

FACTORS IMPACTING GLOBAL OIL PRICES

HEARING
BEFORE THE
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ENERGY AND NATURAL RESOURCES
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FACTORS IMPACTING GLOBAL OIL PRICES

TUESDAY, JULY 24, 2018

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

The Committee met, pursuant to notice, at 10:03 a.m. in Room SD-366, Dirksen Senate Office Building, Hon. Lisa Murkowski, Chairman of the Committee, presiding.

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

The CHAIRMAN. Good morning, everyone. The Committee will come to order.

We are here this morning for a couple reasons. If and when, hopefully it will be shortly, a quorum is present, we will proceed with a business meeting to report four of our nominees for the Department of Energy. But recognizing that we do not yet have 12 members present, I will go ahead with agenda item two which is a hearing to examine the factors affecting global oil prices.

This year has been marked by greater volatility, which has shown up in the prices being paid at the pump by nearly every American family and business. Prices are notably higher than a year ago, so the questions we are here to ask include: why is that, will it remain this way, and what, if anything, can we do about that? Of course, that is what everybody really wants to know, where are we going with this?

When I look at the global markets, I see a number of factors that are pushing oil prices up but also a few significant factors that are also restraining them.

On the one hand, global oil prices are the direct result of strong economic growth. In some ways, this is almost a tradeoff. Prices were a lot lower when our economy was a lot weaker, but I do not think that any of us would want to trade our remarkable pace of job creation and low unemployment to go back to those days.

Another factor leading to the higher prices is that global oil demand is rising, not falling. This is, kind of, Economics 101, and the driver on this front is not the U.S. but much of the rest of the world led by emerging economies such as China and India.

At the same time, we are dealing with the fallout from OPEC's strategy of artificially restricting supply from its members. There is no question that has reduced inventories and pushed prices higher. We are also seeing the effects of supply disruptions across the globe, from Libya to Venezuela to Canada.

On the other side of the ledger, there is somewhat of a silver lining. We are seeing that while prices are higher, it is not as bad as it could have been, and that is largely because of significant increases in U.S. production.

America's Shale Revolution has brought tremendous benefits to our country and the global economy. As we produce more, we are creating jobs, we are generating revenues and we are bringing a degree of stability and confidence to global markets. We have also made smart policy decisions like lifting the ban on U.S. crude oil exports that are allowing us to become a major power on the global stage.

I think it is complicated enough to understand where we are today, but again, I think most folks are interested in figuring out what really lies ahead. Where are we headed? Will markets loosen up as production in the U.S. and countries like Saudi Arabia continues to rise? Are we accounting for strong growth in global demand? Where are the geopolitical hotspots where substantial supply could disappear from the market at a moment's notice?

Then we have the wildcards that are out there. What will happen if we fail to build needed infrastructure in the U.S., to ensure that energy can be transported from where it is produced to where it is consumed? What will happen if the U.S. releases oil from the Strategic Petroleum Reserve, not in response to an emergency but to manage tight market conditions? What will tariffs mean for the viability of domestic energy projects, and our ability to access markets in countries like China? What will happen as global spare capacity shrinks, and we no longer have a cushion of production that can be brought online quickly? Also, what are the looming impacts of regulations like the International Maritime Organization's low sulfur standards? Then, of course, front and center, front page in all the news right now is what will happen with Iran?

I believe our best course is to continue with our efforts to produce more oil here at home, particularly in places like Alaska, where we have the will and capacity to do so. That is why I believe it was the right move to begin to open the Coastal Plain of ANWR to responsible development and why I support the new Five Year Program for Offshore Development. I think there is no substitute for U.S. production, for as long as we need it, even as we seek to diversify away from oil.

Here to help us understand all of this is a truly distinguished panel of witnesses from as far away as the International Energy Agency (IEA) in Paris. We have one witness, Mr. McNally, who literally wrote the book on crude volatility. We have another, Mr. Bordoff, who has come full circle since he testified here in 2016 about the impacts of low oil prices. We also welcome Mr. Auers and Mr. Brazier, who will share their perspectives on the North American market.

So, counting, we are not quite to 12 yet.

Senator Cantwell, why don't we turn to you for your opening statement, and maybe we can get to the business meeting right after that.

**STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON**

Senator CANTWELL. Thank you, Madam Chair.

Thank you for scheduling what is really a very timely hearing on global oil prices, because every family and business across America is feeling the burden of higher fuel prices which is forcing average U.S. households to pay \$155 more in fuel costs this summer's driving season as compared to last year's. Gasoline and diesel prices are currently around \$.60 more than they were at this time last year, and that is the highest that we have seen in four years. My constituents are particularly aware of the prices at the pump since Washington State drivers pay the third highest gas prices in the country. I believe even more than in some places in Alaska, which I find hard to believe.

But currently, drivers are shelling out \$3.41 per gallon. That means that every gas station fill-up costs Washington drivers about \$8.00 more than it did last summer. That means everyone from boaters to people who are moving products that are key to getting product to market are paying more and making things more expensive which means less take home pay and higher retail prices for the goods they transport. Given the profound impact higher fuel prices have on family budgets and our economy, we need to take aggressive action on all fronts to make sure that we are policing these gas prices and markets.

Not only do we have international cartels artificially constraining price, obviously lots of statements in the last couple of days are leading to uncertainty in the markets. What happens if the Iranians do follow through on their threat to shut down the Strait of Hormuz? About a third of the world's seaborne petroleum passes through that chokepoint where a shipping lane is just three kilometers at its narrowest point. So I hope to ask our expert witnesses about that as well.

We also see, in tight oil markets, the opportunity for volatility and potential for manipulation. We must continue to find ways to protect consumers on all of these issues and continue to make sure that we are breaking monopolies at the pump—whether that means continuing to aggressively look for alternatives to fuel markets and solutions or making sure that we continue to focus on opportunities.

I would like to learn more about why record level oil production here in the U.S. is not providing any relief at the pump. Just last week we reached a new production record of 11 million barrels per day, only slightly behind Russia's 11.4 million barrels per day.

Even putting aside the fact that continuing to put that level of carbon in the atmosphere is unsustainable, America's increase in fossil fuel production seems to be only padding a bloated oil economy profit rather than helping the household budgets of many consumers. In fact, I read just yesterday that this Friday analysts expect Exxon to post a 62 percent increase in quarterly profits to \$5.45 billion.

The reality is, even as crude oil prices have doubled over the last two years, oil supplies have been relatively flat despite the U.S. crude oil production. That is because OPEC and other producers like Russia agreed to set market supply quotas starting in January

2017. The more we pumped the harder they worked to make sure that the prices stayed high.

It is very hard for us to drill our way out of this problem. The effective way to reduce our fuel costs both nationally and individually is to beat the OPEC monopoly with some good old-fashioned competition at the pump. Americans should be able to fill up with homegrown biofuels instead of the Saudi-Russian crude, and we should continue to push for electric vehicles and lower operating costs for our consumers.

Members of this Committee have been instrumental in increasing fuel economy standards, but now the Administration is trying to reverse that progress. Reduced consumption of oil in the United States by 2.4 million barrels per day is where we were on track for 2030, saving consumers in the United States \$130 billion.

Implementing these policies and reducing oil consumption, we have learned, has also been creating jobs—it is credited for more than 288,000 automobile manufacturing jobs and 1,200 jobs across the United States. These alternatives are showing that we can produce pressure as an alternative to gasoline supplies and we need to keep moving forward. Unfortunately, as I said, the Trump Administration seems to be adhering to trying to tear down these alternatives.

Today I also want to talk to our witnesses about what else the Executive Branch could be doing using its existing regulatory and investigative authority to make sure that untoward things are not happening in our supply chain. Recent steep, one-day changes in price of crude oil have raised concerns about the role of speculators with automatic trading and algorithms.

On July 11th, domestic and international oil futures had the steepest one-day percentage decline in more than a year and the sharpest one-day point drop in over three years. These dramatic changes in one day have caused market observers and analysts to raise concerns about automated trading. This is something I will ask our witnesses about today.

Madam Chair, obviously all of these tools should be in our toolbox to continue to focus on giving the America driving public the best opportunity to have low fuel prices.

I look forward to asking our witnesses about these questions.

The CHAIRMAN. Thank you, Senator Cantwell.

[RECESS FOR BUSINESS MEETING]

The CHAIRMAN. We will now turn to our panel. As I mentioned, we have a distinguished panel before us and we will begin with you, Mr. Sadamori.

Mr. Keisuke Sadamori is the Director for Energy Markets and Security at the International Energy Agency. We welcome you to the Committee.

Mr. Robert McNally, who I mentioned in my previous comments, is the Founder and President of the Rapidan Energy Group. Welcome.

Mr. Rusty—is it Braziel?

Mr. BRAZIEL. Brazil.

The CHAIRMAN. Braziel. Mr. Braziel is the President and Chief Executive Officer of RBN Energy, LLC. Welcome.

Mr. John Auers is the Executive Vice President of Turner, Mason & Company.

And Mr. Jason Bordoff is the Founding Director of the Center of Global Energy Policy at Columbia University.

We welcome each of you to the Committee this morning. We ask that you try to keep your comments to about five minutes. Your full statements will be incorporated as part of the record. As you can see, we have a great deal of interest from the Committee this morning and the words that you have to share with us.

Mr. Sadamori, if you would like to begin. Thank you.

STATEMENT OF KEISUKE SADAMORI, DIRECTOR, ENERGY MARKETS AND SECURITY, INTERNATIONAL ENERGY AGENCY

Mr. SADAMORI. Thank you, Chairman.

Chairman Murkowski, Ranking Member Cantwell and distinguished members of the Committee, thank you for the opportunity to present the International Energy Agency's view on the factors affecting the global oil prices.

Let me start by conveying his best regards from Dr. Fatih Birol, the IEA Executive Director, to members of the Committee.

For more than 40 years since the IEA's establishment, the United States has played a critical leadership role in the IEA. Thanks to the Shale Revolution in recent years, the U.S. is leading global supply growth, both in oil and gas, making enormous contributions to global oil and gas supply security.

The IEA's role has expanded, but analysis of oil markets and the oil security system continues to be the core mandate for the agency.

Global crude oil prices are more than 50 percent higher than a year ago. This reflects steady oil demand growth and overachievement of the Vienna production cuts agreement by OPEC and some non-OPEC producers and some supply disruptions in other countries.

Commercial oil stocks in OECD countries declined from more than three billion barrels in January 2017 to 2.8 billion barrels in May 2018, and they have been below the five-year average since March. All this points to a tightening market and the rising prices from the low point of less than \$28 per barrel for Brent in January 2016 to nearly \$80 per barrel in May 2018.

So, going forward, the following factors should be considered. The global oil demand growth is relatively steady at the 1.4 million barrels per day, but there are signs of stress in some countries with oil price increase. Many developing countries recently reduced or eliminated subsidies for the oil products, and so higher global oil prices more directly translates to the higher prices at the pump. With the stronger U.S. dollar, some countries in their currency terms have seen sharp rises in their domestic cost of oil. The current trade tensions, if escalated, could adversely impact the global economy with a knock-on effect on oil demand.

There are several major supply uncertainties. The first is Iran. At this time, we cannot know how much Iranian oil will be removed from the world markets by the U.S. sanction, but the recent indications point to the shortfall being significant. Second, collapse of oil production in Venezuela is continuing. Production currently is only 1.3 million barrels per day and could be below 1 million bar-

rels per day at the end of this year. In Libya, the recent strike against the oil infrastructure resulted in production falling from one million barrels per day to about half million barrels per day. The situation seems to be improving but we cannot be sure if the stability stays there. Disruptions are happening in other regions including Iraq, Canada, North Sea and Brazil.

Under such market conditions, a decision by the signatories to the Vienna Agreement to increase the production is welcome in supporting the stability of supply to oil markets, but it comes at the expense of the global spare capacity cushion.

The United States is already the single largest contributor to the supply increase, growing faster than the global demand growth. The IEA, however, sees little scope to revise it upwards even with the recent price increase because of the constraints in pipeline takeaway capacities. The tight supply situation is not helped by the recent low level of investment in the upstream oil and gas industry. We should also not forget that the production from existing fields is declining by more than three million barrels per day, and that's about the size of the entire North Sea field each year.

So we are in a very volatile and challenging period. Geopolitical factors, even more than pure fundamentals, are important in determining oil price movements. Despite the rapid growth of EVs, oil will continue to be the dominant fuel for the transport sector as well as important feedstock for the petrochemical products in decades to come.

The emergency oil stock system, managed by the IEA and its members, therefore will continue to be critical to be prepared for the rainy day and ensure the stable functioning of global economic systems.

For its part, the IEA is engaged in close dialogue with the major oil producers and consumers, both inside and outside the IEA family, and we are monitoring market developments to be prepared to advise on any support that might be needed to ensure market stability.

On behalf of everyone at the IEA, I wish to once again thank you for inviting me before this Committee. I'm happy to answer any questions.

Thank you, Chair.

[The prepared statement of Mr. Sadamori follows:]

Mr Keisuke Sadamori, Director, International Energy Agency

**Written testimony
Hearing of the U.S. Senate Energy and Natural Resources Committee**

**Keisuke Sadamori
Director, Energy Markets and Security
International Energy Agency**

July 24, 2018

Chairman Murkowski, Ranking Member Cantwell, and distinguished Members of the Committee, thank you for the opportunity to appear before you today to present the International Energy Agency's view on factors affecting global oil prices.

Let me start by conveying his best regards from Dr. Fatih Birol, the IEA Executive Director, to members of the Committee. He regrets not being able to appear at this session due to other long-standing engagements, and he asked me to convey his best wishes to you all.

A brief overview of the IEA's role in global oil market

The strong relationship between the United States and the International Energy Agency goes back to the founding of the IEA in 1974. For more than 40 years the United States has played an absolutely critical leadership role in the IEA. One important symbol of this is by providing distinguished officials to hold the role of Deputy Executive Director. Over the years, support for the Agency's work has come from the White House, the Department of State and the Department of Energy, as well as from this Committee and other parts of Congress. Outside of government, the Agency has good relations with many US research institutes, think tanks and companies.

I know that you, Madam Chair, and many of your colleagues know what the IEA does, but I also appreciate that not everyone here will be fully familiar with our role.

The IEA was founded by the United States and 15 other countries in the wake of the 1973/1974 oil crisis to promote energy security, cooperation and stable markets. Since then the Agency's role has expanded alongside developments in global energy systems and we have become the world's leading policy advisor across the entire energy mix. However, analysis of oil markets and the oil security system, in the form of our emergency oil reserve requirement, continues to be the core mandate for the Agency. Each month, the IEA publishes its closely-watched *Oil Market Report*, and once a year it publishes a five-year outlook. The Agency is at the centre of oil market analysis.

Recently, working with its member governments, the IEA has adopted a modernization strategy. This has three pillars: opening the IEA's doors to emerging economies; broadening our energy security mandate; and in addition to our pole position on fossil fuels, also becoming the global hub for clean energy transitions.

And now I turn to the matter at hand.

The Oil Market Situation

The theme of today's hearing is the global oil market and prices. As nearly always seems to be the case, there is considerable turbulence in the market, partly due to geopolitical factors, and forecasting is very challenging. To give you our analysis of today's market, we take as our starting point the fact that global crude oil prices are today typically 55% higher than a year ago. This reflects two main developments in the oil market.

First, global oil demand has been growing steadily. In 2017, it was 1.5 mb/d higher than the year before and we expect that the increase will remain steady both this year and in 2019 at 1.4 mb/d. Later this year, global oil demand is expected to reach the symbolic 100 mb/d level. An important factor underpinning this is that the world economy will continue to grow steadily: our current assumption is that global GDP will grow by 3.8% in 2018 and 3.9% in 2019. Incidentally, in today's oil market, China and India are hugely important as engines of growth and together they contribute about 50% of the increase in global demand.

Second, oil supply has been restrained. The reason for this dates back to oil prices falling below \$30/bbl early in 2016. This was very uncomfortable for oil producers, including, of course, here in the United States. To place a floor under prices and to achieve an increase, OPEC producers and some leading non-OPEC producers committed themselves, under the terms of what is known as the Vienna Agreement, to reduce production by 1.8 mb/d. In fact, earlier this year, according to IEA data, production had fallen by 2.5 mb/d. This over-performance was partly due to the collapse of production in Venezuela and the gradual decline in Mexico, as well as to lower than expected production in Angola and Iraq. More recently, the impact of the Vienna Agreement has been amplified by the return of strife in Libya, and shortfalls in Canada, Brazil, the North Sea and Kazakhstan.

Rising demand and production restraint have worked together to drive down the very high level of global oil stocks: commercial oil stocks held in OECD countries declined from more than 3 billion barrels in January 2017 to 2.8 billion barrels in May 2018, and they have been below the five-year average since March.

All this points to a tightening market and the rise in prices the low point of \$27.88/bbl for Brent crude oil in January 2016 to the highest level seen so far in 2018 of \$79.80/bbl reflects this demand/supply reality. As we try to anticipate what will happen in the second half of 2018 and into 2019, we must consider the following factors, heavily weighted towards supply concerns:

Demand

On demand, although for the time being the IEA believes that global oil demand growth is relatively steady at 1.4 mb/d, there are signs of stress in some consumer markets as oil prices have increased. In many developing countries, when prices fell sharply in 2015 and 2016, they took the opportunity to reduce or eliminate extremely expensive subsidies for oil products. Now that prices are rising again, consumers are inevitably less protected and they are feeling the pain. When the strength of the US dollar is taken into account, we find that in local currency terms some countries have seen very sharp rises in the domestic cost of oil. Examples include: Argentina, where prices are up 124% versus a year ago, Brazil up 89%, Mexico up 78% and in Turkey prices are up by 104%. Here in the US, we see that national average domestic gasoline prices are about 25% higher than a year ago. In all countries, rich and poor alike, higher prices are unwelcome.

In addition to the interactions between oil demand and supply, we should also acknowledge that another important factor in determining oil demand growth are the current trade tensions between major nations and trading blocs. If they escalate, and global trade is reduced, this will adversely impact the global economy with a knock-on effect on oil demand. Incidentally, it might have a disruptive impact on oil trade: so far in 2018 the US exported more than 500 kb/d of crude oil and products to China.

So, demand growth could turn out lower than we currently expect, although the difference is unlikely to be very large. If this happens, it could be argued that it would take some of the heat out of oil prices. However, by far the most significant factors affecting the market are on the supply side, and this is the subject of the next section of my testimony.

Supply

There are several big supply uncertainties in front of us. Individually, they are important enough to present a serious challenge to security, but in 2018 we are faced with the possibility that these factors could impact the market simultaneously and present a challenge to global production capacity that has rarely been seen.

Iran

The first uncertainty we must consider is Iran. The policy of the United States is to reduce Iran's oil exports by the maximum possible volume. At this time, we cannot know how much Iranian oil will actually be removed from world markets, but recent indications point to the shortfall being significant. In May, Iran's oil exports were about 2.4 mb/d, but data for June show that purchases by European customers were about 50% lower than in May, down to 340 kb/d. The world's second and third biggest oil markets, China and India, respectively, each imported more than 650 kb/d of oil from Iran in June and sourcing alternative supplies on this scale, both in terms of volume but also crude quality, will be a major undertaking.

Venezuela

Whatever the eventual fall in Iran's exports, it will almost certainly be accompanied by the continuing collapse of oil production in Venezuela. Since the inauguration of President Chavez in 1999, production has slumped from 3.5 mb/d to only 1.3 mb/d and if the current rate of decline is maintained, and it is more likely than not, production could have fallen by a further 200-250 kb/d by the time Iranian sanctions formally take effect. This will have a big impact on global oil markets of course but it also raises supply issues for the United States, which, according to Energy Information Administration data, has imported 500 kb/d of oil from Venezuela in 2018 which is used in refineries especially configured for this typically heavy, sour crude. Incidentally, China and India, which are major customers of Iran, are also affected by the Venezuelan situation, with each importing about 300 kb/d of its crude oil.

Some analysts have predicted a complete collapse of the oil industry as chaos finally overwhelms Venezuela. Of course, we cannot know how much further the situation will deteriorate, but there is clearly a very serious risk factor affecting oil security.

Libya

The third major uncertainty is Libya. Until recently, at least in oil production terms, Libya was relatively stable with oil production broadly holding steady for about a year at 1 mb/d. The recent outbreak of

fighting and the attacks on oil infrastructure resulted production falling by about half. Today, we are unclear as to the pace of recovery towards normal production. The fresh outbreak of fighting has reminded us that Libya remains a major supply risk in global oil markets.

Other supply concerns

Iraq is another country with production problems. Due to the dispute between Baghdad and the Kurdistan Regional Government, about 250 kb/d of production is shut in. At the moment, we cannot know when supplies will resume.

Production problems are not limited to OPEC producers. Canadian oil supplies plunged sharply from mid-June as the 360 kb/d Syncrude upgrading facility was shut down. Heavy maintenance saw North Sea oil output plunge by 400 kb/d compared with a year ago. Growth in Brazil has been slower than expected so far this year although the start-up of another production unit should ease the situation in coming months.

The point to make here is that in a 100 mb/d oil market, the global oil supply system is under strain. The very small number of producers that can increase production to make up for shortfalls elsewhere face a big challenge to help ensure stability of supply.

