

U.S. GLOBAL ENERGY OUTLOOK FOR 2012

HEARING
BEFORE THE
COMMITTEE ON
ENERGY AND NATURAL RESOURCES
UNITED STATES SENATE
ONE HUNDRED TWELFTH CONGRESS
SECOND SESSION
TO
RECEIVE TESTIMONY ON THE U.S. GLOBAL ENERGY OUTLOOK
FOR 2012

JANUARY 31, 2012



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U.S. GLOBAL ENERGY OUTLOOK FOR 2012

TUESDAY, JANUARY 31, 2012

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 10:02 a.m. in room SD-366, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. OK. Why don't we get started? The hearing will come to order.

Thank you all for being here. This is an oversight hearing on the U.S. and global energy market outlook for 2012. As many of you know we often start the year by holding a broad overview hearing such as this.

Obviously a lot has happened since last year. Since the last time we had an overview hearing of this type many countries, the Middle East and North Africa, the key oil producing region of the world, had popular uprisings resulting in new governments taking charge in what is now referred to as the Arab Spring of 2011. As a result, Libya, an important OPEC member and exporter to Europe, spent much of 2011 with oil production and exports near zero.

With Libyan production and exports now almost totally restored or mostly restored, our focus on that region of the world has a new complexity because of the multi-lateral sanctions against Iran which also is one of the world's largest oil exporting Nations. Although the U.S. has sanctioned Iran since 1980 and has not imported Iranian oil since that time, Iran remains an important source of Asian and European oil imports. So as Europe now works to implement its own sanctions against Iran we can anticipate some dislocation in crude oil flows as the world adjusts to this new situation. These geo-political uncertainties serve as a reminder that oil markets, and to be more specific, oil prices, are a very important factor in our country's economic security. That's why it's so important to fully understand the connection between U.S. and global oil markets.

The oil market outlook in the U.S. is brighter than we would have thought possible even a few short years ago. Our oil production is up. Our production of alternative liquid fuels is up by about the same amount. Our reliance on imported petroleum is down.

At the same time our cars and trucks are using that oil more efficiently than before. The United States has successfully reversed

what seemed to be an inevitable trend of becoming ever more dependent on imported oil. So this is an accomplishment that we can all be grateful for.

However it's important to note that in part because of this enhanced U.S. security, we, the United States, are no longer the primary driver behind the world oil markets and prices. As our oil production has gone up in the past few years, oil prices have gone up as well. The U.S. became a net exporter of refined products in recent months, yet consumers are still paying higher prices at the pump. That's why, I hope, we can use today's discussion to understand broad energy trends in both the U.S. and around the world. My view is that we need to understand not only how to make the U.S. less vulnerable to oil disruptions but understand what events and actions actually affect world oil prices.

We have a panel of 4 expert witnesses today who can help us understand the interrelated markets for oil and for all of our energy sources.

We'll start today's discussion with Dr. Howard Gruenspecht, who is the Acting Administrator of the Department of Energy's Energy Information Administration. He will share the highlights of EIA's latest short and long term energy market forecasts.

This committee is a heavy consumer of EIA products. We always appreciate having EIA share its data and analysis with us. I note President Obama has nominated an impressive candidate, Adam Sieminski, to become the next Administrator of the EIA. In the meantime we very much appreciate Dr. Gruenspecht being here to present the EIA's position.

Next we'll hear from Ambassador Jones, the Deputy Director of the International Energy Agency in Paris. We look forward to discussing IEA's forecast of total world energy supply and demand outlook through 2035. I'll also note that the IEA was founded as a forum for responding to oil supply disruptions and still has an important role to play in that capacity. Given the current geo-political environment we are especially grateful to be able to have Ambassador Jones here today.

We also are pleased to have with us 2 leading energy analysts, both of whom have been before our committee on several other occasions. Both Mr. Diwan and Mr. Burkhard can offer their own thoughts and insights on where the oil markets are headed. They also each have considerable expertise in the geo-politics of oil.

[The prepared statement of Senator Landrieu follows:]

PREPARED STATEMENT OF HON. MARY L. LANDRIEU, U.S. SENATOR FROM MISSISSIPPI

Thank you, Mr. Chairman for convening this hearing. It is very important that Congress be informed of the expected energy outlook for not only the U.S. but for the world so we can make informed decisions on the policies we enact.

Before I get to my questions, I just want to state for the record that I have always been a firm believer that we should and must develop all of our domestic energy resources here at home to ensure our country more energy secure.

Looking back on 2011, it is clear that political unrest in the Middle East, in particular Libya, had a profound impact on the global oil supply. Looking forward, it is clear that sanctions on Iran would have a similar effect on supply, driving the price of oil higher still.

As I review the materials for this hearing, I see that International Energy Agency predicts that 2012 will be another year of increased volatility in the world oil market, due primarily to unrest in oil producing states in the Middle East. I see that

they advocate "investment in new productive capacity, especially in diverse areas likely to be less susceptible to geopolitical risks" as a way to ensure our energy security into the future.

I would point out that one area 'less susceptible to geopolitical risks' is our own Gulf Coast, yet the issuance of permits for new drilling permits still lags behind pre-Macondo levels, which will continue to discourage producers from investing in increased capabilities in the Gulf. In addition, the slow pace of permitting has devastated the essential industries that support drilling- industries like deep sea tugs, helicopter services, and even catering.

According to recently released study from Greater New Orleans Inc., 42% of support businesses along the Gulf Coast are not making a profit, 50% have laid off workers, and 46% have moved operations away from the Gulf Coast.

If we are to continue to take advantage of the bountiful resources in our Gulf, we need these industries which form the ecosystem of support necessary to continue drilling in the Gulf. If we are to have a drilling industry in the future, it is necessary to increase the pace of permitting now to ensure that these businesses can afford to stay in the Gulf Coast.

In addition, the Keystone XL pipeline project, which would have provided both additional cross-border pipeline capacity and essential pipeline capacity from the Midwest to the Gulf Coast, has been rejected with no clear plan to move forward. This rejection threatens to stall the development of Canadian imports and could threaten an essential source of North American oil.

Despite these slowdowns, I am pleased to see that domestic production is projected to increase in 2012, but this enthusiasm is tempered by the thought that we could be producing still greater amounts of the energy we use here at home rather than importing it.

It is clear from reading the materials presented for the hearing today that we are on the cusp of possibly another tumultuous year in the oil market, and that increased investment in domestic production is required to ensure a steady and affordable supply to ensure that consumers are not faced with increased energy costs in these tough economic times.

The CHAIRMAN. Let me defer to Senator Murkowski for any opening statement she has.

**STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR
FROM ALASKA**

Senator MURKOWSKI. Thank you, Mr. Chairman. I appreciate you convening this very important hearing. It's really a scene setting hearing for us here on the Energy Committee.

In looking at the panel before us, I welcome you all back. I recognize that this is a welcome back. We're almost onto Groundhog's Day here. I would suggest that this is not going to be a repeat of what we heard from last year.

As the chairman has noted there has been a lot that has changed from the last time we convened. The conventional wisdom here is that this Congress cannot accomplish any major energy legislation now that we are into, full on into, an election year. I think that that would be a disappointing finish for us. But it doesn't mean that the rest of the energy world is going to be grinding to a halt.

Decisions are still being made or perhaps not being made on a daily basis about where energy can be developed, who is going to buy it, how it will be transported. All of those decisions, of course, have consequences for jobs, for our economy and for the prices that we pay for our energy needs. Those of you who have joined us today will help us understand the major trends and events taking place in both the U.S. and global energy policy.

Whether we're talking about China taking its first steps toward proving up its shale gas resource, which by some estimates is even larger than our resource here in the United States. Or whether we're talking about the Strait of Hormuz where there are a number

of somewhat unforeseen circumstances. I think we would all acknowledge that they could have impact on the everyday lives of Americans.

So I'm interested in whether there's a challenge to conventional wisdom before us today. I can tell you that when oil prices peaked at \$147 per barrel back in 2008, we here in Congress talked a lot about it but you didn't see much in terms of policy changes. We should take a lesson from that experience and recognize that times of relative stability are an opportunity to recall what we said in times of crisis. It's times like now when we're able to have a more reasoned discussion that, I believe, we should see to develop a coherent policy and then act on it.

I'm particularly interested in whether the U.S. can hold it together and truly see through this natural gas revolution that's risen to the top of our energy discussion. Technology developed here at home has allowed us to tap the abundant resources that we have. We're faced with some pretty good problems actually.

What to do with all the gas?

How to handle its rapidly expanding development in a sustainable way?

How to keep growing in this space without self destructing through the misguided regulatory or fiscal policy reactions.

So for obvious reasons I'm going to be asking this morning where Alaska fits into this picture. Our very unique geographical position, our huge resource base, is well placed to satisfy some of the export demand for U.S. gas. So I want to understand the context of this against the concerns that many others, including some on this panel, have regarding the lower 48 scenarios.

I think it is appropriate. Timing is everything. But it's interesting to talk a little bit about what we know about this resource.

The President in his State of the Union address just last Tuesday indicated that this country has potentially a hundred years supply of natural gas. In your new estimates the Marcellus shale which we previously thought held enough gas to meet the entire Nation's demand for 17 years at current consumption rates, has now been revised downward to a 6 year supply. So it seems like, you know, the numbers are all over the place. I think it speaks to fact that you've got changing technology, you have increased exploration that allows us to understand a little bit more about what we're looking at in terms of the reserves. But it does go to the heart of what you all deal with and that is understanding the numbers, understanding what we're dealing with in terms of supply.

A long time before the President agreed with those of us calling for an all of the above energy policy, it became evident that the U.S. still really does matter in terms of influencing world energy trends and truly determining our own fate. If an emergency or a disaster does occur there's a strong likelihood that the rest of the world will look to us for leadership. We've got to be ready for that.

So I'm hopeful that this hearing will help inform, not only this committee, but others of patterns developing and help us to see where we could act, where we should act and where the best investments for our very limited Federal resources might be. I look forward to hearing from each of you this morning and the discussion that will follow.

The CHAIRMAN. Alright. Why don't we go ahead?

Dr. Gruenspecht, why don't you take what time you need to summarize your annual report, your new outlook and then we'll hear from Ambassador Jones?

STATEMENT OF HOWARD GRUENSPECHT, ACTING ADMINISTRATOR AND ENERGY INFORMATION ADMINISTRATION, DEPARTMENT OF ENERGY

Mr. GRUENSPECHT. Thank you, Mr. Chairman and members of the committee. I appreciate the opportunity to appear before you today.

The Energy Information Administration is the statistical and analytical agency within the Department of Energy. EIA does not promote or take positions on policy issues and has independence with respect to the information and analysis we provide. Therefore our views should not be construed as representing those of the Department or other Federal agencies.

Starting with the short term outlook, EIA expects that the global market will rely on both increases in production of crude oil and non crude liquids and a draw on inventories to meet world demand growth this year. The price of West Texas Intermediate crude oil is forecast to average about \$100 per barrel in 2012, roughly \$5 above last year's level. Uncertainties such as surprises in economic growth or geo-political issues affecting Middle East suppliers that, I think, were mentioned in the opening statements could push oil prices higher or lower than projected. Based on recent futures and options data the market believes that there is about a one in 8 chance that the average WTI price in June 2012 will exceed \$125 per barrel and about a 1 in 25 chance that it would exceed \$140 per barrel.

On a related matter to geo-political issues, EIA is working diligently to meet the February 29th deadline to submit to Congress a report on the availability and price of petroleum and petroleum products produced in countries other than Iran as required under the National Defense Authorization Act. This is a report that we are to prepare every 60 days and the first one is due February 29th.

Turning to consumer prices and expenditures EIA has lowered its forecast of average household heating expenditures this winter due to warmer weather. Our baseline forecast for average gasoline prices in 2012 is slightly below last year's level, about a nickel a gallon. Although recent options and futures price data imply that the market believes there is about a one in 5 chance that the U.S. average pump price of regular gasoline will exceed \$4 in June of this year, the idling of 3 refineries on the east coast could have an impact on regional prices, especially as the market transitions to new supply sources. This is another issue that we are watching closely and I know there's a lot of interest in Congress.

I will now turn to the longer term projections from our new Annual Energy Outlook. The reference case represents an energy future reflecting current market and technology trends, current consumer behavior and existing laws and regulations. EIA certainly recognizes that projections of energy markets, whether short term or long term, are highly uncertain and cases addressing a variety

of alternative market, technology and policy scenarios will be released this spring.

In the new reference case increased domestic oil, natural gas and renewable energy production coupled with energy efficiency improvements reduces U.S. reliance on imported energy sources. In the outlook domestic crude oil production is expected to grow by more than 20 percent over the coming decade, again, as alluded to in the opening statements.

Net petroleum imports as a share of total U.S. liquid fuels consumed drop from 49 percent in 2010 and they had been as high as 60 percent in recent years, to 36 percent in 2035. I should note that proposed fuel economy standards covering model years 2017 through 2025 are not included in the reference case and would further reduce projected liquid fuels demand and net petroleum imports.

U.S. production of natural gas is projected to exceed consumption early in the next decade. We expect reliance on renewable energy and natural gas for electric power generation to rise. Putting all of this together, total U.S. energy related carbon dioxide emissions are more than 7 percent below their 2005 level, the 2005 level is something that policymakers look at often, in 2020 and remain below their 2005 level through 2035.

Shifting to the outlook for global energy use. Our latest international reference case projects worldwide energy consumption growing about 53 percent by 2035 with China and India accounting for half of the increase. While fossil fuels continue to dominate, renewable energy is projected to be the fastest growing source of primary energy. Natural gas has the fastest growth rate among the fossil fuels. Developing countries really dominate the growth in all categories of energy use.

There are both similarities and differences in the international energy outlooks developed by the EIA and the IEA, my colleague here.

Starting with similarities in both EIA's reference case and IEA's current policy scenario to which it's most directly comparable, world liquid production reaches similar levels over the next 25 years and developing countries account for the vast majority of the growth in global energy use.

Turning to differences, the IEA projects that the OPEC share of world liquid supply would increase to over 50 percent by 2035. Under similar price assumptions EIA anticipates that the OPEC market share would remain near its current level of about 42 percent and that conventional and unconventional oil production, outside of OPEC, will continue to increase. A big wild card is certainly what happens with tight oil or shale oil, as it's called. Will that become a worldwide phenomenon?

Also the gap between projected U.S. natural gas prices in the latest EIA and IEA outlooks has narrowed as the IEA has cut its price projection for the U.S. market over the last several years. But IEA's U.S. natural gas import prices are still more than 40 percent above EIA's reference case price at the end of the projection. Our price remains under \$7 per million BTU in today's dollars in 2035.

This concludes my testimony, Mr. Chairman and members of the committee. I would be happy to answer any questions you might have.

[The prepared statement of Mr. Gruenspecht follows:]

PREPARED STATEMENT OF HOWARD GRUENSPECHT, ACTING ADMINISTRATOR AND
ENERGY INFORMATION ADMINISTRATION, DEPARTMENT OF ENERGY

Mr. Chairman and Members of the committee, I appreciate the opportunity to appear before you today to discuss the U.S. and global energy outlook.

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

The energy projections that I will discuss today are widely used by government agencies, the private sector, and academia as a starting point for their own energy analyses. EIA prepares both short-term energy outlooks, examining monthly trends over the next one to two years, and long-term outlooks, with annual projections over the next 20-to-25 years. Copies of the most recent outlooks are included as part of my testimony. While I will be focusing primarily on the long-term outlooks in my remarks today, I would like to first summarize some key findings from our January Short Term Energy Outlook (STEO), which includes monthly forecasts through the end of 2013.

The short-term energy outlook

EIA expects the price of West Texas Intermediate (WTI) crude oil to average about \$100 per barrel in 2012, \$5 per barrel higher than the average price last year. EIA expects that the market will rely on both increases in production of crude oil and non-crude liquids and a draw on inventories to meet world demand growth. There are many significant uncertainties, such as changes in expected economic growth or geopolitical issues affecting Middle Eastern suppliers that could push oil prices higher or lower than projected. The National Defense Authorization Act signed by the President at the end of December, requires EIA, in consultation with Treasury, State and the intelligence community, to submit to Congress every 60 days a report on the availability and price of petroleum and petroleum products produced in countries other than Iran. We are working diligently to provide the requested data within the specified timeframe.

Mild weather the first half of this heating season has resulted in a lower forecast of average household heating expenditures for the current winter than published in the October 2011 Outlook. Natural gas inventories continue to set new record highs. As of the most recent report last week, working inventories were 3.1 trillion cubic feet (Tcf), about 20 percent above their level at the same time last year, which was close to the historical five year average. Household expenditures for natural gas, propane and electricity expenditures are now projected to be lower than last winter. While still higher than last winter, average household heating oil expenditures are now expected to increase by only 4 percent down from the earlier projection of an 8 percent.

EIA expects regular-grade motor gasoline retail prices to be slightly lower than last year at an average \$3.48 per gallon in 2012, and \$3.55 per gallon in 2013. There are regional variations in the forecast, with average expected prices on the West Coast about 25 cents per gallon above the national average during the April through September peak driving season each year; nationally prices are forecast to average about 5 cents per gallon higher than the annual average during the peak driving season. The idling of three refineries on the East Coast could have an impact on prices, especially as the market transitions to new supply sources. This issue is addressed in a December 2011 report "Reductions in Northeast Refining Activity: Potential Implications for Petroleum Product Markets," that provides information responsive to several Congressional inquiries to EIA on this matter. We are working on a more comprehensive follow-on report that will be issued in the near future.

Long-term energy outlooks

Annual Energy Outlook—Turning to the Annual Energy Outlook 2012 (AEO2012), the Reference case discussed in this testimony was released last week and is intended to represent an energy future through 2035 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 AEO2012, which EIA will release this spring, will include a large number of alternative cases intended to examine these uncertainties.

A copy of the AEO2012 Early Release Overview* is included as part of my testimony so I will summarize here.

Domestic crude oil production is expected to grow by more than 20 percent over the coming decade—Domestic crude oil production increased from 5.1 million barrels per day in 2007 to 5.5 million barrels per day in 2010. Over the next 10 years, continued development of tight oil combined with the development of offshore Gulf of Mexico resources are projected to push domestic crude oil production to 6.7 million barrels per day in 2020, a level not seen since 1994.

With modest economic growth, increased efficiency, growing domestic production, and continued adoption of nonpetroleum liquids, net petroleum imports make up a smaller share of total liquids consumption—U.S. dependence on imported petroleum liquids declines in the AEO2012 Reference case, primarily as a result of growth in domestic oil production of over 1 million barrels per day by 2020, an increase in biofuel use of over 1 million barrels per day crude oil equivalent by 2024, and modest growth in transportation sector demand through 2035. Net petroleum imports as a share of total U.S. liquid fuels consumed drop from 49 percent in 2010 to 38 percent in 2020 and 36 percent in 2035 in AEO2012. Note that proposed fuel economy standards covering model years 2017 through 2025 that are not included in the Reference case would further reduce projected levels of liquid fuels use and net petroleum imports.

U.S. production of natural gas is expected to exceed consumption early in the next decade—The United States is projected to become a net exporter of liquefied natural gas (LNG) in 2016, a net pipeline exporter in 2025, and an overall net exporter of natural gas in 2021. The outlook reflects increased use of LNG in markets outside of North America, strong domestic natural gas production, reduced pipeline imports and increased pipeline exports, and relatively low natural gas prices in the United States compared to other global markets.

Use of renewable fuels and natural gas for electric power generation rises—The natural gas share of electric power generation increases from 24 percent in 2010 to 27 percent in 2035, and the renewables share grows from 10 percent to 16 percent over the same period. In recent years, the U.S. electric power sector's historical reliance on coal-fired power plants has begun to decline. Over the next 25 years, the projected coal share of overall electricity generation falls to 39 percent, well below the 49-percent share seen as recently as 2007, because of slow growth in electricity demand, continued competition from natural gas and renewable plants, and the need to comply with new environmental regulations.

Total U.S. energy-related carbon dioxide (CO₂) emissions remain below their 2005 level through 2035: Energy-related CO₂ emissions grow by 3 percent from 2010 to 2035, reaching 5,806 million metric tons in 2035. They are more than 7 percent below their 2005 level in 2020 and do not return to the 2005 level of 5,996 million metric tons by the end of the projection period. Emissions per capita fall by an average of 1 percent per year from 2005 to 2035, as growth in demand for transportation fuels is moderated by higher energy prices and Federal fuel economy standards. Proposed fuel economy standards covering model years 2017 through 2025 that are not included in the Reference case would further reduce projected energy use and emissions. Electricity-related emissions are tempered by appliance and lighting efficiency standards, State renewable portfolio standard requirements, competitive natural gas prices that dampen coal use by electric generators, and implementation of the Cross-state Air Pollution Rule.

Other highlights of the AEO2012 Reference case projections

- World oil prices rise in the Reference case, as pressure from growth in global demand continues. In 2035, the average real price of crude oil in the Reference

*A copy of the Early Release Overview has been retained in committee files.

case is \$146 per barrel in 2010 dollars. World liquids consumption grows from 87.1 million barrels per day in 2010 to 109.7 million barrels per day in 2035, driven by growing demand in China, India, the Middle East, and other developing economies.

- Total U.S. primary energy consumption, which was 101.4 quadrillion Btu in 2007, grows from 98.2 quadrillion Btu in 2010 to 108.0 quadrillion Btu in 2035. The fossil fuel share of energy consumption falls from 83 percent of total U.S. energy demand in 2010 to 77 percent in 2035.
- Net imports of energy meet a declining share of total U.S. energy demand as domestic energy production increases. The projected net import share of total U.S. energy consumption in 2035 is 13 percent, compared with 22 percent in 2010 and 29 percent in 2007.

International Energy Outlook—Given the interconnectedness of U.S. energy markets and the broader global markets, the international outlook provides useful context for the more detailed U.S. projections outlined above. I will briefly describe some highlights of EIA’s International Energy Outlook 2011 (IEO2011), which was issued last September. I will also discuss some similarities and differences from the World Energy Outlook 2011 (WEO2011) developed by the International Energy Agency (IEA) that you will also be hearing about today.

