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THE ECONOMIC IMPACT OF INCREASED NATURAL GAS PRODUCTION

HEARING

BEFORE THE

JOINT ECONOMIC COMMITTEE
CONGRESS OF THE UNITED STATES

ONE HUNDRED THIRTEENTH CONGRESS

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THE ECONOMIC IMPACT OF INCREASED NATURAL GAS PRODUCTION

TUESDAY, JUNE 24, 2014

CONGRESS OF THE UNITED STATES,
JOINT ECONOMIC COMMITTEE,
Washington, DC.

The committee met, pursuant to call, at 10:17 a.m. in Room 216 of the Hart Senate Office Building, the Honorable Amy Klobuchar, Vice Chair, presiding.

Representatives present: Brady, Paulsen, Carolyn B. Maloney, and Delaney.

Senators Present: Klobuchar, Casey, Murphy, and Lee.

Staff present: Ted Boll, Hank Butler, Conor Carroll, Gail Cohen, Sarah Elkins, Connie Foster, Niles Godes, Colleen Healy, and Robert O'Quinn.

OPENING STATEMENT OF HON. AMY KLOBUCHAR, VICE CHAIR, A U.S. SENATOR FROM MINNESOTA

Vice Chair Klobuchar. Thank you, everyone. We are calling the hearing to order. I know that Chairman Brady is on his way, and I apologize that we are getting started a little later. There are a lot of hearings going on, and I so appreciate you all coming in, and also many of you we have had to reschedule this hearing several times and I really appreciate your patience with that. This is a very important topic.

We have a distinguished panel of witnesses today who have a wealth of expertise and insight in this area.

First of all, we have Dr. Daniel Yergin, who is the Vice Chairman of IHS, a leading source of information, insight, and analysis. Dr. Yergin is a Pulitzer Prize winning author and leading authority on energy, international politics, and economics.

Mr. Jim Bruce is the Vice President of Corporate Public Affairs for the United Parcel Service. He previously served as senior counsel on the Senate Energy and Natural Resources Committee.

And then we have Ms. Diana Furchtgott-Roth, who is the Director of Economics21, and Senior Fellow at the Manhattan Institute for Policy Research. She was a chief economist of the Department of Labor, and chief of staff at the Council of Economic Advisers in the George W. Bush Administration.

Mr. Elgie Holstein is the Senior Director for Strategic Planning with the Environmental Defense Fund. Mr. Holstein was previously a senior advisor to the Obama Presidential Campaign on Energy and Environmental Policy matters, and co-director of the Department of Energy Presidential Transition Team.

Mr. Charles Meloy is the Executive Vice President, U.S. Onshore Exploration and Production for Anadarko Petroleum Company. Mr. Meloy has over 30 years of experience in the oil and natural gas industry.

So I am going to start by talking about some recent developments in natural gas production. I know a little bit about it, being from the State that is the neighbor to our friends in North Dakota, and having gone to Williston and some of the surrounding areas with Senator Hoeven and seen the amazing development going on there.

The U.S. already produces about 20 percent of the world's natural gas, and there is potential for making that number even higher.

In its most recent annual Energy Outlook, the Energy Information Administration forecasted that natural gas production will grow more than 50 percent by 2040. Much of this projected increase is due to continued exploration and development of shale gas resources.

According to the Energy Information Administration, by 2040 half of the natural gas production in the U.S. will come from shale gas. Net imports of natural gas are now at the lowest level since 1990, and it is predicted that we will be producing more natural gas than we consume domestically by 2018.

Because of this expanded production and the expectation of continued growth, it is expected that natural gas prices will remain low for the foreseeable future. U.S. natural gas prices are less than half of what they are in Europe and Asia. You can see that this gives us a competitive edge.

IHS estimates that without the expanded production from shale and other unconventional sources, Gross Domestic Product would have fallen by an additional .09 percentage points, and an additional 900,000 jobs would have been lost during the Recession.

Unconventional oil and natural gas activity has also been estimated to have increased U.S. disposable income by an average of $1,200 per U.S. household in 2012.

In addition to benefitting from lower energy costs, businesses are using natural gas to move product inexpensively throughout our country. UPS, as we will hear from shortly, now uses over 2,000 alternative fuel delivery trucks in the U.S., about half of which run on natural gas. And by the end of the year, UPS will have natural gas fueling operations in 10 states.

This spring, the St. Cloud, Minnesota, area became my State's first transit system to convert its bus fleet to compressed natural gas buses, reducing emissions and saving the region about $300,000 every year. I would also add, one of the coolest parts about this project, Mr. Chairman, was that they made the buses in St. Cloud, as well, with New Flyer buses. We are pretty proud of that project.

We have Anderson Windows, which is on the Wisconsin border, that is actually building its own fueling stations so that it can transport its windows in a safer and in a cheaper way.

Of course business's use of natural gas extends beyond transportation fuel. Lower natural gas prices are boosting domestic manu-

facturing in natural gas-intensive industries such as fertilizers, chemical manufacturing, and steel production.

Some manufacturers have started moving production facilities back to the U.S. to take advantage of lower natural gas prices.

Despite increased production of natural gas and its byproducts like propane, there have still been problems in some areas. I am well aware of this because there were propane shortages in Minnesota that were very severe. Exports of propane and related products are ten times larger than they were ten years ago. We need to make sure that our export policy is not contributing to the problems like the one we experienced this winter in the Midwest when propane prices spiked and remained at extremely high levels for many weeks.

That price spike has far-reaching and had dangerous effects in rural Minnesota where more than 200,000 households rely on propane to heat their homes. It also hurt livestock and poultry producers who need propane to heat their barns and keep their animals warm.

We took emergency action. Senator Hoeven, Senator Franken, Senator Baldwin, and Senator Johnson and I worked on a bill, and then Senator Thune and I just passed a bill that the House just passed yesterday, last night, that's going to be signed into law. That helps with some of the shipment of propane, but we are continuing to look into the next year and we will be working with everyone in the industry to make sure this does not happen again.

One last concern of course is the environment. As natural gas production continues to grow, we also need to balance the economic needs of businesses and consumers with protecting our environment and preserving our natural resources for decades to come.

Natural gas is cleaner than coal because it is less carbon-intensive and emits less sulfur dioxide. Switching to natural gas for electricity production and transportation should be part of our energy policy. Recent studies do show that methane leaks may be diminishing some of the environmental benefits of natural gas, and I believe that the best practices that the industry and regulators can develop are necessary to make sure that production is done in an environmentally sensitive way.

As we continue to work in this area, we should be mindful that Americans expect and deserve a common-sense approach to regulation, one that protects consumers and the public interest without stifling innovation and economic growth.

Thank you very much for being here today. There is much we are going to be talking about, and I am glad that we have been joined. I know that Chairman Brady had a lot going on today, and I am so glad he made it over here to the Senate side, which is a little bit of a walk, to join us. We also were joined earlier by Congressman Paulsen, and Senator Murphy is here as well.

Chairman Brady.

OPENING STATEMENT OF HON. KEVIN BRADY, CHAIRMAN, A U.S. REPRESENTATIVE FROM TEXAS

Chairman Brady. Well thank you, Vice Chair Klobuchar, Members, and distinguished witnesses:

Free market capitalism and science are revolutionary forces that can change the world for the better. George Mitchell, the founder of my hometown, The Woodlands, Texas, and a noted philanthropist and environmentalist, first combined hydraulic fracturing, which uses pressurized liquid to break rocks and release the natural gas and oil trapped within, and horizontal drilling.

This combination has turned the world of hydrocarbons upside down. In the winter of 1977–78, President Carter warned that the United States could exhaust its supply of natural gas in two generations. In response, Congress passed legislation to limit the use of natural gas in industry and electricity generation.

Even as recently as 2012, President Obama incorrectly warned that "with only 2 percent of the world's oil reserves, we can't just drill our way to lower gas prices, not when we consume 20 percent of the world's oil." Yet, as he was making those dated remarks in his weekly radio address, America was experiencing an energy revolution.

In recent years, fracking and horizontal drilling have greatly increased the potential supply of natural gas and oil in the United States. Consequently, America does not need to import liquefied natural gas and is reducing its dependence on foreign oil outside of sources among our friendly neighbors, Canada and Mexico.

In April's "Annual Energy Outlook 2014," the Energy Information Administration projected that domestic crude oil production will increase from 6.5 million barrels per day last year to 9.6 million barrels per day in 2020, a production level not seen since 1970.

Moreover, the import share of U.S. petroleum and other liquid fuels will fall to about 25 percent during the last half of this decade. Indeed, the U.S. can become a major exporter of LNG (Liquified Natural Gas).

Fracking and other improvements in production technology have opened vast stores of domestic oil and natural gas and have lowered production costs. In light of recent developments in Ukraine and Iraq, increased U.S. production of both oil and natural gas will make our economy far less dependent on costly and unreliable oil imports and will mitigate the prices of both oil and natural gas, if this White House does not interfere or attempt to slow down domestic production.

America's energy revolution has also created tens of thousands of well-paying jobs during a disappointing economic recovery. These jobs cover the entire spectrum from the unskilled to the highly skilled and are a new source of employment for minority workers across the country. And as the energy workforce ages out, even more opportunities will occur for workers of all skills.

Of course more American-made energy means more American-made tax revenues for communities, states, and the Federal Government. With the exception of individual tax receipts, the energy industry is now America's second largest taxpayer. So more natural gas production in America helps to balance the budget and fund necessary services to families who need assistance.

Despite the natural gas and oil revolution, some people prefer renewable, zero-emission energy sources such as wind, solar, and geothermal power. Renewable fuels should be encouraged, but none of these green energy technologies has yet to demonstrate sufficient

economies of scale to compete with fossil fuels as a major energy source without dependence on significant taxpayer subsidies, regulatory mandates, and tax preferences. While future technological breakthroughs are possible, as of today green energy cannot compete affordably with traditional energy in the free market.

Developing countries have rejected the siren song of green energy, and many developed countries that had embraced it, such as Germany and Japan, are backing away from their earlier commitments.

Some environmentalists continue to press for their preferred sources of energy even though natural gas can reduce greenhouse gas emissions more quickly and at less cost. Artificially supporting current green energy technology takes money away from development of new green technologies that could be competitive with fossil fuels on their own merits.

The U.S. legal and regulatory regime for international trade in oil and natural gas as well as a continuing mindset in some quarters are stuck in a time of import dependency. But the United States now is in a position to export natural gas, petroleum products, and even high quality "light" crude oil.

We must adapt our mindset and our rules accordingly. We must do so for the sake of the domestic economy, the stability of world oil and gas prices, and geo-political stability.

The Administration has been slowrolling drilling permits, licenses for LNG export terminals, and approvals for deliveries to countries that do not have a free trade agreement with the United States, meaning all but 20 countries, none of which is in Europe.

The fracking revolution has both profound economic and geo-political implications. Fracking has the potential to increase alternative sources of supply in North America and reduce the world's dependence on supply from North Africa and the Middle East. Exports of domestically produced LNG and refined petroleum products can also alleviate Europe's dependence on Russia.

The fracking revolution is a win for everyone involved. Domestic natural gas and oil production is igniting an industrial renaissance in the United States, especially in the industries that are energy intensive or use natural gas and oil as feedstock; and it is creating tens of thousands of high-paying jobs for middle-class American workers.

With that, Madam Vice Chair, I look forward to the testimony of today's distinguished witnesses.

[The prepared statement of Chairman Brady appears in the Submissions for the Record on page 28.]

Vice Chair Klobuchar. Thank you very much.

Why don't we get started with Dr. Yergin.

STATEMENT OF DR. DANIEL YERGIN, VICE CHAIRMAN, IHS, WASHINGTON, DC

Dr. Yergin. Thank you, Vice Chair Klobuchar, and Chair Brady, Members of the Committee:

It is really an honor to be here today to speak about how America's energy position has changed by what has happened in energy, and specifically natural gas, and what it means for employment, and what it means for economic growth.

One is cautious about using the word "revolution." It is an overused word, but I think given the scale and the speed of what has happened, it is appropriate to talk about an unconventional revolution in oil and gas in the United States.

Natural gas production is up 27 percent between 2007 and 2013. Estimates of recoverable natural gas resources have literally doubled since 2005. Shale gas, which was just 2 percent of our natural gas a little more than a decade ago, is now 44 percent. And certainly the mentality around energy, as the opening statements have indicated, has changed.

The same has happened with oil. Our oil production is up 3.3 million barrels a day since 2008. That is a 66 percent increase. But what really makes it interesting is just the increase is greater than the total output of 11 out of the 12 OPEC countries. So it tells you something really big has happened, as you described, Vice Chair Klobuchar, in North Dakota.

Also as you pointed out, we at IHS have engaged in several studies since 2009 trying to understand what the economic impacts are. We see it in terms of employment: 2.1 million jobs supported by this unconventional revolution in 2012. About 60 percent of those jobs were natural gas. We expect that 2.1 to reach 3.3 million jobs by 2020.

In 2012, this unconventional revolution added $74 billion to federal and state government revenues, a number that we think will rise to about $125 billion by 2020. It is stimulating a manufacturing renaissance, and it has been a very important contributor to the economic recovery.

A few months ago, former Federal Reserve Chairman Ben Bernanke described the unconventional revolution as one of the most beneficial developments, if not the most beneficial development, since 2008 in the economy.

This unconventional revolution came along at the right time. Just consider what our economy would look like today without it: much higher energy bills, higher unemployment, lower growth.

Strikingly, these economic impacts are not limited just to states that produce unconventional oil and gas. Because of the nature of the supply chains across the economy, we see great impact on states that do not have significant shale gas or tight oil activity.

In fact, a quarter of the jobs that I described are in nonproducing states. The State of Minnesota—19,000 jobs in the State in 2012, going to 35,000 jobs by 2020. And $260 million in State and local taxes as a result of it.

If we look at Illinois, 38,000 jobs and $450 million in State and local taxes. New York, 44,000 jobs and $1 billion in State and local taxes. California, 100,000 jobs and $1.6 billion in State and local taxes. And this is because of the supply chains that run all across our economy, how interconnected it is.

It has already been remarked,—we are having a manufacturing renaissance in the United States. There are many reasons for it, but right at the top of it is because of what is happening in terms of affordable and abundant natural gas.

Companies are now planning investments that are very large as a result. In his 2014 State of the Union Address, President Obama

remarked upon the large number of dollars that are going into investment because of the availability of gas.

The latest census that we have seen has that figure at $117 billion going into our economy as a result of this. Obviously, industries like the chemical industry are a big part of that. Dow Chemical has announced $4 billion of new investment in the United States, but what is really striking is that 62 percent of this investment that is going into this economy, 62 percent of this $117 billion is foreign direct investment. It is coming from other countries, other companies abroad coming to the United States because of this advantage we have in terms of low priced gas.

And it is not just chemicals. It is iron, and steel fabrication; it is many other industries that take advantage of this.

Senator Klobuchar has remarked about what it has meant also in terms of household incomes. In 2012, it added $1,200 a number that will grow to $2,700—the benefits to each household.

In all of this, however, I do feel—and before this Committee which concerns itself with the state of the U.S. economy—it is important to have one word of caution.

I mentioned the 3.3 million barrels a day increase in U.S. oil production since 2008. That is just about the same number of barrels that have been removed from the world market by disruption and by sanctions on Iran.

Over the last two weeks a major new crisis has emerged in Iraq. So far the impact on the global market has been minor. The conflict is several hundred miles away from where the major sources of Iraqi production is. But should production in the southern part of Iraq be disrupted, the world oil market could well enter into a crisis of supply with prices spiking much higher than they are today.

Iraq is one of the key sources for new oil. This would be a major setback for the U.S. and the world economy, and I think it is important to be prepared for what could be an imminent risk, and particularly appropriate for this Committee to consider, given its focus on the overall U.S. economy.

To sum up what I have said, altogether this unconventional natural gas and oil revolution has already had a major impact in multiple dimensions on the U.S. economy, whether you're talking about U.S. energy supply, energy costs, government revenues, manufacturing, household spending, and the wider economy. Its significance will continue to grow as this unconventional revolution continues to unfold. These hearings provide a very timely opportunity for assessing the impact and significance, and I am pleased in due course to respond to the Committee's questions. Thank you.

[The prepared statement of Dr. Daniel Yergin appears in the Submissions for the Record on page 30.]

Vice Chair Klobuchar. Thank you very much, Dr. Yergin. Mr. Bruce?

STATEMENT OF MR. JIM BRUCE, SENIOR VICE PRESIDENT OF CORPORATE AFFAIRS, UNITED PARCEL SERVICE, WASHINGTON, DC

Mr. Bruce. Vice Chair Klobuchar, Chairman Brady, and Members of the Committee:

Thank you for the opportunity to testify on the economic impact of increased natural gas production as seen from UPS's vantage point.

To put it simply, natural gas is revolutionizing UPS's trucking, particularly heavy trucking. You have my prepared testimony. In my oral statement I would really like to make just three points:

First, UPS spent the first three quarters of a century of its existence becoming more and more dependent on petroleum. In the last 30 years, we have tried to gradually move away from petroleum. And natural gas is the key to that shift.

Second, although UPS has tested almost every conceivable form of alternative fuel or advanced technology for vehicles, natural gas is the only one that meets the performance requirements that we have for heavy trucks. And heavy trucks are the key, the best candidate for alternative fuels.

The third point is that how fast UPS and other companies shift from petroleum is dependent not only on what we invest, but on what financial incentives we receive from the States. And, frankly, whether the Federal Government removes its Federal disincentives to alternative fuels.

So let me go back to my first point. UPS began in 1907, not dependent on petroleum but on foot, on bicycles. We were carrying messages, not packages. It took six years before we bought our first truck, a Model-T Ford.

Over the next three-quarters of a century, UPS amassed a fleet of 100,000 trucks, a fleet of aircraft, and we obviously became more reliant on petroleum.

Beginning in the 1980s, UPS began testing compressed natural gas delivery trucks. However, the price jolt in the years 2005–2006 on natural gas hurt our confidence in natural gas, and in fact it hurt the confidence of a lot of natural gas vehicle users.