Spare capacity

You will recall that earlier I said that signatories to the Vienna Agreement had over-achieved their target of cutting oil production by 1.8 mb/d. In recognition of this, at their recent meetings signatories to the Agreement committed to *increasing* their oil production so that it would meet their objective, rather than exceed it. According to numbers cited by leading OPEC ministers, this implies a production increase of 1 mb/d. Subsequently, Middle East Gulf OPEC producers have said that they will increase production in the coming months, and they already show signs of having started to do so. Russia is following suit.

While the decision by signatories to the Vienna Agreement to increase production is welcome in terms of helping to ensure stability of supply to oil markets, it comes at the expense of the global spare capacity cushion that could fall to low levels not seen since 2008. You will recall that in that year oil prices soared to record highs at more than \$140/bbl. In the July edition of the IEA's *Oil Market Report*, we showed that there is just over 3 mb/d of spare production capacity held by OPEC countries, with nearly all of it in Saudi Arabia, the UAE, and Kuwait. The number is not certain however, due to lack of transparency in these countries and because the spare capacity has not actually been used for many years. Elsewhere, amongst the non-OPEC countries that signed the Vienna Agreement, only Russia can increase production significantly by the end of 2018 and the 300 kb/d of production that it cut would be a first instalment of higher production.

Elsewhere, the only realistic source of significantly higher oil production is the United States, which is the most important source of growth in the non-OPEC world. The resurgence of the US industry following the fall in output from mid-2015 onwards has been truly impressive. In terms of total liquids the US is now the world's biggest producer and the IEA forecasts that production will grow by 1.7 mb/d in 2018 to reach 14.9 mb/d, with a further 1.2 mb/d due next year. This is a long-standing outlook: the IEA sees little scope to revise it upwards even though prices have increased to three and a half year highs.

The reason is that the impressive growth in production is running up against constraints in takeaway capacity. IEA research published in our five-year outlook *Oil 2018 – Analysis and forecasts to 2023* revealed

an impressive number of pipeline, storage, and export capacity projects in progress in the US, but they will have little impact on the market until well into 2019. This crimps growth potential at a time when the market will be able to absorb any oil that can be produced.

The tight supply situation is not helped by the recent low level of investment in the upstream oil and gas industry. The major exception is, of course, the United States, but in most of the rest of the world the picture was discouraging: in both 2015 and 2016 global investment fell by 25%, and in our recent publication *“World Energy Investment 2018”* we point out that in 2017 it grew by only 2%. This has major implications for the growth of production in the coming years as new investments are not only needed to meet growth in oil demand of more than 1 mb/d per year, but also to offset declines from oil fields currently producing. Recent analysis by the IEA shows that production from oil fields that have already peaked declines by more than 3 mb/d each year. This means that each year the industry must replace the equivalent of production from the North Sea just to stand still.

Conclusions

Although there has been remarkable progress in renewable deployments and other low carbon technologies, oil continues to be the dominant fuel in transportation. A good example is found here in the United States, where more than 90% of transport needs are met by oil. Globally, despite talk of peak oil demand, the requirement for liquid fuels will continue to grow for many years to come. This means that supply must grow. As our discussion of production capacity and consequences of by low investment show, this is no small challenge.

Today, looking at the short term situation, we see a very volatile and challenging period. Geopolitical factors even more than pure fundamentals are important in determining oil price movements. For its part, the IEA is engaged in a close dialogue with major oil producers and consumers, both inside and outside the IEA Family, and we are monitoring market developments in order to be prepared to advise on any support that might be needed to ensure market stability. This is why the IEA was founded in 1974 and this role is as important today as it was then.

On behalf of everyone at the IEA, I wish to once again thank you for inviting me before your Committee. I am happy to answer any questions.

The CHAIRMAN. Thank you, Mr. Sadamori.
Mr. McNally, welcome.

**STATEMENT OF ROBERT McNALLY,
PRESIDENT, RAPIDAN ENERGY GROUP**

Mr. McNALLY. Madam Chairman, Ranking Member Cantwell, members of the Committee, I'm honored to be back before you today.

I thought what I'd do in my brief five minutes is focus on three things: first, the return to authentic boom-bust oil price cycles; second, factors that are pushing oil prices down and up in the near term, as the Chairman alluded to; and third, an oil issue that's been preoccupying us in the industry for years now and, frankly, it's remarkable how little notice it's gotten in Washington and that's IMO 2020.

Before delving into the detail about the up and down, let me just step back and note that these haven't been normal oil prices in the last 15 years. You just don't see a near quintupling in crude oil prices without a war in the Persian Gulf in modern times. That doesn't happen. But it happened from 2004 to 2008. And you just don't see oil prices fall 60 percent in half a year as we did in 2014 without a recession or sudden supply surge. This is unusual in modern times. We have to ask ourselves why?

Since the beginning of the modern oil market, oil prices have exhibited a proneness to wild boom and bust swings. Now, when oil was just a lighting fuel in the 1800s, it wasn't so much of a problem, but when it became the world's lifeblood in the 20th century, it became a problem. This volatility, not just for the oil industry, but for you, for governments, for industry, for airlines, for everyone who depends on oil which is most of us.

To vanquish oil's wide swings and stabilize prices, governments and the industry regulated production, and folks forget the United States was the king of OPEC, specifically, the State of Texas. The State of Texas exhibited heavy-handed intervention in a market that would have made, forgive me, Mao Tse-tung blush.

[Laughter.]

The Texas Railroad Commission met once a month for 40 years and they set quotas well-by-well, field-by-field. When OPEC is getting along they meet twice a year and set quotas most of them ignore. We were the king of OPEC.

Now why did the good folks in Texas, who normally want to limit government and produce oil, why did they agree to heavy-handed intervention in the market? To stabilize prices. To vanquish that boom-bust that we saw from the '20s and the '30s.

Now, some folks thought that OPEC took over from us in 1972 and they lost it in 2008. Now, some folks thought that maybe shale oil would be the new swing producer and we saw that failed—\$28 Brent, \$26 WTI in 2016. So that didn't work out too well. Others think that this new entity formed by Saudi Arabia and Russia will be the new OPEC. I have my doubts, but we can discuss that.

The bottom line is this, and this is very important. It comes from history, but we haven't really seen in four generations this type of volatility. No swing producer, nobody regulating supply, no peace in oil prices.

Now, turning to the here and now, as the Chairman alluded, we have forces pushing prices down. Supply is growing faster than demand. The IEA, the EIA, OPEC, we were barrel counters. All of us see the market loosening up a little bit as we go into next year.

Strong production growth in the United States, Brazil, now Saudi Arabia, other places, even with good demand, kind of, pushing prices down. There's a lot of fear in the market right now with trade wars and the Fed raising rates and the dollar being strong which makes oil more expensive around the world. There's fears about demand. That's putting prices down.

But the concern also is forces pushing prices up and that is geopolitical disruption risk. And this gets back to the spare production capacity issue.

When you have a swing producer regulating supply to keep prices stable, they usually hold back supply from the market. That doesn't happen normally. We call that spare production capacity. Now, that spare production capacity acts like a fire department in a wooden city. Okay? When you get into a disruption or a war, you want to call on the fire department. You call on that extra supply that's being held back by regulators to come in and douse the fire before it burns down the whole city. Right now, spare production capacity is close to or near zero. That is dangerous in light of the disruptions in Libya, Venezuela, Mr. Sadamori referred to and, of course, Iran.

Iran. Iran exports 2.5 million barrels a day and in a 100-million-barrel-a-day market, but in the oil market few barrels make a difference in price. With zero spare production capacity and commercial inventories, kind of, back to normal, the loss of 2.5 million barrels a day would be a big problem in terms of oil price stability.

Now, Iran has threatened over the weekend to interrupt the 19 million barrels a day that flows through the Strait of Hormuz, which Senator Cantwell alluded to. That is even a bigger problem, really the biggest problem that those at the IEA and we in the oil industry prepare for and analyze.

While our military would clearly prevail over the Iranian military in a conflict, I think we ought not be complacent about how long that strait, that narrow strait, would be closed. It's cleaning up the mines. It's ensuring the insurance companies that they can insure those ships to go through. So that is a deadly serious issue for the oil market to continue, to consider.

Oops, I'm on to my last minute, Madam Chairman, so I'll stop here and perhaps get into IMO in the Q and A.

A final quick statement. I wish I could confidently predict stable, comfortable crude oil prices. That would be optimal.

In 2012 I had the honor of testifying to your colleagues in the House Small Business Committee and noted crude oil prices and therefore pump prices had entered a new "Space Mountain" era of boom-bust price cycles. I maintain that view.

We went through a bust recently, and eventually we will go through a boom. If a new swing producer does not emerge, we should all buckle up for a continued roller coaster ride on Space Mountain.

Thank you, Madam Chairman.

[The prepared statement of Mr. McNally follows:]



**Written Testimony of Robert McNally
President, Rapidan Energy Group
Before the Committee on Energy and Natural Resources
United States Senate
July 24, 2018**

“Factors that are impacting global oil prices”

Chairman Murkowski, Ranking Member Cantwell, and members of the Committee:

It is a pleasure to share perspectives on factors impacting global oil prices. I approach this subject with twenty-seven years of professional experience as an oil market, energy policy, and geopolitical analyst and policy official. I currently run Rapidan Energy Group, an energy market, policy, and geopolitical consulting firm. I also served as Special Assistant to the President for Economic Policy on the White House National Economic Council from January 2001 to June 2003 and Senior Director for International Energy on the National Security Council from January 2003 to June 2003. I am a non-resident fellow at Columbia University’s Center on Global Energy Policy and am delighted to join its Director Jason Bordoff on the panel today.

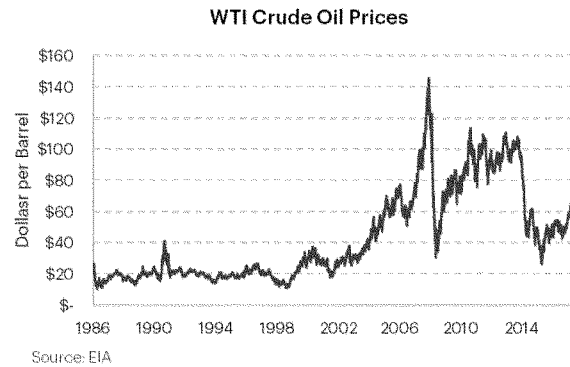
I would like to recognize and thank my colleagues at Rapidan Energy Group, whose continuous, deft analysis of the global oil market, energy policy and regulations, and geopolitical trends and events have fortified my views presented in this testimony. That said, views represented here and in the question and answer session are mine only and do not reflect those of Rapidan Energy Group or its clients.

May I first thank you and your colleagues on the Senate Energy and Commerce Committee for holding this important hearing and inviting me to testify. While petroleum is used in many different applications, from aspirin to Ziploc bags, oil’s biggest and most important use is for transportation. Oil fuels nearly every car, school bus, military aircraft, tractor, airplane and truck on the planet. Electricity, alcohol, hydrogen, or some other competitor may one day vanquish oil. Meanwhile, we must continue to manage its environmental and security externalities. But for the foreseeable future, oil will remain nothing less than the lifeblood of modern civilization; its price, abundance, and stability are therefore of paramount concern to the American people, Congress, and this Committee.

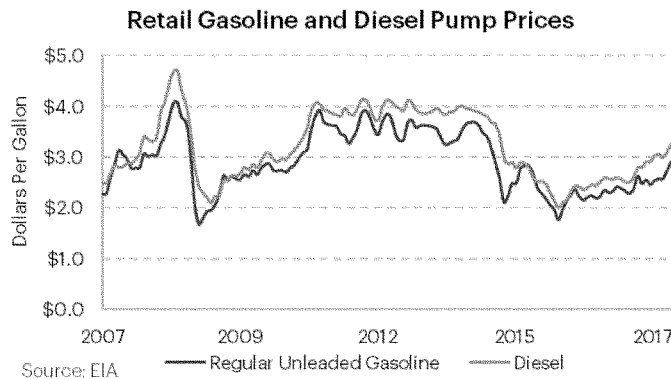
Recent market and price developments

Over the past year, the global oil market transitioned from a glut to a more “normal” state regarding observed commercial inventories in the OECD. Excessive inventories accumulated after 2014 as producers ramped up production and US shale oil proved resilient to lower prices. The daily price of WTI crude oil fell from a high of \$108 per barrel in the summer of 2014 to a low of \$26 in February of 2016. Since the beginning of the modern oil market in 1859, crude oil price busts have terrified the oil industry and often induce producers to restrain production collectively. The price plunge to \$26 was no different: Over the course of 2016, Saudi Arabia and Russia assembled a new coalition of producers with the aim of eliminating oversupply to prevent oil prices from falling to ruinously low levels. Their efforts were uneven but partially successful due to robust demand for oil and a spate of unfortunate

events in the second half of last year that disrupted crude and refined product supply including the Harvey superstorm, Keystone and North Sea pipeline outages, and geopolitical disruptions in northern Iraq. These factors have mostly removed the inventory glut, enabling prices to recover to around \$68 currently. Crude oil prices are near three-year highs. A price chart for WTI is shown below.



Of course, most consumers and businesses do not see “crude oil” prices but instead refined product such as road diesel or heating oil. Global crude oil prices, however, are the primary determinant of refined product prices. In the United States, refined product prices usually follow crude oil prices with a roughly three-week lag. The chart below shows weekly pump prices for the main petroleum products consumed in our country - regular gasoline and distillate. Like crude oil, gasoline and diesel pump prices are near three-year highs.



The oil market is in a new era marked by boom and busts price swings

Before delving into the detail about recent and prospective oil prices, let me step back and note that crude oil prices have exhibited unusually wide swings over the last 15 years. In modern times, crude oil prices don't nearly quintuple over several years absent a war in the Middle East. And they don't normally plunge by 60% in six months without a recession or sudden supply surge as they did in 2014. Oil's unusually wide swings, illustrated in the first chart above, reflect the transition from a nine-decade era of supply management to one in which there is no effective supply manager.¹

Oil prices are unusually prone to volatility because both supply and demand are insensitive or "sticky" in responding to price changes in the short term, while storage is limited and costly.² Oil's notorious price volatility has troubled not only the oil industry but broader economic and government actors, given oil's vital importance for economic growth and security. To vanquish oil's wild swings and stabilize oil prices, governments and producers have resorted to regulating crude oil production with the goal of preventing big surpluses (inventory builds) or deficits and their associated, destabilizing price busts and booms, respectively.

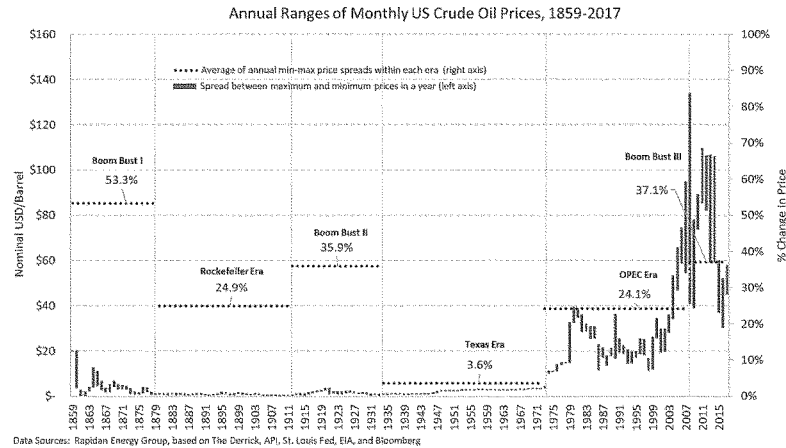
Unpopular boom and bust oil prices during the two decades following the breakup of Standard Oil in 1911 deeply rattled the country and by the early 1930s convinced the US to become the world's first and most successful supply manager or "swing producer." Texas regulators, along with other oil states, the federal government, and major international oil companies, exerted strong control of production over four decades. The Texas Railroad Commission imposed quotas well-by-well, field-by-field, for forty years. OPEC took over from the US in the early 1970s (though not as successful as the volatility chart below illustrates) but has been ineffective since 2008. The crude price bust in 2016 spawned a new group comprised of some OPEC producers (led by Saudi Arabia) and non-OPEC producers (led by Russia) has attempted to play the role of swing producer, but its impact is limited and future success of uncertain.³

The chart below shows how crude oil price volatility has varied through history depending on whether an effective swing producer or supply manager was controlling the market.

¹ McNally, Robert. *Crude Volatility: The History and the Future of Boom and Bust Oil Prices*. (Columbia University Press, 2017).

² Ibid. Chapter Four.

³ For an astute and balanced appraisal of the Vienna Group, see Jason Bordoff's Foreign Policy column "This Isn't Your Father's OPEC Anymore." June 26, 2016. <https://foreignpolicy.com/2016/06/26/this-isnt-your-fathers-pec-any-more/>



Shale oil is neither swing production nor spare capacity and will not keep oil prices stable

When in late 2014 Saudi Arabia and other OPEC producers refused to cut production under soaring US, Canadian, and Brazilian supply, many hoped that US shale oil producers would replace OPEC as the swing producer, keeping oil price stable. These hopes were disappointed, however, and for a good reason: US shale oil producers are in no way a replacement for swing producers, and shale oil does not constitute “spare production capacity” that the market has traditionally relied upon to stabilize oil prices.

Shale oil production is *more* responsive to price signals than conventional production, with lead times for new supply measured in months or quarters instead of years. But shale does not respond fast and large enough to prevent global inventory imbalances and large price swings. To ensure long-term price stability, swing producers must be able, willing, and legally authorized to change oil supply in large amounts, within weeks, and for long periods of time. In some respects, swing producers are akin to central banks that control the supply of base money. The Texas Railroad Commission, Seven Sisters cartel, and OPEC (mainly Saudi Arabia) all constituted genuine swing producers. Shale oil is produced by many dozens of highly idiosyncratic public and private companies, each competing with each other to maximize reserves and production. Shale producers are extremely diverse regarding resources and capital structure, they pursue growth targets instead of price stability, and they abide by punitive anti-trust laws that prevent them from even appearing to cooperate in stabilizing prices.

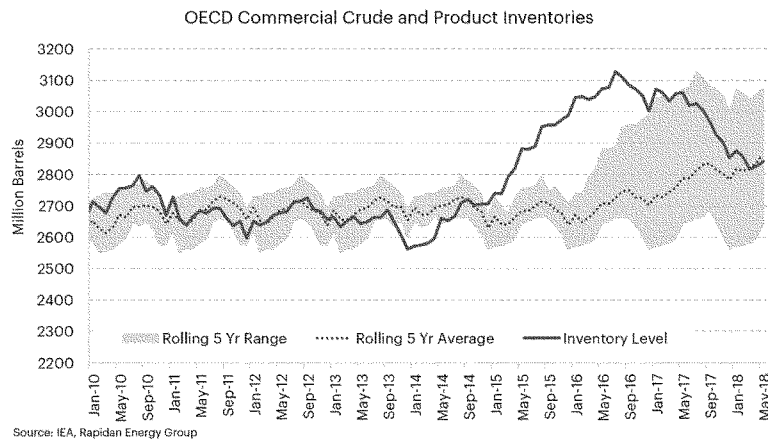
Shale oil production has also proven much more resilient to price declines than many expected in 2014, primarily due to a combination of widespread capital availability and efficiency gains, with the latter driven by innovation and service cost reductions.

A more plausible replacement for OPEC than shale is the new entity founded by Saudi Arabia and Russia, comprising some 25 OPEC and Non-OPEC producers, which I call the Vienna Group, but is also known by “OPEC-plus” or “ROPEC.” This group agreed to restrain production starting in early 2017 and as noted above contributed to the normalization of inventories and recovery of crude oil prices.

The jury remains out as to whether this new Saudi-Russian led entity will prove to be a successful long-term supply manager or instead join the list of ad hoc, temporary cartels formed after price busts but that dissolved afterward. Saudi Arabia and Russia's recent decision to maximize production despite opposition from Iran and other members of the Vienna Group will put the entity's cohesion to the test.

Commercial inventories may have normalized, but the risk of big crude price moves remains high

Turning to the recent past, and as noted above, the oil market has shifted from oversupply to "normal" characterized by commercial inventories near their five-year range (though that range itself has risen in recent years as the average captured the glutted levels post-2014).



This return to normal inventories is due to several factors:

- 1) Robust demand. Oil demand has generally surprised to the upside. For example, oil demand grew by nearly 1.6 mb/d last year, some 23% higher than initially projected by the International Energy Agency.
- 2) Unexpected production outages due to geopolitical disruptions in Venezuela, Iraq, and Libya.
- 3) Large storms Harvey and Nate along with major pipeline outages in the US and the North Sea in the second half of last year.
- 4) Production restraint by Saudi Arabia, Russia, and other OPEC and Non-OPEC producers starting in early 2017.

But the "normal" to which the oil market has returned is precarious and may well be fleeting. Extraordinary shifts and risks arising from supply and demand, geopolitical trends and events, and policy are likely to extend this 15-year old era of boom and bust price cycles, especially if an effective swing producer remains absent.

