditions depressing corn harvests throughout the Midwest, fuel ethanol production fell from an average of 900,000 bbl/d during the first half of 2012 to an average of 820,000 bbl/d in the second half of the year. EIA expects ethanol production will remain near current levels through mid-2013 before recovering to pre-drought production levels, averaging 870,000 bbl/d (13.3 billion gallons) for the year. Ethanol production is expected to rebound in 2014 as previously idled capacity comes back on line. Biodiesel production averaged about 65,000 bbl/d (1.00 billion gallons) in 2012. Forecast biodiesel production averages 74,000 bbl/d in 2013 and 2014, with biodiesel blending meeting the RFS requirement of 1.28 billion gallons set for 2013.

Finally, EIA has developed a new interactive energy mapping feature incorporating the various resource ranges and GIS data on energy infrastructure. The maps allow the user to select the layers to show resources and infrastructure at the national, state, or county level. We will soon add Congressional

districts. Figure 11 A-D demonstrates different resource and infrastructure combinations for several different states.

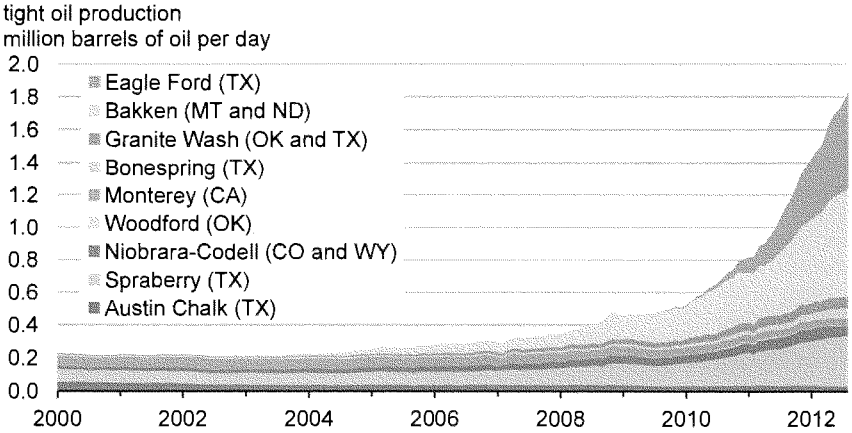
Thank you for the opportunity to testify before the Subcommittee.

Figure 1. Crude oil production beginning to grow due to tight oil development, led by Bakken and Eagle Ford plays



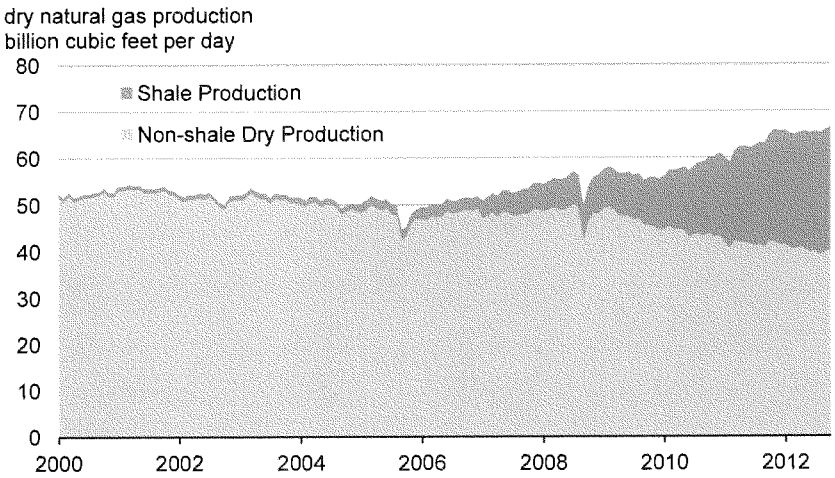
Source: U.S. Energy Information Administration, DrillingInfo (formerly HPDI), Railroad Commission of Texas, and North Dakota Department of Mineral Resources, through August 2012

Figure 2. Tight oil production for selected plays through August 2012 exceeds 1.8 million barrels per day



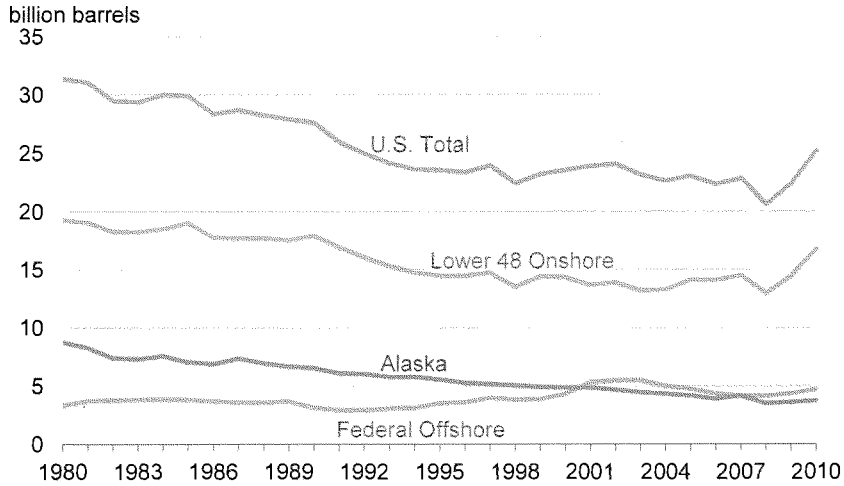
Source: U.S. Energy Information Administration, DrillingInfo (formerly HPDI), Railroad Commission of Texas, and North Dakota Department of Mineral Resources, through August 2012

Figure 3. U.S. shale gas production comprised over 35 percent of total U.S. dry production in 2012



Source: U.S. Energy Information Administration and LCI Energy Insight through October 2012

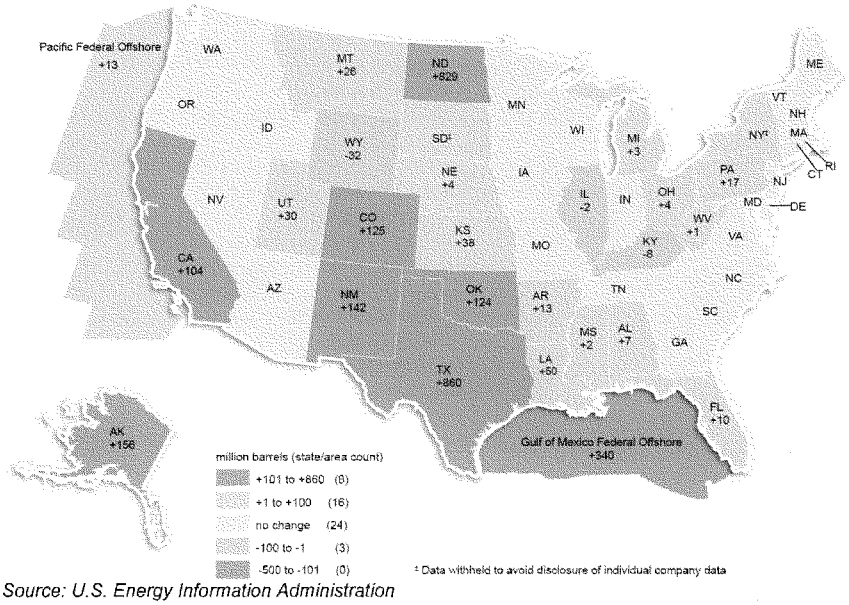
Figure 4. U.S. crude oil plus condensate proved reserves, 1980-2010



Source: U.S. Energy Information Administration

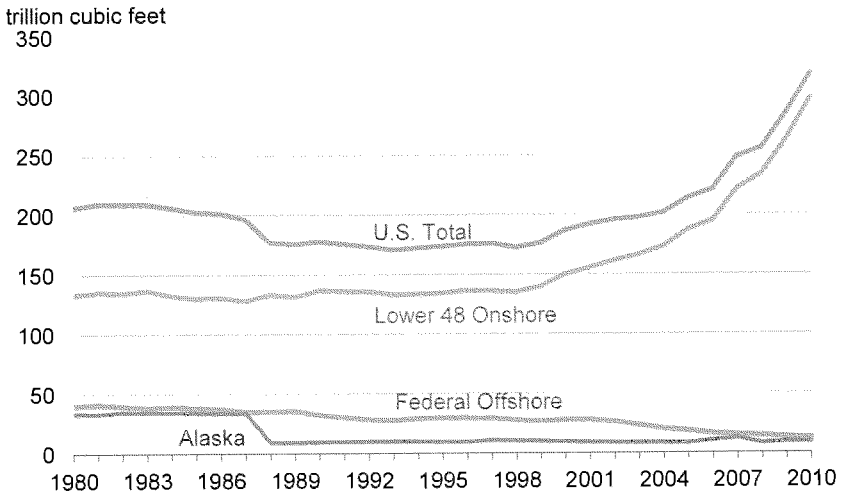
Figure 5. Changes in oil proved reserves by state/area 2009-10

billion barrels of crude oil and lease condensate



Source: U.S. Energy Information Administration

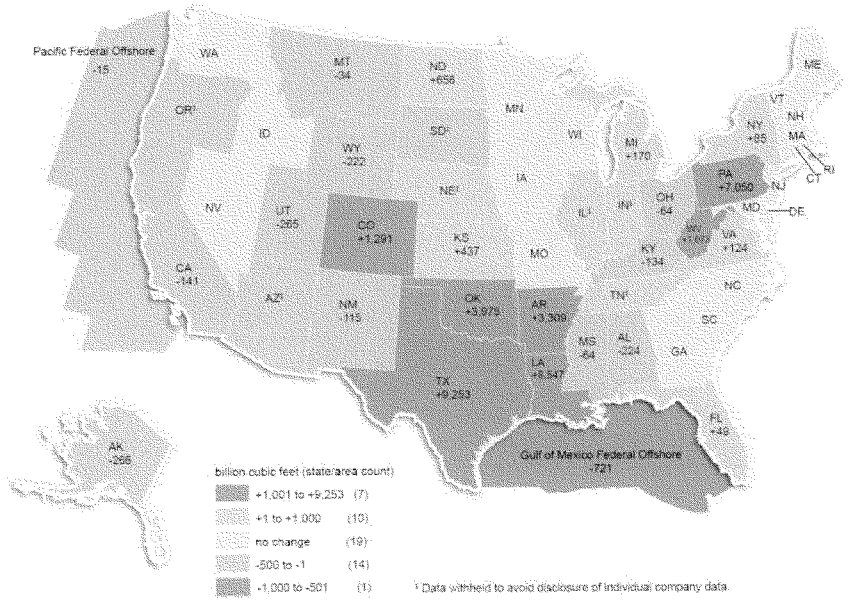
Figure 6. U.S. wet natural gas proved reserves, 1980-2010



Source: U.S. Energy Information Administration

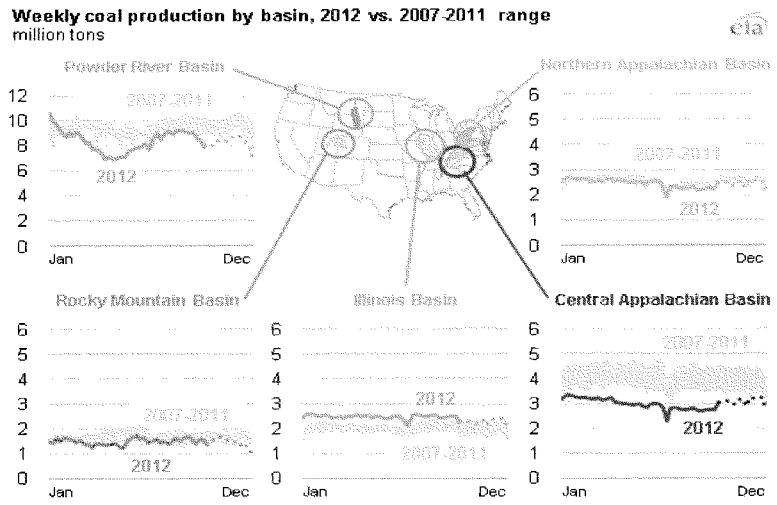
Figure 7. Changes in wet natural gas proved reserves by state/area 2009-10

billion cubic feet



Source: U.S. Energy Information Administration

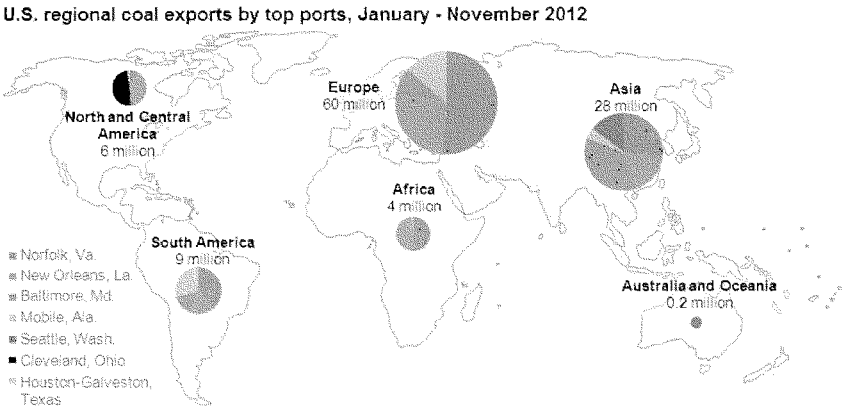
Figure 8. Weekly Coal Production by Basin, 2012 vs. 2007-2011



Source: U.S. Energy Information Administration, Weekly Coal Production, based on MSHA

Note: Data for January 2007 through September 2012 are revised to match the Mine Safety and Health Administration (MSHA). October 2012 through December 2012 are preliminary EIA estimates and denoted with dotted lines.

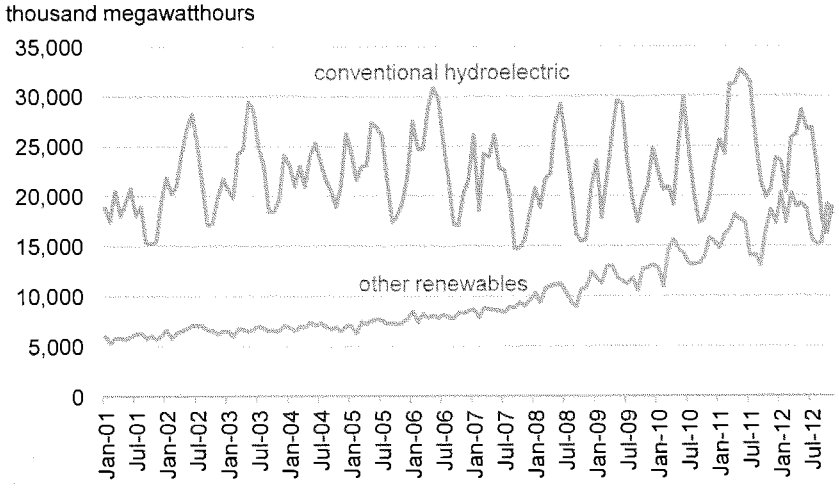
Figure 9. U.S. Regional Coal Exports by Top Ports, January - November 2012



Source: U.S. Energy Information Administration based on U.S. Census Bureau data

Note: For top seven ports totaling 93 percent of U.S. exports. Data for 2012 run through November. Due to limited volumes, Central America is combined with North America.

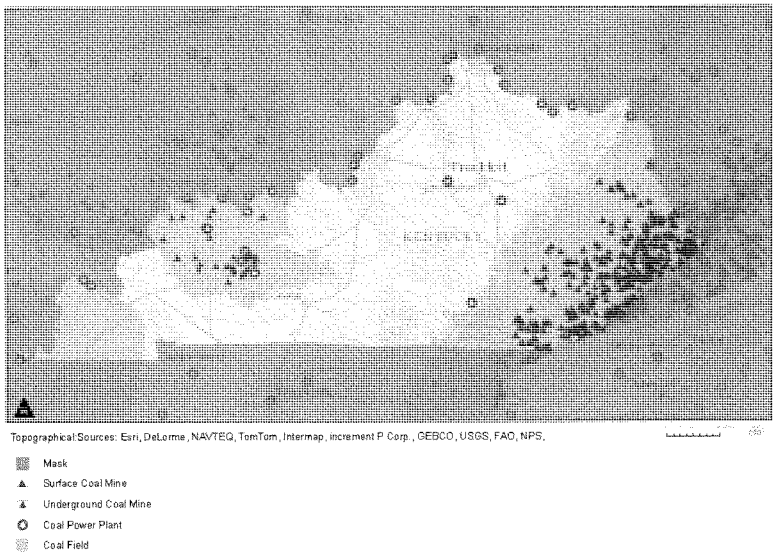
Figure 10. Generation from conventional hydroelectric and other renewable sources

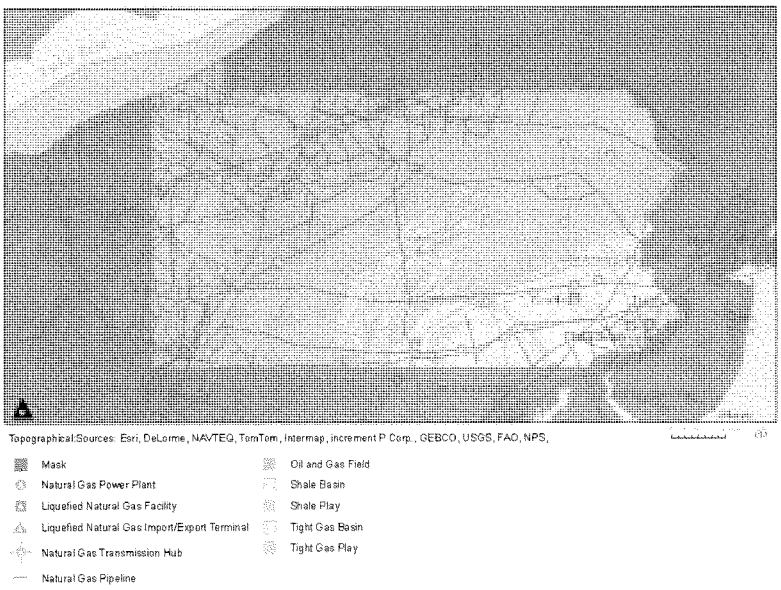


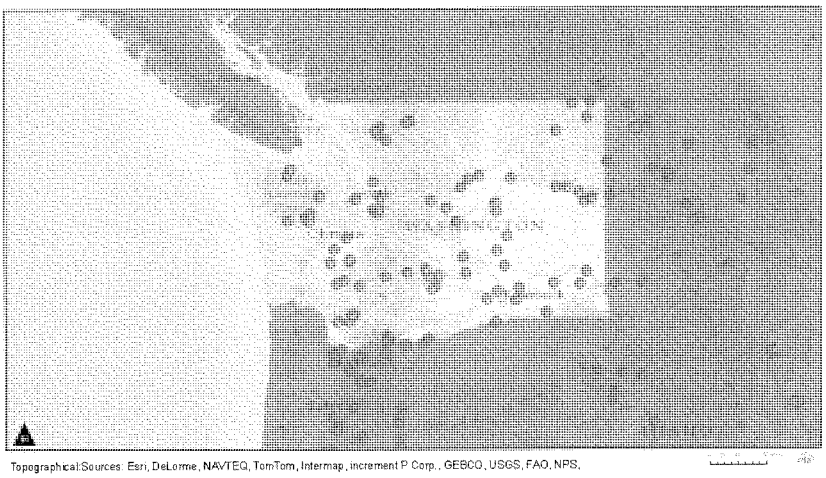
Source: U.S. Energy Information Administration, Electric Power Monthly

Note: Data for 2012 are preliminary. Other renewable sources include wood, black liquor, other wood waste, biogenic municipal solid waste, landfill gas, sludge waste, agriculture byproducts, other biomass, geothermal, solar thermal, photovoltaic energy, and wind.

Figure 11A-D.

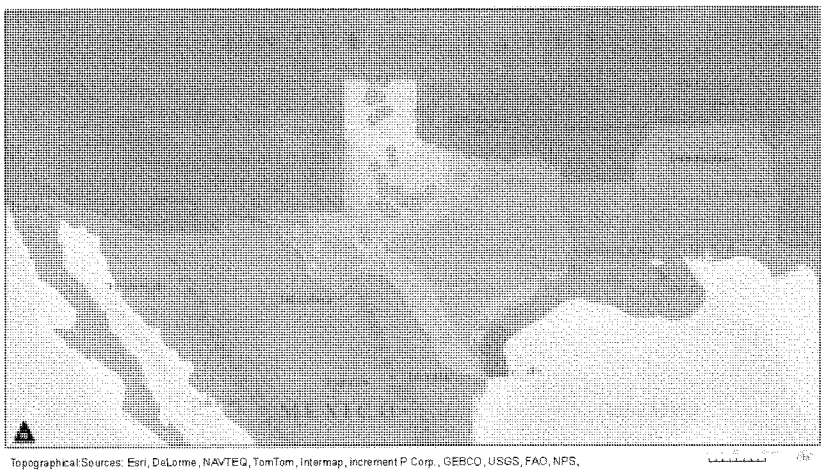

Topographical:Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,
Mask
Surface Coal Mine
Underground Coal Mine
Coal Power Plant
Coal Field


Topographical:Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,
Mask
Natural Gas Power Plant
Liquefied Natural Gas Facility
Liquefied Natural Gas Import/Export Terminal
Natural Gas Transmission Hub
Natural Gas Pipeline
Oil and Gas Field
Shale Basin
Shale Play
Tight Gas Basin
Tight Gas Play



Topographical:Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

- Mask
- Hydroelectric Power Plant
- Pumped Storage Power Plant



Topographical:Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

- Mask
- Wind Power Plant

On Shore 50 Meter Tower Wind Potential

- 7 Superb
- 6 Outstanding
- 5 Excellent
- 4 Good
- 3 Fair
- 2 Marginal
- 1 Poor

Off Shore 90 Meter Tower Wind Speed

- 8.14 to 11.63
- 6.89 to 8.13
- 6.14 to 6.88
- 4.89 to 6.13
- 1.63 to 4.88

Mr. WHITFIELD. Well, thank you.

And Dr. Yergin, you are recognized for 5 minutes.

STATEMENT OF DANIEL YERGIN

Mr. YERGIN. Chairman Whitfield, Ranking Member Rush, members of the committee, I am pleased to be here——

Mr. WHITFIELD. Is your microphone on?

Mr. YERGIN. I don't think so. So I will start over with 5 minutes. Thank you.

Chairman Whitfield, Ranking Member Rush, members of the committee, it is really an honor to be here to have the chance to share some thinking that fits into the framework of the discussion that the members have already laid out.

It is indeed very timely because the United States is in the midst of an unconventional revolution in oil and gas that fits that all-of-the-above strategy that Congressman Rush talked about and also becomes increasingly apparent, goes beyond energy itself, that is, it goes to the economy, and it has only become really apparent in the last year or two that this unconventional revolution is supporting currently about 1.7 million jobs in the United States and it is not only in the oil- and gas-producing States. There are 44,000 jobs in New York, which doesn't produce, 39,000 jobs in the State of Illinois. We think that overall job number will rise to 3 million by 2020.

Last year, this unconventional revolution brought $62 billion in revenues to federal and State government. By 2020, that number could be close to $115 billion. It is helping to stimulate a manufacturing renaissance in the United States. We have noted something like $95 billion of plans for investment in the chemical sector in the United States. I don't know if all of that will get done but that demonstrates it. It is certainly improving the competitive position of the United States in the world and beginning to affect global geopolitics.

I think although great advances have been made in solar and wind—I talk about them in The Quest—the rebirth of renewables, those are really innovations from the last century. In terms of this century, what is happening in oil and gas is the biggest energy innovation so far of the 21st century. It has unfolded fast. Those of you who participated in hearings in 2008 remember those dark, dire days when, I think as Chairman Whitfield reminded, the world was going to run out of oil and the United States was going to run out of oil even more quickly. How that has changed. Shale gas now has gone from 2 percent of our supply to 37 percent of our supply, and what is really dramatic is what has happened on oil, which instead of continuing its long decline has increased dramatically by almost 39 percent since 2008. That increase is equivalent—because you say what does that mean. It is equivalent to the entire output of Nigeria, the 7th largest oil-exporting country in OPEC. It is almost equivalent to Iran's total exports before sanctions went into place. Indeed, it is sobering to consider that without these technologies, and the oil output that has resulted from them, the sanctions on Iran might well have failed.

The environmental aspects have been touched on. U.S. carbon dioxide emissions from energy consumption are down 13 percent

since 2007. I think in discussion we might get to some of the conclusions that we came to as the Deutch committee, the subcommittee of the Secretary of Energy Advisory Board set up at the behest of President Obama, on managing the environmental issues around this. One thing that did come out of that hearing is a focus on the role of the States and in particular the activities of STRONGER, the collaborative organization of the States that seeks collaborative benchmarking and standard setting.

Let me come finally to something that is always contentious, which is imports and exports of oil and energy, which has been a major issue for the United States for about 70 years. Until the end of the last decade, it seemed that the question was only how fast would oil imports go up and how big would our imports of natural gas become, as the chairman referred to in his remarks. Well, this unconventional revolution has sure turned that around. Mr. Rush has cited the decline in our imports over the last 7 years or so, and this is the result both of surging production and greater efficiency. Moreover, the flow of imports has changed. Canada now supplies about 27 percent of our total.

But what gets the most attention right now is the question of whether we are going to become an export of LNG, liquefied natural gas, and I think this needs to be looked at in terms of the overall U.S. supply and global competition. Our view, similar to others, is that the market in the United States is demand constrained, not supply constrained. Many LNG projects have been announced. We think only a handful will be built, these $10 billion projects. The reason is both cost and scale of global competition. Currently already, before any of these get going, already about a third, equivalent to a third of total existing capacity new projects are under construction or have been committed. So the United States capacity will be coming into a market in which there will be new supplies from Australia, new sources such as offshore East Africa and eastern Mediterranean and Canada. Just yesterday, Canada approved a major export project to Asia. Finally, the shale gas development that will occur elsewhere, so these will all be offsets.

So let me just add one other thing. I think for decades, the United States has made the free flow of energy supplies really one of the corner principles of our foreign policy. It is the policy we have urged on many other nations. So to me, at least, it is puzzling how we can say to a close ally like Japan suffering energy shortages as a result of Fukushima that on the one hand we want you to import less oil from Iran, yet on the other hand we don't want to consider new natural gas exports to Japan. So those are some thoughts for consideration on it.

I will just conclude by saying certainly expanded domestic supply will add resilience to shocks and add to our security cushion. Moreover, prudent expansion of U.S. energy exports will actually add an additional dimension to U.S. influence in the world. However, there remains only one world oil market, and a disruption anywhere will be a disruption everywhere.

So all together this unconventional oil and gas revolution has already had a major impact in multiple dimensions. Its significance will continue to grow as it continues to unfold, and these opportu-

nities certainly provide a timely opportunity for assessing the impact and significance in its many dimensions. Thank you.

[The prepared statement of Mr. Yergin follows:]

Subcommittee on Energy and Power of the House Energy and Commerce Committee

Testimony submitted for Hearings on "America's Energy Security and Innovation"

By Dr. Daniel Yergin[1]

February 5, 2013

It is an honor to appear before the Subcommittee on Energy and Power of the House Energy and Commerce Committee, and I do want to express my appreciation for the opportunity to participate in this important hearing.

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.[2] 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. All this sets the framework for the Subcommittee's hearings.

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[1] Dr. Daniel Yergin is Vice Chairman of IHS and founder of IHS Cambridge Energy Research Associates. He is author of *The Quest: Energy, Security, and the Remaking of the Modern World* and received the Pulitzer Prize for his book *The Prize*. He serves on the U.S. Secretary of Energy Advisory Board.

[2] IHS, *America's New Energy Future: the Unconventional Oil and Gas Revolution and the United States Economy*, vol. 1 *National Economic Contributions* (October 2012) and vol. 2, *State Economic Contributions* (December 2012).

Owing to the scale and impact of shale gas and tight oil, it is appropriate to describe their development as the most important energy innovation so far of the 21st century. That is said with recognition of the major technological advances in wind and solar since 2000; but, as is described in *The Quest,* those advances are part of the "rebirth of renewables". As actual innovations, solar and wind emerged in the 1970s and 1980s.[3]

The unconventional revolution has unfolded pretty fast. This Committee has held many important hearings on energy over the decades. Yet it is striking to think back to the hearings of even just half a decade ago, during the turmoil of 2008, when it was widely assumed that a permanent era of energy shortage was at hand.

How different things look today. Shale gas has risen from two percent of domestic production a decade ago to 37 percent of supply, and prices have dropped dramatically. U.S. oil output, instead of continuing its long decline, has increased dramatically – by about 38 percent since 2008.[4] Just the increase since 2008 is equivalent to the entire output of Nigeria, the seventh-largest producing country in OPEC.

People talk about the potential geopolitical impact of the shale gas and tight oil. That impact is already here. It is sobering to consider that, without this increase in oil output based on the same technologies as shale gas, the sanctions on Iranian oil exports might well have failed.

Where did the unconventional revolution come from?

This development is a story of entrepreneurship and innovation. Although hydraulic fracturing dates back to the late 1940s, it took from the early 1980s to the end of the 1990s, in the face of much skepticism and disappointment, to establish that natural gas could be economically extracted from shale rock using

[3] Daniel Yergin, *The Quest: Energy, Security, and the Making of the Modern World* (New York: Penguin Books, 2012), updated edition, chapters 27, 29-30.
[4] Energy Information Administration

that technology. By 2003, it was successfully yoked with another technology, horizontal drilling, to provide proof of concept. [5]

Still, the dominant conviction for the next few years was that the United States was going to become increasingly short of natural gas and would become a large importer of liquefied natural gas (LNG). Only in 2008 was it observed that U.S. natural gas production was going up, instead of down. Many more companies entered into shale gas development, and the pace of effort intensified. Since then, output has grown rapidly, indeed well beyond the capacity of the current market to absorb it. It was not until the autumn of 2009 that the shale revolution became apparent to the policy community. And it was only around 2010 that producers began to shift from focusing on gas production to producing oil and liquids-rich natural gas using the same techniques.

What is the economic impact of the unconventional oil and gas revolution?

While various states had begun to home in on the economic development aspects of shale gas and tight oil, it was only in about 2011 that its significance for the national economy started to come into focus. So far, this unconventional revolution is supporting 1.7 million jobs – direct, indirect, and induced. It is notable that, owing to the long supply chains, the job impacts are being felt across the United States, including in states with no shale gas or tight oil activity. For instance, New York State, with a ban presently in effect on shale gas development, nevertheless has benefitted with 44,000 jobs. Illinois, debating how to go forward, already registers 39,000 jobs.[6]

The total revenues flowing to governments from unconventional amounted to $62 billion last year. Companies are now committing or planning investments that in total appear to go into the hundreds of billions of dollars. A large number of chemical companies, for instance, have announced plans to build or expand facilities in North America – with capital expenditures totaling close to

[5] Yergin, *The Quest*, chapter 16, "The Natural Gas Revolution".
[6] IHS, *America's New Energy Future*, vol. 2, *State Economic Contributions*, p. 14

$100 billion.[7] Will all be built? Time will tell. But what is striking is that, half a decade ago, these companies would have scoffed if they had been told that they would be investing back into the United States. The investments are coming both from U.S. based companies, which are "on-shoring" in response to lower energy costs, and from foreign companies. Many other kinds of manufacturing firms are also investing and expanding based upon this growing business.

The unconventional revolution was one of the major topics at the World Economic Forum two weeks ago in Switzerland. European business leaders and some European policymakers are realizing that United States' new energy situation greatly improves its competitive position vis a vis a Europe that desperately needs new jobs. When I was in China for the Chinese publication of *The Quest,* I repeatedly encountered discussions about how shale gas could change the global competitive playing field to the advantage of the United States.

How to assess the environmental aspects?

The most notable impact is in terms of CO2 emissions. U.S. carbon dioxide emissions from energy consumption are down 13 percent since 2007.[8] The economic downturn is part of the story. But the most significant part is the result of natural gas supplanting coal in electric generation at a rapid rate.

Hydraulic fracturing has been used since the late 1940s, as already indicated. However, it has only been recently applied at this scale and with this degree of intensity in regions that are more densely populated and that are not accustomed to oil and gas development. Understandably, the environmental impacts need to be carefully assessed and monitored, and the public needs to be confident about these impacts.

In March, 2011, President Obama spoke about how "recent innovations have given us the opportunity to tap" large reserves of natural gas –

[7] IHS, Energy and the New Global Industrial Landscape: a Tectonic Shift? (January 2013), p. 2

[8] EIA, *Monthly Energy Review,* January 2013, Table 12.1

"perhaps a century's worth of reserves." But he added that the public needs to be assured that it is being produced safely.[9] As a consequence, a subcommittee to the Secretary of Energy's Advisory Board was established to examine the environmental questions. I served on that committee under Chairman John Deutch of MIT.[10] Our work identified three major environmental issues – water, local air pollution, and community impact. Each, the subcommittee concluded, needs to be managed with great attention and can be managed through best practices in operations and regulation, continuing technological innovation, and community engagement.[11] We see continuing effort going into these endeavors – with, for instance, recycling of water and new approaches to waste water treatment.

One observation that came out of that study is what seems to be a mismatch between perceptions of regulation and actual regulation. Drilling is a highly-regulated activity, but it is mostly regulated at the state level. We identified the need to continue to support, with what amounts to very small funding, the activities of STRONGER – State Review of Oil and Natural Gas Environmental Regulations – a collaborative benchmarking and standard-setting organization that evaluates and promotes continuing improvement of regulatory activities among the states.[12]

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[9] "Remarks by the President on America's Energy Security," March 30, 2011, http://www.whitehouse.gov/the-press-office/2011/03/30/remarks-president-americas-energy-security

[10] Other members of the Subcommittee included Professor Stephen Holditch, chairman of the department of petroleum engineering at Texas A&M University; Fred Krupp, president of the Environmental Defense Fund; Kathleen McGinty, chairman of the Council on Environmental Quality in the Clinton Administration and former Secretary of the Pennsylvania Department of Environmental Protection; and Susan Tierney, former assistant secretary of energy in the Clinton Administration and former Secretary of Environmental Affairs and the Chair of the Water Resources Board for the State of Massachusetts and managing principal of the Analysis Group.

[11] Secretary of Energy Advisory Board, *Shale Gas Subcommittee 90-Day Report,* August 18, 2011.

[12] For STRONGER, http://www.strongerinc.org/

What does the unconventional revolution mean for US imports and exports of oil and gas?

U.S. imports and exports of energy have been a major issue for almost seventy years in the United States. Until the end of the last decade, it seemed that the main question about oil imports was how fast they would increase as a share of total consumption; and, for gas, how large the exports would become. This unconventional revolution has turned around the direction of imports. . U.S.net imports of oil have declined from a peak of 60 percent in 2005 to about 40 percent today. That is the consequence of surging tight oil production, and reduced demand, owing to both greater efficiency and the weak economy. Moreover, the flow of imports has changed. Canada now supplies about 27percent of total U.S. imports.

Net imports of crude will continue to decline. But the United States will continue to remain a net importer for some time. Our import levels are still higher than they were at the time of the first oil crisis, in the 1970s. However, we will see the Western Hemisphere, and North America in particular, moving towards greater self sufficiency. At the same time, the very large, technically-advanced refining complex on the Gulf Coast -- along with the shifting domestic product demand -- will put the United States in the position to continue to expand exports of refined products.

What, of course, gets most attention now is the potential for liquefied natural gas (LNG) exports. This needs to be looked at in terms of overall U.S. supply and global competition. Our view is that, owing to the very large resource base, the market in the U.S. is demand-constrained, rather than supply-constrained. Larger markets – whether they be in electric power, industrial consumption, transportation, or exports -- are required to maintain the investment flow into the development of the resources.

Many LNG projects for the United States have been announced. These would be expensive facilities to build -- $10 billion or more. Only a handful, in our view, are likely to end up being financed and built. The reason is both cost and the scale of global competition. Currently, 95 million tons of new annual capacity

around the world are either under construction or have been committed, which is equivalent to fully a third of existing capacity. Capacity in the U.S. that might be coming into a market late in this decade or early in the next will have to compete with new supply from existing exporters, such as Australia, and the new sources, such as off-shore East Africa and the Eastern Mediterranean. Moreover, western Canada is likely to become a major exporter of LNG to the main markets in Asia. This competition will create a global market offset on how many projects are actually built.

While markets and economics will eventually determine the realistic scale of U.S. exports, one also has to take into account wider considerations in assessing policy regarding future LNG exports. For decades, the United States has made the free flow of energy supplies one of the cornerstones of foreign policy. It is a principle we have urged on many other nations. How can the United States, on one hand, say to a close ally like Japan, suffering energy shortages from Fukushima, please reduce your oil imports from Iran, and yet turn around and, on the other, say new natural gas exports to Japan are prohibited?

What is the geopolitical impact of the unconventional energy revolution in the United States?

This question has moved to the front of international discussion. Last Friday, at the venerable Munich Security Conference, a forum for leading defense and security officials from around the world, this was one of the main topics of discussion. This kind of question was never on that agenda before.

One immediate impact has already been cited. Tighter sanctions on Iran have succeeded in taking half of Iran's oil exports out of the market, even as global demand for oil continues to expand. The increase in Saudi output was part of the formula. But also of great importance has been the growth in U.S. supply – at a rate higher than generally anticipated.

Certainly expanded domestic supply will add to resilience to shocks and add to the security cushion. Moreover, prudent expansion of U.S. energy exports will

add an additional dimension to U.S. influence in the world. However, there will remain only one global oil market, and a major disruption anywhere would affect the entire market. The question as to how the unconventional revolution will affect U.S. involvement in the Middle East is moving to the fore. Current net U.S. imports from the Persian Gulf are equivalent to eight percent of total consumption, as it is. Even if that number goes down, the nature of U.S. interests in the region go well beyond direct oil imports to the importance of the region for the global economy and global security.

Conclusion

Altogether, the unconventional oil and gas revolution has already had major impact in multiple dimensions. Its significance will continue to grow as it continues to unfold. These hearings provide a very timely opportunity for assessing that impact and significance in its many dimensions, and I am pleased to respond to the committee's questions.

Mr. WHITFIELD. Thank you, Dr. Yergin.

Ms. Morgan, you are recognized for 5 minutes.

STATEMENT OF JENNIFER MORGAN

Ms. MORGAN. Thank you very much, Mr. Chairman, and thank you for the opportunity to testify here today. I work for the World Resources Institute, which is a nonprofit, nonpartisan think tank, and we focus on the intersection of environment and improving people's lives.

I am very delighted to speak here today about America's abundant energy resources and the smart choices we need to make to deliver them, and I have two main points to share with you today. First is that an effective, durable and affordable energy strategy must consider the risks of climate change. Why? Well, our climate is changing. Each successive decade in the last 50 years has the warmest on record globally, and extreme weather events are on the rise with tens of billions of dollars in damages in the United States each year. A 2010 National Research Council report concluded that "climate change is occurring, is caused largely by human activities and poses significant risks for, and in many cases is already affecting a broad range of human and natural systems." This is the message of numerous comprehensive science assessments including the draft National Climate Assessment that was released last month.

Directly relevant to this subcommittee are electric infrastructure and reliability are already being affected and are increasingly vulnerable to droughts and other disruptions caused by climate change. Current impacts on energy production are just the beginning. Unless we change course, these impacts will become more extreme, placing our energy infrastructure and our country at great risk, which brings me to my second point, which I think is very important. To avoid the most serious climate change impacts, our energy policy must drive low-carbon technologies forward now and build them out at a much larger scale.