EIA’s IEO2011 Reference case develops a projection that assumes current laws and policies, but does not anticipate new policies or regulations that have not yet been implemented. In the IEO2011 Reference case, worldwide energy consumption grows by 53 percent between 2008 and 2035 with much of the increase driven by strong economic growth in the developing nations. China and India account for half of the projected increase in world energy use over the next 25 years. China alone, which only recently became the world’s top energy consumer, is projected to use 68 percent more energy than the United States by 2035. A few highlights follow:

- Renewable energy is projected to be the fastest growing source of primary energy over the next 25 years, but fossil fuels remain the dominant source of energy. The renewable share of total energy use increases from 10 percent in 2008 to 15 percent in 2035.
- Natural gas has the fastest growth rate among the fossil fuels over the 2008 to 2035 projection period. Unconventional natural gas (tight gas, shale gas, and coalbed methane) supplies increase substantially—especially from the United States, but also from Canada and China.
- World oil prices remain high in the Reference case, but liquids consumption continues to grow; both conventional and unconventional liquid supplies are used to meet rising demand.
- Electricity is the world’s fastest-growing form of end-use energy consumption in the Reference case, as it has been for the past several decades.
- The transportation share of world total liquids consumption increases from 54 percent in 2008 to 60 percent in 2035, accounting for 82 percent of the total increase in world liquids consumption.
- Energy-related carbon dioxide emissions rise from 30.2 billion metric tons in 2008 to 43.2 billion metric tons in 2035—an increase of 43 percent. Much of the increase in carbon dioxide emissions is projected to occur among the developing nations of the world, especially in Asia.

The IEO2011 Reference case is most directly comparable to the Current Policies Scenario (CPS) in the IEA’s WEO2011, and there are many similarities in their projections. In both the IEO2011 Reference case and the WEO2011 CPS, non-OECD countries account for the vast majority of growth in global energy use, which is expected to increase by 1.6 percent per year between 2009 and 2035. Non-OECD energy consumption growth increases by 2.3 percent per year, while China’s energy use grows at a somewhat faster rate of 2.5 to 2.7 percent per year. World liquids consumption reaches about 112 million barrels per day in both projections.

There are, however, also some important differences between the IEO2011 Reference case and the WEO2011 CPS. For example, the WEO2011 CPS projects that the OPEC share of world liquids supply will increase from about 42 percent in 2010 to 51 percent in 2035. Under similar price assumptions, the IEO2011 Reference case anticipates that the OPEC market share will remain at about 42 percent and that non-OPEC supplies from both conventional and unconventional sources will continue to increase.

Another difference concerns the outlook for U.S. natural gas markets. The WEO2011 CPS projects that U.S. natural gas import prices will more than double over the projection, from \$4.40 per million Btu (real 2010 dollars) to \$9.90 per million Btu in 2035. The IEO2011 Reference case also anticipates an increase in U.S.

natural gas import prices, but they rise more slowly, reaching only \$6.90 per million Btu in 2035.

I should note that while the IEO2011 Reference case and WEO2011 CPS are most directly comparable, it is the New Policies Scenario (NPS) rather than the CPS that is featured as the central scenario in the WEO2011. The NPS assumes “recent government policy commitments are implemented in a cautious manner, even if they are not yet backed up by firm measures.” It can be a real challenge of course, to determine what does or does not constitute a “policy commitment” under an NPS-type scenario. Indeed, there are even questions surrounding the definitions of “current policies” for a CPS or Reference case. For example, while the IEO follows the AEO convention that existing energy tax credits and related incentives in the United States that have statutory expiration dates expire as scheduled for purposes of the projections, the CPS appears to contemplate the indefinite extension of existing incentives.

Conclusion

As I noted at the outset, while EIA does not take policy positions, its data, analyses, and projections are meant to assist policymakers in their energy deliberations. In addition to the work on baseline projections that I have reviewed this morning, EIA has often responded to requests from this committee and others for analyses of the energy and economic impacts of energy policy proposals. This concludes my testimony, Mr. Chairman and members of the committee. I would be happy to answer any questions you may have.

The CHAIRMAN. Thank you very much.
Ambassador Jones, go right ahead.

STATEMENT OF RICHARD H. JONES, DEPUTY EXECUTIVE DIRECTOR OF THE INTERNATIONAL ENERGY AGENCY, PARIS, FRANCE

Mr. JONES. Thank you very much, Mr. Chairman, members of the committee. I’m going to keep my remarks short and focus on the oil market today. My longer, prepared testimony also includes remarks on gas and coal markets as well as the outlook to 2035.

Our base case view for 2012 envisages global oil demand growth of just over one million barrels per day. On the other hand, we think that non-OPEC oil supply and OPEC gas liquids, which are not subject to production restraints will rebound by as much as 1.6 million barrels per day combined. At current OPEC production levels this would imply some slack in the market and a recovery in world oil stocks which are now well below 5 year averages after more than a year of steady decline.

However, it appears more likely that OPEC producers will trim supply by around half a million barrels per day to produce at 30 million barrels per day. This would hold inventory levels roughly where they are now which is, as I said, a pretty short supply. Although huge uncertainty surrounds the ability of non-OPEC supply to rebound from the awful year it suffered in 2011, there were a lot of unplanned outages. We, and many of our analytical peers, believe it can.

Libyan production continues to recover. Higher oil prices have put some expansion projects elsewhere back on track while the application of shale gas technology to light tight oil has transformed U.S. upstream oil prospects, as Dr. has said. Tight oil alone could grow by 250 thousand barrels per day to reach 870 thousand barrels per day in 2012. In fact increased supply from the United States, Canadian oil stands and Brazilian deep water output generates much of the expected one million barrels per day growth we

see for non-OPEC production in 2012 with Russia, biofuels and natural gas liquids also making significant contributions.

While there are, of course, downside risks to this forecast of non-OPEC supply growth, oil demand might also fall short of our expectations. Recently announced revisions to the IMF's world economic outlook posit global GDP growth for 2012 at 3.3 percent compared to previous forecasts that were nearer to 3.9 percent. Arguably downside risks for demand and non-OPEC supply might balance each other out. If so, OPEC may well try to navigate through 2012 producing at or around 30 million barrels per day implying underlying spare capacity of between 3 and 4 million barrels per day.

Now this estimate of spare capacity will come under scrutiny as another looming supply side issue for 2012 unfolds. I'm speaking of Iran. The recently announced U.S. sanctions on entities having financial dealings with the Iranian Central Bank and the new European Union embargo on oil imports from Iran will clearly affect the mix of crude oil supply available on a regional basis even if absolute levels of global crude supply may be impacted to a lesser degree.

Iran currently exports around two and a half million barrels per day of crude oil with 65 percent of this going to Asia and some 30 percent into Europe, mostly to refiners around the Mediterranean. A significant portion of the 1.3 million barrels per day of Iranian crude imported by IEA member countries which, of course, include some countries in Asia like Japan and Korea, anyway, increasing a significant portion is likely to be affected by these majors. Even if refiners will have until June or July to source alternative barrels, most are already looking for incremental supplies from outside Iran which is exactly the intent of course of the sanctions.

In terms of crude quality buyers are likely to seek extra barrels from Saudi Arabia, Russia or Iraq to make up for lost sales from Iran. While Saudi Arabia has publicly reassured customers that it will meet their requirements analysts have raised questions over the extent of the Kingdom's spare capacity, the proportion of Arab Medium which is a good substitute for the bulk of Iranian exports within that spare capacity and the Kingdom's logistical flexibility to reorient its exports to European refiners. Ultimately refiners denied the ability to import Iranian oil will most likely find the extra barrels they need, but perhaps at higher prices than might otherwise have been the case.

Of course, Iranian authorities also have threatened to institute an embargo of their own on exports to Europe and to impede traffic through the Strait of Hormuz. The latter threat is of greater concern to world oil markets. 17 million barrels per day, equivalent to some 20 percent of global oil supplies pass through the Strait. To a degree such threats have already been factored into market prices, we believe. The likelihood of a prolonged blockage of Hormuz transits is seen as being fairly low.

Mr. Chairman, in sum, all of this suggests that those who are seeking a more tranquil oil market in 2012 may well be disappointed. At the IEA we'll continue our monitoring of oil market conditions and in particular the availability of alternative market supplies. No physical disruption of oil supply has occurred yet. But

as always, the Agency will remain vigilant and stands ready to act rapidly and decisively if a major disruption occurs.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Jones follows:]

PREPARED STATEMENT OF RICHARD H. JONES, DEPUTY EXECUTIVE DIRECTOR OF THE INTERNATIONAL ENERGY AGENCY, PARIS, FRANCE

Mr. Chairman, and members of the committee, I am grateful for the opportunity to come before you today to discuss the views of the International Energy Agency (IEA) on recent oil market developments and prospects for 2012. I hope that my testimony will help to inform the important work of this committee as it begins crafting policies in the new year.

A retired American diplomat with experience on Middle Eastern and energy issues, I have served as Deputy Executive Director of the International Energy Agency since October, 2008. The IEA is an intergovernmental organization that acts as an advisor to 28 member countries, including the United States, in their effort to ensure reliable, affordable and clean supplies of energy for their citizens. Founded during the 1973-74 oil crisis, the central role of the IEA was and remains to co-ordinate response measures in times of oil supply emergencies. As energy markets have evolved, however, so has the IEA. Its mandate today also incorporates work on market reform, energy-technology collaboration, climate-change policies and outreach to the rest of the world, especially major consumers and producers of energy including China, India, Russia and OPEC countries.

I will use my time this morning to focus on the oil market, which has become a focus of attention once again amid high prices and elevated tensions in the North Africa and Middle East (MENA) region. I have also attached a written appendix, covering market movements for other sources of energy, and the long term outlook for global energy.

Oil market developments in 2011

Having steadily risen from a low point of below \$40/bbl in February 2009 to a high of around \$120/bbl last spring, crude oil prices have shown a degree of stability ever since. A \$100-\$120/bbl envelope looks to have become established, with prices oscillating within that range. Of course, as we have noted before, oil prices at these elevated levels still pose significant problems for import-dependent countries, especially those which subsidise end-user prices heavily. In this regard, we estimate that the proportion of total world GDP dedicated to oil expenditures was back up above 5% for 2011, as it was during the economic slump of 2008 and during several previous periods of severe economic downturn. High oil prices may or may not have caused these episodes of economic difficulty, but they certainly did not help.

Many have pointed to the apparent paradox of prices at or above \$100/bbl when the world apparently faces the prospect of economic slow-down and therefore diminishing levels of likely oil demand growth. The invisible hand of market speculators is often referred to as having held oil prices artificially high. And yet detailed research has so far failed to identify a smoking gun in the commodities derivatives markets:

- there is no clear link between futures market activity and oil price moves;
- market volatility has declined from 2008 highs and is not out of line with historical levels or compared with that in other commodity markets;
- evidence is slim surrounding so-called 'excessive speculation';
- and indeed, both price levels and volatility for exchange-traded commodities have been less exaggerated than they have for their non-exchange-traded counterparts.

This is not to say that interactions between physical commodity and financial markets have not increased: they have. And short term price moves at an intra-day or intra-week level may well be amplified by what is happening in the derivatives markets. But there are more obvious factors that appear to have held prices high in 2011—the relationship between demand and supply, and a steady tightening in OECD inventory levels that has resulted from a marked imbalance between global supply and demand since early-2010.

In 2010, world oil demand grew by a near-record 2.7 mb/d as the global economy rebounded from recession. Growth was particularly strong in the non-OECD economies, which accounted for 80% of the increase. And supply was not able to keep up, rising by less than 2 mb/d. So we saw an implied global stock draw of 0.8 mb/d in 2010.

The picture however changed subtly in 2011: In fact, global oil stocks still declined by 0.5 mb/d, but this time due to severe shortfalls from the supply side, which was unable to keep up even with much more moderate oil demand growth of only 0.7 mb/d. Firstly, a spate of unscheduled disruptions wiped-out expected growth in non-OPEC supply which, in the event, barely held steady in 2011 at 52.7 mb/d. The North Sea, Canada, Brazil, Argentina, Malaysia and China all saw a combination of technical and industrial-related production shortfalls, while political unrest sharply curbed supplies from Yemen, Syria and Sudan. All these events however pale into insignificance compared with the key oil market development of 2011—the loss of Libyan supply. This, you will recall, was an event that prompted the IEA in June of 2011 to call for a release of 60 million barrels of strategic inventories, to act as a bridge to higher supplies from other OPEC producers, to add physical liquidity to the market (notably in the form of light-sweet crude oil), and to try to prevent a potentially abrupt drawdown in OECD inventories during the second half of 2011 if other OPEC supplies did not increase to help offset the loss from Libya.

The agency today feels vindicated. The release of stocks, particularly from the US SPR, provided short term liquidity in light-sweet crude, and allowed the re-routing of export cargoes otherwise headed to North America, back towards European refiners who most keenly felt the loss of Libyan feedstocks. To date, we estimate the Libyan crisis has cost the market 425 million barrels of lost supply, even though production has begun to recover in recent months. While other OPEC members, notably Saudi Arabia, did step in during the summer to raise production, so far their efforts and the IEA stock release combined have only managed to fill around 75% of the gap left by reduced Libyan volumes. OECD company inventories have continued to tighten, but to a much lesser degree than risked being the case back in June. We think the coordinated action by IEA members played at least a partial role in helping avoid a damaging price spike during summer 2011. Nonetheless, operating inventories, particularly for crude oil in Europe, starved of light-sweet Libyan supplies for much of 2011, stand well below the five year average.

In short, market fundamentals have continued to tighten in 2011, yet prices have been stabilized by the countervailing influence of a potentially weakening global economy on the one hand, and geopolitical instability which is raising questions about supplies from the Middle East Gulf region on the other.

How long can this apparent stability last?

We note in the latest issue of the Oil Market Report, our monthly assessment of recent market fundamentals and short term outlook, that this relative price calm could be fragile. While we habitually avoid making specific price prognoses, much depends on whether economic malaise or supply-side problems predominate in the next year.

Our 'base case' view for 2012 envisages global oil demand growth of just over 1 mb/d. We think that non-OPEC oil supply and OPEC gas liquids (which are not subject to OPEC's production management system) will rebound by as much as 1.6 mb/d combined, leaving OPEC producers an opportunity to trim their collective crude supply by around half a million b/d to 30 mb/d and still maintain inventory levels roughly where they are now.

But of course huge uncertainty surrounds the ability of non-OPEC supply to rebound from the awful year it suffered in 2011. We and many of our analytical peers believe it can, continuing the trend of reinvigorated growth that was seen in 2009 and 2010. Higher oil prices have seen upstream spending increase and have brought a number of tentative expansion projects back on track. And not least, favourable oil-gas price differentials and the application of the technologies deployed in the US's shale gas revolution to light tight oil (LTO) have transformed US upstream oil prospects. LTO production alone could grow by 250 kb/d to reach 870 kb/d in 2012. Consensus expectations for non-OPEC growth in 2011 range from around 0.5-1.0 mb/d, with our own at the upper end of that range. Either way, supply from the Americas (not only the US, but also Canadian oil sands and Brazilian deepwater output) generate much of the expected growth, with Russia, biofuels and natural gas liquids also expected to make significant contributions.

There may indeed be downside risks to non-OPEC supply compared with our base case, particularly if higher spending cannot offset the type of disruptions seen in 2011. But two years in a row dogged by that level of outages would be most unusual. Equally likely, oil demand might also fall short. Recently announced revisions to the IMF World Economic Outlook posit global GDP growth for 2012 at 3.3%, compared to previous levels near 3.9%. All other things being equal, this could feed through to reduce our own expectation for oil demand in 2012, although late-winter weather and the degree to which non-OECD economies continue to buck the weakening growth trend of the OECD could complicate matters. Arguably, these down-

side risks for demand and non-OPEC supply might just balance each other out. So OPEC may well try to navigate through 2012 producing at or around 30 mb/d, slightly lower than the 30.9 mb/d we think they supplied to the market in December, and implying underlying spare capacity of between 3-4 mb/d.

Turning to the Iranian Question

This estimate of spare capacity may be brought into sharper focus as another looming supply-side issue for 2012 unfolds, namely that of Iran. Leaving aside the geopolitical merits of measures designed to prevent Iran from attaining nuclear weapons capability, the recently announced US sanctions on entities having financial dealings with Iran, and the upcoming EU embargo on oil imports from Iran, will clearly affect the mix of crude oil supply available on a regional basis, even if absolute levels of global crude supply may be impacted to a lesser degree.

Estimated Jan-Sep 2011 Imports of Iranian Crude

		% Total	
	2011 Oil	% Total	
	kb/d	Demand	Exports
IEA			
Belgium	36	5%	1%
Czech Republic	5	3%	0%
France	58	3%	2%
Germany	15	1%	1%
Greece	103	30%	4%
Italy	185	13%	7%
Japan	327	7%	13%
South Korea	228	10%	9%
Netherlands	19	2%	1%
Poland	3	1%	0%
Spain	161	12%	6%
Turkey	196	29%	8%
UK	11	1%	0%
IEA Pacific	555	8%	22%
IEA Europe	792	7%	31%
IEA Total	1347	7%	53%
Others			
China	550	6%	22%
India	310	9%	12%
Other Asia	240	3%	9%
Non-OECD Asia	1100	5%	44%
Total Asia	1655		65%
South Africa	80	14%	3%
Total	2527		100%

Source: IEA databases, Lloyds/Apex

Iran exports around 2.5 mb/d of crude oil, with 65% of this going to Asia and some 30% into Europe (the bulk of this to refiners around the Mediterranean rim). A sig-

nificant portion of the 1.3 mb/d of crude imported by IEA member countries is likely to be affected by at least one of these measures, even if refiners will have until June/July to source alternative barrels. The extent to which US sanctions are actually applied will depend on a Presidential determination in the spring, and the precise impact of the EU embargo has also yet to be fully assessed. But Mediterranean refiners, together with their IEA Pacific colleagues, will likely be looking for incremental supplies from outside Iran between now and the measures' implementation in the summer. In terms of crude quality, buyers are likely to seek extra barrels from Saudi Arabia, Russia or Iraq to make up for lost sales from Iran. While Saudi Arabia has tried to reassure customers that existing and incremental requirements will continue to be met, analysts have raised questions over the extent of the Kingdom's spare capacity, the proportion of Arab Medium (a good substitute for the bulk of Iranian exports) within the Kingdom's spare capacity, and its logistical flexibility to re-orient exports in a westerly direction if European refiners in particular need extra volumes. Ultimately, we think refiners denied the ability to import Iranian oil will most likely find the extra barrels they need, albeit they may need to pay higher prices than might otherwise have been the case.

Conversely, there is a widespread expectation that Iran will try to retain or increase sales to non-OECD buyers, potentially making extra spot sales into Asia at discounted prices. The success or otherwise of the economic measures taken against Iran will therefore depend heavily on the response of China and India, which together already purchase around 860 kb/d of Iranian oil, or 34% of the country's crude exports.

Nor have the Iranian authorities been silent as these economic sanctions have been deployed. Of greatest concern for the oil market is the threat by Iran to impede traffic through the Strait of Hormuz (17 mb/d, equivalent to some 20% of global oil supplies) if an embargo is applied as well as its threat to retaliate against neighbouring producers if they try to boost exports. To a degree, such threats have already been priced into the market, while the likelihood of a prolonged stoppage for Hormuz transits is seen as being fairly low.

In conclusion

All of this suggests that those seeking a more tranquil 2012 oil market than was seen in 2011 may be disappointed. At the IEA we will continue our ongoing and detailed monitoring of oil market conditions and in particular the availability of alternative market supplies. So far there is no physical supply disruption underway. But as always the Agency will remain vigilant and it stands ready to act rapidly and decisively if a major disruption to oil supply occurs. Emergency oil stocks, as their name suggests, are for use only when the market's ability to efficiently reallocate supplies in a crisis is compromised. Ongoing investment in new productive capacity, especially in diverse areas likely to be less susceptible to geopolitical risks, and a progressive improvement in energy and oil use efficiency provide longer term routes to greater supply security. But, if the mere availability of IEA strategic stocks helps calm otherwise jittery market nerves in 2012, so much the better.

Thank you Mr. Chairman.

APPENDICES

1. Recent developments in gas, coal and power markets

Decoupling of world gas markets has reached a new level. In North America domestic production growth has accelerated. For the January—October period US gas production is up by 7-8% (40bcm), compared to growth rates between 2-3% in recent years. Abundant supply led to persistently low prices under \$3.00/Mbtu. So far, there is no sign of such low prices leading to a slowdown of production. This is most likely due to the financial benefits of natural gas liquids as well as the associated gas from light tight oil.

As a result of low gas prices, gas-fired electricity generation in the US has continuously increased its load factor at the expense of coal. Gas fired power generation in the US is likely to have exceeded 1000 Twh in 2011 for the first time in history, and gas is now 24% of US power generation, up from 21% in 2008. As a mirror image of expanding gas usage, coal-fired power generation in the US is down by 7% on a year on year basis, leading to declining coal demand. As the new IEA publication released in December 2011 (Medium Term Coal Market Outlook) emphasized, due to the competition with gas, US domestic coal demand, which is dominated by power generation is unlikely ever to return to its historical peak seen before the financial crisis.

Due to the continuously growing availability of cheap gas, there is an increasing interest in gas exports from the United States: the Sabine Pass project has signed

export contracts for around 15 million tons of LNG supply for Western Europe (BG and Gas Natural) as well as India. The Medium Term Gas Market Outlook, which will be released in June 2012, will examine the prospects for US gas exports over the next five years in detail.

In a stark contrast to North America, international LNG markets have tightened. This is primarily due to increasing LNG demand in the Asia Pacific region, especially Japan. Due to safety reviews and regulatory checks affecting a substantial part of Japanese nuclear capacity, Japanese nuclear production currently is running at less than one third of its pre-earthquake level. So far, Japan has managed to avoid blackouts by disciplined demand side management and increasing utilization of gas-fired electricity generation, leading to a substantial (10 million tons on an annualized basis) increase of its LNG imports. LNG spot prices in the Asia - Pacific region rose as well and quickly exceeded 16 USD/Mbtu; LNG tanker freight rates have doubled since last year. No major new LNG supply will be coming online in the next 3 years, so market tightness is likely to endure. More detailed IEA analysis of the structure of Asian LNG markets will be included in the upcoming Medium Term Gas Outlook.