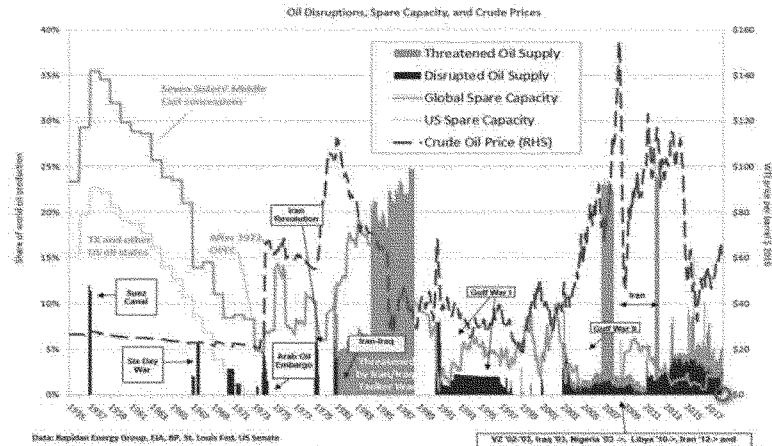
Looking forward, the outlook for crude oil prices resembles a “tug of war” between supply and demand factors that point to lower oil prices and geopolitical disruption risks that point to higher ones. My colleagues and I at Rapidan Energy Group expect geopolitical risk will keep a floor under crude prices near term but that by next year the weight of expected new supplies should exert downward pressure on prices. However, we see pronounced risks that oil prices could rise or fall much more than currently expected. A recession could lead to much lower prices while geopolitical risks and disruptions, with Iran, Libya, and Venezuela near the top of the list, could send crude oil prices back into the triple digits and prices well above \$3 per gallon. I am happy to discuss the details of my firm’s oil price forecast in the question and answer session or afterward.

Low spare production capacity and high geopolitical disruption risks

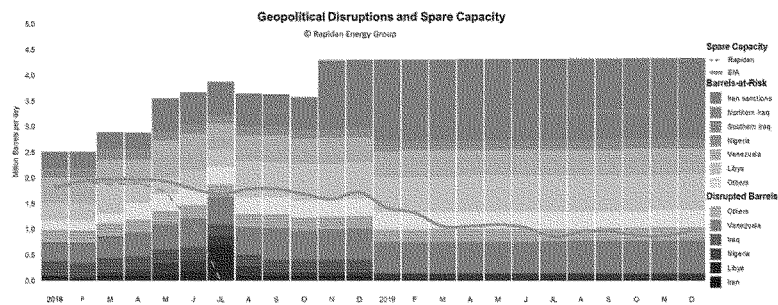
With inventories back to normal and geopolitical disruption risks proliferating, a critical question becomes the amount of quickly producible oil the world can call on in the case of an outage – commonly called “spare capacity.” Oil supply is vulnerable to disruptions from geopolitical conflict, storms, and accidents. The rigidity of oil demand short term means a supply outage can trigger large price spikes. Having a sufficient “spare capacity” buffer is critical for crude oil price stability in general and especially for preventing unexpected outages anywhere from triggering economically harmful price spikes everywhere, including here. Former EIA Administrator Adam Sieminski recently noted academic research finding spare production capacity reduces oil price volatility and generates between \$170 and \$200 billion of annual economic benefits.⁴

Genuine power in the oil market comes less from how much a country produces and instead whether it can stabilize prices and offset major disruptions. Spare capacity is one measure of that power. The US and Seven Sisters cartel controlled spare capacity from 1932 until 1972. Since then Saudi Arabia has held the lion’s share of spare capacity. But with the Kingdom’s recent decision to surge production it has likely approached if not reached zero. Whether zero or extremely low, spare capacity is very tight.

⁴ See <https://www.kapsarc.org/news/the-200-billion-annual-value-of-opecs-spare-capacity-to-the-global-economy/> and <http://www.iaee.org/energyjournal/article/3057>



Tight spare production capacity poses a risk of oil prices spikes given a large number of disruptions and threatened disruptions in the oil market today. The chart below shows our forecast of oil supply likely to be disrupted or threatened alongside both our and EIA's forecast of OPEC spare production capacity.



Venezuela's production has fallen over 0.7 mb/d in the last year and is expected to continue to implode slowly. The fast exodus of PDVSA workers (Venezuela's national oil company), the lack of sufficient chemicals for blending and upgrading Venezuela's heavy crude oil, and PDVSA's severe cash constraints will continue to drive production lower. Prospects for a recovery in oil production are bleak - even if President Maduro were to leave office tomorrow, Venezuela would struggle to boost production back to levels seen 12 months ago.

By contrast, Libya has seen sharp, but so far temporary disruptions as armed factions (both local and national) seek to gain leverage ahead of expected elections later this year, keeping production in a 0.8-1.0 mb/d range. In western Libya, the lack of a unified security force exposes oil facilities to attacks by militias seeking to extract payoffs, contracts, and other resources from the national oil company and the

government in Tripoli. In the east, oil production that was relatively stable under the control of the Libyan National Army (a coalition of eastern militias fighting under the command of General Khalifa Haftar) is likely to be increasingly rattled as Libya's most significant actors jostle for power.

The oil market is currently grappling with a new disruption risk in the form of the loss of a large amount if not all of Iran's 2.5 mb/d of exports. Uncertainty about how sanctions might impact Iran's oil exports arises from several factors:

- Market uncertainty about the number of exemptions that the Trump administration will grant to Iran's current importers after November 4.
- Whether Chinese, Indian, and other state-owned oil companies may increase imports to offset losses from other customers wary of violating US sanctions.
- Whether Iran will choose to escalate tensions by resuming enrichment or threatening safe passage of the roughly 19 mb/d that passes through the Strait of Hormuz, the world's most important choke point.

Looming regulations on marine fuel sulfur limits to roil the oil market next year

Oil is bound up with many policy debates and discussions, from climate change to ethanol and fuel economy standards. But one important policy issue preoccupying the oil industry and likely to impact oil prices has so far gone remarkably unnoticed in Washington: A mandatory reduction in sulfur limit emissions for ocean-going ships starting on January 1, 2020, commonly referred to as "IMO 2020". IMO 2020 is expected to reverberate onshore and impact consumer oil prices, especially for trucking and airline companies, and home heating oil consumers. The International Energy Agency referred to IMO 2020 as "easily the most dramatic change in fuel specifications in any oil product market on such a large scale."⁵

By way of brief background, in October 2016 the United States along with other nations participating in the UN International Maritime Organization (IMO) confirmed an earlier, tentative decision to implement a reduction in the sulfur content of the fuel used in ships on the high seas ("marine bunkers") from 3.5% to 0.5% sulfur as of January 1, 2020. Ship owners have two main compliance options to meet the looming regulations.

First, ships could continue to burn high sulfur fuel but install exhaust gas cleaning systems commonly called "scrubbers" to remove sulfur from the ship's emissions. Only a small fraction of ships have installed scrubbers however and insufficient time remains to install many more before the deadline. Therefore, most will opt for a second option, to switch from high sulfur, heavy fuel oil to lower sulfur heavy fuel oil or middle distillates ("distillate" also referred to as "gasoil" or "diesel").

A major question hovering over the market is whether a big new demand wave for low-sulfur distillate from shippers would overwhelm the refining industry's ability to supply it while meeting demand needs by other users such as motorists, airlines, and home heating oil consumers. While IMO had considered a 2025 implementation date, the decision taken in 2016 to start in 2020 was backstopped by a report

⁵ <https://www.ft.com/content/d0a063c4-452f-11e7-8519-9f94ee97d996>

commissioned by IMO that found “the refinery sector has the capability to supply sufficient quantities of marine fuels with a sulfur content of 0.5% or less...while also meeting demand for non-marine fuels.”⁶ But as the IMO 2020 deadline fast approaches, leading official forecasters and private sector experts expect implementation will trigger a large spike in the price of crude oil and refined products, particularly for “middle distillate” fuels. In a recent report, IEA concluded the *global* refinery system would not be able to produce a sufficient amount of low sulfur fuels in 2020 and at least for a few years afterward. As a result, shippers facing a new IMO mandate will bid low sulfur distillate away from other users mentioned above. IEA expects the scramble for clean distillate triggering a 20-30% spike in the price of heating oil and diesel fuel. IEA noted this “sharp increase in the price of [distillate] following the 2020 IMO changes penalizes demand in other sectors.”⁷

Moreover, IEA warned that IMO 2020 could push up global crude oil prices and therefore pump prices.

A worrying number of refiners, including large integrated oil companies, have publicly stated that one of their options to meet the new sulfur specification would be to use lighter and sweeter crude oil that requires less intensive hydrotreatment. As the two important futures benchmarks, Brent and WTI, are based on light sweet crude oil output, the increased demand for this type of crude oil may fuel a sharp increase in futures prices, with consequences felt across all product markets.⁸

Benefits and winners from lower sulfur limits in marine fuels

There will be clear environmental and human health benefits from reducing sulfur emissions from oceangoing ships. And domestic, deep conversion refiners will benefit from their competitive advantage regarding the production of lower sulfur fuels. If as IEA suggested above IMO 2020 also boosts lighter crude oil prices, our domestic producers will benefit. Longer term, low-sulfur regulations could also enable LNG to see wider use as a bunker fuel.

If policy-driven peak demand disappoints, oil prices will rise sharply

Lastly, a crucial factor driving longer-term drive oil prices is the outlook for oil demand growth in transportation. Transportation accounts for 56 percent of global oil demand, though petrochemicals is an important growth sector for oil use.⁹ Oil market participants and analysts have been preoccupied with the future rapid displacement of oil in transportation due to policies aimed at increasing efficiency or non-petroleum transportation fuels, primarily electric vehicles (EVs). An interesting aspect to this debate - referred to as “peak demand,” “energy transition,” or “decarbonization” of transportation - is the role that autonomous vehicles (AVs) may play in future oil demand.

⁶ *Assessment of Fuel Oil Availability, Final Report*. CE Delft, Stratas Advisors, UMAS, NMRI, Petromarket Research Group, Shimichi Hanayama. July, 2016. https://www.cedelft.eu/publicatie/assessment_of_fuel_oil_availability/1858. A rival study commissioned by shipping and oil industry groups in 2016 and updated this year concluded implementation of IMO regulations in 2020 would lead to 10 to 20 percent spikes in oil prices. <http://www.maritime-union.org.uk/news/101/fuels-and-oils/major-risks-remain-as-sulphur-cap-nears-study-finds>

⁷ *Oil 2018: Analysis and Forecasts to 2023*. International Energy Agency. March, 2018. Pp. 17, 19. The report’s executive summary stated:

One of the biggest and most pressing issues is the implementation of major changes to marine fuel specifications mandated by the International Maritime Organisation (IMO). The new rules loom ever closer and the maritime and refining industries face a huge challenge to implement them. From the vantage point of early 2018, it is not clear how successful they will be, especially as demand for non-marine [distillate] grades is growing steadily. The new regulations will cause a massive switch out of high sulphur fuel oil demand and into marine [distillate] or a new very low sulphur fuel oil. The total demand for oil products will not be dramatically altered, but the impact of the changes on the product mix is a major uncertainty in our forecast.

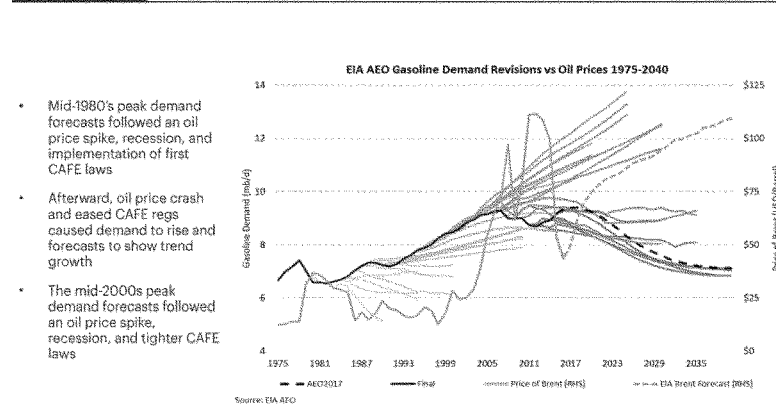
⁸ Oil 2018, p. 96

⁹ “World Energy Outlook 2016.” International Energy Agency, p. 117

Leading official forecasts, from both EIA and IEA, assume decarbonization policies will significantly curtail future oil demand growth. For example, both EIA and IEA assume that US gasoline demand will peak this year at 9.36 mb/d and decline sharply in coming years and decades¹⁰ (falling to 8.0 mb/d in 2025 and 7.2 mb/d by 2030, down by 15% and 23% respectively) by in coming years, largely due to federal fuel economy regulations and California's Zero Emission Vehicle Mandate. Notably, the peak and decline in US motor gasoline demand EIA forecasts would be the first to occur without a recession.

There are good grounds for caution that we will see such a big, imminent "policy peak" in gasoline demand in the United States. As illustrated in the chart below, EIA had predicted peak gasoline demand in the 1980s after a big oil price run up and implementation of federal fuel economy standards. But lower oil prices, strong consumer preference for larger vehicles, and accommodative public policies (the federal government eased CAFE rules in the late 1980s and mid-1990s) ended up proving these forecasts premature, as illustrated below. My firm and I studied the US CAFE and California ZEV programs last year and concluded, for largely the same reasons, they are unlikely to drive a peak in US gasoline demand in the coming years.¹¹

EIA Has Forecasted Peak Demand Before, After Late '70s Price Spike and New CAFE Regs
But pump price relief and CAFE relaxation led to consistent upward demand revisions



"Peak US Gasoline Demand is a Mirage." Rapidan Energy Group proprietary analysis, July 2017.

Whether or not U.S. gasoline demand peaks in the coming years will resonate globally. The U.S. gasoline demand market is massive – accounting for nearly one in ten barrels per day consumed on the planet - and enjoys symbolic importance among leading energy media, forecasters, and analysts. My firm also tracks decarbonization policies around the world, particularly those impacting transportation, and took a hard

¹⁰ EIA, Annual Energy Outlook 2018, Table 11.

¹¹ "Peak US Gasoline Demand is a Mirage." Rapidan Energy Group proprietary analysis, July 2017.

look at the top 20 most material of such policies - from 9 countries accounting for 57 mb/d, or 58%, of global oil demand. What we found is that when accounting for the realities of actually implementing these policies like the US CAFE program - the use of credits, different testing procedures, and other features that reduce stringency - that those policies only resulted in about 53% of the demand destruction assumed “on-paper” by the regulations.

Automated vehicles could significantly boost or reduce oil demand

Whether or not automated vehicles (AVs) will proliferate in the future lies well beyond the scope of my testimony and could occupy a hearing by itself. National Renewable Energy Laboratory (NREL) researchers noted AVs have a “wide range of possible energy impacts.”¹² Energy impacts of widespread AV adoption are highly uncertain, with estimates ranging from a 60 percent decline to a 200 percent increase.¹³ Factors that could increase energy demand include ease of travel, lower perceived and actual cost per mile, and underserved populations obtaining travel services.

But whether mass adoption of AVs would increase or decrease oil demand depends largely on which fuels – oil or electricity - AVs will use. Many assume that AVs will be EVs. If so, oil demand growth would sharply slow. But if widespread AV adoption occurs before EVs proliferate, then oil demand could increase significantly. For example, a 2016 NREL¹⁴ found that widespread AV adoption could *triple* US gasoline consumption from current levels of 9.3 mb/d (2017 average) assuming a fully autonomous fleet, petroleum-fueled vehicles, \$3 gasoline and current fleet wide efficiency. Another NREL¹⁵ study in 2016 similarly found that mass adoption of conventionally powered AVs could have the “unintended consequence” of doubling fuel demand.

If future global oil demand turns out to be stronger than many governments and companies currently expect, oil prices would be higher than currently anticipated. Strong demand would collide into insufficient investment in oil production.

While a recession could send oil prices lower, I expect the next boom phase in oil prices will arise due to faster-than-expected demand, both because policies will turn out weaker than expected and because the recent bust has encouraged demand while hampered investment in new oil fields and production facilities. Again, oil’s demand rigidity means price increases will be significant. And with spare production capacity wafer thin, geopolitical disruption risks will result in further oil price spikes.

Conclusion

In 2012 I had the honor of testifying to your colleagues on the House Small Business Committee and noted crude oil and therefore pump prices had entered a new “Space Mountain” era of boom and bust price cycles. I maintain that view. If a new swing producer does not emerge, we should all buckle up for continued, roller-coaster ride on Space Mountain.¹⁶

¹² <https://www.nrel.gov/docs/fy13osti/59210.pdf>

¹³ https://www.eia.gov/conference/2018/pdf/presentations/nicholas_chase.pdf Slide 10.

¹⁴ <https://www.nrel.gov/docs/fy17osti/67216.pdf>

¹⁵ https://link.springer.com/chapter/10.1007%2F978-3-319-05990-7_13

¹⁶ “Space Mountain” Pump Prices. Testimony by Robert McNally to the House Committee on Small Business. May 9, 2012. https://smallbusiness.house.gov/uploadedfiles/mcnally_testimony.pdf

The CHAIRMAN. Thank you, Mr. McNally.
Mr. Braziel, welcome.

**STATEMENT OF E. RUSSELL "RUSTY" BRAZIEL, PRESIDENT
AND CHIEF EXECUTIVE OFFICER, RBN ENERGY, LLC**

Mr. BRAZIEL. One of the reasons you have these hearings is because you want to get different views. We're going to have a different view.

RBN Energy is a consultancy and market analytics company. We're based in Houston. Most of our work involves infrastructure analysis, production, transportation, processing for both crude oil and gas and natural gas liquids.

You mentioned a few minutes ago that production is up to 11 million barrels a day. In 2011, it was 5.5 million barrels a day. So we're double, right, over the course of that period of time and that's why we called it the Shale Revolution.

But this morning, instead of focusing on the magnitude of that growth, I want to focus on the responsiveness, the "swingness," if you will, Bob, of U.S. production.

What happens when prices go up? What happens when they go down? It's the nature of this responsiveness that, I think, has had such a big impact on global markets, and I'll explain what I mean by that in a few minutes, but let's first talk about a few fundamentals that, kind of, get me to that point.

The big driver in all of this has been productivity improvement, productivity improvement that has radically changed the supply curve for U.S. oil production.

Today, one rig can bring on anywhere between 5 and 11 times the amount of crude oil that one rig could do in 2011. These shale wells come on strong. The producers have learned how to drill them fast.

The result has been a dramatic reduction in the per unit cost of production, in other words, lower marginal cost. And over the course for the past seven years, the U.S. now is shoving about 4.5 million barrels a day of this marginal production back into the global market and that's precisely why OPEC and NOPEC found it necessary to reduce their production two years ago in order to support global prices and, in effect, make room for U.S. production.

The geography of this production in the United States has been quite concentrated. Eighty-five percent of the growth over the last two years since crude oil prices started kicking back up, comes from five basins: Bakken, Anadarko, Eagle Ford, Niobrara, Permian, with more than half of that growth coming from the Permian, by itself. And it's even more concentrated than that. Almost all of the growth in those five basins actually comes from only 28 counties, a land area of only about 50,000 square miles, 1.7 percent of the U.S. Lower 48 surface area, about the size of Louisiana.

But that's today. The land area where crude oil production is economically viable, what producers call their sweet spots, expands and contracts with the price of crude oil. For example, higher prices provide higher revenue per well so smaller wells, wells that produce lower yields of crude oil, become economically viable. So the sweet spots get larger when crude oil prices increase. Of course, the inverse is equally true. And that's what I mean by responsive-

ness. It's been a key to the growing influence of U.S. production now in global energy markets, and it's going to get a lot more responsive.

Our firm prepares a production forecast several times a year for the U.S. We just completed a new update. We did one for prices staying at \$70 flat for the next five years. Another one at \$55 flat for the next five years. That \$15 difference means a three million barrel a day change in the forecast between those two scenarios. So a relatively small price differential in crude oil prices results in a big change for the U.S. production.

The implication for U.S. production for the U.S. is now that we are fully capable of responding in a meaningful way to increases and decreases in price, enough to have a substantial impact on the global crude oil market. So if prices increase, the drilling economics improve, producers drill more wells and production increases. If prices fall, drilling economics become less favorable, producers produce fewer wells and production volumes drop.

But here's the key in this. The oil in the ground didn't go away. When prices are low, production of those barrels are simply put on hold, waiting for a price signal in order to bring those barrels to market. It takes time, but it's almost like those barrels are in a storage tank just waiting for the high sign, for a signal to withdraw that oil and move it to refineries both in the U.S. and throughout the world. The triggering mechanism, of course, is market price, not a government edict.

Of course, that's not to say that oil markets are now free from the intervention of governments. Far from it. But that power has been at least constrained or limited by U.S. shale development and, most likely, that constraint will continue further in the years as shale production in the United States continues to grow. I think that's a good thing for the U.S. and for the world as a whole, for that matter.

I appreciate the opportunity to speak to you today.

[The prepared statement of Mr. Brazier follows:]

Written Testimony of E. Russell Brazier
President and Chief Executive Officer, RBN Energy, LLC
Before the U.S. Senate Committee on Energy and Natural Resources
July 24, 2018

Introduction

Chairman Murkowski, Ranking Member Cantwell, and distinguished Members of the Committee, thank you for the opportunity to discuss U.S. oil production and the impact it is having on global markets. My name is Rusty Brazier. I am president of RBN Energy, an energy market consultancy and analytics company based in Houston. Most of our work involves the analysis of energy markets, especially the development of infrastructure for the production, transportation and processing of North America's crude oil, natural gas and natural gas liquids. I am a member of the North American Energy Standards Board and was recently appointed by Secretary Perry to the National Petroleum Council.