Fortunately, the recent surge in reserves has given us confidence that we can rely on relatively stable prices for natural gas in the future.

Now to that second point. While we have tested almost every kind of alternative fuels, natural gas is the only alternative fuel that works for us in the heavy truck. We have tested in the last 30 years many advanced technologies and alternative fuels, and we test them in service in what we call our "rolling laboratory."

And in my prepared testimony you will see a chart dated April 16th, 2014, which is a snapshot of our fleet. It shows over 2,300 vehicles domestically that are alternative fuels, and over 3,400 worldwide. Natural gas is revolutionizing trucking at UPS because that snapshot from April 16th is already out of date. Yesterday I saw a new internal snapshot dated June 16th. Our total alternative fleet had grown to 3,606 trucks, another 169 trucks, all heavy LNG trucks, and that was in two months.

Looking ahead, we have plans and have committed to deploy almost 5,500 alternative fuel vehicles, and that means, based on current plans, alternative fuel vehicles will be 5 percent of our entire fleet worldwide.

So why are heavy trucks the best candidate for alternative fuels? Simply because they use the most fuel per vehicle. A tractor trailer can average 450 miles a day and burn 100 gallons of diesel fuel;

whereas, the little brown package delivery truck you're familiar with might use a tenth of that per day. The more diesel fuel you displace per vehicle using alternative fuels, the more you can afford to pay for a more costly alternative fuel vehicle up front. So you have to focus on heavy trucks.

But for those big rigs, the tractor trailers, we found no alternative other than natural gas that would give us the power and the torque and the range that we need, to go from hub to hub and back. However, around the year 2000, dual-fuel LNG diesel engines became available that ran on LNG and a small amount of diesel. And in 2002 we began testing 11 of these LNG/diesel engines, and the fleet of LNG trucks has grown ever since. In fact, our LNG tractors are now racking up 2 million miles a week on the road, displacing over 300,000 gallons of diesel. And then the third point is——

Vice Chair Klobuchar. Mr. Bruce, we have votes at 11:00 so just try to—you have great stories to tell here, but maybe just another 10 seconds here.

Mr. Bruce. We are investing from 2010 to 2014, we have committed over $400 million to our alternative fuel fleet and fueling infrastructure in the U.S. and Canada. We will buy 1,000 heavy LNG trucks this year. I think the key point to make is that we have been seeking state financial incentives, but what is really important is to address the federal disincentives, and those are that the federal tax on heavy trucks applies to the total cost. So we are paying a 12 percent tax on the premium cost of an alternative fuel vehicle. And the other is the fact that LNG is taxed at a rate that is substantially more than diesel fuel, and we are trying to get Congress to fix those disincentives.

[The prepared statement of Mr. Jim Bruce appears in the Submissions for the Record on page 41.]

Vice Chair Klobuchar. Thank you. Okay, thank you.

Ms. Furchtgott-Roth.

STATEMENT OF MS. DIANA FURCHTGOTT-ROTH, DIRECTOR, ECONOMICS 21, AND SENIOR FELLOW, MANHATTAN INSTITUTE FOR POLICY RESEARCH, WASHINGTON, DC

Ms. Furchtgott-Roth. Thank you very much, Chairman Brady, Vice Chair Klobuchar, thank you so much for inviting me to testify today.

We have heard a lot about the benefits of natural gas. We have heard a lot about the revolution, the energy revolution, and that is in my testimony, but I certainly do not want to repeat what these eminent witnesses have already said.

What I would like to do is make the case for exporting natural gas and increasing our exports of LNG. The world is a very volatile place. Europe and Ukraine depend on natural gas from Russia, which is far more expensive than our natural gas. And we should be in a position to export it to them, to export our natural gas.

And, Honorable Members, you could immediately assist Ukraine and other countries by amending the Natural Gas Act to ensure that the Energy Department approves LNG export applications within a short period of time.

Now I have a table here that your staff can put up showing liquid natural gas applications under U.S. Department of Energy review. There are about two dozen, over two dozen, of these applications. Many of them have been there since 2012 and 2011. And we should be speeding up this process.

You could also pass legislation allowing LNG to be exported to all World Trade Organization members, irrespective of whether they have Free Trade Agreements with the United States. And you could go still further and you could cease to require approval for all LNG exports.

Steve Jobs of Apple started making iPhones, and he did not just keep these iPhones here in the United States. They were exported all over the world. That made more jobs for Americans, and more important it increased the innovation of the iPhone because more people purchased it. And so Steve Jobs could innovate and sell more types of iPhones.

The same with natural gas. If we exported more technology to improve LNG and fracking would be faster, companies would have an incentive to put in place more infrastructure that would benefit us as well as benefitting other countries to whom we could export because of the substantial price differential.

Last fall in a forum on Capitol Hill, Ambassador Pavilionis, the Lithuanian Ambassador to the United States and Mexico, said, "An ability to import natural gas from the U.S., even very small amounts by U.S. standards, would make a huge impact on the Lithuanian gas market and allow the nation to develop a reliable alternative to Russian gas."

And in the same forum, Jaroslav Zajicek, the Czech Republic's Deputy Chief of Mission, said, "We have already seen examples where the Russian negotiating position during contract-renewal talks was weakened thanks to decreasing prices on the markets in Western Europe."

There are four major reasons for not exporting natural gas, and I would like to just briefly address them.

Myth one: exporting natural gas will increase prices. I have a chart here that your staff can put up for you showing that as natural gas exports increased, prices actually went down. Drilling efficiency has substantially increased and productivity of oil and natural gas wells is increasing, and we can expect this trend to continue.

Myth two: Actions today will not increase exports until it is too late. We have been saying this for years and years, saying there is no point in exporting natural gas because we do not have the infrastructure in place. To export natural gas, we need more pipelines, more terminals, and this is not going to have an effect for another five years until we get all this in place. But this disregards the role of expectations. Look at what has just happened in Iraq. Without one fewer drop of oil on the markets, oil prices went up.

In the same way, when there is the expectation that the United States is going to do something, futures' prices adjust. And that also affects current prices.

Myth three is that exporting natural gas will increase production and emissions. Environmentalists who do not want the use of natural gas say that this will increase production and emissions, the

opposite of what some other people say. But if natural gas substitutes for coal power, we can find that global emissions will decline.

The final myth is that America is incapable of using its economic power to promote our strategic national interest. This is the most dangerous myth of all, that we are incapable of helping our allies through economic means.

I understand we do not want to put boots on the ground, but we have resources here that by exporting we can create jobs here in the United States and we can also help our allies and friends abroad.

It is in your hands, and I hope that you manage to act by just repealing these regulations. Thank you so much for allowing me to testify today.

[The prepared statement of Ms. Diana Furchtgott-Roth appears in the Submissions for the Record on page 48.]

Vice Chair Klobuchar. Thank you.

Mr. Holstein.

STATEMENT OF MR. ELGIE HOLSTEIN, SENIOR DIRECTOR FOR STRATEGIC PLANNING, ENVIRONMENTAL DEFENSE FUND, WASHINGTON, DC

Mr. Holstein. Vice Chair Klobuchar, and Chairman Brady, thank you for the opportunity to be with you today and the other Members of the Committee, to discuss these important natural gas issues.

There is no question that unconventional gas development is lowering energy costs, creating new jobs, supporting more domestic manufacturing, and even delivering some measurable environmental benefits. But it is also imposing localized public health and environmental risks, and it is accelerating global climate change.

Because of intensive shale gas development, the small town of Pinedale, Wyoming, along with many communities in the Upper Green River Basin, have experienced smog concentrations comparable to those of Los Angeles. And in Pennsylvania, wastewater production from drilling operations has posed major challenges to municipal water treatment plants.

Clearly, public concerns are growing and they are posing a rising threat to the industry's social license to operate. For example, last fall in a national poll the Pew Research Center found that 49 percent of those surveyed opposed the increased use of hydraulic fracturing.

In Colorado, four cities in the heart of the Denver/Julesberg shale gas region, have voted either for a moratorium on shale gas development or to prohibit it entirely. And of course in New York, one of the four states under which the Marcellus Shale lies, there has been a moratorium on shale gas development since 2010.

Let me describe specifically the problem with methane. Natural gas is mostly methane, and when that methane leaks and is vented from well sites and from natural gas infrastructure, it is 84 times more potent than carbon dioxide as a greenhouse gas in the first 20 years after it is released.

Although natural gas does burn more cleanly than coal, these leaking and venting methane emissions are threatening to cancel out the climate benefits that come from gas combustion.

Across our economy, the oil and gas sector represents 37 percent of U.S. methane emissions, the largest of all industrial sources.

There is much research underway, including by us, but while this research goes forward we already know that action to limit methane reductions is needed now. We know that methane released into the atmosphere does serious damage. We also know that those emissions can be reduced dramatically and at low cost in the oil and gas sector.

Let me put a number on that. A recent cost analysis performed by experts at ICF International—based on real data directly from the industry—found a striking opportunity for achieving dramatic reductions in methane emissions from the onshore oil and gas sector.

The study revealed that a 40 percent reduction in methane emissions from that sector could be achieved over the next five years at a cost of less than one penny per thousand cubic feet of gas produced. Low-cost reductions of this magnitude would go a long way toward ensuring that the expansion of natural gas production will not be a net loss for the environment.

That opportunity for a 40 percent reduction in emissions from this sector translates into the equivalent of 54 LNG tankers per year.

Moveover, according to ICF, methane emission reductions at this scale can be achieved using current technology. That is, most if not all of the equipment and operational improvements needed to provide meaningful emissions reductions can already be found on the market.

So we believe that state and federal action to require methane emission reductions is needed now. A few states are beginning to respond. Earlier this year, Colorado put in place the Nation's first and most ambitious set of rules designed directly to reduce all hydrocarbon emissions, methane as well as volatile organic compounds. Altogether, the new rules will annually remove 100,000 tons of methane, 90,000 tons of smog-forming VOCs, equal to the emissions of all the cars and trucks in the State of Colorado today.

EDF, Environmental Defense Fund, worked hard in support of the new Colorado rules, but we were not alone. Anadarko Petroleum, Encana, and Noble Energy—among the largest companies at the forefront of new oil and gas extraction in the Rocky Mountain West—supported the new rules as well.

The Colorado model provides a powerful example that can be drawn upon at the federal level to ensure that states and communities across the country receive a similar level of protection from volatile organic compounds, threats to water supplies, and especially the climate-related harm from methane emissions.

Doing so will deliver multiple benefits to society while ensuring that America's new bounty of natural gas can not only advance our Nation's energy and economic interests but our environmental and public health interests as well.

[The prepared statement of Mr. Elgie Holstein appears in the Submissions for the Record on page 58.]

Vice Chair Klobuchar. Thank you very much, Mr. Holstein. Mr. Meloy.

STATEMENT OF MR. CHARLES MELOY, EXECUTIVE VICE PRESIDENT, U.S. ONSHORE EXPLORATION AND PRODUCTION FOR ANADARKO PETROLEUM COMPANY

Mr. Meloy. Good morning, and thank you, Chairman Brady and Vice Chair Klobuchar, for the pleasure of speaking with the Joint Economic Committee this morning about the economic impacts of the natural gas revolution.

We are indeed in the midst of an energy re-boot in America unlike any I have seen in my 30-year career, and driven by the innovation and technology of the many dedicated men and women of the oil and gas industry.

In terms of technology, the confluence of the time-tested, proven techniques of horizontal drilling and hydraulic fracturing served as the game-changer in opening access to shales and other tight-rock formations.

America's new-found abundance of cleaner natural gas is only possible through the combination of these technologies. In other words, without fracking and without horizontal drilling, there is no new age of energy self-sufficiency in America—which is very important for the geo-political reasons spoken to earlier; there is no material carbon reductions from greater utilization of natural gas that have resulted in the U.S. lowering its total carbon emissions to levels not seen since 1994; there are no lower consumer costs that benefit every American, amounting to $1,200 per household as was mentioned earlier; and there are no substantial taxes, royalties, and leases paid by industry to the tune of $85 million per day, which helps governments pay for important public services, including the education of our children.

In addition, if you think back to 2005 when Hurricanes Rita and Katrina hit the Gulf of Mexico, natural gas prices spiked to $14 per million Btu, demonstrating how dependent the U.S. was on natural gas from the Gulf of Mexico. Shales, gas shales, have provided a geographical diversity in the United States that has stabilized and increased supply and significantly dampened the price volatility.

Production of natural gas in the U.S. has increased 30 percent since that time and, whereas the EIA back in 2009 predicted natural gas prices of $35 per million Btus in 2035, they are now predicting $6 per million Btus.

This is outstanding news for consumers, manufacturers, electrical providers, and others; and it is the economic engine that I believe can bolster the U.S. economy for decades.

The company I work for, Anadarko Petroleum, is currently the third-largest natural gas producer in the United States. We are the largest natural gas producer in Senator Mike Lee's home State of Utah, and we have invested more than $4 billion developing natural gas from the Marcellus Shale in Senators Tommey's and Casey's home State of Pennsylvania.

I am proud that we have achieved a 40 percent reduction in the amount of surface space needed to develop oil and gas in Colorado's Wattenberg Field. By expanding gathering and pipeline infrastructure, we have eliminated more than 10 million truck miles in the

Wattenberg Field, significantly reducing the traffic and associated emissions. We continue to invest in technology to reduce emissions, detect methane leaks, and also source, transport, and recycle water.

The key going forward for industry is for our elected leaders to keep working together toward solutions, refusing to perpetuate a climate of obstruction and the demonization of an industry that is fundamental to modern life. It means recognizing that a vibrant oil and gas industry makes other industries more productive—fueling the economy that creates opportunity.

We recognize the need for comprehensive and consistent state-based regulations. They provide legitimacy for our activities and help build public trust. This is why many states continue to benefit from the shale expansion and tight-sands development. Yet these activities are relatively stagnant on federal lands due to the costly and uncertain federal regulatory environment.

Enabling infrastructure and pipeline expansions will help ensure that we stay ahead of other parts of the world that have shale resources but no infrastructure to move it to market.

Creatively partnering with industry to expand compressed natural gas fueling stations can help put more natural gas in the gas tanks of the American fleet vehicles, meaning cleaner cars, cleaner fleets, cheaper fuel, and less reliance on foreign oil.

We do not have to choose between a future with fossil fuel development or a future with a cleaner environment. We can choose both. It is solely dependent upon our ability to continue to collaborate, rely upon sound science, streamline access, and not just identify problems but do what our industry has been doing for decades: use human ingenuity to find solutions.

Thank you.

[The prepared statement of Mr. Charles Meloy appears in the Submissions for the Record on page 67.]

Vice Chair Klobuchar. Thank you very much.

We are going to start with questions. I guess I will start with you, Dr. Yergin, about this idea of exports. There is a lot of discussion among Senators about how far we should go with exports.

Obviously they are allowed for countries with which we have a Trade Agreement, I believe, and there are some pending applications. Obviously we have a situation where the lower prices—and I know Ms. Furchtgott-Roth would dispute some of this—but the concern is that some of the prices will go up; that one of the reasons we are in this situation with bringing manufacturing back is because of the lower prices. And I just wanted to get some more expanded thoughts from you on the exports and how this would affect U.S. consumers if we had unrestricted exports.

Dr. Yergin. Thank you for the question.

I think the first thing to observe is how dramatic the change in the supply base is. Our view is that the market is really constrained by demand, not by supply, which is different from what we have had for many decades. And production could certainly continue to increase. We have more demand for LNG, but the biggest source of new demand is going to be electric power, and also vehicles as has been mentioned.

We should not just look at this in the U.S. context. I just came back from East Africa. They are gearing up to do major LNG exports. And when we look at the number of projects that are out there, they are far larger than actually the global market can absorb.

Vice Chair Klobuchar. I see.

Dr. Yergin. So the global market is actually going to be constrained. British Columbia is going to be exporting. Of the number that we see of projects, only a fraction of those will end up being built.

Vice Chair Klobuchar. Did you look at what happened with that propane crisis? It was a combination of things.

Dr. Yergin. Yes.

Vice Chair Klobuchar. Some of it was a—I think people underestimated how much we would need in the Midwest, the winter was so cold, when we were colder than Mars.

Dr. Yergin. Yes, it's very interesting about the propane and very important, obviously, to your State and others. It was partly, as you say, the polar vortex. It was a confluence of things. There was a very large corn crop, and a very rainy season, the need for extra propane for drying.

Then on top of that, there were exports. There were also pipelines that were down for maintenance.

Vice Chair Klobuchar. Yes.

Dr. Yergin. And then you had people who are on "will call" as opposed to people who "keep full." And so all of those things came together in those few weeks.

Vice Chair Klobuchar. Okay——

Dr. Yergin. Exports was just one element of it.

Vice Chair Klobuchar. One element. I agree. All right, very good.

Why don't we talk just a minute about methane, Mr. Holstein. According to the study you guys commissioned, the oil and gas industry could achieve a 40 percent reduction in methane pollution within five years for a very low cost.

By addressing this, as you know, the industry could address one of the major reasons that people are opposed to this. Do you think industry is moving to do this? And I guess I will ask Mr. Meloy—I know he touched on this—the same question. Mr. Holstein?

Mr. Holstein. We certainly think that some of the progressive members of the industry are. But they are to some extent constrained by competitors who may not be so anxious to move in the same direction.

And one of the things that has been happening in the headlong rush to develop these new gas resources is that all of the focus of the investment has been in obtaining leases, building the infrastructure, and creating the, if you will, the foundation for this new natural gas boom. And environmental considerations have been somewhat of a second thought on the part of some members of the industry, but not all.

Vice Chair Klobuchar. Um-hmm.

Mr. Holstein. The industry, finally, I would say, was absolutely essential in helping us move forward collaboratively in the State of

Colorado with some of the most comprehensive methane and other pollutant-control measures adopted anywhere in the United States.

Vice Chair Klobuchar. Very good.

Mr. Meloy.