High oil prices feeding through oil indexed contracts for natural gas as well as the effect of Asia-Pacific demand on LNG markets have stabilized gas prices at a high level in Europe. High prices, economic weakness and expanding renewable production have led to falling gas demand there. This is also partly due to mild weather, but gas consumption in the April–September period was down by 7%, suggesting structural weakness. A major factor behind this is the electricity sector: OECD Europe power generation was down by 1.6% (Jan-Oct) due to economic weakness, and thermal power generation was down by 2.4%. The disproportionate impact on thermal power was due to renewables rather than nuclear: increasing French and UK nuclear production compensated for the German nuclear moratorium, leading to stable EU nuclear production.

Meanwhile, falling thermal generation cut the need for carbon credits, leading to a price collapse: the CO₂ price fell below 7 Euros/ton, compared to 2010's average of 14.3 Euros/ton. The combination of expensive gas and cheap CO₂ enhanced the competitiveness of coal in Europe: burning coal became considerably more profitable which pushed gas to the margin. As a result of low demand levels and plentiful excess conventional capacities, European power prices have remained low (hovering between 50-60 euro/Mwh) despite the German nuclear phase-out. Nonetheless, concerns persist that a combination of a colder winter and transmission congestion might lead to a tighter situation in certain regions.

Despite falling demand, EU gas imports were slightly up due to declining production and increasing stocks. Libyan gas production and exports are coming back online, and the political uncertainties in the MENA region have had no major impact so far on LNG supply.

Ramp up of non-conventional gas will likely be slow in both Europe and China in the context of heightened concerns over environmental and safety issues. To help address these concerns, the IEA will examine "Golden Rules for the Golden Age of Gas" in detail in a non conventional gas workshop in Warsaw in March. This workshop will feed into a chapter of the same name in the 2012 edition of IEA's "World Energy Outlook".

So far the slowdown in growth of the Chinese economy has not led to any measurable slowdown of electricity or coal demand. China still faces an electricity shortage and 90 GW coal-fired capacity is under construction. The Medium Term Coal Market report projects around 800 million tons coal demand increase in China till 2016. There is a large uncertainty over Chinese domestic production and consequently import needs, which could lead to market volatility. On the other hand, the increase of Indian coal import needs is almost certain as India struggles in vain to satisfy its growing demand with domestic mining. There is sufficient new coal production capacity coming to the market, but there are persistent bottlenecks in transport infrastructure.

2. The long-term outlook for global energy

The IEA's World Energy Outlook 2011 (WEO-2011) identifies key medium- and long-term global energy trends based on scenario analysis. The report, released annually in November, contains detailed global projections for energy supply and demand through the year 2035. Each year, the WEO highlights a different region and fuel as well as other timely issues (in WEO-2011, special attention was devoted to Russia's energy sector, coal markets, energy access and energy subsidies).

Background and assumptions

WEO-2011 analyses three scenarios and multiple case studies differentiated by their respective assumptions about future energy-related policies adopted by govern-

ments. The baseline for our analysis is the New Policies Scenario. Its policy assumptions take current policies as a starting point and then (cautiously) incorporate the broad policy commitments announced by countries around the world to deal with energy security, climate change, local pollution and other energy-related challenges. These commitments include targets for energy production and energy efficiency, phase-outs or additions of nuclear power, national pledges to reduce greenhouse-gas emissions and the elimination of wasteful fossil-fuel subsidies. For the United States, key assumptions in the New Policies Scenario include (1) a shadow price for carbon dioxide (CO₂) emission in the power sector, reaching \$35 per tonne CO₂ in 2035; (2) extended operating lifetimes for nuclear power stations; (3) continued financial support for renewable energy; and (4) more stringent heavy-duty vehicle efficiency standards. The policy assumptions in the New Policies Scenario differ from those in the EIA's Reference Case, which accounts for existing policies, and therefore the two sets of results are not directly comparable.

Economic growth, population growth and energy prices are other major assumptions taken in the WEO-2011 New Policies Scenario. Worldwide, economic growth averages 3.5% per year and that the population expands by some 1.7 billion people between 2010 and 2035. In real terms, the IEA crude oil import price rises from \$78 to \$120 per barrel over the Outlook period; the North American natural gas import price rises from \$4.4 to \$8.6 per MBtu between 2010 and 2035, but is considerably lower than other regions given more abundant supplies; the OECD coal import price increases from \$99 to 110 per tonne. These price paths are not a forecast. Rather, they reflect our judgement of the prices that would be needed to encourage sufficient investment in supply to meet projected demand over the Outlook period. The New Policies Scenario assumes limited CO₂ prices for some countries, with varying price levels, mechanisms and sectors affected.

All WEO-2011 projections cited in this testimony, unless otherwise stated, are derived from the New Policies Scenario.

Key projections and trends in the WEO-2011

Global energy demand is projected to increase by one-third between today and 2035 as a result of economic growth and shifting demographic trends such as population growth and urbanisation. These trends are driven by non-OECD countries, which account for more than 90% of the increase in energy demand in the Outlook period. Given the interdependency of global energy markets, this underscores the critical importance of non-OECD energy policies in shaping our energy future.

Fossil fuels remain the dominant source of energy, however, while demand for fossil fuels continues to rise in absolute terms their share of global energy consumption declines from 81% in 2010 to 75% in 2035 as renewable energy technologies make further inroads. Renewables growth is concentrated in the power sector, where hydropower and wind are projected to account for half of new installed capacity. Natural gas is the only fossil fuel that we project to make up an increasing share of the energy mix.

Increasing demand for mobility in non-OECD countries boosts global liquids (oil and biofuels) demand to 104 million barrels per day (mb/d) in 2035, up from 88 mb/d in 2010. The total number of passenger cars worldwide will double, reaching almost 1.7 billion at the end of the Outlook period. The rise in liquids use comes despite impressive gains in vehicle efficiency, particularly in Europe and the United States.

On the supply side, oil companies increasingly turn to resources that are more difficult to extract and therefore costlier. Conventional crude oil in total oil supply declines slightly by the end of the Outlook period as natural gas liquids (18 mb/d in 2035) unconventional sources (10 mb/d) and biofuels (4 mb/d) make significant contributions to meeting increased demand. Iraq, Saudi Arabia, Brazil, Kazakhstan and Canada account for the largest incremental gains in oil output. We calculate that 47 mb/d of gross capacity additions will be needed to replace declining production at maturing oil fields. This necessitates huge investments in upstream oil in the Outlook period.

With increasing dependence on a small number of oil-producing countries in the Middle East and North Africa (MENA), a shortfall in upstream investment there would have far-reaching implications for the global oil market. Such a shortfall may be prompted by higher perceived investment risks, deliberate policies to slow the development of production capacity or shifting public spending priorities. We find that, between 2011 and 2015, if upstream investment runs one-third lower in MENA countries than what is required in the New Policies Scenario (\$100 billion per year), oil prices could rise to \$150/barrel in the short-term.

The oil landscape changes positively for the United States over the next 25 years, with US oil imports shrinking to 6.2 mb/d in 2035 (lower than 1990 levels). This

trend underlines the critical role of energy efficiency policies, as improved vehicle efficiency causes US oil demand to decline by 3.5 mb/d (or 20%). It also reflects the potential for expanding supply of US domestic crude oil, natural gas liquids and biofuels. US light tight oil production has shown increasing promise. Output from the Bakken, Eagle Ford and Niobrara plays alone may exceed 1.4 mb/d by 2020, with additional light tight oil resources that may yet be developed.

For natural gas, supply and demand factors indicate that the future is very bright. This conclusion echoes the main finding in our June 2011 special report, "Are We Entering a Golden Age of Gas?". The share of gas in the global energy mix rises to nearly surpass that of coal in 2035. About 80% of additional demand comes from non-OECD countries, including China, where a major expansion of gas use is supported by energy diversification policies.

In the United States, the combined application of horizontal drilling and well-stimulation techniques such as hydraulic fracturing has unlocked previously non-commercial resources of unconventional gas (including shale gas, tight gas and coal-bed methane). As described above, this success has dramatically changed the global supply picture and has had positive implications for gas security. Unconventional gas, being more geographically distributed around the world than conventional resources, now accounts for half of the natural gas resource base. We project that it will account for one-fifth of global gas supply in 2035. However, this future hinges in part on the ability of governments and industry to deal successfully with the environmental concerns - air, water and land impacts - associated with unconventional gas production. The largest contributions for future gas supply growth come from Russia, China, Qatar, the United States and Australia. In our special focus on Russia, we note that it could save natural gas equivalent to its exports in 2010 if it could just increase its efficiency to levels of comparable OECD countries.

Over the last decade, coal has met nearly half of the increase in global energy demand. Going forward, coal use and its implications for energy security and the environment will depend largely on policy and technology choices. Furthermore, China and India, the two largest consumers of coal in 2035, will remain key actors in global coal markets. In our New Policies Scenario, we project continued strong growth in coal use in the next 10 years, and a levelling off thereafter as countries diversify and clean up their energy supply. In this scenario, global coal demand grows by 25% in 2035 relative to 2009. If instead we assume that current policies are maintained, global coal demand increases by 65% through 2035. We also find that deploying more efficient technologies could have a major impact on air emissions; if the average efficiency of all coal-fired power plants was raised by five percentage points in 2035 relative to the New Policies Scenario, power sector CO₂ emissions would be 8% lower (with local pollution benefits). While carbon capture and storage technologies might boost long-term prospects for coal use, economic and technical hurdles limit its deployment during the projection period in the New Policies Scenario.

Renewable energy experiences impressive growth during the Outlook period. The share of non-hydro renewables (primarily wind and solar) in power generation rises from 3% in 2009 to 15% in 2035, while hydro maintains its share at 15%. Global biofuels supply triples. Cost reductions are making renewable energy technologies more competitive, but subsidies are expected to play an important role in accelerating their deployment and driving further cost reductions. When well-designed, subsidies to renewable energy can bring lasting economic and environmental gains. Even as unit subsidy costs fall, annual subsidies to non-hydro renewables and biofuels expand to \$250 billion in 2035 as deployment scales up. For comparison, global subsidies to fossil-fuel consumption are estimated at \$409 billion in 2010.

Nuclear energy production is projected to rise more than 70% through 2035, with growth concentrated in non-OECD countries. Despite the events at Fukushima Daiichi, our projection for nuclear power output is only slightly less than last year. However, to examine the possible implications of a major shift away from nuclear power we also analysed a 'Low Nuclear Case', which assumes that no new OECD reactors are built and that non-OECD countries add only half the capacity projected in our New Policies Scenario. We find that while there is some increased penetration by renewables, the gap is filled largely by coal and natural gas. This ultimately tightens markets and worsens emissions of CO₂ and local pollutants.

Finally, a few words on the projections in our 450 Scenario, which outlines an energy sector pathway for stabilising the atmospheric concentration of CO₂ emissions at 450 parts per million and targets limiting the global temperature increase to 2°C. This scenario, which the IEA has included in its World Energy Outlooks since 2008, is based on policies that lead us to a more sustainable future that addresses the threat of climate change. Without new policies we are on track for alarming increases in global average temperature: 3.5°C in the New Policies Scenario and 6°C

or more in the Current Policies Scenario. The key message in the 450 Scenario is that we cannot afford to delay tackling climate change if it is to be achieved at reasonable cost. Nearly 80% of allowable CO₂ emissions up to 2035 are already locked in by existing power plants, buildings and factories. On current policies, this figure could reach 100% before the end of this decade. Moreover, we estimate that for every \$1 of investment in the power sector avoided before 2020, an additional \$4.30 would need to be spent after 2020 to compensate for increased emissions.

Conclusion

Governments have a critical role in setting policy frameworks that engender a more sustainable energy future. The data, projections and analyses in the World Energy Outlook are intended to assist policymakers in that effort. The WEO-2011 New Policies Scenario shows that recent global commitments added to existing policies can take us part of the way, but more must be done to achieve an energy future that balances economic growth, energy security and environmental stewardship.

The CHAIRMAN. Thank you very much.
Mr. Burkhard, go right ahead.

**STATEMENT OF JAMES BURKHARD, MANAGING DIRECTOR OF
IHS, CAMBRIDGE ENERGY RESEARCH ASSOCIATES, CAM-
BRIDGE, MA**

Mr. BURKHARD. Mr.—excuse me, Mr. Chairman, Senator Murkowski, other members of the committee, thank you for the opportunity to share some thoughts with you today.

Mr. Chairman, as you mentioned, 2011 was quite turbulent in the oil market because of the Libyan Civil War, the Eurozone crisis, Iran and the slowing global economy. At the same time in 2011 we saw the highest annual average oil price ever on an annual average basis. But the energy story is not just limited to high prices and geo-political concerns. That's very important and I'll talk about those in a little bit.

But the energy story in the United States is also about creating jobs and economic growth and more domestic supply. One of the most significant stories or developments in energy markets in recent years has been what we call the "Great Revival," the "Great Revival" in U.S. oil production. The long decline in U.S. production was never supposed to end.

But it has come into an end. Between 2008 and 2011 over that 3 year period U.S. liquids production, so that's crude oil, natural gas liquids, some biofuels. U.S. liquids production grew by 1.3 million barrels per day in that 3 year period. That was the biggest increase during that time by any country in the world. Just for context the No. 2 source of growth was Russia which grew by about 500 thousand barrels per day.

North Dakota is an important part of this story. North Dakota, a few years ago, wasn't producing much oil. Today North Dakota produces about as much as Ecuador. Ecuador is a member of OPEC. I don't want to suggest North Dakota is going to join OPEC, but it does give you a sense of the context to how big that increase has been.

Looking out, excuse me, over the next decade. When we look at the potential for the U.S. and Canada combined. We see the potential for U.S. and Canadian production from 2008 to 2020, over that 12 year period, to grow by about 4 million barrels per day. That's more than what Iran produces today. That's the potential. It is quite significant.

On the demand side we've seen peak demand. We believe U.S. demand for liquid fuels peaked in 2005. Given these supply and demand trends imports in 2020 are likely to be well below what they were as recently as 2005. For illustrative purposes if you assume the price of oil is \$100 in 2020 and given these demand/supply trends the U.S. import bill for oil could be about \$182 billion less than what it otherwise would be. That \$182 billion is about one third of the 2011 trade deficit, entire trade deficit.

These gains, these increases, in U.S. production and Canadian production are not guaranteed. Impacts on local communities and the environment, obviously, need to be addressed appropriately. There are new questions that have been raised about the pace of growth in the Canadian oil sands which is an important part of this continental growth story. But the potential is significant. If it were to be realized and perhaps spread to other places around the world it would be a source of downward pressure on oil prices.

Getting to the broader oil market. There's a tug of war right now between slowing global economic growth and geo-political concerns. Oil demand growth is weak.

The global economy has slowed over the last year which would seem to be a recipe for lower prices. Yet, prices are high. Why is that? Limited spare capacity and geo-political concerns.

Spare capacity, which is the oil market shock absorber, is quite low. Today compared with recent years we estimate it's around 2 million barrels per day, roughly, 2 to 2.5. As recently as a couple of years ago it was about 5.5 million barrels per day. So spare capacity is significantly less.

In 2012 the Iranian nuclear issue could have a significant impact on the oil market. The combination of tighter U.S. and European financial sanctions, the European oil embargo on purchases of Iranian oil, political infighting in Iran and Iran's growing fear of encirclement creates a volatile atmosphere where miscalculations could lead to grave consequences. An escalation of efforts to disconnect Iran from the global economy has increased supply anxiety about the reliability and adequacy of oil supplies. It's that supply anxiety which is a key support for high prices amid weak economic and oil demand growth.

Assessing the future course of the oil market is always a challenge. This year there's a wide spectrum of potential outcomes. If the Eurozone crisis were to worsen we can't rule out a recession this year which could lead to economic worries, overwhelming the geo-political concerns right now.

So any oil market outlook faces uncertainties. But in 2012 the uncertainties are perhaps broader than usual and fraught with risk. However, the "Great Revival" and U.S. oil production and gas production are sources of growth and secure production at a time of heightened anxiety.

Thank you.

[The prepared statement of Mr. Burkhard follows:]

PREPARED STATEMENT OF JAMES BURKHARD, MANAGING DIRECTOR OF IHS CERA,
CAMBRIDGE, MA

OIL AND GAS MARKETS IN 2012

It is an honor to speak before the US Senate Committee on Energy and Natural Resources of the 112th Congress. One year ago I testified before the committee just as political turmoil began to dramatically affect a number of countries in North Africa and the Middle East. Oil and gasoline prices were rising and creating headwinds for a fragile economic recovery and worries for American consumers—and for many others around the world as well. In the past year there has been great turbulence in the oil market related to the upheaval in Libya, the Iranian nuclear issue, troubles in the eurozone, and a slowing pace of global economic growth. Today, oil prices are higher than a year ago. In fact, in 2011 oil reached its highest average annual price since the 1860s.

Developments in energy markets remain a top concern, but the energy story is not limited to worries about high oil prices and geopolitical tension. Energy investment is also playing a role in fueling growth in the United States. A “Great Revival” in US oil production is taking shape—a major break from the near 40-year trend of falling output.

The Great Revival

The long decline in US oil production was never supposed to end. From 1970 to 2008 US oil (total liquid fuels) production fell by 3.79 million barrels per day (mbd)—from 11.3 mbd to 7.64 mbd.¹ But the combined power of market signals (namely high oil prices), technology advances, and access to prospective acreage has changed the playing field. Biofuel policy also played a role. The aggregate impact of these forces led to a 1.3 mbd increase in US supply from 2008 to 2011—the largest gain by any country during that time. Out of that 1.3 mbd, nearly 1.1 mbd was crude oil or natural gas liquids, with the remainder coming from biofuels—mainly ethanol. The number two country was Russia, where oil production increased 0.5 mbd (see *Figure 1).

The scale of the opportunity to boost oil production in the United States is larger than in most other countries over the next decade. Indeed, the oil and gas industry has attracted tens of billions of dollars of investment capital. In the United States, spending to develop oil and gas fields rose 37% from 2009 to 2010—from \$50.6 billion to \$69.4 billion. Spending increased further in 2011.

US oil production growth has materialized at the same time that US oil demand has reached a plateau. US oil demand peaked in 2005 and then fell; and IHS CERA does not expect demand to exceed the 2005 level again. The challenging economic climate of the past several years explains part of the decline in demand; but in the longer term, the higher fuel economy standards and an aging population will restrain demand growth. The combined impact of US oil demand and production trends is a decline in US oil imports. By 2020, the net US oil import requirement could be around 5 mbd less than it was as recently as 2005. At an illustrative oil price of \$100 per barrel, this represents an annual reduction in the oil import bill of \$182 billion—an amount equal to about one-third of the entire US trade deficit in 2011.

The Great Revival is the oily equivalent of the “shale gale”—the revolution in unconventional gas production that emerged several years ago. Shale gas now accounts for about 34% of total US gas production, up from just 5% in 2006. The shale gale has not only helped to boost total US gas production by 28% during this time, but it has also created jobs. A new study by IHS Global Insight, *The Economic and Employment Contributions of Shale Gas in the United States*, finds that shale gas production supported more than 600,000 jobs in 2010, a number that is projected to grow to nearly 870,000 by 2015.

US natural gas prices have hit 10-year lows recently because of the vast amount of relatively low-cost shale gas being produced and the warm winter weather, which lowers demand for gas to generate heat. Another factor is that many gas producing wells also produce oil—and oil sells at a much higher price. Even if gas prices remain low, production will continue from these wells because the higher price that the oil fetches in the market can offset the lower price of gas.

Application of advanced technology is critical to the growth in US oil and gas production. Horizontal drilling and hydraulic fracturing are two technologies at the heart of the growth story. They are also part of the debate about the environmental

¹ The term “liquids” is a broader definition of oil that includes crude oil, condensate, natural gas liquids, and biofuels.

*All figures have been retained in committee files.

impacts of rising domestic oil and gas production. Questions about water availability and quality, air pollution, cumulative land use, and the impacts on local communities need to be addressed to ensure that oil and gas development meets environmental needs and enhances public trust.

Last summer an Advisory Board to the US Secretary of Energy released recommendations related to environmental aspects of shale gas production. Increased transparency—particularly through greater public access to data on gas-producing operations—and efforts to assure water and air quality were among the proposed recommendations. A key point made by the Advisory Board was the need for more systematic data collection to better measure environmental impacts.

In addition to addressing environmental impacts, growth in US production along with higher output from our neighbor, Canada, requires the US pipeline system to catch up with changing supply trends. Canada has become, by far, the largest source of foreign oil to the United States. In the first 10 months of 2011, the United States imported 2.2 mbd of oil from Canada, or 24% of total US imports. More than half, 1.2 mbd, of the supply was from the oil sands of Alberta. In themselves, oil sands are now a top source of US oil supply.

The denial earlier this month of a permit for the proposed Keystone XL pipeline project raises the level of uncertainty regarding the long-term growth and disposition of major sources of world supply growth—the Canadian oil sands and American onshore output. The project would have added 700,000 barrels per day of pipeline capacity between the oil sands of Alberta, Canada, and the US Gulf Coast. This is equivalent to about one-third of Iranian oil exports.

If a new application results in a permit by 2013, it is possible that sections of the pipeline could be online by late 2014, with the entire Keystone XL project in service by late 2015. In this case, the January 18 permit denial would have a minimal impact on future crude flows from Canada to the United States.

If no additional cross-border capacity is built, output from the Canadian oil sands would eventually hit the limits of existing cross-border capacity by around 2019. Even before that, however, oil sands supply would run up against the capacity limits of Canada's existing US customers—refineries in the Mid-Continent—to process oil sands production. This could occur as soon as 2015 and is a key reason Canadian producers are seeking access to the much bigger refining market in the US Gulf Coast. Therefore, Keystone XL would have helped to resolve more urgent bottlenecks in the US Mid-Continent. The US pipeline system has not yet caught up with growing US Mid-Continent and Canadian production, as signaled by the price disconnect between West Texas Intermediate—a key US crude oil price benchmark—and similar crudes on the global market. If pipeline infrastructure does not keep pace with growing oil supply from the US Mid-Continent and Canada, then production growth will eventually slow.