The good news is that we don't have to choose between energy security and climate security. America is rich in renewable resources and has large opportunities to increase efficiency. According to the National Renewable Energy Laboratory, 80 percent of our electricity needs can be met in 2050 through renewable generation and existing technology. We can also improve our efficiency across the economy. The National Academy of Sciences found that the United States could save 30 percent of the energy used, and reducing methane emissions from natural gas and capturing and storing CO_2 can put us on the cutting edge of technology development, which I think is a true win-win.

If the United States, however, and we decide not to move forward with a low-carbon future now, we risk not only the severe impacts of climate change but also stranded investments from short-term poorly informed planning. Many utilities are already factoring climate change into their investment decisions, and they are looking for regulatory and climate policy certainty. Investments in high-polluting resources, I think, will prove to be a poor bet over time and these investments will be at direct physical risk from increasing impacts.

So without a rapid shift to a low-carbon economy, the United States is also going to miss out on the clean technology market around the world. The global market for low-carbon technology could double or triple by 2020.

So in conclusion, Mr. Chairman, I think the United States has the opportunity to be both energy and climate secure in the future, and Congress can help and assist in that effort through policies that first ensure climate change risks are more directly incorporated into both public and private decision making; two, build out America's clean energy sector through an approach that is comprehensive, long term, targeted and inclusive; three, increase energy efficiency across the economy; and four, provide funding and incentives for low-carbon and clean energy technologies. Ultimately, Congress will work together to build national energy policies that take these climate risks very seriously and take advantage of all the opportunities presented by our abundant clean energy resources.

Thank you very much for the opportunity, sir.

[The prepared statement of Ms. Morgan follows:]

Hearing Before the U.S. House of Representatives
Energy and Commerce Subcommittee on Energy and Power: "American Energy Security and Innovation: An Assessment of North America's Energy Resources"

Testimony of Jennifer L. Morgan, Director, Climate and Energy Program, World Resources Institute

February 5, 2013

Summary of Key Points:

Our energy choices need to factor in both opportunities and risks. This testimony gives particular attention to why we must consider the risk of climate change, both on our resources being developed and utilized today and on our choices for development into the future. It concludes with the following recommendations:

1. Congress should request that the National Climate Assessment and Development Advisory Committee review the current authorities of federal agencies and national laboratories, and recommend how consideration of risks associated with climate change can be more directly incorporated into decision-making.

2. Congress should support efforts to better assess the impacts of climate change on America's energy infrastructure and incorporate this into planning and investment decisions.

3. Congress should keep in mind four important criteria in considering policies to drive more effective clean energy growth and competitiveness: any energy policy should be comprehensive, long-term, targeted, and inclusive.

4. In capturing energy efficiency across the economy, Congress can play a constructive role in two key areas:

    - Informed consumer choice: supporting and expanding programs to help ensure product labeling is accurate and publicly reported in a timely manner, to encourage energy-wise investment decisions throughout the U.S. economy.

    - Efficiency standards: supporting and extending the ability of federal agencies to develop and update energy efficiency standards for vehicles, appliances, and other energy-consuming equipment that is sold into U.S. commerce.

5. Congress must work toward reaching bipartisan agreement on national energy policies that encourage more efficient energy consumption, increase the diversity of domestic energy production, maximize deployment of low-carbon energy technologies, and minimize environmental impacts throughout our energy systems. In the near-term, it is also critical for Congress to provide funding and incentives for low-carbon and clean energy technologies.

TESTIMONY OF JENNIFER L. MORGAN

DIRECTOR, CLIMATE AND ENERGY PROGRAM
WORLD RESOURCES INSTITUTE

HEARING BEFORE THE U.S. HOUSE OF REPRESENTATIVES
ENERGY AND COMMERCE SUBCOMMITTEE ON ENERGY AND POWER:
"AMERICAN ENERGY SECURITY AND INNOVATION:
AN ASSESSMENT OF NORTH AMERICA'S ENERGY RESOURCES"

February 5, 2013

Good morning, and thank you for the opportunity to contribute to the deliberations of this Subcommittee. My name is Jennifer Morgan, and I direct the Climate and Energy Program at the World Resources Institute (WRI). WRI is a non-profit, non-partisan think tank that focuses on the intersection of the environment and socio-economic development. We go beyond research to put ideas into action, working globally with governments, business, and civil society to build transformative solutions that protect the earth and improve people's lives. We operate globally because today's problems know no boundaries. We provide innovative paths to a sustainable planet through work that is accurate, fair, and independent.

I am delighted to speak with you today about America's energy resources and the smart choices we need to make in developing them. We have been blessed with abundant resources – not just of fossil fuels, but also of solar, wind, and other renewable resources. We also have a vast untapped resource in energy efficiency: the value we place on our resources comes from the energy they can provide, and we increase that value by using energy wisely.

Our energy choices need to factor in both opportunities and risks. In this testimony, I will give particular attention to why we must consider the risk of climate change, both on our resources being developed and utilized today, and on our choices for development into the future. America has a vast potential of low-carbon energy resources; tapping these will allow us to increase our reliance on home-grown resources and still be "climate secure." Innovation in clean energy technology has already created jobs and spurred economic growth, not only through deployment in the United States but also through export into new markets. And in both cases, the potential for expansion is great.

America's prosperity has long depended on our ability to rise above the challenges before us. The investment choices we make today will shape our energy and economic future for decades to come; thus we must deliberately think longer-term and consider the range of risks and costs that will be compounded if today's investments lock in a pollution-intensive energy future.

I will conclude this testimony by recommending actions that Congress can take to ensure that our future is sustainable – actions that will enable the United States to grow our economy and to lead globally on developing clean energy, fostering innovation, and realizing an energy-secure, climate-safe future.

The U.S. Must Integrate Climate Risks into Decision Making

Our climate is changing. In addition to a clear long-term warming trend, extreme weather events are on the rise, with tens of billions of dollars in damages in the United States each year.[1] It is also clear that human activities are the main culprit. In 2010,[2] at the request of Congress, the National Research Council of the U.S. National Academy of Sciences (NAS) published a report concluding that "*Climate change is occurring, is caused largely by human activities, and poses significant risks for—and in many cases is already affecting—a broad range of human and natural systems.*" The NAS study was one of several comprehensive science assessments to have been conducted in recent years – including the recently released draft National Climate Assessment[3] – all of which have reached scientific consensus on the reality of climate change and humanity's major role in it.

Furthermore, the NAS[4] has also urged immediate strong policy actions to curb emissions, concluding that *"the risks associated with doing business as usual are a much greater concern than the risks associated with engaging in strong response efforts."*[5] Current U.S. energy policy lacks a framework for prudently assessing and managing the risks of climate change. Yet all of the evidence suggests that every year of deferred action vastly increases the cost to future generations of investing in a course correction that puts us on a prudent path toward climate stabilization.

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[1] http://www.ncdc.noaa.gov/news/preliminary-info-2012-us-billion-dollar-extreme-weatherclimate-events
[2] http://www.nationalacademies.org/annualreport/Report_to_Congress_2010.pdf
[3] http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-fulldraft.pdf
[4] National Academies, Committee on Climate Choices, Final Report, 2011. http://dels.nas.edu/Report/America-Climate-Choices-2011/12781
[5] http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/ACC-final-brief.pdf

In assessing America's energy resources, we must take into account the impact that climate change is having now on our energy infrastructure, as well as how our energy choices should be informed by the need to avoid greater climate impacts in the future.

Climate Change Impacts in the United States

Around the country, we are increasingly seeing the effects of climate change. From sea-level rise to drought and extreme weather events, our changing climate is increasing the probability and intensity of many impacts. Climate instability directly affects the future security of our energy sector – droughts and flooding threaten grid infrastructure and undermine the ability of power plants to operate; wildfires and extreme storms damage transmission infrastructure; powerful coastal storms threaten our ability to safely develop, refine, and deliver oil and gas to industry and consumers.

Temperature rise

Each successive decade in the last 50 years has been the warmest on record globally, and average global temperatures through the remainder of this century will continue to rise.[6] The average temperature in the United States has risen by 1.5°F since 1895, and in the absence of significant mitigation efforts the increase is projected to be 5-10°F by the end of the century.[7] Last year was the warmest year in observed U.S. history.[8]

[6] http://ncadac.globalchange.gov/
[7] Ibid.
[8] http://www.ncdc.noaa.gov/sotc/

Sea-level rise

It has been well established[9] by scientific bodies such as the U.S. Global Change Research Program that global warming has resulted in rising seas. The 8-inch rise in average global sea level[10] over the last century has exacerbated the impacts of storm surge in the United States and abroad. Interestingly, sea-level rise does not affect all coasts in the same way. In recent decades no other place in the world has experienced higher[11] rates of sea-level rise than the northeastern coast of the United States.[12]

Sea-level rise and associated storm surges and coastal flooding have significant economic implications. For example, damage estimates from Hurricane Sandy have ranged from $30 to $50 billion.[13] In Florida, already occurring sea-level rise impacts are forcing Miami Beach to spend more than $200 million[14] to overhaul its storm drainage system, and Hallandale Beach to spend $10 million[15] on new wells because of saltwater intrusion. Sea-level rise will require[16] increased energy usage in the form of additional pumping for drainage and water supply, as well as for the energy-intensive process of desalinization. The vulnerability of the U.S. economy to sea-level rise is significant, with 41 million Americans living in coastal counties along the East Coast.[17]

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[9] http://www.globalchange.gov/what-we-do/assessment/previous-assessments/global-climate-change-impacts-in-the-us-2009
[10] http://ncadac.globalchange.gov/
[11] http://www.nature.com/news/us-northeast-coast-is-hotspot-for-rising-sea-levels-1.10880
[12] http://ncadac.globalchange.gov/
[13] http://www3.cfo.com/article/2012/11/risk-management_superstorm-sandy-insurance-modeling-air-eqecat-rms-swiss-re-
[14] http://miamibeachfl.gov/publicworks/scroll.aspx?id=27280
[15] http://pdf.wri.org/sea_level_rise_in_florida.pdf
[16] http://www.hq.nasa.gov/legislative/hearings/2012%20hearings/4-19-2012%20BERRY.pdf
[17] http://www.census.gov/prod/2010pubs/p25-1139.pdf

Drought

According to the National Oceanic and Atmospheric Administration (NOAA), over 65 percent of the contiguous United States experienced drought last September,[18] causing widespread damage to the nearly $300 billion[19] in annual agricultural commodities within the United States.[20] Recent scientific findings have strengthened our understanding of the link between climate change, heat, and drought. For example, the heat wave leading to the Texas drought was found in a recent study[21] by NOAA and other institutions to be 20 times more likely to occur now than in the 1960s. According to the recent draft *National Climate Assessment*, disruptions to agricultural production from climate change have increased in recent years and are expected to increase further over the next 25 years.

Extreme weather and climate events

According to NOAA, in 2012 the United States experienced 11 extreme weather events causing more than $1 billion in damages each.[22] The economic losses from extreme events – increased in part by the impacts of storm surge exacerbated by climate change – are significant. For example, hurricanes have cost the U.S. Gulf Coast alone an average of $14 billion in damages per year, and the region could accumulate $350 billion in cumulative hurricane-related damages over the next 20 years.[23] The 150-percent[24]

[18] http://www.ncdc.noaa.gov/sotc/national/2012/13/supplemental/page-9/
[19] http://ncadac.globalchange.gov/download/NCAJan11-2013-publicreviewdraft-chap6-agriculture.pdf
[20] http://www1.ncdc.noaa.gov/pub/data/cmb/bams-sotc/2011-peterson-et-al.pdf
[21] Ibid.
[22] http://www.ncdc.noaa.gov/news/preliminary-info-2012-us-billion-dollar-extreme-weatherclimate-events
[23] http://www.entergy.com/content/our_community/environment/GulfCoastAdaptation/Building_a_Resilient_Gulf_Coast.pdf
[24] http://www.census.gov/prod/2010pubs/p25-1139.pdf

increase in population along the Gulf Coast over the last 50 years, to 14 million inhabitants, has further increased the potential for costly impacts from storm surge and associated hurricanes.

The increase in frequency and cost of extreme weather events has caused ripple effects throughout the insurance industry, which recent research shows has experienced steadily increasing weather-related losses over the last two decades.[25] Aggregate economic losses in 2011 attributed to extreme weather events were $55 billion,[26] and storms such as Tropical Storm Lee and Hurricane Irene were responsible for a combined $8.3 billion in damages that included coastal flooding. With the expectation that sea-level rise and future threats of storms such as Sandy will increase property losses, the financial risk will be transferred more to the public sector as the private sector cannot cover "high-risk" coastal properties.[27]

Climate Change Impacts on the Power Sector

When considering energy resources, we should take into account how climate change can impact America's energy infrastructure. For starters, energy demand is directly affected by rising temperatures; a recent study by the state of Massachusetts[28] estimates that rising temperatures could increase demand for electricity in that state by 40 percent by 2030, requiring substantial investments in increasing peak load capacity.

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[25] http://downloads.usgcrp.gov/NCA/technicalinputreports/Burkett_Davidson_Coasts_Final_.pdf
[26] Ibid.
[27] Ibid.
[28] http://www.mass.gov/eea/docs/eea/energy/cca/eea-climate-adaptation-report.pdf

Energy facilities will also likely be affected by sea-level rise. The contiguous United States has more than 280 electric power plants, oil and gas refineries, and other energy facilities which are situated on low-lying land and thus vulnerable to sea-level rise and episodic coastal flooding.[29] Sea-level rise poses especially substantial challenges for sustaining reliable energy infrastructure in states such as Florida, where 26 energy facilities are located in especially vulnerable areas.[30]

In addition, power sector reliability is affected by extreme weather events. For example, in the aftermath of Hurricane Sandy and the Nor'easter that immediately followed, more than 8 million customers lost power.[31] Refineries, natural gas distribution systems, and petroleum terminals were also affected by these storms. Meanwhile, because the majority of U.S. oil production and refining occurs in the Gulf Coast, hurricanes can impact national energy availability and price, as Hurricanes Katrina and Rita demonstrated in 2005.

The nation's power sector is also highly vulnerable to extreme drought. Water scarcity has emerged as one of the defining challenges of this century, yet a significant amount of water is needed to extract energy resources and use them to generate electricity. Limits on availability of ground and surface water are shaping the current operation and future location of America's power plants. In 2011, over 85% of total electricity generation in the United States was produced by thermoelectric power plants fueled by nuclear and

[29] http://slr.s3.amazonaws.com/SLR-Threats-to-Energy-Infrastructure.pdf
[30] Ibid.
[31] http://www.oe.netl.doe.gov/docs/SitRep13_Sandy-Nor'easter_120312_300PM.pdf

fossil energy sources,[32] most of which rely heavily on substantial water resources for cooling. As fossil energy extraction trends toward unconventional resources and "enhanced" production, more water is needed relative to extracting the same amount of energy using conventional methods. According to the National Energy Technology Laboratory,[33] there are 347 coal-fired power plants in 43 states vulnerable to water supply and/or demand concerns. In a future with increasing likelihood of droughts, our nation's ability to meet growing energy needs through thermoelectric power generation will be highly vulnerable to climate change.[34]

Investment Risks and Stranded Assets

Any company or government – at the national, state, or local level – that makes infrastructure investments needs to factor climate change into their decision-making, and many are already doing so, equating climate risks with those from traditional financial risks like liquidity or competition.[35] Intelligent policies can mitigate investment risk by encouraging investment in the low-carbon technologies that will be a foundational part of a successful 21st century economy. Investor networks around the world recognize this, and are advocating for well-designed policies that can help get money off the sidelines and into climate-secure industries.[36]

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[32] http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_1_1
[33] http://www.evs.anl.gov/pub/doc/DOENETL-2010-1429%20WaterVulnerabilities.pdf
[34] Tidwell, V., Kobos, P., Malczynski, L., Klise, G., and Castillo, C. (2012). "Exploring the Water-Thermoelectric Power Nexus." *J. Water Resour. Plann. Manage.*, 138(5), 491–501. http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29WR.1943-5452.0000222

[35] See http://www.unglobalcompact.org/docs/issues_doc/Environment/Investor_Leadership_on_Climate_Change_An_Analysis.pdf.
[36] See http://www.ceres.org/incr/files/investor-files/2012-global-policy-letter.

According to IHS CERA,[37] the U.S. power sector will require as much as $828 billion in capital investments and expenses before the end of this decade. Many of these investments will be for very long-lived assets – from power plants to transmission systems. U.S. energy companies making investments today are considering 40+ year operational horizons and cannot ignore the potential for a future where climate policies and environmental risks influence the bottom line. One of the surest ways to saddle customers with higher costs from major stranded investments is to ignore the need to factor climate impacts into today's decision-making processes.

As a society, delaying the decision to act on climate change increases the overall cost of mitigating greenhouse gas (GHG) emissions.[38] A recent study by KMPG found that the costs of environmental impacts for a wide array of industries are doubling operational costs every 14 years. The cost resulting from climate change, specifically, was estimated at one percent per year if early action is taken, but five percent per year of delay in establishing climate policy certainty.[39] Other studies have found that climate change could put trillions of investment dollars at risk through 2030.[40]

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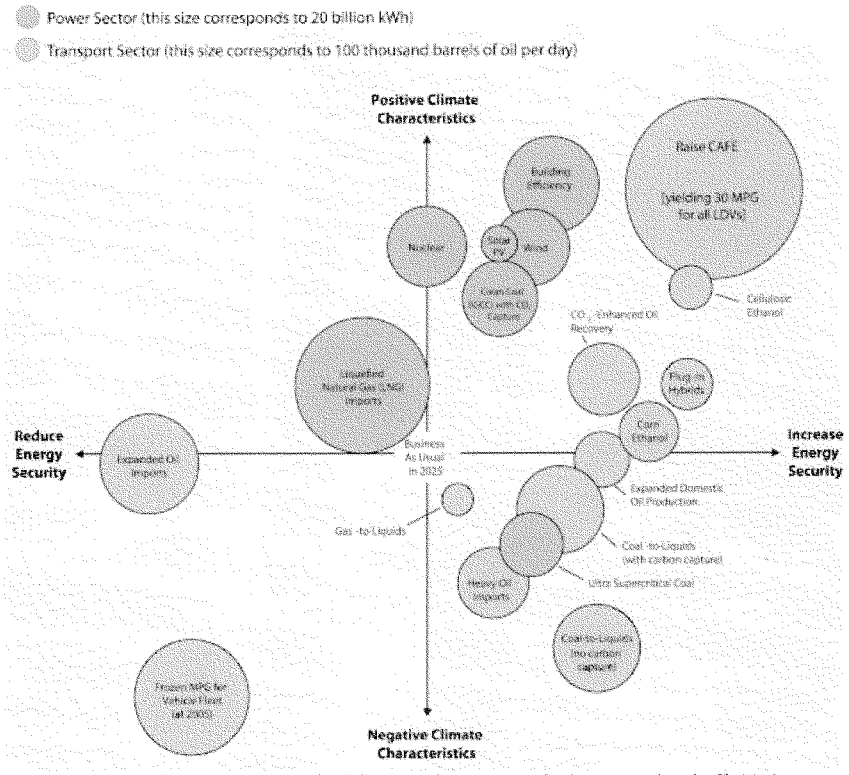
[37] http://www.ihs.com/products/cera/energy-report.aspx?id=1065970374
[38] Rogelj, J., McCollum, D. L., Reisinger, A., Meinshausen, M. & Riahi, K. Nature 493, 79–83 (2013).
[39] http://www.kpmg.com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/building-business-value.pdf
[40] See report at http://www.mercer.com/attachment.dyn?idContent=1407480&filePath=/attachments/English/04028-IC_ClimateChangeAssetAllocationStudy_Report_FNL_lowres.pdf.

America's Clean Energy and Climate-Secure Future

The United States cannot and should not make energy decisions without factoring in the risks associated with climate change. To avoid further climate impacts in the future we must lower greenhouse gas emissions by switching to clean energy and increasing energy efficiency. Scientists at the National Research Council (NRC) of the NAS have concluded that global carbon dioxide (CO_2) emissions need to be reduced in the coming decades by at least 80% below current levels to stabilize atmospheric CO_2 concentrations and thus avoid the worst impacts of global warming.[41] This has serious implications for the energy choices we make today. WRI published the chart below in 2008 to illustrate how various energy choices rate from both climate and energy security perspectives. Although some of the information is dated (i.e., today we talk about LNG exports rather than imports, and the Administration raised CAFE standards in 2011), it provides an important framing in the context of this hearing.

[41] National Research Council, 2011. "Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia," ISBN: 0-309-15177-5, 298 pages. http://www.nap.edu/catalog/12877.html



Source: WRI, 2008. http://www.wri.org/chart/climate-and-energy-security-impacts-and-tradeoffs-2025

As the chart indicates, making energy- and climate-secure choices require shifting away from carbon-intensive energy sources such as coal, and moving toward zero and low-carbon energy sources such as renewables as well as increased energy efficiency. It is worth noting that natural gas could play an essential bridging role in that transition, but, as outlined below, this requires both reducing the upstream GHGs produced during the extraction process, and — if gas-fired power plants are to be a part of a longer-term energy future — using carbon capture and storage (CCS) technology.

The good news is that the United States does not have to choose between energy security and a climate-secure future. Clean energy resources provide the opportunity to be energy independent and ensure economic growth while also protecting the climate.

Natural Gas and Climate – Risk or Opportunity?

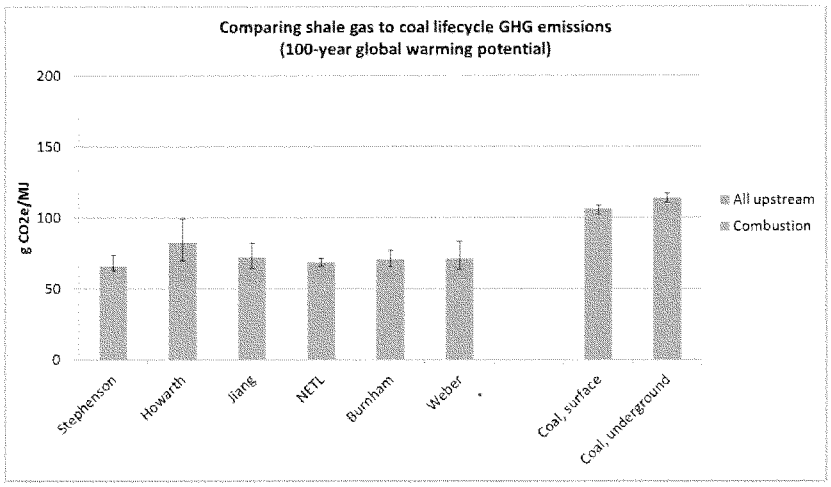
The recent boom in producing natural gas from shale formations has transformed – and will likely continue to transform – the way we generate electricity in the United States.[42] While there are a variety of issues related to shale gas development, for this testimony I am focusing specifically on the opportunities and risks natural gas presents in relation to climate change.

Although natural gas burns cleaner than coal, upstream emissions of methane that occur during exploration and production threaten to reduce or eliminate any advantage natural gas has over coal from a lifecycle GHG perspective. Recent WRI analysis, to be published in a forthcoming working paper, examines the question of upstream methane emissions, evaluates the impacts of recent EPA rules[43] on those emissions, and looks at ways to further reduce natural gas's contribution to climate change.

[42] The Energy Information Administration's Annual Energy Outlook for 2012 projects shale gas production growing by 78% between 2012 and 2035 in the reference case scenario, with the share of total U.S. production from shale gas increasing from roughly one-third to roughly one-half over that period. See http://www.eia.gov/forecasts/aeo/IF_all.cfm, Figure 56.

[43] See text of final rule at: http://www.epa.gov/airquality/oilandgas/pdfs/20120417finalrule.pdf

The International Energy Agency has shown[44] that as the upstream leakage rate of methane increases, natural gas's climate advantage over coal erodes and then disappears. Unfortunately, there is a paucity of measurement data for upstream emissions, making reliable estimates difficult to produce. However, current understanding is that leakage rates for both conventional and unconventional gas (i.e., gas from shale, coal bed methane, and tight sands formations) are in the range of 1.5 - 3%. Several studies are currently underway that should provide more clarity as to the accuracy of these assumptions.



Source: WRI analysis of Stephenson et al. (2011), Howarth et al. (2011), Jiang et al. (2011), NETL (2011), Burnham et al. (2011) and Weber et al. (2012).

[44] International Energy Agency, "Golden Rules for a Golden Age of Gas." Available at: http://www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/weo2012_goldenrulesreport.pdf

Recent EPA air pollution standards[45] for the oil and gas industry help address upstream methane emissions from shale gas systems. The standards will reduce those emissions by 40-45% below a business-as-usual baseline, and from all natural gas systems by 13-25%, according to WRI analysis (reductions increase over time as shale gas production increases). Yet much more can and should be done to further reduce methane leaks and vents. The EPA maintains a list of technologies[46] that industry can use to reduce or capture leaking gas on a voluntary basis, though WRI analysis shows that implementation of many of these technologies should be required if leakage is to be successfully addressed.

Yet even if upstream methane emissions from natural gas were eliminated entirely, combustion emissions – which make up approximately 80-85% of all natural gas emissions – must be significantly reduced if natural gas is to play an effective role in the carbon-constrained economy of the near future. Natural gas still produces significant GHGs, and if the United States wants gas to be a long-term energy solution then it must find ways of controlling or eliminating GHG emissions from this source.

America Is Blessed With Clean Energy Opportunities

The United States is rich in clean energy resources and options, including renewable energy, energy efficiency, and know-how on CCS. Such capacity provides new and untapped opportunities to not only increase energy and climate security, but also to create American jobs and spur economic growth.

[45] http://www.epa.gov/airquality/oilandgas/pdfs/20120417finalrule.pdf
[46] http://www.epa.gov/gasstar/tools/recommended.html

According to the National Renewable Energy Laboratory (NREL), the United States can meet 80% of its electricity needs in 2050 through renewable generation.[47] However, if the United States wishes to harness its renewable resources it needs to put in place a set of clear incentives and frameworks for success.[48]

The United States has immense remaining potential for improving efficiency in its industrial, transportation, and buildings sectors. The NAS found that energy efficiency technologies could save 30% of the energy used in the United States.[49] A series of Department of Energy studies[50] have concluded that significant energy efficiency potential exists across a number of key industrial sectors, as summarized in the table below from a forthcoming WRI report ("*Can The U.S. Get There From Here? Using Existing Federal Laws and State Action to Reduce Greenhouse Gas Emissions*").

[47] See http://www.nrel.gov/analysis/re_futures/
[48] http://pdf.wri.org/delivering_clean_energy_economy.pdf
[49] http://www.nap.edu/catalog.php?record_id=12621
[50] Bandwidth Studies, prepared for the U.S. Department of Energy, are available here: http://www1.eere.energy.gov/manufacturing/resources/energy_analysis.html
Interlaboratory Working Group. 2000. Scenarios for a Clean Energy Future (Oak Ridge, TN; Oak Ridge National Laboratory and Berkeley, CA; Lawrence Berkeley National Laboratory), ORNL/CON-476 and LBNL-44029, November. Available at: http://www.ornl.gov/sci/eere/cef/

Table 2.73 Energy Savings and Energy-Related Carbon Dioxide (Mobility Improvements in the Manufacturing Sector (percent)

	Chemical Industry with Best Practice (Benchmarks)	Energy Savings with Practical Maximum (Benchmarks)	Total Energy Savings in Tons with Similar Savings Than Gas and Products	Reduction of Intensity Improvements from Air Emissions and Carbon Dioxide Emissions in Kilowatts			
				Base Case	Lockheater (10 percent efficiency gain all boilers)	Middle-of-the-Road (CEF)	Go-Gather (CEF = natural gas emissions rate for new units)
Food Products	NA	NA	33	20	26	37	42
Paper	26	39	31	19	25	38	42
Bulk Chemical	18	31	38	27	33	37	38
Glass	15	52	22	11	12	18	19
Cement	NA	NA	31	9	9	22	46
Iron & Steel	3	31	54	33	33	37	45
Aluminum	NA	NA	48	25	28	43	51

Note: The bandwidth study determined baseline energy consumption for paper manufacturing using 2002 Manufacturing Energy Consumption Survey (MECS) data, plus data collected for the report. The bandwidth study for glass was based on data collected through surveys collected for the report prior to publication in 2007. The bandwidth study for steel was based on energy-use data from 2000. The bandwidth study for bulk chemicals was based on energy data collected in 2004 for the report.[44]
Source: Steel Industry Energy Bandwidth Study, Energetics, Inc., U.S. Department of Energy, October 2004; Chemical Bandwidth Study Energy Analysis: A Powerful Tool for Identifying Process Inefficiencies in the U.S. Chemical Industry, Dickson Ozokwelu, Joseph Purcell, and Peter Akinjiola, U.S. Department of Energy, December 2004; Industrial Glass Bandwidth Analysis, David Rue, James Servaites, and Warren Wolf, U.S. Department of Energy, December 2004; Pulp and Paper Industry Energy Bandwidth Study, Jacobs Institute of Paper Science and Technology, American Institute of Chemical Engineers, August 2004.

Source: WRI, "*Can The U.S. Get There From Here? Using Existing Federal Laws and State Action to Reduce Greenhouse Gas Emissions*".

Integrating renewable energy with the existing electric generation fleet

Renewable energy systems – even those with intermittent generation, such as wind and solar – can and should be integrated with the existing framework of primarily fossil-based electricity generation. The technical, regulatory, and economic barriers to such integration can be overcome. The technical barriers are being addressed through research and development, while the regulatory and economic barriers can be eliminated with straightforward policies that reward businesses for investing in renewable generation and set clear frameworks for integrating renewable electricity into the grid. Policies that provide transparency, longevity, and certainty – such as well-designed feed-in tariffs, renewable energy standards, or long-term power purchase agreements – have a proven

track record of increasing renewable generation at low cost, a cost which is likely to decline over time as the price of renewable generation falls with increasing economies of scale.[51] Distributed generation and integrating renewable energy systems with fossil generation can also enhance grid reliability, especially during times of natural disaster.[52]

Cost of clean energy

Renewable energy (including hydropower) continues to grow by leaps and bounds around the world, increasing by 72% between 2000 and 2011; solar and wind saw the greatest growth over that period, with global wind generation growing by a factor of 13 and solar photovoltaic generation by a factor of 51.[53] In the United States, renewable generation has grown at an average rate of 4.2% per year between 2000 and 2011, with wind and solar again representing the fastest growing renewable energy sectors.[54] Just last week, the American Wind Energy Association announced that more than 13,000 MW were installed in 2012, putting U.S. wind capacity at 60 GW.[55] This deployment has led to a dramatic reduction in the cost of electricity produced by these technologies, a trend

[51] See, for example, "The German Feed-in Tariff for PV: Managing Volume Success with Price Response" from the Deutsche Bank Group's DB Climate Change Advisors. Available at: https://www.dbadvisors.com/content/_media/DBCCA_German_FIT_for_PV_0511.pdf.
[52] See, for example, http://insights.wri.org/news/2012/11/rebuilding-cities-after-sandy-3-keys-climate-resilience and http://www.forbes.com/sites/williampentland/2012/10/31/where-the-lights-stayed-on-during-hurricane-sandy/.
[53] National Renewable Energy Laboratory's 2011 Renewable Energy Data Book, available at http://www.nrel.gov/docs/fy13osti/54909.pdf.
[54] Ibid.
[55] http://www.awea.org/learnabout/publications/reports/upload/AWEA-Fourth-Quarter-Wind-Energy-Industry-Market-Report_Executive-Summary-4.pdf
http://www.awea.org/learnabout/publications/reports/upload/AWEA-Fourth-Quarter-Wind-Energy-Industry-Market-Report_Executive-Summary-4.pdf

that is expected to continue as technology improves and manufacturing achieves economies of scale.[56,57]

Currently, the average levelized cost of energy for wind energy is comparable to that for coal, though the low price of natural gas in the United States makes it difficult for any technology – renewable, coal, or nuclear – to compete on the basis of price alone.[58,59] Renewable energy provides price stability, as it is not subject to volatile swings in the cost of fuel.[60] In fact, renewable energy systems – especially using several renewable technologies in conjunction with one another (for example, wind, solar, and hydropower) as well as energy efficiency – can reduce peak load and actually lower the overall cost of electricity, especially during times of high demand.[61]

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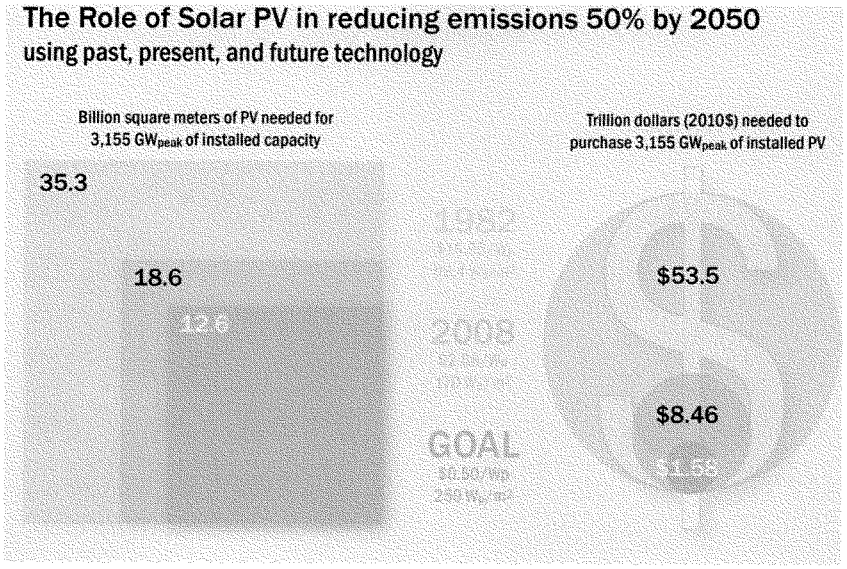
[56] See, for example, Figures 10-12 and 10-13 in Volume 2 of NREL's Renewable Electricity Futures Study, available at: http://www.nrel.gov/docs/fy12osti/52409-2.pdf, and NREL's "The Past and Future Cost of Wind Energy," available at: http://www.nrel.gov/docs/fy12osti/53510.pdf.
[57] http://pdf.wri.org/working_papers/two_degrees_of_innovation.pdf
[58] See Table 1 here: http://www.eia.gov/forecasts/aeo/electricity_generation.cfm.
[59] http://insights.wri.org/news/2012/04/electricity-markets-increasingly-favor-alternatives-coal.
[60] See historical natural gas prices here: http://www.eia.gov/dnav/ng/hist/n9190us3m.htm and historical coal prices here: http://www.eia.gov/totalenergy/data/annual/showtext.cfm?t=ptb0709.
[61] See, for example, "Matching Hourly and Peak Demand by Combining Different Renewable Energy Sources: A Case Study for California in 2020" (available at http://www.stanford.edu/group/efmh/jacobson/Articles/I/CombiningRenew/HosteFinalDraft) and "Examining the Peak Demand Impacts of Energy Efficiency: A Review of Program Experience and Industry Practices" (available at http://www.epa.gov/statelocalclimate/documents/pdf/work_paper_ee_peak_demand_4-12-2007.pdf).



Source: WRI, http://pdf.wri.org/working_papers/two_degrees_of_innovation.pdf

American jobs

American exports of energy equipment and the high-skill jobs required to bring the American energy industry into the 21st century will grow as the market share for renewable energy grows. The United States generated about 12% of its electricity from renewable sources in 2011;[62] at that level of generation, the Environmental and Energy Study Institute estimates that the renewable energy sector employed between 850,000-950,000 people, as compared to 731,000 people in the oil, gas, and coal industries.[63]

[62] National Renewable Energy Laboratory's 2011 Renewable Energy Data Book, available at http://www.nrel.gov/docs/fy13osti/54909.pdf.
[63] Sources: For jobs in renewable energy, see: http://files.eesi.org/jobs_reee_060111.pdf. Coal mining employed 83,420 people in 2011, according to the Bureau of Labor Statistics – see

According to the United Nations Environment Programme, there could be 8.4 million jobs in solar photovoltaic and wind energy, and 12 million jobs in biofuels, globally by 2030.[64]

In fact, transitioning from fossil fuels to renewable sources (or increased energy efficiency) for electricity generation can lead to significant growth in jobs. One recent study published in *Energy Policy* found that a 30% renewable portfolio standard, combined with aggressive measures to promote energy efficiency, could create over 4 million jobs by 2030.[65] The same study looks at average employment over the life of electricity generation facilities, normalizing this data by comparing job-years per gigawatt-hour across ten different generation technologies, as well as CCS and energy efficiency. The authors found that natural gas and coal both created 0.11 job-years per gigawatt-hour; the equivalent numbers for renewable technologies were 0.17 for wind, 0.21 for biomass, 0.23 for solar thermal, 0.25 for geothermal, 0.27 for small hydropower, 0.38 for energy efficiency, 0.72 for landfill gas, and 0.87 for solar photovoltaics. This study demonstrates that getting serious about reducing emissions, reducing peak load, enhancing grid reliability, and providing price stability through increased utilization of renewable energy and energy efficiency will not adversely impact employment. On the contrary, focusing on America's abundant *clean* energy resources will be a boon for both the environment and the economy.

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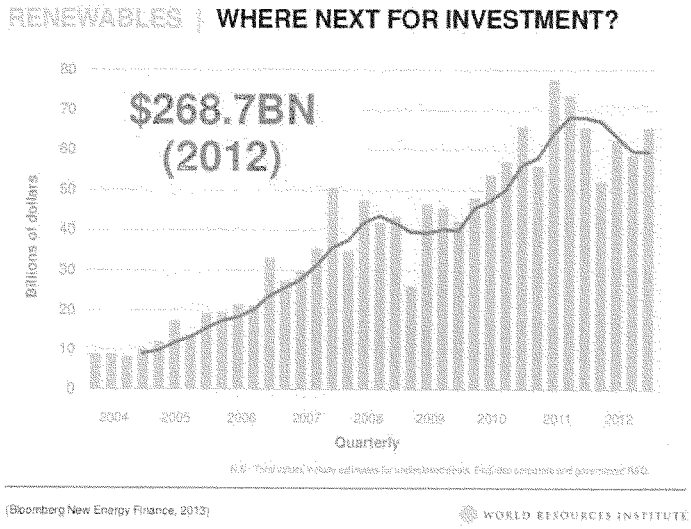
http://www.bls.gov/oes/current/naics4_212100.htm. And 648,000 people were employed in oil and gas extraction, support activities, pipeline construction, petroleum refineries and pipeline transportation – see http://www.bls.gov/iag/.

[64] UNEP "Green Jobs: toward decent work in a sustainable, low carbon world" (24 Sep 2008) p.8.

[65] See "Putting Renewables and Energy Efficiency to Work: How Many Jobs can the Clean Energy Industry Generate in the US?" Available at: http://rael.berkeley.edu/sites/default/files/WeiPatadiaKammen_CleanEnergyJobs_EPolicy2010.pdf.