Mr. Meloy. Yes. I do not think it is a coincidence that since 1994 our emissions—we are back to the emission levels of 1994, while gas production has increased by 30 percent. I think that is clear evidence that this is an opportunity to improve the climate of the planet.

And I think if you take a look at natural gas and the way that we can manage the program, it is in our best interests to put every molecule in the pipeline, and that is what we are working hard to do.

We have worked with EDF and many others to make sure that is the standard by which the operators operate, and we are in favor of it.

Vice Chair Klobuchar. Thank you very much. And one last question, Mr. Bruce. You got cut off a little and I know I only have a minute left here, but did you want to expand on your—some of the proposals you have of what would be getting in the way of you converting these trucks to this more efficient fuel that is better for the environment?

Mr. Bruce. I mentioned the Federal disincentives, which is the fact that liquid natural gas is taxed on a volumetric basis as opposed to an energy equivalent basis to diesel. So it is bearing a 70 percent higher tax.

We would love to see Congress address that.

So, and the other thing is the Excise Tax on heavy trucks is on the entire cost of the truck. So I mean we will pay sometimes $65,000—it used to be $100,000—premium on the truck. So we are paying tax on that, as well. So we are being taxed for doing the right thing.

Vice Chair Klobuchar. Okay. Very good—that doesn't sound good. But I think many of us up here would like to see comprehensive tax reform, including Chairman Brady who knows also a little bit about producing energy in his State and his District.

Chairman Brady.

Chairman Brady. Vice Chairman, thank you very much. And thank you all, to the witnesses. It is hugely helpful testimony.

Dr. Yergin, thank you for making the point that, as impressive as the economic impact from this new technology in natural gas is, it is not just occurring in the Gulf States, or in new giants like North Dakota, Utah, or Pennsylvania, but creating 100,000 new jobs in California, which is experiencing, like much of the country, a disappointing economic recovery. Thanks for making that point.

I do not know if your numbers reflect the growing need for pipelines. The continued studies in that area, the last study I saw showed that to be able to deliver this product to the market and back up to the refineries and back to the market, we will need the equivalent of 2 to 3 Keystone XL pipelines every year for the next 20 years—huge economic growth from that standpoint.

Both you and Ms. Furchtgott-Roth made the point that there are a lot of benefits from exports, both from an economic standpoint for

the U.S., from a global price stability standpoint, but also from the geo-political standpoint.

The Middle East has long used its influence through its energy development to shape foreign relations. Russia is doing that in Ukraine and Europe today. Today Sunni rebels captured the largest oil refinery in Iraq, creating a devastating blow to the government's ability to stabilize there.

The thought that our children would never have to grow up wondering if the Middle East will turn the spigot on or off for the United States is kind of exciting. To both of you, can smart exports from the U.S. give us a stronger footing in foreign affairs?

Dr. Yergin. I think the word you used was "influence" and there is no question that U.S. exports of oil and natural gas will give a new dimension to American influence in the world.

It will be a message that will be read around the world. Frankly, I also think it will provide an answer to some countries where there is a view that there is a zero sum struggle with the U.S. over energy. If they are importing from us it will show that we have very common interests. And so I think it is something that is not going to be a miracle solution, but it will certainly bolster the American position and will affect psychology around the world.

Chairman Brady. Thank you.

Ms. Furchtgott-Roth.

Ms. Furchtgott-Roth. Yes, I would like to agree with Dr. Yergin and also say that if we export that means less revenue for Russia, and that is very important, too. And it lowers the price of the natural gas that Russia can export.

Russia is very dependent on its natural gas revenues. We can be cutting into those revenues by exporting because the price will adjust.

Dr. Yergin. Can I add one thing? It is not only theoretical, it is happening, the sanctions against Iran would not have worked had it not been for the increase in U.S. oil production. Simply, the world market would have been too tight.

So this impact is already there from what is happening in this country.

Chairman Brady. Great point. Thank you. I do have legislation that removes the need for energy permits on natural gas, except to state-sponsored terrorist nations, and it seems to me the number of projects—and they are hugely expensive, the exporting projects—that the market itself will take care of the need for these projects.

And, Ms. Furchtgott-Roth, you made the point, too, economically, if we restrict energy exports, just as if we were to restrict cars being exported, computers being exported, Dow chemicals being exported, the price will not go down; they will simply manufacture less of it. And that will happen in the United States as well.

Mr. Meloy, I want to thank you for being here. Anadarko is really our major iconic corporate citizen in The Woodlands where I live. You are a treasured company for us. I saw a picture of one of your projects I think in Utah, Senator Lee's State, that both while it was occurring and afterwards it was nearly invisible to the human eye. And after it was gone, it was invisible.

You have made tremendous progress in reducing your environmental footprint. Advice to us? Do you think the Federal Govern-

ment can do more to facilitate the expansion of domestic natural gas and oil production? And, conversely, what should we not be doing?

Mr. Meloy. Thank you. I appreciate the comments with regard to our position within The Woodlands, and we certainly appreciate your support in Washington.

Our company has been very active on every element of our environmental footprint, including reduction of the viewshed issues, emissions, and the overall activity that we have to get any one job done. We have made significant investments in infrastructure.

And you have talked about the need for that in the future, and I think it cannot be overstated. Investments in pipelines and infrastructure to move this product, confined inside a pipe so we do not have to deal with multiple transfers of the product, is very important and very economically energizing for our economy because it creates a tremendous amount of jobs and activity.

With regard to the Federal Government, I think access is key. The lands that we hold on the BLM lands have not seen the same sort of revolution that other areas, other states like Colorado, Pennsylvania, and Texas have seen. I think that opportunity exists.

We just have to be—we have to work harder to get the opportunity to drill on those lands so that they can be developed in a similar fashion with a similar remit, and a similar footprint that we are seeing in other states.

I strongly encourage state-based regulation so that they can see. They are closer to the action and provide a broader, more definitive set of eyes and regulation toward our activities.

Chairman Brady. Great. Thank you, sir. Yield back.

Vice Chair Klobuchar. Very good. Thank you very much. Congressman Delaney—or, Senator Casey, I think, because a vote was just called. Thank you.

Senator Casey. I will be—I will just, so the Congressman can get his time—I will just ask one question because I know we are pressed for time.

Dr. Yergin, I want to ask you about manufacturing. One of the great benefits of natural gas extraction and the impact it is having on the economy of my home State of Pennsylvania, as well as the Nation, is the benefit it provides to our manufacturing sector.

As we make decisions about it, I just want to make sure that we are going down the right path. I just wanted to ask you about that benefit and how—what advice would you have, or what perspective would you have on this, taking the right steps to manage what I think so far has been a very positive benefit to our manufacturing sector. Can you speak to that?

Dr. Yergin. Sure. I think that the impact we have seen is this turnaround in psychology in terms of companies who thought they would never be investing again in the United States. Your State clearly is a beneficiary, and it extends to many industries. Chair Brady referred to pipes, manufacturing steel. So as you know, areas that seemed to be in terminal decline have really rebounded with a relocation of manufacturing.

And one of the things that really drives it home is if you look at a country like Germany, which depends for 50 percent of its economy on exports, and manufacturing prowess,—the Minister of

the Economy is talking about a "dramatic deindustrialization" because they see their manufacturing companies leaving Germany and investing in the United States.

So it is, as you point out, a very beneficial trend that goes across the economy.

Senator Casey. I will submit a couple of other questions for the record and yield back 3 minutes and 13 seconds.

[Questions for the Record from Senator Robert P. Casey, Jr. appear in the Submissions for the Record on page 68.]

Vice Chair Klobuchar. That is so impressive, Senator Casey. [Laughter.]

Okay, Senator Lee.

Senator Lee. Thank you, Madam Chair. And thanks to all of you for joining us.

Mr. Meloy, first of all thank you in particular for all you do in my State, and for acknowledging what Utah has to offer in terms of our country's energy potential.

As you and I both know, operating in a state like Utah that has a lot of federal land can be challenging. The Federal Government owns about 30 percent of the land mass in the United States, and about two-thirds of the land in my own state. And as you and I are both painfully aware, energy development has not occurred at the same pace in recent years on federal land, particularly onshore development has not occurred at the same pace. In fact, it has been really slow. It has slowed.

So even though we have seen a big increase in recent years in natural gas production, we have not seen that on federal land.

Now whether this drop, whether this slowing has occurred as a result of permitting delays, uncertainty caused by the regulatory environment, or the regulatory difficulty of building a pipeline, the results are clear, which is that there has been a drop in production on federal land.

Can you explain for us in what ways have federal policies adversely impacted the ability of states like Utah with high concentrations of federal land to fully enjoy economic growth and jobs that have been precipitated by this boom?

Mr. Meloy. Thank you, Senator Lee. I would offer two ideas that we are actually actively working on with the government.

The first of which is modernizing the permitting process, using technology such as GIS, that would significantly reduce the boots-on-the-ground type requirements, and the cost of actually doing the permitting process not only for the operator but for the Federal Government.

The second would be—and you are very aware of this—is the process, modernizing the process, or streamlining the process to achieve EIS on critical projects like what you and I did for the Natural Buttes in Utah. I think this is an opportunity where we can utilize parallel processes, good, modern project management practices, to actually do these things on parallel paths and close the timeline that has been continuing to extend now in excess of 10 years.

This process should take 3 or 4 years, tops. And I think that would incentivize people to move and invest in federal lands at a greater pace.

Senator Lee. Thank you. Thank you, that's helpful.

Ms. Furchtgott-Roth, I also wanted to ask you a question. So a lot of people, including a lot of people within the current Administration, have become fond of saying that they promote an "all of the above" energy strategy, and they are saying that at the same time that they are encouraging more use of natural gas domestically, and at the same time that some are advocating that we also open up natural gas to export.

Is this really an all-of-the-above energy strategy when we complicate the process of developing our natural gas resources through permitting delays, regulatory uncertainty, and making it really difficult to build a pipeline?

Isn't that sort of in tension with an all-of-the-above energy strategy?

Ms. Furchtgott-Roth. That's right. It's not all-of-the-above if we are not allowing permitting on federal lands. We could be getting immense amounts of tax revenue, royalty revenue from such permitting. We also need a vast new infrastructure of pipelines, not just Keystone XL. Oil and natural gas that is being produced in the Bakken Region has lower prices because we just cannot get it out.

Lower prices for that oil means less tax revenue for North Dakota and other States. So the oil that is trapped is selling at a discount to Brent Crude. That means less tax revenue for the states where it is taking place.

And the State Department has just come out with a report saying how if oil is transported by rail rather than pipeline, there will be more fatalities and more injuries. I think it is clear that we need to have a bigger—all-of-the-above should mean more pipelines.

When we talk about "all of the above," we should also be careful not to impose on ordinary Americans' high utility costs caused by the high price of solar and wind, and force them to buy it, because it costs twice the amount to produce electricity through wind and solar as it does through natural gas and coal.

Senator Lee. So part of your concept of all-of-the-above would mean everybody competes, everybody competes on a relatively level playing field——

Ms. Furchtgott-Roth. Exactly, yes, and there are many people concerned about inequality, and the bottom fifth of the income distribution. People in that group spend about 25 percent of their income on energy—that's gasoline and electricity. And we need to be mindful of their welfare and not force them to buy more expensive fuel.

Senator Lee. So this hurts the poor more than anyone else.

Ms. Furchtgott-Roth. Exactly, yes, because the top quintile has spent 4 percent of their income on energy, on average, as opposed to 25 for the bottom quintile. Requiring them to buy electricity produced by wind and solar adds to inequality.

Senator Lee. It sounds very regressive.

Ms. Furchtgott-Roth. Exactly.

Senator Lee. I see my time has expired. Thank you, very much. Thank you, Madam Chair.

Vice Chair Klobuchar. Thank you. I think Congressman Delaney is next, and I am going to the vote now, and so I want

to thank the witnesses very much for being here. It was a good hearing. Thank you.

Ms. Furchtgott-Roth. Thank you, very much.

Representative Delaney. Thank you, Vice Chair Klobuchar, and I want to also thank the witnesses for their testimony here today.

When confronted with these questions about kind of significant energy decisions, I have developed my own kind of three-part test, which is:

The first part is: Is it in the economic interest of the United States?

The second part of the question is: Is it consistent with our national energy policy as it continues to evolve?

And the third part is: Is it consistent with our view of the environment?

And when I look at the decision as it relates to exporting natural gas, to me I get a resounding "yes" on all three of those tests. I do think it is very consistent with the economic policy of the United States. This is a U.S. asset. There is a very big business opportunity associated with producing this.

I understand there are potentially some negatives associated with energy costs related to the manufacturing sector. I tend to think they will work through that over time. But I think it clearly tips in favor of this being a very significant economic opportunity for the U.S.

I think it is consistent with our future energy policy. Natural gas has to be a bridge to the kind of energy future that at least I envision for this country.

And then thirdly, I think it is very consistent with our environmental policy if done in a safe and accountable way, including vesting a certain amount of local control on these decisions to local communities. Again, I think it is very consistent with our future environmental policies.

So to me, I think we should approve all these export facilities. I think it would be very good for the economy. I am not sure how many of them will be successful. I tend to think they will find natural gas all over the world. The technologies and things that we are using here are going to be there, I am sure they're using like crazy all over the world and probably half of them will go out of business but I'm all for approving them all.

When I apply the same test, for example, though, to Keystone, I get a "no." I don't think it is consistent with our economic policy because it is largely not our asset and it will be sold to the world market. It will create some jobs in the short term, but in the long term it does not really do anything.

I do not think it fits with our long-term energy strategy. And it certainly does not fit with our long-term environmental strategy, if you actually care about climate change, which I do quite strongly, which I actually think does have to be factored into the cost.

When we talk about a level playing field, you cannot not include the cost of climate change in that calculus. But my question for the witnesses is:

If there were to be an increase, which I think would be temporary, related to natural gas prices associated with increasing our

exports, do you think that would actually help the renewable business in this country? And in a way, is it in fact somewhat of a pro-environmental policy? Because if you believe in markets, which I do, which is one of the reasons I think we should export because we are America, I do believe in free markets and we shouldn't be hoarding this stuff, but if you believe in markets, you have to assume that if we increase exports the price of natural gas will go up. Do you think that will help the renewable business?

I will start with you, Dr. Yergin.

Dr. Yergin. Well I think the renewable business, two things are helping the renewable business. One, costs are coming down. Solar costs have come down a lot, one significant reason is over-capacity in Chinese manufacturing. Wind costs have also come down.

Natural gas is a kind of natural partner of renewables because of the intermittency. So even if you have a strong renewable strategy or mandates, as we have, as has already been pointed out, you are going to need more natural gas capacity to balance it out.

Representative Delaney. So my question is, though, on the price. Does the price—Ms. Roth, maybe you could comment on this—does the price increase in natural gas, which will probably happen if we increase exports for at least the time being, I know your data suggests otherwise, I'd love to see what is behind some of that data, but if we were to assume for a second, which you may not agree with, that the price might go up, will that actually help the competitiveness of renewables? And to some extent steer the country towards this greener future that at least I want, and many share that view.

Ms. Furchtgott-Roth. The price of natural gas, if it goes up, will still be far below the costs of producing electricity with solar and wind, which those are heavily dependent, by the way, on the tax credit. So that is also going to be a favor, if Congress keeps the tax credits in——

Representative Delaney. But it narrows the gap, it sounds like.

Ms. Furchtgott-Roth. It does narrow the gap, but it doesn't make it a winner.

Representative Delaney. But if we continue to see the kind of cost improvements associated with renewables that Dr. Yergin mentioned, you could actually see how this could take you down the path towards a more competitive renewable portfolio.

Ms. Furchtgott-Roth. I would say the cost of natural gas, electricity produced by natural gas, is always, for the foreseeable future, going to be less than the cost for electricity produced by solar and wind.

And by the way, the reason to have Keystone also is because we have refining facilities in Louisiana and Texas that benefit from the heavy crude being exported from Canada. We want the job of refining that heavy crude. We don't want that to be going elsewhere and be refined elsewhere. We want those jobs.

Representative Delaney. I'm going to switch to Mr. Holstein, but it is interesting you mentioned how the Keystone, because the Keystone tar sands are trapped up there, it is actually allowing it to be sold at cheaper prices to the Midwest. So to some extent Mid-

westerners are getting the benefit of lower energy because we do not have the pipeline, which is interesting.

Ms. Furchtgott-Roth. Yes, but Canada has just approved its Northern Gateway pipeline that is going to take its oil out to the East and to the West and to Asia.

Representative Delaney. Well it's their oil. They can do what they want with it, I guess.

Mr. Holstein.

Mr. Holstein. I think the answer to your question is, it all depends. But the fact is that natural gas actually pairs quite well with renewable energy, because it helps compensate for the intermittency of renewables.

So as we continue to make strides in advancing the complexity and functionality of the Nation's grid, the opportunity for natural gas to dramatically expand the penetration of renewables goes up, even if natural gas prices go up somewhat.

Representative Delaney. Right.

Mr. Holstein. It is very difficult to predict just where international natural gas prices would settle, because that depends, as you suggested, on new sources around the world, the level of demand, and very heavily on the rather high transportation costs from the United States to foreign markets.

Representative Delaney. Right. Mr. Meloy, I don't know if you have a view on this?

Mr. Meloy. I think Mr. Holstein made some great comments. I would add that I sense that it has a very similar lifecycle to what natural gas has seen, where the new technologies that are being employed today and deployed in the oil fields and gas fields of America have delivered a lower cost, and even safer condition.

So I foresee that renewables will follow that trend and, because of its pairing with natural gas and renewables, that that is a very complementary and virtuous cycle.

Representative Delaney. I see my time is up. Thank you.

Chairman Brady [presiding]. Thank you, Mr. Delaney.

Former Chairman of the Joint Economic Committee, Mrs. Maloney is recognized.

Representative Maloney. I thank all the panelists, and the Chairman, and the Ranking Member, for holding this truly important meeting.

I want to really raise an issue that Mr. Holstein raised with methane. In many studies after studies, researchers have found that Americans living near these sites are more likely to develop respiratory illnesses, birth defects, and other possible health problems.