The controversy over Keystone XL means Canada will push harder to diversify its oil export markets. The United States is currently the sole foreign market for the oil sands. The permit denial highlights the risk to Canada of such demand dependence.

THE WORLD OIL MARKET—"TUG-OF-WAR" BETWEEN A WEAK ECONOMY AND GEOPOLITICAL CONCERNS

Slow economic growth and modest gains in world oil demand—this is the starting point for 2012. We project the world economy to grow 2.7% in 2012—well below the 3.7% average over 2010 and 2011. World oil demand is expected to increase 0.7 mbd, which is well below the 10-year average increase of 1.1 mbd per year.

This would appear to be a recipe for lower oil prices. Yet oil prices are high and spare crude oil production capacity is limited. IHS CERA estimates there is about 1.8 to 2.5 mbd of effective spare oil production capacity in the world—all of it concentrated on the Arabian Peninsula. This is a small "shock absorber" for the oil market—equivalent to about 2% to 3% of world oil demand. As recently as 2010, spare capacity was much higher—around 5.5 mbd. Geopolitical fears have a more pronounced impact on oil prices when spare capacity is low—as it is today.

Tension over Iran's efforts to develop nuclear technology and potentially apply it to military purposes is the most prominent—and worrisome—geopolitical issue for the oil market. The decade-long nuclear standoff has become a constant feature of the oil market, with anxiety fluctuating in response to Iran's volatile posture toward negotiations. A threat several weeks ago by an Iranian official to close the Straits of Hormuz—the most important oil export route in the world—sent a shudder through oil markets.

In 2012 the Iranian nuclear issue could have a significant impact on the oil market. The combination of tighter US and European financial sanctions, the European

oil embargo on purchases of Iranian oil, political infighting in Iran, and Iran's growing fear of encirclement creates a volatile atmosphere in which miscalculations could lead to grave consequences. Escalation of efforts to disconnect Iran from the global economy has increased "supply anxiety" and is a key support for high prices amid weak economic and oil demand growth.

The Iranian nuclear issue is not the only geopolitical concern. Violence in Iraq threatens the pace of infrastructure rehabilitation and expansion of oil production and export capacity. Iraq's potential to increase oil supply is enormous, but realizing that potential will be difficult. Supply disruptions need not be large scale to have an impact. For example, disputes between South Sudan—the world's newest country—and Sudan are constraining oil flows from these countries. This and other potential difficulties in Africa or other parts of the world can collectively have a big impact. This was the case in the middle part of the past decade when a series of events removed large volumes of oil from the market—what we referred to at that time as the "aggregate disruption."

Apart from geopolitical concerns, the oil and gas industry continues to struggle with rising costs to find and develop new fields. As was the case a year ago, costs are on the rise. Indeed, the IHS CERA Upstream Capital Costs Index—a type of "consumer price index" for the global oil industry—illustrates the cost pressure. After a modest dip during the recession, costs are likely to approach or set a new record level in 2012 (see *Figure 2).

Wide Spectrum of Potential Outcomes

In early 2012, assessing the future course of the world oil market is a challenge because of the wide spectrum of potential outcomes. Limited spare capacity, geopolitical concerns, and the risk of disrupted supply point toward the possibility of higher prices and even a severe price spike. However, the global economy is in a fragile state. The eurozone crisis remains unsettled and could worsen. The pace of growth in India and China has also showed signs of slowing down. And unemployment is still high in the United States.

IHS CERA has long used a scenario framework to assess the potential course of change in the oil market and the broader energy industry. Several years ago we constructed a scenario called "Vortex," which envisions a member country exiting the eurozone, the United States unable to adequately address its fiscal problems, and much weaker growth in emerging markets. The outcome in the Vortex scenario is another global recession, followed by several years of below-trend growth. Oil prices fall below \$50 per barrel. We do not believe the world has entered such a scenario, but it cannot be ruled out for 2012 given the concerns emanating from the eurozone.

Any oil market outlook faces uncertainties. But in 2012, the uncertainties are broader than usual and fraught with risk. However, the Great Revival in US oil output and further expansion in gas supply are sources of growth and secure production at a time of heightened anxiety.

The CHAIRMAN. Thank you very much.

Mr. Diwan, thank you for being here. Please, go right ahead.

STATEMENT OF ROGER DIWAN, PARTNER AND HEAD OF FINANCIAL ADVISORY, PFC ENERGY

Mr. DIWAN. Good morning. It's an honor to speak again before the U.S. Committee on Energy and Natural Resources. I will focus today my remark on the state of the oil market in the beginning of the year and talk a little bit what's happening in the United States.

The way I'm looking at the oil market and the way to summarize what the panelists before me said is really we have a bipolar crude oil market where we have significant downside risk because of the economic conditions in Europe. On the other side we have significant upside risk because of the tensions with Iran and the possibility to lose some supply from this market. The implication of losing barrels from the Persian Gulf.

If you look at the forward looking balances we are seeing that the acute market tightening experience in 2011 is not likely to be in store in 2012. Demand is under performing. We believe, actually,

that demand will be probably smaller than what the IEA believe, probably below a million barrel per day on average and with significant downside with a few exceptions when we look at oil demand globally it's all negative or the growth is decelerating, particularly in Asia it's decelerating. Growth is only focused on 3 regions: the Middle East, Latin America and emerging Asia.

The bulk of the near-term weaknesses in Europe and also in the United States, where we have significant structural trends of declining demand.

On the supply side, we had a very disappointing year last year because we had obviously the problems in Libya, but we also had a number of problems during the summers which we all believe are one off and not recurring. So 2012 we'll see a recovery, a lot of these supply and new projects coming online mostly from the U.S., Canada and Russia. We don't believe actually Brazil will be able to add a lot of barrels this year.

There is one uncertainty that we haven't talked about which is Iraq. Baghdad maintains an optimistic outlook on production growth of around 5 to 6 hundred thousand barrels per day for 2012. In our view the Iraqi government forecast is over optimistic given the security condition on the ground.

We also have to remember we're basically lost 2 small countries in the recent months from production, Sudan recently, Syria a couple of months ago. We might still have problems in Libya and Nigeria that are not solved. So the supply risk is still abundant even if we still believe that we can have a million barrels per day of growth from non-OPEC crude and liquids and OPEC liquids.

We also need to talk about Iran and the impact of sanctions. When we look at the potential countries that Iran could divert its European supply to we actually don't see a lot of them. We don't see a lot of countries willing to be reliant, more reliant, on Iranian barrels.

So there's a good chance that by the end of the year if you move with the sanction that Iran will have to shut down 4 to 5 hundred thousand barrels per day that need to be replaced by other producers. So that—we need to take into account that forcing OPEC to produce more, reducing further the spare capacity which is not very large to start with. If you add to that the supply risk that I talked about, that would make oil market pretty nervous.

Finally from the U.S. perspective the development of oil production and the declining oil demand mean that security and reliability of supply is rising. Last year when I testified here I was asked where do I believe is the best place to invest. I answered to many of you were surprised that it's the United States. We see that now where we have the full revolution, if you want, in the gas being translated to oil.

We believe that actually by 2020 the United States will become again the largest producer of hydrocarbon in the world, surpassing Russia. What we have seen between 2004 –2008 in the U.S. gas market the increases in prices has allowed the industry to crack the share code and to unleash this new golden era in the U.S. oil patch. This golden era is really reshaping the global oil and gas industry.

We need to think about that when you look at investment globally right now. In the last 3 years the U.S. has been the key area of investment flows. If you look at the last 10 years a producer in the United States used to produce, make profit here and invest abroad because they didn't believe that they can make sustainable reinvestment in the United States.

What we see right now is exactly the contrary. The global oil and gas industry is making profit all over the world and investing in the United States. The United States is a net absorbent of cash. That's a huge change in the industry.

Thank you.

[The prepared statement of Mr. Diwan follows:]

PREPARED STATEMENT OF ROGER DIWAN, PARTNER AND HEAD OF FINANCIAL
ADVISORY, PFC ENERGY

- Tension between geopolitical risks to supply on the one hand and macro-economic/financial risks emanating from the Eurozone on the other will remain a feature of the market through 2013 and will weigh against previously expected price softening.
- Forward-looking balances indicate that the acute market tightening experienced in 2011 is not likely to be in store for 2012, and we believe that the opposite is far more likely. Amid softening oil demand, rising non-OPEC supply will prevent any growth in the Call on OPEC crude until 2013. Without a reduction in OPEC production by some members in order to offset the recovery in Libyan output, commercial inventories are likely to build.
- While significant downside risks to demand persist, the risks to supply will be driving market perception in 2012 and will offset the bearishness inherently embedded in the large projected stock builds over the next two quarters. Furthermore, a significant portion of the projected rise in global inventories will be located in China and India, where the streaming of new refining capacity will necessitate the building up of working inventory in the first half of the year. Both countries' crude imports are expected to accelerate sharply in the months ahead as a result.
- Our 2012 price forecast for Brent stands now at \$111.25/b, with the last two quarters of the year being when we anticipate the greatest impact of anti-Iranian sanctions. WTI (Cushing) will average \$10/b lower in 2012, a discount to Brent that reflects our belief that improving refinery complexity in the Midwest cuts demand for light sweet crude in the region. Even with the reversal of the Seaway pipeline and its planned expansion, the marginal barrel of US inland crude will still be shipped by rail through much of 2013, and possibly beyond if Bakken production continues to surprise expectations.

GLOBAL OIL DEMAND IS SLOWING, BUT BY HOW MUCH?

- With few exceptions, oil demand is expected to either contract or decelerate in most markets: overall, oil demand will effectively grow by 900,000 b/d at most even though our top line demand growth forecast show a higher number: this is due to the anticipated rebound in Libyan demand to near pre-civil war levels as well as the post-flood recovery in Thailand.
- Significant downside risks to demand still remain from the unresolved Eurozone debt crisis, but the chances of a world-wide recession have diminished due to stepped-up efforts by the European Central Bank to support the banking system.
- Virtually all of the growth in oil demand this year will be concentrated in three market regions: Emerging Asia, the Middle East and Latin America. As in the past decade, Emerging Asia will be the chief oil demand growth region, led by China and India. While world trade has dampened prospects for net exports of manufactured goods from China, economic growth spurred by monetary and fiscal easing will be supportive of higher fuel consumption.
- The Middle East—the second largest demand growth region—is also slated to see accelerated growth this year (rising another 250 mb/d compared to 2011's growth of 200 mb/d). The main driver is Saudi Arabia, where residential construction is leading to greater power use.

- The bulk of the near-term weakness is in Europe and the US: Europe is likely to see a decline of 200 mb/d in 2012 with the markets most heavily affected have been those that have undergone some degree of fiscal austerity (Greece, Spain, Portugal, Ireland and the United Kingdom) or have seen a sharp rise in their cost of borrowing (Italy).
- The United States will witness a small contraction in demand by about 90 mb/d for 2012, where tight household budgets have led motorists to cut back discretionary vehicle use and gasoline consumption. Meanwhile, middle distillate consumption remains supported by positive commercial activity.

SUPPLY RISING IN THE WEST, GROWTH AT RISK IN IRAQ

- Although non-OPEC supply growth (crude, gas liquids and biofuels) continued to disappoint in 2011, we expect gains to resume in 2012. Final 2011 data for all countries is still a few months away, but our current estimate is for a paltry increase of 0.1 mmb/d after a long list of outages spanning many countries.
- The year 2012 is forecasted to show a recovery in non-OPEC liquids growth and is led by these countries: the US, Canada, Colombia, Brazil and Russia.
- The United States will lead the growth in Liquids growth in 2012 led by a rise in oil shale output from the Bakken and the Eagle Ford shale. There are several other shale areas that are just starting to be drilled and if those prove as prolific then our forecast is likely to be raised. We have also penciled in an end to output losses in the Gulf of Mexico after the Macondo spill.
- An area of considerable uncertainty is gas liquids. Volumes have been growing rapidly as drillers turn to exploiting the wet gas parts of the many shale plays, especially the Marcellus. We saw that September gas liquids production reached 2,274 mb/d, roughly 73 mb/d above the all-time high of the prior August. This is far higher than what we estimated and may mean a material revision is in order if subsequent months hold to this level.
- A sizeable increase in 2012 liquids is due to the ramp-up to full capacity of Shell's 140 mb/d Pearl GTL project in Qatar. That facility will process 1.6 bcf/d of natural gas that will yield 120 mb/d of gas liquids accounting for nearly all of 2012's unusually large gain.
- Iraq's production levels will remain one of the key supply uncertainties over the next 18 months. Baghdad maintains an optimistic outlook on production growth, anticipating a 500-600 mb/d increase in output for 2012. In our view, the Iraqi government's forecasts are overly optimistic given deteriorating security conditions on the ground. We believe that . output increases are more likely to be in the 200-250 mmb/d range, with risks to this forecast weighted firmly on the downside.

A WEAK ECONOMY WILL DRAG ON OIL DEMAND

- Global oil demand growth is forecast to rise 1.1 mmb/d in 2012 when accounting for 0.2 mmb/d of growth resulting from year-on-year base effects due to the return of Libyan demand to pre-civil war levels as well as post-flood recovery in Thailand. ?
- In effect, oil demand is slowing down from 2011 levels, and we expected to the growth delta to remain sub-one million b/d in 2013.
- Demand in the advanced economies will continue to be challenged by macro-economic headwinds, with a mild recession expected for Europe.
- Japanese crude burning is forecast to continue offsetting underlying structural declines in OECD Pacific through 2012. In 2013, new gas-fired generating capacity will push liquids out of the fuel stack.
- As international trade cools, key emerging markets will also be affected, especially in Emerging Asia and Latin America.
- Non-OECD demand will nevertheless remain the key growth driver, offsetting recession-related and structural declines in OECD demand. Growth remains concentrated in China and the Middle East.

IN NORTH AMERICA, HEIGHTENED PRICE SENSITIVITY WILL DAMPEN OIL DEMAND GROWTH

- The brighter US economic outlook is not expected to support oil demand growth in 2012-13.
- Structural declines in residential heating oil, fuel oil and other products demand are expected to outweigh gains in diesel and jet fuel.
- Gasoline consumption will remain under pressure from tight household balance sheets and high gasoline prices, as seen in 2011 with the collapse in discretionary vehicle use.

- The main reason for lower vehicle miles traveled in the United States in 2011 was the sharp increase in retail gasoline prices (reaching \$4/gallon) early into the US driving season. This will be repeated this year, and prices will continue to dampen demand.
- Although notable efficiency gains are being made, price elasticity is still expected to play greater roll in reducing near-term demand prospects.
- Given inadequate pipeline capacity from the US Gulf Coast, further reductions in refining capacity planned for the East Coast will tighten regional balances and lead to higher gasoline prices during the peak demand periods of 2012-2013.
- As a result, total final oil demand growth in North America is expected to contract 90 mb/d in 2012 and another 70 mb/d in 2013. Risks are on the downside, with prices potentially impacting demand further.
- Slower naphtha and gasoil demand growth together with base effects weighed on year-on-year product demand growth in 4Q11 and will continue to depress the first two quarters of 2012.
- But growth should speed up in the second half of 2012 on expected stimulus measures, bringing annual product demand growth to 420 mb/d, a sharp drop from the 610 mb/d seen in 2011.
- The longer term effect of the stimulus measures and a ramp up in domestic petrochemical production capacity (which will find a market by backing out imports) will carry total product growth momentum into 2013. Annual demand growth then is expected to average 540 mb/d.

NON-OPEC BOLSTERS SUPPLY GROWTH

- Gains in non-OPEC supplies last year came in below expectations due to numerous outages as well as delayed project development. The outlook for 2012 and 2013, however, will show marked improvement, posting gains of 0.8 mmb/d and 0.4 mmb/d respectively.
- The year 2012 is forecasted to show a recovery in non-OPEC liquids growth and is led by these countries: the United States, Canada, Colombia, Brazil and Russia. Clearly, our forecast is largely a Western hemisphere story.
- Rapid development of unconventional shale plays in the United States are also yielding high liquids content and may exceed our current forecast
- GLs and condensates will see steady growth as natural gas production expands in the FSU, Asia-Pacific and MENA.
- Partially offsetting these gains will be a deceleration in global biofuels growth.
- Ethanol output will moderate as the United States approaches maximum blend levels for conventional motor gasoline (not helped by the structural decline in demand for the fuel).
- Brazil ethanol growth recedes from poor sugar harvests and lagging investment in distilleries.
- Iran's crude oil exports averaged 2.2 mmb/d in 2011.
- EU embargo has been agreed in principle but details are yet to be worked out. Any implementation would not occur immediately.
- Complete EU embargo would require Iran to find replacement market for about 600 mb/d.
 - Italy is asking for an exception so ENI can continue to receive in kind payments for work performed in Iran.
 - Greece, cut off from normal credit markets, has greatly increased its intake of Iranian crude in recent months. Locating and financing replacement supplies presents a major financial issue for the country, despite reports it will comply.
- India, South Korea and Turkey have increased imports this year as they are less wedded to strict sanction regimes.
 - Supplies will continue but will make the case to the US that efforts have been made to reduce the volume or to find alternate crudes.
- Streaming of new refineries in India and China will see their demand for imports grow by around 600 mb/d so an EU-only embargo could be managed.
- Expecting other Middle East producers to fill void while surrendering market share allowing Iran to sell barrels into Asia—is likely unreasonable.

The CHAIRMAN. Thank you very much.

Senator Manchin, did you have a question you wanted to ask at the beginning? I was told you had to leave and—

Senator MANCHIN. As I was walking in—

The CHAIRMAN. OK. Why don't you go ahead?

Senator MANCHIN. Thank you, Mr. Chairman. I thank all of you for coming here—

Thank you. I'll get right to the point. It's the XL pipeline.

I'm going to ask all of you to comment. But I have a hard time understanding why this has become a political football. It makes so much common sense that you want to buy off of your friends and not your enemies.

Also, I think in going down to where we're going to go as amount of jobs. I want to hear you alls, just a yes or no, maybe comment. There should be jobs created in the United States by this building of the pipeline.

I understand that there's a difference between what the State Department has done, the environmental verses the EPA in conflict, our own government, if you will is fighting among itself for whatever reasons. Next of all the ability that Alberta and Canadians are going to produce this no matter what. If China becomes a player or the Asia becomes a player, market taking this product if we don't. What it does to our security. Security should be the most factor, I think, the main factor of what we should be concerned about.

So I would ask, I think the question I would ask. Doctor, I'll start with you, if you would. Do you believe the oil sands will be developed no matter whether we buy it or not?

Mr. GRUENSPECHT. Thank you. At the prices we have in our long term projections, the oil sands would likely be—the oil sands, tar sands, call them what you will, would likely be developed whether or not we purchase.

Senator MANCHIN. OK. Does everybody agree?

Ambassador, do you agree that they're going to develop the oil sands?

Mr. JONES. Yes, I would agree with that.

Senator MANCHIN. OK. I'm sure that everybody else agrees with that too.

I would assume that you all think that would be a job creator for America if we built it through, into America? Do you all agree that there would be jobs? I'm sure it has to take jobs of people to build a pipeline, right? So it would be a job producer for us?

Mr. GRUENSPECHT. Again this goes a little bit beyond what EIA does but I guess our view is—

Senator MANCHIN. I mean common sense. You're experts. It takes Americans to build it, right?

Ambassador.

Ambassador JONES. You'd have an initial spurt of construction jobs.

Senator MANCHIN. Yes.

Ambassador JONES. Then you'd have some jobs that operate the pipeline. I'm not sure what the numbers would be. I don't know that it would be a great percentage of increase of employment. But there would be some increase, sure.

Senator MANCHIN. Mr. Burkhard.

Mr. BURKHARD. Yes, it would create jobs. I think the broader point here is the oil sands development in Alberta. There are many American companies that are involved in that. So the American economy does benefit from further development of the oil sands as well.

Senator MANCHIN. Which country and government? Which country would benefit most if America does not build the pipeline and that product does not come? Who would take it? Who would benefit most?

Mr. DIWAN. I think it's likely not to be built is the case. I think it's very difficult to send that oil outside of the United States for Canada to take it to the west coast and ship it abroad actually pose even bigger environmental concern.

So let me try to answer it a little bit differently. I think what we're seeing here between the development of the oil sands and the United States.

Senator MANCHIN. I hate to rush you. I don't have much time. They've only given me so much time here. I'm going to have to run.

But you're saying you think they're going to be held captive. We're understanding that the Alberta province is already meeting right now with China in order to develop this.

Mr. DIWAN. Correct. But from all the economics, if you look at it this oil is most likely to come to the United States. By the way, we still have capacity for the next 4, 5, 6 years to absorb with the present infrastructure, that oil.

Senator MANCHIN. Thank you.

Doctor, if I could I want to switch to the manufacturing jobs that insourcing is the new word, is a new buzz word that we're all using now. We want to start building things again in America. As I'm understanding and Senator Murkowski just talked about the now projections as far as what supplies will be for the shale and the shale gas.

West Virginia has been a big player in Marcellus as you know. The coal and everything, all the resource we've been blessed with. If that's been downgraded now to the point to where it could affect the cost of what we would manufacture. Do you see the supply having a big impact on pricing and thus manufacturing in this country again by not having to dependability with the slashing of the reserves?

Mr. GRUENSPECHT. I think this reserves or resource story is a more accurate way to phrase it because I think the numbers we're talking about are total recoverable resources not reserves which is a much smaller number. Sometimes too much emphasis is placed on the estimates of recoverable resources. In fact, despite this downward adjustment that we made in fact our natural gas production projections are higher and price projections are actually lower in the new outlook than in the previous one.

We rely very heavily on the U.S. geological survey for information about geology. They came out with a new assessment of the Marcellus after we published our last year's outlook. They raised their estimate of Marcellus resources forty fold from 2 trillion cubic feet to 84 trillion cubic feet. We had been using a number like 400 trillion cubic feet.

After looking at what they had done and also looking at well productivity data which continually comes out we deferred to the U.S. GS on geology. But, looking at the latest well productivity data we came in somewhat higher than the GS number of 84 trillion cubic feet.

So again, it's lower than what we had in the last outlook, but it's higher than what U.S. GS came out with recently. It's a lot of natural gas.

Again our outlook is out there. Our view is that the U.S. will become a net exporter our production would exceed our consumption. Prices are lower than in the last outlook. I understand the desire to focus on one number and changes and disputes in that number.