Today I will focus on the dynamics of U.S. crude oil production growth, what that growth has meant for oil trading patterns here in North America, and why market forces unleashed by that production growth have dominated global energy markets over the past five years. I'll then turn to what these developments mean for the future of oil markets, both here in the U.S. and globally.

Of course, the driver behind all of this is what has become known as the *Shale Revolution*, an umbrella term that I will use for that combination of technological advances, petroleum engineering breakthroughs and productivity improvements that have transformed U.S. energy markets from an era characterized by shortage into one of abundance. The intricacies of how these developments launched the Shale Revolution are beyond our scope in this discussion, but a short recap of what happened to energy markets as a consequence of shale development will help us understand what is likely to happen next in these markets.

How the Shale Revolution Happened

Less than ten years ago, the accepted wisdom of most energy industry participants, and regulators of the industry here in Washington, was that the U.S. was rapidly depleting its oil and gas resources and would someday run out. Pundits pointed toward the decline of U.S. production from the mid-1980s through the 1990s as conclusive evidence that this must be true. As the world entered the new millennium, the U.S. energy industry was in full swing with investments to accommodate a world of energy shortage. Multi-billion-dollar investments in liquefied natural gas (LNG) import terminals were underway. Refineries were gearing up to run far greater quantities of imported crude oil because U.S. oil was running out. Power generation companies were scrambling to bring on coal, wind, solar, and even nuclear generation to avoid being caught by declining supplies of natural gas.

But then, seemingly overnight, evidence started to emerge that something had changed. Ten years ago this month (July 2008), natural gas prices started a steep decline and stayed low. Defying conventional wisdom, gas production started to ramp up toward all-time historical highs. That caught much of the industry by surprise. Historically, lower prices had resulted in

fewer working drill rigs, which reduced drilling activity, and less drilling resulted in lower production volumes due to the natural volumetric decline of all oil and gas wells. This time, in the natural gas markets of the late 2000s, that relationship did not hold true.

Over time it became apparent that a technological transformation – the Shale Revolution – had fundamentally changed the historical cause-and-effect relationships among price, active rigs, drilling activity and production. Initially that transformation was confined to natural gas. But by 2012, it was apparent that the same phenomenon had come to the markets for natural gas liquids (NGLs) – including ethane, propane, and butanes. With gas prices low, to augment their revenue more producers were drilling for natural gas containing greater quantities of NGLs and production was increasing. Just like gas a few years before, eventually NGL prices succumbed to oversupply and consequently many producers shifted their targeted drilling activity to crude oil. Oil production increased, the U.S. market struggled with regional supply surpluses, and by 2014 the full brunt of this oversupply hit global crude oil markets. Global crude prices crashed.

It was simple economics that brought about this transformation. Due to the advances in drilling and well-completion technologies that have been applied over the past few years to shale and other “tight” formations, today a single rig can drill more wells within a given timeframe, produce far more hydrocarbons during the well’s initial highly productive period and do so at a much lower per-unit cost than was possible in the pre-shale era.

Consider the following productivity improvements monitored by the Department of Energy’s Energy Information Administration (EIA) in its monthly Drilling Productivity Report (DPR). In 2011, one rig operating in the Bakken (the shale play located in the Williston Basin, being developed primarily in North Dakota) could bring on incremental daily production of about 225 barrels each month. Today that rig can bring on daily production of approximately 1,450 barrels every month, a productivity improvement factor of 6.5 times over a period of seven years. A few hundred miles to the south in the Niobrara (mostly in Colorado and Wyoming), the monthly productivity improvement has been nearly *eleven* times, from 110 barrels per day in 2011 to about 1,200 barrels per day today.

There are a number of factors that have contributed to these remarkable advances, but two factors stand out: (1) each well drilled produces far more hydrocarbons than in the pre-shale era, and (2) producers have learned to drill shale wells much faster than in the early days of the Shale Revolution. Also, while each well is more costly to drill than most wells in the pre-shale era, the output of these new wells is so much greater that the per-unit cost of production has been reduced dramatically. It is this improvement in productivity on a per-barrel basis that has changed the landscape of energy markets.

Economics 101 tells us that commodity prices tend to reach equilibrium at a level equal to the marginal cost of production – that is, the cost of producing the next incremental unit. As U.S. crude oil production from shale increased, the per-unit cost of that production was declining, and U.S. production became the marginal barrel (subject to economic decision processes). As advances in U.S. productivity continued, the result was a collapse in global crude prices from the \$100+ per barrel level down to a low of under \$30 per barrel in early 2016. Even today, the price for crude oil is at only about two-thirds of its pre-crash level – \$69 per barrel at the time of this writing – a price that would have been viewed as quite cheap four years ago on July 24, 2014, when the price of West Texas Intermediate oil at the Cushing, Oklahoma hub was \$102 per barrel.

U.S. Crude Oil Production Growth

The doubling in U.S. crude oil production from 5.5 million barrels per day in 2010 to 11.0 million barrels per day, as reported by EIA for the week ended July 13, 2018 – a 9% compound annual growth rate – is well documented, so there is no need to belabor the issue here. But there are a few aspects of this surge in production that are worth noting.

First, U.S. shale production of crude oil has been highly responsive to price. For example, when prices crashed in 2014-15, drilling activity waned and production fell by about 550,000 barrels per day in 2016. When prices partially rebounded, so did drilling activity and production.

Second, the decline in production following the 2014-15 price crash was far less than expected by many market participants. Back then it was a widely held belief that crude prices in the \$50 per barrel range would devastate the economics of shale well drilling, and for a brief time it appeared that might be true. But U.S. producers responded to the market adversity by radically cutting their costs; by concentrating their drilling activities in their core, most productive acreage (called their “sweet spots,” discussed below); and by exercising rigorous financial discipline. Many were able not only to survive, but to thrive through the downturn, which positioned them for aggressive drilling programs as oil prices increased in 2017 and 2018.

Third, the oil production growth enjoyed by the U.S. as a whole has not been evenly distributed on a geographic basis. For example, the decline in total U.S. crude production following the 2014-15 price crash bottomed out in September 2016 at just under 8.6 million barrels per day. Production has since grown to the 11.0 million barrels per day mentioned above, an increase of more than 2.4 million barrels per day. Of that total, 2.1 million barrels per day – or 85% of the growth – has come from only five basins: the Bakken, the Anadarko, the Eagle Ford, the Niobrara, and the Permian. An incredible 55% or 1.4 million barrels per day of the total growth has come from only one basin: the Permian. In fact, most of the growth in U.S. production over the past 22 months has come from only a relatively small geographic footprint within each of these basins: twenty-eight counties with a total land area of only fifty thousand square miles, or about 1.7% of the U.S. lower-48 surface area.

It is important to note that the land area in which crude oil production is economically viable expands and contracts with oil prices. That is because higher prices provide higher revenue per well, which means that as prices increase, new wells that would yield lower quantities of crude oil production can become economically viable. When crude prices declined in 2014-15, producers focused on their “sweet spots” – the specific counties and parts of counties within key shale plays where new wells could be expected to produce economically viable quantities of crude at then-current crude prices. And, more recently, as crude prices surpassed \$55, \$60 and then \$65 per barrel, the geographic areas within which new wells would be economically viable increased too. This dynamic is key to understanding the responsiveness of U.S. crude oil production. *Higher crude prices improve the economics of crude production over a broader geographic area.* Thus, crude oil production will increase in response to higher prices. Of course, the reverse is true as well. Lower prices shrink the “sweet spots,” producers drill fewer wells, and production levels off and ultimately declines. This price responsiveness has been the most important contributor to the still-growing influence that U.S. crude production now has over global energy markets.

Implications for Oil Trading Patterns in North America

As the Shale Revolution has advanced over the past few years, it has resulted in dramatic shifts in U.S. oil flow patterns, and consequently the need for additional infrastructure to support the transportation and processing of those barrels. In the pre-shale era, imported barrels dominated crude flows – moving to the U.S. coasts on ships, and continuing from the Gulf Coast into the U.S. heartland on pipelines. Significant volumes of imported crude also moved south from Canada on pipelines. But the huge Gulf Coast demand tended to dominate flow patterns, both from the large number of refineries in the region, and because of access to pipelines that moved still more imported barrels to refineries in the Midwest and Midcontinent (Midcon) regions.

Then shale happened. As crude production increased in those basins named above – Bakken, Anadarko, Eagle Ford, Niobrara, and Permian – the Midwest and Midcon became oversupplied. There were not enough pipelines to get this new production now coming from the heartland to the country's refineries – mostly those same Gulf Coast refineries that had been so dependent on imports. As regional crude surpluses grew, crude prices in the Midcon traded at significant discounts to crude at the coasts, providing the economic incentive for new infrastructure development. U.S. midstream companies responded, reversing existing pipelines and building new systems to move U.S. crudes to U.S. refineries, both in the coastal regions and elsewhere. Consequently, oil flow shifted from its historic south-to-north pattern, flipping around to move largely north-to-south.

Then on December 18, 2015, Congress voted to remove the ban on exporting U.S. crude oil to countries other than Canada and President Obama signed the bill into law. It took some time for the market to respond to this new potential outlet for U.S. crude oil, but respond it did. During 2016 new infrastructure and commercial deals were put in place, and that year an average of about 600,000 barrels per day were exported, nearly all of it from the Gulf Coast. In 2017 that export volume rose to 1.1 million barrels per day, and so far this year crude exports have averaged just under 2.0 million barrels per day. According to recent statistics from EIA, crude exports hit *3.0 million* barrels per day for the week ended June 22, 2018.

The export market has enabled U.S. crude oil to become even more responsive to – and influential in – global crude oil markets. Now, if global crude oil prices increase, incremental U.S. production moves directly into that market – potentially dampening further price increases. That is exactly what has happened over the past year.

However, the combination of geographically concentrated production growth – and geographically concentrated demand from Gulf Coast refineries and exports – has not been without consequences, or without implications for infrastructure. As the Permian Basin has increasingly dominated growth in U.S. crude oil production, output there has outstripped pipeline takeaway capacity from the region to the Gulf Coast and other markets. The result has been a surplus of crude oil in the Permian without adequate pipeline access to market, forcing incremental barrels into very expensive truck and rail transportation alternatives, or in some cases forcing producers to curtail drilling programs for lack of “takeaway” infrastructure to move their product to market.

Crude pricing in the region tells the story. As of this writing, the price of crude on the Gulf Coast (a hub known as Magellan East Houston) was about \$70 per barrel while the West Texas

price at the Midland, Texas hub in the Permian Basin was only \$55 per barrel, a differential of \$15 per barrel. This price discrepancy exists solely because of the lack of pipeline capacity between the Permian and the Gulf Coast. There are at least ten new pipeline projects in the works designed to bring a total of about 5 million barrels a day of additional takeaway capacity online over the next three years, with almost all of them planning to bring the incremental volumes to the Gulf Coast. That should be more than enough capacity to meet the demands of the market. Unfortunately for Permian producers that did not secure pipeline capacity contracts to move their barrels out of the constrained region, it will be sometime late next year before the first of these projects is online. In the meantime, Permian prices will remain low and production growth stalled. This is a clear example of how lack of adequate infrastructure can result in shackled production and thus lower supply available to the market. The good news for Permian producers is that the problem will be resolved sometime next year, and prices at the Midland hub will rebound to levels near those on the Gulf Coast.

Consequences for Global Oil Markets

As U.S. crude oil production has increased from 5.5 million barrels per day in 2010 to 11.0 million barrels per day today, as noted above, most of that production growth has found its way into the global market, either directly or indirectly. According to EIA data, between 2011 and 2018, imports of crude oil into the U.S. fell by about 1.2 million barrels per day, effectively displacing that volume back into the global market. Said another way, if the volume does not come to the U.S., it must go somewhere else, which increases global supply. And, as described above, since 2016 the U.S. has been exporting significant volumes of crude directly into the global market, up from less than 50,000 barrels per day in 2010 (mostly to Canada) to an average of 1.8 million barrels per day thus far in 2018.

There is more. A significant portion of the growth in U.S. crude supplies moves to U.S. refineries, which are enjoying very high run rates. (According to EIA, refinery crude-input volume hit an all-time record of 17.8 million barrels per day the week ended June 22, 2018.) Consequently, refineries are churning out more gasoline, diesel and other products than the U.S. can consume. Net exports of finished and unfinished barrels of gasoline, diesel and jet fuel have increased from about zero in 2010 to average 1.5 million barrels per day in 2018. These volumes have essentially the same impact as crude exports on the global market – increasing supply. Adding together the 1.2 million barrels per day of lower crude imports plus 1.8 million barrels per day of crude exports plus the 1.5 million barrels per day increase in net gasoline, diesel and jet imports, the sum is 4.5 million barrels per day. That was more than enough volume to have a significant impact on global markets, and potentially drive other producing countries to cut production to make room for U.S. barrels.

And of course, they did. Oversupply crushed prices in 2014-15 and into early 2016, and in response, in November 2016 OPEC and NOPEC (non-OPEC producers, with Russia the principal player) implemented a production curtailment of 1.8 million barrels per day. Of that, 1.2 million barrels per day came from OPEC, almost half of it from Saudi Arabia. From the U.S. perspective, the production cut had two important outcomes. First, its goal of supporting higher prices worked. As a result of the agreement (aided by a few market disruptions), substantial production volumes were taken off the market, the supply/demand balance moved to correct itself, and prices increased. Second, OPEC/NOPEC effectively ceded market share to U.S. producers. That provided a hefty boost to profits of U.S. producers, providing funds for still more drilling. In the nearly two years since the OPEC/NOPEC agreement was reached, the

number of rigs drilling for crude oil in the U.S. has increased from 440 to 845, according to Baker Hughes, a gain of more than 90%.

The fact that OPEC/NOPEC found it necessary to cut production in order to support prices is strong evidence that U.S. production has become a dominant factor in the global oil market. But the success of their production cut reminds us that the newfound U.S. status is not impervious to global markets, nor those that hold sway in those markets.

U.S. Production and Global Oil Markets: Current Developments and Outlook

In recent weeks, OPEC/NOPEC reached a new deal to *increase* production, ostensibly to dampen crude prices but also to allow certain players – Saudi Arabia and Russia in particular – to sell additional barrels at today’s higher prices for the cash flow those sales will generate. Although prices did drop slightly in response to this agreement, they have remained relatively resilient – mostly due to a series of market disruptions, including conflict in Libya, an outage at a huge Canadian syncrude upgrader, the looming impact of Iranian sanctions and continuing turmoil in Venezuela. No doubt these factors have muted the price impact of OPEC/NOPEC’s agreement to allow some production increases.

All that said, today’s price levels do suggest that the market is tighter than it has been in the recent past – meaning that a combination of increasing global demand, lower production from several countries, and pipeline capacity constraints on U.S. production growth could combine to make global markets more susceptible to short-term supply disruptions, resulting in another round of price increases. However, if such a shortfall does develop, it is quite likely that price increases will be, at least in part, mitigated by growing production in the U.S. The global crude oil market will always be susceptible to disruption due to regional conflicts, equipment malfunction, cartel supply curtailments and economic maladies. But generally speaking, it is important to recognize that the U.S. now provides a market-based balancing mechanism that the global market has not enjoyed in decades, if ever. It is not perfect, it is a delayed response and its reach is limited. But there is no doubt that if global prices increase, then U.S. production will respond positively, counteracting the prospects for long-term periods of very high prices such as were experienced in the 1970s.

It is highly likely that the responsive capacity of U.S. crude oil production will continue for many years into the future. Our firm prepares production forecasts for U.S. crude oil several times a year, and we have just completed a new update. These forecasts are based on historical production trends in each basin, recent drilling results (the initial production from new wells and the rate of production decline experienced by existing wells), and the relationship between the economics of drilling a new well to the activity level historically experience in each basin (e.g., the rig count). Based on this data we can compute the likely level of production under several alternative price scenarios for West Texas Intermediate (WTI) crude oil at the Cushing, Oklahoma hub – the benchmark for most crude pricing in North America, and based on that price by extension for crude production across the U.S.

Three scenarios that we assessed in our most recent update were (a) \$70 per barrel flat for the next five years, (b) \$55 per barrel flat for the next five years, and (c) a scenario similar to the current futures market forward curve (Chicago Mercantile Exchange as of July 19, 2018), which declines from about \$70 per barrel in August 2018 to average about \$55 per barrel in 2023, an implied price decline of \$15 per barrel over the next five years. Using these price trajectories, we see U.S. production increasing by about 5.0 million barrels per day by 2023 in the \$70 per

barrel scenario, increasing 2.0 million barrels per day in the \$55 per barrel scenario, and increasing 3.5 million barrels per day in the forward curve scenario. We consider these to be relatively conservative projections, since we do not assume productivity improvements in our calculations for future well results – even though such productivity gains have been a consistent fixture of the Shale Revolution since its inception.

There are three important conclusions that can be reached based on this analysis. First, U.S. oil production growth is quite sensitive to price. The \$15 per barrel difference between the \$55 per barrel and the \$70-per-barrel scenarios results in a 3.0 million barrels per day difference in 2023 production levels. Recall that prior to the Shale Revolution, total U.S. production was only 5.0 million barrels per day. So a relatively small shift in oil prices results in a big change in our outlook for U.S. production. Second, U.S. production grows even in our low case of \$55 per barrel flat price over the five years. It would take a price well below \$55 per barrel to shut down growth in U.S. production. And finally, with the higher level of production that comes from the higher price scenarios, so goes the need for more infrastructure to move those barrels to market. Since that infrastructure is being actively developed, this implies that midstream companies and their committed shippers are betting that prices will be high enough to drive production to the level needed to justify the infrastructure investments. This commercial risk has always been a part of the energy industry in the U.S., and while the Shale Revolution has created many opportunities for infrastructure development, it has not eliminated this fundamental energy market dynamic.

Conclusion

The U.S. Shale Revolution has upended much more than prices and global petropolitics. As the analysis above illustrates, U.S. production is now fully capable of responding in a meaningful way to both increases and decreases in price – enough to have a substantial impact on the global crude oil market. If prices increase, drilling economics improve, producers drill more wells, and production increases. If prices fall, drilling economics become less favorable, producers drill fewer wells, and production volume drops. But the oil in the ground does not go away! The production of those barrels is simply put “on hold,” waiting for the price signal needed to bring those barrels to market. It is almost as if the barrels were in a storage tank, just waiting for the sign to be withdrawn from storage and moved to refineries – both in the U.S. and throughout the world. And moreover, the triggering mechanism for that withdrawal is the market price, not a government mandate or political maneuver.

Of course, that is not to say that oil markets are free from the intervention of governments, both friendly and less than friendly. Far from it. These markets are critically important to the global economy, which makes them frequent targets of government intrusion. A number of key players in the global market retain significant market power, regardless of U.S. shale. But that power has been restrained by U.S. shale development, and most likely it will be further checked in coming years as shale production continues to grow. That is a good thing for the United States of America.

Thank you for the opportunity to discuss my firm’s views on U.S. oil production and the impact it is having on global markets. I look forward to your questions.

The CHAIRMAN. Thank you, Mr. Braziel.
Mr. Auers, welcome.

**STATEMENT OF JOHN R. AUERS, EXECUTIVE VICE PRESIDENT,
TURNER, MASON & COMPANY**

Mr. AUERS. Thank you very much, and I express my thanks to all the Senators and Committee members for allowing me to present my testimony which will focus on the downstream industry in the U.S.

For decades, the U.S. has set energy independence as a goal, but the current Administration has more recently upped that to energy dominance. While that might seem like standard political posturing, the U.S. refining industry, with support from the upstream and midstream, has in fact already established dominance in its own sector of the energy business. Since 2007, the U.S. has transitioned from being the world's largest importer of refined products to being the largest exporter by most measures. In that time, the U.S. net product balance has moved from a shortage of 2.5 million barrels per day to a surplus of well over 3 million barrels per day.

The U.S. refining industry's ability to become a global export powerhouse, and to maintain that position, has and will be dependent on both things they have and will do well and also on the failures by their competitors around the world. On the domestic side of that equation, the free market environment in which the U.S. refining industry is allowed to operate, which isn't the case in most other countries, has been a key driving force. Over the years, market signals have "thinned the herd," as uncompetitive refineries were closed and the remaining facilities evolved into the most advanced and complex set of refineries in the world. This allows U.S. refiners to run heavier and more difficult to process crudes, turning them into more valuable products, all at higher yields than refiners in any other region of the world.

The U.S. also has the deepest, most talented and experienced refinery labor pool in the world, all the way from management through the technical ranks and down to the skilled and hourly levels. Combined with more flexible employment and work rules than exist in many other countries, this allows U.S. refiners to run their plants more reliably, safely and at higher throughput rates. It also allows them to operate the plants, execute capital projects and perform maintenance activities at lower costs, despite high wage rates.

A major boost to the competitiveness of U.S. refineries in recent years has been the Shale Revolution. This event, which was also facilitated by the free market environment in this country, has allowed both oil and gas production to soar. Resulting low domestic natural gas prices provide U.S. refiners significant operating cost advantages versus many global competitors, particularly in Europe and Asia. Even more important has been the boom in oil production, which has substantively lowered refiner's relative crude costs.

Further advantaging the U.S. industry has been the difficulties experienced by foreign refiners. Building and running refineries is a very complex task, requiring not only experienced and skilled manpower, but efficient and properly incentivized operating, maintenance, project execution and planning efforts. Many of those ele-

ments have been lacking in other parts of the world, in large part due to over-regulated market environments.