And I very much appreciated Mr. Holstein's testimony which focused on the real costs of increased methane emissions, and his point that we need to make sure that it is not leaking, that the methane is not leaking. And it is a huge greenhouse gas, and we need to control that.

But my question to you, Mr. Holstein: Before we further increase natural gas production, we need to evaluate this, the methane and how that is being controlled, and other issues to determine that all necessary safeguards are in place to protect the water and air. And are we doing that? Your comments and words on that?

Mr. Holstein. Thank you, Congresswoman Maloney. I strongly agree with the sentiment that the race to develop America's bounty of new natural gas is one that needs to be accompanied by an equally fervent effort to ensure that the new infrastructure that is built to produce and transport and use that natural gas, including in transportation, be as tight as it can be.

And the good news there is that the technology exists, as I indicated in my testimony, to tighten up the system and also to ensure that new infrastructure is very tight, as well. The fact that natural gas is 84 times more powerful in the near term than CO–2 as a bad actor on climate merely exacerbates globally the local conditions you just referred to in terms of air quality and public health.

Representative Maloney. I think that is important, and I think a broader issue is how do we accomplish what you are saying? If the technology exists, why are we not using it? Of course it is very expensive. And most of the fracking and other activities are exempt from important federal protections that Congress passed, such as the Clean Water Act.

So we cannot go in and enforce Clean Water protections that we have in other areas because this is specifically exempt. So I would like to ask all the panelists, yes or no, do you think it is a good idea to exempt from important federal protections that Congress passed, such as the Clean Water Act, these harmful—in some cases, they are, like the methane emissions that Mr. Holstein mentioned. Yes or no, do you think it is a good idea to exempt fracking from the Clean Water Act?

Mr. Yergin, yes or no? Yes, or no, because I have a lot of questions.

Dr. Yergin. I will just say that I think this is a highly regulated activity. Much of it is regulated by the states. And——

Representative Maloney. Okay, so yes, or no. Do you think it is a good idea for it to be exempt from the Federal Clean Water Act?

Dr. Yergin. I think as long as it is heavily regulated appropriately by the states.

Representative Maloney. Okay. All right. Mr. Bruce?

Mr. Bruce. Yeah, I mean as far as we're concerned, we pay for the gas and we have safety concerns to worry about, so what you're describing is upstream of us. I mean, we would——

Representative Maloney. Yes or no? I mean, you can talk all day on this.

Mr. Bruce. I would agree with Dr. Yergin, that we would presume that——

Representative Maloney. Yes, okay. Ms. Roth?

Ms. Furchtgott-Roth. Yes, it should be up to the states. We should roll back all that legislation and leave it——

Representative Maloney. Mr. Holstein——

Ms. Furchtgott-Roth [continuing]. To the states.

Mr. Holstein. In general, I don't think it's a good idea and I do think that we need to have more comprehensive federal and state regulation to be sure——

Representative Maloney. But do you think it should be exempt from the Clean Water Act?

Mr. Holstein. No.

Representative Maloney. No? Okay.

Mr. Malay.

Mr. Meloy. Meloy.

Representative Maloney. Meloy, I'm sorry.

Mr. Meloy. No. I think it's a heavily regulated industry and the states are best suited to regulate us.

Representative Maloney. Okay. So it should be exempt from the Clean Water Act, according to you. Right.

Okay, also do you think it should be exempt from the Clean Air Act? Because it is already now, even though fracking involves dangerous, harmful chemicals.

Mr. Yagan, yes, or no?

Dr. Yergin. "Yer-gin." Yergin.

Representative Maloney. Yergin, I'm sorry, that pertains to your testimony. Yes, or no.

Dr. Yergin. I'm going to defer to Mr. Holstein who will have——

Representative Maloney. Mr. Bruce?

Mr. Bruce. I'm not aware of the implications of that.

Representative Maloney. So you're not taking a position?

Mr. Bruce. No.

Representative Maloney. Okay, Ms. Roth?

Ms. Furchtgott-Roth. Yes, the states should be regulating their own affairs, not the Federal Government.

Representative Maloney. Okay.

Mr. Holstein.

Mr. Holstein. Exemption from the Clean Air Act? Absolutely not. I think the Administration has the authority and should use it to ensure that these localized emissions that you referred to are addressed.

Representative Maloney. No, you don't have it if you're exempt from it. Okay, Mr. Meloy?

Mr. Meloy. Thank you. I actually think the state regulators are doing a fine job in this arena and they have provided, as has Colorado, with a very sound basis on which to regulate this activity.

Representative Maloney. But we know that states have different standards, and some states have higher standards than others. So how should policymakers specify and document the health costs to communities that could come from fracking to clean water that's been documented in others?

And also, Dr. Yergin, you recently released a report, an IHS report, that supports the economic benefits of developing America's natural gas resources. But I was concerned that the report did not account for the negative impact of poorly executed extractions.

We know that there are many positive benefits, but how do we make sure that the technology is there, that the problems aren't there? And do your reports assess whether a lack of health and environmental protections could hurt the public? Just on your report, Dr. Bergin, and also in a broader sense I would like to go to Mr. Holstein first and then others on how do we document the environmental and health costs? We are documenting the benefits, the money you make, but not what happens to our environment and the health of individuals.

First, Dr. Yergin, and thank you for your research.

Dr. Yergin. Thank you, Representative Maloney. I served on the Commission that President Obama had set up on the environmental aspects and concerns around fracking and around shale gas. And I think that report pointed to four areas to focus on, and said that these are issues that need to be managed. And I think the takeaway was that they are largely being managed.

I think the issue of methane that has been surfaced, and EDF has played a particularly important role in trying to actually get a handle on measuring it, to know what are the volumes of methane that are being emitted or not being emitted, and they have been very constructive in that.

Representative Maloney. Okay—and may we have time for Mr. Holstein to respond?

Chairman Brady. Yes, why don't we have him wrap up.

Representative Maloney. Thank you.

Mr. Holstein. Thank you, Mr. Chairman.

Representative Maloney. And anyone else who wants to testify.

Chairman Brady. I didn't say that.

Mr. Holstein. Environmental Defense Fund, together with roughly a hundred university, academic, scientific, and industry partners, are in fact doing many of these measurement studies to which you allude.

But there also exists the technology necessary to monitor the air in many of these regions, and for these reasons the State of Wyoming has adopted stronger rules with respect to volatile organic compounds. Because as I said in my testimony, they have so much natural gas development going on there that they have ended up with air quality in much of the Upper Green River Basin equivalent to downtown Los Angeles. So the technology already exists at the state and local levels to monitor air quality.

We in particular are looking at methane emissions.

Ms. Furchtgott-Roth. This is a very complicated issue, and states make their own tradeoffs. For example, if New York were to have fracking at the same rate as Pennsylvania, New York State would have another $8 billion over the next four years, but it has made that tradeoff not to do so.

Individual states make their tradeoffs with respect to fracking and jobs and employment and what they need. And we need to leave it like that because there are many advantages to Washington D.C., but we cannot decide on the combination of oil exploration and jobs and income for all of the 50 states, not to mention all of the counties.

Chairman Brady. Thank you very much.

I want to thank Vice Chair Klobuchar who hosted this hearing today. This is a timely subject. There is a lot to it that matters. The witnesses have been tremendously insightful and I want to thank you all for being here today.

With that, the hearing is adjourned.

(Whereupon, at 11:32 a.m., Tuesday, June 24, 2014, the hearing in the above-entitled matter was adjourned.)

SUBMISSIONS FOR THE RECORD

PREPARED STATEMENT OF HON. KEVIN BRADY, CHAIRMAN, JOINT ECONOMIC COMMITTEE

Vice Chair Klobuchar, Members, and distinguished witnesses:

Free market capitalism and science are revolutionary forces that can change the world for the better. George Mitchell, the founder of my hometown, The Woodlands, Texas and a noted philanthropist and environmentalist, first combined hydraulic fracturing, which uses pressurized liquid to break rocks and release the natural gas and oil trapped within, and horizontal drilling.

This combination has turned the world of hydrocarbons upside down. In the winter of 1977–78, President Carter warned that the United States could exhaust its supply of natural gas in two generations. In response, Congress passed legislation to limit the use of natural gas in industry and electricity generation.

Even as recently as 2012, President Obama incorrectly warned that "with only 2 percent of the world's oil reserves, we can't just drill our way to lower gas prices, not when we consume 20 percent of the world's oil." Yet, as he was making those dated remarks in his weekly radio address, America was experiencing an energy renaissance.

In recent years, fracking and horizontal drilling have greatly increased the potential supply of natural gas and oil in the United States. Consequently, the United States does not need to import liquefied natural gas (LNG) and is reducing its dependence on foreign oil outside of sources among our friendly neighbors, Canada and Mexico.

In April's Annual Energy Outlook 2014, the Energy Information Administration projected that domestic crude oil production will increase from 6.5 million barrels per day in 2012 to 9.6 million barrels per day in 2020, a production level not seen since 1970. Moreover, the import share of U.S. petroleum and other liquid fuels will fall to about 25 percent during the last half of this decade. Indeed, the United States can become a major exporter of LNG.

Fracking and other improvements in production technology have opened vast stores of domestic oil and natural gas and have lowered production costs. In light of recent developments in Ukraine and Iraq, increased U.S. production of both oil and natural gas will make our economy far less dependent on costly and unreliable oil imports and will mitigate the prices of both oil and natural gas, if this White House does not interfere or attempt to slow down domestic production.

America's energy revolution has also created tens of thousands of well-paying jobs during a disappointing economic recovery. These jobs cover the entire spectrum from the unskilled to the highly skilled, and are a new source of employment for minority workers across the country. As the energy workforce ages out, even more opportunities will occur for workers of all skills.

Of course, more American-made energy means more American-made tax revenues for communities, states and the federal government. With the exception of individual tax receipts, the energy industry is now America's second largest taxpayer. So more natural gas production in America helps to balance the budget and fund necessary services to families who need assistance.

Despite the natural gas and oil revolution, some people prefer renewable, zero-emission energy sources such as wind, solar and geothermal power. Renewable fuels should be encouraged, but none of these "green" energy technologies has yet to demonstrate sufficient economies of scale to compete with fossil fuels as a major energy source without dependence on significant taxpayer subsidies, regulatory mandates, and tax preferences. While future technological breakthroughs are possible, as of today "green" energy cannot compete affordably with traditional energy in the free market.

Developing countries have rejected the siren song of "green" energy, and many developed countries that had embraced it, such as Germany and Japan, are backing away from their earlier commitments.

Some environmentalists continue to press for their preferred sources of energy even though natural gas can reduce greenhouse gas emissions more quickly and at less cost. Artificially supporting current "green" energy technology takes money away from development of new "green" technologies that could be competitive with fossil fuels on their own merits.

The U.S. legal and regulatory regime for international trade in oil and natural gas as well as a continuing mindset in some quarters are stuck in a time of import dependency. But the United States now is in a position to export natural gas, petroleum products, and even high quality "light" crude oil. We must adapt our mindset and our rules accordingly. We must do so for the sake of the domestic economy, the stability of world oil and gas prices, and geopolitical stability. The Administration has been slowrolling drilling permits, licenses for LNG export terminals, and ap-

provals for deliveries to countries that do not have a free trade agreement with the United States, meaning all but 20 countries, none of which is in Europe.

The fracking revolution has both profound economic and geopolitical implications. Fracking has the potential to increase alternative sources of supply in North America and reduce the world's dependence on supply from North Africa and the Middle East. Exports of domestically produced LNG and refined petroleum products can also alleviate Europe's dependence on Russia.

The fracking revolution is a win for everyone involved. Domestic natural gas and oil production is igniting an industrial renaissance in the United States, especially in industries that are energy intensive or use natural gas and oil as feedstock; and it is creating tens of thousands of high-paying jobs for middle-class American workers.

With that, I look forward to the testimony of today's witnesses.

JOINT ECONOMIC COMMITTEE OF THE UNITED STATES CONGRESS

WASHINGTON, DC • JUNE 24, 2014

PREPARED TESTIMONY:

AMERICA'S NATURAL GAS REVOLUTION: WHAT IT MEANS FOR JOBS AND ECONOMIC GROWTH

by Dr. Daniel Yergin[1]

Vice Chair Klobuchar and Chair Brady and members of the Committee,

It is an honor to speak with you today about how America's energy position has been transformed over the last half decade by what is happening with energy and, specifically natural gas, and the new opportunities this provides for economic growth and employment.

One is cautious about using the word "revolution"; but, given the scale of the change, it is appropriate to describe what is unfolding in the United States in terms of shale gas and tight oil as an "unconventional revolution in oil and gas". Natural gas production increased 27 percent between 2007 and 2013. Estimates of recoverable natural gas reserves have more than doubled

[1] Daniel Yergin is Vice Chairman of IHS, and author of *The Quest: Energy, Security, and the Remaking of the Modern World* and *The Prize*, for which he received a Pulitzer Prize. He chairs the Energy Security Roundtable at the Brookings Institution..

since 2005. U.S. oil production has increased 3.3 million barrels per day since 2008 – a 66 percent increase. This increase alone is larger than the output of 11 of 12 OPEC countries.

It has become apparent that the impact goes far beyond energy itself. Since 2009, we at IHS have engaged in several studies to better understand and quantify the dramatic economic contributions associated with this unconventional revolution.

- By 2012, the unconventional natural gas and oil activity was already supporting more than 2.1 million jobs across a vast supply chain–a considerable accomplishment given the relative newness of the technology. About 60 percent of these jobs – 1.3 million – were from shale gas activity; the rest from tight oil.
- We expect the total number of jobs to rise to 3.3 million by 2020 – with 1.8 of those jobs from shale gas.
- In 2012, this revolution added $74 billion to federal and state government revenues, a number that we project to rise to about $125 billion by 2020.[2]

What is now becoming clear is that the lower costs of energy brought about by this abundant growth in natural gas supply is helping to stimulate a manufacturing renaissance and improving the competitive position of the United States in the global economy and further stimulating job creation in the United States. Overall, the unconventional revolution – shale gas and tight oil – has helped to strengthen the U.S. economy and has proved to be an important contributor to the U.S. economic recovery. A few months ago, former Federal Reserve Chairman Ben Bernanke described the unconventional revolution as "one of the most beneficial developments if not the

[2] IHS, *America's New Energy Future: the Unconventional Oil and Gas Revolution and the United States Economy, vol. 1 National Economic Contributions* (October 2012); *vol. 2, State Economic Contributions (December 2012); vol. 3 A Manufacturing Renaissance.*

most beneficial development since 2008" in the economy.[3] The unconventional revolution came along at the right time. One might well wonder how our economy would look today without it – much higher energy bills, higher unemployment, lower growth.

How did the unconventional revolution develop and how big is this natural gas revolution?

It took about two decades for the development of the technological base. But, since 2008, the unconventional revolution has unfolded rapidly. As recently as just six years ago it was widely assumed that a permanent era of energy shortage was at hand. The country, it seemed, was on a path to spending several hundreds of billions of dollars more every year on imports to meet oil and natural gas demand. How different things look today. US crude oil output, after a nearly 40 year decline, has increased dramatically, as recounted above.

With respect to natural gas, in just six years, US Lower 48 natural gas production has risen from 52 billion cubic feet (bcf) per day in 2007 to 66 bcf per day in 2013 – a 27 percent increase. This rapid rise was driven primarily by shale gas production. Today, unconventional natural gas activity accounts for nearly 67 percent of total U.S. lower-48 natural gas productive capacity and is projected to rise to nearly 75 percent by the end of the decade. This "unconventional gas" includes shale gas, tight gas, and coal bed methane. Shale gas alone accounts for 44 percent of total natural gas production – compared to 2 percent a little over a decade ago. Estimates of the recoverable natural gas resource base in the US Lower-48 have grown from about 1,400 Tcf in 2005 to a conservative estimate of about 3,000 Tcf today.[4] This includes proved reserves as well as probable and possible resources and includes conventional resources as well as

[3] IHS CERAWeek, March 7, 2014

[4] Energy Information Administration; Potential Gas Committee; IHS.

unconventional resources. Total natural gas consumption in the US Lower 48 in 2013 was 70 Bcf per day, or 25.7 Tcf for the year. This means that US Lower 48 resources are sufficient to supply current consumption rates for over 100 years.

This rapid rise in unconventional production has also enhanced US energy security. Six years ago, due to constrained production, the United States seemed locked into importing increasing amounts of liquefied natural gas (LNG) and was heading towards spending as much as $100 billion dollars annually on future imports. Now, these newly available resources ensure that the United States will need, at most, minimal LNG imports to balance supply with demand. Instead of debates over US imports, there is the opportunity to begin exporting some of the domestic surplus, as well as the potential for using natural gas in some classes of vehicles.

How has this shale gas and tight oil revolution affected the economy and individual states?

While various states had begun to home in on the economic development aspects of shale gas and tight oil, it was only in last few years that its significance for the national economy started to come into focus. We have undertaken a series of studies to assess the economic impact of the unconventional revolution. The studies have examined the national and state-by-state impacts and the impact on manufacturing.[5]

So far, as already noted, this unconventional revolution supported more than 2,1 million jobs in 2012–direct, indirect, and induced. Looking towards the future, the industry will continue to contribute to strong job growth bringing the total to 3.3 million workers by the end of this decade. The federal budget continues to be a source of great concern. Thus, it is significant to

[5] IHS, *America's New Energy Future: the Unconventional Oil and Gas Revolution and the United States Economy, vol. 1 National Economic Contributions* (October 2012), *vol. 2, State Economic Contributions (December 2012), and vol. 3 Manufacturing Renaissance (Sept. 2013). . vol. 3, A Manufacturing Renaissance*

observe the impact on revenues arising from this energy revolution.. Between 2012 and 2035, unconventional activity is expected to generate nearly $1.6 trillion in cumulative government revenues.