I think this will be an issue that we face for a long time. Total recoverable resource is inherently a squishy concept of what's totally under there. But I think the United States has a very bright future with natural gas.

Senator MANCHIN. Thank you.

If I may, just 1 second, Mr. Chairman. If I could just—the Ambassador really quick.

I'm concerned about the jobs that we would be capable of even producing here manufacturing and so on with the rising cost of our energy making it more difficult to use our natural resources such as coal to natural gas or the downturn as far as the projection of what we have. Do you see that as a long term concern and problem?

Ambassador JONES. Actually right now, I mean, with the increasing supply in the domestically, the United States, gas prices have fallen. I think oil prices in the United States may also be, I mean, right now at WTI, you know, the kind of the market crude for the United States is running under Brent by about ten bucks a barrel. The differential has been even greater. In the last year it was, I think, peaked at 24 or 27, something like that.

So relatively speaking, U.S. prices are relatively low. You know, obviously if prices go down that could be a stimulus to the economy. But prices in the United States are generally lower than in other markets already.

Senator MANCHIN. Thank you, Ambassador.

The CHAIRMAN. Thank you.

Senator Murkowski.

Senator MURKOWSKI. Thank you, Mr. Chairman.

Dr. Gruenspecht, just very quickly I want to ask for some clarification here. There's an article coming out of a local Alaska newspaper from yesterday that indicates that the Alaska to Alberta gas pipeline, the proposal that's been under consideration for several years has been taken out of the outlook reference case because it determined that the project would not be economical based on the price forecast through 2035.

Then there is another statement that says that the final 2012 outlook which is to be issued in the spring will in fact include some aspect or will include Alaska in its determination. Can you help clarify this for me? The statement here is, "EIA's new outlook could bode well for Alaska as the state continues to seek a project to bring its national gas to market, but the full picture won't be known until this 2012 outlook."

Mr. GRUENSPECHT. In terms of piping natural gas from Alaska—it had already been out of the reference case.

Senator MURKOWSKI. Right.

Mr. GRUENSPECHT. Which again, is just a projection.

Senator MURKOWSKI. Right. I understand.

Mr. GRUENSPECHT. In last year's outlook, and it still is, primarily for the same reason that at the prices of natural gas that are now being projected the economics are tough to build a pipeline.

Senator MURKOWSKI. The economics are tough for an overland route through Canada into the lower 48.

Mr. GRUENSPECHT. Right.

Senator MURKOWSKI. But do you take into account Alaska's natural gas potential and the opportunities for it for export?

Mr. GRUENSPECHT. We will look closely at that going forward.

Senator MURKOWSKI. Several of you have discussed the issue of spare capacity. I think it was you, Mr. Burkhard that indicated 2, I think you said \$2 billion—excuse me, 2 billion barrels per day down from 5 million barrels. Did I say billion or million?

Two million barrels per day is our spare capacity and Mr. Diwan, you have mentioned some of the supply risk factors that are out there. Some pretty considerable risks whether you're talking about Iraq and their ability to move things online. We don't know with Nigeria and strikes. You mentioned Sudan, Syria, Strait of Hormuz with Iran.

I mean there—when we're talking about supply risk, it's, it is, very, very difficult to predict. So I guess the question is is how certain are we that we do have spare capacity in the numbers that you have referenced. Given the volatility that you have with the supply risk out there how are we dealing with this?

You had mentioned, Mr. Diwan, or excuse me, I guess it was you, Mr. Jones. You state that, "to a degree threats surrounding the Strait of Hormuz have already been priced in the market by the likelihood of a prolonged stoppage for Hormuz transit as seen as being fairly low." So when we're talking about what is going on with the price of oil, what we have available with spare capacity, what we know and perhaps what we don't know with supply risk.

To what degree, Ambassador Jones, has the uncertainty already been priced into the market? How do we know that? These are some pretty gnarly questions that we're dealing with here that go to the heart of the reliability of any kind of an assessment that any of you may do.

So Ambassador Jones, if you want to start first and then we'll go down the line here.

Ambassador JONES. When we look at the situation, the market, I mean we basically see actually quite a bit of price stability over the last year plus now. Prices peaked around 120 in April I think it was of last year. They've been oscillating between 120 and 100 ever since.

Senator MURKOWSKI. But if you had price stability last year the picture going forward is a little different.

Ambassador JONES. I'm getting there.

Senator MURKOWSKI. OK. Alright. I won't—

Ambassador JONES. So what's been going on? We basically see that the concern for the disruptions has put a floor under prices

that's about at the \$100 level. The concern of—yes, at the—that's put a floor and a ceiling on prices is put because of the fear of economic activity.

Because we all know that if prices go up it produces an external burden on importers. For example, I said last year before this committee, that all or several major recessions had been preceded by an oil import bill of 5 percent or more. In 2011 we had an oil import bill for the world of 5 percent or more.

So there has been constant pressure put on the world economy. So you can't look at it in isolation. Yes, there are risks to the supply. But there's also risk on the demand side. So that's—and of course if there's a supply shortage and prices go up that puts more burden on the economy which increases the likelihood that they'll be a demand shortfall because of economic activity.

So what we're seeing is the interplay of these 2 has kept the price within this range. We think it's, basically, we think the price is quite high when you consider the availability of oil in the market. That's why we think that the market is including a premium for this threat of the disruption in the Iranian case.

Senator MURKOWSKI. My time is expired. But Mr. Burkhard, Mr. Diwan, anything briefly that you would add to that?

Mr. BURKHARD. Very briefly. Expectations about the future play a big role in oil price formation. When you look at the limited amount of spare capacity we estimate it's around 1.8 to 2.5 million barrels per day, call it 2 for this year.

There's a reasonable case to be made that Iranian exports could have some degree of disruption this year which would eat into spare capacity. So it is that limited amount of spare capacity. This fear or concern about disrupted oil supplies that are keeping prices high. They could even go higher despite the weak economy.

Senator MURKOWSKI. Mr. Diwan.

Mr. DIWAN. I largely agree with Ambassador Jones. I think the band will be working between 120 with the floor due to politics and the ceiling due the economics is exactly what we're in. However, we have really 2 tales and risk going on right now.

One is that the natural crisis in Europe.

The other is conflict in the Middle East.

So these 2, in a way, can blow up that range and that's the risk we're facing in 2012.

If neither of which occur we're very likely to stay in that band.

Senator MURKOWSKI. Thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Let me ask Dr. Gruenspecht. You have in your testimony here that net petroleum imports as a share of U.S. liquid fuels consumed will drop you project, from 49 percent in 2010, to 38 percent in 2020 and 36 percent by 2035. That's your projection.

Then you say that this projection was made without including the reference case of any further reduced projected levels of liquid fuels as a result of the fuel economy standards. Have you calculated if these fuel economy standards which have been announced by the Administration and by the auto industry and by various others, if those are included, what that does to the percentage of liquid fuels that we have to import?

Mr. GRUENSPECHT. Thank you, Mr. Chairman.

We are certainly going to include a case like that, in our full outlook. It makes a significant difference I'd say in the last decade of the projection. By 2035 liquid fuels consumption would probably be lower by a million, 1.4 million barrels a day, roughly. I'm trying to remember the number. Most of that would come out of imports.

So it's a pretty big deal.

The CHAIRMAN. So instead of it being then 36 percent by 2035 what percent would it be?

Mr. GRUENSPECHT. I would need to calculate that. But I will be glad to get back to you with that or maybe one of my colleagues will calculate it while we're talking.

EIA has not yet performed an analysis of the impact of the recently proposed fuel economy standards for model years 2017 through 2025. However, based on information that is currently available and preliminary results using the Annual Energy Outlook 2012 Early Release Reference case, EIA estimates that domestic liquid fuels consumption would be reduced between 1 and 2 million barrels per day by the year 2035. EIA's Early Release Reference case projects that imported petroleum as a share of total liquid fuel use declines from about 50 percent currently to 36 percent by 2035. Given the estimated reduction in fuel use associated with the proposed model year 2017 through 2025 fuel economy standards, imported petroleum as a share of total liquid fuel use would decline several additional percentage points by 2035 if other Reference case assumptions are unchanged.

The CHAIRMAN. That would be a good figure because I think a lot of the effort here in Congress and in the Administration has been to try to put in place policies that would reduce the amount of petroleum we have to import.

Dr. Diwan, you referred, I think, in your comments to structural trends of declining demand in the United States. Could you elaborate on what you're talking about there?

Mr. DIWAN. Yes. There's obviously the gasoline story where we have more car efficiencies. But also we're seeing the residential heating fuel oil also declining. Another product, cheap natural gas, cheaper coal and the extension of the gas network will reduce the heating oil consumption too.

So you have a number of trends here for different fuels which are on the decline. But the biggest gain is obviously on the gasoline side structurally.

The CHAIRMAN. OK. Let me ask about the closing of refineries. We've seen refineries being closed in the United States, in Hawaii, in the Virgin Islands, even in Europe.

What is the impetus for this and for the results that we're seeing?

Are we in a circumstance where we're going to see higher prices for gasoline at the pump because of a shortage of refined product even while we've got an ample supply of oil being produced?

I mean, what is going on here with refinery closures?

Dr. Gruenspecht, do you have a perspective?

Mr. GRUENSPECHT. I have something of a perspective. We've sent a—we put a report on our website right before Christmas, a short report on Northeast U.S. refining. We are expecting to provide a much more detailed piece probably by February.

But I guess the short answer is that certain types of refineries, you know, in certain regions are not economically very attractive. I would point out that in the Gulf there are significant expansions of refinery capacity and in the Midwest there have been significant expansions of refinery capacity. So in the strange EIA speak, it's really PADD One or the East Coast and some places in Europe and the Hovensa refinery in the Caribbean where refineries are being closed. But there are other places where refinery capacity is being added.

Our concerns, which we expressed in the preliminary report released in December, are really about the transition. There are a lot of petroleum products in the world. Demand trends, as discussed, are in some sense moderating with fuel economy standards and with increased use of biofuels which reduce the demand for petroleum based products.

There are potential fuel transportation, bottlenecks, logistical issues. It's a challenging environment and something that I've asked the people at EIA to dig into a lot more deeply.

The CHAIRMAN. Mr. Diwan, did you want to add a comment?

Mr. DIWAN. Yes. I want to add structurally to understand what's happening here. In Europe we have declining demand which means the refining capacity they have is too big for the market they're serving. So everybody has to run at low utilization rates which makes a lot of these sectors unprofitable. So the smaller refinery, the least profitable ones basically, are under tremendous economic pressure to shut down. Their refiners are losing money basically.

The United States is slightly different. We have these structural trends and demand which are shifting. If you want where demand and which product is in a different region. At the same time we have the shift in the crude supply with giving certain refiners location advantage and certain refiner location disadvantage.

So what we're seeing here is a shift of utilization rate or construction of refineries toward the ones who are better positioned than others. It's really location issue which has to match the changes in the supply. So you're trying to make sure that your infrastructure is adapting to your growth of supply in the United States.

While in Europe in the overall sector is declining and needs to shrink.

The CHAIRMAN. Alright. Thank you very much.

Let me go to Senator Barrasso.

Senator BARRASSO. Thank you very much, Mr. Chairman. I graciously appreciate the opportunity to hear from these experts today. I want to thank them for sharing their knowledge.

If we're going to grow our economy and get Americans back to work we need to have access to affordable supplies of American energy. We heard that in this room when we sat and visited with Bill Gates not too long ago. To me this means coal, oil, natural gas, uranium and renewable energy.

So I was pleased last week at the State of the Union when the President said that, "This country needs an all out, all of the above strategy that develops every available source of American energy." My concern is that the President's rhetoric doesn't match the poli-

cies that he pursues. Just a week before the State of the Union the President rejected the Keystone XL pipeline.

That's a pipeline that is estimated to create tens of thousands of direct jobs.

Will facilitate oil production in North Dakota and Montana.

Will improve our Nation's energy security.

So it's my hope that Congress will reverse the President's decision soon and get Americans back on track to a more secure and prosperous future.

So, Mr. Burkhard, in your written testimony you specifically talk to the issue of the denial of the permit for the proposed Keystone XL pipeline. You said that that raises the level of uncertainty regarding the long term growth and disposition of major sources of world supply growth including the Canadian oil sands and the American on shore output. I wondered if you could expand on that and specifically with regard to U.S. oil production.

Mr. BURKHARD. Sure. The—Canada over the last decade has become the most important source of foreign oil to the United States by far. The oil sands has been the principle reason for that. So the oil sands are not just an important source of supply to the U.S. market. They've been a major source of global oil supply growth.

In fact, if you look at the oil sands alone, the U.S. imports about as much oil just from the oil sand as we do from Mexico or some other leading suppliers. The denial of the Keystone permit does raise a question about the future pace of growth of oil sands production where it is sent. It is leading many Canadian decision-makers to put more effort into exploring potential export routes to the West Coast of Canada which could open up the Asian oil market.

The more immediate question with regard to the Keystone XL pipeline is there is the U.S. midcontinent is the principle market for oil sands going into the United States. That U.S. midcontinent, the Midwest is nearing a saturation point for the oil sands. There's only so many refineries in the U.S. Midwest. There's only so much crude oil from Canada that they can take.

So to expand the reach of Canadian oil into the U.S. you need a pipeline to the U.S. Gulf Coast which is the largest, most sophisticated refining center in the world. In fact it's been an important source of export growth for the U.S. But this denial does raise an uncertainty about whether that growth will continue as previously thought.

Senator BARRASSO. Thank you.

Dr. Gruenspecht, I'd like to ask you about diesel prices. In my home State of Wyoming this weekend noticed that a gallon of diesel is about a dollar higher than regular unleaded gasoline. It's my understanding that this difference can be attributed in part to a shortage of diesel in the West and the upper plains and a lot of diesel is being shipped to North Dakota to service some of the oil field work being done there.

Can you help me understand why diesel prices are so much higher than gasoline prices right now in Wyoming?

Mr. GRUENSPECHT. Thank you.

I couldn't specifically speak to Wyoming without doing some more research, but I do know that this issue of diesel and gasoline

prices is a broader phenomenon. There may be special circumstances in Wyoming.

In part, because of some of the issues we've been discussing, demand for the petroleum components of gasoline has been depressed by fuel economy gains and the switch toward biofuels. The developing world is driving a lot of the increase, and demand there is much more heavily oriented toward diesel than toward gasoline.

In the world mix of products. The demand growth is in the distillates diesel and heating oils, affecting Senator Shaheen's constituents and me, personally, since I happen to be one of the few people in Washington who uses heating oil. It's really with that set of products, the differential between gasoline and distillates, including heating oil has grown.

Heating oil and diesel prices are both much higher than gasoline. That's driving some of these refinery changes for refineries that produce relatively less of the higher valued distillate products. Which refineries are profitable? Which ones are not, that have been discussed. So a lot of these things do tie together.

Senator BARRASSO. Thank you.

Ambassador Jones, just my final question. We just talked about global issues. I want to ask you about global coal demand.

According to the IEA's world energy outlook you said that the importance of coal in the global energy mix is the highest since 1971. Port says that for all the talk about natural gas and renewables, coal, it says unquestionably won the energy race in the first decade of the 21st century. It explains that globally coal is the most important fuel after oil and that coal is the backbone of global electricity generation alone accounting for 40 percent of electricity output in 2010.

Will you elaborate on the importance of coal to China, India and other developing countries?

Ambassador JONES. Certainly.

First of all one statistic that you didn't mention in your resume which is quite accurate is that in that first decade coal accounted for half of the world's growth in energy. It's truly an impressive performance.

Why was this? This was largely the countries you mentioned China and India, where they have electrified their countries. They have brought electricity service to literally hundreds of millions of people in recent years who never had electricity before. A lot of that electricity was coal fired electricity.

At the same time China, in particular, has been wrestling with the growing pollution in its cities from these coal fired power plants. As a result China is eagerly looking for alternatives. They are looking at renewables and they are looking at natural gas.

But like in any country a lot of decisions that are taken in China on power are taken on economic basis. Coal has been a cheap competitor. That is why it is grown so rapidly.

Whether or not that will continue in the future is another question especially now that China has aggressively decided to markedly expand their use of natural gas. But I do think that and our projections show that coal has a bright future as well.

Senator BARRASSO. Thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Shaheen.

Senator SHAHEEN. Thank you, Mr. Chairman. Thank you to all of our witnesses for being here this morning.

I think every one of you in your comments and projections talked about demand and how that's affecting energy projections for the future. You may be aware that Senator Portman and I have sponsored energy efficiency legislation that addresses a number of sectors of the economy here.

Can you talk about how energy efficiency is incorporated into your projections and what increased use of energy efficiency would do to your future projections?

Dr. Gruenspecht, if you want to begin?

Mr. GRUENSPECHT. Sure.

Energy efficiency obviously plays a very big role in our projections. For instance, our economic growth projection for the next 25 years for the United States is on the order of two and a half percent per year, plus or minus. Our growth in energy use is much lower than that, like half a percent a year. So energy efficiency plays a very important role in that.

I've already indicated that in our reference case projection we build in existing laws and policies including final regulations, but not new ones. In response to a question from the Chairman, I indicated that even one very important, proposed, likely to become final regulation would have a significant impact. There are certainly other policies that might be implemented by policymakers, which you are and I am not, that would also, potentially have, effect.

So, yes, there's a lot of the impact of energy efficiency in our reference case already with existing laws and policies. So, I think I would leave it there.

Senator SHAHEEN. Ambassador Jones.

Ambassador JONES. Yes, we have a variety of scenarios. We have a scenario similar to the EIA scenario that's based on existing policies. We also have a scenario that we the new policy scenario which is based on announced intentions of policies. Then we have a climate scenario that is designed to limit global warming to 2 degrees centigrade.

In all 3 of those scenarios energy efficiency plays a very important role. In fact we believe that, you know, looking at climate change and the need to restrict emissions of carbon dioxide. Basically we think that energy efficiency alone with currently available technologies can lead to at least 50 percent of the emissions reductions we need if we're going to produce or prevent global warming beyond 2 degrees centigrade.

But of course energy efficiency isn't just important for the environment or for climate change. It's important for energy security. It's important for economic success as well because the more efficiently you can use your resources the more competitive you can be in the international market.

The more efficiently you use your resources, the less of them you need. Therefore the less dependent you have to be on imports of foreign energy. So energy efficiency is the one thing that we see that serves all of the objectives that are important to the IEA.

We include it in our models. We include, in the base case scenario, are the current policies. We include a, you know, a relatively small improvement in efficiency, the 2 more aggressive policy scenarios that we see a stronger growth in energy efficiency. That makes a very big difference.

I can't emphasize too much how much important we see energy efficiency for the world's energy future. I want to distinguish this from conservation. Conservation can be important in certain ways, but what I'm talking about is getting the same services for less energy rather than doing with less services.

Senator SHAHEEN. Thank you. I'm not going to ask either of you about job projections since you've pointed out that's not under your purview. But I would just editorially point out that there are a lot of jobs that are also created in energy efficiency.

I don't Mr. Burkhard or Mr. Diwan, if either of you would like to add anything to what's been said?

Mr. BURKHARD. Fuel economy standards, we already mentioned. Those play a tremendous role in oil consumption in the future. We're seeing higher fuel economy standards not just in the U.S. but also Europe and China, other markets.

One more challenging aspect to the energy efficiency efforts are buildings and structures. A car is on the road for maybe 12 years. A building can be around for a hundred years. Encouraging, providing incentives for greater building efficiency could go a long ways.

Senator SHAHEEN. Yes, Mr. Diwan.

Let me ask a very quick final question for Dr. Gruenspecht since you mentioned heating oil in the Northeast. I, personally, am very concerned about PAD-1, as you pointed out. You talked about the refineries that are down on the East Coast.

Can you talk about the correlation between that, if there is any and what we're seeing increased costs for home heating oil in the Northeast?

Mr. GRUENSPECHT. Thank you.

I don't think there's really much correlation. I described the broader picture of gasoline.

Senator SHAHEEN. Right.

Mr. GRUENSPECHT. Distillate and you know, as Senator Barrasso pointed out, the distillate prices in Wyoming were very high. So I don't think the refinery issue this winter so far has been much of the issue. We do a winter fuels outlook at the beginning of each winter, I think in October, and we did flag the heating bills as being for oil users as being pretty significant.

Senator SHAHEEN. Higher.

Mr. GRUENSPECHT. This upcoming winter.

Senator SHAHEEN. Right.

Mr. GRUENSPECHT. We've gotten a little bit of a break on the weather, which has helped everybody. The projected expenditure increases have come down a little bit.

But I think we're still looking at the average heating oil user. It varies a lot depending on what temperature you set the thermostat, where you are, how well your house is insulated, going back to energy efficiency. But it's still looking like \$2,400, \$2,300, as the

winter fuel bills for heating oil households. That's much higher than households using other fuels.

Senator SHAHEEN. Yes. Thank you. Very much higher.

Thank you, Mr. Chairman.

The CHAIRMAN. Senator Portman.

Senator PORTMAN. Thank you, Mr. Chairman. I really appreciated the testimony. I got a chance to read through some of it while I was away and ask the question that I missed earlier.

This is actually, I think, a lot of good news today that we're hearing in terms of additional energy supplies. Particularly heartened by the comments of Ambassador Jones and Mr. Burkhard about efficiency because it's an issue where, I think, we can make huge progress. I'm one of those.

I won't necessarily associate my colleague and co-sponsor with this. But, you know, we need to produce more. Also use less. Those are not inconsistent.

But my colleague and I do work very hard on trying to promote efficiency. As Mr. Burkhard mentioned, a lot of this has to do with buildings. Our focus is really manufacturing efficiency and buildings. It's time to deploy, as Ambassador Jones said, some existing technologies.

So we're not as much focused on even the innovative side of this. Although we certainly want to encourage that as simply taking best practices and the United States, of course, has tremendous potential here to even catch up with some other industrialized economies namely Japan and some of the European countries. We can be, as Ambassador Jones said, more economically efficient and therefore, help our economy by being more competitive and also, of course, as you said, we can use fewer imports by doing so.

But we also need to produce more. Again, I think, those 2 are not only not inconsistent, but I think they both help to create jobs and economic activity. But again, I found looking at your testimony some very good news.