The issues our neighbors to the south in Latin America have encountered have been particularly helpful to the U.S. refiners. Utilization rates in most countries in the region average between 50 percent and 70 percent, compared to over 90 percent in the U.S. Despite growing regional demand, regional capacity and throughput has declined over the last decade. This hasn't been for a lack of trying, as a significant number of expansion and greenfield projects have been planned and initiated. Most have either not gotten off the ground or encountered significant cost overruns and delays. Much of the problems relate to the sponsorship of those projects by government-controlled companies, with the accompanying issues of confused and conflicted planning, incorrect staffing, corruption and, in many cases, simple incompetence. Those same issues have negatively impacted the operations at existing plants and as a result, U.S. product exports into Latin America have grown by almost 2 million barrels per day over the last decade.

The ability to successfully penetrate and grow export markets has been a necessity for the health of the U.S. refining sector, considering stagnant domestic demand. Even with the strong growth experienced over the last three years as a result of lower prices, total domestic consumption was still over 900,000 barrels per day lower in 2017 than in the peak demand year of 2005. Despite this, and while our friends in Europe and Japan were shutting down over 3 million barrels per day of refining capacity in a similar environment, the U.S. was able to increase refining capacity by 1.4 million barrels per day.

The U.S. refining renaissance has benefited the country as a whole and consumers of petroleum products at all levels. Together with the boom in domestic crude and gas production, the refined product surplus has been a major contributor in reducing the trade deficit. It has also led to a higher degree of supply security, and lower prices versus the previous environment where products had to be imported. This is particularly important during major supply-disrupting events. A prime recent example of this, and a true confirmation of the robustness and resiliency of the U.S. refining industry, was last year's rapid return of supply after Hurricane Harvey's devastation at the U.S. Gulf Coast.

Looking to the future, the health of the U.S. refining industry will be dependent on a variety of factors, including market forces, geopolitical developments and changes in the regulatory environment, both domestically and globally.

On the regulatory front, new domestic regulations which depress demand, increase costs, or limit market or feedstock access all could negatively impact U.S. refining competitiveness. More costly environmental rules certainly fall in this category, but perhaps the biggest threat to refiners and other segments of the petroleum industry could be more restrictive trade policies. Tariffs being imposed on steel and aluminum would have a very direct and negative impact on critical capital projects in all sectors. As just one example, three-quarters of the steel used in U.S. pipelines comes from overseas due to the lack of availability of the necessary grades

domestically. More impactful still could be tariffs on crude and products themselves, but the biggest threat could be the potential of an all-out trade war which leads to slowing or declining global and domestic economic growth and product demand.

New regulations and policy initiatives can also be positive for the industry and consumers. Certainly, the cut in corporate taxes has and will lead to more capital investment in every segment as more projects move above the hurdle rate. Also, as countries around the world move toward lower sulfur transportation fuels and more stringent environmental rules, U.S. refiners who have already had to make those investments will further their relative advantages. The International Maritime Organization mandate to decrease bunker fuel sulfur in 2020 might be the single biggest event on the horizon and while it will advantage many U.S. refiners, especially the most complex facilities, it could be a major challenge to others.

To close out my prepared remarks, let me just say that a thriving refining industry is a critical resource for any country. It provides not just major benefits to both the economy as a whole and consumers, but it is also an important national security asset. Nations around the world have targeted self-sufficiency in product supply and spent billions in an attempt to achieve this goal. But it has been the U.S. whose refining system has risen to the top, not through government involvement or subsidization, but by being allowed to develop and grow in a true free market environment. I believe it is incumbent on policymakers to remember this and thoroughly examine the impacts on the health of this vital industry and the resulting effects on consumers in any legislation that they consider.

Thank you very much.

[The prepared statement of Mr. Auers follows:]

The United States Refining Industry
Senate Committee on Energy and Natural Resources
Informational Hearing – July 24, 2018
Oral Testimony
John R. Auers – Turner, Mason & Company

For decades, the U.S. has set energy independence as a goal, but the current Administration has more recently upped that to energy dominance. While that might seem like standard political posturing, the U.S. refining industry, with support from the upstream and midstream, has in fact already established dominance in its own sector of the energy business. Since 2007, the U.S. has transitioned from being the world's largest importer of refined products to being the largest exporter by most measures. In that time, the U.S. net product balance has moved from a shortage of 2.5 million barrels per day to a surplus of well over 3 million barrels per day, currently.

The U.S. refining industry's ability to become a global export powerhouse, and to maintain that position, has and will be dependent on both things they have and will do well and also on the failures by their competitors around the world. On the domestic side of that equation, the free market environment in which the U.S. refining industry is allowed to operate, which isn't the case in most other countries, has been a key driving force. Over the years, market signals have "thinned the herd," as uncompetitive refineries were closed and the remaining facilities evolved into the most advanced and complex set of refineries in

the world. This allows U.S. refiners to run heavier and more difficult to process crudes, turning them into more valuable products, all at higher yields than refiners in any other region of the world.

The U.S. also has the deepest, most talented and experienced refinery labor pool in the world; all the way from management, through the technical ranks and down to the skilled and hourly levels. Combined with more flexible employment and work rules than exist in many other countries, this allows U.S. refiners to run their plants more reliably, safely and at higher throughput rates. It also allows them to operate the plants, execute capital projects and perform maintenance activities at lower costs, despite high wage rates.

A major boost to the competitiveness of U.S. refineries in recent years has been the shale revolution. This event, which was also facilitated by the free market environment in this country, has allowed both oil and gas production to soar. Resulting low domestic natural gas prices provide U.S. refiners significant operating cost advantages versus many global competitors, particularly in Europe and Asia. Even more important has been the boom in oil production, which has substantively lowered refiner's relative crude costs.

Further advantaging the U.S. industry has been the difficulties experienced by foreign refiners. Building and running refineries is a very complex task, requiring not only experienced and skilled manpower, but efficient and properly incentivized operating, maintenance, project execution and planning efforts. Many of those elements have been lacking in other parts of the world, in large part due to over regulated market environments.

The issues our neighbors to the south in Latin America have encountered have been particularly helpful to U.S. refiners. Utilization rates in most countries in the region average between 50% and 70%, compared to over 90% in the U.S. Despite growing regional demand, refining capacity and throughput has declined over the last decade. This hasn't been for a lack of trying, as a significant number of expansion and greenfield projects have been planned and initiated. Most have either not gotten off the ground or encountered significant cost overruns and delays. Much of the problems relate to the sponsorship of these projects by government controlled companies, with the accompanying issues of confused and conflicted planning, incorrect staffing, corruption, and in many cases simple incompetence. These same issues have negatively impacted the operations at existing plants and as a result, U.S. product exports into Latin America have grown by almost 2 million barrels per day over the last decade.

The ability to successfully penetrate and grow export markets has been a necessity for the health of the U.S. refining sector, considering stagnant domestic demand. Even with the strong growth experienced over the last three years as a result of lower prices, total domestic consumption was still over 900,000 barrels per day lower in 2017 than in the peak demand year of 2005. Despite this, and while our friends in Europe and Japan were shutting down over 3 million barrels per day of refining capacity in a similar environment, the U.S. was able to increase refining capacity by 1.4 million barrels per day.

The U.S. refining renaissance has benefitted the country as a whole and consumers of petroleum products at all levels. Together with the boom in domestic crude and gas production, the refined product surplus has been a major contributor in reducing the trade deficit. It has also led to

a higher degree of supply security, and lower prices versus the previous environment where products had to be imported. This is particularly important during major supply disrupting events. A prime recent example of this, and a true confirmation of the robustness and resiliency of the U.S. refining industry, was last year's rapid return of supply after Hurricane Harvey's devastation at the U.S. Gulf Coast.

Looking to the future, the health of the U.S. refining industry will be dependent on a variety of factors, including market forces, geopolitical developments and changes in the regulatory environment – both domestically and globally. On the regulatory front, new domestic regulations which depress demand, increase costs, or limit market or feedstock access all could negatively impact U.S. refining competitiveness. More costly environmental rules certainly fall in this category, but perhaps the biggest threat to refiners and other segments of the petroleum industry could be more restrictive trade policies. Tariffs being imposed on steel and aluminum would have a very direct and negative impact on critical capital projects in all sectors. As just one example, three-quarters of the steel used in U.S. pipelines comes from overseas due to the lack of availability of the necessary grades domestically. More impactful still could be tariffs on crude and products themselves, but the biggest threat would be the potential of an all-out trade war which leads to slowing or declining global and domestic economic growth and product demand.

New regulations and policy initiatives can also be positive for the industry and consumers. Certainly, the cut in corporate taxes has and will lead to more capital investment in every segment as more projects move above the hurdle rate. Also, as countries around the world move toward lower sulfur transportation fuels and more stringent

environmental rules, U.S. refiners who have already had to make those investments, will further their relative advantages. The International Maritime Organization mandate to decrease bunker fuel sulfur in 2020 might be the single biggest event on the horizon and while it will advantage many U.S. refiners, especially the most complex facilities, it could be a major challenge to others.

To close out my prepared remarks, let me just say that a thriving refining industry is a critical resource for any country. It provides not just major benefits to both the economy as a whole and consumers, but is also an important national security asset. Nations around the world have targeted self-sufficiency in product supply and spent billions in an attempt to achieve this goal. But it has been the U.S. whose refining system has risen to the top, not through government involvement or subsidization, but by being allowed to organically develop and grow in a true free market environment. I believe it is incumbent on policy makers to remember this and thoroughly examine the impacts on the health of this vital industry and the resulting effects on consumers in any legislation that they consider.

The CHAIRMAN. Thank you, Mr. Auers.
Mr. Bordoff, welcome.

**STATEMENT OF JASON E. BORDOFF, FOUNDING DIRECTOR,
CENTER ON GLOBAL ENERGY POLICY, AND PROFESSOR OF
PROFESSIONAL PRACTICE IN INTERNATIONAL AND PUBLIC
AFFAIRS, COLUMBIA UNIVERSITY SCHOOL OF INTER-
NATIONAL AND PUBLIC AFFAIRS**

Mr. BORDOFF. Thank you.

Chairman Murkowski, Ranking Member Cantwell, members of the Committee, thanks for the invitation to appear before you again today.

As the Chairman noted, I was here last in April 2016 to testify about low oil prices at a time when prices had collapsed from about \$115 a barrel in mid-2014 to the high \$20s in early 2016—and they’ve since surged back to around \$80.

So let me explain the factors that have driven those swings and then offer three observations about the policy implications of them. Key factors in the 2014 oil price collapse included surging U.S. shale production, which you’ve heard about, and the decision by OPEC countries led by Saudi Arabia not to cut production in November 2014, widely condemned by many at the time as a war on shale.

In 2016 after oil prices had fallen below \$30 a barrel, OPEC, along with several non-OPEC countries, notably Russia, came together to cut production and prop up prices, oil prices recovered into the mid-\$50s for much of 2017 and then they began to surge again for several reasons. One, the OPEC cuts worked and brought down excess inventories; second, oil demand growth has been exceptionally strong, above its 10-year average; and then, we’ve heard from the IEA about Venezuela’s production collapse in light of its tragic economic situation.

More recently, several additional factors pushed up prices even further. President Trump pulled the U.S. out of the Iran Nuclear Agreement, raising concerns about additional oil supply loss; Libyan production fell by half due to political unrest; there were short-term outages in Canada and elsewhere; and then all of this was exacerbated by fears about the historically small buffer of spare capacity, as my colleague, Bob McNally, has explained so well in his book for our book series at Columbia.

In the last few weeks then prices fell again as OPEC countries announced they would put more supply in the market. Libyan supply came back online and the Trump Administration did three things. First, it signaled a softer approach toward the implementation of Iran sanctions; second, it raised more fears about the potential for a global economic slow down as a result of an escalating trade war; and third, it was reported to be considering tapping the SPR.

So, what does all this mean for policy?

First, it is impossible to predict future oil prices and few policy actions we have at our hands today provide relief at the pump in the near term. So I think energy policy decisions, whether it’s to increase production or reduce consumption or anything else, should largely be made independent of today’s oil price. One policy action

that would reduce oil prices, possibly, albeit temporarily, could be a release of the SPR. I do not believe current conditions warrant that and there are better ways to mitigate the potential price impacts of re-imposing sanctions on Iran. There are a few signs of shortage in the oil market today, significant geopolitical risks still loom and, as I testified before this Committee before, I think Congress should avoid further selling off this important national security asset to pay for other priorities.

Second, the shale revolution has been transformational for the U.S. energy outlook delivering enormous economic and geopolitical benefits, but gasoline prices are still based on oil prices and oil prices are still set in an integrated market. And so, that means when global oil prices spike, consumers feel it at the pump regardless of how much less import dependent we are. Shale can be ramped up and down more quickly. I do not think it is true swing supply. Geopolitical influence in the global market comes less from how much you produce than from that buffer of spare capacity you might choose to hold. And so, when oil prices fell below \$30 two years ago and then soared to \$80 this year, shale could not stabilize the market. That job fell to OPEC, mainly Saudi Arabia which is the only country that chooses to hold a meaningful amount of spare capacity.

Third, the best way to reduce the exposure of consumers to inevitable future oil price shocks is to reduce how much oil our economy uses in the first place, continuing with planned CAFE increases is one good way to do that, not to mention to reduce greenhouse gas emissions.

While increasing production does not insulate consumers for higher pump prices, it is important to note that more supply, along with the potential for reduced demand, can reduce the harm to the economy overall from higher oil prices by lowering import dependence because more of the increased consumer spending on fuel circulates within the U.S. economy rather than flows overseas.

The converse of that is why the U.S. economy saw much less benefit from the oil price collapse of 2014 and '15 than would previously have been the case because the consumer savings at the pump were offset by reduced oil-related investment which is a bigger share of the economy now as a result of the shale boom.

We've heard about the infrastructure bottlenecks. I think policymakers can facilitate responsible production by efficiently permitting infrastructure without undermining needed environmental reviews and by avoiding a trade war that threatens to raise material costs like steel or aluminum or possibly lead to retaliatory tariffs on U.S. energy exports.

Members of the Committee, thank you again for inviting me here today, and I look forward to your questions.

[The prepared statement of Mr. Bordoff follows:]



July 24, 2018

Congressional Testimony of

Jason E. Bordoff

Founding Director, Center on Global Energy Policy, and Professor of Professional Practice in International and Public Affairs, Columbia University School of International and Public Affairs

Before the

Committee on Energy and Natural Resources

United States Senate

2nd Session, 115th Congress

Chairman Murkowski, Ranking Member Cantwell and Members of the Committee, thank you for inviting me here today to discuss factors that impact global oil prices.

My name is Jason Bordoff. I am Professor of Professional Practice at Columbia University's School of International and Public Affairs and Founding Director of Columbia University SIPA's Center on Global Energy Policy.

It is an honor to appear again before this Committee to discuss high oil prices. The last time I was here, in April 2016, I was asked to testify about low oil prices—at a time when prices had collapsed from \$115 per barrel in mid-2014 to the high \$20's by early 2016. Since then, prices rebounded to \$80 per barrel this year, before falling back to today's level in the low \$70's. That context is helpful as a reminder that oil prices are hard to predict and inherently volatile, and may be increasingly so in the future, as my fellow panelist Bob McNally has so well explained in his recent book for our series at Columbia's Center on Global Energy Policy.¹

In my testimony, I will first describe the factors that have affected oil prices over the last several years. Among the most consequential factors are the shale revolution, major geopolitical supply disruptions such as in Venezuela, the supply agreement between Organization of Petroleum Exporting Countries (OPEC) and several non-OPEC countries, strong oil demand, and recent U.S. policy shifts on trade and sanctions on Iran.

Next, I offer three observations about the policy implications of recent oil price movements:

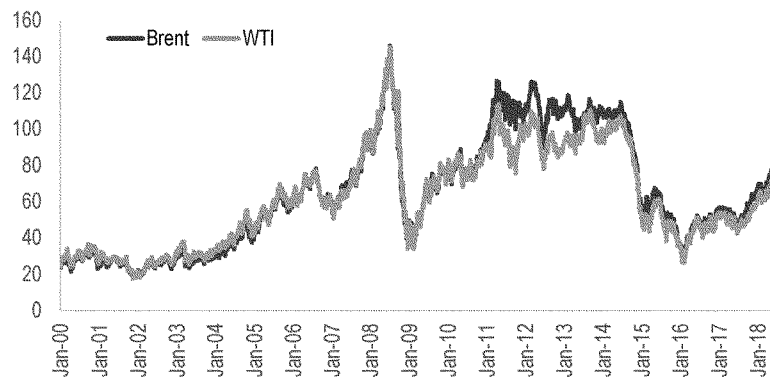
¹ Robert McNally, *Crude Volatility: the History and the Future of Boom-Bust Oil Prices*. New York: Columbia University Press, 2017.

- First, because policymakers cannot predict oil prices and because few policy responses impact oil prices in the near-term, energy policy choices should not be based on today's oil prices. I also explain why the use of the Strategic Petroleum Reserve (SPR), although it may reduce prices in the near-term, is not justified at present.
- Second, increased U.S. oil supply does not insulate drivers from higher pump prices, which are largely determined by oil prices set in a globally integrated market. Although shale oil is more responsive to price changes than conventional supply, it cannot serve as a swing supplier to stabilize oil markets in the way true spare capacity (largely held by Saudi Arabia) can.
- Third, the most effective policies to protect consumers from ineluctable oil price spikes are those that reduce the oil intensity of the economy through increased efficiency and alternatives. Reducing oil import dependence, whether through increased supply or reduced consumption, helps mitigate the macroeconomic harm from oil price shocks, even if consumers still see oil price increases at the pump.

The Evolution of Oil Prices in Recent Years

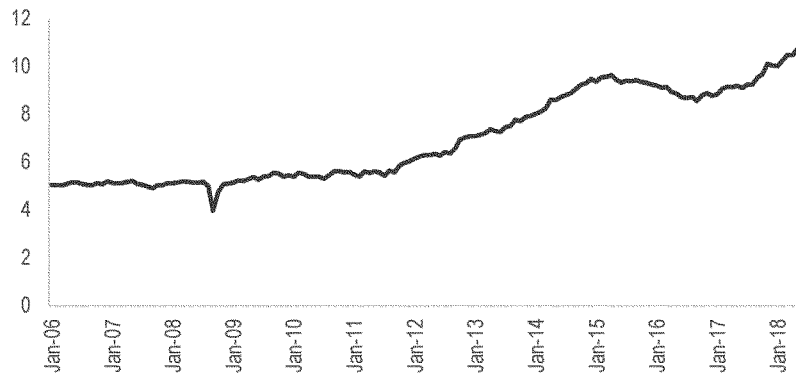
Following a period of sustained high oil prices from 2011 to 2014, in the range of roughly \$100 to \$120 per barrel (figure 1), oil prices began to slide in the summer of 2014. Several factors explain the oil price decline, but key among them was surging U.S. oil production, which nearly doubled from 2008 to 2015 (figure 2) as a result of the shale revolution.

Figure 1: Crude Oil Price History (\$ per barrel)



Source: Bloomberg

Figure 2: US Crude Oil Production (million barrels per day)



Source: EIA Short-Term Energy Outlook (July 2018)

In November 2014, oil prices plummeted, following a decision by OPEC not to cut output to prop up prices. At the time, many commentators viewed the decision as a “war on shale,” accusing OPEC of cratering prices to stymie U.S. shale oil production,² which was believed to require oil prices of at least \$65-70 per barrel to be viable.³ Oil prices collapsed from a high of \$115 per barrel in mid-2014 to below \$30 per barrel in early 2016. In a lagged response, U.S. oil production growth slowed and eventually started falling in April of 2015, declining by roughly 1.1 million b/d through September 2016.

In November 2016, OPEC countries came together with non-OPEC producers, most importantly with Russia (known together as OPEC+ or the Vienna Group), to agree to cut production to prop up prices. U.S. oil firms and oil-producing states breathed a sigh of relief. The governor of Oklahoma went so far as to issue a press release thanking OPEC for cutting production.⁴

Many commentators were skeptical at the time that the OPEC+ agreement would hold. Russia, in particular, had promised to participate in production agreements many times in the past, but rarely followed through. In his 2016 memoir, former Saudi Oil Minister Ali Al-Naimi wrote that he thought there was “zero” chance that countries outside the group, notably Russia, would join production cuts.⁵

Yet the production agreement has been far more effective than anticipated. Indeed, OPEC actually cut production more than it promised, largely as a result of the steep involuntary decline in Venezuelan oil production that began in 2016 (figure 3). In response to the OPEC+ cuts, plus strong oil demand growth (figure 4), oil prices gradually recovered, hovering in the mid-\$50's per barrel through most of 2017.