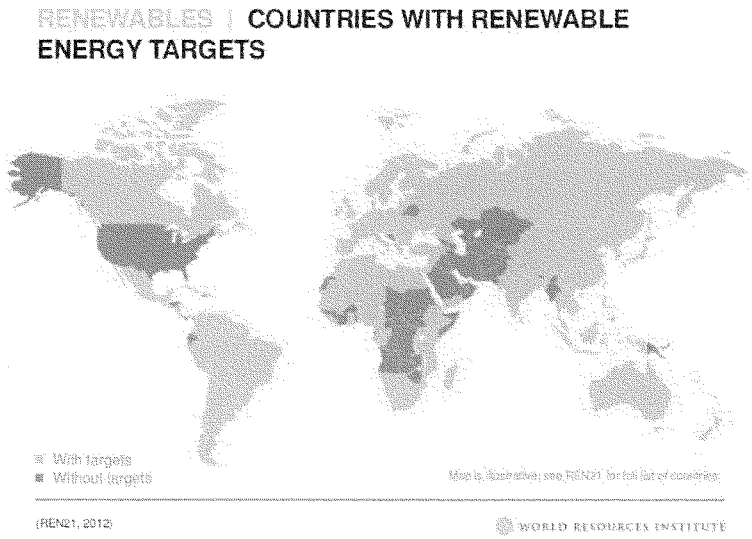
Global Perspective on the Way of the Future

Throughout the world, countries are making significant investments in clean energy technology and infrastructure. Globally, clean energy investment in 2012 was $268.7 billion, five times higher than in 2004. Approximately half of the estimated 208 GW of new electric capacity added globally in 2011 came from renewable energy sources.[66] In 2011, global investments in non-hydro renewable energy surpassed net investment in fossil-energy power plants.[67] The market opportunities are significant. The global market for low-carbon technology could double or even triple, to between $1.5 and $2.7 trillion annually by 2020.[68]



[66] REN 21, Renewables 2012: Global Status Report
[67] UNEP - BNEF, Global Trends in RE Investment
[68] HSBC. "Sizing the Climate Economy." September 2010. These estimates include investment in energy efficiency, accounting for roughly half of all investment in the authors' "most likely" scenario.

Source: WRI, Stories to Watch 2013



Source: WRI, Stories to Watch 2013

How competitive is the U.S. in the clean energy race?[69]

The United States is the world leader in clean energy research and development (R&D) and has been among the top three countries globally in renewable energy investment for years. This could provide a good base for a strong U.S. renewable energy industry. However, the United States has been less successful relative to countries in deploying renewable energy technologies into the market and capturing these new industries and related jobs, because of a lack of policy and regulatory certainty.

[69] WRI recently released a comparative study across five countries (U.S., China, India, Germany, Japan) to assess which countries have been most successful in deploying wind and solar energy domestically and also in capturing global markets through domestic manufacturing. This section of the testimony draws heavily on the study. For details, see http://www.wri.org/publication/delivering-on-the-clean-energy-economy

In terms of R&D:

China's 12th Five Year Plan has a target for R&D expenditure in all industries to account for 2.2% of GDP by 2015. By comparison, the United States and Germany both spend about 2.8% of GDP on R&D.[70] Compared to health ($34 billion) or defense-related research ($81 billion), the amount spent by the United States each year on clean energy technology R&D ($4.7 billion) is small.[71] Nonetheless, the United States spends more than any other country on R&D, and public and private R&D spending on renewable energy in the United States accounts for 30% of the global total.[72,73] However, the clean energy innovations created in U.S. national laboratories and universities often do not get manufactured or deployed into the marketplace. For instance, a recent WRI report comparing clean energy industries across major countries highlighted that the United States had the highest public investments in wind energy R&D. Yet, it was the only wind energy market among the five countries analyzed that maintained a long-term trade deficit in wind equipment, importing more than it exports, due largely to the uncertainty surrounding the longevity of support policies.[74]

In terms of investment:

In 2012, $44.2 billion was invested in clean energy in the United States, a 32% decline

[70] http://www.rdmag.com/articles/2011/12/2012-global-r-d-funding-forecast-r-d-spending-growth-contin
[71] http://www.brookings.edu/~/media/Research/Files/Papers/2012/4/18%20clean%20investments%20muro/0418_clean_investments_final%20paper_PDF.PDF
[72] http://battelle.org/docs/default-document-library/2012_global_forecast.pdf
[73] http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Report/FINAL_forweb_WhoIsWinningTheCleanEnergyRace-REPORT-2012.pdf, p. 12
[74] http://www.wri.org/publication/delivering-on-the-clean-energy-economy

compared to the record $65.4 billion invested in 2011.[75] China led the world in clean energy investment with $67.7 billion in 2012, a 20% increase over 2011.[76] China is also investing in clean energy abroad, and in joint ventures with global partners. Chinese firms invested $264 million in the U.S. clean energy sector in 2011, with an annual growth rate of 130% over the previous two years.[77] Although the United States has traditionally been among the world's top three clean energy investors, such investment in the United States has grown neither as steadily nor as fast as clean energy investment elsewhere in the world. The five-year rate of investment growth between 2006 and 2011 was 37% in China, 23% in India, 22% both in Japan and Germany, and only 12% in the United States. The United States does not even make the top 10 among the G-20 economies in investment growth, and risks falling behind in the long run.[78]

In terms of installed capacity:

Countries with comprehensive, predictable, and targeted policies have seen the biggest scale-up of domestic renewable energy installations. This trend is evidenced in both Germany and China, where supportive policy frameworks are integrated into national economic and energy plans that have at least a five-year lifespan. Germany's comprehensive renewable energy law incorporates feed-in tariffs, and provisions for grid interconnection and priority power dispatch. This has been instrumental in providing fast project realization times, investment certainty, and lower overall transaction costs for

[75] http://bnef.com/WhitePapers/download/266, p. 11
[76] http://about.bnef.com/2013/01/14/new-investment-in-clean-energy-fell-11-in-2012-2/
[77] Linden Ellis, Devin Kleinfield-Hayes, and Jennifer Turner. "Chinese Investment in Clean Energy." China Business Review. https://www.chinabusinessreview.com/public/1204/ellis.html
[78] http://www.pewenvironment.org/uploadedFiles/PEG/Publications/Report/FINAL_forweb_WhoIsWinningTheCleanEnergyRace-REPORT-2012.pdf, p. 12

installations. These policies have helped Germany become the country with the most solar photovoltaic capacity and the third-most wind and biomass capacity in the world.[79] China has recently tied support policies into broader economic development goals in its 5-Year Economic Development Plans. A package of renewable energy policies – supporting installations, domestic manufacturing, and R&D – all helped the industry triple its solar PV installations from 1 GW to 3 GW, and increase its on-shore wind capacity from 44 GW to 62 GW in 2011 alone. The United States, with a patchwork of national and state policies, has not seen comparable scale-up.

In terms of manufacturing:

In developing a domestic clean energy manufacturing industry, the United States has lagged behind those countries that have used the stable and predictable incentives highlighted above and supplemented this market creation with targeted support for innovative manufacturing. To date, the United States has had a largely passive approach to supporting renewable energy manufacturing, with short bursts of national investment and policy support (e.g., through the 2009 stimulus package). This seems to have been ineffective in the context of global competition. Meanwhile, in the realm of solar photovoltaics, Japan has the highest average module prices but has still managed to maintain module manufacturing production comparable with Germany (~2 GW) and twice that of the United States (~1 GW), due to a concerted focus on policy strategies that support quality and performance. This has been supported through collaborative innovation between industry, government, and academics.

[79] See the National Renewable Energy Laboratory's 2011 Renewable Energy Data Book, available at http://www.nrel.gov/docs/fy13osti/54909.pdf.

In wind power, America has suffered from the fact that short-term policies have not sent a clear signal that there will be a market for wind turbines beyond the end of any calendar year. This has meant that equipment suppliers have preferred to import rather than to produce in the United States. As noted above, the United States was the only one of the 5 major markets WRI analyzed that maintained a long-term trade deficit in wind equipment. It is not just the size of the market that matters; predictability and investor certainty are crucial.

Concluding Recommendations

1. The risks associated with climate change and federal capacity to address these risks must be better understood. Congress should request that the National Climate Assessment and Development Advisory Committee review the current authorities of federal agencies and national laboratories, and recommend how consideration of risks associated with climate change can be more directly incorporated into decision-making. The recommendations should include actions that each agency can take to most effectively limit the magnitude of climate change and improve our ability to adapt to it.

2. The impacts of climate change on America's energy infrastructure must be better assessed and incorporated into planning and current investment decisions. To support such efforts, Congress can:
    - Adopt policies that encourage hazard mitigation approaches which make the electricity and energy supply sectors more resilient to climate impacts.

- Adopt policies that require a systematic assessment of climate impacts as part of the planning processes so that all new energy investments take into account climate risks.

3. We must build out America's renewable energy sector. The United States is one of a small set of countries that currently lack a federal renewable energy target. As Congress considers how to achieve growth in renewable energy, there are four important criteria for a policy to drive more effective clean energy growth and competitiveness:[1]

   First, any energy policy should be **comprehensive** – extending beyond deployment subsidies and incorporating support for manufacturing.

   Second, it should be **long-term** – with a predictable time horizon extending a minimum of three years, particularly for manufacturing.

   Third, it should be **targeted** – technology-neutral policies such as carbon prices need to be complemented with support that takes issues such as tradability of renewable energy components into account.

   Fourth, it should be **inclusive** of the complete value chain for renewable energy technologies – since economic benefit opportunities extend beyond just the manufacturing sector.

[1] http://www.wri.org/publication/delivering-on-the-clean-energy-economy

4. We must capture energy efficiency across the economy. The federal government can play a constructive role in two key areas:

   Informed consumer choice: the relative performance of energy services and energy-consuming products – including vehicles, appliances, and buildings – should be more visible to consumers so that they can make informed choices about the true cost and value of their investments. Congress should support and expand such programs to help ensure product labeling is accurate and publicly reported in a timely manner, to encourage energy-wise investment decisions throughout the U.S. economy.

   Efficiency standards: Several federal agencies have been charged by Congress with setting energy efficiency standards for vehicles, appliances, and other energy-consuming equipment that is sold into U.S. commerce. Congress should support and extend the ability of agencies to develop and update such standards, in the interest of consumer protection and to increase the energy productivity of the U.S. economy. For example, the recently finalized vehicle efficiency standards are projected to save consumers $1.7 trillion at the pump while reducing U.S. oil consumption by 12 billion barrels of oil per year by 2025.[2]

5. Finally and most importantly, Congress must work toward reaching bipartisan agreement on national energy policies that encourage more efficient energy

[2] http://www.whitehouse.gov/the-press-office/2012/08/28/obama-administration-finalizes-historic-545-mpg-fuel-efficiency-standard

consumption, increase the diversity of domestic energy production, maximize deployment of low-carbon energy technologies, and minimize environmental impacts throughout our energy systems. In the near-term, it is also critical for Congress to provide funding and incentives for low-carbon and clean energy technologies. The most effective way to achieve all these goals would be to move forward on comprehensive national energy and climate legislation.

Mr. WHITFIELD. Thank you, Ms. Morgan.

Ms. Hutzler, you are recognized for 5 minutes.

STATEMENT OF MARY J. HUTZLER

Mr. HUTZLER. Chairman Whitfield, Ranking Member Rush and members of the subcommittee, thank you for the invitation to participate in today's hearing.

The Institute for Energy Research is a nonprofit think tank that conducts research and analysis concerning global energy issues. In the last several years, IER has monitored closely the boom in energy production that is taking place in the United States, primarily on private and State lands. IER also tracks regulations and policies that limit the potential to reduce our dependence on overseas oil regimes, hinder our ability to generate much-needed revenues, and harm efforts to foster an energy-based economic recovery that creates jobs.

Just this morning, we released a study on the economic effect of immediately opening federal lands onshore and offshore to energy production. According to our analysis, immediately opening federal lands that are currently unavailable because of statutory or administrative action would result in an additional $14.4 trillion to our GDP over the next 37 years. In light of the recent Commerce Department report, the GDP shrank for the first time since 2009. Our economy needs the lasting stimulus that robust energy development on federal lands and waters would provide.

But today's hearing is focused primarily on the resource availability and the potential under our feet and off our shores to achieve domestic energy goals, almost unthinkable just a few years ago. In fact, for decades Americans were asking the question, where we will get the energy we need to heat our homes, fuel our cars and meet the demands of a strong 21st century economy. Due to hydraulic fracturing and horizontal drilling technologies, we no longer question whether we have the resources. Rather, we question whether we will be able to develop them and thus reap the nationwide economic benefits such development would foster.

The myth of energy scarcity that has plagued our national conversation has been exposed. Just in the last year, the misleading refrain that the United States only possesses 2 percent of the world's oil reserves has been replaced by the mounting evidence of our Nation's resource abundance. IER highlighted this in an inventory of North America's energy resources. Using government information, we cataloged the vast resources of the United States and our neighbors. The United States has enough resources to provide reliable and affordable energy for centuries to come. The question is whether the federal government will permit us to access these abundant resources and not whether sufficient resources exist. We can now unlock our shale resources using technology proven for more than 60 years in over 1 million wells without a single confirmed case of contamination.

Furthermore, while our use of fossil energy has dramatically increased over the last 50 years, our air quality has improved. According to the EPA, emissions from the six criteria pollutants under the Clean Air Act have decreased 68 percent since 1970, even though our energy consumption has increased by 45 percent.

Therefore, however troubling trends in policy that threaten to restrict access to our vast energy resources, which could make American-made energy less available, affordable and reliable. Oil shale development has all but stopped because Administration policy withdrew research in much-needed leasing activity that could bring these resources to market.

Increased oil sands imports from our neighbor Canada could free the United States from energy dependence on foreign countries where American workers face increasing threats of kidnapping by terrorists and even murder. But we need the transportation infrastructure to get it here and the energy security this infrastructure would provide. Onshore development on federal lands, which is roughly estimated at 700 million acres of subsurface mineral estate, is extremely limited and is increasingly so. In fiscal year 2009, for example, the current Administration leased fewer onshore acres for energy development than in any preceding year on record. Offshore development on 1.76 billion acres of mineral lands has suffered from the de facto Administration embargo with lease plans canceled, moratoria imposed and cumbersome regulatory activity that served to discourage exploration.

Today, permitting delays by federal regulators have driven the wait to more than 300 days before drilling can begin on federal lands, about twice as long as it took in 2005. By contrast, States like North Dakota are now turning permits in 10 days, in Ohio, 14 days, in Colorado, 27 days. Alaska's energy resources lie dormant even though its pipeline has enough unused capacity to take twice the daily production of North Dakota.

Decisions made today about access to energy resources affect energy production for years and decades to come. The more areas accessible to energy production today increases the likelihood of domestic production tomorrow, and with it, increased jobs, government revenues and economic activity.

Thank you for the opportunity to testify today, and I look forward to your questions.

[The prepared statement of Ms. Hutzler follows:]

Summary of IER Testimony before Subcommittee on Energy and Power, February 5, 2013

- The U.S. has a vast amount of technically recoverable oil, natural gas, and coal resources
  - Technically recoverable U.S. oil, natural gas, and coal resources can easily supply our energy needs for hundreds of years
- **"Reserves" do not measure resource capability**
  - The term "reserves" only includes resources that have been discovered and are economical to recover *at the current price* with *current technology* on the lands *currently made available* for industry to develop.
  - U.S. oil "reserves" in 1944 were 20 billion barrels but today they are larger even though we found, produced and consumed 167 billion barrels over that time period.
- Hydraulic fracturing and horizontal drilling dramatically increase the amount of oil and gas we can recover.
  - Between 1995 and 2008, the USGS estimate of technically recoverable oil in the Bakken formation **jumped by a factor of 25** due to hydraulic fracturing.
  - Hydraulic fracturing has been used for over 60 years in over one million wells **without a confirmed case of groundwater contamination**.
- The U.S. is now the **largest natural gas producer in the world** and forecasters expect it to be the largest oil producer by 2017
  - Shale oil production has **increased by 400 percent over the past ten years**.
  - Shale gas production increased by over 300 percent from 2007 to 2010
- U.S. oil shale technically recoverable resources are nearly four times the amount of Saudi Arabia's proven oil reserves; oil shale is a sedimentary rock that contains kerogen, an oil and gas bearing organic
- Federal land leases have declined continuously since the 1980's, putting extensive limits on our oil, natural gas, and coal resources
  - The U.S. is the **only developed country in the world that has banned access to its own offshore energy sources**.
- 96 percent of the increase in oil production between fiscal years 2007 and 2012 came from private and state lands.
  - It takes over 300 days to process a permit to drill on federal lands onshore. It takes less than 30 days to process a permit for private and state lands.
- **Opening federal lands to oil and gas leasing would add $14.4 trillion in economic activity** and $3.8 trillion in federal, state and local tax revenues over the next 30 years, according to a forthcoming study commissioned by IER.
  - 552,000 jobs annually over the next seven years, 1.9 million jobs per year in the long-run.
- Over the past 50 years, our use of coal, oil, and natural gas resources has dramatically increased and air quality improved dramatically.
- Emissions from the six criteria pollutants under the Clean Air Act have decreased 68 percent since 1970.
  - The Utility MACT rule would add $21 billion per year in compliance costs on businesses, destroy 183,000 jobs per year, increase electricity prices by 10-20%

BEFORE THE SUBCOMMITTEE ON ENERGY AND POWER

COMMITTEE ON ENERGY AND COMMERCE

HEARING ON American Energy Security and Innovation: An Assessment of North America's Energy Resources

FEBRUARY 5, 2013

TESTIMONY OF MARY J. HUTZLER

THE INSTITUTE FOR ENERGY RESEARCH

The Institute for Energy Research (IER) is a non-profit organization that conducts research and analysis on the functions, operations, and government regulation of global energy markets. IER articulates free market positions that respect private property rights and promote efficient outcomes for energy consumers and producers. IER staff and scholars educate policymakers and the general public on the economic and environmental benefits of free market energy. The organization was founded in 1989 as a public foundation under Section 501(c)(3) of the Internal Revenue Code. Funding for the institute comes from tax-deductible contributions of individuals, foundations, and corporations.

The United States is Energy Rich

The United States has vast resources of oil, natural gas, and coal. In a few short years, a forty-year paradigm—that we were energy resource poor—has been disproven. Instead of being resource poor, we are incredibly energy rich. The world

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www.instituteforenergyresearch.org

is changing and the private sector in the United States is leading the way. In December 2011, IER published a report entitled *North American Energy Inventory* that provides the magnitude of these resources for the United States, Canada, and Mexico.[1] As the report shows, the United States is vastly endowed in all three forms of organic fossil energy. In fact, the amount of technically recoverable oil in the United States totals almost 90 percent of the entire oil reserves in the world.[2]

Technically recoverable resources are not equivalent to reserves, but comparing their magnitudes provides a way to measure size. Technically recoverable resources are undiscovered resources that are recoverable with existing drilling and production technologies, but may not be economic at today's prices. Reserves, on the other hand, are resources that are easily accessible and recoverable with today's technology and at today's oil prices. IER's estimate of technically recoverable oil in the United States is 1,422 billion barrels. That amount of oil can satisfy U.S. oil demand for 250 years at current usage rates or it can fuel every passenger car in the United States for 430 years. It is also more oil than the entire world has used in all human history.

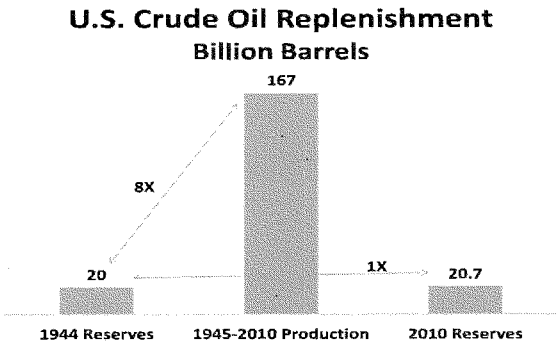
The technically recoverable natural gas resources in the United States total 40 percent of the world's natural gas reserves. At 2,744 trillion cubic feet, it can fuel natural gas demand in the United States for 175 years at current usage rates, or selectively, it can satisfy the nation's residential demand for 857 years or the nation's electricity demand for 575 years.

The technically recoverable coal resources in the United States are unsurpassed and total 50 percent of the world's coal reserves. At 486 billion short tons, it can supply our country's electricity demand for coal for almost 500 years at current usage rates. In fact, the United States has the largest coal reserves of any country in the world with Russia and China rounding out the top three countries in ranking. While we have the largest coal reserves in the world, we do not consume the largest amount of coal. China consumes almost 4 times the amount of coal as we do here in the United States, although its coal reserves are much smaller than ours.[3] In 2011, China consumed more than 3.8 billion short tons of coal while the United States consumed 1 billion short tons.[4] Because government policies are making coal more difficult to use in the United States, some U.S. mining companies are exporting coal to China and elsewhere, in turn keeping mining jobs here at home.

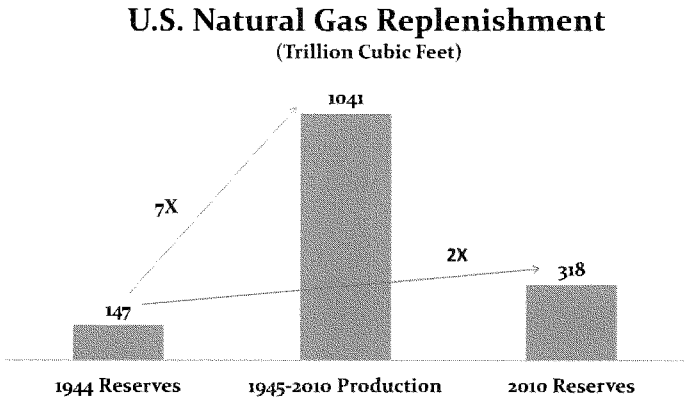
The reason why technically recoverable resources are important is that they become reserves when one or more of the following occurs: technology is developed that enables the resource to become economic such as with hydraulic fracturing, the price of the resource increases to enable production with existing technology, or more resource-rich lands or waters are made available to industry to develop.

Historical production and reserve numbers provide documentation regarding the transition from technically recoverable resources to reserves. For example, in 1944, U.S. oil reserves totaled 20 billion barrels and yet our oil and gas industry produced 167 billion barrels between 1945 and 2010—*8 times the amount of reserves available in 1944*—and the amount of U.S. oil reserves in 2010 still totaled 20.7

billion barrels. Thus, there was no reserve depletion; there was reserve replenishment.



The same is true for natural gas. In 1944, the United states had 147 trillion cubic feet of natural gas reserves, and yet had produced 1,041 trillion cubic feet between 1945 and 2010—7 times the amount of reserves available in 1944. In this case, however, the U.S. oil and gas industry was able to double the 1944 natural gas reserve level with 318 trillion cubic feet in reserves in 2010.



The Myth of Peak Oil, Natural Gas, and Coal

For many years, we have heard of fossil fuels reaching their peak production levels or at the verge of being depleted. For instance in 1855, an advertisement for "Kier's Rock Oil" indicated "...Hurry, before this wonderful product is depleted from Nature's laboratory!" and that was four years *before* the first U.S. oil well was drilled! And in 1919, David White, the Chief Geologist of the United States Geologic Survey stated "...the peak of [U.S.] production will soon be passed—possibly within three years." But, instead, we find that our oil production is growing with forecasters such as the International Energy Agency now predicting that the United States will become the world's largest oil producer by 2017.[5] Further, the IEA predicts that the United States will become almost energy self-sufficient by 2035.

And the peak production myth was not confined to just oil. For example, in January of 2007, Paul Hanrahan, the Chief Executive Officer of AES Power stated "The U.S. is running out of natural gas—production is declining and demand growing—so the expectation is that the import levels will go from 3 percent today to about 24 percent in 2020." Forecasters such as the Energy Information Administration were predicting that there would not be enough North American natural gas to meet demand and that we needed to build facilities for importing liquefied natural gas. Just a few years later, we find instead a shale gas boom and economics dictating that those *importing* facilities will become terminals for *exporting* natural gas as long as the government approves.

The same is true for the myth of 'peak' coal. In 2007, David Hughes, Geologist for the Geological Survey of Canada, stated, "Peak coal looks like it's occurred in the lower 48." And yet, the United States still has the largest coal reserves in the world. Rather than depletion effects, our coal industry is faced with overly broad and restrictive regulations on the use of coal and increasing restrictions on coal production from the U.S. Environmental Protection Agency.

The U.S. Shale Oil and Gas Revolution

The reason for the boom in both oil and natural gas production in the United States is that our oil and gas industry was able to revolutionize drilling and production from shale formations by combining hydraulic fracturing and horizontal drilling technology. Hydraulic fracturing uses water, sand, and trace amounts of chemicals to break apart the shale rock and horizontal drilling allows the oil to be produced

from the shale formations which, vein-like, run parallel to the surface thousands of feet below . Hydraulic fracturing has been in use since the 1940s, but combining fracturing with horizontal drilling allows much more of the oil and natural gas to be extracted than if the hydraulic fracturing was only used in vertical wells. When combined with the incredible advances in computer interpretive capabilities, an energy miracle is afoot.

That these technologies have combined to revolutionize the industry can be seen from the following example. In 1995, before hydraulic fracturing was being used in shale oil and shale gas drilling, the U.S. Geological Survey (USGS) estimated that the Bakken formation held 151 million barrels of technically recoverable oil. But in 2008, after the impact of hydraulic fracturing and horizontal drilling was included in the USGS's assessment, the estimate of recoverable oil in the Bakken jumped by a factor of 25.[6] The oil was always there, but it was human ingenuity, free enterprise and the application of technology—the things that have always made America great—that combined to free these energy riches.

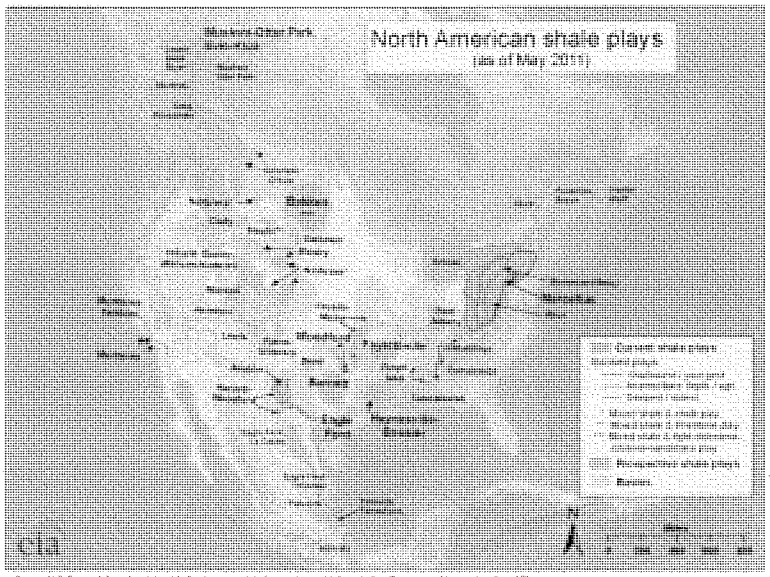
Ten years ago, shale oil formations produced about 200,000 barrels of oil a day. Today, these formations produce over one million barrels and production could reach three million barrels a day by 2020. This new oil production is occurring in a number of places around the country, including the Bakken formation in North Dakota, the Eagle Ford formation in Texas, and the Niobrara formation in Colorado. Unlike the large oil fields of the past few decades such as the fields in the Gulf of Mexico or Prudhoe Bay, Alaska, these new shale fields are mostly on private and

state lands. As a result, total U.S. oil production has increased, in spite of the federal government leasing fewer and fewer acres for energy production.

Shale gas has greatly increased the nation's supply of natural gas and has made the United States the largest natural gas producer in the world. In 2011, the United States out produced Russia by almost 5 trillion cubic feet (28.6 trillion cubic feet of natural gas produced here compared to 23.7 trillion cubic feet produced in Russia).[7] The U.S. Marcellus and Barnett shale formations are providing vast new natural gas reserves. U.S. proven reserves of shale gas increased from 21.7 trillion cubic feet in 2007[8] to 60.6 trillion cubic feet[9] in 2010. Between 2007 and 2010, shale gas production increased by over 300 percent from 1.3 trillion cubic feet produced in 2007 and 5.3 trillion cubic feet produced in 2010.[10]

The outlook for natural gas production in the United States has dramatically changed over the last decade. Just a few years ago, U.S. manufacturing facilities were moving abroad to pursue more affordable gas. At the time, the U.S. had relatively high natural gas prices. Now, due to hydraulic fracturing technology, energy companies are considering building liquefied natural gas terminals to export natural gas and new manufacturing plants are springing up around the country. The boom in natural gas production has completely changed the natural gas landscape and has greatly lowered natural gas prices for consumers and industrial users.

Lower energy prices benefit the entire economy, but especially the economically disadvantaged and those on fixed incomes. Expanded energy production resulting in lower prices is thus a benefit to society.

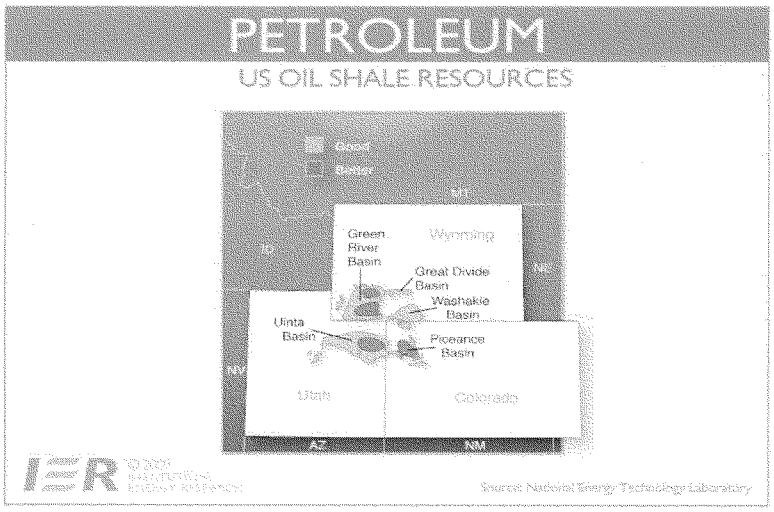


Source: U.S. Energy Information Administration based on data from various published studies. Canada and Mexico plays from ARI.
Updated: May 9, 2011

The increase in hydraulic fracturing, however, has led to attacks on natural gas production. Many special interest groups have launched anti-hydraulic fracturing campaigns, claiming that it is a new, dangerous technology that contaminates groundwater. But the reality is far different. Hydraulic fracturing has been used for over 60 years in over one million wells. Despite this widespread use—much of which occurred well before there were as rigorous state regulatory programs as there are today—there are no confirmed cases of groundwater contamination from hydraulic fracturing. If there was a problem, it would have shown up by now.

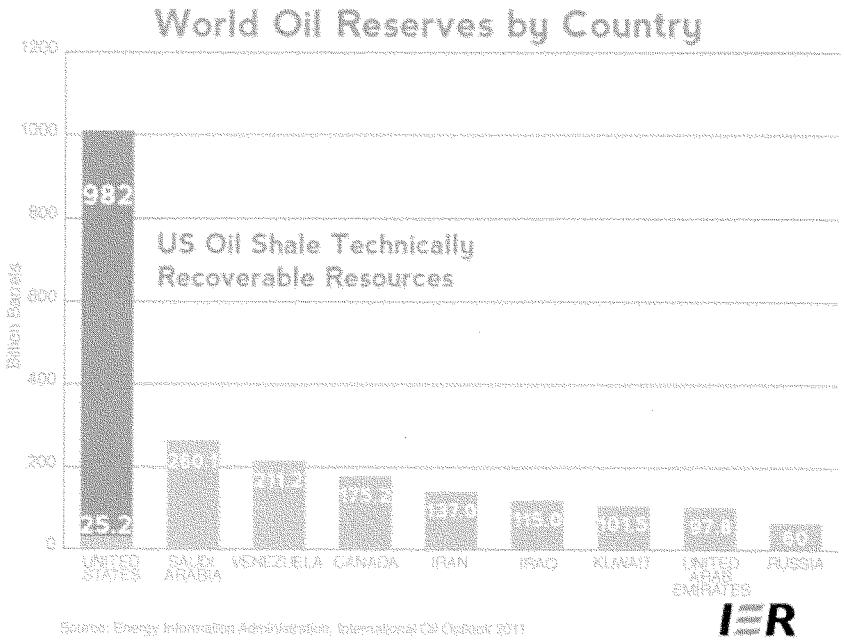
Oil Shale

Another area of potential oil growth is oil shale, a sedimentary rock that contains kerogen, a solid organic material. When the kerogen is heated to high temperatures, it releases petroleum-like liquids that can be processed into liquid fuels. The USGS estimates that U.S. oil shale resources total 2.6 trillion barrels of oil; about one trillion barrels of which are considered recoverable under current economic and technological conditions.[11] These one trillion barrels are nearly four times the amount of Saudi Arabia's proven oil reserves—a large enough supply for about 140 years at America's current rate of oil use. Oil shale is concentrated in the western United States in Utah, Wyoming, and Colorado and mainly on Federal lands.



Despite the great promise these resources hold, one of the first acts of the Obama administration was to withdraw the research and development oil shale leases that the Bush administration had offered consistent with the Energy Policy Act of 2005.[12]

Private sector research and development is necessary to bring these resources to market. Without these leases and the potential to commercialize the energy resource, companies will not invest the hundreds of millions of dollars required to develop the necessary technology. In Jordan, for example, Shell pledged to spend $500 million in exploration of the country's oil shale resources in return for the right to develop these resources if the exploration was successful.[13] The potential that oil shale holds here in the United States can be seen by the following graph:



Oil Sands

Another unconventional oil is oil sands. Oil sands are permeated with bitumen, which is a form of petroleum in solid or semi-solid state that is typically found blended with sand, clay, and water. Petroleum is extracted from oil sands by either traditional pit mining on the surface or in-situ production underground. Once extracted, the petroleum is diluted with condensate or other light oils or upgraded using processing units into a light, sweet "synthetic" crude oil.

Our northern neighbor, Canada, ranks third in the world in oil reserves (175 billion barrels) due mainly to its oil sand deposits. It is also the largest supplier of oil and petroleum products to the United States, supplying us with almost 3 million barrels per day.[14] Because of Canada's large oil reserves, TransCanada proposed an addition to its Keystone pipeline system, the Keystone XL, which would move oil from Canada to U.S. Gulf Coast refineries, with a capacity of 830 thousand barrels per day.

The Keystone XL pipeline would not only move Canadian oil but it would also help to move oil from areas in the United States where it is land-locked, such as shale oil production in North Dakota and crude oil stored at Cushing, Oklahoma. However, before the pipeline can be built, it must receive a permit from the U.S. State Department indicating that it is in the 'national interest' since it would cross the U.S. border with Canada. The U.S. government has delayed, denied and delayed again its approval due to environmental concerns regarding its original proposed route that crossed an environmentally sensitive area in Nebraska. TransCanada then submitted a revised route that the state of Nebraska approved, but U.S. State Department approval is still under study.

In the mean time, TransCanada is building the southern section of the pipeline, from Cushing to the Gulf Coast refineries, which does not need a Presidential permit, but which will help with the oil that is being land-locked in Cushing. Construction of Keystone's "Gulf Coast Project" began in the fall of 2012 and is expected to be in service by mid-to-late 2013.

The consequences for our neighbor and ally of pipeline construction delay has been a significant decrease in the price Canada receives for its oil, which in turn will reduce investment in Canadian energy production. Railroads are now moving oil, which is more costly and less safe than transport by pipeline.

Increased domestic production and increased imports from Canada along with approval of the pipeline could enable the United States to be almost independent of overseas oil in the future.

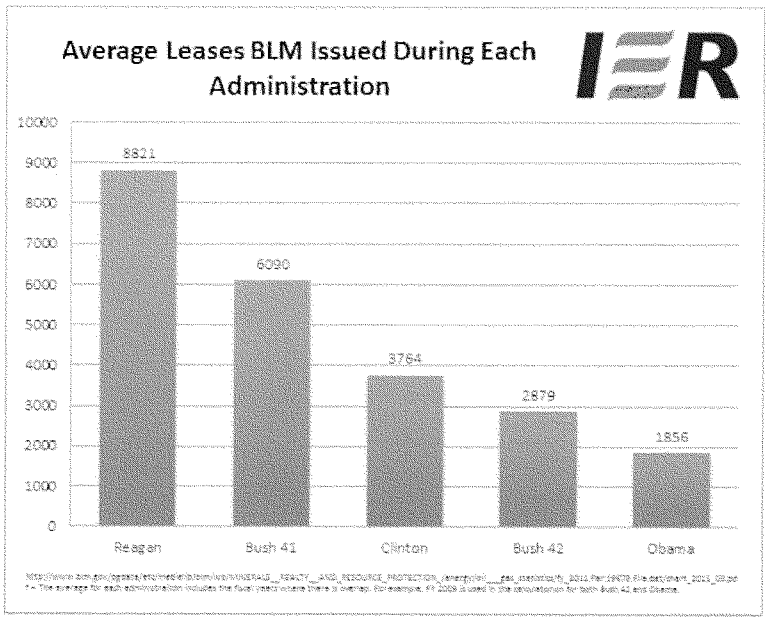
Production on Federal Lands

The United States is an energy-rich country with large quantities of U.S. energy resources found on federal lands. The federal government owns 28 percent of the land in the United States, and a majority of the land in the energy-rich western states.[15] The federal government also controls oil and natural gas leasing on the Outer Continental Shelf (OCS)—the submerged area between land and the deep ocean. Developing oil and natural gas production on federal lands is becoming more difficult and time consuming. As a result, oil production is decreasing in the

federally-controlled offshore areas and Alaska, but increasing on state and privately-controlled onshore areas.

Furthermore, the federal government offers very little of its land for energy exploration or production. In fact, the federal government has leased less than 2.2 percent of federal offshore areas[16] and less than 6 percent of federal onshore lands for oil and gas production.[17] The extent of the government's energy holdings is little understood. The United States owns roughly 700 million acres of subsurface mineral estate onshore throughout the nation. Additionally, it owns 1.76 billion acres of offshore mineral lands, for a total of 2.46 billion acres. *The U.S. government's mineral estate acreage holdings therefore are larger than the land masses of all nations on earth except Russia and Canada.* The extent to which this mineral estate has been examined for energy wealth for the benefit of U.S. citizens has been extremely limited and is increasingly so. If additional lands were leased, more domestic energy production, jobs and economic development could be pursued.

In 2009, the Obama administration leased fewer onshore acres for energy development than in any other year on record.[18] But the declining trend did not begin with the Obama administration. For example, President Bush leased less land than President Clinton.[19] The next graph shows the decline in federal lands leased by the Bureau of Land Management since the 1980s.[20]



Part of the reduction in area offered for lease occurred because in 1982, Congress banned the development of oil and natural gas resources on most of the Outer Continental Shelf. America's OCS encompasses 1.76 billion acres of submerged, taxpayer-owned lands, with over 97 percent of these offshore lands not leased for energy exploration and development.[21]

The Bureau of Ocean Energy Management (BOEM), an agency of the U.S. Department of Interior, estimates that the OCS contains 86 billion barrels of technically recoverable oil (over 12 years of supply at current consumption rates) and 420 trillion cubic feet of technically recoverable natural gas (about 18 years of supply at current consumption rates).[22] The Congressional prohibition was reinforced by a

presidential moratorium instituted in 1990 by President George H.W. Bush. These moratoria made the United States the only developed country in the world that comprehensively banned access to its own offshore energy sources.

The moratoria remained in place until the price of oil rose to more than $145 a barrel in 2008, prompting a public outcry that led President George W. Bush to finally lift the presidential offshore ban. Congress followed by allowing its moratorium to expire on September 30, 2008. It was finally permissible for the United States to move forward with developing its offshore energy resources.

Following the removal of the moratoria, the Department of the Interior issued a plan to lease newly opened offshore areas between 2010 and 2015, but this plan was quickly rescinded by the Obama administration. President Obama proposed opening a few additional offshore areas in March of 2010,[23] but canceled those plans less than a month later, following the Deepwater Horizon accident in the Gulf of Mexico. Instead of offering more areas for energy production, the Obama administration halted all drilling in the Gulf, initially as a six-month moratorium.