Mr. Burkhard, you talked about the fact that IHS Global has now said that shale gas production has supported more than 600,000 jobs in 2010. They project 870,000 jobs by 2015. I think that's low just based on what's happening in Ohio where we have another projection showing another 200,000 jobs from Utica alone during that time period which would account for almost all that growth.

So I think there's a lot of good news here.

What is holding back the natural gas production and distribution, Mr. Burkhard?

Mr. BURKHARD. The—on the natural gas side prices are quite low because of this revolution and shale gas production. But what we're seeing is more companies shift toward liquids or producing oil. One of the factors that's influencing the pace of investment is that the rising costs, finding the right people, the right equipment is not a limitless supply.

There's, in fact, a missing generation of folks in the petroleum industry because from about 1986 to earlier this decade oil prices were low. The industry was consolidating. There weren't many people entering the industry at that time. As prices have risen, oil prices have risen and activity has picked up, particularly in this

country, there's been a great deal of pressure in finding the right people and getting the right equipment to the right places.

So that's a significant challenge.

Senator PORTMAN. In some of the testimony this morning, it's interesting you all talked about the fact that because there is both wet gas and oil in some of the shale finds that that has encouraged people to go ahead and explore and extract even though the natural gas prices are relatively low. Will that continue?

I think of Marcellus where maybe there's less of the wet gas or oil. But Utica maybe there's more. Will that encourage more development in some of those finds?

Yes, Mr. Diwan.

Mr. DIWAN. Yes. I mean when you think about the U.S. gas market as an island, so if we're in oversupply which we are right now and prices are low. On the oil side we don't have the same issue. Oil prices are really global and at the present prices and the present taxation system in the United States, these barrels are very profitable.

So we will see a continued development of liquid plays. I think in the next 2 to 5 years we'll have 3 or 4 new plays emerging just because of that price differential.

Senator PORTMAN. Mr. Burkhard, when I asked you about what might hold it back you talked about skills, personnel and just resources devoted to oil maybe taking away from natural gas, the price of natural gas. You didn't mention infrastructure. Although in your testimony you talked about that.

Can you talk a little about what you see as some of the limitations on natural gas use and distribution because of our infrastructure challenges?

Mr. BURKHARD. One of the new, really exciting developments in energy is the Northeast or from Ohio, Pennsylvania, that area becoming a significant gas producer and possibly oil producer as well. So there weren't—the U.S. pipeline system wasn't set up to ship gas away from those areas it was shipping gas to those areas. So the challenge now is forming or getting the right pipelines to the right places so that gas and liquids can be economically developed.

What we're seeing is this great revival on the supply side. This great revival has showed, illustrated, that our infrastructure system, our pipeline system whether we're talking about the U.S. Midwest or the U.S. Northeast, has yet to catch up with this great revival.

Senator PORTMAN. You would add Keystone to that as well in terms of—as Mr. Diwan said earlier there still is adequate capacity now but soon there won't be. That would limit as well some of the developments of our North American resources.

Mr. BURKHARD. There is enough cross border capacity for the next few years, probably, maybe, until around 2019. But the problem in the short term, say in the next 1 to 2 years, excuse me, is saturation of the Midwest refining market. There's only so much oil that refiners in the Midwest can take from Canada. So that's expanding the reach of Canadian oil to other markets in the U.S., namely the Gulf Coast.

Senator PORTMAN. Listen, great testimony. I thank Dr. Gruenspecht and all of you. My time is up. But we appreciate your continuing to give this committee good information.

The CHAIRMAN. Senator Landrieu.

Senator LANDRIEU. Thank you, Mr. Chairman. I really appreciate the testimony. As usual it's very, very helpful as we try to direct our policies to respond to some of the changing reality.

I'd like to submit first for the record a report that just came out from our greater New Orleans ink that talks about the hidden job loss along the Gulf Coast. A story that really, in my view, hasn't been told because the unemployment numbers after the Macondo spill has stayed relatively flat, employment and unemployment. But it's because of the shift from South Louisiana to North Louisiana with the shale plays.

But in South Louisiana we still are experiencing tremendous downturn because of the slow permitting process. The deep water plays are significant. But the shallow water drillers have really been hurt.

According, Mr. Chairman, to this report which is really the hidden story of the Macondo spill and the, I thought, inappropriate moratorium put down.

Forty-one percent of the respondents said that they are not currently making a profit. These are the small oil and gas, independent, marine operators.

Seventy percent said they have dipped into their cash reserves. So they're not laying off their employees but at great hardship to these small and independent businesses that are servicing an industry that the top line looks good but there's a lot underneath.

So I'd like to submit that for the record.

The CHAIRMAN. We'll be glad to include that.

Senator LANDRIEU. Second in the report, Supply Rising in the West, Growth at Risk in Iraq, I think this is—the page is not numbered. But this is in your report. You all say that we have penciled in an end to output losses in the Gulf of Mexico after the Macondo spill. It's in the paragraph where you talk about the U.S. will lead the growth in liquids, etcetera.

Can you help us understand what the output losses in the Gulf were after the Macondo spill?

Yes?

Mr. GRUENSPECHT. Yes, I'm not sure that the report you're reading from is from EIA, but maybe it is.

The CHAIRMAN. I believe it's Mr. Diwan's report.

Senator LANDRIEU. I'm sorry Mr. Diwan's report. I'm sorry.

Mr. Diwan.

Mr. GRUENSPECHT. Yes. I could help you with your question anyway.

Senator LANDRIEU. But let's get to him and then we'll get to you.

Thank you.

Mr. DIWAN. I mean, the delay in permitting has had an impact on our projection for the deep water output. With the restart of the permitting process now we do not see the decline anymore. We're seeing a flattening before a rise further out on the horizons.

So we passed the bottom of that forecast.

Senator LANDRIEU. But I will say as the representative from the state that has the most, besides Texas, of offshore drilling, it's been a very painful 3 years. I know that Senator Portman talked about producing more. We have got to get the Gulf back up and operating and producing. Not only is it the home to tremendous opportunities for oil and gas, both deep and shallow. But the refining capacity for the country is in large measure or a large part of it in the pipeline system which is much more robust than other pipeline systems there.

So getting the Gulf back up and operating, Mr. Chairman and Ranking Member, is important. It's going to remain a priority.

Let me ask any of you to further discuss the significant increase in liquid fuel production because while climate is important and the environment is important, I'm really and my constituents are very concerned about the economic vitality of the United States going forward. The President talked about building an economy to last. People are very interested in making America more energy secure.

You talked about the increase, substantial increase, in liquid fuels. Could someone describe in a little bit more detail? Are we talking about oil? Are we talking about biofuels? Where is the growth potential there?

What about new fuels created from other agricultural or other scientific processes like algae, etcetera? Does anybody want to comment on that? Because the combination of increasing our liquid fuel production and decreasing our use through efficiencies in automobiles is extremely exciting because I think, if I'm hearing what you're saying, that we could have a major impact on not just job creation but on the economic security of the United States.

Am I reading too much into the possibilities here?

Starting with you, Mr. Diwan.

Mr. DIWAN. Yes, actually I think you are not reading enough in what we're saying. We all believe that actually the production of crude oil and natural gas liquid in the United States will grow tremendously over the next 10 years. The technology is there now. The resources are there. Industry is investing to bring them up.

So we are really talking about a major revival of the U.S. oil and gas industry. I don't think we really disagree on the magnitude even. So we all believe it's really the biggest thing happening in the oil and gas industry going forward.

The investments are available. The funds are available. We have, as Jim described, issues in finding enough people actually and costs are rising because of that.

That development, I think, limit also the growth of the other fuels outside of oil and natural gas liquids because we have such an abundance now. So much to invest into that area that, I think, we all have limited growth in other fuels. I'll let—

Senator LANDRIEU. We call them drop in fuels, you know, alternative fuels that you can drop in to the pipeline without having to redo all the pipelines. What are our most significant opportunities in drop in fuels?

Go ahead.

Mr. GRUENSPECHT. In the Energy Independence and Security Act of 2007, Congress enacted and the President signed a very ambi-

tious mandate for increased use of biofuels. Right from the start it looked pretty challenging for us.

The cellulosic biofuels, in particular, are supposed to go to 15 billion gallons by 2022. We've always been fairly skeptical that you could actually get there. The passage of time has not ameliorated that skepticism.

We do think there was a vision, perhaps in some people's minds that a lot of that would be cellulosic ethanol, and that a lot of it would be a drop in. What we call, biomass to liquids, a diesel type fuel that unlike ethanol would go into the normal stream of commerce, if you will, as interchangeable with regular diesel fuel.

Senator LANDRIEU. That doesn't require as much of a subsidy.

Anything from you, Ambassador Jones?

Thank you, Mr. Chairman.

Ambassador JONES. Yes, first of all I agree with all the comments that have been made.

In terms of biofuels worldwide, all types of biofuels, we, in our World Energy Outlook, we saw them tripling between now and 2035. So that's probably a little bit more than 3 percent per year worldwide. In the United States they're fairly aggressive policies, although they fluctuate.

Again I agree that cellulosic biofuels are going to be a long time coming. Ethanol is going to be the main source of biofuel I think for some time, particularly sugar cane ethanol which the Brazilians are trying to spread their experience around the world in tropical climates. But other crops can also of course be turned into that.

Senator LANDRIEU. The one other thing I mentioned that's significant. The country first, Mr. Chairman and Ranking Member, issued its first permit to build an export facility for natural gas, the Chenier Company received its permit. I helped to push that and proud of it.

I know there's a debate about whether we should keep the natural gas as an island. The problem is if you don't create a market for it you get prices that are as low as they are today which is a disincentive to production. So you've got to figure out the right price point where you can get people to invest in natural gas which is a cleaner fuel. But also, you know, so opening up that export, I think, is the right thing to do.

I just want you all to say yes or no. Do you agree with that or not opening up exports for gas?

Yes or no?

Mr. GRUENSPECHT. I don't think I'm allowed to have a position on that.

Senator LANDRIEU. Ambassador Jones?

Ambassador JONES. Yes, we believe in the trade. The trade should be driven by the market, in the market, if there's market demand for it. We don't think there should be export restrictions.

Senator LANDRIEU. Mr. Burkhard.

Mr. BURKHARD. Developments that foster and enhance global trade of energy makes for a more robust system.

Senator LANDRIEU. Mr. Diwan?

Mr. DIWAN. I agree with them.

Senator LANDRIEU. Thank you.

The CHAIRMAN. Senator Murkowski, did you have additional questions?

Senator MURKOWSKI. I do, Mr. Chairman.

A couple follow ups, one on Iran sanctions and then the second on the issue of reserves that I mentioned in my opening.

So let me start with the sanctions. This is directed to you, Mr. Diwan, dealing with the potential impact of additional sanctions there. We know that the Iranian—the Europeans have agreed in principle to ban the imports, but reading from your testimony it seems that neither Italy nor Greece will comply at least to the extent that would have been expected.

Given your point that you've got India, you've got South Korea, Turkey, all increasing imports combined with what we know about the strong demand from China. What do you think the practical effects of these new sanctions will be?

Mr. DIWAN. Italy, Spain and Greece will have to comply with EU sanctions by July 1st. The question is would they do much between now and then to try to diversify their source of supply. They have long term contracts. I think it's not very easy unless the Iranians decide to embargo them.

The problems are specific for each country which refinery gets what from where and there's long term commercial relations. But it's likely that over the course of year, by the end of the year that will not be allowed or they won't be able to import as much as they are right now. So we believe that they will have to decrease their supply by around 400,000 barrels per day combined.

The question is are there other countries willing to pick up that slack from Iran and in a way just shift the barrels, as Ambassador Jones has said. When you look at the countries which are really potential clients here, Turkey can increase a little bit. The question is how much it will face the U.S. side of the sanctions.

It's unlikely that any OECD in Asia, country in Asia, will take more Iranian crude. The question is really how much India and China are willing to become more dependent on Iran as a source of supply. We don't believe actually that China will be very aggressive in increasing its imports of Iranian barrels because it will make them more dependent and more vulnerable to a potential disruption of Iranian barrels.

They have somehow indicated that they're likely to keep the percentage of imports from Iran stable which is around 10 percent of their crude imports. Their crude imports are rising. So that 10 percent means a little bit more barrels than the year before but it is not significant.

The question is really India. But the volume we're talking about, 4 to 5 hundred thousand barrels per day from Iran which do not have a place to go in Europe. It's unlikely that India can absorb that much.

So in a way Iran is—will have difficulty to be able to replace these markets. We believe it's more likely actually they will have to shut down some production or at least have floating storage for some of that production before they shut it down.

Senator MURKOWSKI. Then following on that can you discuss the ways that Iran could possibly circumvent the current sanctions both in terms of financial payments or physical delivery then?

Mr. DIWAN. They need a client who is willing to circumvent the financial sanction. The way to do it is to deposit local currencies in the local bank that the Iranians can draw from to buy whatever they need to import back into Iran. I think they will have real difficulty to go through the international financial system.

So it limits, again, here, which countries have the capability and the ability to do that.

Senator MURKOWSKI. So really is going to be incumbent on all those that are adhering to the sanctions, some pretty robust monitoring and some enforcement there, I would imagine.

Dr. Gruenspecht, I wanted to follow up with regards to the EIA's lower natural gas reserve estimates indicated that they've dropped precipitously 40 percent, as I recall. Do you expect that this lowering of the estimates may possibly discourage further exploration? Is this going to have any impact one way or another?

Mr. GRUENSPECHT. I would say not. Whether the U.S. has 100 years of total recoverable resource at current rates or 90 years of total recoverable resources estimated at current rates, I just don't think it has much of an effect. I think the thing that would affect development would be the view of companies on the ground as to how much it costs them to drill a well and what they can recover by drilling the well and the price.

So they care about the quantity they can recover by drilling a well, what it costs them to drill a well and what they think the price is going to be. That's really what they're focused on. Whether we have 90 years of total recoverable resource or 100 years total recoverable resource.

Senator MURKOWSKI. I would agree with that, 40 percent reduction is noticeable. But as you put it in those contexts.

Let me ask then how much of the EIA reserve estimate then is actually driven by the production data that's out there?

Mr. GRUENSPECHT. Again I would say that USGS is the primary agency in the U.S. Government that does resource estimates. We do the work on reserves primarily. Resources is a larger concept.

The USGS had not done a Marcellus estimate in a long time. They had a very, what we considered to be, a very low estimate, one that we couldn't use. So we developed our own.

Mr. GRUENSPECHT. Then after we did that, USGS came out with an updated Marcellus estimate which was the 84 trillion cubic feet compared to their prior estimate of 2 trillion cubic feet. The 84 trillion cubic feet was significantly lower than the number that we had developed internally. We obviously said that when they came out we would update our work based on the USGS work. We did try to do that.

Senator MURKOWSKI. So do you think that you will revise the estimate again?

Mr. GRUENSPECHT. I think that this is a really tough area. I think there's too much emphasis really put on that number, no matter whose number it is. I think that as we gain more and more experience with actual drilling the numbers will always tend to evolve on total recoverable resource.

Again, I don't think it's that material for the 25 year horizon that we have been looking at in our projections, long term, that the IEA looks at. In fact we have more production and lower natural gas

prices in this outlook than we had in the previous one. That really reflects the lowered drilling costs and the well productivity.

Senator MURKOWSKI. I think this is an important part of what it is that we're talking about and understanding what's going on. Again, the President's State of the Union that he gave last week, he again repeats the fact that—or his—I shouldn't say it's a fact, the statement that this country only has 2 percent of the world's oil. When we're talking about reserves verses resources and recoverable, we all—you all know at this table that the number can be all over the board here.

It's how we define it. I think sometimes it's a pretty loose definition that would lead people in this country to believe that we really don't have much.

Senator MURKOWSKI. Of a recoverable resource. So it's important that we use the right terminology and try to be as accurate as we can recognizing that we're dealing with a very fluid assessment again as our technologies and our capabilities expand.

Mr. Chairman, that's all that I have. Thank you.

The CHAIRMAN. Thank you.

Let me ask one other line of question.

Dr. Gruenspecht, in your testimony you, in discussing the world or the international energy outlook, you say renewable energy is projected to be the fastest growing source of primary energy over the next 25 years. The renewable share of total energy use increases, in your projection, from 10 percent in 2008 to 15 percent in 2035.

Do you also have in your report an analysis of what those trends would be with regard to renewable energy in the United States?

Mr. GRUENSPECHT. Yes, we have, particularly in our annual energy outlook, there's a lot of information on renewable energy. Again, it's very fast growing for two reasons.

One, in the transportation sector you have the mandates for biofuels, which even though we don't believe that the target at 2022 would actually be met, are certainly driving renewables in that sector.

In the electricity sector the share of generation from renewables, I think, grows from 10 percent of generation to 16 percent of generation. So that's a pretty big increase.

We have renewables being pretty fast growing in the United States. In the electricity side it's mostly driven by the state renewable portfolio standards. There's also some interaction between the transportation side and the electricity side because the plants that produce cellulosic biofuels, there will be some, and those plants will throw off some extra electricity.

It's a very interesting story.

The CHAIRMAN. Ambassador Jones, is the analysis that your agency has made consistent with this as far as renewable energy being the fastest growing source of primary energy over the next 25 years?

Ambassador JONES. It's certainly growing very rapidly. Yes.

I was just checking my testimony. According to World Energy Outlook, the share of non-hydro renewables primarily wind and solar in power generation rises from 3 percent in 2009 to 15 per-

cent in 2035. Hydro, of course, which is a major source of power generation, maintains its share at 15 percent.

So overall we're saying all renewables will be about 30 percent of world power generation by 2035.

The CHAIRMAN. OK.

Alright. I think this has all been very useful testimony. We appreciate you all being here. We will try to stay in touch with you as these trends change.

Thank you very much.

[Whereupon, at 11:45 a.m., the hearing was adjourned.]

APPENDIX

RESPONSES TO ADDITIONAL QUESTIONS

RESPONSES OF RICHARD H. JONES TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. Your testimony indicated that a “prolonged” stoppage for Hormuz is a low likelihood. Is a temporary stoppage, by inference, much higher of a likelihood?

Answer. This statement was a reference to comments made by political-military analysts that were reported extensively in the press. The International Energy Agency (IEA) was created to monitor developments in energy markets and respond to physical disruptions in oil supply. However, the Agency does not generally analyze the risk of a disruption, which would require geopolitical and military expertise beyond the capabilities of our market analysts.

Question 2. While some countries are looking to the potential phase-out of nuclear power, others, like China and India, are moving forward with new nuclear power plants. Do you see more interest internationally for large-scale reactors, or small modular reactors? For those countries that might phase-out nuclear, is it opposition to all nuclear or just the larger, more visible power plants?

Answer. The only real life deployment of small and medium modular reactors so far has been in the Russian arctic, which has some unusual characteristics: It is not connected to the main Russian transmission grid and extreme conditions make conventional energy supply very difficult and expensive. The vast majority of nuclear investment in the countries actively pursuing nuclear power— China, India, South Korea and even in Russia— is in interconnected central regions and focuses on GW scale II+ and III. generation units. In fact, the average size of plants under construction is considerably larger than the average size of the existing fleet globally. The major nuclear investors have massive and growing demand for baseload power as well as national transmission systems that can incorporate such large nuclear units.

The main social and political concern in countries that have turned away from nuclear power is nuclear safety risk and nuclear waste management. These are not particularly related to reactor size. Even in countries that favour new nuclear investment such as the United Kingdom, it is considerably easier to gain licensing consent for new units on existing sites than for greenfield nuclear plant. This also creates incentives for larger units.

On the other hand, even in a supportive political framework, the capital intensity and unusual financial risk profile is a major obstacle for private investment in nuclear plants. The initial capital investment can exceed \$10 billion which is a huge burden on the balance sheet of even the largest energy companies. Project management issues usually preclude EPC (engineering, procurement, construction) financing. Consequently, if smaller scale modular reactors became commercially available (they are currently not, the Russian ones are prototypes derived from submarine reactor designs of the Russian navy) that has the potential to relieve one of the major financial rather than political barriers to nuclear investment.

Question 3. EIA reports consistently show little to no growth in the hydropower sector. In 2008, the EIA testified before Congress that the Annual Energy Outlook (AEO) forecasts less than 1 GW of new hydropower capacity to be added by 2030. In the 2011 AEO, hydropower is not even included in the discussion with the forecasts for other renewable technologies and the report shows an annual growth rate of only 0.1 percent in net summer capacity through 2035.

Do you believe that the EIA modeling is accurately reflecting the hydropower sector? In 2011 alone, FERC received approximately 610 MW of conventional hydropower applications for original licenses, exemptions and also capacity additions at existing facilities. In my state of Alaska alone, work is proceeding on a 600+ MW new hydropower project. And these statistics do not even include pumped storage, which would double or triple these numbers.

Answer. The IEA World Energy Outlook 2011 (WEO) has three main scenarios: the Current Policies Scenario (CPS), the New Policies Scenario (NPS) and the 450 Scenario (450). In each of these scenarios, by 2035 the WEO sees hydro output growing from 3252 TWh in 2009: to 5144 TWh (CPS), 5518 TWh (NPS) or 6052 TWh (450) at a global level. For the USA, the output is 276 TWh (2009), and for 2035 the expected numbers are 303 TWh (CPS), 306 TWh (NPS) and 310 TWh (450).

By 2035, world hydro generating capacities would increase from 1007 GW (2009) to 1509 GW (CPS), 1629 GW (NPS), or 1803 GW (450). Hydro power capacities in the USA would increase from 101 GW (2009) to 113 GW (CPS), 114 GW (NPS) or 115 GW (450).

The IEA is currently in the midst of preparing an even deeper analysis than appears in the WEO. While full results of this analysis are not yet ready, we can already say that we expect significantly stronger growth for pumped-hydro power plants (providing storage, not additional energy) than for traditional hydro power.

Question 3b. How does the EIA reporting square with these on-the-ground numbers? Is the EIA re-examining the NEMS model and other data to refine and improve its hydro forecasts? And if not, why not?

Answer. The IEA cannot speak on behalf of the US Energy Information Administration (EIA), its models and ongoing work. We believe the EIA could answer this question more appropriately.