Strikingly, the economic impacts are not limited to states that produce natural gas and oil. Owing to the long supply chains, the job impacts are being experienced across the United States, including in states without significant shale gas or tight oil activity.[6] In other words, when it comes to unconventional activity, a state does not need to have a major unconventional play within its geographic boundaries to benefit economically from the activity. In fact, more than a quarter of all jobs associated with the unconventional energy revolution are found in states with no appreciable unconventional activity. For example:

- *Minnesota* supplies – among other items – many of these special sands required for hydraulic fracturing. The economic activity directly and indirectly supported over 19,000 jobs in the state in 2012 and is expected to increase to nearly 35,000 jobs by 2020. In 2012, it generated over $525 million in taxes for state and federal coffers. This includes over $260 million in state and local taxes
- *Wisconsin* is an important supplier of the special sands required in unconventional extraction using hydraulic fracturing techniques. Machinery manufacturers in the state also provide significant oil and gas field machinery to the unconventional activity around the country. As a result, in 2012 Wisconsin's economic activity

[6] Producing states are defined as those that are part of the 20 largest unconventional oil and natural gas producing plays in the US Lower 48, such as the Bakken and Marcellus Shale plays. Non-Producing states are not part of the 20 largest unconventional oil and natural gas producing plays in the US Lower 48 and are not part of an emerging oil or natural gas play in the 2012 to 2035 forecast horizon. These states may be part of plays that are currently producing oil and/or natural gas, but nevertheless are classified as non-producing states, because current production is relatively small and the prospect for future unconventional production is unknown.

associated with unconventional production directly and indirectly supported nearly 20,000 jobs and generated $330 million in state and local taxes.

- In *Illinois*, the supply chains supporting unconventional oil and gas production directly and indirectly supported more than 38,600 jobs and generated over $1 billion in taxes for state and federal coffers. This includes $450 million in state and local taxes. This employment is expected to increase to just over 66,600 jobs by 2020.
- In *New York*, a state that currently bans unconventional activity, 44,000 jobs along with $1 billion in state and local taxes can be attributed to activities supporting the supply-chain associated with shale gas and tight oil in other states across the country in 2012.
- In *California*, the economic activity associated with unconventional oil and gas produced in other states supported nearly 100,000 jobs in the state in 2012, mostly in the industrial and chemical manufacturing sectors. This number represents 8% of the state's total manufacturing jobs. These employment numbers are expected to increase 50% to 153,000 jobs by 2020. Another contribution of unconventional gas employment is to government revenues. In 2012, it generated nearly $3 billion in taxes for state and federal coffers. This includes over $1.6 billion in state and local taxes.

A key reason for the profound economic impact of the unconventional activity is the fact that it combines a capital-intensive industry with a broad domestic supply chain. The United States is a leader in all aspects of the unconventional industry, which means that most of its suppliers are domestically-based, and that means a larger portion of the dollars spent are supporting domestic

jobs in trucking, steel fabrication, information technology, aggregates, heavy equipment manufacturing, finance, hotels, housing, and restaurants, among many others.

Manufacturing Renaissance?

There are also significant implications for American manufacturing. Several factors are shifting the economics in favor of on-shoring and fueling the resurgence of manufacturing in the US. First, global labor wage rates for many off-shoring locations have significantly outpaced US wage increases, narrowing the wage gap. Second, in an increasingly advanced manufacturing world, technology is shifting the balance away from the importance of low cost labor toward higher skilled workforces. Third, a rapidly evolving energy landscape is fundamentally shifting the traditional economics around supply chains as higher oil prices are altering transportation costs and incentivizing companies to site manufacturing locations closer to end markets, thus making off-shoring less attractive;

But what looms largest is the new era of affordable and abundant domestic natural gas. This is creating significant competitive advantages for both energy intensive industries and their supply chains and industries that rely upon natural gas derivatives as critical feedstock into production.

As a result, companies are now committing or planning investments that in total are very significant. In his 2014 State of the Union Address, President Obama pointed to the large amount of new investment in U.S. industry as a result of lower natural gas prices. One new census finds $117 billion of new investment announced just in petrochemical facilities .[7] Other censuses of

[7] State of the Union Address, January 28, 2014; American Chemistry Council, "Notes on Shale Gas and Manufacturing," June 2014.

investment range higher. The chemical industry is well positioned to capitalize on the benefits of this unconventional revolution. This industry is highly energy intensive, using energy inputs, mainly natural gas and natural gas liquids, as both the major fuel source and feedstock. The US chemical industry's feedstock prices are now among the lowest in the world. As a result, the US is gaining a decisive competitive advantage in the cost of producing basic petrochemicals like ethylene, ammonia, methanol, and their downstream derivative products. The chemical manufacturing industry currently stands as one of America's largest exporting industries with $198 billion in annual exports that accounted for 13% of all US merchandise exports in 2012 and representing a 30 percent increase in value of net exports since 2007.

The investments are coming from many US based companies. Dow, for instance, has announced $4 billion dollars of new investment in the United States owing to lower gas prices. Dow's chairman and CEO Andrew Liveris explained this shift thusly: "Manufacturing in the United States is undergoing a renaissance, facilitated in substantial part by reasonable and stable natural gas prices. For the first time in over a decade, domestic manufacturers in multiple industries, including petrochemicals, fertilizers, glass, aluminum and steel, are planning to invest in production facilities in the United States."[8]

But it also most notable that 62 percent of that $117 billion represents foreign direct investment by non-U.S. companies. For instance,

- Methanex has announced plans to disassemble two $500 million methonal plants in Chile to reassemble them in Geismar, Louisiana;

[8] Andrew Liveris, Testimony, Senate Energy Committee, February 12, 2013.

- And since 2009, BASF has invested more than $5.7 billion in North America to significantly expand production and take advantage of the lower gas prices.

Moreover, this manufacturing renaissance is carrying far beyond the petrochemical industries. Other industries – such as iron and steel fabrication –are seeing benefits as will industries that can take advantage of the economic opportunities being unlocked by all the activity associated with natural gas. These varied companies are committing many billions of dollars to additional investment in the United States. Again this includes foreign as well as U.S. companies. For example:

- Austrian steelmaker Voestalpine announced plans to invest $715 million to build an iron-ore processing plant in Texas Investment that will double its total output by 2020 and mostly abandoning any major new investments in Europe.
- Siemens invested $350 million in a new Gas Turbine facility to supply steam turbines and generators;

This new competitive advantage is recognized by both companies operating in Europe and now governments. Germany depends upon exports for about 50 percent of its GDP, compared to 13 percent for the United States. Germany's economy has been the foundation for Europe during these years of economic crisis, and its export prowess has been the envy of many nations.

But now there is widespread concern in both the German government and German industry about the loss of competitiveness to the United States owing to Germany's own high-cost energy strategy and the US' new energy advantage. Investment in industry in Germany is stagnating, while German companies, along with other European companies, are now making major commitments to investment in the United States. The German Economics Minister

warned of a "dramatic deindustrialization" of Germany owing to this disparity[9]. Earlier this month, in response to this situation, the German government indicated that it would consider the development of shale gas[10].

How does this directly impact American households?

Finally, and perhaps most importantly, the unconventional gas revolution increased average household disposable income in 2012 by $1,200 – a number that will grow to $2,700 by 2020. Most of this is natural gas related: First, households spend less of their total income on utilities, whether directly for less-expensive natural gas or by lowering the cost of electricity generated with natural gas. Second, savings are passed on from the lower costs of goods and services in the broader economy as producers and retailers enjoy lower energy costs.

But an Immediate Risk

A word of caution to bring to the attention of this Committee because of its focus on the overall U.S. economy. While U.S. crude oil production has increased dramatically since 2008, the 3.3 million barrels per day increase has almost exactly balanced the amount of oil currently missing from the world market owing to disruptions in countries like Libya and Iraq and sanctions on Iran. In other words, the increase in U.S. oil production has compensated for loss of oil elsewhere. Without that increase, we would be looking at much higher oil prices than today.

[9] IHS, *A More Competitive Energiewende: Securing Germany's Global Competitiveness in a New Energy World (2014), p. 1*

[10] *Financial Times*, June 4, 2014.

Iraq has been regarded as one of the key sources for new oil supplies for the world. The unfolding crisis in Iraq has removed, it appears, a couple of hundred thousand barrels per day from the world market. This – plus overall anxiety -- has led to relatively small increases in oil prices. Southern Iraq is the major source of Iraqi production. It is hundreds of miles from the current struggle in the north. But if either conflict or breakdown in governance or sabotage disrupts supplies from the southern region, then the world oil market could well enter into a crisis of supply, with prices spiking much higher than they are today. This would be a major setback for the U.S. and world economy. It is urgent to be prepared to deal with what may be an imminent risk.

Conclusion

Altogether, the unconventional natural gas and oil revolution has already had major impact in multiple dimensions–beginning with U.S. energy supply and costs and now extending to government revenues, manufacturing, household spending, and the wider economy. Its significance will continue to grow as it continues to unfold. These hearings provide a very timely opportunity for assessing that impact and significance in its many dimensions, and I am pleased to respond to the committee's questions.

Testimony of Jim Bruce

Senior Vice President, Corporate Public Affairs

UPS

To the United States Joint Economic Committee

Hearing on "The Economic Impact of Increased Natural Gas Production"

216 Hart Senate Office Building

June 24, 2014

Vice Chair Klobuchar, Chairman Brady, and Members of the Committee

Thank you for the opportunity to testify on the economic impact of increased natural gas production as seen from UPS's vantage point. Natural gas is revolutionizing trucking, especially heavy-duty trucking, for UPS and the rest of the industry, creating domestic jobs, and offering the promise of lower transportation costs and a cleaner environment. To appreciate just how important natural gas production is to UPS today requires some history.

Our company began in Seattle in 1907, over a century ago, as couriers of messages, not packages, couriers on foot with a few bicycles. We graduated to motorcycles, but six years elapsed before the company purchased its first truck, a Model-T Ford. As the telephone gradually displaced message couriers, the company reinvented itself and began delivering customers' packages for department stores. Over the next three quarters of a century, UPS acquired more and more trucks, eventually an aircraft fleet, and became ever more dependent on petroleum. (I should mention that we acquired a fleet of plug-in electric trucks for New York City in the 1930's, but gradually retired them.) This petroleum dependence brought two problems. The first was vulnerability to petroleum supply disruptions, higher oil prices, and especially to the volatility of those prices. Even today, we reflect this as a business risk in our financial reports.

The second problem was that the proliferation of motor vehicles, among other sources, created air pollution, especially in urban areas. Remember that there were no significant emission controls on trucks until 2007. Compared to diesel fuel, natural gas, actually compressed natural gas ("CNG") offered an inherently cleaner, domestically sourced fuel and at times natural gas was cheaper than petroleum. Beginning in the 1980's, UPS began testing medium-sized delivery trucks that operated on natural gas.

In short, UPS spent its first 80 years growing our dependence on petroleum, but the last 30 years trying to move gradually away from petroleum, to fuels that are cleaner and cheaper than refined petroleum products. We currently have nearly 100,000 trucks worldwide, some 17,000 heavy tractor trailers in the U.S. alone, and about 60,000 package delivery trucks. In fact, we are now the world's largest package carrier.

In these last 30 years, we tested in service several alternative fuels and advanced technologies in what we call our "rolling laboratory" seeking ways to reduce our use of petroleum and emissions. That included electricity, hybrids (both electric and hydraulic hybrids), propane, and of course natural gas. The chart included in my testimony is a snapshot, dated April 16, 2014, of this "rolling laboratory" of over 2,300 vehicles domestically and a total of over 3,400 worldwide. From just 2010 through what we plan to spend in 2014, UPS has committed over $400 million on this alternative fuel fleet and its infrastructure in the U.S. and Canada. Since 2000, these alternative fuel vehicles have traveled more than 300 million miles, the average distance from Earth to Mars.... And back. By the end of 2017, we expect that fleet to have traveled a billion miles.

Global Alternative Fuel and Advanced Technology Vehicles

Total Alternative Tech Vehicles (U.S. & International): 3,437

U.S. Alternative Tech Fleet: 2,378 (+301)

- Compressed Natural Gas Vehicles: 939 (+62)
- Hybrid Electric Vehicles: 380
- Liquid Natural Gas Vehicles: 488 (+239)
- Propane Vehicles: 28
- Electric Vehicles: 102
- Hydraulic Hybrid Vehicles: 41
- Composite Body Diesel: 400

International Alternative Tech Fleet: 1,059 (-6)

- Compressed Natural Gas Vehicles: 85 (-3)
- Hybrid Electric Vehicles: 6
- Propane Vehicles: 847 (-1)
- Electric Vehicles: 56
- Ethanol Vehicles: 46 (-4)
- Biomethane Vehicles: 19

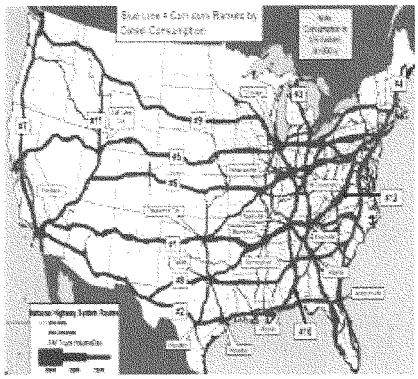
So with all these alternative fuel options available to UPS, why did we end up zeroing in on natural gas as a key alternative fuel for UPS? The largest segment of our alternative fuel fleet is powered by natural gas, and is our primary focus these days.

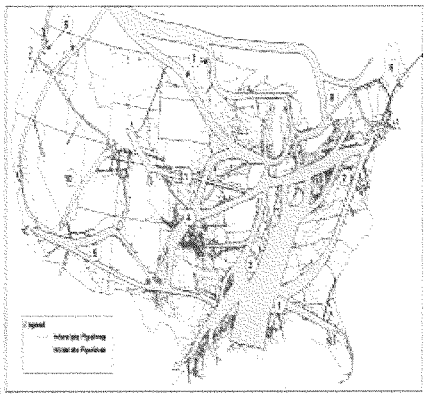
First, we quickly realized that theoretically the best candidate for conversion to alternative fuels was the large, over-the-road heavy truck, the tractor trailer, because they use far more fuel than our small delivery trucks. Our big rigs travel an average of 450 miles per day and can consume 100 gallons per day, as compared to a package delivery vehicle that might burn only a tenth of that much diesel fuel per day. Alternative fuel vehicles nearly always cost more to purchase than conventional vehicles and so the more diesel fuel you displace with the cheaper alternative fuel, the more savings there are to pay the higher upfront cost of that alternative fuel vehicle.

While there were several alternative fuels suitable for the small delivery trucks, for these big rigs, the semis, we found at first that we had no alternative fuel to give us the range and power that diesel fuel provided and that we required. Not electricity, not propane, not hybrids, not even CNG at first. However, around 2000, diesel engines became available that ran on cryogenically-cooled liquid natural gas (LNG) and a small amount of diesel fuel to ignite the combustion in the engine. This dual-fuel engine worked well. In fact, in 2002, UPS began in-service use of 11 of these LNG/diesel powered tractors, as a part of our "rolling laboratory" and has had a growing fleet of these LNG trucks ever since. We thought the availability of heavy LNG tractor trailers significant enough that our CEO wrote the Secretary of Energy stating that the LNG tractor meant that we had now at least one suitable alternative fuel for each type of truck, including the big over-the-road semis.

But there was a problem, and this is where the natural gas production that the U.S. enjoys today became critically important. The early switch to natural gas vehicles fizzled when natural gas prices surged around 2005-2006. We and others lost confidence that natural gas would remain low enough in cost to become a viable alternative vehicle fuel. However, the enormous expansion in U.S. natural gas production and natural gas reserves created new confidence that natural gas prices will stay much lower than diesel prices, perhaps for decades to come and instead, natural gas has proven a much cheaper and inherently cleaner fuel than diesel or gasoline. This anticipated price stability and other factors has led UPS to shift to natural gas as a fuel and justify paying the considerable extra cost of limited production natural gas vehicles. New engine designs coming on the market today permit the heavy trucks to run on CNG with tolerable performance reductions, as compared to LNG powered trucks. Natural gas (LNG or CNG) remains the only major commercial alternative to diesel for the heavy trucks.

As an aside, it is convenient how the major routes for heavy trucks co-inside with the major natural gas pipeline flows within the United States. The chart below shows this:





Thanks to the surge in natural gas production and reduced prices, natural gas in the U.S. is significantly less expensive than crude oil on an energy equivalent basis. Many cite specific per gallon equivalent cost figures for natural gas, but there is wide variation geographically and generalization is difficult. Yet consider that natural gas at $5 per MMBTU is equivalent to crude oil at $29 per barrel, well below oil's current market price. This price gap is narrowed, however, as it costs more to convert natural gas to a transportation fuel (CNG or LNG), there are additional specialized fueling infrastructure costs, and finally the alternative fuel vehicles themselves are more expensive. That price gap between natural gas prices and crude oil is what will determine how fast transportation turns to

natural gas as a fuel. Understand that UPS paid over $4 billion last year for fuel overall and you see why natural gas matters to us.

UPS, as an industry leader and, we hope, a thought leader, is making significant investments and commitment to natural gas. We already have more than 1,000 CNG medium "package cars" and over the next year UPS will buy nearly 1,000 heavy over-the-road tractors that run on LNG with a few running on CNG. In fact, in 2014, the only new tractors that UPS will purchase for its domestic small package delivery business will run on natural gas. This will in one year nearly double the number of our natural gas vehicles here in the U.S. By the end of this year, UPS will have LNG fueling operations across 10 states serving one of the largest LNG truck fleets in the world.

Clearly, we think that this is good for UPS. We also believe that this shift to natural gas in trucking should prove good for the consumer. If trucking is able to reduce its fuel costs, this should over time lower freight and package delivery costs, from what they would otherwise be, to customers across a wide array of products. As most of us know, nearly everything moves by truck.

To the extent that natural gas is used as a transportation fuel, it will create jobs in the domestic natural gas industry to satisfy demand from the transportation sector. Further, engine and truck manufacturers are serving a booming market for alternative fuel vehicles.