Later, the administration claimed to have relaxed the moratorium, but a *de facto* moratorium remained in place because the administration granted only a handful of the necessary government permits needed for drilling on federal land (including offshore areas). A federal judge eventually held the administration in contempt for their "determined disregard" to take action on drilling permits.[24]

After a disaster like the Deepwater Horizon, a review is understandable, but the response was considered by many experts as overblown. For example, the drilling moratorium and the subsequent de facto moratorium not only affected deepwater drilling, but also shallow-water drilling in the Gulf of Mexico. Yet shallow-water operators have a very impressive safety record. Over the last 15 years, 11,070 wells were drilled in shallow water and less than 15 barrels of oil were spilled.[25]

Since March 2011, the administration has been slowly issuing deep-water offshore permits for the Gulf of Mexico.[26] The administration has also approved a few supplemental plans to applications for deepwater drilling that were originally submitted in the 1980s. But these moves were made too late for the deepwater drilling rigs that had already moved to Brazil, French Guiana, Egypt, and other parts of Africa.[27]

Additionally, the administration's proposed leasing plan for 2012 through 2015 is the most anemic 5 year OCS leasing plan since the Outer Continental Shelf Leasing Act of 1978 (OCSLA). In sum, the 5 year plan in place through 2017 includes virtually none of those areas removed from the moratoria by Congress and the President in 2008. Barring changes, the OCS moratorium will be 35 years old when it expires at the end of the current OCS lease plan in 2017. For two generations, the federal government has denied its citizens access to the energy resources they own on their own lands.

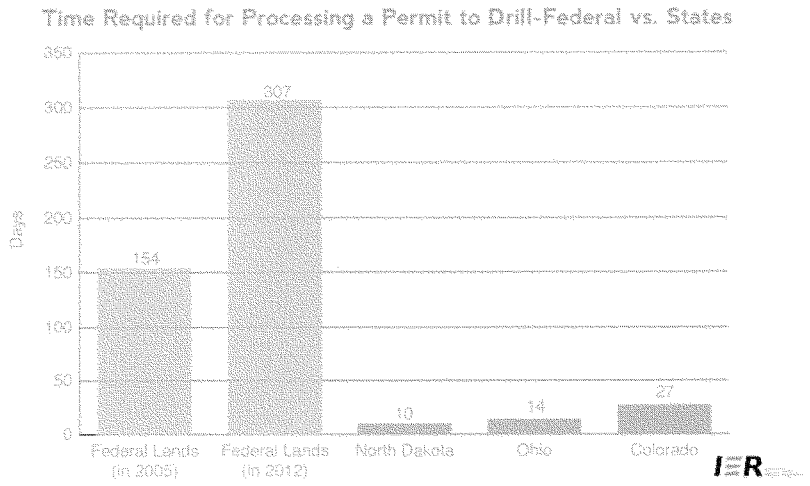
Data from the Energy Information Administration (EIA) show that production in the Gulf of Mexico slowed significantly following the moratorium. In 2010, 1.55 million

barrels of oil a day was produced in the federal offshore Gulf of Mexico and only 1.32 million barrels a day in 2011. Thus, after the moratorium and permitting difficulties, oil companies produced 15 percent less oil a day in 2011.[28] In 2012, EIA expects oil production in the federal offshore Gulf of Mexico to drop further to 1.27 million barrels per day before increasing to 1.37 million barrels per day in 2013. Even in 2014, the agency does not expect oil production from the Federal offshore Gulf of Mexico (1.44 million barrels per day) to reach the level of 2010 production.[29]

The large increases in oil production that have occurred in the United States are mainly on private and state lands. The Congressional Research Service (CRS) found that oil production on private and state lands makes up about 70 percent of total U.S. oil production. According to CRS, 96 percent of the increase in oil production between fiscal years 2007 and 2012 came from private and state lands and production there increased 11 percent in fiscal year 2011 from fiscal year 2010 levels. In contrast, the CRS report found that oil production from the federal onshore mineral estate was a mere 306,000 barrels per day (5.5 percent) out of a total of 5,590,000 barrels produced daily in the United States in fiscal year 2011.[30]

Total natural gas production on federal and Indian lands has decreased each year since fiscal year 2003, the first fiscal year that EIA provides the information. In FY 2011, production was 4,859 billion cubic feet—a 10-percent decrease from fiscal year 2010, and a 31-percent decrease compared with the fiscal year 2003 level. Offshore natural gas production has been on a consistent downward trend over the last 9 years, falling more than 60 percent.[31]

Oil and gas producers prefer to explore and drill on private and state lands because there is a lot less red tape involved and much shorter approval times, which means it is less costly to invest and drill for them on state and private lands than on federal lands. The states and private land owners have just as much interest in the protection of their lands, but they have found ways to balance environmental protection with economic growth. In any enterprise, time is money, and as it stands now, it takes over 300 days to process a permit to drill on Federal lands onshore, while it takes less than a month to process a permit to drill on private and state lands.



Oil and gas production projects frequently have very long lead times, unlike some other businesses. We know, for example, the speed with which information technology progresses, and know that most high tech firms would quickly abandon

economic commitments constrained by government policies that take a decade or more before deployment. Multi-billion dollar projects, such as many of the large offshore oil projects, take years to plan and build the necessary infrastructure to bring oil to market. For example, the Thunder Horse field was discovered in the Gulf of Mexico in 1999, but the first barrel of oil was produced in 2008. This long lead time means that decisions made today affect oil production for years in the future.

One frequent criticism of the development of the Alaskan National Wildlife Refuge (ANWR), for instance, is that it would take years to start producing oil. In 1995, President Clinton vetoed a bill to permit oil exploration and development in ANWR. If he had signed that bill, oil would be produced in ANWR today, and the Trans Alaskan Pipeline would not be running at about one quarter of its capacity.

Meanwhile, Shell has paid the government over $2.5 billion and spent in excess of $4 billion to explore for oil offshore Alaska, but has yet to receive permits from the government to drill for oil and gas. If more oil is not allowed to be produced soon from Alaska, the Trans Alaskan Pipeline System, one of North America's most valuable energy assets will be at risk. The pipeline, which once delivered 2.1 million barrels of oil per day to the West Coast, now has sufficient underutilized capacity to accommodate twice the amount of oil that is currently being produced in North Dakota, the second largest oil producing state in the Union. There is no lack of oil in Alaska or off its coasts; the problem is that government policies stand in the way of additional oil production in Alaska.

Areas that the federal government could open to oil and gas development include:

- The 10.4 billion barrels of oil and 8.6 trillion cubic feet of natural gas in the Arctic National Wildlife Refuge
- The 86 billion barrels of oil and 420 trillion cubic feet of natural gas in the outer continental shelf of the lower 48 states
- The 896 million barrels of oil and 53 trillion cubic feet of natural gas in the Naval Petroleum Reserve-Alaska
- The 25 billion barrels of oil in the outer continental shelf of Alaska
- The 90 billion barrels of oil and 1,669 trillion cubic feet of natural gas in the geologic provinces north of the Arctic circle
- The 982 billion barrels of oil shale in the Green River Formation in Colorado, Utah, and Wyoming.

These technically recoverable resources total 1,194 billion barrels of oil and 2,150 trillion cubic feet of natural gas that is owned by the federal taxpayer. At today's prices ($100.00 per barrel of oil and $4.00 per thousand cubic feet of natural gas), the value of the estimated oil resources is $119.4 trillion and the value of the estimated natural gas resources is $8.6 trillion for a grand total of $128 trillion.[32]

The **Congressional Budget Office (CBO) estimated** that under current policies, revenues from royalties, rents, and bonuses from oil and gas leases on public lands will generate about $150 billion over the next 10 years. The CBO further estimated that if certain resources currently off limits were immediately opened to oil and gas leasing, another $7 billion would be realized over that period.[33] The CBO study

estimates are considered to be conservative when compared to historical data and estimates by other analysts and do not consider the earnings from taxes paid by these industries or their employees.

Partially in response but also for education purposes, IER commissioned a groundbreaking paper that will soon be released highlighting the larger economic effects, including economic growth, wages, jobs, and federal and state and local tax revenues, of opening Federal lands and waters to oil and gas leasing. The IER paper relies on the CBO natural resource and oil and gas price estimates to maintain direct comparability with the CBO analysis while recognizing that those figures have historically been proven to vastly underestimate resources and revenues. The government's resource information is poor in large part due to the lack of exploration resulting from practices limiting access to federal lands such as the moratoria.

The study finds that if the federal government opened up additional federal lands and waters to exploration and production, the increase to GDP would be $127 billion *annually* for the next seven years, and $450 billion *annually* in the long run. Most impressively, the opening of federal lands would have a cumulative increase in economic activity of up to $14.4 trillion over a period of 30 years. And the ripple effect of that boom would be 552,000 in job gains *annually* over the next 7 years with *annual* wage increases of up to $32 billion over that time period and an increase of 1.9 million jobs *annually* in the long run with *annual* wage increases of $115 billion. Federal and state and local tax revenues would also increase to the

tune of $2.7 trillion in federal revenues and $1.1 trillion in state and local revenues over 30 years.[34]

Coal is also produced on federal lands, but its production decrease has not been as great as that for oil and natural gas. Coal production on federal and Indian lands peaked at 509 million short tons in fiscal year 2008 and has been decreasing slightly each year since then. In fiscal year 2011, coal sales from production on federal and Indian lands reached 470 million short tons, a 2-percent decrease from fiscal year 2010 and an 8-percent decrease since the peak in fiscal year 2008.[35]

At today's prices, the value of the government's estimated coal resources in the lower 48 states is $22.5 trillion for a total fossil fuel value on federal lands of $150.5 trillion. Most of the coal resources in Alaska are deemed to be federally owned and are estimated to be 60 percent higher than those in the entire lower 48 states but are not included in these estimates.

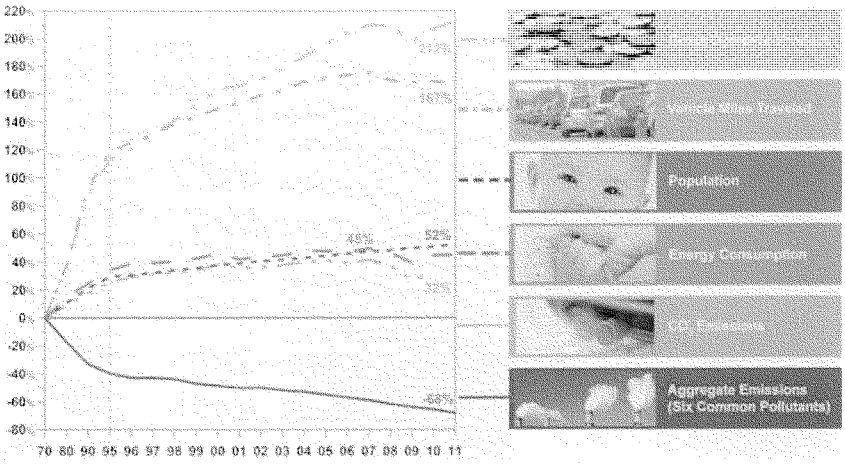
Coal's Environmental Issues

Over 90 percent of coal in the United States is used for electricity generation. Until recently, coal had been used to produce 50 percent of the nation's electricity, but is losing market share to natural gas and renewable energy as natural gas prices drop, renewable energy is mandated and subsidized, and new environmental regulations take effect. The Environmental Protection Agency (EPA) has produced regulations that essentially ban new coal plants and make its continued use in existing plants

extremely costly. As a result, coal produced only 42 percent of our electricity in 2011[36] and is expected to have produced only 38 percent in 2012.[37]

One of the biggest stated concerns about coal is air pollution. Coal produces more emissions than natural gas when burned. However, due to actions taken by industry and technological advances, our air quality is improving and new coal plants are cleaner than ever before. Pollution control technologies such as flue gas desulfurization, selective catalytic reducers, fabric filters, and dry sorbent injection have greatly reduced coal plant emissions. According to the National Energy Technology Laboratory (NETL), for example, a new pulverized-coal plant (operating at lower, "subcritical" temperatures and pressures) reduces the emission of nitrogen oxides (NOx) by 86 percent, sulfur dioxide (SO_2) by 98 percent, and particulate matter by 99.8 percent, as compared with a similar plant having no pollution controls.[38]

These advances in technology have enabled large improvements in air quality. Since 1970, the total emissions of the six criteria pollutants have declined by 68 percent, even though energy consumption has increased by 45 percent, vehicle miles traveled have increased by 167 percent, and the economy has grown by 212 percent.[39] (The "criteria pollutants" are carbon monoxide, lead, sulfur dioxide, nitrogen oxides, ground-level ozone, and particulate matter.) The following chart from EPA shows the increase in economic measures compared to the decrease in pollution emissions.[40]



As technology continues to advance, coal-fired power plants will become even cleaner and air quality will continue to improve. In fact, as the *New York Times* has reported, China is actually constructing some coal plants that are cleaner than those allowed to be built in the United States.[41] An irony of our current regulatory policy may be that China will ultimately become the world's supplier of the most advanced clean coal plants, despite the U.S. coal resource base which dwarfs their own.

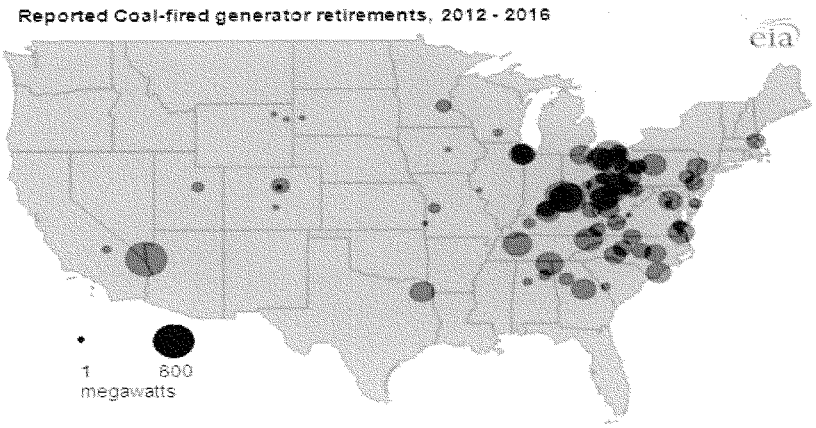
Although coal produces relatively inexpensive energy, many activist groups adamantly oppose coal mining and coal-fired power plants. The Sierra Club, for example, has worked particularly hard to stop coal-fired power plants. They claim that they have prevented 150 new coal-fired power plants from being built.[42]

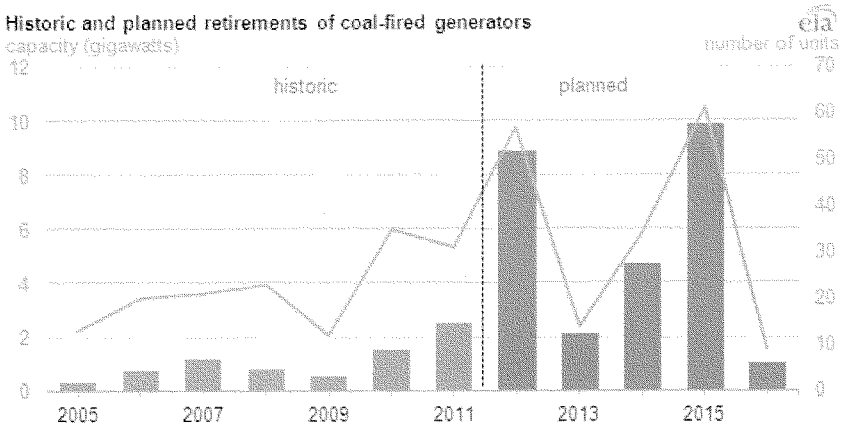
Coal mines, especially in Appalachia, are coming under increasing fire from environmental interest groups and the Obama administration. The EPA revoked a

clean water permit that the Army Corps of Engineers had previously awarded, despite the fact that, according to the Army Corps, the permit complies with West Virginia state water law and the federal Clean Water Act.[43] The problem, according to EPA, is that granting the permit would lead to changes in the conductivity (or salinity) of the water that might be detrimental to mayflies, stoneflies, and caddis flies.[44] In other words, EPA denied the permit, not because of impacts on human health, but potential impacts on mayflies. Because EPA implemented this conductivity guidance without going through the proper regulatory process, a federal district court threw out EPA's conductivity standards.

The EPA has promulgated new regulations that target mercury from coal-fired power plants (the Mercury and Air Toxic Standards), which many call Utility MACT because the rule requires "Maximum Achievable Control Technology" for mercury at coal-fired power plants.[45] These technologies must be installed over a tight 3-year period between 2012 and 2015, raising the cost of generating power from existing coal-fired plants where the economics make sense to install the technology, or forcing those plants to retire or to convert to natural gas. The National Economic Research Associates found compliance costs to be $21 billion per year and lost jobs to amount to 183,000 per year. Because the increased costs will be passed to consumers through higher electricity rates, businesses will be forced to reduce jobs as well. Studies project that retail electricity prices will increase between 10 and 20 percent in most of the country and over 20 percent in the coal-dependent states in the Midwest.[46]

EIA announced that plant owners and operators expect to retire about 27 gigawatts of coal-fired capacity by 2016 — four times the 6.5 gigawatts of capacity retired between 2007 and 2011 mostly because of the new regulations imposed by the EPA. In 2012, electric generators are expected to retire 9 gigawatts of coal-fired capacity, the largest amount of retirements in a single year in America's history. The 27 gigawatts of retiring capacity is 8.5 percent of total coal-fired capacity (318 gigawatts). The 2012 record retirements are expected to be exceeded in 2015 when nearly 10 gigawatts of coal-fired capacity are expected to retire.[47] Most of the units retiring are located in the Mid-Atlantic, Ohio River Valley, and Southeastern United States as shown in the map below.





EIA's numbers are based on current utility expectations. The Edison Electric Institute expects a larger number of forced retirements—about 48 gigawatts of coal units at 231 plants—between 2010 and 2022, or about 15 percent of the coal fleet.[48]

Further, pending greenhouse gas regulations will require all new coal-fired plants to reduce their greenhouse gas emissions even though there is no cost effective way to do so. This is essentially a ban on new coal-fired plants because the technology does not exist commercially for them to meet natural gas carbon dioxide levels that are required by the EPA regulation.

Many believe that the administration is planning on releasing regulations effectively requiring all coal-fired power plants to reduce their greenhouse gas emissions or close. EPA could decide that the modifications made to plants during the upgrades to comply with utility MACT are significant and treat the existing power plant as a "new source" forcing the plant to almost halve its carbon dioxide emissions or

shutter. While EPA has denied this, the agency's recent anti-coal track record calls for close attention to upcoming regulatory initiatives. There is little reason in the record to believe that the EPA will not attempt to regulate carbon dioxide emissions from existing coal-fired power plants.

Regulating carbon dioxide emissions for coal-fired plants will force mass coal plant retirements, causing unemployment at coal-fired power plants and coal mines. According to a report from the United Mine Workers of America, job losses associated with the closure of EPA-targeted coal units (due to Utility MACT and tighter greenhouse gas standards) could amount to more than 50,000 direct jobs in the coal, utility and rail industries, and an indirect job loss figure exceeding 250,000.

Some have suggested that these closures are mainly due to the low price of natural gas made possible through shale gas discoveries. Regardless, it would be prudent for policy makers and analysts to consider the consequences of removing one of the major three sources of electrical generation from our fuel mix for electricity. Currently our electrical generation mix is largely coal, natural gas and nuclear power. While natural gas prices are currently low, gas-directed rig activity is also very low, which could have an impact on supplies in the out years. Further, the Wall Street Journal reported on January 29 that pressure is increasing to shutter nuclear power plants.[49]

If the United States decides that it can provide the vast majority of its electricity from natural gas, it must assure that those supplies will not be threatened by government actions, including the federalization of hydraulic fracturing regulation or other attempts to require federal permission to drill natural gas wells. The consequences of skyrocketing electricity prices brought on by bad public policies will only exacerbate the economic ills our nation faces going forward.

Conclusion

The United States has more combined oil, coal, and natural gas resources than any other country on the planet. As we used these energy resources over the past 50 years, not only did we grow our economy and improve our quality of life, but we improved our air quality as well. We are energy rich, not poor. We have enough energy resources to provide reliable and affordable energy for decades, even centuries to come. The real question is whether the federal government will permit us to have access to our abundant energy resources, not whether sufficient resources exist.

Decisions made today about access to energy resources affect energy production for years and decades into the future. The more areas that are accessible to energy production today increases the likelihood of more domestic energy production later. Increased energy production promotes jobs, government revenues from taxes and lease sales, and increased economic activity.

In turn, this supplies the revenue, wealth and technology to provide the energy breakthroughs of the future. Energy is defined as "the capacity to do work." Its reliability, affordability and abundance are critical to the future work of our nation.

Thank you for the opportunity to supply this testimony for the Committee's use.

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economically recoverable oil shale resources at 800 billion barrels. Assuming the same rate of recovery for the additional 0.5 trillion barrels brings the total recoverable oil shale resources to 982 billion barrels.

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[17] According to the Department of Interior, 38 million acres of onshore lands are leased for oil and natural gas production. See Table 3 in Department of Interior, Oil and Gas Lease Utilization – Onshore and Offshore, http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&pageid=239255 According to the Congressional Research Service, the federal government owns just over 650 million acres of land. See Appendix A. Congressional Research Service, Major Federal Land Management Agencies: Management of Our Nation's Lands and Resources, May 15, 1995, http://www.ncseonline.org/nle/crsreports/natural/nrgen-3.cfm . The federal government also controls an additional 58 million acres of federal mineral estate below privately owned surface estate. *See* Bureau of Land Management, Split Estate, http://www.blm.gov/pgdata/etc/medialib/blm/wo/MINERALS__REALTY__AND_RESOURCE_PROTECTION_/bmps.Par.98100.File.dat/SplitEstate08finalWeb.pdf .

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Mr. WHITFIELD. Thank you, Ms. Hutzler.

Mr. Vidas, you are recognized for 5 minutes.

STATEMENT OF E. HARRY VIDAS

Mr. VIDAS. Chairman Whitfield, Ranking Member Rush and members of the subcommittee, I appreciate the opportunity to discuss my work in estimating the U.S. endowment of oil and natural gas resources.

Due to technology advancements, the U.S. natural gas and oil resource base is now widely seen as large and diverse. Lower-48 production of shale gas, tight oil, and associated natural gas liquids has been an engine of economic growth in recent years. Our analysis of the remaining resource base indicates that this unconventional resource base is large and that this production activity is in the early stages of the resource development cycle. Therefore, we expect growing production and increased jobs many years into the future.

In recent years, ICF has extensively evaluated shale gas and tight oil resources, both in terms of technical and economic recovery. This work has been sponsored by private companies, industry associations and government agencies. We have evaluated the geology, historic production and costs of all the major U.S. and Canadian geologic settings, or as we say, plays. This analysis shows that these resources are geographically widespread, and are economic to develop at moderate wellhead prices. The ICF analysis of these emerging natural gas and oil resources is done using a geographical information system, a process that evaluates the resource at a highly granular level, accounting for variations in geology, resource quality and economics within the plays.This ICF analysis reflects recent upstream technology including advances in horizontal drilling and steering, multistage hydraulic fracturing, improvements in fracturing fluids and methods, and improvements in seismic and geophysical analysis that helps identify the best locations for the wells. And finally, I would point out advances that reduce the environmental impacts of drilling. These are such things as using multi-well drilling pads, conservation of water and recycling of water resources, reformulation of chemical additives, and reduced emission completions that capture gases in the flow-back.

These upstream technology advances have enlarged the U.S. economic resource base by expanding areas where drilling can take place, increasing recovery factors and reducing capital and operating costs per unit of production. ICF estimates that the remaining technically recoverable U.S. natural gas resource base is 3,850 trillion cubic feet, which represents 155 years of current consumption. The U.S. shale gas resource is almost 2,000 tcf, and that makes up 52 percent of the total. One should look at these assessments as conservative in the sense that they are developed assuming current technology and no major new plays are discovered.

In terms of U.S. oil production, as already been mentioned, U.S. production started increasing in the year 2009 for the first time since 1984 and there is the potential for the United States to become a much larger oil producer in coming decades due, as we have heard, from expanded production of tight oil. Our current assessment of the U.S. oil resources in terms of technically recoverable

resources is 264 billion barrels. This represents 110 years of production at current production rates.

The U.S. tight oil potential is excellent due to the wide range of potential producing plays in diverse geologic settings at numerous basins. The success in tight oil across a wide spectrum of geologic settings indicates that most historic oil-producing areas will eventually see horizontal drilling, and in many cases, this tight oil development will dominate activity and production.

So in summary, recent advances in drilling and completion technologies have dramatically increased estimates of technically recoverable natural gas and oil resources and have led to a much more optimistic outlook for future oil, gas and natural gas liquids production. Our forecast for natural gas is that it is going to be growing at about 2.2 percent per year up to about 32 tcf by 2025, and our forecast for the oil production is even faster 2.6 percent, up to 9 million barrels per day by 2025.

The other point I want to make is that we expect upstream technologies to continue to improve and therefore we expect these resource base number to be going up in the future as well as the economics to improve as well. Thank you.

[The prepared statement of Mr. Vidas follows:]

One-page Summary of Harry Vidas Testimony Before the Subcommittee of Energy & Power of the U.S. House of Representatives Committee on Energy and Commerce

Due to technology advancements, the U.S. natural gas and oil resource base now is seen as extremely robust and diverse. Lower-48 production of shale gas, tight oil, and associated natural gas liquids has been an engine of economic growth in recent years. Our analysis of the remaining resource base indicates that this "unconventional" resource base is large and that this production activity is in the early stages of the resource development cycle with growing production and increased jobs expected for many years into the future.

In recent years, ICF has extensively evaluated shale gas and tight oil resources, both in terms of technical and economic recovery. This work has been sponsored by private companies, industry associations and government agencies. We have evaluated the geology, historic production and costs of all major U.S. and Canadian plays. This analysis shows that these resources are geographically widespread, and are economic to develop at moderate wellhead prices. The ICF analysis of these emerging natural gas and oil resources is done using a geographical information system (GIS) process that evaluates the resource at a highly granular level, accounting for variations in geologic factors, resource quality and economics within plays.

The assessed remaining recoverable U.S. natural gas resource base of 3,850 trillion cubic feet (Tcf) represents about 155 years of current annual consumption. The shale gas resource of 2,000 Tcf represents 52 percent of the total. This assessment should be viewed as conservative in that it assumes current technology and no major new plays. A very large portion of this resource base is economic at relatively low wellhead prices, and industry continues to make strides in reducing development costs.

U.S. oil production is increasing for the first time since 1984 and there is the potential for the U.S. to become a much larger oil producer in coming decades. The currently assessed U.S. oil resource base of 264 billion barrels represents 110 years of current annual production.

Crude oil and condensate production are surging as a result of tight oil plays such as the Bakken in North Dakota and the Eagle Ford in Texas. Tight oil production in the Permian Basin of West Texas is increasing and rig activity is very high. Future U.S. tight oil potential is excellent due to the wide range of potential producing plays and diverse geologic settings in numerous basins.

Relatively low cost and abundant gas and liquids resources are creating an upsurge in domestic manufacturing and chemicals industries. Chemical manufacturers in the U.S. have a large advantage over international firms whose energy and feedstock costs are higher. In addition, natural gas is increasingly displacing coal for power generation, resulting in reductions in greenhouse gas emissions. There is also a potential for natural gas to play a larger role as a transportation fuel.

The shale gas revolution has created a large demand for new and expanded mid-stream infrastructure, including gathering systems and processing plants. Liquids production from tight oil is driving the need to expand long-distance crude oil pipelines and will allow the expanded and more economic utilization of U.S. refineries.

U.S. Oil and Gas Resources

Harry Vidas
ICF Resources, LLC
Fairfax, VA
February 5, 2013

Introduction

Chairman Whitfield, Ranking Member Rush, and members of the Subcommittee, I appreciate the opportunity to discuss my work in estimating the U.S. endowment of oil and natural gas resources.

Due to technology advancements, the U.S. natural gas and oil resource base now is seen as extremely robust and diverse. Lower-48 production of shale gas, tight oil, and associated natural gas liquids has been an engine of economic growth in recent years. Our analysis of the remaining resource base indicates that this "unconventional" resource base is large and that this production activity is in the early stages of the resource development cycle with growing production and increased jobs expected for many years into the future.

In recent years, ICF has extensively evaluated shale gas and tight oil resources, both in terms of technical and economic recovery. This work has been sponsored by private companies, industry associations and government agencies. We have evaluated the geology, historic production and costs of all major U.S. and Canadian plays. This analysis shows that these resources are geographically widespread, and are economic to develop at moderate wellhead prices. The ICF analysis of these emerging natural gas and oil resources is done using a geographical information system (GIS) process that evaluates the resource at a highly granular level, accounting for variations in geologic factors, resource quality and economics within plays.

This ICF analysis reflects recent upstream technology advances including those in the following areas:

- Horizontal drilling and steering
- Multi-stage hydraulic fracturing
- Fracturing fluids and techniques
- Seismic and other geophysical analyses of drilling locations
- Reductions in environmental impacts (multi-well pads, water conservation and recycling, reformulation of additives, reduced emission completions (RECs), etc.)

These upstream technology advances have enlarged the U.S. economic resource base by expanding areas where drilling can take place, increasing recovery factors and reducing capital and operating costs per unit of production.

ICF's estimate for the remaining technically recoverable U.S. natural gas resource base is 3,850 trillion cubic feet (Tcf), representing about 155 years of current annual consumption. Our total assessed remaining recoverable natural gas resource base for the U.S. plus Canada is 4,990 trillion cubic feet (Tcf), representing about 180 years of current consumption in the two counties. The North American shale gas resource of 2,600 Tcf makes up 52 percent of the total, with the U.S. assessed shale resources being almost 2,000 Tcf and Canada's portion being 600 Tcf. This assessment should be viewed as conservative in that it assumes current technology and no major new plays. A very large portion of this resource base is economic at relatively low wellhead prices, and industry continues to make strides in lowering development costs.

U.S. oil production is increasing for the first time since 1984 and there is the potential for the U.S. to become a much larger oil producer in coming decades. The currently assessed U.S. oil technically recoverable resource base of 264 billion barrels represents 110 years of current annual production and is roughly equivalent to the proved reserves of Saudi Arabia.

Crude oil and lease condensate production are surging as a result of tight oil[1] plays such as the Bakken in North Dakota and portions of the Eagle Ford in Texas. Tight oil production in the Permian Basin of West Texas is increasing and rig activity is very high. Future U.S. tight oil potential is excellent due to the wide range of potential producing plays and diverse geologic settings in numerous basins. Canadian tight oil production is also increasing rapidly across a wide area. The success of tight oil across such a wide spectrum of geologic settings indicates at a general level that most, if not all, historic oil producing areas will eventually see horizontal drilling. In most onshore areas, tight oil will likely ultimately dominate activity and production.

So called "wet gas" production is surging in shale gas plays such as the Eagle Ford in South Texas and the Marcellus in Pennsylvania. This wet gas exists in a transition zone between crude oil and dry gas. Wet gas contains natural gas liquids such as ethane, propane and butane that are key feedstocks in the petrochemical industry.

Relatively low cost and abundant gas and natural gas liquids resources are creating an upsurge in domestic manufacturing and chemicals industries. Chemical manufacturers in the U.S. have a large advantage over international firms whose energy and feedstock costs are higher. In addition, natural gas is increasingly displacing coal for power generation, resulting in a large reduction in greenhouse gas emissions. There is also a potential for natural gas to play a much larger role in the transportation sector as a vehicle fuel.

The shale gas revolution has created a large demand for new and expanded mid-stream infrastructure, including gathering systems and processing plants. Liquids production from tight

[1] Tight oil is defined as light-to-medium weight crude oil contained in petroleum-bearing formations of relatively low porosity and permeability such as shales and low permeability carbonates and sandstones. Extraction of the oil usually takes place through hydraulically fractured horizontal wells using natural reservoir drive mechanisms, that is, without the application of external heat or energy to change the characteristics of the oil or to "push" the oil out.

oil is driving the need to expand long-distance crude oil pipelines and will allow the expanded and more economic utilization of U.S. refineries.

There remains the potential for major new plays to emerge in both existing and frontier areas. For example, the Monterey tight oil play in Southern California has the potential to grow into a major supply in that region, with implications for infrastructure, refining, and economic activity.

Internationally, many countries are actively attempting to replicate the North American success with shale gas. ICF estimates that world shale gas technically recoverable resources are in the range of 12,000 Tcf. However, after several years of effort, it has become apparent that this effort will take longer than previously thought. Reasons cited in various countries include lack of industry expertise, lack of infrastructure, regulatory hurdles, poor economic incentives and problematic geology or economic factors. Well costs are generally much higher than in the U.S. and resource access is sometimes an issue in densely populated areas within Europe, India and China.

Analytic Framework and Assessment Summary

Over several decades, ICF has evaluated and assessed North American oil and gas resources. The assessments combine elements of the assessments by the U.S. Geological Survey, [2] the Bureau of Ocean Energy Management,[3] industry assessments such as that of the National Petroleum Council,[4] and in-house research.

In recent years, ICF has done extensive work to evaluate shale gas, tight gas, and coalbed methane in the U.S. and Canada using engineering and geology-based geographic information

[2] U.S. Geological Survey National Oil and Gas Assessment website http://energy.usgs.gov/OilGas/AssessmentsData/NationalOilGasAssessment.aspx
[3] BOEMRE 2006 OCS resource assessment http://www.boemre.gov/revaldiv/RedNatAssessment.htm
[4] National Petroleum Council, 2003, "Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy," Washington, D.C.

system (GIS) approaches. This has resulted in one of the most comprehensive and detailed assessments of North American unconventional gas and oil resources available. It includes the analysis of all major unconventional gas plays and the most active tight oil plays.

The following resource categories have been evaluated:

> **Proven reserves** – the quantities of oil and gas that are expected to be recoverable from the developed portions of known reservoirs under existing economic and operating conditions and with existing technology. (Volumes shown are as of year-end 2010, and include conventional, tight gas, coalbed methane (CBM), and shale gas proven reserves).
>
> **Reserve appreciation** – the quantities of oil and gas that that are expected to be proven in the future through additional drilling in existing (producing) fields. Does not include growth in CBM or shale gas.
>
> **Enhanced oil recovery (EOR)** – recoverable oil volumes related to tertiary oil recovery operations, primarily CO_2 EOR.
>
> **New fields** – future new conventional field discoveries. Conventional fields are those with higher permeability reservoirs, typically with distinct oil, gas, and water contacts.
>
> **Shale gas and tight oil** – recoverable volumes of gas, condensate, and crude oil from future development of shale plays. Shale plays are defined as those in which the source and reservoir are the same (self-sourced). Tight oil plays are those shale plays that are dominated by oil and associated gas, such as the Bakken in North Dakota.
>
> **Tight gas** – recoverable volumes of gas and condensate from future development of very low permeability sandstones.
>
> **Coalbed methane** – recoverable volumes of gas from future development of coal seams.

Exhibit 1 summarizes the current ICF gas and crude oil assessments of the U.S. and Canada. Resources shown are "technically recoverable resources." This is defined as the volume of oil or gas that could technically be recovered through vertical or horizontal wells under existing technology and stated well spacing assumptions without regard to price.

The assessment of remaining technically recoverable gas resources in the Lower-48, including proven reserves, is 3,545 Tcf and Alaska is assessed at 303 Tcf. The estimate for Canada is 1,142 Tcf. Shale gas in the Lower-48 is assessed at 1,964 Tcf and Canadian shale gas is

assessed at 601 Tcf. The combined 2,565 Tcf of shale gas represents about 52 percent of the assessed gas resource base. The total resource base of 4,990 Tcf represents approximately 180 years of production and consumption at the current rate of about 28 Tcf per year for the U.S. plus Canada.

The estimate for remaining crude and condensate resources in the Lower-48 is 214 billion barrels, of which 56 billion barrels is from gas-prone or oil-prone shale and tight oil plays. Alaska resources are assessed at 50 billion barrels and do not yet include estimates of tight oil. The combined U.S. resource of 264 billion barrels can be compared to current U.S. annual production of 2.4 billion barrels and proven reserves of 23 billion barrels. North American crude and condensate resources total 307 billion barrels, of which 45 billion barrels is tight oil. The ICF resource assessment method results in a single point estimate of resources, rather than a probability range. However, the assessment inherently includes risk factors that are applied for individual plays, based upon geologic factors and the maturity of the play. Thus, the results represent a risked mean assessment.

Exhibit 1: ICF North America Oil and Gas Resource Base Assessment

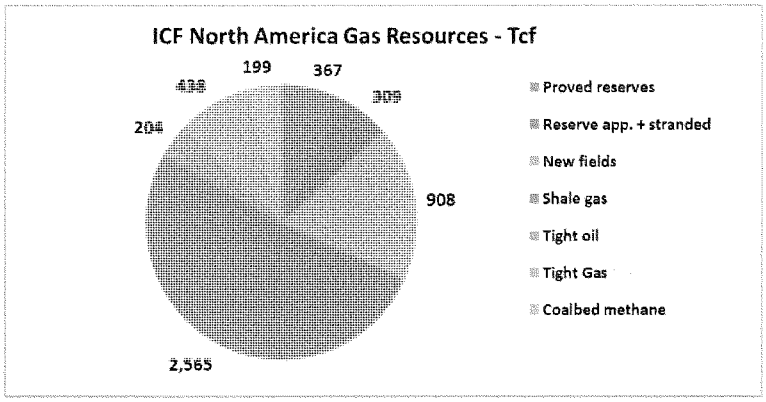
(excludes Canadian and U.S. oil sands)

Technically Recoverable Resources; Proved as of year end 2010
ICF Feb 2013

Lower-48	Dry Total Gas Tcf	Crude and Cond. Bn. Bbls
Proved reserves	297	21
Reserve appreciation	204	23
Stranded frontier	0	0
Enhanced oil recovery	0	42
New fields	488	68
Shale gas and condensate	1,964	31
Tight oil	88	25
Tight gas	438	4
Coalbed methane	66	0
Lower-48 Total	**3,545**	**214**

Alaska	Dry Total Gas Tcf	Crude and Cond. Bn. Bbls
Proved reserves	8.8	3.7
Reserve appreciation	22.0	3.5
Stranded frontier	14.0	0.0
Enhanced oil recovery	0	12.4
New fields	201	30.2
Shale gas and condensate	not assessed	not assessed
Tight oil	not assessed	not assessed
Tight gas	0	0
Coalbed methane	57	0
Alaska Total	**303**	**50**

Canada	Dry Total Gas Tcf	Crude and Cond. Bn. Bbls
Proved reserves	61	4.3
Reserve appreciation	29	3.0
Stranded frontier	40	0.0
Enhanced oil recovery	0	3.0
New fields	219	12.0
Shale gas and condensate	601	0.3
Tight oil	116	20.4
Tight gas (with conventional)	0	0.0
Coalbed methane	76	0.0
Canada Total	**1,142**	**43**
U.S. Totals	**3,848**	**264**
North America Totals	**4,990**	**307**



Sources: ICF, EIA (proved reserves)

Conventional Oil and Gas

The remaining conventional oil and gas resource consists of proven reserves, reserve appreciation in existing conventional fields, and undiscovered conventional fields. Conventional fields are higher permeability fields, typically with oil, gas and water contacts within a structural or stratigraphic trap.