RESPONSES OF ROGER DIWAN TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. Iran: I am really struck by something in your testimony, dealing with the potential impact of additional sanctions on Iran. We know that the Europeans have agreed in principal to ban imports of Iranian crude, but from reading your testimony, it seems that both Italy and Greece will find it hard to comply. Given your point that India, South Korea and Turkey are all increasing imports combined with what we know about strong Chinese demand for Iranian oil, what will be the practical effect of these new sanctions?

Question 1a. How will the new European sanctions affect oil prices?

Answer. In effect, the imposition of the EU and US financial sanctions were behind the sharp increase in oil prices in February and March. There was a strong fear that oil market will be disrupted by the embargo and large volumes of oil will be missed during the summer months when oil demand is strong. We expect that the combined US/EU sanctions will cause 700-800 mb/d of Iranian crude to be taken off the market this year. Since sanctions and potential retaliations are placing a large portion of the world's available liquids supply into doubt, precautionary stock building by Asian importers has amplifying the effect on prices and so far has largely negated Saudi Arabia's efforts to increase market liquidity. Refining turnaround in the second quarter, and high OPEC production is filling storage fast and oil markets do not show real current shortage of worldwide crude. Would that be the case in the third quarter when Iranian barrels are lost? Would the drop off anticipated and mitigated in the second quarter?

Iranian production is quickly moving down. We estimate March output at 3.29 mmb/d, down from 3.49 mmb/d in January. With Iran needing to use its own tanker fleet to move crude to customers, additional tankers would have to be chartered for use in floating storage. However, toughened restrictions on tanker insurance by the European Union have left fewer (if any) tanker owners willing to engage in this business. As a result, we anticipate that Iran's production will simply be shut-in. The bulk of the losses (roughly 550 mb/d) is attributed to the EU embargo, but cuts have or will be made by Japan, South Korea, Turkey and South Africa.

Question 1b. What do you believe is the true Saudi spare capacity, and to the extent your answer diverges from EIA's or IEA's, please describe what deficiencies you see in those analyses.

Answer. OPEC production remains at elevated levels as the GCC countries provide oil markets with extra liquidity at a time when more countries began the process of backing out Iranian import volumes in response to the EU embargo and US sanctions. We estimate show OPEC March output at 31.2 mmb/d, the highest level since the summer of 2008, led by a boost in Saudi production now reaching 9.9 million b/d.

The Saudis are concerned about high prices destroying demand and ultimately cutting the need for their main export commodity. As such, Saudi Aramco will do everything it can to keep markets supplied (and we do not dispute the company's stated 12.5 mmb/d of capacity). But as spare capacity continues to decline over the summer (both because of its replacement of Iranian supplies and Saudi Arabia's own summer requirements for power generation), market concern over a narrowing

global supply cushion will become more acute. Indeed, unused Saudi production capacity has been trending downward since the Libyan outage, from a comfortable 4.0 mmb/d to around 2.5 mmb/d today. That is not reassuring in a 90 mmb/d global oil market.

However, one risk that cannot be mitigated is the perception of dwindling spare capacity: with every additional barrel of crude that Saudi Arabia will produce to replace missing Iranian barrels, spare capacity in the Kingdom declines. This perversely heightens concerns about future supply availability and contributes to the risk premium currently embedded in prices. That element of the price premium is likely to stay alive even if no disruption in physical markets is felt on July 1st.

Question 2. You mention in your testimony that “non-OPEC supply growth continued to disappoint in 2011.” How does this reconcile with the major growth we have seen in U.S. onshore production of both oil & gas, particularly from shale plays?

Answer. The major growth occurring in the US onshore production of oil & gas has been counterbalanced by decreases in production in the rest of non-OPEC producing countries as well as disruptions in supply elsewhere. Decreases in production from South Sudan, Syria, the North Sea, as well as minor decreases in Colombia, Russia, and China overshadowed the North American growth in 2011. The simultaneous supply disruptions in Yemen, Syria, and South Sudan and Sudan while fears of the impact of the EU embargo on Iranian oil production stated to start on July 1st has had a real effect on crude markets. This effect is right now muted as oil markets as well supplied by OPEC, and demand for crude are at its seasonal nadir. However, a close look at the data shows that the Sudanese conflict has removed over 200,000 b/d in the last three months, and the cumulative loss is now over 600,000 b/d and expected to last through 2012.

Question 3. Your testimony indicates that the U.S. will lead the growth in global liquids in 2012, owing to a rise in shale oil output from the Bakken and the Eagle Ford plays. Please discuss the several other shale areas that are just starting to be drilled, and what you expect in terms of production from those new plays?

Will these new supplies coming have an impact on the amount of oil that we import from OPEC countries?

You mentioned that in September, gas liquids production reached an all-time high. Do You expect that this level of production is a trend that will continue?

Answer. Within the next ten years, crude production is expected to grow significantly, carried mainly by the Bakken and Eagle Ford plays. Moreover, other plays will be coming online or be further developed to add to the growth. These plays include mainly the revival of the Permian basin, the Utica, the Niobrara and the Monterey. The chart below shows our expectations for production from shale oil in the next decade.

The new domestic supplies will have an effect on imports of OPEC crude. By 2020, oil imports will be just 40% of demand, and when including “Safe” Canadian crude imports, dependence outside North America will drop to below 25%. However crude import demand from OPEC and other countries will continue to a certain extent, so while volume risk from such countries is diminished, price risk remains. The following graph* shows North America’s net crude imports throughout the next decade.

The increased production of gas liquids is expected to carry on throughout the decade. The upward trend is likely to be maintained and gas liquid production will increase steadily as a result of growing production from the Marcellus, the Utica and the Eagle Ford. The following graph shows our expectations for gas liquids trends.

Question 4. You also mention that Canada will be a leader for liquids growth in 2012. Could you discuss the effect of the Keystone XL pipeline delay and/or rejection relative to this projection? Please explain whether you believe this will have an impact on Canadian production, or if you expect the Canadians to proceed “full steam ahead” without it.

Answer. Canadian oil production will be rising fast in the next decade. There has been jockeying between the different pipeline companies to ensure that they gain market share as more oil would need to move to the US. Existing pipeline capacity will allow to carry all the incremental Canadian crude production until 2016 or even 2017, and it would mostly benefit the incumbent companies that have already the infrastructure in place. We will need more pipeline capacity by 2017, and a number of projects are competing for signing up volumes to transport. Keystone XL is one of them. This project had the advantage of trying to resolve two bottlenecks (Bakken and Canada) in one project, but the same result could be achieved with other options, including by separating the two issues: a pipeline from the Bakken through the Midcontinent, and added capacity from Canada to the US.

*All graphs have been retained in committee files.

We don't believe that lack of pipeline capacity at this stage if slowing Canadian developments. A bigger danger down the road would be the sheer amount of US crude production filling the US system and limiting the room for Canadian production in US refineries if neither countries can export crude out of the Gulf Coast.

Question 5. Your testimony indicates that Iraq's production levels will remain one of the key supply uncertainties over the next year and a half, and pointed to deteriorating security conditions on the ground. Can you explain what factors are driving this and to what extent is Iran playing a role?

Answer. Prospects for rising Iraqi oil production are being undermined by a series of challenges which are hampering operators' ability to achieve contracted output targets. On the political front, continued infighting between rival factions and a lack of coherent institutional framework has severely hampered effective, strategic decision-making. It is also delaying the development of critical onshore infrastructure which PFC Energy sees as the key determinant of production levels in the future. Bottlenecks around critical pumping stations have already effectively capped production in southern Iraq, with an estimated 100-200 mb/d shut in at times in 2011; this figure will rise as first licensing round investors ramp up production in the short term. But PFC Energy sees ongoing risks to production from mid-stream related problems over the next decade, as infrastructure expansion fails to keep pace with proposed production increases due to a lack of government institutional capacity, delays of tenders and awards, and uncertainty surrounding government funding for pipeline and export plans.

On the level of security on the ground, Iraq has been witnessing increased risks, stemming mainly from Prime Minister Maliki's stances. His move against senior Iraqiyya faction leaders is indicative of his determination to consolidate his power now that US troops have left Iraq. Maliki's gambit is extremely high risk, and offers little room for compromise should he fail to consolidate his power at the expense of his rivals. He has betrayed what little trust remained between the different factions. Maliki's position will make him more dependent on the Islamist Shia Iraqi National Alliance—especially the Sadrists—and on Iran. He is unlikely to make a deal with the Kurds, largely because their agendas on federalism are incompatible. The risk of protracted communal violence has grown significantly, not just between the Sunnis and Shia. If the Kurds overplay their hand, especially by seeking to move aggressively in disputed territories, they could open up an additional front. Oil and gas infrastructure in the south will be a tempting target for Maliki's foes.

Question 6. Given recent focus on the potential impact of the Iranians closing the Strait of Hormuz, could Iran's activities in Iraq, particularly as relates to Basra, have a greater impact on global supplies?

Answer. Iran, through some of its proxy could impact Iraqi production, and if sustained, these disruptions can certainly impact prices as Saudi Spare capacity is running thin.

Question 7. In your testimony, you indicate that inadequate pipeline capacity combined with further reductions in refining capacity planned for the East Coast will lead to higher gasoline prices over the next year. Can you summarize key drivers causing these refinery closures and share your view of how both of these factors, particularly with reference to Keystone XL delay and/or rejection, might impact gasoline prices over the near to medium term?

Answer. In 4Q11, two Philadelphia-area refineries, Sunoco's Marcus Hook and ConocoPhillips' Trainer facilities, were indefinitely idled. A third refinery, Hovensa, located in the US Virgin Islands but a major supplier to the East Coast, was shuttered in early-2012. The closure of these three refineries, which produced more than 260 mb/d of motor gasoline last year, was blamed for the sharp rise in Mid-Atlantic gasoline prices this year. In reality, despite the closure of such a large portion of regional refining capacity (these three facilities collectively accounted for nearly 40% of the gasoline produced in PADD 1), Mid-Atlantic gasoline prices have not meaningfully deviated from those in the rest of the Atlantic Basin.

The limited impact on regional gasoline prices demonstrates that external supplies typically undercut local PADD 1 refinery production. If these shuttered facilities were more competitive, the loss of their supply would have caused a spike in East Coast gasoline spot prices and a divergence from Gulf Coast and Midwest markets. However, New York Harbor prices are actually set more by supply from the Gulf Coast and (to a lesser extent) European imports. PADD 3 refineries, which supplied some 58% of East Coast gasoline demand, are more sophisticated and benefit from lower operating costs, greater economies of scale, and cheaper crude inputs. Put another way, the NYH gasoline price is often cheaper than the breakeven price for many East Coast refineries, which is why these facilities are being shuttered in the first place. It is also why the loss of these locally-produced volumes has not influenced the NYH price so far. Any incremental volumes needed to fill the supply

gap, whether sourced from PADD 3 or Europe, have a lower price than the erstwhile production from these three shuttered refineries.

Of course, supply/demand factors have also contributed to the lack of relative movement in the NYH gasoline price. The closing of these three refineries has coincided with the seasonal low point in East Coast (and the broader Atlantic Basin) gasoline demand. PADD 1 consumption during the first nine months of 2011 averaged some 3,150 mb/d; since then, demand has averaged closer to 3,030, including less than 3,000 mb/d in January 2012. This demand destruction alone accounts for a large chunk of the 260 mb/d in “lost” supply from Trainer, Marcus Hook, and Hovensa. At the same time, PBF Energy’s Delaware City refinery, closed since late-2009, resumed normal operations in October 2011, adding as much as 90 mb/d to the East Coast gasoline supply. Thus, we believe that the “extra” volume of gasoline that must now be sourced externally (whether from PADD 3 or abroad) only amounts to around 2% of total regional demand, certainly not enough to change the price setting dynamics of PADD1.

The adoption or rejection of the Keystone XL pipeline will have no impact whatsoever on gasoline prices on the east coast in the next few years. Many more factors will impact prices, but this one certainly not.

Question 8. EIA reports consistently show little to no growth in the hydropower sector. In 2008, the EIA testified before Congress that the Annual Energy Outlook (AEO) forecasts less than 1 GW of new hydropower capacity to be added by 2030. In the 2011 AEO, hydropower is not even included in the discussion with the forecasts for other renewable technologies and the report shows an annual growth rate of only 0.1 percent in net summer capacity through 2035.

a. Do you believe that the EIA modeling is accurately reflecting the hydropower sector? In 2011 alone, FERC received approximately 610 MW of conventional hydropower applications for original licenses, exemptions and also capacity additions at existing facilities. In my state of Alaska alone, work is proceeding on a 600+ MW new hydropower project. And these statistics do not even include pumped storage, which would double or triple these numbers.

b. How does the EIA reporting square with these on-the-ground numbers? Is the EIA re-examining the NEMS model and other data to refine and improve its hydro forecasts? And if not, why not?

Answer. I am not qualified to answer this question since I am not an expert on the Hydropower sector.

Question 9. EIA reports consistently show little to no growth in the hydropower sector. In 2008, the EIA testified before Congress that the Annual Energy Outlook (AEO) forecasts less than 1 GW of new hydropower capacity to be added by 2030. In the 2011 AEO, hydropower is not even included in the discussion with the forecasts for other renewable technologies and the report shows an annual growth rate of only 0.1 percent in net summer capacity through 2035. a. Do you believe that the EIA modeling is accurately reflecting the hydropower sector? In 2011 alone, FERC received approximately 610 MW of conventional hydropower applications for original licenses, exemptions and also capacity additions at existing facilities. In my state of Alaska alone, work is proceeding on a 600+ MW new hydropower project. And these statistics do not even include pumped storage, which would double or triple these numbers. b. How does the EIA reporting square with these on-the-ground numbers? Is the EIA re-examining the NEMS model and other data to refine and improve its hydro forecasts? And if not, why not?

RESPONSES OF HOWARD GRUENSPECHT TO QUESTION FROM SENATOR CANTWELL

Question 1a. Historical vs. Future Coal Prices: According to Energy Information Administration (EIA) data (Annual Energy Review 2011, Table 7.9), coal prices in the United States rose by more than 5 percent annually, on average— from \$18.93 to \$32.2 per ton— between 2000 and 2010. The EIA’s Annual Energy Outlook 2012 Early Release projects rising U.S. coal production and exports, but average annual coal price increases of just 0.9 percent over the period 2009-2035.

In EIA’s analysis, what factors contribute to this significant departure from historical trends in coal prices?

Answer. The key reason coal prices do not continue to rise as rapidly in our projections as they have in recent years is that we assume that the coal mining productivity will not continue to decline as rapidly as it has in recent years. The sharp increase in coal prices from 2000 to 2010 was due to many factors, including declines in coal mining productivity and the rising costs of mine equipment, parts and supplies, fuel prices, explosives, and, more recently, labor. Between 2000 and 2010, U.S. coal mining productivity declined at an average rate of 2.3 percent per year.

However, the recent trend of increasing coal prices and declining coal mining productivity is a departure from longer term trends in the industry. For example, from 1980 through 2000 average U.S. coal prices declined 4.5 percent per year in inflation adjusted dollars, and coal mining productivity increased 6.2 percent per year. We take account of both the short- and long-term productivity trends in the industry when preparing our long-term projections. As a result, in the Annual Energy Outlook 2012 Early Release Reference case we assume that coal mining productivity continues to decline, but only 1.3 percent per year, just over half the rate of decline seen over the last five to ten years. In the full Annual Energy Outlook to be released in the spring of 2012, we will include a sensitivity analysis that examines the impacts of alternative assumptions about coal mining productivity.

Question 1b. Historical vs. Future Coal Prices: According to Energy Information Administration (EIA) data (Annual Energy Review 2011, Table 7.9), coal prices in the United States rose by more than 5 percent annually, on average—from \$18.93 to \$32.2 per ton— between 2000 and 2010. The EIA's Annual Energy Outlook 2012 Early Release projects rising U.S. coal production and exports, but average annual coal price increases of just 0.9 percent over the period 2009-2035.

Would environmental regulations that effectively limit U.S. coal use to relatively cleaner supplies be likely to increase future coal prices?

Answer. Without details on the environmental regulations envisioned it is difficult to assess their potential impact on coal prices. Generally, regulations that reduce the supply of usable coal would lead to higher coal prices for power plants and other consumers, but the size of the increase would depend on the specifics of the regulations. Conversely, regulations that would lower the demand (i.e., restrictions on power plant use of coal) would decrease the price of coal.

Question 2a. Baseline Projection: In an investment analysis published one year ago (<http://www.anga.us/media/180381/deutsche%20report-%20nov%202010.pdf>), Deutsche Bank concluded that coal use for electricity production in the United States is likely to decline significantly in coming decades—from 47 percent in 2009 to 22 percent in 2030. Several factors contribute to coal's decline, including capital cost increases relative to gas, retirement of aging plants, increasingly stringent regulation of criteria pollutants, rising ash disposal costs, and financial barriers due to the regulatory uncertainty associated with greenhouse gas emissions. In contrast, EIA's Annual Energy Outlook 2012 Early Release projects that U.S. aggregate coal use will continue to rise and that coal will still account for 39 percent of U.S. electricity production in 2035. Does EIA believe the Deutsche Bank analysis is credible? If not, please explain the stark differences between its conclusions and those of EIA.

Answer. The Deutsche Bank report Natural Gas and Renewables, A Secure Low Carbon Energy Plan for the United States (November 2010), provides an analysis that is driven by a policy-oriented initiative, specifically the identification of a low cost solution for achieving a 17-percent reduction in overall U.S. greenhouse gas (GHG) emissions by 2020 and an 83-percent reduction by 2050 relative to the 2005 level. A statement to this effect is made at the beginning of their "Key Research Findings" section on page 8 of their report. Those policy goals were not represented in the Annual Energy Outlook 2012 (AEO2012) Early Release.

In addition, it appears that some of the assumptions used for Deutsche Bank's analysis may vary substantially from those used by EIA for the AEO2012 Early Release. For example, in their analyses Deutsche Bank indicates that natural gas prices will remain in a range of \$4.00 to \$8.00 per million Btu in nominal dollars, with perhaps \$6.00 being their primary natural gas prices assumption. In the AEO2012 Early Release, the nominal price of natural gas at Henry Hub increases from \$4.39 per million Btu in 2010 to \$8.98 per million Btu in 2030 and to \$11.48 per million Btu in 2035. Another important difference between Deutsche Bank's analysis and EIA's AEO2012 Early Release is the outlook for electricity demand, with Deutsche Bank projecting average electricity demand to increase by 0.5 percent per year between 2009 and 2030 and EIA projecting growth of 1.0 percent per year for this same time period.

In the area of coal-fired generating capacity retirements, Deutsche bank projects 152 gigawatts of capacity retirements (most likely nameplate) by 2030, which is considerably higher than the amount of net summer coal-fired capacity retirements projected in the AEO2012 Early Release during the years 2011 through 2030. In the Deutsche Bank report, the authors indicate that the costs of some environmental rules not represented in EIA's AEO2012 Early Release, such as the EPA's recently finalized Mercury and Air Toxics Standards (MATS) and forthcoming EPA rules on cooling water intake and ash disposal were represented in their analyses. EIA plans to represent the new MATS rule in the updated AEO2012 Reference case scheduled for publication later this year. In our preliminary modeling runs, the representation

of the MATS rule does result in some additional retirements of coal-fired generating capacity.

Question 2b. Baseline Projection: In an investment analysis published one year ago (<http://www.anga.us/media/180381/deutsche%20report-%20nov%202010.pdf>), Deutsche Bank concluded that coal use for electricity production in the United States is likely to decline significantly in coming decades—from 47 percent in 2009 to 22 percent in 2030. Several factors contribute to coal's decline, including capital cost increases relative to gas, retirement of aging plants, increasingly stringent regulation of criteria pollutants, rising ash disposal costs, and financial barriers due to the regulatory uncertainty associated with greenhouse gas emissions. In contrast, EIA's Annual Energy Outlook 2012 Early Release projects that U.S. aggregate coal use will continue to rise and that coal will still account for 39 percent of U.S. electricity production in 2035.

Does EIA concur with the broad consensus that anticipated plant retirements, increasing regulatory obligations, and higher hurdles to capital finance for new coal plants will have a profound impact on U.S. coal consumption?

Answer. While the factors listed above certainly affect the outlook for coal consumption, many other factors also influence the outlook for coal consumption. Forecasts of changes in laws and regulations which are not reflected in EIA's Reference case but may be included in some projections that are part of the "broad consensus" cited in the question can significantly affect future U.S. coal consumption. Other factors such as slow electricity demand growth, competitive natural gas prices, increased competition from renewable energy sources, and rising cost estimates for new coal-fired generating capacity are also key drivers affecting projected coal consumption.

Question 2c. Baseline Projection: In an investment analysis published one year ago (<http://www.anga.us/media/180381/deutsche%20report-%20nov%202010.pdf>), Deutsche Bank concluded that coal use for electricity production in the United States is likely to decline significantly in coming decades—from 47 percent in 2009 to 22 percent in 2030. Several factors contribute to coal's decline, including capital cost increases relative to gas, retirement of aging plants, increasingly stringent regulation of criteria pollutants, rising ash disposal costs, and financial barriers due to the regulatory uncertainty associated with greenhouse gas emissions. In contrast, EIA's Annual Energy Outlook 2012 Early Release projects that U.S. aggregate coal use will continue to rise and that coal will still account for 39 percent of U.S. electricity production in 2035.

If EIA does agree with the consensus of plant retirements, increasing regulatory obligations, and higher hurdles to capital finance for new coal plants, what is driving future increases in U.S. coal consumption in EIA's modeling and analysis?

Answer. In the AEO2012 Early Release Reference case, increasing demand for electricity leads to increased generation from all fuels, except petroleum. Between 2010 and 2035, EIA projects an overall increase in U.S. electricity generation of 928 billion kilowatt-hours. By fuel, increased generation from natural gas-fired power plants account for 42 percent of this increase, renewables account for 39 percent, coal accounts for 11 percent, and nuclear accounts for 9 percent. The increase in coal generation comes mainly from increasing output from existing coal plants in the later years of the projections as natural gas prices begin to increase.