The environment is also a big winner here. As I said before, natural gas burns cleaner than diesel or gasoline. EPA's emission requirements on trucks today make new diesel trucks burn very cleanly. But this is because each truck has very expensive on-board, emissions after-treatment equipment requiring considerable maintenance. We estimate that this equipment and its maintenance on a new heavy diesel truck can cost $30,000 per truck over its life. A truck burning natural gas alone needs much less of such equipment, if any. We are investigating ways to use natural gas, or fuels made from natural gas, along with diesel fuel in dual-fuel applications to maintain the efficiency and power of the diesel engine, and yet meet the emissions standards of today, but without the complex, expensive, high-maintenance emissions after-treatment equipment. That could improve the

economics of alternative fuel vehicles and accelerate their deployment in the fleet.

Besides our commitment to invest in natural gas vehicles, UPS has sought for years to partner with federal and state governments for incentives for the vehicles themselves and the necessary fueling infrastructure. Such incentives encourage large and small businesses to make the investments. Generally, all our alternative fuel deployments have enjoyed such incentives and they often determine just where we decide to deploy. At the federal level we have recently focused on eliminating disincentives to alternative vehicles, such as the federal excise tax that taxes not just the basic cost of the truck but also the increased cost of the alternative fuel version. We are also asking Congress to fix the disparity in how LNG is taxed compared to petroleum.

The key to all of this has been the surge in U.S. natural gas production. It drove natural gas prices well below oil prices with the expectation that those prices may fluctuate, but will continue to make natural gas an attractive transportation fuel for UPS and other firms like us.

Thank you. I would be pleased to try to answer any of your questions.

The Benefits of Natural Gas Exports

Diana Furchtgott-Roth
Senior Fellow and Director, Economics21
Manhattan Institute for Policy Research

Testimony before the Joint Economic Committee

June 24, 2014

The Benefits of Natural Gas Exports

Chairman Brady, Vice Chair Klobuchar, thank you very much for inviting me to testify on U.S. natural gas exports. I am a senior fellow at the Manhattan Institute for Policy Research, where I direct the Manhattan Institute's economics portal, Economics21.org, which focuses of ways that America can increase economic growth.

Even with Gazprom, Russia's state-owned energy company, cutting off natural gas supplies to Ukraine last Monday, no one wants to use military force to counteract Russia. President Obama's 2015 Budget will shrink the military still further. But the United States has another weapon at our disposal, liquid natural gas exports. Exporting liquid natural gas would help our allies and hit Russia where it hurts, in the pocketbook. This would make Putin think twice about his next move in Ukraine or about invading another sovereign nation.

The recent turmoil in Iraq shows how even with increased U.S. oil production, global oil prices have the potential to become volatile. This increases the value of natural gas exports. Liquid natural gas can now power trucks more cheaply than diesel. If fighting continues and moves south, Iraq's oil production could be substantially decreased for an extended time period. This would make U.S. natural gas exports even more vital as individuals and businesses around the world look for ways to offset the increase in oil prices.

Of the 18.7 trillion cubic feet of natural gas consumed by Europe in 2013, according to the Energy Information Administration, Russia supplied 30 percent (5.7 trillion cubic feet). The Energy Department estimates that 16 percent (3.0 trillion cubic feet) of the natural gas consumed in Europe passed through Ukraine's pipeline network.[1]

In the past, as much as 80 percent of Russian natural gas exports went through Ukraine, but that has declined to 50 percent to 60 percent due to the Nord Stream pipeline, built in 2011, which provided a direct link between Russia and Germany under the Baltic Sea.

Nearly 12 billion cubic feet of natural gas flows through Ukraine per day in the winter and about 6 billion cubic feet per day in the summer.

Honorable Members of Congress, you could immediately assist Ukraine and other countries by amending the Natural Gas Act to ensure that the Energy Department approves LNG export applications within a short period of time.

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[1] Metelitsa, Alexander, "16% of Natural Gas Consumed in Europe Flows through Ukraine," U.S. Energy Information Administration, March 14, 2014.

You could also pass legislation allowing LNG to be exported to all World Trade Organization members, irrespective of whether they have free trade agreements with the United States.

You could go still further, and cease to require approval for LNG exports.

More than half of Ukraine's natural gas, and 30 percent of Europe's natural gas, is provided by Russia. Russia gets about half of its revenue from oil and gas. Natural gas is cheaper in the United States than in Russia, so increasing America's exports of LNG would lower Russia's profits.

Last fall, in a forum hosted on Capitol Hill, Zygimantas Pavilionis, Lithuanian Ambassador to the United States and Mexico, said, "An ability to import natural gas from the U.S., even very small amounts by U.S. standards, would make a huge impact on the Lithuanian gas market and allow the nation to develop a reliable alternative to Russian gas."

And according to Jaroslav Zajicek, the Czech Republic's Deputy Chief of Mission, "We have already seen examples where the Russian negotiating position during contract-renewal talks was weakened thanks to decreasing prices on the markets in Western Europe."

This week natural gas for July delivery was trading at about $4.50 per million British thermal units, compared to over $10.00 per million BTUs in Europe.

America is overtaking Russia as the world's largest oil and gas producer, and could be exporting natural gas abroad. However, companies face barriers because there is substantial red tape in exporting natural gas. Many believe that the United States should keep all its natural gas, rather than exporting it. That is why it takes a long time to get approval to build terminals to export LNG, and to get permits to export LNG to countries without free trade agreements with the United States.

This is misguided. America has massive natural gas expansion capacity, and LNG exports are unlikely to harm U.S. manufacturing's comparative advantage in cheap energy. Even if we export LNG, it will still be less expensive in the United States, because of transportation costs.

If companies want to sell to a country which has no free trade agreement with the United States, they need approval from the Energy Department, which can take years. America has free trade agreements with only 20 countries, and the Energy Department has approved only six LNG export terminal projects since 2011.

The Energy Department is sitting on two dozen applications to export natural gas, some from 2011 and 2012. Table 1 shows the details of these companies. In total, potential exports of 29 billion cubic feet per day of natural gas are being held up by delayed review from the Department of Energy. This amount highlights the strength of both domestic supply and international demand for natural gas. Undoubtedly, if the export process were not so onerous, there would be even more companies willing to invest in natural gas exports and apply for export permits.

It is not just in issuing LNG export permits that the federal government is slow. Uncle Sam cannot make any energy decisions rapidly.

According to data collected by the Institute for Energy Research, federal drilling permits have become more difficult to acquire. Between fiscal years 2006 to 2008 and 2009 to 2011, the number of permits approved fell from 20,479 to 12,821. Moreover, between 2005 and 2011, the time it took to acquire such a permit rose from 154 days to 307 days.[2] Even with the decrease in issued permits, the average number of days it took the Bureau of Land Management to process a completed permit application nearly tripled from 2005 to 2013, from 39 days to 95 days.[3]

To get a better idea of how the federal government is slowing down the process, an August study by the U.S. Government Accountability Office found that applications to the Bureau of Land Management for drilling permits declined by 50 percent between 2007 and 2012. Plus, the Bureau said in an internal memorandum that it has not been able to process applications within a month, as is required to do by law.[4]

The economic benefits of exporting LNG include more economic activity and more employment at home. But the geopolitical benefits could be even greater if we care, as we should, about freedom and democracy in Ukraine and other neighbors of Russia that were formerly part of the Soviet Union.

Many reasons are given to prevent more exports of U.S. natural gas. They are practically all wrong, made by people who underestimate the amount of natural gas America has and the potential effect exports could have on the world market.

Russia has swallowed parts of Georgia and Ukraine. No one is proposing that America send soldiers to defend these countries – even though we guaranteed Ukraine's sovereignty in 1994 under the Budapest Memorandum, reaffirmed by President Obama

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[2] Institute for Energy Research, "U.S. Oil Production Up, But On Whose Lands?," September, 24, 2012.
[3] U.S. Department of the Interior, "Average Application for Permit to Drill (APD) Approved Timeframes: FY2005 – FY 2013," Bureau of Land Management, March 19, 2014.
[4] Government Accountability Office, "Report to Congressional Requesters: Oil and Gas Development," August, 2013.

in 2009. What we can do is help our allies by diminishing Russia's economic power over them. That power rests on oil and gas.

It is no coincidence that the former head of Yukos, the oil and gas company, Mikhail Khodorkovsky, spent ten years imprisoned by the Russians and that the government effectively took over Yukos, indirectly absorbing it into Gazprom. This shows the importance of oil to Russia's leadership. Oil is one of the few big businesses in Russia, and President Putin is watching us carefully.

America is overtaking Russia as the world's largest oil and gas producer, and we could be exporting natural gas abroad, cutting into Russia's markets. We are producing enough natural gas for ourselves for the foreseeable future, as well as for export to other countries.

In North Dakota, for example, natural gas production has outpaced additions to gas pipeline capacity and processing facilities. The average amount of nonmarketed natural gas output per day through the end of 2013 was 0.31 billion cubic feet, up from 0.16 billion cubic feet a day in 2011. That is an increase of almost 100 percent. Flaring has decreased as a percentage of total production, however, from 37 percent in 2011 to 33 percent in 2013. North Dakota's goal is to reduce its percentage of nonmarketed gas to 10 percent by the fourth quarter of 2020.[5]

Most nonmarketed natural gas is wasted, flared into the atmosphere like an open burner on a gas stove. Flaring gas releases C02 as a byproduct of combustion, so it would be environmentally preferable for the gas to be sold.

Between 2008 and 2012, North Dakota accounted for 0.5 percent of total gross natural gas withdrawals in the United States. At the same time, North Dakota accounted for 22 percent of all natural gas that was flared or vented.

North Dakota has recently taken a number of steps to increase its ability to bring more natural gas to market. A new Garden Creek processing plant was built in Watford City, processing plants in the northwestern part of the state are now linked to the Northern Border Pipeline which runs from Canada to other Midwest states, and construction of the Tioga Lateral Pipeline from Tioga, North Dakota to the Alliance Pipeline which flows to Chicago was authorized. General Electric has developed a new system for compressing and cooling natural gas, called CNG In a Box.

The productivity of oil and natural gas wells is increasing across many places in the United States because horizontal drilling and hydraulic fracturing are becoming more

[5] Ford, Michael and Neal Davis, "Nonmarketed Natural Gas in North Dakota Still Rising Due to Higher Total Production," U.S. Energy Information Administration, March 21, 2014.

precise and efficient. Drilling activity in U.S. shale is generally producing more oil and natural gas than in the past.

Of the six U.S. shale plays tracked by the EIA Drilling Productivity Report, five have seen increases in oil and natural gas production per rig over the past few years.[6]

The Eagle Ford Shale in Texas has the most increased production of oil per rig. Each drilling rig in the Eagle Ford Shale will contribute 400 barrels of oil per day more in April 2014 than it would have in the same formation in January 2007, an increase of over 800 percent.

The Marcellus Shale has the most increased production of natural gas per rig. A Marcellus Shale well completed in April can produce over 6 million cubic feet of natural gas per day more than a well completed in 2007, an increase of 1,200 percent.

Here are four reasons for not exporting natural gas, and why they are wrong.

Myth 1: Exporting Natural Gas will Increase Prices. According to Massachusetts Senator Ed Markey, exporting natural gas will increase prices by $2.50 per thousand cubic feet. In a press release he stated, "U.S. energy consumers could be facing as much as $62 billion per year in higher energy costs as a direct result of exporting."[7]

This is misguided. America has massive natural gas expansion capacity, as I described above. The price might rise, but not by much—between three and six percent in 2025, according to estimates by Stanford University's Energy Modeling Forum.[8] Over the past five years, as exports have increased, prices have declined. This can be seen in Figure 1.

Natural gas exports are unlikely to harm U.S. manufacturing's comparative advantage in cheap energy. Even if the United States exports natural gas, it will still be less expensive in the United States than elsewhere because it is costly to transport. Energy-intensive multinationals will still face a cost advantage locating in the United States. Yet foreign consumers will benefit from our exports, which, even with transportation costs, will be less expensive than what they are paying Russia now.

Drilling efficiency has substantially increased over the past seven years. Productivity of oil and natural gas wells is increasing across many places in the United States because horizontal drilling and hydraulic fracturing are becoming more precise and efficient.

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[6] Krohn, John and Mike Ford, "Growth in U.S. Hydrocarbon Production from Shale Resources Driven By Drilling Efficiency," U.S. Energy Information Administration, March 11, 2014.
[7] Markey, Ed, "New Natural Gas Export Approval Crosses Cost Threshold for American Consumers, Businesses," March 24, 2014.
[8] Energy Modeling Forum, "Changing the Game?: Emissions and Market Implications of New Natural Gas Supplies," Stanford University, September, 2013.

According to the Energy Information Administration's Annual Energy Outlook forecasts, natural gas production will increase 56 percent through 2040.[9]

Exports stimulate the economy and result in more jobs, rather than fewer, because foreign customers buy U.S. products. With increased natural gas exports more people would be employed in its production and transportation. Over 1.1 million people are already directly employed and about 9 million are indirectly employed in the oil and gas sector, the vast majority from small and mid-size companies.[10]

Myth 2: Actions Today Won't Increase Exports Until It Is Too Late. There is no point in exporting natural gas, according to naysayers, because we do not have the infrastructure in place. To export gas, we need more pipelines to get gas to shipping terminals, and more shipping terminals. That could take as much as five years.

However, this disregards the role of expectations. Announcements about our intentions to build infrastructure to export send signals to futures markets, which affect prices today. President Putin is watching our intentions carefully.

Lucian Pugliaresi, president of the Energy Policy Research Foundation, has testified before the Energy and Power Subcommittee of the U.S. House Energy and Commerce Committee, "If we open up our resources for development, we can open up the opportunity to shift long-term expectations on domestic supply and receive the benefits of lower prices even before the supplies come to market."[11]

This can be seen by the speed with which events influence current prices. When war breaks out in the Middle East, or a hurricane is forecast to blow through the Gulf states, or when a refinery is shut down due to an accident, prices climb on the news—even though supply has not changed. Prices climb not due to the disruption in supply, which as not yet occurred, but due to expected disruption in supply, and to a change in futures prices.

This works in the opposite direction too. An announcement that oil will be released from Strategic Petroleum Reserve sends prices down before they are released. Futures prices change, affecting current prices.

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[9] U.S. Energy Information Administration, "Annual Energy Outlook 2014 Early Release Overview," December, 16, 2014.
[10] Mills, Mark P., "Where the Jobs Are: Small Businesses Unleash America's Energy Employment Boom," Manhattan Institute for Policy Research, February 2014.
[11] Pugliaresi, Lucian, "Testimony Before the Subcommittee on Energy and Power, U.S. House of Representatives Committee on Energy and Commerce," Hearing on the American Energy Initiative, March 17, 2011.

Myth 3: Exporting Natural Gas Will Increase Production and Emissions. The environmentalists take a different approach. Rather than forecasting that exports will result in less supply for Americans, they admit that exports mean more production—which, by the way, will keep price levels stable and raise the numbers of Americans employed. Environmentalists are opposed to increased usage of natural gas because they are concerned that greenhouse gas emissions will rise.

It is likely that American natural gas would displace not only Russian gas, but also some coal use. To the extent that natural gas displaces coal, greenhouse gases will be reduced. And energy production in Asia (and Africa) is far dirtier than in America, so our gas exports would lower global emissions even more. Increased production of cheaper gas could reduce world prices and lead to greater consumption, which would lower greenhouse gas emissions.

Over the past decade, imports of natural gas have declined, exports have increased, and prices have declined. That is because American withdrawals of natural gas have grown from 24 trillion cubic feet to 30 trillion cubic feet. In 2013, about 15 percent of natural gas withdrawals were not marketed.[12] This amounted to 4.5 trillion cubic feet per day, most of which was wasted. Exporting 15 percent of natural gas would not raise the price substantially.

Myth 4: America Is Incapable of Using Economic Power to Promote Our Strategic National Interest. Perhaps this is the most dangerous myth of all, that America is helpless in the face of its adversaries, and that we just have to let Russia gobble up and abuse its neighbors without being able to retaliate. It is false.

The slow approval process for exporting natural gas and the ban against exporting to non-free trade agreement countries stand in the way of us using our vast natural gas resources to help friendly allies. Congress and President Obama should embrace international markets and end this harmful policy that limits American economic and geopolitical power.

Most important, we should take a hard look at ourselves. Instead of seeing a helpless country incapable of assisting itself or its friends, we would then see the greatest economic power in the world. Instead of seeing ourselves paralyzed by weakness, we would see the possibilities that free enterprise and free trade can provide. Instead of seeing a perennial loser rudderless in a hostile sea, we would see a country capable of exercising commercial example and moral authority—but rarely having to use it because other countries recognize that capability as well.

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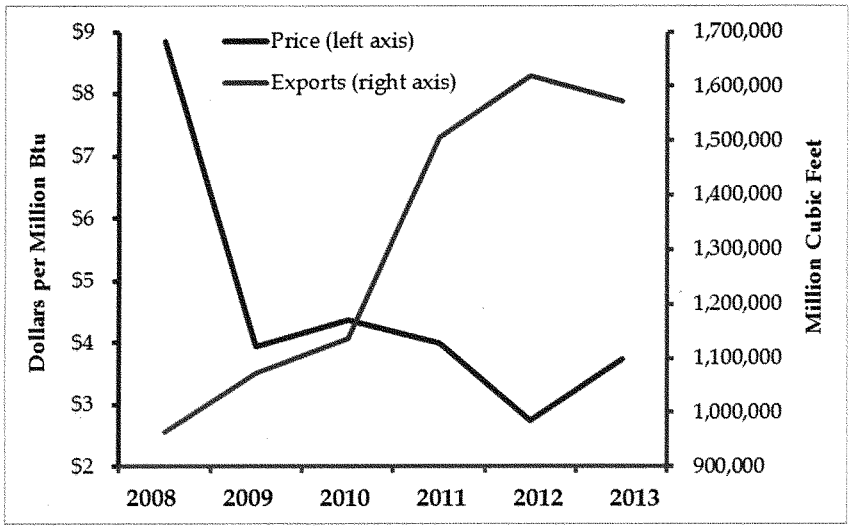
[12] U.S. Energy Information Administration, "Natural Gas Gross Withdrawals and Production," March, 31, 2014.