Proven reserve estimates are published by the U.S. Energy Information Administration each year, at the state and district level. This series is based upon a large scale survey of operators. By definition, proven reserves are those quantities in existing fields that are recoverable under current economic conditions with existing technology. Production from proved reserves provides a base deliverability that can be projected into the future as part of future production. All of the volumes of proved reserves should be produced in future years, unless market and price conditions deteriorate, in which wells could be shut in earlier than anticipated.

Reserve appreciation in existing conventional fields represents a major component of future available resources. For many decades, operators have explored producing fields to add

reserves through the discovery of new pools or through infill or extension activity. The advent of new technology that reduces costs or increases recovery per well can also result in the addition of new reserves. There are numerous methods used to estimate reserve appreciation, the most prevalent being "year of discovery" data series in which historical growth is evaluated, and factors are developed to be applied to recent discoveries. ICF also uses an analytic approach based upon trends in well recovery within a group of older fields.

For over 25 years, ICF has used a computerized modeling framework to evaluate remaining conventional undiscovered North American gas resources. This model contains a characterization of reserve appreciation, new conventional fields, and unconventional gas. Undiscovered fields are evaluated by drilling depth interval, water depth, and field size class.

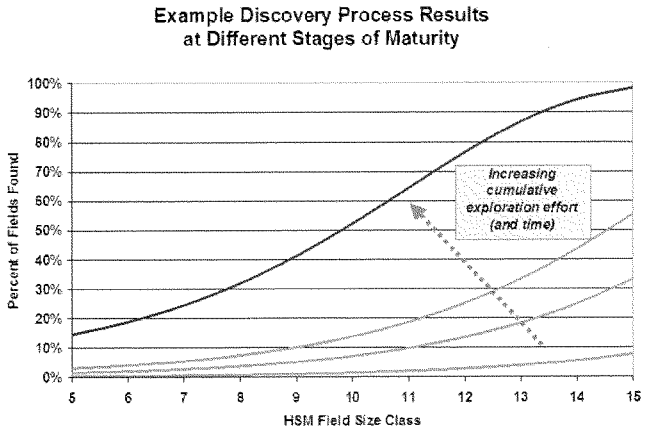
U.S. and Canada conventional resources are based largely on USGS and MMS (and other agencies in Canada) assessments made over the past 15 years or so. These assessments were extensively reviewed by industry representatives in the U.S. and Canada as part of the 2003 National Petroleum Council study, and recommended changes were implemented.[5] The model includes representations of oil, gas and natural gas liquids by play and depth interval. Costs are based upon actual drilling and completion costs and various scenarios for offshore fields as a function of water depth.

The model uses a discovery process algorithm to simulate the drilling of new field wildcats in a play. It estimates what is "discovered" by each increment of new field wildcat drilling. Some of the simulated discoveries are economic and many are not. The ones that are not economic are "banked" for future development. There is a procedure to add these undeveloped fields to the curve when the average cost of an exploration step reaches their development cost. **Exhibit 2**

[5] U.S. National Petroleum Council, 2003, "Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy," http://www.npc.org/

illustrates the discovery process model. The upper blue curve illustrates the late stages of exploration in which all of the large fields in the play have been found.

Exhibit 2: ICF Discovery Process Model – Conventional Undiscovered Fields



Unconventional Oil and Gas

ICF has assessed future North America unconventional gas potential, represented by shale gas, tight sands, and coalbed methane. This work incorporates information on the geologic, engineering, and economic aspects of the resource. Evaluation with a geographic information system (GIS) allows a wide range of studies to better understand future trends in supply and infrastructure needs.

In recent years ICF has prepared various studies of U.S. and Canadian natural gas and oil supplies. For example, ICF produced reports on U.S. oil and gas resource endowment and

future activity levels for the American Petroleum Institute (API)[6], the National Petroleum Council natural gas studies[7], the INGAA Foundation[8] and America's Natural Gas Alliance. We have also produced midstream infrastructure assessments for the NPC and the INGAA Foundation. ICF recently completed a study for the INGAA Foundation and other sponsors to project oil and gas resource development and infrastructure needs for the U.S. over the next 25 years.[9] The study included play level analysis of past and future drilling activity, estimated ultimate recovery (EUR) per well, and production for both gas and oil plays.

Shale Gas and Other Unconventional Gas Well Gas

ICF developed a GIS-based analysis system covering 32 major North American unconventional gas plays. Proprietary models were developed to work with GIS data on a 36-square-mile unit basis to estimate unrisked and risked gas-in-place, recoverable resources, EUR per well and wellhead and Henry Hub resource costs at a specified rate of return. The GIS analysis focused on gas and NGLs and addressed the issue of lease condensate and plant liquids, both in terms of recoverable resources and their impact on economics. Recently, ICF has developed assessments of several U.S. and Canadian tight oil plays, which also contain natural gas resources.

The ICF unconventional gas GIS model was originally developed in 2010 with the emergence of U.S. horizontal shale plays. The resource assessment component is based upon mapped parameters of depth, thickness, organic content, and thermal maturity, and assumptions about

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[6] ICF, "Strengthening Our Economy: The Untapped US Oil and Gas Resources," prepared for API, December 2008. http://www.api.org/aboutoilgas/upload/Access_Study_Final_Report_12_8_08.pdf

[7] National Petroleum Council, 2003, "Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy." NPC. Washington, D.C. http://www.npc.org/. Also available at: http://www.fossil.energy.gov/programs/oilgas/publications/npc/03gasstudy/NG_Vol1_9-25.pdf

[8] INGAA Foundation, 2008, "Availability, Economics, and Production Potential of North American Unconventional Gas Supplies," prepared by ICF for Interstate Natural Gas Association of America, Washington, DC. http://www.ingaa.org/cms/31/7306/7628/7833.aspx

[9] INGAA Foundation, 2011, "North American Midstream Infrastructure Through 2035 – A Secure Energy Future, INGAA, Washington, DC http://www.ingaa.org/Foundation/Studies/14904/14889.aspx

porosity, pressure gradient, and other information. The unit of analysis for gas -in-place and recoverable resources is a 6 by 6 mile or 36 square mile grid unit. Gas-in-place is determined for free gas, adsorbed gas and gas dissolved in liquids and well recovery is modeled using a reservoir simulator. Well recovery is estimated as a function of well spacing. **Exhibit 3** is a map of Lower-48 shale gas plays, most of which are included in the model.

Economic analysis is also performed on a 36-square-mile unit and is based upon discounted cash flow analysis of a typical well within that area. Model outputs include risked and unrisked gas-in-place, recoverable resources as a function of spacing, and supply versus cost curves.

One of the key aspects of the analysis is the calibration of the model with actual well recoveries in each play. **Exhibit 4** shows Fort Worth Basin Barnett shale play well recoveries. These data are derived from ICF analysis of a commercial well level production database. The actual well recoveries are compared with the model results in each 36 square mile model cell to calibrate the model. Thus, our results are not just theoretical, but are ground-truthed to actual well results.

Exhibit 3: North America Shale Gas Plays (EIA)

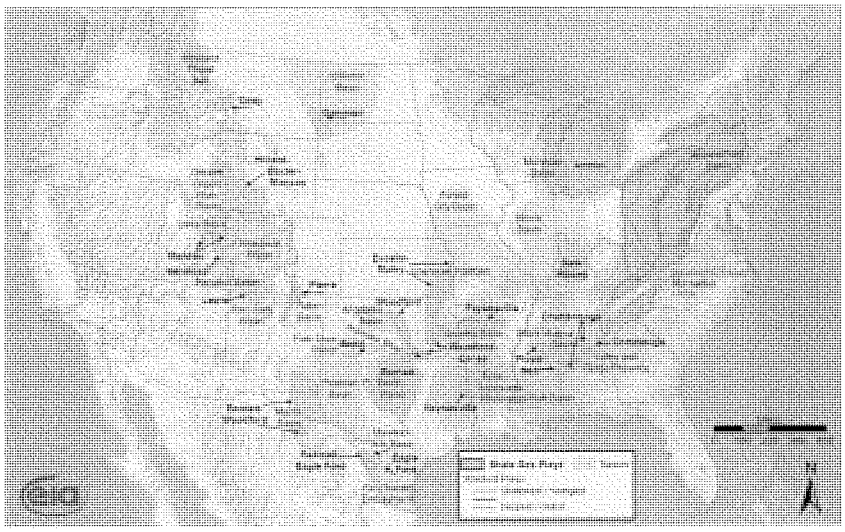
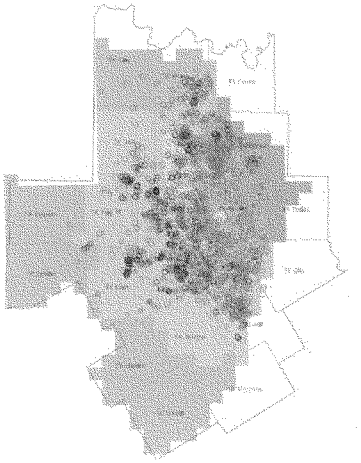


Exhibit 4: ICF Map of Fort Worth Barnett Shale Well Recoveries



Tight Oil

Tight oil production is black oil production from shale and other low permeability formations including sandstone, siltstone, and carbonates. The tight oil resource has emerged as a result of horizontal drilling and multi-stage fracturing technology. Tight oil production in both the U.S. and Canada is surging. Production in January of 2013 is approximately 1.4 million barrels per day (b/d) in the U.S., up from almost zero in 2007, and 250,000 b/d in Canada.

Tight oil includes the development of previously undrilled plays, such as the Bakken shale, and in other cases concentrates on the fringes of old oil fields, which is occurring in Canada.

Exhibit 5 lists the tight oil plays that have been assessed by ICF. The assessment of each play is based upon map areas or "cells" with averaged values of depth, thickness, maturity, and organics. The model takes this information, along with assumptions about porosity, pressure, oil gravity, and other factors to estimate original oil and gas-in-place, recovery per well, and risked recoverable resources of oil and gas. The results are compared to actual well recovery estimates. A discounted cash flow model is used to develop a cost of supply curve for each play. Well recoveries in the model are compared with actual drilling results where such data are available.

As presented previously, the ICF estimate for remaining crude and condensate resources in the Lower-48 is 214 billion barrels. The resource can be compared to current Lower-48 annual production of 1.8 billion barrels and proven reserves of 21 billion barrels and U.S. oil production of 2.4 billion barrels. North American crude and condensate resources total 307 billion barrels, of which 45 billion barrels is tight oil. Currently assessed tight oil resources alone represent about 20 years of current annual production.

Exhibit 5: Tight Oil Plays Assessed by ICF

Play	Unrisked Square Miles	Play	Unrisked Square Miles
US			
US Bakken Shale - Williston Basin	21,852	Monterey - San Joaquin Basin, CA	1,530
Niobrara Shale - Denver Basin	8,900	Kreyenhagen - San Joaquin Basin, CA	1,845
Niobrara Shale - Powder R. Basin	6,300	**Canada ***	
Niobrara Shale - Green River Basin	2,088	Canada Bakken Shale - Williston Basin	1,944
Niobrara Shale - Piceance Basin	3,528	Montney-Doig	2,800
Avalon Shale - W. Texas	7,900	Duvernay - WCSB	31,896
Bone Springs Clastics - W. Texas	4,400	Cardium - WCSB	11,011
Wolfberry Clastics - W. Texas	5,100	Viking - WCSB	8,715

* Additional preliminary studies of Shaunavon, Ameranth, Exshaw, Slave Point, and Beaverhill Lake fms.

Technology Assumptions

An important aspect of resource assessment is the underlying assumption about technology. The ICF resource assessment is based upon the assumption of existing technology. This is a conservative assumption, as has been demonstrated by the very rapid technology growth in shale gas and tight oil development in just five years. Technology improvements may result in higher well recoveries, lower costs, and less environmental impact.

Comparison with Other Assessments

The ICF gas resource assessment, especially for shale gas, is higher than other published assessments. The difference results from the inclusion of more plays and from our more inclusive and extensive geological and engineering approach to resource assessment.

Several groups in the U.S. and Canada publish oil and gas resource assessments. These include the following:

- The U.S. Energy Information Administration (Annual Energy Outlook). This assessment is revised each year and is primarily based upon USGS and BOEM assessments, with a recent EIA evaluation of shale gas. [10] The USGS assessment is an ongoing assessment being carried out basin by basin.
- The U.S. Potential Gas Committee. This is a group of U.S. gas supply experts from industry and academia that put out an assessment of the Lower-48 and Alaska every two years. [11]
- Canadian Society for Unconventional Gas (industry group) [12]
- MIT Energy Initiative. This is an academic group that published a study in 2011.[13]
- Advanced Resources International. ARI is a private firm that has done oil and gas assessment work for DOE and others. [14]
- INTEK shale assessment for EIA. This is a private firm that has developed a new shale assessment under contract to EIA [15]

A comparison of various recently published assessments is shown in **Exhibit 6**. Most of the difference is with the shale gas assessment. [16]

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[10] EIA assumptions of the 2011 Annual Energy Outlook http://www.eia.gov/forecasts/aeo/

[11] U.S. Potential Gas Agency, 2011, "Potential Supply of Natural Gas in the United States," Potential Gas Committee, Colorado School of Mines, Golden Colorado. http://www.potentialgas.org/

[12] Canadian Society for Unconventional Gas (CSUG), 2011, http://www.csug.ca/

[13] MIT Energy Initiative, 2011, "The Future of Natural Gas," http://web.mit.edu/mitei/research/studies/report-natural-gas.pdf

[14] Advanced Resources International, 2010, "U.S. Natural Gas Resources and Productive Capacity," prepared for Chenier Energy LNG export application, August 26, 2010. http://www.cheniereenergypartners.com/lng_documents/application_exhibits.pdf (pages 234-349)

[15] INTEK, 2010, "Review of Emerging Resources – U.S. Shale Gas and Shale Oil Plays," included with EIA AEO documentation materials; http://www.eia.gov/analysis/studies/usshalegas/

[16] In some cases these may not be the most recent assessment.

Exhibit 6: Comparison of Lower-48 Natural Gas Assessments

ICF, January 14, 2013
TCF of technically recoverable gas; excludes proved reserves

Group	Shale Gas and Tight Oil	Tight Gas	Coalbed	Conventional	Unproved Total
ICF, 2013	2,052	438	66	707	3,263
EIA AEO, 2011	827	369	117	703	2,016
PGC, 2011	687	(with conv.)	102	858	1,647
MIT, 2011	631	173	115	951	1,870
ARI, 2010	660	471	85	831	2,047

Notes:
ICF shale gas includes tight oil associated gas.
PGC assessment does not break out tight and conventional.
MIT assessment of conventional gas shown here includes Alaska

There are several reasons why the ICF shale gas assessment is higher than other published assessments:

- More plays are included by ICF. ICF includes all major shale plays that have significant activity or industry interest.
- ICF includes the entire shale play, including the oil portion. Several plays such as the Eagle Ford have a large liquids area. The oil portion of the play may contain large volumes of associated gas.
- ICF employs a bottom-up engineering evaluation of gas-in-place, original oil-in-place (OOIP), and recoverable hydrocarbons. This analysis is based upon mapped geological parameters and well accepted reservoir simulation and modeling methods.
- ICF estimate incorporates infill drilling and the latest current technologies that increase the volume of reservoir contacted and recovery factors.
- ICF includes conventional gas in the areas of the outer continental shelf (OCS) that are currently off-limits, such as the Atlantic OCS. Some of this resource may be made available, but it is not a large part of our resource base.

- ICF evaluates all hydrocarbons at the same time (dry gas, NGLs, crude, and condensate). The inclusion of liquids is a critical aspect of prospect economics and has a large impact on the supply curve.
- The ICF resource is a "risked" resource. ICF employs an explicit risking algorithm based upon the proximity to nearby production and factors such as thermal maturity or thickness.

The ICF assessment is based upon extensive geologic, engineering, and economic analysis. ICF believes that other shale assessments are low because they are not as inclusive or comprehensive in their approach and may not include the most recent data. The ICF well recovery estimates and development and production forecasts are supported by actual production and EUR per well results where historical data are available.

Gas Resource Costs

ICF has developed supply cost curves for the U.S. and Canada. These curves represent the aggregation of discounted cash flow analyses at a highly granular level. Resources included in the curve are all of the resources discussed above – proven reserves, growth, new fields, and unconventional gas. The unconventional GIS plays are represented in the curves by thousands of individual DCF analyses.

Conventional and unconventional gas resources are determined using different approaches due to the nature of each resource. For example, conventional new fields require new field wildcat exploration while shale gas is almost all development drilling. Offshore undiscovered conventional resources require special analysis related to production facilities as a function of water depth.

The basic ICF resource costs are determined "at the wellhead" prior to gathering, processing, and transportation. However, cost estimates have been developed to allow costing at points

farther downstream of the wellhead. In addition, costs can be adjusted to a "Henry Hub" basis for certain type of analysis that consider the remoteness of the resource.

Supply Costs of Conventional Oil and Gas

Conventional undiscovered fields are represented by a field size distribution. Such distributions are typically compiled at the "play" level. Typically, there are a few large fields and many small fields remaining in a play. In the model, these play level distributions are aggregated into 5,000 foot drilling depth intervals onshore and by water depth interval offshore. Fields are evaluated in terms of barrels of oil equivalent, but the hydrocarbon breakout of crude oil, associated gas, non-associated gas, and gas liquids is determined. All areas of the Lower-48, Canada, and Alaska are evaluated.

Costs involved in discovering and developing new conventional oil and gas fields include the cost of seismic exploration, new field wildcat drilling, delineation and development drilling, and the cost of offshore production facilities. The model includes algorithms to estimate the cost of exploration in terms of the number and size of discoveries that would be expected from an increment of new field wildcat drilling.

Supply Costs of Unconventional Oil and Gas

ICF has developed models to assess the technical and economic recovery from shale gas and other types of unconventional gas plays. These models were developed during a large-scale study of North America gas resources conducted for a group of gas producing companies, and have been subsequently refined and expanded. North American plays include all of the major shale gas plays that are currently active. Each play was gridded into 36 square mile units of analysis. For example, the Marcellus Shale play contains approximately 1,100 such units covering a surface area of almost 40,000 square miles.

The resource assessment is based upon volumetric methods combined with geologic factors such as organic richness and thermal maturity. An engineering based model is used to simulate the production from typical wells within an analytic cell. This model is calibrated using actual historical well recovery and production profiles.

The wellhead resource cost for each 36-square-mile cell is the total required wellhead price in dollars per MMBtu needed for capital expenditures, cost of capital, operating costs, royalties, severance taxes, and income taxes.

Wellhead economics are based upon discounted cash flow analysis for a typical well that is used to characterize each cell. Costs include drilling and completion, operating, geological and geophysical (G&G), and lease costs. Completion costs include hydraulic fracturing, and such costs are based upon cost per stage and number of stages. Per-foot drilling costs were based upon analysis of industry and published data. The API Joint Association of Drilling Costs and Petroleum Services Association of Canada (PSAC) are sources of drilling and completion cost data, and the EIA is a source for operating and equipment costs.[17,18,19] Lateral length, number of fracturing stages, and cost per fracturing stage assumptions were based upon investor slides and other sources.

In developing the aggregate North American supply curve, the play supply curves were adjusted to a Henry Hub, Louisiana basis by adding or subtracting an estimated differential to Henry Hub. This has the effect of adding costs to more remote plays and subtracting costs from plays closer to demand markets than Henry Hub.

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[17] American Petroleum Institute, various years, "Joint Association Survey of Drilling Costs," API, Washington, DC.
[18] Petroleum Services Assn. of Canada, 2009, "2009 Well Cost Study." http://www.psac.ca/
[19] U.S. Energy Information Administration, 2011, "Oil and Gas Lease Equipment and Operating Costs," http://www.eia.gov/petroleum/reports.cfm

The cost of supply curves developed for each play include the cost of supply for each development well spacing. Thus, there may be one curve for an initial 80-acre-per-well development, one for 40-acre-per-well. This approach was used because the amount of assessed recoverable and economic resource is a function of well spacing. In some plays, down-spacing may be economic at a relatively low wellhead price, while in other plays, economics may dictate that the play would likely not be developed on closer spacing. The factors that determine the economics of infill development are complex because of varying geology and engineering characteristics and the cost of drilling and operating the wells.

The analysis is based on current practices and costs and therefore does not include the potential for either upstream technology advances or drilling and completion cost reductions in the future. Throughout the history of the gas industry, technology improvements have resulted in increased recovery and improved economics. In oil and gas resource assessment and forecasting, assumptions are typically made that well recovery improvements and drilling cost reductions will continue in the future and will have the effect of reducing supply costs. Thus, the current study may be considered a conservative representation of the resource base.

Aggregate Cost of Supply Curves

North America supply cost curves on a "Henry Hub" price basis are presented in **Exhibits 7 and 8**. The costs in each basin have been adjusted to account for basis differential to Henry Hub, Louisiana. The supply curves were developed on an "oil-derived" basis. That is to say that the liquids prices are fixed in the model (crude oil at $95 per barrel) and the gas prices in the curve represent the revenue that is needed to cover those costs that were not covered by the liquids in the DCF analysis. The rate of return criterion is 10 percent, in real terms. Current technology is assumed.

For the Lower-48, 2,300 Tcf of gas resource is available at $10.00 per MMBtu or less. For Canada there is 650 Tcf at at $10.00 per MMBtu or less. At $5.00 per MMBtu, over 1,200 Tcf is available in the Lower-48 and approximately 300 Tcf is available in Canada.

This analysis shows that a very large component of the technically recoverable resource is economic at relatively low wellhead prices. This assessment could well be conservative in that it assumes no improvement in drilling and completion technology and cost reduction, while in fact, large improvements in these areas are being made.

Exhibit 7: ICF U.S. Natural Gas Supply Curve – Henry Hub Basis

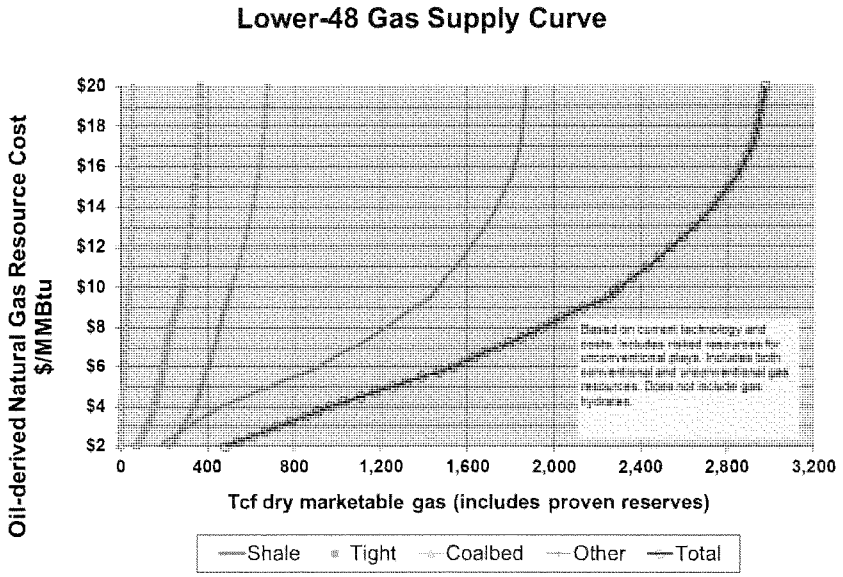
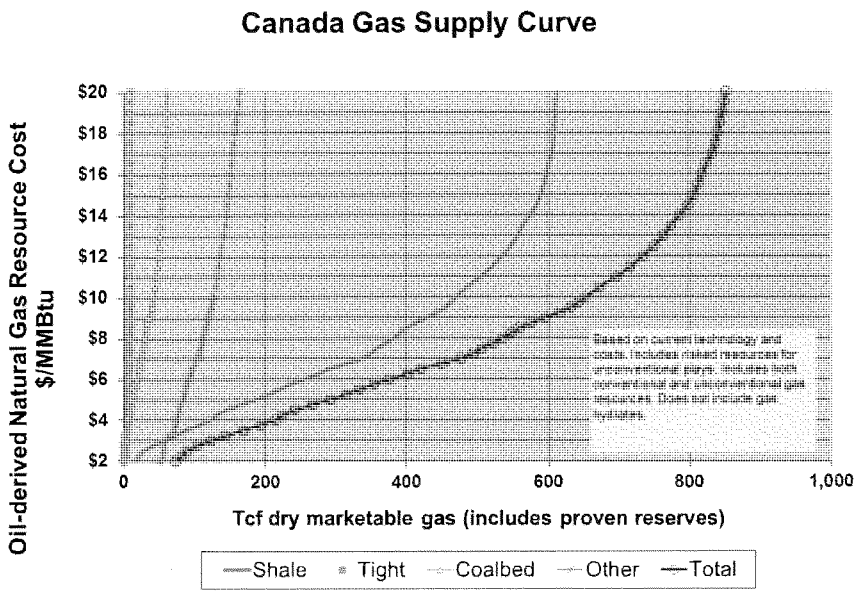


Exhibit 8: Canada Natural Gas Supply Curve – Henry Hub Basis



Source: ICF

Mr. WHITFIELD. Thank you, Mr. Vidas.

At this time we will go into the question-and-answer period, and I will recognize myself for 5 minutes for questions. Once again, I want to thank all of you for your testimony. It is quite encouraging that we find ourselves in America today with abundant natural resources—gas, oil, coal—as well as renewables, and your testimony, as I had indicated in my opening statement, shows how just a short period of time how everyone was talking about we were depleting our natural resources. So it is really exciting that we find ourselves in America in this situation and particularly at a time when we really are in a global marketplace and we find ourselves competing with other countries for jobs and for job creation. How many of you attended the World Economic Forum in Davos? Dr. Yergin? OK.

Now, I had read some comments that there was a lot of discussion in Davos about the focus on American energy independence, and the articles that I read indicated it was a major concern for the Europeans because fortunately in America, most of our production and discoveries have occurred on private lands which we have been able to develop even though permits on public lands are down, and I know that in Europe, a lot of these discoveries are on government-owned lands. But would you make a comment about your observation of the Europeans' views on what is happening in America in the energy sector?

Mr. YERGIN. Yes. I think it was summarized for me at the World Economic Forum, I asked a prominent journalist what he thought the number one theme was, and I expected him to say the euro, and he said shale, and it took me by surprise, but I think that, you know, it takes time for thinking to catch up with changes, and I think Europe is suffering from enormous unemployment problems. Spain has 26 percent unemployment. And they are looking at the United States and saying the United States, because of this low-cost, abundant energy is going to be a very formidable competitor and people kind of stopping investing Europe and wanting to transfer their investment to the United States, and I think companies that are European based saying that they are going to be at a disadvantage competing against the United States.

I heard the same thing when I was in China for the publication of my book The Quest. I spent 2 weeks there and I heard the same intense discussion about shale in the sense that the United States was going to be changing the competitive playing field in the global economy because of this, so I think the rest of the world has really kind of become obsessed with this development in the United States because of how it changes the competition, as I say, in the global marketplace.

Mr. WHITFIELD. Well, I agree and I think we are very fortunate to live here, and the policies that we adopt are going to go a long way in determining how far we can go down this road, and I said in the beginning, one of our primary focuses today is about economic growth and job creation, and we have what I will refer to as a magic key to really facilitate that in many ways.

Let me just briefly talk about the export of liquefied natural gas. I know it is controversial and I know there are a lot of different sides to it. My understanding is that a permit has been issued and there is a facility being built in Louisiana for the purpose of doing

that. I know the chemical industry, for example, is very much opposed to it, but would some of you just make a brief comment on what you think about it? I mean, do you think this is something we should be looking at? When you think about the impact it would have on our trade deficit too, that is good. But Dr. Yergin, I know you mentioned it briefly. Just give me your views on that.

Mr. YERGIN. Well, I think that some of us can remember a few years ago when we were going to have all these importing facilities for LNG, and you would look at a map and you would see 30 or 40 of them and it turned out it is sort of zero right now, so I think there is a kind of boom discussion about all these facilities, and our conclusion is that the number that will be built is perhaps, you know, you could count them on one hand because a lot of the discussion has left out, as I said, the competitive factor that there are a lot of other people. Canada might have three to five just in British Columbia and they cost a lot, and a lot of new projects. There is new gas off of East Africa. There is new gas off Israel. All that is going to be coming into the marketplace, so that will kind of put a balance upon it, and I think as many of us feel on this panel that the issue is that we are demand constrained. We have a lot of gas and so it would not have a dramatic impact on gas cost and it would unfold over a decade or more.

Mr. WHITFIELD. Did you want to make a comment, Ms. Morgan?

Ms. MORGAN. We haven't worked extensively on LNG exports but I think the key point I think across the board is, if the United States is successful in integrating carbon capture and storage along with gas from shale and other resources, you actually, I think, would have even greater opportunities.

Mr. WHITFIELD. I see my time is expired so at this time I will recognize the gentleman from Illinois for 5 minutes, Mr. Rush.

Mr. RUSH. I want to thank you, Mr. Chairman.

Dr. Yergin, it is so good to see you again. I remember having breakfast with you at the Aspen Institute and I thought you did quite well and you are doing quite well now. In your testimony, you report that the unconventional energy revolution supports 1.7 million jobs currently and that that number will grow significantly over the next decade. Can you speak to these new jobs and what we can expect to see? How will the number grow, the types of jobs that will be created and where these jobs will be located nationally?

Mr. YERGIN. We undertook this research over about the last six or seven months, and we were surprised by a couple of things, one, the scale of the jobs. We use the same methodology that the Bureau of Economic Analysis and Commerce Department uses. And secondly, that it really spread across all the States. That is why I mentioned New York and Illinois as examples because of these long supply chains, and I think this too, if we talk about the surprise around unconventional resources, the first surprise was the scale of it and the speed and the second has been this wider economic impact. So the jobs, that 1.7 million that we talk about includes direct jobs, which would actually be working in the oil and gas fields. It would include the technology jobs, the service jobs that support it, and then it is the jobs that are created—this is called the induced jobs that are created by the rising incomes that people have

to spend and it is the kind of services that would be provided. So it is kind of package of all of them, and you know, it is a demonstration of how tightly integrated our national economy is, that it goes across the entire country. So it could be everything from somebody working in manufacturing steel in Ohio to somebody working in information technology in California that feeds into this industry.

Mr. RUSH. Are we equipped now? Is the American workforce prepared to take these jobs? Are we prepared to deal with these jobs?

Mr. YERGIN. I think so up to a point, but it does require training. For instance, the State of Ohio is getting prepared for activity there, and Governor Kasich there has made a big emphasis on vocational training in the schools to train workers who would be working directly in the oil or gas field, in the Utica shale, as it is called. I think it is striking that this job creation or job support has really occurred during a period of high unemployment and it has been in a sense one of the bright spots during these 5 tough economic years that we have had.

Mr. RUSH. Thank you.

Ms. Morgan, in your testimony you state that the United States has been a world leader in clean energy research and development but it has had less success relative to other countries in actually developing a domestic clean energy manufacturing industry. In your opinion, what has prevented the United States from developing a robust clean energy manufacturing sector?

Ms. MORGAN. Thank you. We recently did an assessment across five countries of the wind and solar value chain to look at who is winning the clean energy race, and what we found across the board is that the countries that are ahead, which include Germany and China, have a long-term policy signal that provides certainty for investors in manufacturing. So you need to have something that goes beyond 3 years. So now with our short-term benefits, you may see some wind turbines come up but you may be creating the perverse piece where you are not creating the manufacturing capacity domestically because there is no long-term policy signal around renewable energy and therefore you may see the import of those parts because investors don't know what is going to happen in 2 years or 3 years, so it is mostly that lack of national renewable energy policy that is lacking here.

Mr. RUSH. Along the same lines, what does the United States need to do to become a net exporter of clean energy technology?

Ms. MORGAN. I think there are a number of pieces across the value chain that would be essential. The first is that national policy that provides that long-term certainty, so that could be anything from a renewable portfolio standard to a feed-in tariff to whatever policy of choice provides that long-term certainty. The second really is putting in place the innovation centers that bring together public and private actors to be able to develop those new technologies rapidly. The third is to increase our research and development. We are doing pretty there, but our problem really is that although we are leading the world in R&D, we are not doing it fast enough vis-&-vis other players. Thank you.

Mr. RUSH. Thank you very much, Mr. Chairman. You have been very kind.

Mr. WHITFIELD. Thank you. At this time I recognize the gentleman from Texas, Mr. Barton, for 5 minutes.

Mr. BARTON. Thank you, Mr. Chairman.

I would like to ask Mr. Yergin if he is familiar with the emerging technology on hydraulic fracturing that greatly minimizes the amount of water that is used. Have you studied that in any detail?

Mr. YERGIN. I am certainly aware of companies who are working to perhaps reduce the water requirements by as much as 75 percent, and I think, you know, one of the things when we did this study for the Secretary of Energy Advisory Board, we said that the needs here, as your question suggests, are going to really promote a lot of innovation and there sure is a lot of innovation going into the water issues right now, and we do see the water usage as a major part of it.

Mr. BARTON. There is a company in my district and then there are a number of companies around the country that they haven't commercialized it to a great degree yet but they have certainly shown that it works on a prototype basis, and some of them can take as much as 99 percent of the water that is currently used to frack a well. It is no longer necessary. And I think that if we can solve that issue satisfactorily, the sky is the limit. I think that seems to be the larger environmental issue.

Mr. YERGIN. Congressman Barton, if I can say, it is striking that this is all—you know, this is only in the last 4 or 5 years and already to see this innovative response, which is part of our hearing, it kind of shows the creativity of our industries to respond to immediate needs.

Mr. BARTON. When I was chairman of the full committee, we passed a bill called the Energy Policy Act of 2005, and we put in language that gave the Federal Energy Regulatory Commission ultimate say on siting LNG facilities for import. We thought we were going to be importing liquefied natural gas. That authority is now being used by the FERC to license facilities to export, in some cases the same facility. They are just turning it around. Do you see LNG for export radically changing the price structure for natural gas, which right now is a little under $3 1,000 cubic feet?

Mr. YERGIN. No, we don't see LNG exports as having a major impact on price. I mean, what we see is a continuing growth of supply and there is actually a need for additional market, whether it is LNG, whether it is vehicles, it is electric power, and we don't think that these projects will have much impact.

Mr. BARTON. So you don't see any national security issues if we were to license LNG facilities?

Mr. YERGIN. I think we see a gain to national security from the United States being an energy exporter and the influence that will come from that that is a net positive for our national security.

Mr. BARTON. I happen to agree with that.

And finally, I have got about another minute and a half, Dr. Yergin, how do you see the combination of hydraulic fracturing and horizontal drilling in terms of oil production? A lot of companies down in Texas 5 or 6 years ago when I talked to them about using this technology for oil production, they kind of laughed. They said it is just not the same, it doesn't work. And a company in Houston, EOG, and also a privately owned company, Hunt Energy up in Dal-

las, they decided to try it, and I will be darned, all you have to do is look at the Bakken up in North Dakota, and I think almost all of that production is horizontally drilled with hydraulic fracturing. Do you see that becoming the norm or do you still see the conventional drilling for oil dominating?

Mr. YERGIN. I think it is really spreading. I mean, as you say, it was only around—this is only really is 2009, 2010 that it took off for oil, and I think the numbers keep—I don't know what Administrator Sieminski would say but the numbers keeping exceeding the projections that are happening so fast and we see it being applied in traditional areas like the Permian Basin, which has been pronounced dead several times and of course is going through another——

Mr. BARTON. They had an all-time year last year.

Mr. YERGIN. Yes, so I think it is going to be applied, and I think that we will see probably impact of this faster globally than we will see it in terms of natural gas.

Mr. BARTON. My final question is to Mr. Sieminski. Do you see the United States being self-sufficient in oil production in the next 10 years?

Mr. SIEMINSKI. In oil production?

Mr. BARTON. Yes.

Mr. SIEMINSKI. In our reference case for the Annual Energy Outlook, which we just published, we have oil self-sufficiency getting down to the low 30s, low 30 percent, so 30 percent of our consumption would still be imported. In the side cases, which we will publish in March for the Annual Energy Outlook, we have looked at what it would take to get to self-sufficiency in oil. It involves closer well spacing, greater estimates of what the resource base is and a number of other factors that would drive oil production higher. We also looked at the demand side; that is, could fuel efficiency standards for automobiles, for example, be improved, and other steps that could be taken to reduce demand. In that set of circumstances, which requires further policy changes on both supply and demand, we could get to a crossover where the United States would be self-sufficient.

Mr. BARTON. You are not saying it is probable but it is possible?

Mr. SIEMINSKI. It is possible.

Mr. WHITFIELD. The gentleman's time is expired.

Mr. BARTON. Thank you, Mr. Chairman.

Mr. WHITFIELD. At this time I recognize the gentleman from Texas, Mr. Green, for 5 minutes.

Mr. GREEN. Thank you, Mr. Chairman. I am proud to follow my colleague in Texas, on the success we have had on directional drilling in both natural gas and oil. You might remember, you were chair of the committee, Congressman Barton, in 2005 when we did a bipartisan energy bill that we put in a little provision for the DOE to do a study on directional drilling because they had a great lab in Wyoming to do it, and we had a Houston or a Texas company who was drilling at that time out to 35,000 feet and they thought they could get to 50,000 and on, and we are seeing some of the success of that both for natural gas but also for the tight oil, as we call it.

I have always believed a balanced energy policy must support all domestic sources of energy including oil, natural gas and renewables, and again, the last question was, we are also using our energy smarter now because each time I buy a new car, I am getting 5 to 10 miles more per gallon than I did on the previous one, so we are using our energy smarter. Limiting this production would only serve to jeopardize our small-business jobs and increase our reliance on foreign sources of energy. It may also have an impact on our ability to address climate change because if we fail to provide the natural gas needed to meet our short-term carbon reduction targets while providing affordable and reliable sources to American consumers.

Administrator Sieminski, the EIA expects natural gas production to remain close to its 2012 level in both 2013 and 2014. Is that correct?

Mr. SIEMINSKI. Yes.

Mr. GREEN. I know currently there are a lot of wells comprised of just gas, or just dry gas, that are not being produced due to the low price of natural gas. This is one of the reasons I support the export of LNG so that there is additional incentive to produce these gas wells. Has EIA looked at what these export opportunities might mean for our future natural gas production levels?

Mr. SIEMINSKI. We have done that. Coming back to the major driver behind why we have natural gas holding even this year and next year, it is mainly because we are assuming natural gas prices are going to recover to $4 by the end of next year. That begins to allow coal to compete more effectively for electric utility generation markets and holds natural gas back. So one of the interesting factors here that comes into play is that because of continuing strong supplies, natural gas prices remain low. That would actually lead to more demand in the electric utility sector.

As far as LNG is concerned, and in response to the question that Chairman Whitfield asked at the beginning of the hearing, Mr. Green, the United States is already exporting natural gas. We export by pipeline to Mexico and Canada. Of course, we get more gas from Canada. In the reference case that we examined for the Annual Energy Outlook, EIA has LNG exports from the lower 48 States and Alaska rising towards about 5 percent of domestic output over the period out to 2040.

Mr. GREEN. Well, I actually have two issues, I guess, on that. One, I represent an area that is heavy in the chemical industry who is concerned about the rise in natural gas prices but I also know that when I drive through south Texas and I see so much flaring of the dry gas because we don't have the capacity or the infrastructure or the customers for it, it is just such a waste of our utilization of natural gas, and so if we could sell it to someone for $15 an mcf, I wouldn't mind doing that.

But has the EIA incorporated the increased use of enhanced oil recovery in its oil projections? In Texas, for example, the use of EOR has changed our predicted production levels, and you mentioned the Permian Basin area as a good example of that.