Question 2d. Baseline Projection: In an investment analysis published one year ago (<http://www.anga.us/media/180381/deutsche%20report-%20nov%202010.pdf>), Deutsche Bank concluded that coal use for electricity production in the United States is likely to decline significantly in coming decades—from 47 percent in 2009 to 22 percent in 2030. Several factors contribute to coal's decline, including capital cost increases relative to gas, retirement of aging plants, increasingly stringent regulation of criteria pollutants, rising ash disposal costs, and financial barriers due to the regulatory uncertainty associated with greenhouse gas emissions. In contrast, EIA's Annual Energy Outlook 2012 Early Release projects that U.S. aggregate coal use will continue to rise and that coal will still account for 39 percent of U.S. electricity production in 2035.

Does EIA work with financial analysts to try to incorporate what the private sector predicts will happen to coal usage?

Answer. EIA considers a wide range of information in formulating its projections. In the course of developing our Annual Energy Outlook each year, we meet with a wide array of interested groups and analysts to discuss assumptions we plan to make, proposed model changes and review preliminary results. EIA staff and management also participate actively in public meetings and conferences where these issues are discussed by analysts from the private sector and non-governmental organizations. They also keep up with relevant literature from all sources.

Many private sector analyses incorporate assumptions about policy changes that have yet to occur, that are not included in EIA projections. EIA's Reference case projections assume continuation of current laws and regulations. For example, the Deutsche Bank study referred to in an earlier question appears to assume a GHG policy objective as a basis for their projections of the U.S. electricity market, something that is not included in EIA's Reference case analyses.

Question 3a. Effects of Coal Exports: The 2011 Annual Energy Outlook shows U.S. exports of coal increasing annually by 1.8%, from 1.51 quadrillion Btu in 2009 to 3.24 quadrillion Btu in 2035. In contrast, U.S. production of coal is only projected to increase by 0.3% annually, from 21.63 quadrillion Btu in 2009 to 23.51 quadrillion Btu in 2035. This suggests that exports will account for over 13 percent of coal production by 2035.

Could coal prices increase substantially more than projected if world demand increases faster than expected? If exports were to increase annually at twice the projected rate such that 20% of U.S. coal production was exported by 2035, roughly in what range would coal prices be?

Answer. Increased exports of U.S. coal could lead to higher U.S. coal prices, depending on a number of factors including the availability of other fuels and/or technologies to generate electricity. EIA includes a representation of the international market for coal trade in our analyses, but the projected increase in exports of coal leads to only a slight increase in regional coal prices.

Question 3b. Effects of Coal Exports: The 2011 Annual Energy Outlook shows U.S. exports of coal increasing annually by 1.8 percent, from 1.51 quadrillion Btu in 2009 to 3.24 quadrillion Btu in 2035. In contrast, U.S. production of coal is only projected to increase by 0.3 percent annually, from 21.63 quadrillion Btu in 2009 to 23.51 quadrillion Btu in 2035. This suggests that exports will account for over 13 percent of coal production by 2035.

As the rest of the world consumes an increasing percentage of U.S. coal, will coal act more like a fungible commodity subject to prices set by the world market, causing U.S. coal prices to increase? Would this also cause more volatility in U.S. coal prices?

Answer. The relationship between the prices of internationally traded coal and domestic U.S. coal prices is not well established, so it is difficult to predict how future trends in international coal prices will affect U.S. coal prices. The swings in international coal prices are a relatively recent phenomenon, with generally flat to declining trends in inflation adjusted prices prevailing from the 1980's through the early 2000's.

In general, there are two distinct markets for international coal trade: one representing steam or thermal coal primarily for electricity generation and a second market representing coking coal used in the manufacture steel. In terms of thermal coal markets, it is difficult to see a strong relationship between international and U.S. domestic coal prices at this time because the share of U.S. steam coal exported is so small. In the AEO2012 Early Release, U.S. exports of steam coal rise from 26 million short tons in 2010 to 51 million short tons in 2035, or 3 percent and 5 percent of overall U.S. thermal coal production, respectively.

In contrast, there does appear to be a relatively strong relationship between the international and domestic prices for coking coal. However, for this market the export share of total U.S. coking coal production is much higher, amounting to 74 percent in 2010 and rising to 85 percent in 2035. Also, while U.S. steam coal faces substantial competition from other fuels such as natural gas, renewables, and nuclear for electricity generation, substitutions for coking coal in steelmaking are more limited.

Question 4a. Regulations and the Cost of Coal: In 2011 the Environmental Protection Agency (EPA) issued a number of new rules. As these policies go into effect, the price of coal-fired generation is expected to rise. The National Research Council's 2010 report "The Hidden Costs of Energy" showed that the average additional cost of coal generation due to emissions of SO₂, NO_x, and particulate matter was 3.2 cents per kilowatt-hour in 2005 and will decrease to roughly 1.7 cents per kilowatt-hour by 2030.

To what extent are these externalities incorporated into EIA's models? How do the costs of reducing these emissions from recent regulations compare?

Answer. It is our understanding that the additional costs per kilowatt-hour that the National Resource Council (NRC) calculated for emissions of SO₂, NO_x, and particulates from coal-fired generating capacity refer to the cost of externalities such as the impact on health, environment, and security. These types of non-market costs are not accounted for in EIA's models because they do not generally enter into the dispatch decisions of electric systems operators. We do explicitly represent the capital and operating costs associated with meeting new environmental regulations, but

those are not directly comparable to the non-market costs discussed in the NRC report cited in the question.

Question 4b. Regulations and the Cost of Coal: In 2011 the Environmental Protection Agency (EPA) issued a number of new rules. As these policies go into effect, the price of coal-fired generation is expected to rise. The National Research Council's 2010 report "The Hidden Costs of Energy" showed that the average additional cost of coal generation due to emissions of SO₂, NO_x, and particulate matter was 3.2 cents per kilowatt-hour in 2005 and will decrease to roughly 1.7 cents per kilowatt-hour by 2030.

If the additional cost of coal generation estimated by the NRC were included in EIA's modeling how would that change the estimate for future coal consumption and the price through 2035?

Answer. Estimating the value of externalities is very difficult and often subjective. Externalities exist for the use of most fuel types, including natural gas, petroleum, and renewable fuels. EIA does not attempt to quantify externalities in its analyses. Generally speaking, inclusion of externality values reflecting social rather than private costs would result in higher projected electricity prices and lower projected coal consumption.

Question 4c. Regulations and the Cost of Coal: In 2011 the Environmental Protection Agency (EPA) issued a number of new rules. As these policies go into effect, the price of coal-fired generation is expected to rise. The National Research Council's 2010 report "The Hidden Costs of Energy" showed that the average additional cost of coal generation due to emissions of SO₂, NO_x, and particulate matter was 3.2 cents per kilowatt-hour in 2005 and will decrease to roughly 1.7 cents per kilowatt-hour by 2030.

Which regulations, in addition to the Mercury and Air Toxics Standards (MATS), will be included in AEO 2012? Will disposal costs due to coal ash regulations be included? Which Boiler MACT rule is used? The one finalized last year that is currently binding or the proposed rule issued in December?

Answer. The Cross State Air Pollution Rule was modeled in the AEO2012 Early Release, but the December enactment of the MATS did not leave sufficient time for inclusion. The full AEO2012 to be released in spring will include the MATS rule by requiring that all coal plants install either a Flue Gas Desulfurization (FGD) scrubber or a Direct Sorbent Injection (DSI) system in order to continue operating beyond 2012. The potential additional costs associated with stricter ash disposal requirements that have not yet been established in final regulations are not addressed in our Reference case projections.

The Industrial Boiler MACT Rule was most recently proposed in December 2011, after our cutoff date for the AEO2012. In any event, EIA's Reference case generally reflects final rules, not proposed ones. The prior version of the Boiler MACT finalized and then stayed by EPA last year is also not included.

Question 4d. Regulations and the Cost of Coal: In 2011 the Environmental Protection Agency (EPA) issued a number of new rules. As these policies go into effect, the price of coal-fired generation is expected to rise. The National Research Council's 2010 report "The Hidden Costs of Energy" showed that the average additional cost of coal generation due to emissions of SO₂, NO_x, and particulate matter was 3.2 cents per kilowatt-hour in 2005 and will decrease to roughly 1.7 cents per kilowatt-hour by 2030.

Although regulations on greenhouse gas emissions are forthcoming, has EIA attempted to model their effect?

Answer. EIA has not explicitly attempted analyze the impact the forthcoming greenhouse gas rules on new plants. In the past we have prepared numerous analyses of legislative proposals to curb emissions of greenhouse gases (GHGs) that are available on our web site.

RESPONSES OF HOWARD GRUENSPECHT TO QUESTION FROM SENATOR MURKOWSKI

Question 1. You mention in your report that EIA recognizes that projections of energy markets over a 25-year period are highly uncertain and subject to many events that cannot be foreseen.

What factors impact how these numbers move, and how easy is it to predict those factors?

Answer. The number of uncertainties involved in projecting long-term energy markets is large, and the degree to which they affect energy markets varies. Readers of the Annual Energy Outlook are cautioned that Reference case results should not be viewed in isolation and are encouraged to review the alternative cases included in the full publication. The alternative cases published in the Annual Energy Outlook (AEO) provide perspective on the sensitivity of energy market outcomes to dif-

fering assumptions in key areas. Recent energy market developments have strongly reinforced the aphorism, 'expect the unexpected'.

The list below categorizes areas of uncertainty and highlights some of the alternative cases that are included in each year's AEO.

- The U.S. economic environment is subject to variation in business cycles and to uncertainty about the pace of long-term economic growth. Low and high economic growth alternatives explore the effects of varying rates of economic growth on energy markets.
- Energy prices can fluctuate rapidly and are sometimes influenced by developments beyond the U.S. (e.g., international economic developments, oil embargos, natural disasters, other supply disruptions). The AEO includes a set of alternatives featuring low and high world oil prices.
- The future pace of technological change and the resulting effects on energy markets may diverge from what is expected due to varied success in research and development or the potential for disruptive technologies. The AEO looks at the potential effects of different technological paths through cases profiling differing nuclear power costs and life extension alternatives, differing costs for renewable energy technologies, and a suite of cases highlighting a wide range of assumptions about the rate of improvement in energy-using technologies.
- Energy policy changes that depart from current laws or regulations are not included in the AEO Reference case, allowing the case to serve as a baseline for policy analysis. However, a number of additional scenarios relevant to current policy discussions are included in the AEO.
- Exploration and production often leads to changes in estimates of resource availability and/or drilling productivity and cost. The AEO includes alternatives with differing assumptions for oil and gas supply to explore uncertainties in this area.

Question 2. In reviewing EIA's most recent report on the impact of US LNG exports on domestic energy markets, the build-out scenarios appear to be aggressive. Please explain your view on the likelihood of these various scenarios:

a. In all 16 of EIA's scenarios, your findings about the long-term impact of exports appear to be somewhat minimal, but the conclusions about short-term impact, however, seems quite extreme. I realize that EIA's conclusions may be based on the export schedule it modeled, but could industry respond to such price increases somewhat quickly by producing more gas?

b. How realistic is EIA's projected short-term price impact given that production will likely increase?

Answer. The scenarios contained in the report, Effect of Increased Natural Gas Exports on Domestic Energy Markets, were specified by DOE's Office of Fossil Energy. EIA has not performed an analysis of the likelihood of these LNG export scenarios. The Office of Fossil Energy has indicated that these scenarios were specified to capture a wide range of possible outcomes. The shorter-term rapid increase in prices shown in the report largely reflects expected increases in production costs due to the production of more natural gas, which occurs relatively quickly. Domestic production increases, on average, from 4 to 12 percent when exports are added. Production costs increase due to the increased demand for equipment (e.g., rigs) and labor to support the necessary drilling, as well as for lease rights.

The shorter-term rapid increase in prices shown in the report largely reflects increases in production costs due to the production of more natural gas, which occurs relatively quickly. Domestic production increases on average from 4 to 12 percent when exports are added. Production costs increase due to the increased demand for equipment (e.g., rigs) and labor to support the necessary drilling, as well as lease rights.

The projected price impacts associated with the additional exports in the scenarios specified by the Office of Fossil Energy for the study already reflect the expectation of higher natural gas production. Factors that accelerate the need to produce greater volumes will cause prices to rise faster than in the Reference case.

In reviewing EIA's most recent report on the impact of US LNG exports on domestic energy markets, the build-out scenarios appear to be aggressive. Please explain your view on the likelihood of these various scenarios:

c. Has Alaska's history of natural gas export significantly impacted Lower 48 natural gas prices?

d. If Alaska were to significantly increase its natural gas exports, to the order of 4 bcf/day, would EIA forecast any significant impact on Lower 48 natural gas prices?

Answer. The scenarios contained in the report, Effect of Increased Natural Gas Exports on Domestic Energy Markets, were specified by DOE's Office of Fossil Energy. EIA has not performed an analysis of the likelihood of these LNG export sce-

narios. The Office of Fossil Energy has indicated that these scenarios were specified to capture a wide range of possible outcomes. The shorter-term rapid increase in prices shown in the report largely reflects expected increases in production costs due to the production of more natural gas, which occurs relatively quickly. Domestic production increases, on average, from 4 to 12 percent when exports are added. Production costs increase due to the increased demand for equipment (e.g., rigs) and labor to support the necessary drilling, as well as for lease rights.

The Alaska and Lower 48 natural gas markets have not been historically linked. Over the years, proposals have been developed for building a pipeline to supply natural gas to the Lower 48 from Alaska. However, this pipeline is not projected by the EIA to be built before 2035 under Reference case conditions (although it is viable under some side cases with higher prices in the Lower 48 States).

EIA has not assessed the economic viability of transporting LNG from Alaska to international markets or the Lower 48 States markets via tanker. Shipment of LNG from the Alaska North Slope may pose significant logistical challenges in terms of tanker access. With the construction of a West Coast liquefaction terminal or with the eventual widening of the Panama Canal, it is possible that exports out of Alaska could compete with Lower 48 LNG exports in Asian markets and thus have an indirect (and likely limited) impact on Lower 48 prices.

Question 3. Earlier this week, EIA announced that some of the most important data in the latest Annual Energy Review may be flawed and would need to be revised. Do you know the source of that potential error, and how long it may take to correct if the data is indeed inaccurate?

Answer. We discovered after publication of the Annual Energy Review 2010, that the data in Table 1.14, Fossil Fuel Production on Federally Administered Lands, was incomplete. In reviewing the data, EIA identified the underreporting and, in consultation with the Office of Natural Resource Revenues (ONRR) of the Department of the Interior (DOI), identified further data limitations.

- The fossil fuel volumes are sales and not production. The data sources are the Form 2014 and the Solid Mineral Production and Royalty Report, which collect information on sales of fossil fuels produced on federal leases. The distinction of sales and production is important because sales exclude production such as lease use and storage volumes. Sales volumes are a lower bound on actual production.
- The fossil fuel volumes are assigned to the year in which the royalty was paid and not the year the sale took place. For example, if a sale took place in 2007, but ONRR received the royalty payment in 2010, the volume is included in the total sales in 2010.
- The reported sales volumes are on a fiscal year (FY) and not a calendar year basis. For example, FY 2009 covers the period from October 1, 2008 through September 30, 2009.
- EIA had been using the ONRR source due to the difficulty of obtaining data for onshore federal lands. EIA has been reporting offshore production data in its petroleum navigator and will continue working with ONRR to improve the reporting of the production data for onshore federal lands for the year in which production occurred and on a calendar year basis as with the rest of the production data.

EIA has worked with ONRR to obtain a complete set of data to update and revise the table. A report entitled Sales of Fossil Fuels Produced from Federal and Indian Lands, FY 2003 through FY 2011 was published on March 14, 2012. We have also confirmed that the reporting problem that is corrected in the new report was isolated to Table 1.14 in the AER and does not affect any other tables in the AER or any other EIA analyses.

Question 4. Last year, Administrator Newell testified with regard to Keystone XL that “Whether or not that pipeline exists, one question is whether or not the oil would be produced. That is one question. That study seemed to suggest that it would be produced regardless of whether there was a pipeline, and it would likely be exported to the west, to Asia, as opposed to south to the United States.” Does EIA still agree with each part of that assessment?

Answer. In his testimony last year, Administrator Newell was referring to a study performed for DOE rather than an EIA analysis. However, EIA’s Annual Energy Outlook and International Energy Outlook both consider the global balance between liquid fuels supply and demand. In both of those publications, the world oil price is the key determinant of the level of unconventional liquids production, including production from Canada’s oil/tar sands resource. At Reference case oil prices used in recent editions of these publications, production of this resource is expected to increase substantially.

Question 5. In the early release of the latest Annual Energy Outlook, EIA projects that biofuels usage will continue to increase in the United States through 2035—but only offset roughly 600,000 barrels of liquid fuel demand.

a. How much biofuel does EIA project we will be using in 2035, on a gallons-per-year basis?

b. To what extent does EIA project the mandates within the Renewable Fuel Standard will be met? Do you still project a substantial shortfall of cellulosic biofuel?

Answer. EIA projects in the AEO2012 Early Release Reference case that 38.3 billion gallons of renewable biofuel will be consumed in 2035. The 600,000 barrels per day (9.2 billion gallons) refers to a statement in the report which says, “In the AEO2012 Reference case, some of the demand for biofuel, which in 2035 is projected to displace more than 600 thousand barrels per day of demand for other liquid fuels, is as a direct replacement for diesel and gasoline”, (AEO2012 Early Release Overview, p.6.). This refers to biofuels that can be used directly (unblended) in vehicles (e.g., biomass-to-liquids and renewable diesel) as opposed to the majority of biofuels that are blended with petroleum first (e.g., ethanol and biodiesel).

EIA projects that the cellulosic biofuel standard will require repeated annual waivers until it can be administratively modified in 2016. The AEO2012 early release projects that the 16 billion gallons target for cellulosic biofuels established under the renewable fuels standard provisions of the Energy Independence and Security Act of 2007 will be reached sometime after 2030.

Question 6. EIA reports consistently show little to no growth in the hydropower sector. In 2008, the EIA testified before Congress that the Annual Energy Outlook (AEO) forecasts less than 1 GW of new hydropower capacity to be added by 2030. In the 2011 AEO, hydropower is not even included in the discussion with the forecasts for other renewable technologies and the report shows an annual growth rate of only 0.1 percent in net summer capacity through 2035.

a. Do you believe that the EIA modeling is accurately reflecting the hydropower sector? In 2011 alone, FERC received approximately 610 MW of conventional hydropower applications for original licenses, exemptions and also capacity additions at existing facilities. In my state of Alaska alone, work is proceeding on a 600+ MW new hydropower project. And these statistics do not even include pumped storage, which would double or triple these numbers.

b. How does the EIA reporting square with these on-the-ground numbers? Is the EIA re-examining the NEMS model and other data to refine and improve its hydro forecasts? And if not, why not?

Answer. We believe that the EIA modeling of hydropower is consistent with the very slow growth in the industry that has been seen in recent decades. At the end of 2010, conventional hydropower capacity was 78,825 megawatts (MW), essentially unchanged from the 78,562 megawatts in place in 1995. During that same time, although there were more than 2000 hydropower license applications, FERC only approved 82 projects, for 555 MW of capacity. The relatively small number of projects approved reflects both applicants who decided not to pursue projects, as well as projects that FERC disapproved. While the breakdown of these categories is unknown, it is clear that only a small number of license applications lead to installed projects.

The projected hydroelectric capacity additions in the Annual Energy Outlook are based on a number of factors, including expected increases in demand for electricity, the cost and availability of hydro resources, and the cost of alternative sources of generation. State and Federal incentives are also accounted for, to the extent possible. Current EIA projections show a surplus of generating capacity to meet near-term electricity demand, with little need for additional capacity of any sort through the remainder of this decade.

EIA’s projections include all reported, in-service electricity generators greater than 1 MW in capacity, as well as projects greater than 1 MW that are under construction, based on respondent-provided completion dates. Projects not yet under construction are not explicitly included in the forecast. However, additional hydroelectric capacity can be built within the model if it is the most economic alternative to satisfy electricity demand.

EIA is not able to model the electricity markets in Alaska or Hawaii, which depend on energy supply resources and market dynamics that are unlike the interconnected grids in the contiguous States. Additionally, EIA does not currently project demand for new pumped storage projects.

EIA plans to re-examine and expand its assessment of the cost of conventional hydropower on a site-by-site basis during 2012 using information developed by the Idaho National Laboratory. If this work is completed in time, the results will be incorporated in the AEO2013.

RESPONSES OF JIM BURKHARD TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. The President stated this week that the U.S. only has 2% of the world's oil. Is that accurate? Does it tell the whole story? Does the 2% figure include anywhere within US lands or waters where we haven't drilled? How are "reserves" classified in the United States?

Answer. Proved oil reserves are a broad indication of oil resources. But the lack of a uniform, global standard for estimating reserves makes comparisons across countries a challenge. Actual production levels are another indication of how oil resources are distributed around the world. In 2011, the United States was the 3rd largest oil producer in the world behind Saudi Arabia and Russia.

Question 2. When a country experiences a major oilfield discovery, like Brazil's Tupi field or our own Prudhoe Bay, is the impact on global oil markets typically significant?

Answer. Large discoveries of oil generally require many years and large sums of capital to develop-particularly if the discovery is in an area where infrastructure to ship the oil to market is undeveloped. It often takes many years for a discovery to have an impact on physical levels of oil supply.

Question 3. IHS Global Insight recently published a report on the economic and employment contributions of shale gas in the U.S. Mr. Burkhard, under existing policy, can direct and indirect jobs in natural gas also contribute to paying down the national debt?

Answer. Extraction of oil and gas in the United States has created many new jobs in recent years. This has been driven by growth in oil and gas production. For example, from 2008 to 2011 US liquids production increased 1.3 million barrels per day while demand fell. The development of oil and gas in the US has created many new jobs and reduced the US oil import bill.

Question 4. EIA reports consistently show little to no growth in the hydropower sector. In 2008, the EIA testified before Congress that the Annual Energy Outlook (AEO) forecasts less than 1 GW of new hydropower capacity to be added by 2030. In the 2011 AEO, hydropower is not even included in the discussion with the forecasts for other renewable technologies and the report shows an annual growth rate of only 0.1 percent in net summer capacity through 2035.

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b. How does the EIA reporting square with these on-the-ground numbers? Is the EIA re-examining the NEMS model and other data to refine and improve its hydro forecasts? And if not, why not?

Answer. I am not qualified to answer this question.