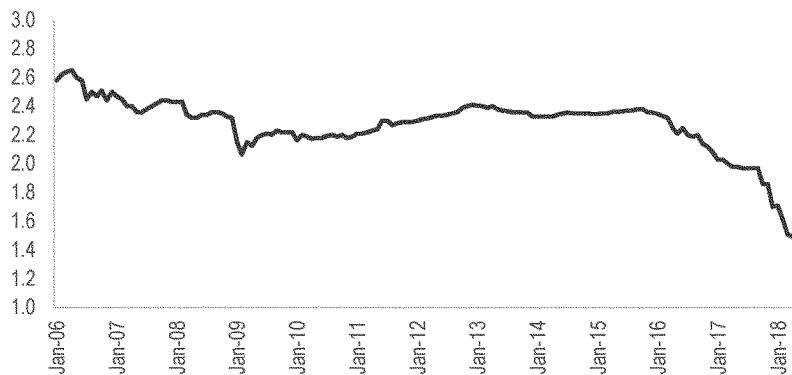
² See, e.g., Alex Lawler, Amina Bakr and Dmitry Zhdannikov, “Inside OPEC room, Naimi declares price war on U.S. shale oil,” *Reuters*, November 28, 2014, <https://www.reuters.com/article/us-opec-meeting-shale/inside-opec-room-naimi-declares-price-war-on-u-s-shale-oil-idUSKCN0JC1GK20141128>; Anjali Raval and Neil Home, “Oil plunges as Opec tests the mettle of US shale industry,” *Financial Times*, November 27, 2014, <https://www.ft.com/content/eda2b8a6-7645-11e4-a777-00144feabdc0>.

³ “In a bind: Will falling oil prices curb America's shale boom?” *The Economist*, December 4, 2014, <https://www.economist.com/finance-and-economics/2014/12/04/in-a-bind>.

⁴ Oklahoma Governor's Office, “Gov. Fallin Statement on OPEC Agreement,” Press Release, December 1, 2016, http://services.ok.gov/triton/modules/newsroom/newsroom_article.php?id=223&article_id=27193.

⁵ Ali Al-Naimi, *Out of the Desert: My Journey from Nomadic Bedouin to the Heart of Global Oil*, Penguin, 2016.

Figure 3: Venezuelan Crude Oil Production (million barrels per day)



Source: Bloomberg

Towards the end of 2017, oil prices began rising again. In part, this reflected the success of OPEC+ in achieving its stated goal of drawing down excess global oil inventories. Additionally, global oil demand growth was strong in 2017 at 1.5 million b/d, notwithstanding all the recent talk that oil demand is on the verge of peaking.⁶ Indeed, oil demand growth in 2017 (at 1.6%) was much faster than the 10-year average (around 1.2%).

Another factor pushing up prices has been the continuing collapse of production in Venezuela. In November 2017, Venezuela appointed a military general with no oil industry experience to lead the state-run oil firm PDVSA, once a highly respected oil company, which has since fallen apart as a result of mismanagement and corruption. Venezuela's economy has collapsed. China and Russia, Venezuela's last remaining creditors, are increasingly reluctant to provide financing. The country continues to suffer as a result of debt defaults and U.S. financial sanctions, which, together, have closed access to credit and significantly limited PDVSA's access to basic inputs and services. The lack of equipment and investment—along with rampant hyperinflation and a dramatic deterioration of the security situation—have significantly worsened the conditions for foreign companies and workers operating in Venezuela, and led to a significant outflow of oil personnel from the country.

⁶ International Energy Agency, Oil Market Report, July 12, 2018, p. 51.



ConocoPhillips's seizure of PDVSA's Caribbean assets following an arbitration ruling also threatens 300,000-400,000 b/d of Venezuelan exports.

Factors Driving Up Oil Prices in 2018

Throughout 2018, oil prices continued to climb higher, breaking the \$80 per barrel threshold in May, and approaching it again in late June and early July. Several factors drove the oil price recovery in 2018.

Part of the reason for this surge can be seen in the supply and demand fundamentals. On the demand side, oil demand forecasts remain strong for 2018, with the IEA projecting growth of 1.4 million b/d (figure 4).⁷

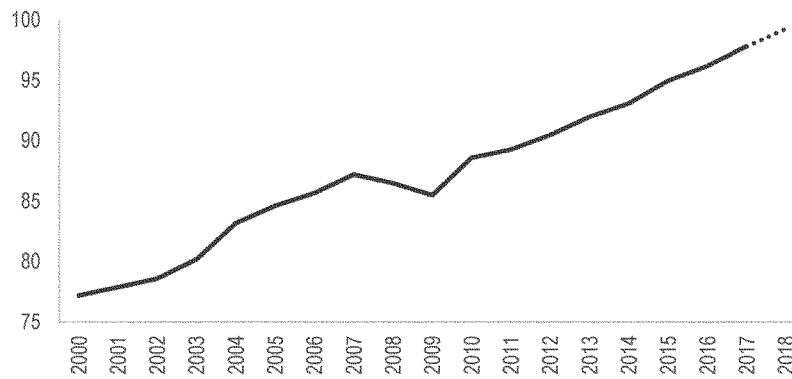
On the supply side, the stated OPEC+ goal of bringing global oil stocks back down to the five-year-average level was achieved earlier this year, leading the International Energy Agency (IEA) to declare "mission accomplished" on OPEC's behalf in April 2018.⁸ According to the IEA, the global oil market was undersupplied by more than 200,000 b/d in the second quarter of 2018.⁹ The OPEC+ agreement aimed to reduce the output of those 24 countries by 1.8 million b/d, but production from those countries actually fell by up to 2.8 million b/d as a result of involuntary cuts by Venezuela, among other countries.

⁷ U.S. Energy Information Administration, Short-Term Energy Outlook, July 10, 2018, p.3, https://www.eia.gov/outlooks/steo/pdf/steo_full.pdf.

⁸ International Energy Agency, Oil Market Report, April 13, 2018, p.3.

⁹ International Energy Agency, Oil Market Report, July 12, 2018, p.49.

Figure 4: Global Oil Demand (million barrels per day)



Source: IEA Oil Market Report (via Bloomberg)

Additionally, geopolitical risk helped push oil prices higher just as the summer driving season was commencing, in at least five ways:

First, and perhaps most importantly, the recent oil price surge was driven by President Donald Trump's decision to withdraw from the Iran nuclear agreement and thus re-impose sanctions on Iranian oil sales. While there is great uncertainty about the ultimate impact of new sanctions, the market was understandably concerned about the potential hit to Iran's oil production (figure 5) and 2.2 million b/d of exports (as of June).¹⁰

¹⁰ International Energy Agency, Oil Market Report, July 12, 2018, p.19.

Figure 5: Iranian Crude Oil Production (million barrels per day)



Source: Bloomberg

A key question remains whether the Administration will offer exceptions from the imposition of sanctions to countries that significantly reduce their purchases of Iranian crude oil, as permitted under Section 1245 of the FY 2012 National Defense Authorization Act (NDAA), as amended by the relevant sections of FY 2013 NDAA (also known as the Iran Freedom and Counter-Proliferation Act or IFCA). Under this law, foreign financial institutions are subject to sanctions if they process transactions for Iranian crude unless the country housing the financial institution reduced its purchases of Iranian crude oil to a significant degree. Companies can also be subject to sanctions under the terms of Executive Order 13662, which was terminated under the agreement but which will be re-imposed by November 4.

The law gives the Executive Branch the authority to define significant reduction. President Obama defined “significant reduction” as roughly 20 percent by volume in every 180-day evaluation period. After President Trump announced he would withdraw the U.S. from the Iran deal, there was great uncertainty about how the current Administration would use its exception authority. On June 26, an unnamed State Department official speaking to reporters said that the Administration would take the hardest line possible on sanctions implementation, not offer any exceptions, and require all

buyers of Iran crude oil to zero out imports by November, the end of the 180-day implementation period.¹¹ The price for crude oil shot up in response.

The second factor that pushed up prices recently was the unexpected collapse of Libyan production from nearly 1 million b/d in May to around 500,000 b/d in July,¹² following attacks on key export infrastructure and a subsequent blockade of several oil ports by the forces of Libyan military commander Khalifa Haftar, who attempted—unsuccessfully—to hand over control of oil export terminals in Eastern Libya to a newly formed national oil company from the one controlled by the UN-backed government in Tripoli.¹³

Third, Venezuelan production continues to fall, and there is a significant risk that its decline could accelerate further in the near future. The IEA projects Venezuelan production to fall below 1 million b/d by the end of the year from just under 1.4 million b/d in May, but this may well be too conservative an estimate.

Fourth, short-term production outages in Canada, Brazil and the North Sea have further reduced supply in recent months. And other risks of geopolitical supply disruptions in places like Nigeria, Iraq, or around the Strait of Hormuz continue to loom over oil markets.

Fifth, there is a very narrow buffer of spare capacity in today's oil market. Sufficient spare capacity is a critical factor to maintain crude oil stability, as it allows the market to quickly adjust to unexpected supply disruptions. Particularly with Saudi Arabia's recent decision to ramp up production, the level of spare capacity in the market today is at a historic low.

Factors Pushing Prices Back Down in July 2018

In the last two weeks, however, oil prices have fallen again by roughly 10 percent. Several factors are responsible.

First, at the OPEC+ meeting in late June, producers agreed to hike production, following public and private pressure by the U.S. to bring oil prices down, including several tweets by President Trump attacking OPEC for pushing up prices. Following the OPEC+ meeting, Saudi Energy Minister Khalid Al-Falih said he would do “whatever is necessary” to keep the market well-supplied and that

¹¹ Gardiner Harris and Stanley Reed, “Roiling Markets, U.S. Insists World Must Stop Buying Iranian Oil,” *New York Times*, June 26, 2018, <https://www.nytimes.com/2018/06/26/world/middleeast/us-iran-oil-sanctions-.html>.

¹² International Energy Agency, Oil Market Report, July 12, 2018, p.18.

¹³ Aidan Lewis, “How unstable is Libya's oil production?,” *Reuters*, July 16, 2018, <https://www.reuters.com/article/us-libya-oil-explainer/how-unstable-is-libyas-oil-production-idUSKBN1K61Y6>.

an additional 1 million b/d would be added to the market.¹⁴ Saudi Arabia gave itself the flexibility to increase output further if needed to cap prices. Saudi oil production has risen from below 10 million b/d to 10.5 million b/d in June and is expected to rise still further to 11 million b/d.¹⁵

Second, the Trump administration's surprise announcement of its intention to impose a 10% tariff on an additional \$200 billion worth of Chinese goods have raised fears that the escalating trade war between the U.S. and China may lead to a slowdown in global economic growth and thus in commodities generally, including oil demand.¹⁶ Commodity prices across the board, not just oil, fell in response to these escalating trade risks.

Third, General Khalifa Haftar on July 11 handed over Libya's eastern export terminals to the Tripoli-based National Oil Company following several weeks of blockade, allowing operations to resume and expectations of a return to pre-disruption production levels of roughly 1 million b/d as shipments from Eastern ports resumed. However, the instability of the country remains, and this recent increase is not secure and is highly likely to fall again.

Fourth, the Trump Administration softened its rhetoric about the implementation of sanctions against Iran, leading to expectations that the loss of Iranian oil supply would be more gradual.¹⁷ After oil prices rose sharply in response to statements that buyers would be required to reduce Iranian oil imports to zero by November, the State Department reversed course. Administration officials have since clarified that exceptions will be available,¹⁸ although the level of significant reduction necessary to qualify remains unclear.

Fifth, press reports suggested that the Trump Administration may consider releasing oil stocks from the Strategic Petroleum Reserve.¹⁹

Finally, and more broadly, the price rebound of the last year has given a boost to several sources of non-OPEC production, notably the U.S., Canada and Brazil, all of which are likely to grow robustly this year and next.

¹⁴ David Sheppard and Anjali Raval, "Russia backs Opec plan to pump more oil," *Financial Times*, June 23, 2018, <https://www.ft.com/content/d9e95584-76f7-11e8-8e67-1e1a0846c475>.

¹⁵ International Energy Agency, Oil Market Report, July 12, 2018, p.16.

¹⁶ Chris Giles and Robin Wigglesworth, "IMF warns Trump tariffs could hit global growth by 0.5%," *Financial Times*, July 16, 2018, <https://www.ft.com/content/b3e31d4a-8901-11e8-b18d-0181731a0340>.

¹⁷ Lesley Wroughton, "Mnuchin says U.S. to consider waivers on Iran sanctions," *Reuters*, July 16, 2018, <https://in.reuters.com/article/usa-iran-mnuchin/mnuchin-says-u-s-to-consider-waivers-on-iran-sanctions-idINKBN1K6117>.

¹⁸ Nick Wadham, "State Department Leaves Door Open to Iran Oil Import Exemptions," *Bloomberg*, July 2, 2018, <https://www.bloomberg.com/news/articles/2018-07-02/state-department-leaves-door-open-to-iran-oil-import-exemptions>.

¹⁹ Ari Natter, "Trump Considers Tapping U.S. Oil Reserve as Prices at the Pump Rise," *Bloomberg*, July 13, 2018, <https://www.bloomberg.com/news/articles/2018-07-13/trump-said-to-mull-tapping-u-s-oil-reserve-as-pump-prices-rise>.

Implications of High Oil Prices

As I noted at the outset, I last appeared before this Committee two years ago to discuss low oil prices, a reminder of the ineluctable cyclical nature of the oil markets. Oil prices will always rise and fall. Indeed, my colleague Bob McNally argues we are likely to see even greater oil price volatility in the future, particularly as global spare capacity wanes—precisely the situation we are facing today.²⁰

Few policy responses can meaningfully impact oil prices in the near-term

For policymakers, the uncertainty about future oil prices means that current policy choices should be divorced from near-term oil price movements. Few policy actions can meaningfully affect oil prices in the near term in any case.

There are credible arguments for and against opening new areas to drilling, for example. But these arguments are little changed by movements in oil prices. Whether the oil price is high or low, a careful balance must still be struck between the economic and geopolitical benefits of increasing domestic production and the environmental risks associated with drilling operations, especially in sensitive ecosystems.

Moreover, these policy changes have little bearing on oil prices today. It can take up to a decade or more to bring new supply to the market, even after a new area is opened up for drilling. While the economic benefits of increased production may be greater at higher oil prices, we cannot know what the price of oil will be a decade hence. Even if domestic production could be ramped up more quickly, oil prices are still set in a global market with daily production close to 100 million barrels. The U.S. only accounts for about 10 percent of total oil supply, so the price impact of higher U.S. production is modest at best, absent a historic surge in output like the recent shale boom.

A gasoline tax holiday is another policy measure often suggested to provide consumers relief during times of high oil prices. However, this policy tool has a similarly small impact on fuel prices at the pump, because refineries tend to produce gasoline at close to maximum capacity, especially during summer driving season in America. As the supply of gasoline is largely inelastic (that is, unresponsive to even large price changes) in the short run, the price paid by consumers will rise until demand matches the quantity supplied. A gasoline tax holiday would thus likely benefit refiners and oil producers more than consumers.²¹ Moreover, the need to internalize the full externalities of driving—from climate change to air pollution to congestion—not to mention pay for crumbling

²⁰ Robert McNally, *Crude Volatility: the History and the Future of Boom-Bust Oil Prices*. New York: Columbia University Press, 2017.

²¹ Len Burman and Eric Toder, “What Were They Thinking???” Tax Policy Center, April 15, 2008, <https://www.taxpolicycenter.org/taxvox/what-were-they-thinking>.



infrastructure argues against waiving the modest federal gasoline tax, which has not been raised in a quarter century.

One policy action that *could* potentially reduce oil prices, albeit temporarily, would be a release of oil from the SPR. However, as I have also testified before this Committee, the SPR should generally be reserved for true supply emergencies like the Gulf War or the aftermath of Hurricane Katrina.²² It would be ill-advised to use the SPR in present circumstances given that large geopolitical and other risks remain to oil supply—from Libya to an unexpected worsening of conditions in Venezuela to hurricane season in the U.S. Gulf Coast, not to mention those risks we cannot anticipate.

The current market dynamic demonstrates few signals of a shortage. While the price of oil has risen over the last year as inventory levels have declined back to more normal levels, crude and refined product markets are not demonstrating the type of physical tightness evident in other periods of SPR releases. Oil market participants, in both the physical and financial markets, generally cite weak physical cash differentials in key global benchmarks as well as soft refining margins as indications of an adequately supplied market.

Although sanctions against Iran could remove a large volume of oil from the market, the SPR is best used to deal with short-term disruptions to global oil supply. It was not designed to restrain oil price increases resulting from long-term supply losses, such as those associated with sustained economic sanctions. If sanctions were to disrupt all of Iran's current 2.2 million b/d of exports, today's SPR could replace that volume for only 300 days, after which the United States would be left with no ability to respond to oil disruptions—including by hostile actors—anywhere in the world. That buffer is getting smaller, too, as planned sales by Congress will reduce the SPR from 665.5 million barrels to 405 million barrels by 2027.²³ Moreover, releasing crude from the SPR might very well blunt the price signal that is needed to allow the market to adjust, as higher prices induce producers to bring more supply online and consumers to curb demand.

Because it can take time for markets to adjust to supply losses, and sharp price spikes can harm consumers and the economy, oil sanctions should be designed with consideration given to the price impacts of lost supply given current oil market conditions. Rather than use the SPR to reduce price impacts of sanctions, that is precisely why the Iran sanctions statute affords the President the flexibility to offer countries exceptions if they significantly reduce purchases of Iranian crude and to define what constitutes a significant reduction. That flexibility allows the Executive Branch to determine by how steep of a glide path to reduce a targeted country's oil sales. The law also allows

²² Jason Bordoff, "Testimony before the Senate Committee on Energy and Natural Resources," October 6, 2015, https://www.energy.senate.gov/public/index.cfm/files/serve?file_id=6ffc0bd9-49b8-485d-b961-439ac6b38bd2.

²³ U.S. Government Accountability Office, *Strategic Petroleum Reserve: DOE Needs to Strengthen Its Approach to Planning the Future of the Emergency Stockpile*, GAO-18-477 (Washington, DC 2018), accessed July 20, 2018, <https://www.gao.gov/assets/700/692/692113.pdf>

the President to cease oil sanctions entirely if the White House determines there is insufficient oil in the market to make up for any Iranian shortfall.

The recent increase in oil prices stemming from supply disruptions globally is also a reminder of the value of the SPR, despite the drop in U.S. oil imports. The new U.S. energy fortune has given rise to a view that the SPR could be sold off to plug spending holes without creating energy security risks, as reflected in recent Congressional budget sales. I testified before this Committee in October 2015 about the reasons I believed selling off the SPR was misguided.²⁴ I also argued that further study was needed about the how changes in the oil market and in the U.S. supply outlook should change the size, use and composition of the SPR. The Center on Global Energy Policy undertook such a study and published the results in May 2018.²⁵

We find that despite the drop in US oil import dependence, the SPR remains an important national security asset that can help mitigate the economic impacts of oil price shocks. Oil prices are set in a global market, so consumers will see pump prices rise when oil prices rise regardless of whether the U.S. imports oil or not. As a member of the International Energy Agency, the U.S. is required to hold strategic oil stocks equal to 90 days of imports. Yet changes in the global oil market in the last 40 years since the IEA's creation mean that oil import dependence is no longer the right way to measure our vulnerability to global supply disruptions. Rather than physical shortfalls, the risks against which the SPR protects today are oil price spikes that affect U.S. energy prices regardless of our level of net import dependence. Moreover, the SPR protects not only against geopolitical disruptions, but disruptions from severe weather events that are increasing in frequency and severity. Some have argued that a possible transition away from oil in the future also argues for reducing the size of the SPR, but our study finds that the multi-decade period of transition itself is likely to be uneven, disorderly and volatile, and thus actually strengthens the case for a strategic buffer. We also identify ways in which the use and management of the SPR can be improved and modernized to increase its effectiveness.

Energy dominance does not insulate drivers from higher pump prices

The shale oil revolution has been extraordinary. It produced the largest ramp up of oil supply over a five-year period of any country in history, delivering significant economic and geopolitical benefits for the U.S. in the process. But oil prices are still set in a global market, and gasoline prices faced by

²⁴ Jason Bordoff, "Testimony before the Senate Committee on Energy and Natural Resources," October 6, 2015, https://www.energy.senate.gov/public/index.cfm/files/serve?File_id=6ffc0bd9-49b8-485d-b961-439ac6b38bd2.

²⁵ Jason Bordoff, Antoine Halff and Akos Losz, "New Realities, New Risks: Rethinking the Strategic Petroleum Reserve," Center on Global Energy Policy, May 2018, https://energypolicy.columbia.edu/sites/default/files/pictures/CGEP_New%20Realities_%20New%20Risks_%20Rethinking%20the%20Strategic%20Petroleum%20Reserve.pdf

U.S. consumers reflect global oil prices. Gasoline prices at the pump in the U.S. are especially sensitive to changes in the global crude oil price due to the relatively low level of fuel taxation compared to other OECD economies. According to data from the IEA, more than 80% of the retail price of gasoline in America is directly or indirectly exposed to fluctuations in the price of crude oil.²⁶ Because oil and refined petroleum products can be freely traded, surging U.S. production and decreasing import dependence does not protect consumers at the pump from global oil price shocks.

Shale oil production can be ramped up and down more quickly than conventional supply, but the recent run up in oil prices demonstrates the limits of shale oil to function as a “swing supplier” that can stabilize oil prices, as many prominent experts had predicted.²⁷ While U.S. crude oil production increased by more than 2 million b/d over the past two years, shale oil still takes time to ramp up and down. Shale output reflects the decisions of thousands of private firms, and its flexibility is likely to decline as the sector consolidates among larger companies with stronger balance sheets, capital markets impose greater discipline, and companies plan to better weather price moves to avoid the disruption that comes from frequently ramping up and down personnel, equipment, and services. Additionally, shale oil output in the Permian basin is constrained in the near-term by pipeline takeaway capacity bottlenecks that are likely to persist well into 2019, as well as shortages of workers and equipment.