Mr. SIEMINSKI. We have built in some assumptions along those lines, and in separate cases, we look at other factors that could help drive oil production. One of the main questions raised at this

hearing is, what is the extent of the resource base, and if we were to see the same improvements that have taken place in the last 5 years in natural gas occurring in the oil shale area, what we would end up saying is that rather than our roughly 6.4 million barrels of oil production we had last year getting up to about 8 before it begins to taper off, then it could get up closer to 10 million barrels a day and then hold pretty steady at that level, and one of those things includes better technology and recovery.

Mr. GREEN. Well, and 10 million barrels a day sounds like a lot, but I actually have five refineries in East Houston and Harris County that use over a million barrels a day right now to make refined product, so we still are going to have to import or produce the needs for our own country.

Mr. WHITFIELD. The gentleman's time is expired.

Mr. GREEN. Thank you, Mr. Chairman.

Mr. WHITFIELD. At this time I recognize the vice chair, Mr. Scalise, for 5 minutes.

Mr. SCALISE. Thank you, Mr. Chairman. I appreciate you having this hearing on America's energy security, and specifically to look at an assessment of our resources because, you know, I think the chairman had mentioned, the first natural gas facility, the first LNG export facility is in south Louisiana. I have actually toured that facility, Cheniere Energy, in south Louisiana, and that was originally built to be an import facility because we didn't think we had the reserves that we needed for natural gas, and then eventually because of the technology, the advancements that brought all these shale plays online, now the actual opposite has happened where we have so much that in many cases they are not even drilling in areas where they have leases because all of a sudden we found these resources that we didn't really know we could access just a few years ago and so they spent billions of dollars to retrofit and shift that from an import facility to an export facility, allowing us to create more American jobs and to continue to advance that new technology, which has really helped start a revolution, as I think a number of you talked about in your testimony.

I want to ask you, Ms. Hutzler, because you specifically mentioned production on federal lands versus non-federal lands, and it is one of the misnomers that we hear about up here in Washington, you know, and the President will go around saying that production has never been higher, and yet you actually look at some of his policies that have shut production off on federal lands in the areas where the federal government doesn't currently have the ability to go and have an impact in those States where they are seeing a real revolution, it is on non-federal lands. So if you can touch a little bit on that, about maybe some of the factors behind such an increase on non-federal lands where you actually have some problems and in some cases reductions on federal lands on production.

Ms. HUTZLER. Production, for instance, production of oil on private and state lands over the past 5 years has increased, is essentially 96 percent of the total production that we have gotten, and the reason generally is that there is a lot of red tape when you try to deal with production on federal lands, and I think I mentioned in my opening remarks and in my testimony that it takes over 300 days to now get a permit to drill on federal lands where in the

States it is less than 30 days. So all of this is taking much longer for a company to invest their money in terms of trying to deal with production on federal lands.

Mr. SCALISE. Yes, and we can see, especially if you look at the shale natural gas plays, they are actually regulated. You know, the EPA might try to give the impression that there are no federal regulations and they need to step in, and I think that concerns a lot of people because the EPA doesn't have a good track record of implementing good regulations where States have actually done a really good job at regulating natural gas shale plays, and frankly, the topography in Louisiana is a whole lot different than it is in Pennsylvania or North Dakota or Texas, and so the States have the ability to do that much better and have a great track record, by the way, of doing that, and so I think it is a good point to make because where we have seen real growth not only in energy but in jobs where in North Dakota, the lowest unemployment in the Nation they have up there because of all of this new economic growth coming from this technology, and so we surely don't want to see the federal government come in and try to slow that down in the name of good regulations when in fact you already have good regulations the way it is supposed to be done and that is where the States themselves do it.

I want to ask you, Mr. Vidas, because you have looked at some of the data. We get data from the Energy Information Agency and they have even shown that there has been a decrease in production on federal lands but some of the information you have on resources, on the known resources, are dramatically higher, I think 50 percent in some cases higher than the numbers that come out of EIA. Can you explain what data you look at that shows the outlook for this country is even better than what we get from the EIA's numbers?

Mr. VIDAS. Well, in any type of resource assessment, there is going to be uncertainty because what we are talking about is some activity that has yet to happen, so we are predicting then the productivity of potentially hundreds of thousands of wells that will be drilled in the future, and the way we do it is to first start with the geology and to develop maps of each of the plays, and we try to deal with and get data on the key parameters like what is called the structure maps, which is the drilling depth you need to go down to, the thickness of the shale, some of the parameters of the shale in terms of their carbon content, the porosity, the pressures and temperatures, and from that we can develop what is called a gas-in-place estimate, which is an estimate of how much gas there is in the ground in the formations that will be targeted. And then we have information on wells that have already been drilled and we can look at their production profiles and estimate over their lives how much gas they are going to produce. So, for example, if we looked at Pennsylvania and we looked at the Marcellus shale, we would see that the horizontal wells there that have been drilled have been improving in terms of their productivity and now are producing about 4–1/2 billion cubic feet per well. But that is in the better parts of the play because producers have gone to look for the best gas first, the most economic gas, but then we can look at the other areas of the play in terms of either being thinner or less pres-

sure or lower porosity and we can correct for the productivity using basic engineering principles and thereby forecast that into the future, the future productivity of the wells, which we think on average will be about half of that, maybe 2 bcf per well.

Mr. SCALISE. I am seeing I am out of time. I apologize, but I thank you for your testimony and your answers, and Mr. Chairman, I yield back.

Mr. WHITFIELD. At this time I will recognize the gentlelady from California, Ms. Capps, for 5 minutes.

Mrs. CAPPS. Thank you, Mr. Chairman, very much, and thank you, each of you, for your testimony.

You know, assessing our current energy resources is obviously important, especially in light of the numerous advancements in research and technology in recent years and that is why I appreciate today's hearing, but I am concerned that we are not getting the full picture. Today's testimony and the questions coming from the majority have focused overwhelmingly on fossil fuels. Oil, natural gas and coal obviously dominate our energy supply but they are certainly not the only resources available. The EIA Energy Outlooks makes this clear, pointing out that renewable energy sources such as solar, wind and biofuels make up a sizable portion of our energy use.

So my first question is to you, Administrator Sieminski. EIA projects that use of renewables will continue to grow, in some cases by double digits. Is that right?

Mr. SIEMINSKI. Yes, that is correct. We actually have renewables growing the fastest in percentage terms of all of the fuel sources over the period out to 2040. I would also like to point out that the share of generation of electricity from renewables grows from 13 percent in 2011 to about 16 percent in 2040. Electricity generation from solar and to a lesser extent wind energy sources grows as recent cost declines make them more economical. The 2013 projection is a little bit less optimistic about advanced biofuels because of the difficulty that companies have had in gearing up their manufacturing process but in general renewables are growing pretty strongly and help the fact that overall carbon dioxide emissions from energy in our forecast actually remain below the peak of 6 billion metric tons that we hit in 2005.

Mrs. CAPPS. Thank you. And in addition to what you just said, Ms. Morgan, you established a direct link between burning fossil fuels and climate change, and that has already been well established from a variety of sources, and we have begun to see these impacts if we just even look at extreme weather events like Hurricane Sandy, all the droughts and the wildfires as well, and I represent a coastal State and a costal district. I am particularly mindful of climate change impacts on higher sea levels and increasing erosion.

Ms. Morgan, in your testimony you discuss some of these impacts. Could you elaborate, particularly on sea-level rise and increased erosion for those of us who do represent coastal communities?

Ms. MORGAN. Certainly, yes. Sea-level rise is one of the major threats to the United States and is already occurring along the Eastern seaboard and certainly also on the West Coast. I am famil-

iar, we have done some work looking in Florida particularly where you see that Miami Beach is already having to spend more than $200 million to overhaul its storm damage system. You are seeing that Hallandale Beach has to spend $10 million a year on new wells because of saltwater intrusion. Florida is built on limestone, which means sea walls don't help much. So that is a major piece of worry. Also, certainly, the energy infrastructure that is located along the coast is also at risk.

Mrs. CAPPS. I just want to add an example to that. I represent the central coast of California, and the city of Pismo Beach is installing sea walls itself to protect two sewage lift stations that are threatened by erosion, and in Santa Barbara, our central creek that comes right down through the heart of the city has been widened to increase its flood capacity. These projects come at a high cost, and I know these communities have struggled to find necessary resources.

One final one, in the last few seconds, is this something other communities are also struggling with and finding that the cost is really prohibitive?

Ms. MORGAN. Absolutely, and I know in Florida there are four counties that have joined together and are facing tremendous cost. If you look here in Lewes, Delaware, not far away from communities that are struggling with it, go up to Maine. So it is a real issue that we need to face on our infrastructure investments but also the cost to local communities. It puts an imperative on emission reductions as well.

Mrs. CAPPS. Thank you very much. I will yield back.

Mr. WHITFIELD. At this time I recognize the gentleman from Nebraska, Mr. Terry, for 5 minutes.

Mr. TERRY. Thank you, Mr. Chairman.

This fall I hosted a natural gas forum in Omaha where we had representatives from just about every facet of the natural gas world from users, producers and potential future users. One theme came from that, and that is that we have a great supply of natural gas, we can argue 100 years or 150 years, that there is enough supply that we could expand the uses of natural gas into transportation, and this begs of question, we have been talking about exporting surplus but we could also have discussions of additional uses of natural gas.

But one thing always came back, and that is the uncertainty of regulations and the regulations when you drilled further down were defined as uncertainty about whether the federal government was going to start regulating fracking, if and how, and that that in itself is the worry for the users. I am one of those that feels that expanding natural gas into vehicles will help our country not only because we are using a domestic product but the fact that diversity in auto fuels, whether we start with trucks, heavy trucks or whatever, enhances our national security status.

So starting with Mr. Sieminski, honorable, and then going down, this is the question I would like to have your respective opinions, and that is, is it fair to say that moving more of our transportation to natural gas will impact our national security?

Mr. SIEMINSKI. Thank you, Mr. Congressman, for calling me honorable. I guess I get that because the Senate confirmed me in my

appointment. I tell people that a lot of folks in my new place of employment call me sir, and that is very different than when I was in the private sector, but I have to fly economy when I travel.

Mr. TERRY. I understand that. With a 9 percent approval rating here, we get called a lot of things, but honorable is not one of them.

Mr. SIEMINSKI. I think that you are on to a really interesting question here. We actually took at look at how quickly natural gas could grow in transportation, and it is a very small number, a rounding error in terms of percentages. We do use 3 percent of our natural gas to move natural gas in the pipelines, but when most people think about transportation, they are thinking about trucks or cars and so on. We believe that LNG in freight trucks and then eventually natural gas being turned into liquids like a high-quality diesel fuel—there is a plant under consideration down in Louisiana to do just that—could actually almost double the amount of total natural gas in transportation so that we could get up from 3 percent now to easily 6 percent and possibly as high as 8 or 9 percent. A lot of that is because natural gas, from a pricing standpoint, looks really, really attractive compared to global oil prices. So there is a lot of effort underway there.

Mr. YERGIN. I think we have pretty much the same view as EIA, that, you know, it does now appear that natural gas will become an important fuel for large trucks, for railroads and so forth. At this point we don't see it becoming a major fuel for private automobiles because of the nature of the infrastructure and so forth that would be needed.

Mr. TERRY. I would like to hear your opinion.

Ms. MORGAN. I would be happy to.

Mr. TERRY. You are the contrarian.

Ms. MORGAN. We haven't done extensive research on this area but the one piece that I can add to the discussion perhaps is that it is clear that gas a lower global warming potential than oil, so from that perspective, it is more beneficial, and I think as I was saying earlier, if we can also tackle the carbon capture and storage piece of that, you will see even greater benefit.

Mr. TERRY. Thank you.

Ms. HUTZLER. From our standpoint, we essentially agree with Dr. Yergin in the sense that there is certainly a market in the heavy-truck area, and it is easier to deal with the infrastructure problems there of supplying the natural gas but in the private sector for residential vehicles, it is more difficult.

Mr. VIDAS. The analysis that we have done is very similar, that although we expect natural gas and liquefied natural gas vehicles to triple their use over the next 20 or 25 years, it still represents a relatively small part of the overall sector. The more likely way that natural gas could be used to displace oil would be through gas-to-liquids technologies or even using natural gas to generate electricity and then using electricity in battery cars.

Mr. WHITFIELD. The gentleman's time is expired.

Mr. TERRY. Thank you.

Mr. WHITFIELD. At this time I recognize the gentlelady from California, Ms. Matsui, for 5 minutes.

Ms. MATSUI. Thank you, Mr. Chairman. I would like to also thank the witnesses for being with us today. I am pleased to be

back on the Energy and Power Subcommittee this Congress, and I look forward to working with my colleagues to comprehensively address our Nation's energy needs, and that also includes dealing with climate change.

Right now there are thousands of clean technology companies manufacturing innovative products that will help fundamentally shift our country away from carbon-intensive energy sources. Many of these are small-business owners and entrepreneurs. My district of Sacramento has over 220 such companies. I have seen firsthand the progress they have made in solar, wind, hydrogen fuel cells and waste-to-energy conversion techniques. These companies are working on the technology to ensure that America remains a leader in green energy global market. We are rapidly losing ground in this sector to countries like China and Germany who are heavily investing in the renewable energy markets, and the United States must level the playing field to allow our clean technology companies to better compete. Low-carbon energy sources must have a seat at this table. Energy efficiency must have a seat at this table, and clean energy technology must have a seat at this time. Anything less is shortsighted and detrimental to our economy, our environment and our energy goals.

I want to follow up to Ranking Member Rush's questions regarding the clean energy manufacturing sector. Last month, Chairman Emeritus John Dingell and I introduced H.R. 400, which is a bill to promote American clean energy exports and increase clean energy manufacturing. This bill passed the House with bipartisan support during the 111th Congress and it is my hope that this committee will consider it soon.

Ms. Morgan, can you expand on the economic benefits we would receive by boosting our clean energy manufacturing sector?

Ms. MORGAN. Certainly. I think one key piece, if we are able and hopefully will build out our manufacturing sector would be in the area of jobs. Currently, according to the Energy and Environment Study Institute, you have more jobs created in clean energy than you do in oil, fossil and coal combined, and a recent study by the University of California actually looked at the fact that you can—over time if you were to really go for 30 percent renewables and push your energy efficiency in the economy, you could have 4 million jobs by 2030. So the job benefits are certainly significant, that is for sure.

Ms. MATSUI. OK. And in your testimony, one of your recommendations is that we must build out America's renewable energy sector. Now, what are some criteria that policymakers should consider for driving clean energy growth and competitiveness?

Ms. MORGAN. I think the main criteria right now, if I look at where the United States stands on clean energy, is the clear, long-term, long, loud and legal signal that investors are looking for to see that this is a growing area, so that means that national renewable energy policy, I think it can take many different forms but optimally one that goes beyond 3 years. I think certainly having grid access for that renewable energy is another key criteria that I would look for, and I would add in training. I think the other piece that is very important, Colorado is doing some work on this, and

that is happening in Germany, is a really specific training program, big job opportunities.

Ms. MATSUI. OK. And do you think we need to consider creative financing options for smaller clean energy companies to succeed?

Ms. MORGAN. Definitely. I mean, I think that if you look at—there is a number of different innovative ways that you can bundle the demand for renewable energy and create new financing mechanisms to do that. We have had some experience with that in the United States and we are now seeing that happening in India as well.

Ms. MATSUI. Thank you. And I also believe too as we look forward, we are not—because of my focus on clean energy, clean energy technology, it does not at all mean that we cannot look at the transitional aspects of things like natural gas as long as I believe we look at some of the areas of carbon capture and storage which I think needs to be looked at alongside the wonderful aspects of how much gas we have. So anyway, I really appreciate your testimony and I hope that we can continue the conversation and looking at somewhat all of the above as we move forward.

Thank you very much. I yield back my time.

Mr. WHITFIELD. Thank you. At this time I recognize the gentleman from Illinois, Mr. Shimkus, for 5 minutes.

Mr. SHIMKUS. Thank you, Mr. Chairman, and I thank the panel for coming to Mr. Sieminski and Dr. Yergin and actually Hutzler, and I can't see the name and we don't have paper anymore, so—Vidas. I had to go flip back on the side pad to find the testimony a couple times.

Because in your presentations, a lot of you have the maps and the various plays, whether it be the shale, tight oil, coalbed, others in your testimony. What I would like to know is, how far behind are we from the pipeline infrastructure to move this product? I mean, the pipeline issue, we are dealing with Keystone and Keystone XL, part of the North Dakota play, the problem is, we don't have access to a pipeline so a lot of this North Dakota oil is being inefficiently trucked down versus through pipelines. So can you all just briefly talk about pipeline infrastructure?

Mr. SIEMINSKI. Thank you, Mr. Shimkus. So just to start, the infrastructure issues take time. I mean, you can often get some production going and you get a lot of wells being drilled. Whether or not companies can then afford to build the pipeline infrastructure to move those products, oil and gas, around depends on their own view about how long the production activity will last.

Mr. SHIMKUS. Yes, and if you would just a little brief, because most of the pipeline infrastructure now is based upon traditional oil and gas and refineries and the like, so all these new plays are in areas where there may not be access to.

Mr. SIEMINSKI. Exactly.

Mr. SHIMKUS. I guess the point is, is that something we ought to consider in public policy debates? Dr. Yergin?

Mr. YERGIN. Yes, I absolutely think so. I mean, it is like I said, our thinking needs to catch up with reality. Our logistics need to catch up with new production. Everything has been turned upside down. Instead of going south-north, it is going north-south. A big question, you know, we just managed to survive, save those refin-

eries on the East Coast, but they have to be hooked into North Dakota. We see, as you say, trucking, we see railroad cars. Ultimately, the most efficient way to move these supplies is by pipeline. Canada's output of oil sands is equivalent to Libya's before the revolution there. That supply—you know, we talk about U.S. energy independence. It is really a North American integration. So we have got to get, you know, a pipeline system that catches up with the fact that technology has changed.

Mr. SHIMKUS. There is also some oil being barged down on the Mississippi, and there was a recent one that ran into the bridge down in the southern part of the Lower Miss, so, I mean, there is also issues with that type of transportation.

Ms. Hutzler?

Ms. HUTZLER. Yes, I agree with Dr. Yergin. We do have oil that is landlocked in North Dakota. We have built up in our storage facilities in Cushing and it is more efficient to move by pipeline. We are moving by rail now, I think I saw a number of 800,000 barrels a day, which is pretty substantial, and it is also safer to move it by rail—I mean by pipeline than rail.

Mr. SHIMKUS. Mr. Vidas?

Mr. VIDAS. I agree with the other speakers, that oil and natural gas infrastructure that is going to be needed to move this oil and gas to market is very important and it involves a substantial investment each year and thousands of miles of pipe. The other point that I would emphasize as well is that pipelines in general tend to be the least expensive and usually the safest way to transport both gas and oil.

Mr. SHIMKUS. Thank you. And I will finish with Dr. Yergin. This whole debate on slowing down or not exporting natural gas I find pretty problematic as natural gas is just a basic commodity product just like corn or beans or pork or anything else, and that it has to be priced on the world market and we have to get it. You mentioned in your comment that there is a need for additional markets. Why did you say that and what do you mean by that?

Mr. YERGIN. Well, because we have seen as been described my colleagues on this panel this growth, this technology has opened up a huge amount of new supply and right now, you know, there is a lot of supply that can't get to market and you see activity going down.

Mr. SHIMKUS. So if there is no price signal, then all these jobs for location discovery and recovery would be gone because there is no price signal to continue the——

Mr. YERGIN. Yes. What has happened is of course a lot of it has flipped into looking for either oil or for gas that is rich with liquids but nevertheless I think the general view is that at this low level that this is not a sustaining price to maintain the growth in supply that we need for electric power, that we need for our industry and might need for transportation and to meet global markets.

Mr. SHIMKUS. Great. Thank you very much. Thank you, Mr. Chairman.

Mr. WHITFIELD. At this time I will recognize the gentlelady from the Virgin Islands, Ms. Christensen, for 5 minutes.

Mrs. CHRISTENSEN. Thank you, Mr. Chairman, and I want to thank you and the ranking member for this hearing as well.

Mr. Sieminski, I represent our U.S. territory, the U.S. Virgin Islands, and they are plagued with the highest rates of electricity in the United States. In my district of the U.S. Virgin Islands, current electricity rates are five times the national average. An average family pays, if they can, 50.8 cents per kilowatt compared to the 9.83 U.S. average. A visit to your Web site shows a very clear breakdown of State electricity profiles with the U.S. average retail price reported but in order to find information about the territories, you have to really search and it is quite confusing. The majority of information is on a beta site that says, for public testing and comment only and there is a country analysis brief on the Virgin Islands, but this is really unacceptable. So why is it that the territories' electricity cost information is not included there even if it is as an outlier and what can we do to have that information included?

Mr. SIEMINSKI. Thank you, Congresswoman Christensen. I said at my confirmation hearings that EIA needed to get its data better, faster and cheaper, and we are working on that. We need to receive complete and timely data from everybody. This has been a problem with some of the territories but I will look into that question and I will see what we can do.

Mrs. CHRISTENSEN. And we can work to try to make sure that you have the information. It is important for that information to be out there. Thank you.

We have spent a lot of time talking today about oil and gas resources but the United States has been said by Ms. Morgan and others that we are blessed with ample renewable energy resources as well. The question is whether we and the rest of the world are doing enough quickly to develop those clean energy resources and make our economies more energy efficient. Last November, the IEA released their World Energy Outlook for 2012 and found that our current energy system is unsustainable and they projected that in a little more than 20 years we could see average global temperatures increase up to 6.5 degrees Fahrenheit as approximately 80 percent of future global emissions are already locked in by existing infrastructure.

Ms. Morgan, how much would we have to reduce fossil fuel use in order to prevent more than, I think that would be 2 degrees Centigrade rise in temperature and what does it mean that we would be locked into these emissions?

Ms. MORGAN. Thank you. Well, on the longer term what the scientific estimates state is that we need to be reducing our emissions by 80 to 95 percent by 2050, which means that we have to really have the longer term in mind. The estimates for 2020 time period for developed countries tends to be around a 25 to 40 percent reduction. The United States has made a commitment to 17 percent. I think the thing to recognize is that there are points of no return where we hit tipping points where you are no longer able to restore coral reefs, where the arctic ice melts completely. Those are the types of irreversible impacts and the lock-in of our infrastructure that, you know, comes from the current pathway on high carbon is very much responsible for that.

Mrs. CHRISTENSEN. And, you know, they also say that it is possible to prevent that 2-degree Centigrade increase if we were to act

to reduce CO_2 emissions prior to 2017. So I don't know if you wanted to comment or Mr. Sieminski wanted to comment on what is it that—you know, the window we have is rapidly closing. It hasn't closed yet. But the IEA has said that it is ambitious but still possible. So what is it that we would have to do? What kind of technology should be included in this rapid development in climate policy if we could reduce that increase, in order to reduce that increase by 2017?

Ms. MORGAN. I will answer quickly. I think the key points are, we have to have a revolution in the renewable energy space and energy efficiency. We have these technologies now. We need to put in place the policy frameworks and the R&D to get those going. We need to price carbon. Most other major economies around the world price carbon. It drives efficiency. And we need very much to drive R&D much more quickly.

Mrs. CHRISTENSEN. It is only 5 years.

Mr. SIEMINSKI. I won't make any policy recommendations but I would like to point out that this is a global issue so to deal with the 2-degree Centigrade we need cooperation around the world. EIA's forecasts show that almost all of the growth in carbon dioxide emissions from energy will be taking place in the non-OECD countries so outside of the developed world what we really need is to help countries like China and India move towards lower-carbon fuels.

Mr. YERGIN. I think one of the things just to add is, our CO_2 emissions from energy consumption are down 13 percent since 2007, so this is already actually happening. And the other thing that we can do that has a huge impact is simply become more energy efficient. We are twice as energy efficient as a Nation than we were a few decades ago. We have technologies and tools to do that today and that is a big thing. But as Adam Sieminski says, the growth is in the emerging markets and those numbers tend to overwhelm what we are doing.

Mrs. CHRISTENSEN. Thank you.

Mr. WHITFIELD. Time is up. At this time I recognize the gentleman from Texas, Dr. Burgess, for 5 minutes.

Mr. BURGESS. Thank you, Mr. Chairman, and I thank you for convening this panel. It really has been a fascinating morning.

I am going to start off this new session of Congress by agreeing with the ranking member of our committee. In his opening statement, he said we must not betray our children and our future generations. I agree with him. Now, while he was referencing carbon capture and storage, I would reference the economic conditions that have prevailed for the past 4 or 5 years. The last Congresses, I was also on the Joint Economic Commission. It was our duty the first Friday of every month to receive from the Bureau of Labor Statistics the employment numbers from the previous month, and you saw a pattern emerging through all of that bad news, and there was a lot of bad news during the years, but mining and manufacturing always led that list of new job creation.

Now, we see this morning Forbes magazine is reporting that four out of the top 10 best places to live in the world are in Texas. I knew that. They didn't need to tell me. But Austin leads the list followed by Houston second, Dallas third, San Antonio ninth. In

fact, the State of Texas has added almost a half million people over the past years from last summer to—the summer of 2011 to the summer of 2012, and the reason for that of course is the availability of energy and the cost of energy, and while energy in and of itself cannot be its own end, it does help drive our economy. So when we talk about not wanting to betray our children and future generations, I think we have a responsibility to the economy, and part of that responsibility is the energy supply that is available to our economy.

Dr. Christensen talked about tipping points. I will just ask an open-ended question. I know you guys don't like to speculate, but what kind of tipping point would we have seen with the economy in the last 4 or 5 years in the absence of shale? What might have happened to our economy without the ability to produce this energy and produce these jobs? And either Dr. Yergin or the Honorable Sieminski, I would like to hear your thoughts on that.

Mr. YERGIN. Well, if we had remained on the track that we had been on prior to when we were going to build all of those LNG receiving stations, we would probably be spending $100 billion a year now to import LNG into the country, so that would have been a big burden. Secondly, had we not seen this increase, this substantial increase in oil production, as I said, this equivalent to Iran's total exports before sanctions, we would be paying a lot higher prices for oil, and it would be a much, much tighter and more vulnerable market and we would not have had what we have seen is that these supply chains are so long in our economy, these are dollars that stay here. They are going to jobs here rather than going into a sovereign wealth fund somewhere else in the world. So in that other universe, it would have been a much more difficult picture and more congruent with what seemed to be the picture in front of people in 2008.

Mr. SIEMINSKI. Virtually every economic study that I have seen suggests that higher domestic production of fuels leads to greater GDP, and when you get to the import issue you obviously have lower trade deficits. All of that helps the economy, leads to greater job creation, as Dr. Yergin said. I think one of the things to keep in mind is that the availability of relatively low-cost natural gas has actually, I believe, helped to sustain some of the growth in wind and solar on the renewable side because those are intermittent sources. They need a backup supply and it is often natural gas that provides the backup for these rapidly growing renewables that are going to become a fairly significant part of U.S. energy production and consumption.

Mr. BURGESS. Sure. We have peaking demands in north Texas where in the summertime when the air conditioners are all cranked down low, even if you had a substantial wind component, you would never be able to keep up with that peak demand.

I just have to tell you, this is such a different hearing than we had in this very room in 2008 and, I mean, it is good news. It is good news for the American people, it is good news for the American economy. Regardless of political party or political persuasion, this is a good-news hearing.

The other part of the good news, and Mr. Vidas, I won't leave you out down on the end, yesterday flying up here reading in the

Star Telegram and the concept of having an environmentally friendly fracking fluid that is being developed now by Halliburton in Texas. I understand other companies are doing that as well. But the technology is changing and it is changing in a way that is environmentally responsible, and you referenced some of that in your testimony but do you have additional thoughts on that?

Mr. VIDAS. Yes. What I said was there are several ways in which the industry has tried to adapt their technologies to reduce the footprint of drilling these wells. One is the surface footprint and trying to reduce the amount of space that it takes by combining multiple wells on a single path, and that can reduce the amount of space used by a factor of eight. The other point that I made is the drilling fluids themselves, which in the old days had been formulated with diesel oil. That has almost totally been eliminated now, and some of the toxic substances in the frack fluids are being replaced by more environmentally benign fluids.

And then the other point that has been raised is the use of water itself. Typically, a well will take about 3 million gallons in terms of the fracking process, and one of the ways the industry is reducing that is by recycling the water and being able to use it over and over again, and the other thing that they have been doing is trying to reduce the total amount of water used by various different techniques including substituting other fluids such as CO_2, nitrogen and in some cases propane instead of water.

Mr. WHITFIELD. The gentleman's time is expired.

Mr. BURGESS. Thank you, Mr. Chairman.

Mr. WHITFIELD. At this time I recognize the ranking member, Mr. Waxman from California, for 5 minutes.

Mr. WAXMAN. Thank you, Mr. Chairman. I appreciate that we have made great advances and it is a reason for celebration. We ought to be very pleased with the advantages that have come to us with the production of more oil and gas resources, and we now have advances in technology that have allowed us to drill in many new areas.

But as we congratulate ourselves for these new discoveries, we also, I think, need to discuss how energy choices we are making today will have long-term impacts for our climate. We have a rapidly diminishing window to act to reduce our carbon pollution before the catastrophic impacts of climate change are irreversible.

Ms. Morgan, in your testimony you say the United States cannot and should not make energy decisions without factoring in the risks associated with climate change. This committee is charged with developing energy policy for the United States. Ms. Morgan, how should this committee factor in climate when making energy policy?

Ms. MORGAN. Well, I think that if you look longer term, it is quite important. First of all, you need to take into account the intensity, the greenhouse gas intensity of the fuels you are looking at and you need to put a price on those fuels in order to drive innovation and energy efficiency. That is point one. The second point I think is that although emissions of CO_2 have reduced extensively, which is very good news, they are plateauing out and emissions of methane and other gases are increasing, so that means that we need to put in place mandatory and voluntary approaches to reduce

methane emissions as well, and we need a very solid renewable energy approach. The countries that are moving forward, you see those kind of three pieces in there. Carbon pricing, renewable energy policy, energy efficiency standards are all quite important, and then support mechanisms around those to make them work.

Mr. WAXMAN. I have been on this committee for a number of decades, and I remember the period of time when we decided that we will continue to subsidize the fossil fuels through not requiring them to pay their external costs and in some cases directly through the tax code, and we undermined the alternatives that could have made us less dependent on these fossil fuels, which made us, of course, more dependent on Saudi Arabia and Iran and other countries, the OPEC countries that held us hostage. We made a mistake not diversifying our energy sources at that time. We should develop our energy policy under this new circumstance that doesn't make the same mistakes and put us all in the same situation where we will look back and regret that we didn't recognize that our energy policy had to be more thought through.

What are the potential economic repercussions if we fail to integrate climate risk with our energy policymaking?

Ms. MORGAN. I think that there are three main risks. I think the first really is around stranded investments because I think companies today that are investing in high-carbon infrastructure without putting in place the mechanism to deal with CO_2 are being shortsighted and that as climate change unfortunately gets worse and policies get put in place, those will be stranded investments, and if we wait to act, those likely will be more expensive as we go forward.

The second really is missing out on new and existing markets around the world which are growing exponentially. You are looking at up to $7 trillion in new capital and renewables by 2030 and there is national policies in every other major economy in the world on renewables. They are serious about this. They are moving forward for a range of reasons. And the third are the impacts actually on our infrastructure itself and on the country, which as you know, as the EIA said, if we keep going the way we are going, you are looking at a 10.8-degree Fahrenheit rise in temperature, which is unprecedented in our time.

Mr. WAXMAN. Dr. Yergin, aside from the investment we ought to be making and looking at alternative energy sources, renewables, efficiency, some of that research is threatened by the budget cuts that members want to make. Do you think we ought to develop a policy that looks at the environmental consequences of where we are going in energy development?

Mr. YERGIN. I think so. In the 1990s, I headed a taskforce on energy R&D for the Department of Energy, and I think one of the things, you know, we found very distressing was this volatility in spending on R&D, and whether you are talking about, you know, MIT where more people work on solar than anything else or advances in drilling or whatever it is, I think that a sustained commitment to R&D——

Mr. WAXMAN. But aside from that——

Mr. YERGIN. —is the most important investment.

Mr. WAXMAN. I absolutely agree with you, but aside from that, do you think we ought to make policies in the energy area that look at not just the research but the consequences to the future in reducing carbon emissions?

Mr. YERGIN. I mean, I think so. I think the environmental considerations obviously should be part of how you make energy policy.

Mr. WAXMAN. Thank you. Thank you, Mr. Chairman.

Mr. SCALISE [presiding]. The gentleman's time is expired. The gentleman from Louisiana, Mr. Cassidy.

Mr. CASSIDY. Mr. Yergin, there are those that say that we shouldn't export liquefied natural gas because in some way by doing so we will promote the production of more natural gas and therefore contribute to global warming, but what you are saying is that is absurd because if we don't do it, Australia or Canada or some other country will export liquefied natural gas. Is that a fair statement?

Mr. YERGIN. Yes, I think people will fill the market and fill the need, and in fact are racing ahead to do that.

Mr. CASSIDY. Now, as they race ahead, it is fair to say that if is a $5 billion or $10 billion project to create one of these export terminals, those are a heck of a lot of jobs that will be sacrificed because of an absurd premise? Again, is that a fair statement?

Mr. YERGIN. The absurd premise is that——

Mr. CASSIDY. Being that if we don't export liquefied natural gas, then natural gas will not be mined.

Mr. YERGIN. Well, I think in fact if you take a country like China, which as Adam Sieminski pointed out, it is very heavily oriented towards coal and wants to reduce its use of coal and use more natural gas to produce electricity to reduce pollution, they will look in one direction or another, and if we are sending natural gas we would be contributing to their reducing their pollution.

Mr. CASSIDY. So if we can create those jobs, we will simultaneously improve our economy, but too, improve, decrease carbon release worldwide potentially?

Mr. YERGIN. Yes. I think what is happening now is——

Mr. CASSIDY. I am going to let you hold that.

Mr. YERGIN. OK.

Mr. CASSIDY. Mr. Sieminski, in 2007 you published a report at the request of Congress demonstrating subsidies for different sources of fuel, and at that time biofuels got $5.72-per-million-BTU subsidy from the government, solar got $2.82, coal got 4 cents per million BTU and natural gas got 3 cents per million BTU. Your updated report did not have this chart, but when we speak about subsidies for various forms of energy, there is an order of magnitude difference there. Is that still the ballpark of the federal subsidies?

Mr. SIEMINSKI. I would have to look at the numbers, Congressman, but the number of assumptions and factors that you have to take into consideration to do those calculations are numerous and complex, but I think it is fair to say that in addition to fossil fuel subsidies that there are also obviously subsidies on renewable fuels and many of the other things that we do.

Mr. CASSIDY. Yes, like 100 fold, 100 fold going to renewables.

Mr. Yergin, back to you. When you were at the World Economic Summit, you are right, if we don't send energy to Japan, their economy will tank. That is on my mind when I go around to the exporters in Louisiana. I say what do you need to create more American jobs. They say more robust markets to export to. Right now Japan and Europe are in the doldrums. We need those economies to do better so we can create more American jobs.

So is it fair to say, let me ask, at the World Economic Summit, what is the prognosis for the Japanese economy as an example if they cannot replace their nuclear capability with some reasonable——

Mr. YERGIN. Well, they have turned—I mean, the new government in Japan is going to reconsider, and I think in July is going to come out with its policy about whether it is going to keep some of the plants operating or not. With that said, the Japanese are kind of in a panic about energy supplies right now, very focused on LNG as their kind of major increment, and I think the point you say, a Japanese economy that is a weak economy as part of a global economy contributes to global weakness. So we are pretty interdependent with them. That is why I said, you know, they are a close ally and if they do well, we do better.

Mr. CASSIDY. It is in our self-interest to make sure that they have adequate energy supply.

Mr. YERGIN. That is right, and it is in our political interest and it is in our economic interest.

Mr. CASSIDY. OK. Sounds great.

Ms. Morgan, you spoke about methane emissions. I think it is important to make sure the record is straight. A lot of times folks who are critical of natural gas state that the—quote that Cornell study, Mr. Howarth's study, and which finds very high levels of methane released with natural gas production. But just to set the record straight, that is kind of an outlier study, isn't it? I mean, both the Department of Energy as well as MIT peer-reviewed study have found a tenth of the emissions as the Howarth study. Is that a fair statement?

Ms. MORGAN. We are actually in the process of putting out a study on this. We think that that study is on the upper end.

Mr. CASSIDY. The Howarth study is on the upper end?

Ms. MORGAN. Yes, but that there are also real measures that can be put in place to control methane even on the lower level that are important.

Mr. CASSIDY. Mr. Yergin?

Mr. YERGIN. Just to add, I know my colleagues in the Howarth study used data that supposedly came from us, and my colleagues had written a letter to the journal which was published saying the data had been quite distorted, and there is now a cooperative program with the Environmental Defense Fund and a number of companies to actually measure methane and come out with some hard data on it.

Mr. CASSIDY. I just say that because Ms. Morgan, your testimony suggested that the lifecycle carbon release of natural gas is not as favorable as we would presume, but that really seems to assume the Howarth study is valid, and frankly, there seems to be a general agreement that it is not.

Ms. MORGAN. I think even on the lower levels, it is important to put in place measures to deal with——

Mr. CASSIDY. Well, I am not arguing that. I am just saying the lifecycle release has been overstated.

Ms. MORGAN. The lifecycle as a whole, that study does overstate it.

Mr. CASSIDY. I yield back. Thank you.

Mr. SCALISE. The gentleman's time is expired. The gentlelady from Florida, Ms. Castor.

Ms. CASTOR. Good morning, and thank you very much for your insightful testimony.

The outlook from the Energy Information Agency is very positive for the economy and I think beyond the current outlook there is great potential for additional economic growth tied to domestic supplies if we have the appropriate environmental safeguards, and I think here in America we can do more for consumers and for electric reliability or reliability from all energy sources. But in order to build that more sustainable energy system, we need to bring greater balance between fossil fuels and renewable sources, and I don't think it is all about generating energy from cleaner sources. We also need to make our economy more efficient so that we use less energy overall, and I think that it may be time to look at the business models for utilities and the incentives and modernizing those business models.

According to the IEA, energy efficiency is an enormous unrealized opportunity for the world to reduce energy use and thereby carbon pollution. The IEA projects two-thirds of potential efficiency gains will remain untapped through 2035 under current policy. That is a real hit on the pocketbooks of American families and businesses.

Ms. Morgan, in your testimony you say the United States has immense remaining potential for improving efficiency in its industrial, transportation and building sectors. Which energy efficiency measures have the most potential to reduce energy consumption from the U.S. industrial sector?

Ms. MORGAN. I think there are a number of different measures, and they can come in on either the State level or on a national level. There is tremendous potential of combined heat and power on the State level for industrial facilities. In the building sector, certainly also you look at both the opportunity for new business models but also for jobs in retrofitting buildings. There is great potential there. And certainly, you know, the evidence base is quite strong if you look at the benefits that have come from the new car standards that have been put in place.

Ms. CASTOR. Can you give me some more specific examples or the most innovative energy measures in use today? Are there energy efficiency measures being implemented at the State level or abroad that we should expand or employ on a national level?

Ms. MORGAN. There is a program actually in Germany that is very focused on the retrofitting of buildings and you need to look at the ownership structure obviously but they are looking at how you can get at the point that the owner and the renter don't always share the benefits and looking at new models of how they can put in place measures to retrofit those buildings extensively across the

country. They are funding that actually with revenue from their emissions trading system so it is not additional funding coming in. I think that is a very strong example. You actually have a very strong program in China around their enterprises as well where they are putting in place measures to share practices and set targets for companies to increase their efficiency.