Table 1: Non-Free Trade Agreement Liquid Natural Gas Applications Under U.S. Department of Energy Review

Company	Quantity (billion cubic feet/day)	Application Submission Date
Carib Energy (USA) LLC	0.01	10/20/2011
Gulf Coast LNG Export, LLC	2.8	1/10/2012
Gulf LNG Liquefaction Company, LLC	1.5	8/31/2012
LNG Development Company, LLC	1.25	7/16/2012
Southern LNG Company, L.L.C.	0.5	8/31/2012
Excelerate Liquefacation Solutiions I, LLC	1.38	10/5/2012
Golden Pass Product LLC	2.6	10/26/2012
Cheniere Marketing, LLC	2.1	8/31/2012
CE FLNG, LLC	1.07	9/21/2012
Waller LNG Services, LLC	0.19	11/26/2013
Pangea LNG Holdings, LLC	1.09	12/19/2012
Trunkline LNG, Export, LLC	2	1/10/2013
Gasfin Development USA, LLC	0.2	12/23/2012
Freeport-McMoRan Energy LLC	3.22	2/22/2013
Sabine Pass Liquefaction, LLC	0.28	2/27/2013
Sabine Pass Liquefaction, LLC	0.24	4/2/2013
Venture Global LNG, LLC	0.67	5/13/2013
Eos LNG LLC	1.6	8/23/2013
Barca LNG LLC	1.6	8/23/2013
Sabine Pass Liquefaction, LLC	0.86	9/10/2013
Delfin LNG LLC	1.8	11/12/2013
Magnolia LNG, LLC	1.08	1/15/2013
Texas LNG LLC	0.27	12/31/2013
Louisiana LNG Energy LLC	0.28	2/18/2014
Total	**28.59**	

Source: U.S. Department of Energy, "Applications Received by DOE/FE to Export Domestically Produced LNG," March 24, 2014.

Figure 1: Natural Gas Exports Rise, Prices Decline



Source: Energy Information Administration

Testimony of Elgie Holstein

Senior Director for Strategic Planning, Environmental Defense Fund

Hearing of the Joint Economic Committee on

"The Economic Impact of Increased Natural Gas Production"

June 24, 2014

Vice Chair Klobuchar and Chairman Brady, thank you for this opportunity to discuss with you and the other members of the Committee the economic impact of increased natural gas production.

Environmental Defense Fund is a national environmental advocacy organization with more than 750,000 members and supporters nationwide. We are dedicated to finding innovative approaches to solving some of the most difficult national and international environmental challenges. Whenever possible, we collaborate with private-sector partners, state and federal leaders, and other environmental organizations – including grassroots groups – interested in maximizing incentives for market-based solutions to environmental problems.

My testimony focuses on the real and substantial risks to public health and the environment associated with the rapid expansion of natural gas exploration and production activities in the U.S. If unaddressed, those risks will result in increased global warming pollution, harm to communities where gas development is taking place, and public opposition to the continued expansion of natural gas production and use.

The question before all levels of government -- federal, state, and local -- is whether the appropriate steps are being taken to implement and enforce the regulations necessary to minimize the risks. While there is evidence of progress in this area, it remains the case that the pace of increased natural gas development and use is outpacing the implementation of necessary protections.

Natural Gas Opportunities and Challenges

There is no question that unconventional gas development is lowering energy costs, creating new jobs, supporting more domestic manufacturing, and even delivering some measurable environmental benefits. For example, relative to coal, gas-fired electricity generation produces about half the carbon pollution, no sulfur dioxide or mercury emissions, and a small fraction of the fine particulate pollution common with the combustion of coal.

But as anyone who has lived next to or visited a well site can attest, unconventional natural gas development is heavy industrial activity, imposing significant public health and environmental risks on the communities where production takes place.

While there has yet to be conclusive evidence that hydraulic fracturing itself has caused drinking water contamination, it is well understood by industry and oil and gas regulators alike that poor well construction and spills of chemicals or wastewater at the well site, or in transit, can pollute streams and groundwater.

Because of intensive shale-gas development, the small town of Pinedale, Wyoming has experienced smog concentrations comparable to those of Los Angeles. And production activities in close proximity to homes, churches, and schools have turned once-quiet rural and suburban communities in Pennsylvania, Texas, Colorado, and elsewhere into industrial zones rife with constant noise, dust, and truck traffic.

Some gas enthusiasts downplay these environmental concerns, and characterize those citizens who raise them as alarmist. But they are wrong to do so. For champions of natural gas, the signs of public concern are ominous. Last fall, in a national poll, the Pew Research Center found that 49% of those surveyed opposed the increased use of hydraulic fracturing.

In Colorado, four cities in the heart of the Denver/Julesberg shale gas region have voted either for a moratorium on shale gas development or to prohibit it entirely. New York, one of four states under which the Marcellus Shale lies, has had a moratorium on shale gas development since 2010.

Achieving a true balance of interests is critical. The country can reap economic and environmental benefits from our burgeoning new gas reserves, so long as we ensure that public health and the environment are protected through strong regulation and enforcement. Striking the right balance also means continuing to invest in the deployment of energy efficiency and renewables even as our nation rushes to develop our new natural gas resources.

Whatever role natural gas may play in helping us to achieve energy security and carbon emission reductions in the short term – for example, through helping to integrate more renewables into the electric grid -- a sustainable long-term energy future depends upon shifting away from fossil fuels toward efficiency, renewables, and other zero-carbon energy technologies.

The Methane Problem

Though it burns cleaner than coal, un-combusted natural gas is mostly methane, a greenhouse gas 84 times more potent than carbon dioxide in the first 20 years after it is

released. Decisions made now about methane emissions will have a major impact on the rate at which the climate changes over the lifetimes of Americans spanning the next several generations. (For more details about the science underlying concerns about methane and other short-lived climate "forcers," please see the attached article from Science magazine.) As natural gas exploration and production continue to expand, methane emissions threaten to cancel out the climate benefits that natural gas proponents often claim, especially with regard to the growing share of electricity generation fueled by gas.

Across our economy, the oil and gas sector represents 37% of U.S. methane emissions, the largest of all U.S. industrial sources, according to EPA. Estimates vary widely about how much methane is being leaked or vented during the production and transportation of natural gas.

EDF is actively working to better understand the magnitude of methane emissions across the natural gas supply chain, from well site through to delivery of natural gas to homes and businesses. Our effort involves over 100 different research universities and companies across the natural gas supply chain and will produce 16 different scientifically peer-reviewed studies. This, along with research efforts by other credible, independent institutions, will help us better understand the magnitude of the problem and opportunities for improvement.

While research is on-going, we already know enough to know that there is much that can and should be done. A recent cost analysis performed by experts at ICF, International – based on real data from industry -- found a striking opportunity for achieving dramatic reductions in methane emissions from the oil and gas sector. The study revealed that a *40% reduction in methane emissions from the sector could be achieved over the next five years at a cost of less than 1 penny per thousand cubic feet of gas produced.* Low-cost reductions of this magnitude would go a long way toward ensuring that the expansion of natural gas production will not be a net loss for the environment.

Moreover, according to ICF, methane emission reductions at this scale can be achieved using *current* technology. That is, most if not all, of the equipment and operational improvements needed to provide meaningful emissions reductions can already be found in the market.

Accordingly, in any discussion about the need, means, or opportunities for reducing methane emissions from the supply chain, there need be no debate about whether the equipment exists to get the job done. It does, and it is cost-effective to use.

The Case for Federal Action on Methane

It is reasonable to ask why, if methane emissions can be so cost effectively reduced, they remain a problem. Part of the answer is that methane reduction has not been a priority in an industry that has been allocating huge amounts of capital to acquire leases, explore for and produce new reserves, and build the treatment and transportation infrastructure necessary to get natural gas to markets. For local gas utilities, where public safety concerns bring heightened attention to natural gas leaks, financial constraints and state regulatory hurdles can slow or prevent the kind of actions (e.g., aggressive replacement of aging pipes) necessary to make environmentally meaningful methane reductions.

Therefore, we believe that state and federal action to require methane emissions reductions is needed now.

Current federal air emission standards for oil and gas operations apply only to a small subset of activities, and as the ICF study implies, expanded regulation could yield very large environmental benefits for a very small total cost.

At the end of March, the White House announced an interagency strategy regarding methane emissions across the economy, including oil and gas operations. As part of that strategy, the Environmental Protection Agency has issued five white papers for public comment pertaining to known methane emission reduction opportunities in the oil and gas sector. We expect EPA to make a decision on whether and how to regulate emissions from this sector later this year.

Likewise, the Administration's economy-wide methane strategy calls on the Bureau of Land Management (BLM) to take steps to reduce air pollution and methane emissions from production on federal lands. BLM has an obligation to be a good steward of our federal lands, which above all else requires them to take all steps to avoid waste of the resources that can be produced from them.

While our interest in reducing methane emissions is driven by environmental concerns, we note that every ounce of methane that is vented or leaked into the atmosphere or flared at the well site is a loss to our economy and our national energy security. The 40% reduction in methane emissions identified in the ICF Report is the equivalent of 54 LNG tankers worth of natural gas, every year. Surely, we all have an interest in putting an end to that kind of waste.

State Actions

When it comes to environmental regulation of oil and gas operations, states are not waiting for the federal government to act.

Wyoming, where air quality has been severely compromised in a portion of the state by rapidly expanding oil and gas operations, finalized new rules for the Upper Green River Basin, where production activities were contributing to ozone non-attainment as bad as

in some cities. The state's new program includes quarterly leak-detection-and-repair inspections for new and modified emission sources. About a week ago, Wyoming initiated another rulemaking that will apply similar requirements to existing sources.

In the area of water protection, Wyoming has also adopted some of the country's best requirements for groundwater testing around all new oil and gas wells: one baseline sample supplemented by two rounds of post-completion follow-up testing. The results are made public.

In Ohio, Governor Kasich supported changes to the general permit for oil and gas operations implementing leak-detection-and-repair program for volatile organic compounds from new, unconventional (hydraulically fractured) wells. Methane reductions will occur as a co-benefit of the rules. The Governor also supported chemical disclosure rules, which are now in place. Ohio is currently considering new measures that would further reduce methane.

In North Dakota, a state where new unconventional oil and gas development is transforming the economy, the massive amount of flaring of natural gas – which is both a waste of an important national energy resource and a significant source of air pollution in northwestern North Dakota – has attracted national attention. The state recently announced its intention to establish enforceable rules to crack down on unconstrained flaring.

In Pennsylvania, municipal water treatment facilities proved inadequate to handle the wastewater sent to them from hydraulic fracturing operations. Now, Pennsylvania has put an end to this practice, and toughened water quality rules, including creating a strong incentive for producers to conduct baseline water treatment before drilling. In addition, the state has adopted more rigorous air quality monitoring, stricter well construction standards, and tougher requirements for wastewater management. It is now beginning the process of strengthening those rules.

And earlier this year, Colorado put in place the nation's first and most ambitious set of rules designed to directly reduce all hydrocarbons -- methane as well as volatile organic compounds.

The rules require leak-detection-and-repair programs for all wells. The highest-emitting wells will be inspected monthly. Unnecessary venting during well maintenance will no longer be allowed. And so-called high-emitting valves will be replaced by low- or zero-emission valves. Existing storage tanks will have to meet new pollution limits as well as current federal limits applicable to new tanks. Altogether, the new rules will annually remove 100,000 tons of methane and 90,000 tons of smog-forming volatile organic compounds, equal to the emissions of all of the cars and trucks in Colorado today.

Collaborating to Build Knowledge, Improve Practices, and Establish Policy

EDF worked hard in support of the new Colorado rules, but we were not alone. Anadarko Petroleum, Encana, and Noble Energy – among the largest companies at the forefront of new oil and gas extraction in the Rocky Mountain West – supported the new rules as well. We worked closely with them and with the governor's office to craft a strong, sensible approach to keeping more methane in the pipeline as product, instead of in the air as a pollutant. Indeed, recognizing the growing public concern about the environmental and public health impacts of oil and gas-related emissions, they helped make the case that reducing methane and volatile organic compounds could be done cost effectively, with no loss of jobs or productivity.

We have also partnered with industry in efforts to define best practices in the field. EDF was instrumental in helping launch a new collaboration known as the Center for Sustainable Shale Development (CSSD). Based in Pittsburgh, CSSD is designed to foster continuous improvement and innovation in shale gas development in the Appalachian Basin. CSSD's board of directors includes oil and gas companies like Shell and Chevron, environmental leaders, leading scientists and academics, and former governors and cabinet members.

Regional centers of excellence like CSSD play an important role in spreading leading practices, but they are not a substitute for comprehensive regulatory approaches, and they have no authority to compel compliance with whatever standards they recommend.

Natural Gas and Renewable Energy

Stronger regulation of unconventional gas production and distribution is essential to protecting public health and the environment and maximizing the greenhouse gas benefits of natural gas relative to coal, However, even with the best regulations in place, natural gas is not a cure-all for climate change or the other environmental ills associated with coal; it is still a fossil fuel. To truly achieve a low carbon future, we will need a progressively cleaner mix of energy sources and strategies, including more renewable energy, demand response, and – the cheapest source of all -- energy efficiency. We must maintain our focus on maintaining and strengthening policies that are helping to develop and deploy the next generation of energy technologies even as our nation continues to develop its existing natural gas resources.

Conclusion

The shale gas boom has the promise of delivering valuable economic and environmental benefits to the country, but at least with respect to the environment, it is a promise not fully realized.

We see a near-term opportunity and need for federal action on air emissions, especially on methane, and we now know that the cost of such action would be minimal. The Colorado model described earlier provides a powerful example that can be drawn upon at the federal level to ensure that states and communities across the country receive a similar level of protection from volatile organic compounds, threats to water supplies, and, especially, the climate-related harm from methane emissions.

Our experience working with states gives us the confidence that there is a growing realization among progressive companies involved in various aspects of the natural gas business that the problems of methane emissions, as well as other air and water concerns, can and should be addressed.

Doing so will deliver multiple benefits to society while ensuring that America's new bounty of natural gas can not only advance our national energy and economic interests, but our environmental and public health interests as well.

to each patient this necessary information.

Clinicians are ethically free to filter incidental findings that have so little clinical significance that they would not actively seek them as secondary findings. Here, too, in keeping with shared decision-making, clinicians live up to their highest calling when they discuss how they will handle incidental findings with their patients.

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CLIMATE CHANGE

What Role for Short-Lived Climate Pollutants in Mitigation Policy?

Parallel strategies must focus on long- and short-lived pollutants, but not at the cost of reducing pressure for action on CO_2.

J. K. Shoemaker,[1] D. P. Schrag,[1]* M. J. Molina,[2] V. Ramanathan[3,4]

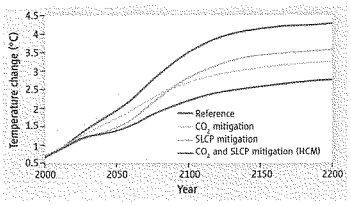
Short-lived climate pollutants (SLCPs) include methane (CH_4), black carbon (BC), tropospheric ozone, and hydrofluorocarbons (HFCs). They are important contributors to anthropogenic climate change, responsible for as much as one-third of the current total greenhouse forcing (*1*). An emerging strategy, which we refer to as hybrid climate mitigation (HCM), emphasizes reducing SLCPs in parallel with long-lived carbon dioxide (CO_2) so as to achieve climate goals, as well as health and food security benefits, associated with some of the SLCPs. Proponents of HCM argue that we should focus substantial effort on reducing SLCPs now, as we wait for sufficient political will to reduce CO_2 emissions (*2*–*4*). But others (*5*) worry that any strategy involving SLCPs risks delaying efforts to reduce CO_2, the main greenhouse gas most important for long-term warming if emissions continue as projected.

We attempt to clarify this emerging HCM strategy. Reducing emissions of SLCPs is an essential component of any comprehensive climate action plan for addressing both near-term and long-term climate change impacts (*1*, *3*). There are real opportunities to reduce emissions of SLCPs without distracting from other mitigation efforts focused on CO_2. But the dangers of delaying efforts to reduce CO_2 emissions are serious and must be articulated clearly to the policy community. We believe that such a delay can be prevented with appropriate policies, and that both short (decades) and long (century or longer) time scales must be considered.

Direct comparisons of the climate influence of SLCPs and CO_2 require making a judgment about the relative importance of short and long time scales. SLCPs have a powerful impact on climate, but they persist in the atmosphere for only a short time—days to weeks for BC, a decade for CH_4, and about 15 years for some HFCs. Thus, immediate reductions in SLCPs will result in relatively immediate climate benefits, as the effects on climate depend largely on the emission rate, or flow, of SLCPs to the atmosphere. In contrast, CO_2 has a very long atmospheric lifetime; more than 20% will remain for thousands to tens of thousands of years (*6*). Thus, climate effects from CO_2 depend on the cumulative emissions, or stock, of CO_2 in the atmosphere (*7*).

In the next year, monthly mean CO_2 concentrations will reach 400 parts per million (ppm); annual mean CO_2 concentrations have been rising more than 2 ppm per year because of emissions from fossil fuel use, and this will continue for at least the next several decades because of the dominance of fossil fuels in our world energy system. Because it is the most dominant greenhouse gas, near-complete reduction in CO_2 emissions is the only way to limit the rise of global temperatures and to avoid the risk of catastrophic impacts. But a partial reduction in CO_2 emissions over the next few decades will produce minimal relief from climate impacts until mid-century because of the long time scales of CO_2 in the atmosphere and the momentum of climate change due to the CO_2 already emitted.