Although shale oil is much more responsive to oil prices, oil prices still plunged below \$30 per barrel at the start of 2016 and soared to \$80 per barrel earlier this year. Shale oil could not swing quickly enough to stabilize markets. This role fell to OPEC instead in both cases, first to put a floor under prices by cutting supply and, more recently, to provide relief by ramping up production.

Only a handful of OPEC members, particularly Saudi Arabia, hold a meaningful amount of spare capacity—the ability to ramp up production in a matter of weeks and sustain it over time. That is why, despite the shale boom, President Trump nonetheless was forced to ask Saudi Arabia publicly and privately to provide price relief by increasing production. Without that spare capacity buffer, the only supply tool to stem sharp oil price spikes is government-held strategic stocks. A new article by scholars at a Saudi research institute published in *The Energy Journal*, the quarterly journal of the International Association of Energy Economics, finds that OPEC spare capacity has reduced oil

²⁶ International Energy Agency, Monthly Oil Price Statistics, July 12, 2018, p.7, <http://www.iea.org/media/statistics/surveys/prices/mps.pdf>.

²⁷ Alan Greenspan, “Opec has ceded to the US its power over oil price,” *Financial Times*, February 19, 2015, <https://www.ft.com/content/92ab80e4-b827-11e4-b6a5-00144feab7de>.

price volatility by as much as half over the years.²⁸ Thus, while pushing OPEC to boost output to its full capacity may offer some modest price relief, running down the spare capacity cushion close to zero poses risks of oil price spikes in the event of additional geopolitical or other supply disruptions. Indeed, by exacerbating market fears of future price spikes, a low margin of spare capacity, by itself, can create upward price pressures.

The most effective policies to protect consumers would reduce the oil intensity of the economy

When oil prices soared in the mid-2000s and many fretted that oil supplies were running out, few people foresaw the shale revolution that would shift the energy landscape from scarcity to abundance. In 2014, former Chevron CEO John Watson noted that new oil supply was so expensive that “\$100 per barrel is becoming the new \$20.”²⁹ Oil prices plummeted from \$115 per barrel to less than \$30 per barrel in the two years that followed, only to bounce back to \$80 by mid-2018.

The lesson is that policymakers cannot predict oil prices reliably, nor, in an integrated world oil market, can they guarantee consumers low prices. Oil prices will inevitably go up and down, perhaps with more volatility in the future than in the past.³⁰ The best policy response to high oil prices thus recognizes the inevitability of future oil price shocks, and takes actions that may not be able to provide relief today, but can help protect consumers in the future from the next inevitable price spike.

The best way to reduce our exposure to future oil shocks is by reducing our oil consumption in the first place. Continuing with planned fuel economy increases through CAFE standards is one effective way to reduce the oil intensity of the economy and mitigate the adverse impact of future oil price increases on American drivers. Continuing to invest in R&D in alternative transportation fuels and technologies can also help reduce our society’s oil use. In addition to protecting consumers from price volatility, such policies are also needed to address the long-term threat of climate change.

Lower consumption, along with more oil production, can also help lower our net oil import dependence. Although reduced imports do not insulate consumers at the pump from higher global oil prices, they can nonetheless reduce the adverse macroeconomic impacts of higher fuel prices.

²⁸ Axel Pierru et al., “OPEC’s Impact on Oil Price Volatility: The Role of Spare Capacity,” *Energy Journal*, Vol. 39, No. 2, March 2018, p.173-196, <https://web.a.cbscohost.com/ehost/pdfviewer/pdfviewer?vid=0&sid=48dc64de-0a79-4e6c-8ea5-48a81047ac06%40sessionmgr4008>.

²⁹ Zain Shauk, “Chevron CEO Says \$100 a Barrel Is the New \$20,” *FuelFix*, March 4, 2014, <https://fuelfix.com/blog/2014/03/04/chevron-ceo-says-100-a-barrel-is-the-new-20/>.

³⁰ Robert McNally, *Crude Volatility: The History and the Future of Boom Bust Oil Prices*, Columbia University Press, 2017.

Based on historical experience, an oil price drop of the magnitude seen in 2014-2015 should have boosted U.S. GDP by around one percentage point.³¹ Instead, recent economic evidence shows that the U.S. economy saw almost no benefit from the latest oil price collapse because the boost in consumer spending was almost entirely offset by a reduction in oil-related investment.³² U.S. net petroleum import dependence has fallen from around 60 percent to below 20 percent and is projected to decline further. As net oil import dependence approaches zero, more and more of the consumer savings on fuel comes at the expense of American rather than overseas producers.

Importantly, the converse is true as well. Oil prices are set in a global market, so when oil prices rise, consumers see pump prices rise regardless of how much oil the U.S. imports. But the negative effects of oil price spikes on the economy are far more muted when our import dependence is lower, because much more of the increased consumer spending circulates within the U.S. economy rather than flows overseas.

An important caveat, however, is that higher consumer spending on gasoline and diesel may not lead to increased oil investment if constraints exist, such as scarcity of labor, equipment, or pipeline capacity. Such constraints are very much present at the moment. As a result, rising oil prices are more likely to be a net negative for the economy overall, even if falling oil prices delivered little economic benefit during the down cycle.

State and federal policymakers can help overcome these barriers by efficiently and expeditiously permitting necessary energy infrastructure without short-cutting necessary environmental reviews. An escalating trade conflict also threatens the outlook for U.S. production growth, as tariffs raise the costs of steel, aluminum and other materials needed to invest in U.S. energy infrastructure. Moreover, the increase in U.S. energy production and concomitant exports makes U.S. oil and gas a new target for retaliatory tariffs, as China recently threatened.

Conclusion

Oil prices have been on a wild ride. After rising to \$115 per barrel in 2014, they fell to less than \$30 per barrel in 2016, and rebounded to \$80 per barrel earlier in 2018 before easing off to their current level in the low \$70s. The primary drivers of the surge in prices this year have been geopolitical supply disruptions, notably in Venezuela and Libya, supply risks from the Trump Administration's decision to re-impose oil sanctions on Iran, and strong demand growth. In recent weeks, oil prices have declined again in response to concerns about the impact of a possible trade war on economic

³¹ U.S. Council of Economic Advisers, *Economic Report of the President 2016*, U.S. Government Publishing Office, February 2016, p. 55-58, https://obamawhitehouse.archives.gov/sites/default/files/docs/ERP_2016_Book_Complete%20JA.pdf.

³² Christiane Baumeister and Lutz Kilian (2016), "Lower oil prices and the U.S. economy: Is this time different?," *Brookings Papers on Economic Activity*, Fall 2016, https://www.brookings.edu/wp-content/uploads/2016/09/5_baumeisterkilian.pdf.

growth, the return of Libyan production, increased Saudi Arabian supply, and a seeming willingness by the Trump Administration to consider a more gradual path to reduce Iranian oil sales.

The oil market of the past five years should provide all of us with humility to realize that we cannot accurately predict oil prices. Nor do most policy actions that we can take today have an impact on fuel prices in the near term. Consequently, energy policy choices should be made largely independently of today's oil price environment. While increased production and reduced imports can help insulate the U.S. economy from inevitable oil price shocks, in an integrated global oil market American motorists still face higher pump prices when oil prices spike regardless of how much oil the U.S. imports. For that reason, the best way to protect consumers from future oil price shocks is to reduce the overall oil use of our economy in the first place.

The CHAIRMAN. Thank you, Mr. Bordoff.

And thank you all—very, very interesting testimony this morning.

I want to start off with, again, the subject that everyone has been talking about this week and that is Iran. We have heard several of you mention the supply disruptions, the global disruptions, that we have seen in Venezuela and Libya and certainly with the potential for Iran going offline.

The question, and I think I will direct this to you, Mr. Sadamori and Mr. McNally. We have a 100 million barrel per day oil market, so where does this supply come from in this short-term to meet the potential for a shortfall? Then, if I could have you both discuss this issue of spare capacity? This is something that I have raised over the years, and I am trying to get a real handle on what we truly understand to be spare capacity right now within OPEC, within the non-OPEC countries.

Mr. Bordoff, you had mentioned that, really, it is only Saudi Arabia that has true spare capacity. You suggested that U.S. shale oil is not necessarily spare capacity or that swing supply that is needed.

So can we have a conversation about this? Where do we go if we do have this severe disruption that Iran can clearly contribute to in addition to what else we have seen, and how does the global spare capacity factor in and to what assurance do we have that we have enough to take us through?

Mr. Sadamori.

Mr. SADAMORI. Thank you, Chair.

So the question about where the additional supply can come from in the very short-term. We have to take note of the fact that the Vienna Production Cuts Agreement by the OPEC and some of the non-OPEC oil-producing countries, they are still maintained. And, of course, they are producing a lot less than their target and also they are coming from the unintended production declines in countries like Venezuela, but the fundamental agreement, we understand, in the last June meeting was that they would recover the oil, increase the production and lower the level of compliance to 100 percent.

That means that there are some countries in that group who are producing less intentionally, a lot less than their capacity. The normal expectation is that those additional barrels should come from them.

The CHAIRMAN. To what extent should the U.S. increased production play?

Mr. SADAMORI. Yes, and also in terms of the numbers, in our most recent oil market report, we expect that those, the OPEC members along the Gulf Coast, the Saudi, UA and Kuwait, together they should have a bit more than 2 million barrels per day over spare production capacity. Also the other producer who can increase production will be Russia. Indeed, we are already seeing that today. I mean, the Saudi and Russia, they already started to open taps in June, so the increase is already happening. That is about the OPEC and some non-OPEC side, the participants to the production cuts agreement.

On the other hand, in the United States, of course, the U.S. is increasing the production at a very fast pace. The 1.7 million barrels per day, in one year, in 2018 and we expect that to continue a bit slower, but still 1.2 million barrels per day in 2019.

But in a sense, we, I mean, the market participants already incorporated that very fast production growth in the United States. What we are seeing right now is the, as I said, there is the pipeline takeaway capacity which is somewhat preventing the further growth.

In the short-term, of course, we understand that many projects are going on in regions like Texas and those pipeline projects will be completed sometime in 2019, but before that, in the very short-term, it is really hard to expect U.S. production to grow significantly before the pipeline takeaway infrastructure issues are solved.

The CHAIRMAN. Mr. McNally, do you have anything to add to that?

Mr. McNALLY. Yes, Madam Chairman, this is something I have thought about and worked with when I was on the White House National Security Council, like my colleague, Jason Bordoff, under President Obama, working for President Bush when we liberated Iraq and we thought very much about this.

The problem, the policy problem again is, even though it is 100 million barrels and we are only talking about a couple-million-barrel disruption, a small disruption can mean a big price spike and a problem for our economy.

So where do you go for quick supply because you cannot bring on an oil field really fast? The first place you want to go for something like that, if you suddenly lost 2.5 million barrels a day or 3 or 4, you go to spare production capacity held by, mainly, Saudi Arabia. We went there in 1990 and '91. They were a little late in getting there. Saudi Arabia provided that before we liberated Iraq in 2003. That is the first resort. That is what the fire department is for. You call the fire department. The problem is there is no fire department today.

Mr. Sadamori mentioned the Saudis are going up. I want to have a word about defining spare capacity in a second, but spare capacity, we all must agree, is at least very tight, if not completely absent.

The next place you go is commercial inventories. Now, back in the last two years we had this glut. We had this glut and we had extra inventories. If we had to work it off a little faster, that would have been okay. We wouldn't have had to have higher prices. But commercial inventories, and we could only see them in the rich world, now the growing part of the world in Asia and Africa, we don't see those inventories. So the rich world's inventories are normal. The rest of the world is probably a little tight on inventories. If we were to draw down commercial inventories right now by that 2.5 million barrels a day, it would put upward pressure on prices.

That leads to our last resort which is strategic stocks, held in the United States and in other IEA countries, principally Germany and Japan. We, unfortunately, decided to sell off our strategic stocks to pay for budgetary expenses so our protection is being reduced, but that is where you would want to go and frankly, in my view, were

we to lose Iran's 2.5 million barrels a day later this year or next and, certainly, were there to be an interruption in the Strait of Hormuz of 19 million barrels a day, that would constitute a legitimate use of strategic stocks.

Final word on defining spare capacity because folks do define it a little differently. The IEA has a higher number for spare production capacity. They have, I think it is above 3 million barrels a day because they count oil that Saudi Arabia could bring on but in several months.

In history and the EIA, we have a little stricter definition. It is oil that you can get in weeks, four weeks to be exact, and on that definition the EIA has a little lower definition of about 1.5 million barrels a day. The way we count it, it is even lower than 1 million barrels a day, but however you count it, it is really tight and relative to the risk we face.

The CHAIRMAN. Thank you. Thank you both.

Senator Cantwell.

Senator CANTWELL. Thank you, Madam Chair, and thanks to the witnesses.

You have painted, all of you collectively, a picture of what the roller coaster looks like for the future. I think that is the most challenging thing for us to get our minds around is that the roller coaster is going to continue.

For consumers at home it, obviously, can be very, very devastating and so, to me, I think, Mr. Bordoff, you said it best that the best thing we can do is diversify off of oil just because of that integrated market and now, spare capacity issue. That even though we have upped production, we are not going to avoid still being wrapped around that global market and the challenges of that global market.

One thing I wanted to ask about, obviously we talked, everybody has talked a lot about Iran. When we were focusing on high prices a decade ago, one of the issues that people put or at least a lot of the oil executives would say there is a terrorist premium, a threat of terrorism activity disrupting supply. They would say that there is something between a 15 and 20 percent increase in price just based on that fear factor.

Do you have some sense of what the Iranian issue might be causing in the market today?

Yes, Mr. Bordoff.

Mr. BORDOFF. It is hard to put a dollar figure on it. We do see oil prices move in response to signals from the Administration that it will take a harder or softer line toward implementing sanctions a few weeks ago when an unnamed State Department official was giving an anonymous briefing and said there would be no exceptions for significant reductions in Iranian oil purchases. So countries had to go to zero by November, we saw oil prices spike several dollars a barrel, I do not remember how much exactly, and then the Administration seemed to walk that back a little bit.

So I do think that tool is an important one we should remember. I think that the Strategic Petroleum Reserve is designed to deal with short-term, temporary, severe supply disruptions not the potential for a long-term supply loss from implementing sanctions against any country, against their oil supply.

The Iran statute was written with a mechanism built into it to try to take account of conditions in the global oil market and make sure we were imposing pain on Iran without imposing, shooting ourselves in the foot at the same time.

Senator CANTWELL. But you are saying both trade wars and this issue are causing some level of increase in price.

Mr. BORDOFF. Well, I think recently it has had a little bit of the opposite effect because the new sanctions that were announced against it, sorry, the new tariffs that were announced against Chinese goods, raised fears that the trade war could be worse and that might have a negative effect on global economic growth. The rate of GDP growth is one very important factor in how strong oil demand growth is which could push up prices in a tightly-balanced market.

So there are a lot of geopolitical risks out there. Obviously, Iran is one. Libya is another. Venezuela is another and there is general potential for increased tensions or conflict in the Middle East or elsewhere as we have seen on social media and other places in the last few days.

Senator CANTWELL. What did we get out of the \$4 billion tax break, the new tax break in the tax plan that we gave oil companies? What did we get out of that? You know, in the context of here we are months later. We gave a \$4 billion tax break, a new one in addition to the lowering of the corporate rate. We gave them additional foreign investors, yet here we are paying higher gas prices. So what did we get out of that?

Mr. BORDOFF. Well, it is hard. I do not know that I can comment specifically on what was in the tax bill.

The general point about increased production and to what extent it helps consumers at the pump, I think in your opening remarks you made the comment about how we have increased production, yet prices have still gone up. That's partly because prices are set in a global market. There is a limit to what shale can do, as extraordinary as doubling oil production has been, I mean, this is the largest five-year increase of oil production of any country in history. That is a staggering turnaround from what the outlook was not long ago. And I think it is fair to say that if that had not happened, we would be facing a different oil price outlook right now.

Senator CANTWELL. I guess I would say I do not think that is a fair use of the taxpayer money to give these oil companies a huge tax break and now we are seeing a spike in prices. I would have preferred us to think about this issue of what can we do on the spare capacity side.

What more can we do if the SPR has infrastructure issues? The Chair and I were both very interested in making sure that we worked with Secretary Moniz at the time to increase the SPR infrastructure so that it was robust enough.

What about the way Europeans look at jet fuel? Why not look at creating more mechanisms for industry to have more spare capacity? They have a reserve as it relates to—we are not at that point yet, but definitely the last decade was a huge roller coaster for the airline industry because of high fuel cost. A lot of people lost their jobs, lost their pensions, lost everything because of that spike.

What can we do now if spare capacity is such a big issue that is controlled by somebody else, the Saudis, not us? What can we do?

Mr. BORDOFF. We do not have the ability that a company that controls its national oil production has to hold back spare capacity. The responsiveness of shale and the extent to which shale grows is determined by the individual economic decisions of thousands of independent actors throughout the United States. Companies hold some level of inventory that makes sense for them.

We have government held stocks which, I think, are more responsive than privately held stocks, when they are used by the government. But that is, again, sort of extraordinary circumstances.

So it raises the question of whether government's role is actually to provide oil price stability moving forward and whether there are other actions we can take to reduce how exposed our economy is because of how dependent we are on oil.

I will just make one—oh, sorry.

Senator CANTWELL. Go ahead.

Mr. BORDOFF. I was just going to make one other point which is we are, sort of, talking about to what extent shale can be a swing supply source and ramp up and down quickly and if it can, it can, sort of, vanquish the role OPEC or others could have. That comes at a cost, and I do not need to tell Senators here from oil-producing states, to U.S. communities. I mean, when truck drivers are making six figure salaries and then they lose their jobs, when the school funding base soars and then collapses. The volatility in oil output can be different for communities to manage even though it may have a benefit in stabilizing global prices.

Senator CANTWELL. My time, I am way over.

I would just say, yes, I endorse your statement that the best thing to do is get us off the roller coaster by diversifying off of oil. I endorse that.

In the meantime though, I do think we should be—I will write something for a question for the record, Madam Chair, on this issue. But I do think that Europe has looked at jet fuel as a specific way of increasing supply, so we will ask that for the record.

Thank you.

The CHAIRMAN. Great.

Senator Gardner.

Senator GARDNER. Thank you, Madam Chair. Thank you to the witnesses for being here today.

I wanted to talk a little bit about—I think the tax cut conversation is a fascinating one because, I think, in the context of other energy costs, if you look at utility rates, for instance, 101 utilities have cut their rates as a result of the tax cut. That is \$3 billion in savings to the American people as a result of those utility rate cuts. I think it is important to talk about all the ways that the economy has grown as well as people saving money because of the tax cuts in every Congressional district.

I wanted to ask you, Mr. McNally, a little bit about the concerns I have on state policies. There may be some efforts in Colorado this year to, once again, try to ban oil and gas production. The EIA estimates that in August we could have about 611,000 barrels of oil being produced in the State of Colorado. This is an incredible num-

ber. What happens if you were to see success in banning oil production in a state like Colorado with that level of production?

Mr. McNALLY. Thank you, Senator Gardner.

What we would do in that case is forgo an opportunity to avoid a real problem. If you look back to 2011 and 2012 when crude oil prices were \$100, gasoline prices were \$4.00 a gallon, we lost Libya and then we put sanctions on Iran. Spare capacity was really tight. The reason we didn't go back to \$150 a barrel in 2012 and '13, like we were just almost at in 2008, is because shale oil production, kind of, galloped over the hill and started ramping up just in the nick of time.

Now, even though shale is much more responsive and does act more quickly in response to prices, you have to have states that are open to the permitting. You have to have openness to the resources, to the takeaway capacity. It has to be well-regulated because shale oil, like all energy production, needs social license to operate.

But you don't want to have across-the-board bans. Had we had anything like that, we not only would have not had the cavalry save us in 2011 but maybe double-dipped into a recession, but we wouldn't have had the gas boom earlier which changed things in the Atlantic and made Russia, a force then, to loosen their price and power in Europe and so forth. So across-the-board bans would have deprived us of some of the biggest wins we've had geopolitically and economically in the last 20 years and, going forward, one would hate to think about what we would lose by doing something like that.

Senator GARDNER. Thank you.

Mr. Sadamori, if you could just talk about, perhaps a little bit, your take on the Nord Stream 2 pipeline and what effect that has on geopolitical security, particularly security in Europe, and what it could mean for Ukraine.

Mr. SADAMORI. I think I would like to refrain from making comments on the specific projects, but in general terms, we think that the gas supply security would be a very crucial issue for the European countries.

The fundamental question is how they can really diversify the supply in the real sense. Of course, that also comes to the issue of, kind of, transit routes. So whether they can secure the, kind of, a diverse supply security in that sense. I understand that the various discussions are going on at the various levels, so we would like to monitor the development.

Senator GARDNER. Does your organization take a look at the concerns that Russia may pose when it comes to energy deliveries to Europe and what that could mean for European energy security?

Mr. SADAMORI. Well, it may not be appropriate to talk about the kind of hypothetical, kind of, the situation but IEA recalled that in the G7 Energy Ministers Meeting there was an agreement by the Energy Ministers of the leading countries of G7 that the energy resources, energy should not be used as a weapon. And so, kind of a diverse, secure supply needs to be secured. I think that would be a very important issue for the global economy as well.

Senator GARDNER. I agree with that.

Has Russia used their energy as a weapon?