Ms. CASTOR. And in your written testimony, you state that the federal government can play an important role in improving energy efficiency across the economy. You said the first step is to support programs that ensure consumers can make informed choices. What were you talking about? What else can the Congress do to encourage consumers to make energy-efficient choices in the marketplace?

Ms. MORGAN. I think there are things like smart metering, information provided in all products that is much clearer about energy saved, money saved, CO_2 saved. There is ways when you start looking at our grid on the smart metering side of things. I think if consumers first of all have more information but then also, you know, can be able to buy the top products as affordably as possible.

Ms. CASTOR. Wouldn't it help if then the electric utilities really had an incentive to promote conservation and greater efficiency? They would help empower consumers to do that. It would be a win for families. They would have more money to spend at home, and the utilities, their business would change a little bit. For example, in my neck of the woods, we have this terrible debacle with a broken nuclear power plant, and it is enormously expensive, and we like the diversity in power supply, it is very important, but it seems now that we would get more bang for the buck if we helped save energy and the utility had some incentive. Where is that happening? Are those discussions happening?

Ms. MORGAN. Yes, they are happening somewhat on the State level, I think, in certain States where you have these kind of demand-side management models that are put together where both utilities and consumers benefit. I think they need to be much more broadened out so that they occur across the country more systematically.

Ms. CASTOR. Do any of you have information on those kind of incentives of changing the business model?

Mr. SIEMINSKI. I could just add very quickly that the lighting standards that have been put in place starting this year, changes in appliance efficiency, the improvements in auto fuel efficiency, lower vehicle miles traveled, all of that is leading to lower energy use per capita, which is good. You are getting more value for less consumption.

And quickly, the difference between the new auto fuel efficiency standards that got adopted last year so between 2012 and 2013 in our forecast by the year 2035 that is worth something like 1½ million barrels a day of oil imports.

Ms. CASTOR. Thank you very much.

Mr. SCALISE. The gentlelady's time is expired. The gentleman from Texas, Mr. Olson.

Mr. OLSON. I thank the Chair, and welcome to the witnesses. I thank you for your time and expertise as we lay the groundwork for a broader discussion about federal energy policy and the importance of robust domestic energy industry. I want to dig a little

deeper into the geopolitical challenges we are facing in the new energy era. As we move forward as a Nation, we need to better understand how our newly realized energy resources can advance our foreign-policy goals.

One historic example of how U.S. production or a lack thereof impacts the geopolitical landscape, the Persian Gulf. At the end of World War II, our geopolitical focus was on containing communism. When I joined the Navy in 1989, we had four numbered fleets: the 2nd Fleet in the Atlantic, the 6th Fleet in the Mediterranean Sea, the 3rd Fleet in the eastern Pacific and the 7th Fleet in the western Pacific in Japan. Communism fell in 1991, and as a result, our global military forces changed dramatically. We added the 5th Fleet in the Persian Gulf. We disestablished the 2nd Fleet in the western Pacific in September of 2011, and the 7th Fleet has now become the largest fleet in our Navy, and it is ramping up very quickly with China's aggression in the South China Sea. American innovation and our abundant energy resources can and should be leveraged to protect our allies around the world from unreliable and unfriendly regimes and promote our interests.

Another example of how U.S. energy supply can strengthen our relationships with important countries is India. They have the world's largest democracy and they are in a pretty unreliable neighborhood. They have Pakistan to the west, China to the north, Bangladesh to the east. I had lunch with the Indian counsel general in Houston a couple weeks ago. We spoke for 20 minutes about India getting U.S. LNG, export natural gas to India. Right now they have got a big problem: they have no pipelines. Because of their neighbors, they can't have overland pipelines so all their energy supply has to come in the form or oil or gas, has to come either via train or via boat, mostly boat. They want to be our partner.

And so my question for you, Dr. Yergin, in your view, how can our energy resource base reshape our foreign-policy objectives? What countries should we develop or strengthen our ties with and how can we pressure rogue states without relying on military intervention?

Mr. YERGIN. Well, that is a big question. I think that first we are seeing, as we have been describing, a rebalancing of global oil that is occurring and that we will see the Western hemisphere largely self-sufficient in years to come and more of the oil from the Middle East going to the Far East, so I think that is kind of one of the fundamental changes. I think what you referred to with India, I found when I was in Asia recently in Singapore and other countries also that interest in seeing the United States at least a player as an energy exporter, if not a massive one, because for them it is diversification and they would like to actually be more reliant and diversified more to depend upon the United States. I think as these technologies develop and we see it develop elsewhere, a key country actually is what Mexico does in terms of opening itself up to these new technologies. It is something that I think is right on the foreground.

In terms of new relationships, Brazil is on course to be a global energy powerhouse and I think the U.S.-Brazilian relationship is

one that grows in significance for us. So those would be some of the changes.

Mr. OLSON. How about Eastern Europe, who buys their natural gas largely from Russia?

Mr. YERGIN. Well, Poland is very interested in—it is interesting, you have different mixes in Europe on policy. Poland certainly wants to develop its shale gas to reduce its dependence on Russian gas, and Ukraine, of course, there is constant friction between Russia and Ukraine over the price of natural gas, and Ukraine, I think just last week or the week before, started signing some large agreements to develop shale gas in Ukraine, and for them, it is not only economic but it is also a geopolitical development.

Mr. OLSON. I get emails back home every week from people along the Silk Road, you know, where Turkey starts and heads east toward all those countries right there, the former Soviet states up there on the Caspian Sea, they want our natural gas. So again, I think it is a great opportunity for our country to actually have an influence on these people, make some friends, create American jobs, and again——

Mr. YERGIN. And I think they wanted to be integrated in the global markets as a way to sustain their nationhood.

Mr. OLSON. Yes, sir. It looks like I am out of time. I yield back the balance of my time. Thank you.

Mr. WHITFIELD. At this time I recognize the gentleman from Pennsylvania, Mr. Doyle, for 5 minutes.

Mr. DOYLE. Thank you, Mr. Chairman, and thank you to our witnesses today.

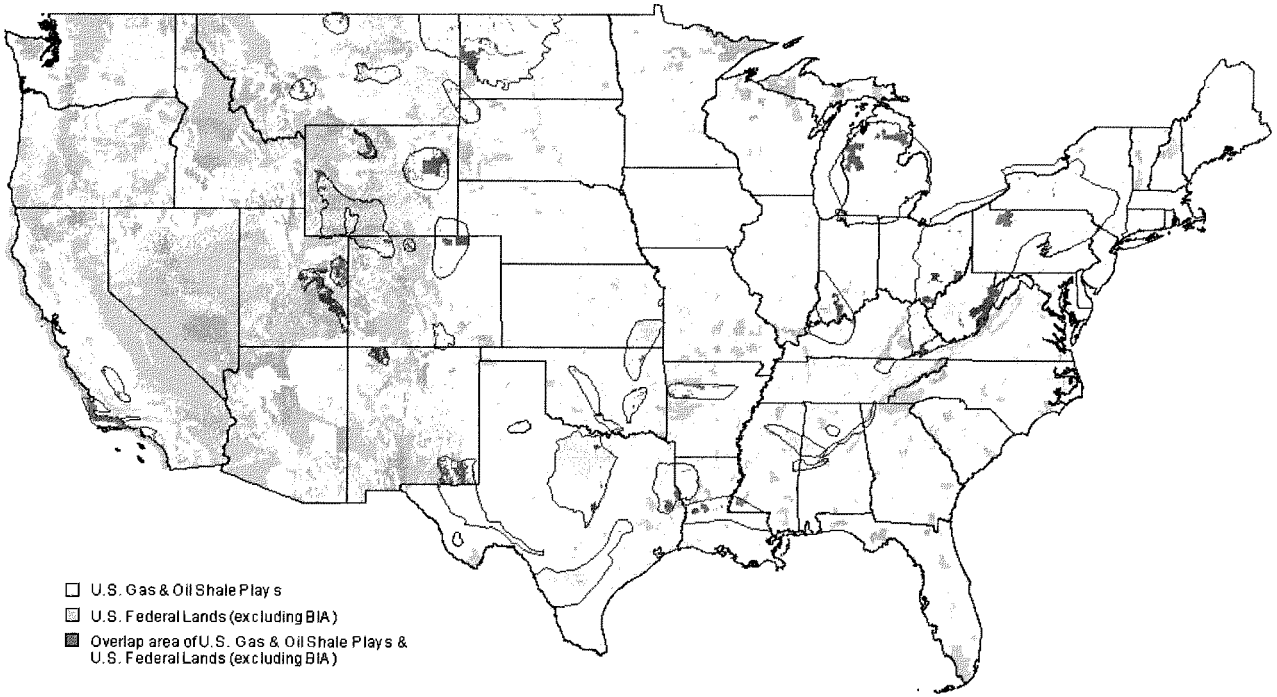
This morning we are discussing a new landscape for North America's energy resources and how we develop an effective energy policy in the absence of resource scarcity. In my home State of Pennsylvania, especially in western Pennsylvania where I represent, we are experiencing a surge in energy development that each of you have discussed in your testimony. In my neck of the woods, we have natural gas, coal, nuclear. We have got steelworkers making wind turbines. We have got universities producing energy startups that are harnessing renewables. Marcellus shale alone in my State has provided thousands of new jobs and we are burning a cleaner fuel for our transportation and electric industries. So it is important to me that policymakers fully understand energy reserves that we have and the best ways to develop them. But something that is equally important to me is how we manage the effects of carbon emissions that come from burning these resources. I have worked many years on this committee—this is my 13th year on the committee and the 19th year in Congress—to do this in a comprehensive way, and I think most of the members of this committee know that I want to get our fossil fuel resources out of the ground. I don't think it has to be an either-or proposition. But what I am interested in is how we find that sweet spot where we can develop North American energy resources and effectively manage our carbon emissions simultaneously.

So I have some questions about that, but before I ask those questions, I just want to provide some clarity to something that we heard at this hearing, and we hear a lot. My good friend, Mr. Scalise—and he is my good friend—had asked Ms. Hutzler why we

weren't seeing more development on federal lands, and her reply was that the permitting process takes up to 300 days. I want to put a map up on the screen that I think we have that I think should provide a little bit of clarity. As you look at the United States, that dark area, the gray shaded area, that is the federal lands, and the light red, the pinkish area, is where our oil and gas shale plays are, and then the dark red that you see is where there is an overlap of federal lands and oil and gas shale plays, and Mr. Sieminski, I think back in August you testified to this committee that because basically the shale resource basins are largely outside of the federal lands, so too is the shale production, I think your quote was in this case the geology is working in favor of non-federal landowners.

[The information follows:]

Lower 48 oil and gas shale plays and federal lands



Source: EIA

So we hear this a lot that there is all this development that could be taking place on federal lands but the permitting process is so bad, and I think the map pretty graphically illustrates that there is just not much federal lands where the oil and gas shale plays are in the United States. I just wanted to provide that for clarification.

I want to ask Dr. Yergin and Ms. Hutzler too, you both briefly addressed climate change and greenhouse gases in your written testimonies, and I just wonder, as we start to reassess these vast new energy resources, and it is not that they are new, you know, technology has given us a way to make them economically feasible to go and recover them now, right? And everything we do is a technology question, whether it is how we dispose of nuclear waste, what do we do with carbon emissions, just all of this, the answer is in technologies, and we are discovering new ways to do things in a more environmentally sound way. We hear about new types of fracking fluids because there is this tremendous potential to get this out of the ground, and I guess my question is, I am interested to hear, do you believe that we should also factor in climate change in these environmental concerns? Because it seems to me that once industries, you know, have to address these carbon issues too, we are going to see technology innovations there also that are going to be very valuable to U.S. companies to help these economies like in China and India and others. They are not going to be the leaders in figuring out to deal with carbon emissions. That is going to hopefully come here and then we are going to sell that technology all over the world. So I guess what I want to ask you is, do you think we should factor this in as we are looking at a new energy policy and these new fuels, factoring in environmental concerns and climate change as we develop policy?

Mr. YERGIN. I think we are certainly factoring them in. As I said, I had spent some time on that Secretary of Energy Advisory Board committee that I think provided a framework for looking at the environmental questions and saying how do you address them, and there is climate change but there is also the water questions, what do you do about wastewater, questions that you know very well from your district that need to be addressed. I think that as we have just discussed, understanding the methane emissions from natural gas drilling is a very important contribution to it. There are different views as to what the results will be.

And I would say that the other thing is that you have to see this in an entirety. It is not that we are going to more oil because we are producing oil but it means our cars, as Adam says, are going to get a lot more efficient as we do it but the question is, is that oil going to be produced in the United States or are we going to import it. So we have to see it in the framework.

Ms. HUTZLER. I want to address your map again, and maybe that is the case for the shale formations, but on the other hand, the federal government has a lot of non-shale-based areas that——

Mr. DOYLE. But all the growth is in the—I mean, the boom we are seeing right now is happening because we figured out how to get this oil and gas out of shale.

Ms. HUTZLER. Well, let us take the offshore area in terms of oil drilling. We were drilling a lot, and as a matter of fact, the oil

numbers offshore in fiscal year 2010 were very high but then it dropped by 17 percent. So you can still get a lot of oil offshore if you allow the permitting to go on.

Mr. DOYLE. The point is, we are seeing this huge boom in oil and gas shale and it basically exists on non-federal land, so I just think it is somewhat of a red herring.

Mr. Chairman, I see my time is up.

Mr. WHITFIELD. The gentleman's time is expired. At this time I recognize the gentleman from Colorado, Mr. Gardner, for 5 minutes.

Mr. GARDNER. Thank you, Mr. Chairman, and thank you to the witnesses today, and if I could have that last slide put up on the screen again, that would be fantastic.

If you look at the State of Colorado as it appears on the map that is right there, you can see the state of Colorado. That red spot is in my district in northern Colorado. But there is tremendous opportunity for development in the gray spots, and a lot of that gray spot that you see in Colorado with the Rocky Mountain areas, it is BLM land, it is U.S. Forest Service land. They are unable to get permits through the BLM because of various bureaucracies. In fact, according to the Western Energy Alliance, over 100,000 jobs could be created in the western United States, primarily on those gray lands, if the permitting delays were simply lifted. Over 100,000 jobs could be created in the western United States. That is not because all the development is taking place in the red areas or the pink areas. That is because Bureau of Land Management and other agencies have been so slow in their permitting that we can't get those permits through to create those kinds of jobs. So I think you would see a lot more red areas if we could actually get a government that was willing to allow us access to those resources in a responsible manner, and so I for one would like to see over 100,000 jobs being created in the western United States.

But I would also like to ask a couple of other questions, pointing out that in that red area you see in northern Colorado right there, because that development is taking place in that play. There was an article in Greeley Tribune on January 17 that said—the Greeley Tribune is the newspaper in northern Colorado—that said Weld County rose 20 spots in a year to rank number 42 in the Nation in job and wage growth. There was an article in that same newspaper January 8, 2013, that said Weld County wage growth hits number five in the Nation because of in great party the energy development that is taking place in Colorado. So we can see the opportunities, and I believe it was Ms. Hutzler that talked about the amount of economic impact that we have seen. I think your statement—what was it again you said about the trillion dollars over 30 years? What was the amount of money you said as a result of development?

Ms. HUTZLER. If we opened up new areas onshore and offshore to development, that we would get over the next 37 years $14.4 trillion to the economy.

Mr. GARDNER. And I believe the President's budget said that if we had—and I am going to get this number in the ballpark—if we had 1 percent GDP growth over the next 10 years, we would generate around $2 billion or so in new revenues for the federal gov-

ernment, so you can see the kind of activity, the GDP growth we would see, the kind of GDP growth we would see as a result of energy development across the country.

Ms. Hutzler, you mentioned the permitting delays on federal land. What do we need to do in order to alleviate those delays?

Ms. HUTZLER. We need to make the process more streamlined. We need to get rid of all the red tape and the delays and look at the States to see how they are doing it to remove those delays or in fact allow the States to actually do the permitting because they certainly know the geologic areas and what is best for the State.

Mr. GARDNER. Ms. Morgan, you had said something in your statement regarding 2050 carbon emissions. Is that reducing carbon emissions by 80 percent by 2050? Twenty percent of today's carbon emissions would be, what, about a billion tons of CO_2? Is that roughly what it would be?

Ms. MORGAN. Roughly, yes.

Mr. GARDNER. Can you give me an emissions inventory for 2050 of specific sources that would add up to 1 billion tons in CO_2?

Ms. MORGAN. In 2050?

Mr. GARDNER. Yes, a specific inventory of emissions.

Ms. MORGAN. Well, I can certainly—I mean——

Mr. GARDNER. Does the technology exist today to do that?

Ms. MORGAN. Yes, it does exist today. The National Renewable Energy Laboratory actually said you can get to the 80 percent renewables by 2050 with existing technologies. What the inventory would be then would be much less CO_2. There would probably be a bit left over in some of the non-CO_2 gases. But the point is that I think if we were to build out and put in place the policies, you can find that sweet spot of extracting or clean energy resources while also producing the gas in a more climate-friendly fashion.

Mr. GARDNER. And I think that is something that I have long been supportive of is an effort to find a sweet spot when it comes to bulk renewable alternative energy sources as well as traditional energy sources, but unfortunately, what I see in Colorado and what I see out of this Administration are attempts to actually make it more difficult to develop that traditional resource. In fact, I was reading a letter from one of the EPA regions, I believe it was region 3 of the EPA, concerning an LNG export facility that they were asking how many new wells would have to be drilled across the country as a result of that one single LNG facility, and I think when we start asking those kinds of questions, what happens to this LNG to wells being drilled in Colorado, that seems to me to be a very adverse tone for energy production in this Nation.

I see my time is expired and I will yield back.

Mr. WHITFIELD. At this time I will recognize the gentleman from New York, Mr. Tonko, for 5 minutes.

Mr. TONKO. Thank you, Mr. Chair, and thank you to the witnesses for presenting at this hearing.

There has been a lot of discussion about the oil and gas production and the estimates of oil and gas reserves. I believe there is most likely this gap between proven and technically recoverable reserves. To what degree, if any, have the environmental costs of exploiting oil and gas been considered in estimating the technically recoverable reserves? Anyone?

Mr. VIDAS. I can try to address that issue. In the work that we have done, we have defined technically recoverable to be based on current technology and current activity, so we apply a factor of so many bcf or so many barrels per well based on what is going on right now. So it does not take into account future changes to regulations that might change the cost.

However, when we look at the economically recoverable resource base, which is a subset of the technically recoverable, we have to make certain assumptions about the costs. So depending on what kind of scenario we are looking at, we may use today's costs, which are based on today's environmental rules, or we may hypothesize new regulations that might be imposed in the future. And typically when we look at that, we would look at a series of different rules about water use, different types of materials that can be used and so on, and generally when we have looked at that, we would say that the future regulations might add something like 7 percent to the cost of a well, so that would produce then a resource cost that would be about 7 percent higher than today's cost, but of course, that depends on what regulations are implemented in the future.

Mr. TONKO. Anyone else? Many of you did not respond, so I am assuming there was no environment cost. Ms. Morgan?

Ms. MORGAN. Yes, sir. I believe that environmental costs are actually not factored in, and we would be happy to provide data from a recent National Academy of Sciences report on the climate and non-climate impacts that has a United States focus.

Mr. YERGIN. If the environmental costs, if you mean, for instance, regulations that require how you manage water, how you manage land, how you manage air quality, those are all environmental costs that are then internalized because they are part of the regulatory process.

Mr. TONKO. Well, Dr. Yergin, you discussed the implications of the expansion in gas production for our domestic markets and for the global market. The demand in the United States has leveled out recently but global oil consumption continues to expand and fossil fuel use continues to expand. How do the rates of increase in our reserves compare to the rate of increase in oil and gas consumption globally?

Mr. YERGIN. Globally, the world is now divided into two. There is the OECD, the United States, western Europe, Japan where we really started in about 2005, 2007 to have peak demand in terms of oil and our oil consumption is going to go down, not up, because of more efficient cars, because of demographic changes in our population, because people reach a limit to how many hours they want to spend sitting in a car, so I think that is happening, but the great boom is of course in the emerging markets and they roughly now consume about the same amount of oil as the advanced markets but that is where all the growth is going to be. China in 2000 sold 2 million new cars, we sold 17 million new cars. By 2010, we were selling 12 new cars and they were selling 17 million. So that tells you where the growth is going to be.

Mr. TONKO. And we are experiencing this period of relative abundance but we have been there before in our recent past history, so oil and gas markets are volatile and have led us to a false sense of energy security in the past. So how do we develop a national en-

ergy policy that is less shortsighted and more strategic? Basically, how can we best use these reserves to maximize——

Mr. YERGIN. Well, what you said is quite right, that what we have seen overall, this is just development in the last 3 or 4 years and we are focusing this discussion and our resource base, but look at the Middle East. I mean, people used to talk about the arc of instability going from Syria to Iran. Now they talk about it going from the Sahel in Africa to central Asia. So you look at the map and there are many parts of the world which have abundant energy supplies, where there is a lot of very evident political risk, and I think your point that we shouldn't—there is no reason here for complacency.

Mr. TONKO. Ms. Morgan?

Ms. MORGAN. I just wanted to say that I think that if you look at the—we really can pull out all of our resources, that we don't need to be thinking of an either-or, and that renewable energy resources, energy efficiency and CCS are all part of that and you need to take that longer-term view or else we will be making shortsighted decisions and not building the CCS in now to our gas and oil decisions.

Mr. TONKO. Thank you very much. With that, I yield back.

Mr. WHITFIELD. Thank you very much. At this time I recognize the gentleman from Virginia, Mr. Griffith, for 5 minutes.

Mr. GRIFFITH. Thank you, Mr. Chairman. I have to say I think we have to use all of our energy resources to develop a plan long term.

That being said, in regard to natural gas, Administrator Sieminski, you would expect at some point in the next few years for gas to return to $4? Is that correct?

Mr. SIEMINSKI. We have natural gas prices getting back to $4 a million BTUs by the end of next year.

Mr. GRIFFITH. OK. And in fact, they have been going up. They hit a low in April of $1.95 and in December they were $3.34. Is that correct?

Mr. SIEMINSKI. I believe so, sir.

Mr. GRIFFITH. And if I understood your testimony earlier, when it gets to $4, coal becomes very competitive again?

Mr. SIEMINSKI. It is a sliding scale but as natural gas prices go higher, coal becomes more attractive.

Mr. GRIFFITH. I appreciate that very much coming from a coal district, and I will turn to you, Ms. Hutzler.

A lot of what we have been doing has been ignoring coal and its potential as a major resource in this country. It has always been that way. And I would point out that I think in your testimony you said that we relied on three major sources. Of course, we have got our renewables but our three major sources are nuclear, coal and natural gas. Is that correct?

Ms. HUTZLER. Yes.

Mr. GRIFFITH. And I think you also reported that just the mercury utility MACT rules would cost about $21 billion a year and 183,000 jobs a year. Is that correct?

Ms. HUTZLER. Yes.

Mr. GRIFFITH. And that retirement of coal power plants by 2016, we are going to be retiring 27 gigawatts. Is that also accurate?

Ms. HUTZLER. I think that is through 2015 and that is an EIA number that has been reported to them by electric utility companies.

Mr. GRIFFITH. All right. And that is much higher than the EPA's estimates when they first came out with this new regulation. Isn't that correct?

Ms. HUTZLER. Yes.

Mr. GRIFFITH. And in fact, not only is it going to affect jobs in the coal fields and at coal-fired power plants, but it also will cause our electric rates to go up by 10 to 20 percent in most of the country. Isn't that correct?

Ms. HUTZLER. Yes.

Mr. GRIFFITH. And in fact, in some parts in the Midwest, I don't represent them but in some parts it could be right up there at the 20 percent.

Ms. HUTZLER. Yes, in States that are highly dependent on coal-fired generation.

Mr. GRIFFITH. Now, you acknowledge in your written testimony that the EPA claims that they are not going to do this but you do raise some concern and worry that the EPA may decide that the modifications in regard to greenhouse gases could impact existing coal-fired power plants because that would force them to, if they interpreted that complying with Utility MACT created them into a new source that that would then put a tremendous amount of pressure on the existing coal-fired power plants and cause even more closures. Is that correct?

Ms. HUTZLER. Yes, because under the Utility MACT rule, if there are substantial changes, they might be able to look at that particular unit as a new unit and therefore treat it as a new unit where they don't want the amount of greenhouse gas emissions to be any more than from a natural gas plant essentially.

Mr. GRIFFITH. And you cited a report from the United Mine Workers of America that would indicate that if that were to happen, that job losses could amount to more than 50,000 direct jobs if you could coal, utilities and the railroad industry, and as much as 250,000 jobs indirect. Is that a correct assessment of what the UMWA said?

Ms. HUTZLER. Yes.

Mr. GRIFFITH. So this is of great concern in my area because we have railroads, coal and utility companies.

I would point out also that it is kind of interested that your written testimony indicates that the Chinese are using about four times as much coal as we are and that while they are building cleaner plants, they are not putting their older, less clean plants out of existence in the meantime, are they?

Ms. HUTZLER. No, they are not. With their GDP growth, they need all the power they can get, and in fact, according to the National Energy Technology Laboratory, they are building 60 to 80 gigawatts of coal-fired plants a year, and they think that will happen easily through 2016 and maybe further.

Mr. GRIFFITH. And so they are relying on coal including maybe some of our coal to generate their energy and the growth in their economy. Isn't that true?

Ms. HUTZLER. Yes. They have to import coal now. They can't produce enough themselves to satisfy their demand and we are exporting coal to them.

Mr. GRIFFITH. And so when I tell my constituents that not only are we damaging coal but we are also damaging jobs in the United States, we are allowing the Chinese to grow their economy while retarding our economy by not using our clean coal technology. Isn't that correct?

Ms. HUTZLER. Yes.

Mr. GRIFFITH. And in fact, in my district there is a plant that just opened this year that is extremely clean, and because of the carbon rules, the greenhouse gas rules, it wouldn't be allowed to be built if it hadn't already been in construction and opened this year. Isn't that correct?

Ms. HUTZLER. Yes.

Mr. GRIFFITH. And so for all intents and purposes, at least at this point in history, there is not the technology available for the United States to build any more clean coal plants, coal-fired electric generation plants, and we are really handicapping ourselves in relationship to our competitiveness with the Chinese. Isn't that also true?

Ms. HUTZLER. Yes. We don't—currently, CCS technology is not available, commercially available for these plants.

Mr. GRIFFITH. I thank you, and I yield back, Mr. Chairman.

Mr. WHITFIELD. At this time I recognize the honorable gentleman from Massachusetts, Mr. Markey, for 5 minutes.

Mr. MARKEY. I thank the gentleman very much.

Just a point. In 2009 in this committee and on the House Floor, Mr. Waxman and I built in $60 billion for clean coal technology, carbon capture and sequestration. We voted it out of this committee with no Republican support. Over the last 5 years, unfortunately, coal has dropped from 51 percent down to 35 percent of all electrical generation in the country, and what has gone up? Natural gas. It is less expensive and it is cleaner. So coal is being attacked but it is by the natural gas industry, so let us just get that clear, and we put the $60 billion in and the coal industry opposed the Waxman-Markey bill. They opposed now, and now they suffer from not having the investment in technology to make it cleaner. So don't blame us, blame the coal industry for not wanting the funding and blame the natural gas industry for their technological breakthroughs that have allowed for the production of more and cheaper and cleaner sources of energy.

Mr. Sieminski, recently the Department of Energy released a study of the economic impacts associated with exporting large quantities of natural gas that was performed by NERA Consulting. The study used outdated 2010 EIA projection data and concluded that while exports would lead to higher domestic energy prices and adverse impacts to American manufacturing, the overall economic impact would be positive. Mr. Sieminski, isn't it true that EIA's 2010 data predicted that domestic natural gas use in the power sector would decline between 2010 and 2020, though its use in the power sector has actually ended up growing by 27 percent just since 2010?

Mr. SIEMINSKI. I have been in the forecasting business a long time——

Mr. MARKEY. No, I am just asking, is that true or not? I am not asking for your personal history.

Mr. SIEMINSKI. Yes.

Mr. MARKEY. OK. That is all I needed to know. So way off. EIA was way off. Natural gas and the utility sectors not only did not go down, it has now gone up 27 percent since that report. Isn't it true that EIA's current projections of natural gas use in the transportation sector are seven times as high as the 2010 data used in the NERA study?

Mr. SIEMINSKI. And our supply estimates are also higher.

Mr. MARKEY. I am only—I am not asking you—I am asking you to just go back to this study that is being relied upon. Is it not seven times higher in the transportation sector than NERA projected in just 2010?

Mr. SIEMINSKI. Yes, sir.

Mr. MARKEY. OK. Thank you. So this data was released in 2010, and since then 100 major manufacturing projects totaling $95 billion in investment have been announced. These are manufacturing facilities that would produce chemicals, fertilizer, steel, aluminum, gas, tires, plastics and other goods, all of which rely on cheap natural gas. That is what is driving this manufacturing. These announced projects alone would push U.S. industrial demand for natural gas 30 percent beyond the estimates used in the NERA study. Just yesterday, the Wall Street Journal described decisions made by German and Canadian companies to locate new facilities in the United States because of low natural gas prices. The Germans, the Canadians are coming to the United States with their manufacturing facilities.

Do you believe that we should be making decisions about what to do with domestic natural gas in 2013 and beyond using data that reflected what was going on in that sector 3 years ago that vastly underestimated what is happening today?

Mr. SIEMINSKI. I think it is always better to have recent and accurate date in making forecasts but——

Mr. MARKEY. Especially since the data we are talking about is like a Frankie Avalon record except it only took 3 years to turn it into completely outdated information that was totally wrong about where we would be 3 years later——

Mr. SIEMINSKI. Congressman Markey, as I was trying to say earlier——

Mr. MARKEY. Let me just continue. Last year your agency found that exporting 12 billion cubic feet per day of natural gas could lead to a 54 percent increase in domestic prices but today companies are applying to export nearly three times that amount. It seems to me that before we permit more natural gas exports to occur, we should have an understanding of the potential economic impacts on consumers, on the manufacturing sector and on the transportation sector in the United States in terms of our own internal domestic growth in those sectors of our economy and have it based upon real data, not old data that bears no resemblance to what is happening in the natural gas sector today.

Now, let me just ask this question. This panel led by the Republicans voted in 2012 to repeal the ability of EPA to increase fuel economy standards for the vehicles which we drive. Let me just go down the line here and just ask each of you, do you support the repeal of the ability of the EPA to increase fuel economy standards or do you oppose repealing the authority? Can we just go down and we will just get your views on that way in which we deal with oil consumption in the United States? Mr. Sieminski?

Mr. SIEMINSKI. It is not a question for me, Congressman.

Mr. MARKEY. It is not?

Mr. SIEMINSKI. No, it is not. It is a policy issue.

Mr. MARKEY. OK. Good.

Mr. Yergin?

Mr. YERGIN. I think fuel efficiency standards are an important contribution to energy efficiency and our overall energy mix.

Mr. MARKEY. Thank you.

Ms. MORGAN. I agree, it is a great example of how you can meet energy and climate security goals at the same time.

Mr. MARKEY. Thank you.

Ms. HUTZLER. Well, they are important and certainly make a difference. You have to take a look at——

Mr. MARKEY. No, just that one issue. One issue, please.

Ms. HUTZLER. Well, there are safety issues with vehicles and other issues that have to be taken into account.

Mr. MARKEY. So you would consider repealing EPA authority?

Ms. HUTZLER. I would think that it needs to be studied and you have to look at the entire situation.

Mr. MARKEY. Yes, sir?

Mr. VIDAS. I don't want to state any policy opinions like that, but as a personal consumer of cars, I certainly like to have more efficient cars.

Mr. WHITFIELD. The gentleman's time is expired.

Mr. MARKEY. Thank you.

Mr. WHITFIELD. At this time I recognize the gentleman from Illinois, Mr. Kinzinger.

Mr. KINZINGER. Thank you, Mr. Chairman, and thank you all for coming in. Just a couple of questions, and this may not take all my 5 minutes.

Mr. Yergin, last week's Wall Street Journal, there was an article titled "Can Gas Undo Nuclear Power?" which discusses how low natural gas prices are problematic for our baseload energy production, and I would like to know your thoughts on low gas prices as it impacts fuel diversity into the future and existing domestic resources like nuclear.

Mr. YERGIN. I think what has happened with natural gas prices, remember, when people went out to start developing shale gas, it was—the incentive was very great for these independents. It was like $12 and now we know we are talking around $3, and that is really changing the marketplace, the electric power marketplace for everything, certainly including nuclear.

Mr. KINZINGER. So does that give you concerns for maybe the viability of nuclear in the future if this continues? And also, what do you think is going to happen? Do you think in 10 years if you can

magically look forward that we will have a diverse energy supply or do you think we will have too many eggs in one basket?

Mr. YERGIN. Well, I think it is the—we have four reactors that are under construction, two projects now. I think that in this cost environment it is very hard to see anybody committing to a current generation of new power plants. The Secretary of Energy Advisory Board, the last session was partly devoted to small modular nuclear reactors, in other words, where there is technological innovation. And I think the other question about our nuclear fleet is, it is about 20 percent of our electricity. Lives have been extended. What happens after another 20 year and does that shrink away then.

Mr. KINZINGER. And then another question. You mentioned my home State of Illinois as a State that already employs 39,000 people in oil and gas.

Mr. YERGIN. Well, who are benefiting from the unconventional oil and gas revolution.

Mr. KINZINGER. Right.

Mr. YERGIN. Although Illinois hasn't yet passed the regulations.

Mr. KINZINGER. No, it is about time we get there.

What would the economic impact be on Illinois if they allowed oil and gas production, in your mind, as far as new——

Mr. YERGIN. It would be—it would lead to considerable generation of income in the State, as we have seen in other States. Mr. Doyle mentioned it in his State. And when I was out in Illinois, that day the front page of USA Today was about how income is shifting, new income is being created in areas, rural areas, areas that had been depopulated and so forth because of this activity and kind of in the center of the State, and the——

Mr. KINZINGER. They are the areas that are frankly suffering sometimes the hardest under this recession, or this economic difficulty, we will call it, to avoid argument on it.

Mr. YERGIN. The new Albany shale could be very important for the economy of your State.

Mr. KINZINGER. And what price do you think natural gas would need to be in order for production to occur in Illinois?

Mr. YERGIN. Well, I think it is really—I mean, I think people are ready to go ahead. It depends on happens in Springfield, I think, as to whether it goes ahead or not and at what——

Mr. KINZINGER. I will say Springfield makes Washington, D.C., look highly functional.

Well, thank you, and I appreciate everybody's testimony. I appreciate your answering my questions. The big concern here into the future is, I have always been a believer in saying you can't have too few energy supplies, and when it comes specifically to nuclear, I think it is important we ensure nuclear maintains a major part of our energy portfolio because in the future you never know how things change.

With that, I want to say thank you. Thank you, Mr. Chairman. I yield back.

Mr. WHITFIELD. At this time I recognize Mr. Pompeo from Kansas for 5 minutes.

Mr. POMPEO. Thank you, Mr. Chairman, and I thank the witnesses. It has been a long morning. I think I am hitting cleanup today.

A couple thoughts. It has been great to listen to. I have heard words like renaissance and revolution thrown around and all the good things that are happening. I think it is worth noting for everyone here, almost all of that happened with almost zero role of the federal government. Most of the things that the federal government's resources have gone to in this intervening period between the hearing in 2008 and the one in 2013 continue to provide a very, very negligible set of outputs important to the American economy. So I think that suggests the direction of travel for us as well as we think about new policies.

Mr. Yergin, I have got a question for you about pipelines. Mr. Shimkus talked about it a little bit. You know, there is an article in Energy Daily talking about how long it is taking for permitting. I would like to introduce that article into the record if I might, Mr. Chairman.

Mr. WHITFIELD. Without objection.

[The information appears at the conclusion of the hearing.]

Mr. POMPEO. The study found that nearly 20 percent of natural gas pipelines have delays of over 6 months or more, enormous capital at risk when you think about building a new pipeline, and it is important not only for existing fields to get those pipelines—the Mississippi shale in my district is a good example. We have got production but relatively little demand in towns like Anthony and Coldwater, Kansas. We have got to this product to the right places.

I think there is also a circular effect, that is, if you know that you can efficiently build a pipeline, folks will go look for in other places as well. Can you talk about the interplay between challenges in building pipelines and people's willingness to take risks in finding these fields in North America?

Mr. YERGIN. Well, Ms. Hutzler spoke about that before too. I think that getting—the word she used, streamlining permitting for pipelines. I mean, pipelines are literally a pretty straightforward thing and that we ought to—that you need them to keep up with where we are and otherwise you either are using flaring for gas or you are shipping oil by truck and so forth and that is not a very efficient way to do it.

Mr. POMPEO. I appreciate that. I am actually—I am working on some legislation to give FERC a little more authority in trying to streamline this process. I think it will be bipartisan. I think we can do this in a way that provides all the protection for the environment, all the things we need to do, but getting us to a finish line where we actually make decisions about these. Whether the pipeline is a go or a no go, we do it in a much more timely and reliable fashion.

We talked about energy exports. I was surprised Mr. Griffith didn't talk about coal exports. We have been talking about LNG mostly but it is a broad set of energies that we ought to be exporting from America. Today with respect to LNG exports, we have a delineation about DOE's authority, whether we are going to transport this to a free trade agreement country or a non-free trade

agreement country. I guess this is for anyone on the panel. Is there any reason for that demarcation to continue to exist?

Mr. YERGIN. I think it is an artifact.

Mr. POMPEO. Yes, that is my sense as well.

Mr. YERGIN. I mean, Japan, the example I gave, is not a free trade country and yet it is an incredibly important country to us.

Mr. POMPEO. It seems to me too that there is a history. I read a little history of how it came to be and it seems something that we as a policy matter could get rid of. We could direct those two places for shipment to be treated identically. I have a few of what DOE's authority ought to be. I don't think the—I think the national interest finding is by definition free trade, it creates wealth in America. I think it is by definition but I am sure others would have a slightly different view on that but at least we could get rid of that demarcation.

Ms. Hutzler, I was reading an article about renewable energy, and in Eastern Europe they subsidized it even longer than we have and even more than we have, and they have had some power blackouts. There is an article in Bloomberg on October 25 that I would also like to submit for the record that talks about these energy blackouts.

Mr. WHITFIELD. Without objection.

[The information appears at the conclusion of the hearing.]

Mr. POMPEO. You know, our grid could suffer the same kinds of things, in my view, if we have non-storable, non-reliable energy source. Do you have a view of the risk of us subsidizing this at such a rate that we get to a place where we have got less reliable electricity in America?

Ms. HUTZLER. Yes. Germany is a good example because they are phasing out their nuclear units and turning to renewable energy in its place, but obviously it has to be backed up, and it has caused instability to their grid. Neighboring countries are not allowing them to export their renewable energy, their wind energy, to them such as Poland, and in fact, industrial users are seeing some disruptions in their service that is causing them hundreds of thousands of dollars in equipment and they have already told the German government that either you fix this problem or we are going to leave.