One way to diminish climate impacts in the next few decades is to also reduce emissions of



Climate temperature response to reductions in emissions of CO_2, SLCPs, or both. Based on scenarios detailed in the supplemental material. Temperature change is shown relative to a pre-industrial baseline. In the Reference scenario, annual CO_2 emissions peak in 2080, after which they decline rapidly, while SLCP (CH_4, BC) emissions remain at or above current levels. In the "SLCP mitigation" scenario, deep cuts in BC (80%) and CH_4 (40%) emissions, relative to 2010 levels, are implemented linearly from 2010 to 2050. In the "CO_2 mitigation" scenario, CO_2 emissions are reduced by 20% relative to the reference scenario by 2050, followed by slowly decreasing emissions that intercept the reference scenario emissions at 2150. In this scenario, emissions of both BC and CH_4 are partially decreased relative to the reference scenario owing to those sources associated with fossil fuel consumption. The "HCM" scenario includes simultaneous mitigation of CO_2, CH_4, and BC, as described above. For simplicity, we ignore HFCs as well as different sulfate aerosol trajectories. Including these would slightly change the shape of the curves, but not the relative time scales between them.

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SLCPs. Some have argued that mitigating SLCPs to the maximum extent possible by using available technologies can reduce the projected warming by about a half, and sea level rise by about 25%, during this century, relative to a scenario in which only CO_2 emissions are reduced (*8*). Others have argued that the benefits would be smaller, because of the possibility that measures to mitigate CO_2 emissions will also mitigate emissions of SLCPs (*9*).

A key point is that the development of new, low-carbon technologies is driven by policies aimed at reducing CO_2 emissions. Removing political and economic pressure for their development can result in slower innovation, and lead to continued emissions and a warmer climate. In contrast, no new technological innovation is required for many cuts in SLCPs, such as sealing natural gas leaks or reducing biomass burning. Thus, if one delays societal pressure to reduce CO_2 emissions, one will end up with higher cumulative emissions and higher peak and long-term warming.

It is easy to understand why focusing on SLCPs is attractive. Reducing SLCPs achieves climate benefits on generational time scales. In contrast, a substantial reduction of CO_2 emissions requires a deep transformation of the world's fossil energy dependence. Some have argued that reducing emissions of SLCPs will help to avoid "tipping points" in the climate system, irreversible thresholds with drastic consequences. Exactly how to define a tipping point and when we might cross one remain controversial (*10*), but if such thresholds do exist, it is clear that reducing SLCPs alone can only delay by a few decades our reaching them (*1*, *11*), as long as the concentration of atmospheric CO_2 continues to rise.

Another proposal is that an initial focus on SLCPs will slow the rate of warming by as much as 50% by 2050, allowing for easier adaptation by both human society and natural ecosystems (*12*), while we wait for political will to address CO_2 emissions. But if the focus on SLCPs inhibits actions to slow the growth of fossil CO_2 emissions, it will result in a higher peak temperature overall, and we will trade a slower rate of warming in the first half of this century for a steeper rise in temperature imposed thereafter (see the graph).

It is also important to recognize that CO_2 and SLCP emissions are not independent. Some of the steps to reduce CO_2 emissions will drive down emissions of SLCPs, as some of the largest sources of BC and methane are associated with fossil fuel production and combustion. There is also the complicated case of sulfur emissions, which produce sulfate aerosols that are short-lived, like BC, but reflect sunlight and cool the climate, partially compensating for greenhouse warming. Reducing some types of fossil fuel use, especially sulfur-rich coal and ship fuel, will also reduce the concentration of sulfate aerosols, which may amplify warming in the near-term, but reduce the peak warming over the long term.

A common metric for valuation of different greenhouse gases, the 100-year global warming potential (GWP) (*13*, *14*), compares the average radiative forcing of a greenhouse gas relative to CO_2 over the next 100 years. Some have argued that the 100-year GWP undervalues SLCPs, as the formulation includes no discount rate to prioritize near-term impacts. Others have argued that the 100-year GWP overvalues SLCPs as the formulation completely ignores any impacts beyond 100 years. Efforts to improve the GWP metric have encountered criticism from both perspectives (*15*). Our view is that there is no scientifically correct answer, as it requires trading near-term benefits for avoidance of substantial costs passed down to future generations, essentially in perpetuity.

Policy discussions about SLCPs are happening now. For example, the U.S. State Department, along with five other countries, unveiled in early 2012 an initiative for reducing emissions of BC, HFCs, and CH_4, and many other nations have now joined the initiative. If successful, such an initiative could lead to important health, agriculture, and climate benefits in the near-term. At the same time, there is legitimate concern that this initiative could be used to shield some countries from international pressure to reduce CO_2 emissions. It is imperative that this does not happen. The only way to permanently slow warming is through lowering emissions of CO_2. The only way to minimize the peak warming this century is to reduce emissions of CO_2 and SLCPs.

We suggest that the best way to prevent the slowing of CO_2 mitigation efforts is to emphasize parallel strategies for reducing SLCP and CO_2 emissions. For example, efforts to reduce BC emissions can be undertaken through air pollution measures whose main focus is on public health, such as regulations on diesel exhaust or the promotion of cleaner cooking technologies. HFCs can be regulated through the Montreal protocol. Such strategies have already proven to be effective. In California, for example, new regulations of particle emissions from diesel exhaust resulted in a reduction in ambient BC over all of the state by 50% within the last 25 years (*16*). Another example is the recent agreement at the G-20 Summit in St. Petersburg to reduce use of HFCs.

An implication of our proposal is that trading between CO_2 and SLCP emissions, CH_4 in particular, should be discouraged. If efforts to reduce greenhouse gas emissions, both SLCPs and CO_2, were at a mature state with a well-developed market, we would embrace a broader discussion of the time scales of climate change and encourage society to reach a consensus on how to value short-term and long-term climate change. But we do not believe that real decisions about health policies and climate policies are made through an interconnected market, so parallel efforts are essential. We recognize that compromises may be required to achieve political goals; in particular, giving developing countries some form of "credit" for reductions in SLCPs may be important to broaden participation in international climate agreements. But more widespread trading between different greenhouse gases, especially when it may affect markets for low-carbon technologies, risks committing our children and grandchildren to even greater climate impacts in the more distant future.

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PREPARED STATEMENT OF CHARLES A. MELOY, EXECUTIVE VICE PRESIDENT, U.S. ONSHORE EXPLORATION AND PRODUCTION, ANADARKO PETROLEUM CORPORATION

Good morning, and thank you Chairman Brady and Vice Chair Klobucher for the pleasure of speaking with the Joint Economic Committee this morning about "The Economic Impacts of the Natural Gas Revolution."

We are indeed in the midst of an energy re-boot in America, unlike any I've seen in my career—a re-boot that is driven by innovation and technology, and the nearly 10 million dedicated men and women in the oil and natural gas industry.

In terms of technology, the confluence of two time-tested, proven techniques, horizontal drilling and hydraulic fracturing (fracking), served as a game-changer in opening access to shale and other tight-rock formations.

America's new-found abundance of cleaner natural gas is only possible through the combination of these technologies. In other words, without fracking and horizontal drilling there is no 1) new age of energy self-sufficiency in America, which is very important given the current geo-political instability in places like Russia, Iraq, Syria and others; 2) material carbon reductions from greater utilization of natural gas that have resulted in the U.S. lowering its total carbon emissions to levels not seen since 1994; 3) lower consumer costs for the benefit of each and every American, amounting to $1,200 per household per year; and 4) substantial taxes, royalties, and leases paid by the industry to the tune of $85 million each day, which help governments pay for important public services including education.

It wasn't that long ago, America was contemplating LNG import terminals to meet natural gas demand. How times have changed, as today, we're expanding our ability to export natural gas, enhancing our nation's global influence and balance of trade. Every barrel of oil or molecule of gas we produce here is one less we have to import.

I'm proud to say the natural gas revolution has also spawned a U.S. manufacturing renaissance and tremendous growth in the chemicals industry, because of the cheaper natural gas feedstock.

In addition, if you think back to 2005 when Hurricanes Rita and Katrina hit the Gulf, natural gas prices spiked to more than $14 per MMBTU (million British thermal units), demonstrating how dependent the U.S. was on natural gas from the Gulf of Mexico. Shales have provided a geographic diversity that has stabilized supply and significantly dampened price volatility.

Production of natural gas in the U.S. has increased by 30 percent since that time, and whereas the EIA, back in 2009, projected natural gas prices to be near $13 per MMBTU by 2035, the newest projections show prices will more likely be around $6 per MMBTU. This is outstanding news for consumers, manufacturers, electricity providers and others and is an economic engine that can bolster the US economy for decades.

Thanks to the natural gas revolution, the American economic recession has been muted in many sectors of the economy. Our industry is adding jobs. Plus, for every oil and natural gas job that's created, an additional three jobs are created in other sectors of the economy.

The company I work for, Anadarko, is currently the third-largest natural gas producer in the U.S. We are the largest natural gas producer in Senator Mike Lee's home state of Utah, and we've invested more than $4 billion developing natural gas from the Marcellus Shale in Senators Toomey's and Casey's home state of Pennsylvania.

Among the achievements I'm most proud of, is that as we perfect the technologies we're also optimizing how we deploy people, equipment and best practices to drive efficiency gains in every aspect of our business. This translates into fewer days on location drilling and completing a well. Our innovations in Utah's Greater Natural Buttes field have resulted in six Utah Earth Day Awards.

We've achieved 40-percent reductions in the amount of surface space needed to develop oil and natural gas in Colorado's Wattenberg field. By expanding gathering and pipeline infrastructure, we've eliminated more than 10 million truck miles and avoided more than 450,000 truckloads in the Wattenberg field, significantly reducing traffic and associated emissions. We continue to invest in technology to reduce emissions, detect methane leaks and source, transport and recycle water.

We're also working collaboratively with all stakeholders. This includes Anadarko's work with the Clean Air, Clean Jobs Act in Colorado in 2010, which was a state-based solution to federal air quality requirements. It also includes our work with Colorado Governor John Hickenlooper, industry partners and the Environmental Defense Fund (EDF) resulting in new air-quality regulations in Colorado, and our efforts with federal and state regulators, tribal leaders and the Southern Utah Wil-

derness Alliance on the 2012 Greater Natural Buttes yielding a Record of Decision and project approval to develop the extensive resources of Utah.

The key going forward for our industry is for our elected leaders to keep working together toward solutions, refusing to perpetuate a climate of obstruction and the demonization of an industry that is fundamental to modern life. It means recognizing that a vibrant oil and natural gas industry makes other industries more productive—fueling the economy that creates opportunity.

We recognize the need for comprehensive and consistent state-based regulations. They provide legitimacy for our activities and help build public trust. This is why Arkansas, Colorado, Louisiana, New Mexico, North Dakota, Ohio, Oklahoma, Pennsylvania, Texas, Utah, West Virginia, and Wyoming continue to benefit from shale and tight-sands development. Yet, these activities are relatively stagnant on federal lands due to the costly and uncertain federal regulatory environment.

Our industry can do so much more with reasonable access to federal lands. Consider the oil and natural gas industry more than pays for the cost of all leasing, permitting, monitoring, and inspecting activities by returning almost $89 for every dollar BLM spends administering the onshore program.

Enabling infrastructure and pipeline expansions will help ensure we stay ahead of other parts of the world that have shale resources but no infrastructure to move it to market. Creatively partnering with industry to expand compressed natural gas (CNG) fueling stations can help put more natural gas in the gas tanks of America's fleet vehicles, meaning cleaner cars, cheaper fuel and even less reliance on foreign oil.

We don't have to choose between a future with fossil fuel development or a future with a cleaner environment. We can choose to have both. It is solely dependent upon our ability to continue to collaborate, rely upon sound science, streamline access, and not just identify problems, but do what our industry has been doing for decades—use human ingenuity to find solutions. Thank you.

QUESTIONS FOR THE RECORD SUBMITTED BY SENATOR ROBERT P. CASEY, JR., AND RESPONSES FROM DR. DANIEL YERGIN

Senator Casey:

We have our own major shale play in Pennsylvania that is now making meaningful contributions to our Nation's natural gas supply, as the Marcellus is now responsible for as much of 20 percent of America's natural gas supply. You have watched shale plays develop around the U.S. and the jobs generated from direct investments from shale operators. However, we now have domestic natural gas selling for half of what it sold in 2008.

Question #1

How do you see this dynamic benefitting the manufacturing sector? Could we begin to see a significant ramp up in manufacturing jobs being generated due to affordable and abundant supplies of natural gas in Pennsylvania?

Dr. Yergin's Response:

The Marcellus is an extraordinary engine of economic growth and development – one with great impact both on Pennsylvania's economy and on the nation's. Overall, in the IHS study America's New Energy Future (2012–2013), we examined the impact of the unconventional energy on US manufacturing and concluded that manufacturing will benefit from the new discoveries and the resulting lower natural gas prices. The benefits will be concentrated in drilling activity, the supply chain sectors (those that provide goods and services to support capital expenditures for drilling and completion of new wells and for the construction of related facilities, such as pipelines, and for on-going support of the activities), industries that use natural gas as a feedstock (primarily petrochemicals), and those that benefit through lower energy input (gas or electric power) cost.

Energy intensive sectors like energy-related chemicals, petroleum refining, aluminum, glass, cement and the food industry are investing and expanding their US operations in response to declining domestic prices for their energy inputs. Over $100 billion of new investment has been announced just for the petrochemical sector in the United States, and the eventual total manufacturing investment as the result of this unconventional revolution will be measured in many multiples of that hundred billion. This will translate into economic growth and substantial job creation, directly and indirectly.

Pennsylvania manufacturing does have growth potential due to the development of the Marcellus and the state's skilled workforce in manufacturing and related sectors, as well as its proximity to major population centers and numerous transportation nodes. However, a significant ramp up in Pennsylvania manufacturing jobs does not necessarily follow. As drilling activity continues, the supply chain sectors operating within the state will continue to support the oil and gas industry in its drilling and related efforts, and this sustains and creates jobs. There is also the prospect of petrochemical industry expansion within the state. The degree to which manufacturing does ramp up will be affected by the overall business climate both for the upstream gas industry and manufacturing and by state policies on taxation and regulation.

A recent IHS study on 'Manufacturing Growth Strategies for Philadelphia MSA' (2013) identified competitive strengths of the manufacturing sectors in, among others, chemicals and refining. However, the study showed that the region is not achieving the maximum benefit from Marcellus development. These industries use natural gas liquids as a feedstock, and access has been limited by insufficient natural gas liquids pipeline capacity, among other things.

Senator Casey:

I understand that some industries that rely on natural gas as a feedstock or energy uses are concerned that new demand for natural gas by the transportation sector, or an aggressive move to export natural gas, might dramatically increase demand, and as a consequence drive up prices.

Question #2

What is the long-term outlook on the supply and price of natural gas?

Dr. Yergin's Response:

We estimate that technically recoverable natural gas resources in the US are approximately 3,000 trillion cubic feet (Tcf), enough to supply current levels of consumption (26 Tcf in 2013) for well over 100 years, and enough to accommodate significant growth in consumption for decades, even without additional discoveries or technology developments that would increase the recoverability of gas resources. Over the next 20 years we project US natural gas consumption will total 692 Tcf (cumulatively), leaving some 2,300 Tcf of resource for future consumption. And given the industry's track record for increasing recoverability and reducing unit costs, we would expect the resource base to continue to grow in coming years. We consider our estimate to be conservative.

The technologies that have been developed for recovering gas from impermeable formations—so-called "unconventional" gas—yield significant scale economies, with individual wells producing far more gas than was true in the recent past using more conventional drilling and completion techniques. Because the costs of drilling and completing today's wells now can be spread over a higher volume of production, the unit cost of gas production is today much lower than it had been before the unconventional gas revolution.

IHS Energy estimates that a large volume of gas from unconventional dry gas plays can be produced economically at a Henry Hub price at moderate prices. There is the potential for cost inflation to affect this likely price range. If the costs of key inputs such as steel pipe, fracking sand, labor, or other inputs increases faster than general inflation, the likely price band will shift upward accordingly.

Question #3

Given the supply, how viable is natural gas as a transportation fuel, and are there specific segments of the motor vehicle market where it is particularly applicable?

Dr. Yergin's Response:

Natural gas—either as LNG or as CNG—can be economically competitive in the high-mileage parts of the transport sector. Fleet operators whose vehicles return to base every night—trash trucks and buses, for example—are showing the highest rate of adoption, but represent a relatively small portion of US fuel demand. The trade-off between incremental up-front costs (it costs more to buy a natural gas engine) and fuel savings (natural gas is cheaper than diesel) means that the more the vehicle consumes, the more competitive natural gas is. In the longer-term, the highest natural gas fuel usage can be expected in marine bunkering, heavy-duty trucking, and possibly even rail. Long-distance heavy-duty trucks are considered one of the prime potential markets. There are, however, two notable constraints on the penetration of natural gas in trucking. One is infrastructure—the lack of a widespread refueling system. The other is competitive—the fact that the fuel economy

of diesel trucks is improving. Passenger vehicles, the majority of fuel demand, however, currently show less promise because of the low miles traveled, on average, but could still prove competitive in some circumstances.

Over the past several years, Congress has encouraged the use of alternative fuels by providing tax credits. We have heard that many alternative fuels are not economically viable in the marketplace without long-term government support.

Question #4

What are the economics of natural gas as a transportation fuel versus conventional fuels? And, if the economics are positive, what would providing tax credits achieve?

Dr. Yergin's Response:

The economics of switching to natural gas can be positive, with the balance being determined by the incremental costs (higher capital cost) and fuel savings (lower operating expense). LNG costs are about $1.50-$1.75 per diesel gallon equivalent (dge) cheaper than diesel pump prices, and the CNG discount is near $2 per dge or more. With oil and gas prices in North America fundamentally disconnected, these discounts could change.

While LNG truck engines cost $40,000-$75,000 more than their diesel counterparts, incremental CNG engine costs are considerably lower. The economics are highly sensitive to these two factors, and in particular how much fuel is consumed by each vehicle. The more fuel consumed, the more positive the economics.

Whether tax credits should be used is a matter for policy discussion, in terms of overall objectives and long-term effects. One question is whether the tax credits would be applied to capital costs of new vehicles or to fuel prices. It would also be useful to compare current levels of taxation on an energy basis.

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