Mr. POMPEO. I have got just 20 seconds. Mr. Sieminski, you talked about renewables growing at a huge rate. It is easy to grow at a huge rate off a small base. I remember, I ran a small company at one point too. It is still not a hugely important part of our energy resource base. When you made these assumptions about its economic growth, what did you assume for federal policy? Did you believe that we would continue our current—somebody on the other side of the aisle called it creative financing. I will call it getting in the pockets of taxpayers. But what assumptions did you make about state RPSs and these kinds of non-economic policies remaining in effect supporting——

Mr. SIEMINSKI. EIA's forecasts always use existing law and regulation. We don't try to forecast regulation or law. We do have the California renewable and other laws built into our forecasts. Renewables go from about 13 percent over the last few years to 16

percent of total electricity generation, so there is a lot of growth but it is still a small portion.

Mr. POMPEO. Great. Thank you. Thank you, panelists, all for being here today.

Mr. SIEMINSKI. Congressman, I just want to add one other quick thing if I might, Mr. Chairman.

Mr. POMPEO. It is OK with me. My time is up.

Mr. SIEMINSKI. Your background in the oil service industry, a number of questions have come up here this morning about the impact of hydraulic fracturing and need for water. In Pennsylvania, I know that most of the flow-back water is now being recycled and used again, and changes in technology like the multistage fracturing could lead to much less water use simply because the identification of where to frack along a horizontal well could cut the number of feet that you have to frack in half, and all these things, these changes in technology are taking place at such a rapid pace. It is one of the reasons why EIA's forecasts have fallen short, as Mr. Markey suggested.

Mr. POMPEO. Great. Thank you.

Mr. WHITFIELD. OK. All time is expired, and I want to thank the panel of witnesses. So thank you all very much. We will keep the record open for 10 days, and I am asking unanimous consent to submit into the record a copy of a statement from National Petroleum Council and also the executive summary of the IER study on opening federal lands to oil and gas leasing.

[The information appears at the conclusion of the hearing.]

Mr. WHITFIELD. So with that, we will conclude today's hearing, and once again, I appreciate the participation of everyone.

[Whereupon, at 1:05 p.m., the subcommittee was adjourned.]

[Material submitted for inclusion in the record follows:]

PREPARED STATEMENT OF HON. ELIOT L. ENGEL

Thank you Mr. Chairman.

As we start a new legislative year, I am pleased to see a strong focus on North American energy resources. I have been a strong proponent of doing everything we can to make the United States energy independent. One of the reasons I formed the Energy and National Security Caucus was to draw attention to the fact that our dependence on imported oil affects our national security.

I believe in an "all of the above approach" to energy independence, but we must include renewable energy as part of the mix, even as we tap new fossil fuels. Our country, the climate, and the world cannot afford for us to rest on our laurels. Climate change is a serious threat to our country and to the entire planet. We must tackle this threat by seriously by focusing on renewable energy resources which do not contribute to global climate change.

New York, New Jersey and Connecticut were recently devastated by Superstorm Sandy; western states are still suffering through record droughts, and many areas were devastated by wild fires. Climate change is contributing to these weather patterns. We can no longer afford to ignore climate change and I am hopeful that this Committee will seriously deal with the issue.

One method for helping to grow renewable energy resources is make sure it is on an even playing field with fossil fuels. I will soon be reintroducing my "Open Fuel Standard Act", that would require 95% of new vehicles to be able to operate on another fuel in addition to or instead of gasoline.

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INGAA report seeks Hill action on gas pipe delays

BY CHAD WOODWORTH

While Congress acted in the Energy Policy Act of 2005 to speed federal permitting of new interstate natural gas pipelines, an increasing number of those projects have seen approval delays since the law was passed, according to a new industry study that calls for legislation to help the Federal Energy Regulatory Commission enforce deadlines for completion of reviews by other federal agencies.

The study, issued January 16 by the research arm of the Interstate Natural Gas Association of America (INGAA), also says that despite the growing permitting problems, pipeline developers have rarely exercised provisions of the

(Continued on p. 4, click here)

Mississippi Power reaches deal with regulators on clean coal plant costs

BY CHRIS HOLLY

In an unusual deal aimed at ending protracted litigation over cost recovery for a $2.76 billion gasified coal plant, Mississippi Power Co. Thursday inked a settlement agreement with state regulators that would give the utility a new opportunity to recover millions of dollars in project construction financing costs while mitigating high costs for Mississippi Power ratepayers, including giving them a slice of the revenues earned from licensing the plant's proprietary gasification and carbon-capture technology.

The settlement would give Mississippi Power the opportunity to recover up to $172 million in construction-related financing costs it expects to incur through 2013 while building its 542 megawatt integrated gasification combined cycle (IGCC) coal plant in Kemper County, Miss., which is a lead facility nationally for demonstrating advanced clean coal technology.

The agreement also calls for the Mississippi Public Service Commission and the utility to ask the state Supreme Court to dismiss a challenge the utility filed in July asking the high court to strike down a June commission order barring recovery of $55 million in Kemper construction-related financing costs Mississippi Power had incurred.

In denying the cost-recovery request, the commission cited separate ongoing litigation before the high court in which the Mississippi chapter of the Sierra Club is challenging an

(Continued on p. 3, click here)

Maine PUC okays pricey terms for Statoil floating wind pilot

BY ERIC LINDEMAN

Reflecting deep divisions over the project among residents and politicians in the green-leaning state, the Maine Public Utilities Commission voted 2-1 Thursday to allow Statoil North America to move forward with an innovative floating wind farm pilot project off the state's coast by approving the terms of a pricey power purchase agreement that Statoil will seek to secure with one or more of the state's regulated utilities.

The commission backed the Hywind Maine initiative despite concerns expressed by one of Maine's biggest utilities and Maine Gov. Paul LePage (R) that the costs of the project to ratepayers would outweigh any economic or job benefits to the state.

However, Hywind Maine has the support of Sen. Angus King (I)—the state's former governor and newly elected U.S. senator—Democrats in the Maine legislature and renewable energy advocates.

Maine residents have debated the project since Statoil North America, a unit of Norway's government-controlled oil and gas giant Statoil ASA, proposed Hywind Maine in May 2011 in response to a request for proposals issued by the state after its legislature passed the Ocean Energy Act in 2010. It was the only company to respond.

Statoil submitted a lease application that October to the Interior Department's Bureau of Ocean Energy Management to install four moored, floating turbines in a 22 square-mile area about 12 nautical miles offshore Boothbay. It envisions the 12 megawatt Hywind as a pilot project for more expansive offshore wind energy development.

The vote by the Maine PUC approved Statoil's term sheet for a proposed 20-year power purchase agreement (PPA) to sell electricity from the pilot to one or more of the state's investor-owned utilities—Bangor Hydro, Central Maine Power (CMP) or Maine Public Service Co.

Although PUC Chairman Thomas Welch had said publicly in October that he would vote against the project unless Statoil revised its term sheet to

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USEC sells spent fuel storage unit to Japanese company

USEC Inc., moving to shore up its finances and raise cash for its new uranium enrichment plant project, announced Thursday it would sell its NAC International Inc. unit to Hitz Holdings U.S.A. Inc., a subsidiary of Hitachi Zosen Corp., for $45 million in cash.

Maryland-based USEC said the sale of NAC, a leading supplier of spent fuel storage and transport equipment and services to the nuclear industry, is part of its effort to focus resources on deployment of its advanced American Centrifuge enrichment technology at a plant that USEC is building in Ohio.

Financially ailing USEC has been struggling to pay for the $3.5 billion American Centrifuge plant, and has leaned heavily on federal assistance to keep the project moving forward.

USEC said the sale would also bolster its balance sheet and represented a hefty profit on its 2004 acquisition of NAC, which it bought for $16 million to diversify its business line.

NAC has thrived in recent years as the lack of disposal options for spent reactor fuel forced many utilities to increase their dependence on dry storage casks. USEC said NAC expects to deliver more than 100 dry storage systems in 2013, and that the accident at Japan's Fukushima Daiichi plant also offered major new opportunities for NAC given Hitachi Zosen's strong position in serving cleanup operations at the stricken nuclear plant.

Japan-based Hitachi Zosen has a longstanding business relationship with NAC as a fabricator of NAC's dry cask storage and transportation systems and is a leading supplier of such systems in Japan.

Among other regulatory reviews, the sale of NAC will have to be cleared by the Committee on Foreign Investments in the United States, a federal panel that examines sale of U.S. businesses to foreign companies to assure they do not compromise national security.

Maine PUC okays pricey terms for Statoil floating wind pilot... *(Cont'd from p. 1)*

abate concerns about high generation costs and projected long-term economic benefits to the state, he ended up casting the vote that approved moving ahead with a PPA for the project.

After Welch tabled action of the application in October, Statoil did amend its term sheet in January to reduce the original price for Hywind generation from 29 cent per kilowatt-hour to 27 cents.

However, that price is still significantly higher than the initial 18.7 cents that National Grid will pay for power from the long-delayed Cape Wind offshore wind project off the coast Massachusetts near Cape Cod.

CMP submitted comments to the PUC earlier this week stressing that even with its downward price revision, Statoil is proposing a Hywind electricity price that is 4.5 times higher than current market prices.

"That translates to a $190 million ratepayer subsidy to Statoil," wrote CMP Senior Counsel Richard Hevey.

Bangor Hydro and Maine Public Service declined comment on the term sheet revisions, saying they believed they would not have to buy from Hywind because they already had signed long-term PPAs to buy expensive power from an ocean energy project in the state.

The two utilities told the PUC that in December 31 contracts they accepted the entire obligation for Ocean Renewable Power Co.'s (ORPC) tidal power project in Washington County—20-year PPAs for an initial 4 MW increasing up to 50 MW—with "an understanding that [they] would not be responsible for any obligation under the Statoil contract."

The term sheet for the Portland, Maine-based ORPC project sets rates at 21.5 cents per kilowatt-hour.

Statoil also sought to make its project more politically palatable by revising its term sheet to promise "commercially reasonable efforts" to give 40 percent or more of the work associated with Hywind to Maine companies; employ at least 150 residents during construction; and locate the project's operations and control center in Maine.

In addition, Statoil offered a "good faith" commitment to use Maine contractors in any commercial offshore facilities the company may develop along the Eastern Seaboard from Maine to Maryland before 2025.

But Patrick Woodcock, director of the governor's energy office, urged the commission Wednesday to reject Statoil's revisions as not ensuring that the Hywind project would benefit Maine's economy or protect the interests of the state's ratepayers.

In written comments to the PUC, he said: "While the supplier certainly indicates the intention of supporting Maine jobs, this office does not believe the supplier has demonstrated clear investments in the state of Maine." He added that the 2010 Ocean Energy Act calls for a "demonstrated" commitment to investment in Maine manufacturing.

Also in written comments, the Industrial Energy Consumer Group, which represents businesses that use large amounts of electricity, said the high costs of Hywind generation "clearly outweigh the speculative benefits that it may offer, and therefore violates the requirements of the Ocean Enetgy Act."

But Welch said that while voting for the project's PPA was "a difficult decision," he was ultimately persuaded by Statoil's "price reductions and indications of future activities in Maine, recognizing that those are speculative."

King was sanguine about the financial and clean energy benefits of Statoil's project and its prospects for expansion—and he warned that Maine would regret losing Hywind to a more hospitable host country or state.

"I haven't the slightest doubt that if we reject this proposal, Statoil and their competitors will simply go elsewhere," he said in his comments to the PUC, "and we will read with regret of great projects, thousands of jobs and renewed coastal economies in Scotland, Portugal or (worse yet!) Massachusetts."

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www.theenergydaily.com IHS THE ENERGY DAILY Friday, 25 January 2013 • 3

Texas regulator to be NARUC gas chair

Texas Railroad Commission Chairman Barry Smitherman has been appointed chairman of the National Association of Regulatory Utility Commissioners' natural gas committee, replacing outgoing chairman Timothy Simon of California.

Smitherman, appointed to the Texas oil and gas regulatory body in 2011, previously chaired the Public Utility Commission of Texas (PUCT) from 2007 to 2012.

Among other key goals, the NARUC gas committee is leading efforts by the state regulator group to increase coordination between electricity and gas sectors in light of growing gas use by power generators.

Mississippi Power reaches deal with regulators on costs... *(Cont'd from p. 1)*

April commission order granting a certificate of convenience and public necessity for the project.

The adverse cost recovery order issued by the commission in June shocked Mississippi Power, and led Fitch Ratings in July to downgrade the credit outlook for the Southern Co. subsidiary from "stable" to "negative," saying the uncertainty posed by the order "has already caused significant stress on Mississippi Power's credit metrics."

The state high court has scheduled oral argument on the Mississippi Power appeal of the commission's June order for Monday. The utility and the commission late Thursday filed a petition asking the court to dismiss the case in light of the settlement agreement.

Sierra Club officials said the settlement agreement emerged in part because the high court has allowed an intervener in the case to argue Monday that a state statute authorizing the recovery of construction-related financing costs—a law specifically enacted to enable the Kemper plant—violates the Mississippi Constitution.

The deal establishes a schedule under which Mississippi Power will file a new request for construction work in progress (CWIP) costs within three months and the commission must respond with an order approving or denying the request within three months after it receives the Mississippi Power filing. That would mean a final commission order on the CWIP rate request no later than late June.

The deal also responds to commission concerns about the substantial rate increases—estimated at 30 percent or more—that the Kemper project will impose on Mississippi Power's residential customers.

In a novel wrinkle clearly designed to make the deal more attractive for ratepayers, Mississippi Power agrees to provide for 30 years a credit to its customers of 10 percent of any royalty revenues that it or affiliate Southern Holdings LLC receives from the sale of proprietary gasification and carbon capture technology being demonstrated at the Kemper plant.

The Transport Integrated Gasification (TRIG) technology was developed jointly by Southern Co. and Houston-based engineering firm KBR LLC with support from the Energy Department. TRIG is designed to allow the combustion of synthesis gas from low-rank coals with exceedingly low pollution levels, while cutting emission of carbon dioxide by roughly 50 percent.

In a deal announced in October, Southern, through its subsidiary Southern Generation Technologies LLC, and KBR will market TRIG to power companies worldwide. Southern Generation Technologies was formed in 2010 to license advanced power generation technology developed and owned by Southern and its subsidiaries.

In another apparent move to shield ratepayers from huge rate impacts, the settlement agreement obligates Mississippi Power to work with commission staff to propose within three months a rate plan to govern cost recovery for the Kemper project during its first seven years of operation. According to the agreement, this plan "should be designed to mitigate and stabilize the up-front rate impacts to customers during the ramp-up period for the Kemper plant by locking in a series of annual revenue requirements for the first seven years of operation."

The plan would incorporate a $2.4 billion cost cap for the base rate portion of the project, but allows the commission to exclude other costs from the cap. It also allows Mississippi Power to pursue alternate financing for costs it incurs that are not otherwise recovered in any subsequent rate proceeding.

The design of the rate plan appears to reflect "acknowledgments" by the commission and the utility that "certain regulatory and accounting options " exist that would provide benefits to customers by requiring that a portion of rates collected before the plant begins operating and during the pendency of the Sierra Club challenge before the state Supreme Court be "be recorded in accounts for the benefit of [Mississippi Power's] customers to mitigate future rate impacts, while mitigating the risk posed to customers should the Kemper Project's certificate ultimately be determined by the courts to be invalid."

The deal calls for the commission to act on this seven-year rate proposal within four months of receiving it. However, the agreement appears to suggest that the commission currently lacks the authority to approve such a rate plan. A section of the agreement that enumerates a series of conditions under which Mississippi Power may opt out of the deal states that the utility can withdraw upon the "failure of the proposed legislation authorizing the seven-year rate plan described herein to become law."

This provision is puzzling because the opt-out provisions are the only place in the six-page agreement in which the word "legislation" appears. Mississippi Power and the commission did not respond to repeated requests for clarification on this provision. However, an environmentalist said Thursday that legislation appearing to give the commission authority to approve the seven-year rate plan was recently introduced in the state Senate.

The Kemper project has been buffeted by intense opposition from local environmentalists, who charge it is far too expensive for Mississippi Power's customers.

Sierra Club officials panned the settlement deal as a "$172 million flip-flop by the commission," noting only months ago the panel had refused to approve CWIP recovery while the environmentalists challenge remained before the state high court.

"The Mississippi Public Service Commission has flip-flopped again, and it will cost hard-working families millions," Louie Miller, director of the Sierra Club's Mississippi chapter, said Thursday. "Today's reckless actions by the commission have opened the door for Mississippi Power to charge their customer base for the boondoggle Kemper County coal plant while it's under construction with no guarantee that the plant will ever produce a single megawatt of electricity."

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Wholesale power prices hit record low in New York in 2012

In a record driven by low natural gas prices, New York's grid operator reported this week that the average wholesale price for electricity in the state in 2012 was the lowest since it established the state's competitive power markets 12 years ago.

The New York Independent System Operator said Wednesday the average annual wholesale price of electric energy in New York was $45.23 per megawatt-hour (MWh) in 2012, below the previous record low price of $48.63 per MWh in 2009.

As a primary fuel for power plants, natural gas sets the price for power in states and regions with competitive wholesale markets, and gas prices plummeted last year due to rising U.S. production.

The rock-bottom prices in New York occurred despite a decrease in the state's generating capacity, with more than 1,400 megawatts of older power plants being retired or mothballed last year and only 745 MW of new generation coming on line.

INGAA report seeks Hill action on gas pipe delays... (Continued from p. 1)

Energy Policy Act of 2005 (EPACT) allowing them to sue federal agencies responsible for inordinate delays.

The study noted that EPACT authorized FERC to require other federal agencies to make final decisions on pipeline permits no later than 90 days after FERC publishes its final environmental review under the National Environmental Policy Act (NEPA).

However, the study said the 90-day deadline clearly has been ineffectual in speeding permitting because more pipelines have experienced delays since EPACT was enacted.

Before EPACT implementation, 7.7 percent of projects failed to get all agency approvals within 90 days of FERC's final NEPA assessment, according to the study. After the 2005 law was passed, 28 percent of pipeline projects experienced delays of more than 90 days, with the percentage of projects experiencing delays of 180 days or more after FERC NEPA approval jumping from nearly 3.5 percent prior to EPACT to 19.5 percent after its enacrment.

The report did not offer any explanations for the increased delays, but pipeline projects have faced growing opposition over potential environmental and safety impacts in recent years, as evidenced by controversy over the Keystone XL oil sands project in Nebraska, where critics have cited contamination threats to sensitive ecosystems and endangered species. Natural gas pipelines have received additional scrutiny over safety issues in crowded urban areas after several high-profile accidents have caused multiple fatalities.

But the INGAA Foundation study said extended federal reviews have frustrated the congressional intent in EPACT to speed pipeline permitting, and that the problem is that EPACT "does not give FERC any means to enforce the 90-day deadline or impose consequences on the agencies for failure to comply."

Further, pipelines facing delays have not exercised EPACT provisions allowing them to file suit in the U.S. Court of Appeals for the District of Columbia Circuit against federal agencies that exceed the 90-day deadline for completion of project reviews, according to the study.

None of the companies interviewed for the INGAA report chose to pursue legal action even when they faced delays beyond 90 days. More generally, while FERC has approved more than 100 pipeline projects since EPACT was passed, the legal option "has rarely been used," said the study, although it did not specify how many times that option had been exercised.

"The fact that none of the survey respondents for the post-EPACT 2005 projects petitioned for review, even though these projects experienced increased delay, is a strong indicator that the judicial remedy provided by EPACT 2005 is not an effective method to combat delay," the report said. "Despite the increase in number and length of delays, pipeline companies are very reluctant to use legal remedies to address agency delay in the permitting process."

The study called for congressional action to amend the Natural Gas Act to give FERC greater authority to ensure timely permitting of pipeline projects, which see increased construction costs and miss in-service dates due to federal delays.

"In order to achieve the [law's] stated goal of streamlined permitting, there must be consequences for agencies that fail to meet deadlines," the study said. "Additional process improvements, regulatory revisions, and/or legislative actions likely are needed. EPACT has not lived up to its promise to reduce the time required to obtain necessary federal permits and further amendments to the act may be the solution."

Specifically, the report called for amending the Natural Gas Act to give FERC authority to grant approval of a pipeline project if another agency does not meet the permitting timetable set by FERC.

In addition, the report suggested statutory changes that would result in automatic permit approval if an agency fails to come to a permitting decision by the deadline.

The report, based on surveys and interviews of pipeline company personnel representing 51 interstate natural gas pipeline projects completed before and after the passage of EPACT, found that state agencies with delegated federal permitting authority were a common source of delays. In addition, survey respondents said they encountered major delays when fulfilling U.S. Fish and Wildlife Service requirements under the Migratory Bird Treaty Act and when complying with Army Corps of Engineers requirements under the Clean Water Act.

To improve the permitting process, the INGAA Foundation suggested that Congress or the courts take action to loosen the requirements under the Migratory Bird Treaty Act to allow the "take" of migratory birds during gas pipeline development. Further, the report called for recognition by other agencies that FERC's National Historic Preservation Act and Endangered Species Act reviews are "sufficient" for other permits that require them, minimizing duplicative reviews.

FERC could also take a harder line with state and local laws that overlap or conflict with the Natural Gas Act, which preempts those requirements, by revising its policy that promotes local engagement and cooperation, the INGAA Foundation said. In addition, Congress could change the law to authorize pipeline companies to access private property for "non-invasive" project surveys and to authorize FERC to apply its federal agency deadlines to non-federal authorizations required from state and local agencies.

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Bloomberg

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Windmills Overload East Europe's Grid Risking Blackout: Energy

By Ladka Bauerova and Tino Andresen - Oct 25, 2012

Germany is dumping electricity on its unwilling neighbors and by wintertime the feud should come to a head.

Central and Eastern European countries are moving to disconnect their power lines from Germany's during the windiest days. That's when they get flooded with energy, echoing struggles seen from China to Texas over accommodating the world's 200,000 windmills.

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World's Most Powerful Lasers to Zap Nuclear Waste in EU Project
Sustainability news

Renewable energy around the world is causing problems because unlike oil it can't be stored, so when generated it must be consumed or risk causing a grid collapse. At times, the glut can be so great that utilities pay consumers to take the power and get rid of it.

"Germany is aware of the problem, but there is not enough political will to solve the problem because it's very costly," Pavel Solc, Czech deputy minister of industry and trade, said in an interview. "So we're forced to make one-sided defensive steps to prevent accidents and destruction."

The power grids in the former communist countries are "stretched to their limits" and face potential blackouts when output surges from wind turbines in northern Germany or on the Baltic Sea, according to Czech grid operator CEPS. The Czechs plan to install security switches near borders by year-end to disconnect from Europe's biggest economy to avoid critical overload.

Wind Farms

The bottleneck is one of many in the last eight years as $460 billion of wind farms were built worldwide on plains, hills and at sea before networks were fully expanded to deliver the power to consumers. Upgrading Germany's system alone to address capacity and technical shortfalls will cost at least 32 billion euros ($42 billion), its four grid operators said in May.

Germany installed more than 8,885 megawatts of wind energy since 2007, mostly in the north. Now it's studying how to build the power backbone to connect to the industrialized south, home to hundreds of factories such as those of chemicals manufacturer Wacker Chemie AG (WCH) and Siemens AG. (SIE) The electricity detours through the Czech Republic and Poland when German cables can't handle the load as the countries' grids are interconnected.

The problem may intensify with the approaching winter. With an insufficient north-south connection, Germany's power network came close to a collapse last February when high winds in the Baltic sea flooded it with power and the Czech Republic and Poland threatened to disconnect their grids. The coming winter can be critical, German Economy Minister Philipp Roesler said last week.

Aging Plants

Chancellor Angela Merkel's decision to shut down aging atomic plants and exit nuclear power by 2022 following last year's reactor meltdowns in Fukushima, Japan, exacerbated the power imbalance. Germany more than ever will have to rely on power generated in the more windy north.

"We do understand that the Czech and the Polish grid operators are concerned about market and system security," Volker Kamm, a spokesman for grid operator 50Hertz Transmission GmbH, said in a phone interview from Berlin. "We are seeking a constructive solution."

Lack of grid connections, such as in China, or oversupply as in Texas have made wind energy's global rollout a lumpy process. Wind farms in West Texas earlier this year were paying utilities to use their electricity on particularly gusty days because they can still earn $22 a megawatt-hour in federal tax credits.

Excess Flows

Utilities like Prague-based CEZ AS (CEZ) and Warsaw-based PGE SA (PGE) are occasionally forced to disconnect some coal-fired plants in the western parts of the Czech Republic and Poland because of excess power flowing from Germany. CEZ's Prunerov plant is often a casualty of the unplanned flows, CEPS said.

"Measures we're using are costly and at times not sufficient," said Jerzy Dudzik, an executive from Poland's grid operator PSE. PGE had to adjust generation schedules at its Dolna Odra and Turow plants, he said.

Both Poland and the Czech Republic are planning to install so-called phase-shifter transformers in the trans-border area with Germany to regulate power flows and protect their transmission networks. While the Czechs are still negotiating with Germany on other short-term solutions and pushing for a creation of smaller power-trading areas with realistic capacity allocation, they're already counting on installing four transformers by 2017, CEPS said.

'Free Lunch'

"The Germans are using our infrastructure in an excessive manner," CEPS board member Zbynek Boldis said in an interview in Pragne. "At this point they're getting a free lunch."

Germany's eastern neighbors have also said that the common German-Austrian power market puts them at a disadvantage since they must reduce cross-border transmission capacity because of trades between the two nations and have to take costly measures to protect their grids.

Southern Germany imports power from Austria's pumped- storage hydroelectric power stations in the Alps during peak periods, again using the Czech grid while excluding the Czechs from the benefits of trading within a single-border area.

"Traders within the Austrian-German common zone don't need to bid for capacity in auctions even though they're using up the capacity of its neighbors, who do have to pay," CEPS's Boldis said. "That's discrimination."

The German-Austrian common market's physical transmission capacity doesn't correspond with the volume of transactions between the two countries, so they end up using the Czech, Polish, Slovak and Hungarian grids, Boldis said. The four countries want Germany and Austria to redraw the power-trading map, creating smaller areas that would better reflect electricity flows.

"Electricity follows a path of least resistance in the grid, according to the laws of physics," Boldis said. "The result is that our transmission system is overloaded, we have security threats."

To contact the reporters on this story: Ladka Bauerova in Prague at lbauerova@bloomberg.net; Tino Andresen in Dusseldorf at tandresen1@bloomberg.net

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Statement for the Record

National Petroleum Council

U.S. House Energy and Commerce Subcommittee on Energy and Power

February 5, 2013

Mr. Chairman, Mr. Ranking Member, distinguished committee members; thank you for the request to submit a statement for the record concerning North America's oil and natural gas resources and the potential for their development. This statement is based on the National Petroleum Council (NPC) report, *Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources*, which was issued a little over a year ago. The study that produced this report reached four principal conclusions:

- First, the potential supply of North American natural gas is far bigger than previously thought. It is now understood that the natural gas resource base is enormous and that its development, if carried out in acceptable ways, is potentially transformative for the American economy, energy security, and the environment, including reduction of carbon and other emissions. These resources could meet high projections of demand.
- Second – and surprising to many – North America's oil resources are also much larger than previously thought. These oil resources offer substantial supply for decades and could help the United States reduce, though not eliminate, its reliance on imported oil. (Note: Oil from Canada is included in U.S. oil imports.)
- Third, natural gas and oil resources will be needed even as energy efficiency reduces demand and lower-carbon alternatives become more economically available on a large scale. Moreover, the natural gas and oil industry is vital to the U.S. economy, generating millions of jobs, widely stimulating economic activity, and providing significant revenues to governments.
- Fourth, realizing the benefits of natural gas and oil depends on environmentally responsible development. The nation can realize the benefits of these larger resources by ensuring they are developed and delivered in a safe, responsible, and environmentally acceptable manner in all circumstances.

The National Petroleum Council concluded that there is an abundance of North American oil and natural gas resources, which if prudently developed can significantly contribute to the environmental protection, economic growth, and energy security wellbeing of the United States.

A number of more recent analyses by academia, consultants, private companies, associations, and government organizations, including the International Energy Agency (IEA), have reached similar conclusions regarding the potential for North American oil and natural gas resources and the contribution these can make to our nation's future.

A copy of the Summary Volume of the NPC's *Prudent Development* report is attached to this Statement for the Record. This Summary as well as the Full Report Volume, 55 supporting topic papers, and other study materials are publically available to be viewed and downloaded from the NPC 's website (www.npc.org).

The National Petroleum Council study was undertaken in response to a request from the Secretary of Energy to assess North American resources of natural gas and oil; describe their development potential; describe the key technologies that will be used in this development; set out how development can be achieved while ensuring high standards of environmental performance and management of community impacts; and analyze the contribution that greater use of natural gas can make in reducing CO_2 and other air emissions, while achieving objectives of environmental protection, economic growth, and energy security. The study was requested in September 2009 and the final report was delivered in September 2011.

The NPC is a federally chartered, self-funded Advisory Committee with the sole purpose of providing advice to the Secretary of Energy and Executive Branch by conducting studies at their request. It is not an advocacy group and does not lobby. NPC study participants represent diverse interests and expertise relating to the topic being addressed. There were over 400 participants involved in the study that produced the NPC's *Prudent Development* report, the majority of whom were from organizations outside of the oil and gas industry.

A more complete description of the NPC's origins and operations, membership, and other reports also can be found on the NPC 's public website (www.npc.org).

Department of Energy
Washington, DC 20585

March 15, 2013

The Honorable Ed Whitfield
Chairman
Subcommittee on Energy and Power
Committee on Energy and Commerce
U. S. House of Representatives
Washington, DC 20515

Dear Mr. Chairman:

On February 5, 2013, Adam Sieminski, Administrator, Energy Information Administration, testified regarding "American Energy Security and Innovation: An Assessment of North America's Energy Resources."

Enclosed are the answers to two questions that were submitted by Representative Eliot L. Engel to complete the hearing record.

If we can be of further assistance, please have your staff contact our Congressional Hearing Coordinator, Lillian Owen, at (202) 586-2031.

Sincerely,

Christopher E. Davis
Deputy Assistant Secretary
for Congressional Affairs
Congressional and Intergovernmental Affairs

Enclosures

cc: The Honorable Bobby L. Rush, Ranking Member

Printed with soy ink on recycled paper

QUESTIONS FROM REPRESENTATIVE ELIOT L. ENGEL

Q1. You and several of the other witnesses today have spoken at length regarding new oil reserves and how this brings us closer to energy independence. Since the price of oil is set on the world market, can you explain the impact of these domestic sources on price of oil?

A1. Additional production of domestic crude oil affects world oil markets over various time horizons. For example, domestic crude oil production was nearly 800,000 barrels per day higher in 2012 compared to 2011, largely due to the dramatic growth in tight oil that has only recently been recognized as an economically attractive resource. Increased U.S. production was roughly equal to the total growth in non-OPEC crude oil production in 2012, a year in which global spare production capacity was relatively tight given the effect of sanctions on Iran and production disruptions in countries including Sudan, South Sudan, and Syria. Absent the 2012 increase in U.S. production, already-low global spare capacity in 2012 would have been nearly cut in half, creating a significant prospect for world oil prices well above the levels that were actually realized.

Even in a longer-term setting, additional production of domestic crude oil tends to reduce our need for crude oil imports. Increased availability of oil that the U.S. would otherwise import to other global buyers would tend to drive world oil prices lower, assuming constant demand. However, in a longer-run scenario, both global demand and supply forces may work to substantially reduce the sensitivity of world oil market prices to an increase in the level of U.S. production. On the supply side, members of the Organization of the Petroleum Exporting Countries (OPEC), may respond to higher U.S. production by reducing either their output and/or their investment in additional

production capacity to offset the market impact of higher U.S. production. On the demand side, growth in global consumption is likely to be more responsive to changes in prices that persist for an extended period. Such a global demand response would work counter to the price-lowering effects of increased U.S. production.

Q2. As you stated in your remarks, one of EIA's responsibilities is measuring energy and its impact on the economy and the environment. Can you speak to the impact accessing these new fossil resources will have on the environment?

A2. The U.S. Energy Information Administration (EIA) provides data and analysis related to the supply and demand for energy, including the mix of primary fuels and the use of different energy technologies. Our data and analyses provide insight into a variety of environmental indicators. For example, our data on primary energy consumption provide a basis for computing emissions of energy-related carbon dioxide emissions. Our energy projections provide insight into how energy-related carbon dioxide emissions might grow under a variety of assumptions about future energy markets and policies. We also track emissions control technologies used in the electric power sector, which together with information on the sulfur content of fuels, can be used to estimate emissions of sulfur dioxides and nitrogen oxides from power plants.

EIA does not track carbon dioxide or methane emissions that may be associated with the extraction and shipment of fossil energy resources. The amount of emissions depends on how the fuel is extracted, processed, and how far it is moved to the point of use. The Environmental Protection Agency and a variety of academic and non-academic

researchers have estimated emissions associated with production of shale gas and tight oil.

With regard to impacts stemming from the development of new fossil resources, such as natural gas produced from shale formations, joint consideration of the work done by a variety of Federal agencies and researchers can provide the basis for a comprehensive picture. For example, recent U.S. shale gas development has significantly contributed to an abundance of supply that has reduced the price of natural gas in U.S. markets. As a result, over the past several years and especially in 2012, natural gas became increasingly competitive with coal as a fuel for baseload electric power generation in many regions of the country where plants using either of these two fuels may be dispatched to meet load. Taking account of both the difference in carbon content per unit of energy and the greater efficiency of a typical natural gas combined-cycle generation plant relative to a coal-fired steam plant, the former produces only about 40 percent of the carbon dioxide emissions per kilowatt-hour as the latter.

As a result of lower natural gas prices, 30 percent of the total electricity generated in 2012 was fueled by natural gas, up from 21 percent in 2008. The coal share of generation in 2012 was 37 percent, down from 48 percent in 2008. The increase in gas-fired electricity generation has significantly reduced U.S. carbon dioxide emissions associated with electricity generation. Combining this information with data from non-EIA sources that estimate extraction and shipment emissions for both coal and natural gas would provide a basis for an initial impact assessment.

FRED UPTON, MICHIGAN
CHAIRMAN

HENRY A. WAXMAN, CALIFORNIA
RANKING MEMBER

ONE HUNDRED THIRTEENTH CONGRESS

Congress of the United States

House of Representatives

COMMITTEE ON ENERGY AND COMMERCE

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February 21, 2013

Ms. Jennifer Morgan
Director, Climate and Energy Program
World Resources Institute
10 G Street N.E., Suite 800
Washington, D.C. 20002

Dear Ms. Morgan:

Thank you for appearing before the Subcommittee on Energy and Power on Tuesday, February 5, 2013, to testify at the hearing entitled "American Energy Security and Innovation: An Assessment of North America's Energy Resources."

Pursuant to the Rules of the Committee on Energy and Commerce, the hearing record remains open for ten business days to permit Members to submit additional questions to witnesses, which are attached. The format of your responses to these questions should be as follows: (1) the name of the Member whose question you are addressing, (2) the complete text of the question you are addressing in bold, and then (3) your answer to that question in plain text.

To facilitate the printing of the hearing record, please respond to these questions by mail by the close of business on Thursday, March 7, 2013. Please also e-mail your responses to the Legislative Clerk in Word format at Nick.Abraham@mail.house.gov.

Thank you again for your time and effort preparing and delivering testimony before the Subcommittee.

Sincerely,

Ed Whitfield
Chairman
Subcommittee on Energy and Power

cc: The Honorable Bobby Rush, Ranking Member,
Subcommittee on Energy and Power

Attachment

RESPONSES TO QUESTIONS RESULTING FROM THE TESTIMONY OF JENNIFER L. MORGAN

DIRECTOR, CLIMATE AND ENERGY PROGRAM

WORLD RESOURCES INSTITUTE

HEARING BEFORE THE U.S. HOUSE OF REPRESENTATIVES ENERGY AND COMMERCE SUBCOMMITTEE ON ENERGY AND POWER: "AMERICAN ENERGY SECURITY AND INNOVATION: AN ASSESSMENT OF NORTH AMERICA'S ENERGY RESOURCES"

The Honorable Eliot Engel

1. **In your testimony you addressed all sources of energy and the threat of climate change, I applaud you for that. Can you expand on your comments regarding electrical generation from renewable resources? How much generation, do you think, we can expect from these sources over the next decade?**

According to *Renewable Electricity Futures*,[1] a recent study by the National Renewable Energy Laboratory, 80 percent of continental U.S. electricity demand in 2050 could be met by commercially available renewable electricity generation technologies.

However, we are not yet on track to see such widespread deployment. Today renewable resources represent 13 percent (53 billion kilowatt-hours per year) of U.S. electricity generation. According to the early release of the U.S. Energy Information Administration's *2013 Annual Energy Outlook*, assuming current policies this is only expected to grow to 14 percent (65 billion kilowatt-hours per year) in 2023, and 16 percent of generation in 2040. Under this business-as-usual scenario, EIA finds that new renewable generation would be driven by state renewable standards, voluntary purchases of "green" energy, and decreasing renewable costs.

[1] http://www.nrel.gov/analysis/re_futures/

Significantly increasing renewable generation will require enacting new federal and/or state policies. Options include renewable portfolio or clean energy standards, longer-term extensions of the production and investment tax credits, feed-in-tariffs, and greenhouse gas (GHG) reduction policies. Renewable generation could also be stimulated by GHG performance standards for existing power plants, which the U.S. Environmental Protection Agency (EPA) has the authority to establish under Section 111(d) of the Clean Air Act. The actual level of investment in renewables will depend on the stringency of the EPA program and on decisions made by each individual state, as the Clean Air Act provides considerable flexibility in how they meet EPA's guidelines.

Our recent report, *Can the U.S. Get There from Here?*, provides some insight into the level of renewable generation that could be achieved through such standards.[2] In our "go-getter" scenario, which provides what we think is an upper bound of the reductions that could be achieved using existing federal authorities, renewable generation increases roughly 50 percent over current levels in 2020.

2. **In your testimony you also spoke about job creation. Can you explain more about the types of jobs we can expect from an expansion in renewable energy?**

Expanded renewable energy in the U.S. would create jobs across the value chain, from construction and manufacturing to skilled scientific, engineering, and service roles. Deployment of renewable generation will lead to jobs in project planning and financing (e.g., engineers, lawyers, bankers), equipment installation (e.g., construction workers), and operations and maintenance (e.g., engineers, maintenance workers). As noted in my testimony, WRI's research on the clean energy economy has found that a key to

[2] http://www.wri.org/publication/can-us-get-there-from-here

capturing manufacturing jobs is comprehensive, long-term, targeted, and inclusive support for renewable energy deployment.[3]

3. **In your opinion what would be the single most important thing Congress can do to get the United States to energy Independence while reducing our dependence on fossil fuels?**

The most important thing is for Congress to enact the suite of policies that will drive an energy-efficient and low-carbon economy. First, this includes putting a price on carbon. Second, Congress should aim to enact bipartisan national energy policies that encourage more efficient energy consumption, increase the diversity of domestic energy production, maximize deployment of low-carbon energy technologies, and minimize environmental impacts throughout our energy systems. As noted above, options for renewables policies include renewable portfolio or clean energy standards, longer-term extensions of the production and investment tax credits, feed-in-tariffs, and greenhouse gas reduction policies. Options for energy efficiency include policies that enable informed consumer choice as well as energy efficiency standards for vehicles, appliances, and other energy-consuming equipment that is sold into U.S. commerce. Finally, the United States must invest in R&D in clean energy solutions, including high-risk, high-reward research on novel ideas along the lines of ARPA-E as well as sustained funding for pilot- and commercial-scale demonstrations of new clean-energy technologies. While existing efficiency programs are in place, Congress should provide continued support for these programs and look for opportunities to expand them.

[3] http://www.wri.org/publication/delivering-on-the-clean-energy-economy

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