Mr. SADAMORI. So, I'm not talking about the specific behavior of a specific country. What I'm talking about is the kind of general agreement made by the—

Senator GARDNER. Would you consider shutting off a pipeline to a country, perhaps in the middle of winter, shutting down that supply, is that utilizing energy as a weapon?

Mr. SADAMORI. Well, the—I don't mean to talk about the real, the use of energy as, kind of, a weapon, but the recent history, back in, I recall, that was 2008 and '09 and then again 2014, that there were serious concerns on the European-consuming countries about the stable supply of their natural gas and that was in the middle of winter.

The gas was intensively, a lot was used for their purposes of heating the buildings and unlike the electricity who has other generation sources like the coal or other sources when it comes to, kind of, a heating based on the, kind of, infrastructure setting, it's really hard to find a replacement for other fuels. So in that respect there are, kind of, serious concerns on the European side and that led to the, kind of, intensive discussions inside Europe about how they can secure the gas supply security in the countries.

Senator GARDNER. Well, thank you.

I'm just—I am out of time, but I am concerned about the security of energy and I think we have seen one country use it as a weapon. That is Russia. To see Europe become more reliant on that is a concern.

The CHAIRMAN. Thank you, Senator Gardner.

Senator Smith.

Senator SMITH. Thank you, Madam Chair, and thank you to all of you for being here today, very interesting testimony.

As I listened to you it is really clear that we can see that production in this country has grown tremendously over the last decade and yet, obviously, we are still susceptible to rising prices because this is essentially a global market. You are talking about the issues around what we can do to effect prices on the supply side and then what we can do to effect pricing on the demand side.

Mr. Bordoff, at the end of your testimony, as Senator Cantwell remarked, you make a point that I think is really important. The best way to reduce our exposure to future oil shocks is by reducing our oil consumption in the first place. This seems to be such a timely observation given that we are wondering what the Trump Administration is going to do, their anticipated move to roll back fuel efficiency standards.

In Minnesota the strong efficiency standards that were put in place by the Obama Administration are estimated to have saved Minnesota consumers about \$650 million. In 2030, if those standards are left in place, the average Minnesota household will be almost \$3,000 richer. So it has a real pocketbook impact. Of course, it also creates jobs in Minnesota, because our state is a biofuels producer.

Could you just talk a little bit more, Mr. Bordoff, about the role that these vehicle efficiency standards can play in our ability to cope with higher prices?

Mr. BORDOFF. Yeah, as I said in my testimony—thank you for the question, Senator. The gasoline prices are set in a global mar-

ket so whether, regardless of how much we are producing in the United States, consumers are still going to face prices at the pump based on what is happening in the global oil market.

U.S. shale production can help as an additional source of supply and putting another 5 million barrels a day on the market certainly has. But fundamentally, reducing the energy intensity of the economy, I think, is what makes it most resilient to oil price shocks which are inevitable. That will happen. Bob wrote a whole book about it.

We are going to see prices go up and down and that is difficult for consumers to manage. They do not have the same ability to hedge prices the way airlines and large companies do. They do not have those tools available and that's difficult.

So I think policies that help reduce the energy intensity of the economy and improve energy efficiency are good for those reasons, economic reasons, as well as for the problem of climate change.

Senator SMITH. Thank you.

Does anybody else want to comment on that? On that question of what else we can do? Thinking about, particularly, the opportunities around keeping vehicle efficiency standards in place in order to help protect consumers from price increases?

Mr. AUERS. Well, I will say a few things on that.

I mean, efficiency standards are good, but as I made a point in my remarks, the free market and taking leases off of, you know, this wonderful thing that is the free market, allows them to innovate and increase efficiency. And they will do that on their own given the proper price signals.

The problem with having efficiency standards that are too regimented and too fixed, it can cause situations where we are not creating the optimal environment to make the most efficient decisions on, whether it is on fuel efficiency or anything else. So, you know, it is important to keep in mind to provide, to allow the market to do its thing.

I always look at how a football game or a basketball game is officiated. You know, government should play the role of an official, an official that is not flag happy or calling ticky tack fouls, but an official that keeps the game moving and allows the teams to become as, you know, let them make the decisions, sometimes—and not play the role of coach.

Senator SMITH. I am hearing your point, but I think the challenge is that the way the prices are set do not always include all of the externalities that are involved in the full cost of that price. So in your analogy, the market is not including all of those things. At first, this is an issue in Minnesota, at first glance, biofuels appear to be higher cost than oil, but if you consider the low-carbon fuel standard shows that if you look at these, if you account for all of those costs, the price is actually competitive. Of course, those costs are assigned to the market.

I don't have too much more time, but I think that is a really important point here.

Mr. Bordoff, I would love to follow up with you on this, I mean, what are the benefits to consumers and the environment if we adopt a California-style, low-carbon fuel standard in order to consider all of those issues?

Madam Chair, I know I am out of time, but I want to just note I am going to be leaving to go to the Agriculture Committee where we are going to be discussing how speculation is affecting oil prices and what we need to do to take a look at that. The Agriculture Committee is holding a hearing right now on the nominee of the CFTC Commissioner, and it is going to be one of the issues that we are discussing, so I appreciate that being raised here as well.

Thank you.

The CHAIRMAN. Thank you, Senator Smith.

Senator Cassidy.

Senator CASSIDY. Gentlemen, I just enjoyed your testimony, all of you.

A couple things just for the record.

In terms of selling the Strategic Petroleum Reserve, one of you mentioned that we have already sold off a portion of it. We have not sold it yet. Ed Markey and I have an amendment that allows the government to time the market to sell at high and replenish back low. Theoretically, I think it is 2023 that they currently plan to sell, but they can move it up now to take advantage of high market prices and kind of, if you will, win-win. A win for the taxpayer, but also to get the higher price now to do the repairs to the infrastructure that Madam Chair was able to put in.

Secondly, I also want to point out that Senator Cantwell asked what has the Tax Cut and Jobs Act bill done for this? I have been told by folks that companies have accelerated their pipeline construction that was planned for the early '20s into these current years because of the five-year depreciation. They are taking advantage of the Tax Cut and Jobs Act bill just to move these projects now, and so midstream is responding to our tax bill—so that would be one answer to Senator Cantwell's problem.

The other thing I want to point out is that the delay that occurred in the last Administration on the construction of the Keystone XL pipeline has definitely created a supply constraint. My Gulf Coast refineries use that oil from the Canadian tar sands and from the Bakken. The last Administration put in constraints, and now we are complaining about higher gas prices when it was the previous Administration's policy which has contributed to that. I also wish to point that out and we would not be talking about midstream constraint had there not been some of the strategies of the previous Presidential Administration. With all that said, I have used up two minutes.

Let me just explore something. I will note that when prices fell, part of the reason they fell is that overextended shale producers had hedged future production. They continued to produce even though prices were \$30 because they had hedged to sell, let's say, at \$60. And that, kind of, drove prices down.

We have now shaken out the production market—knowing that you know this, but just for context—we have shaken it out so the more efficient, those who had the cash cushion to get through the low price period, survived.

But in a sense, shale will respond as a swing producer because now that prices are up more fields will be developed, inevitably there will be some who will again hedge, but they will bring out—

Somebody mentioned or I read in my state, Austin Chalk, which is coming online and is going to be, at least in the near-term an intermediate, a new source of production which probably will, maybe, over-produce a little bit.

Any comments on the role of things like Austin Chalk and the OCS and these other fields coming online to lease in the intermediate, maybe six months from now, making some impact upon these high prices?

Yes, sir.

Mr. BRAZIEL. Well, Austin Chalk certainly will and the reason why Austin Chalk works is exactly the reason that you said is because the economic support in drilling in Austin Chalk and support drilling in Eagle Ford and Permian and all the other basins that I mentioned a few minutes ago too.

So, what is happening in the market is, in fact, giving us the response that we would expect.

Now, shale in the United States is not going to be a swing supplier getting to your four weeks, whichever one of you guys said four weeks has got a hit. Austin Chalk is not going to happen in four weeks.

Senator CASSIDY. Well, we really cannot expect relief, after say, Labor Day, because not only will the summer driving season be over, but the Russians going into winter, I understand, have to keep full production or else they freeze in. And then, some of these things like Austin Chalk will be, perhaps, hitting their stride. Is that a fair statement that we can expect after Labor Day some relief from this?

Mr. BRAZIEL. That is a fair statement.

And one of the things that has not been mentioned in this hearing so far is the forward price of crude oil at West Texas Intermediate and in Cushing, Oklahoma. That is the price that we have been talking about here, for the most part.

That price in five years, in 2023, is \$55. So going back to Senator Cantwell's question a few minutes ago of what's the price premium in the market for all these various uncertainties that we're seeing right now in the marketplace? I could make an argument that all of the uncertainties added up are a \$15 premium because if somebody wants to sell or buy crude oil right now in 2023, they will do it at \$15. Keep in mind then, back to your decision that you have to make about when you want to do something with the SPR, I tend to think SPR ought to be saved for some real crisis.

Senator CASSIDY. Well, we have only made the commitment to sell it. It has just not been sold if the Markey amendment and the Cassidy amendment has been adhered to.

Mr. BRAZIEL. My only point would be the price right now is \$70. The price in 2023 is \$55 on the futures markets.

Senator CASSIDY. So, now—

Mr. BRAZIEL. I was a trader for 15 years of my career. I would sell now.

Senator CASSIDY. You mentioned, Mr. McNally, that we are going to always be in boom and bust. On the other hand, plausibly, we can say that with the Keystone XL pipeline being built, the intermediate being built from the Permian and elsewhere, the mid-stream, and then I am told by the super majors that they are going

back out into the Outer Continental Shelf, that we are going to have significant production supply over the next one to four years which may account for the \$55 barrel but we may see some leveling off. Is that a fair statement?

Mr. McNALLY. Certainly, Senator Cassidy, that is a fair statement. I believe the IEA and others believe that the United States is going to be half or more of non-OPEC supply growth. So we took the lion's share since 2009, and we are going to take the lion's share as we build out this midstream infrastructure and connect it. Again, as long as we remain open to production and permitting, we can expect that to expand.

But if I may, on the SPR. I was never a trader. I worked for a hedge fund for 12 years and I never traded, but I am a student of history. In 1996, Congress and President Clinton last sold SPR crude for budget expenses in '97. At that time oil prices were on the high end of the range. They thought they were selling high, about \$26 a barrel. I was in the White House on the National Security Council after 9/11 and oversaw the refilling of the SPR at much higher prices.

I will predict and I predicted before—I am afraid, sir, that we may think we are selling high, but I predict we will put those barrels back in. We may have to buy them from the Chinese at higher prices after the next Gulf emergency. So I agree with Mr. Brazier, I think, not on the selling now. I think we should hold it for emergency, with respect.

Senator CASSIDY. Well, again, that decision to sell has already been made. It is just a question of timing of the market.

Mr. McNALLY. Right, right.

Senator CASSIDY. I have more questions but I am way over time, and I yield back.

The CHAIRMAN. Yes, some of us did not think that we should have sold.

[Laughter.]

Senator Manchin.

Senator MANCHIN. I agree, Madam Chairman.

I just want to make it as simple as I can. We are producing more oil than we have ever produced in the United States on a daily basis and that is an accurate statement, correct? Then for 40 years we froze our exporting ability of oil from '75 to 2015. We have opened that up since 2015 with twice the production that we have ever had.

The people back home in West Virginia are asking, how come our prices are going up if we are so enriched with all this new technology and all this oil and surplus? I have heard all the comments today. It is hard to go back home and talk to somebody in Maine or West Virginia and explain we are doing better than ever, we are producing more. Are we producing more to stabilize the global market of oil or are we producing for the benefit of the United States' market? Which one do you think is getting the best play on this?

Either one? Both of you all, yes.

Mr. McNALLY. Senator, as Jason Bordoff said, our pump prices in Montana or West Virginia are all set in a global market. So to answer your question, I would say we are exporting to stabilize the global oil market so that we may stabilize our own market.

It is all——

Senator MANCHIN. We tried to put an amendment on that. I do not know if you knew that, Mr. McNally. We tried to put an amendment on that that said if the prices spiked in the United States, our main customer and our main purpose, our constituency, is the United States and West Virginia, Maine, all of us here and Alaska too.

Where would you predict a spike that would concern us that the Americans are paying to stabilize the global market, Americans are paying a higher price than normal?

Mr. McNALLY. Which price spike led——

Senator MANCHIN. Yes, I mean is there a ceiling do you think we could break?

Mr. McNALLY. There is and when I think about the roller coaster and Space Mountain we are on, I am very worried about how we diagnose the price booms and sometimes the misdiagnoses. And I am concerned that if we, when we go back to \$4.00 or \$5.00 a gallon, we will say it's exports, but sir, with respect, I believe if we were to close that ban and ban exports, I think we would have less production and higher prices.

Senator MANCHIN. We are not saying ban it. We are saying basically when it hits a critical mass that concerns us that the Americans are carrying this load.

Mr. McNALLY. Right, yes.

Senator MANCHIN. And we are producing twice as much. We are asking people to accept the new in technology and production and more pipelines and everything that is going to benefit our economy.

Mr. McNALLY. Right.

Senator MANCHIN. And they do not see a benefit to them.

Mr. McNALLY. Yes, sir.

Senator MANCHIN. That is why we get to push back. We are very much concerned about that.

I want to move on to something very quickly on natural gas. In West Virginia, I think you know about the Marcellus, Utica, and now we have Rogersville that will come on. We have hit some pretty good opportunities and we are producing an awful lot of liquids. Those liquids are extremely valuable.

We also know that we are vulnerable down in the Southwest. Rick Perry and I were Governors together, and we were talking. He said, "Joe, I have seen a model with a horrific hurricane, a class five, moving up the Houston Channel, what it does and disrupts the energy chain and energy markets in America."

We are trying to get what we call a mid-Atlantic energy hub, storage hub, strategically. Do you all know enough about that? Have you looked into it enough, Mr. Braziel?

Mr. BRAZIEL. I have looked at it some, particularly in terms of ethane. I am generally familiar with what is going on with the ethane side.

Senator MANCHIN. Well, do any of you want to comment on what it would do to stabilize the energy markets in America, because we are very vulnerable and you know that every time we have weather hit down in the Southwest—we are not too prone to hurricanes in West Virginia, we have been blessed.

Mr. BRAZIEL. Anything that creates the optionality in the transportation system, the ability to go multiple directions with any particular hydrocarbon is a good thing. That is what the hub is going to do.

Senator MANCHIN. Yes, with all the natural liquids that we have, if we are able to help with the global supply even, because we are exporting that too and there is more and more coming on terminals where we can send the liquids out. Is that a benefit?

Mr. BRAZIEL. It is a benefit.

There is a new pipeline that is being built over in the Philly area that they are having a little trouble getting finished right now. So you want that pipeline to be finished relatively soon.

Senator MANCHIN. Yes, but we want to keep some of that product in our central states, in West Virginia, Ohio and Pennsylvania because we become the back-up, strategically, for our national interest and concerns, but also, we can create a whole new energy hub in that, chemicals, cracking and all these things that need to go in line with downstream.

Mr. BRAZIEL. It will all be. It will be a good thing.

Senator MANCHIN. You all—

Mr. BRAZIEL. The more storage you have is good and that is better—

Senator MANCHIN. We have all our eggs in one basket right now. Do you all agree that most of our energy eggs are in one basket as far as production, refineries, everything down in the Southwest?

Mr. BRAZIEL. Well, no. You are moving a lot of ethane down to the Gulf Coast right now on the Enterprise pipeline. So you have, that is one basket. You are moving a lot of ethane up to Canada right now.

Senator MANCHIN. Right.

Mr. BRAZIEL. So that is another basket.

You have some supply diversity, some demand diversity, I guess you would say.

Senator MANCHIN. If you all could, if you would look into the storage hub that we have been talking about and see how you think it would stabilize the markets and, I think, help the resilience of the United States' markets also.

Thank you, Madam Chair.

The CHAIRMAN. Thank you, Senator Manchin.

Senator King.

Senator KING. Thank you, Madam Chair, and thank you for calling this fascinating hearing and thank you all.

The most profound observation I ever heard about oil prices was back in the '80s from a professor at the University of Maine that said, "Oil prices in the future will always be the opposite of what you think today."

[Laughter.]

That has proven true, if you think about it. If we think prices will be high then two things happen: we have more drilling, and we have more conservation. If we think they will be low, we have less drilling and less conservation. People buy trucks instead of Priuses and that seems to be the dynamic. I remember that from 35 years ago and it has, sort of, carried through over the years.

A couple of very specific questions and we have a limited time, just like you did in your statements, so try to be as brief as you can.

One is, what is Saudi Arabia's cost of production? Anybody know?

Mr. McNALLY. Senator, I believe that would be, the cost of production, it would be in the single digits, \$5, \$10, \$12.

Senator KING. So they can sell oil at \$30 a barrel and make money? They just don't make as much?

Mr. McNALLY. Their budget revenues—their budget couldn't handle it. Their country would fall apart. They could cover their production costs at that, but they couldn't meet their social spending at that level.

Senator KING. But their cost of production is a lot lower than, for example, shale.

Mr. McNALLY. Yes, sir. Yes, sir.

Senator KING. Second question. Is there—

Mr. AUERS. I want to add something to that, though. That is true on existing production but on incremental new production, it is much higher.

Senator KING. It is higher?

Mr. AUERS. It is totally, you know—yeah, which is not different.

Senator KING. Are there estimates? Is there a limit to the shale oil production that we have or is it, sort of like, producible reserves? Is there any upward limit? Is there a finite capacity here?

Mr. BRAZIEL. Depends on the price.

Senator KING. Okay.

Mr. BRAZIEL. The higher the price, the more you can produce.

Senator KING. The more you can produce because less economic wells suddenly are economic.

Mr. BRAZIEL. That's exactly it.

And so, if the price does go to \$75, we'll produce more than if the price stays at \$68.

Senator KING. Okay, next one. Mr. Bordoff, maybe you can try this one.

Is taking Iran out of the market through sanctions priced into the market today or will it increase prices later on? Is the threat already priced in?

Mr. BORDOFF. To some degree, pulling Iranian oil off the market, I think, is priced in, but there is a wide range of views out there about how severe the impact of re-imposed sanctions will be from maybe half a million barrels a day up to 1.5 or 2 million barrels a day and that's why the signals from the Administration about how strict it will be in the enforcement of sanctions has an impact on the market.

Senator KING. But the testimony was there is very limited spare capacity so 2 million a day out may only be two percent of world supply but it would be significant in terms of price. Is that correct?

Mr. BORDOFF. If the re-imposed sanctions were to actually pull 2 million barrels a day off by the end of this year or next year, that would have a very big impact on global oil markets.

Senator KING. I think we can all agree that a disruption in the Strait of Hormuz would be a catastrophe of the level that we are

talking about the Strategic Petroleum Reserve being important. Is that correct? That is 19 million, I think one of you testified.

Mr. McNALLY. Yes, Senator.

If prolonged beyond a few days, it would be a genuine catastrophe.

Senator KING. What is the size of the Strategic Petroleum Reserve? How many million barrels?

Mr. McNALLY. I'm going to look back to smarter colleagues. I believe it's, 670 million barrels is the latest, 670 million barrels in the U.S. I do believe we have sold off a little bit of that over the past few years. We were a little over 700 at the top, so we're just down about 670 million barrels.

Mr. BORDOFF. I think it's, yeah, about 650 million in the recent GAO study that was commissioned with sales projected to bring it down to just over 400 million in a decade.

Senator KING. So Strait of Hormuz, I am just doing the arithmetic, would be about a month.

Mr. McNALLY. Senator, if we think about that, though, it's not the stockpile, it's the flow rate. So Strait of Hormuz is 19 million barrels a day. We average, DOE says it can flow at 4 million barrels a day. So there are questions we can do that. We can't cover the Strait of Hormuz.

Senator KING. So even the Strategic Petroleum Reserve is not instantly fully—

Mr. McNALLY. No, no, sir. Not even with the IEA, Japan and Germany coming in, we could not cover the Strait of Hormuz. We could cover Iran at 2.5 million barrels a day, but not the Strait of Hormuz at 19 million barrels a day.

Mr. BORDOFF. And if I may, I would just say that is part of the reason the modernization of the SPR for which a little bit was sold and funding has been made available is important to increase that flow rate.

Senator KING. And the flow rate is a technical constraint?

Mr. McNALLY. It is technical, yes. We built the reserve and we pointed the pipes north because we thought we would be taking oil off. We would be blockaded or embargoed from the water, and we would have to feed our refineries.

Now we need to export that oil mainly and get it out. So we have to move the pipes around, but there has also been degradation in the logistics and so forth, so that gets into it as well.

Senator KING. Now when we are projecting global demand, what do we think about electric vehicles and conservation? I mean conservation and electric vehicles have moved faster than people thought they would. I think, as you mentioned, the principle use of petroleum is transportation.

Mr. McNALLY. Yes, sir. We have our eggs all in one basket, and transportation—it is all about oil.

Jason Bordoff's Center on Global Energy Policy just came out with a fabulous study done by Marianne Kah that looks at 15 forecasts from government and others about electric vehicle penetration and it casts some—I'll let Jason perhaps speak to it as well, but there is some skepticism about maybe we are being a little too optimistic about how quickly batteries will fall and consumers will take them up.

You know, folks say that if you took a picture in 1910 and 1912 in Manhattan you would see horses in one and cars in the other. Why can't we do that? Well, the reason was we developed an energy source and a technology that consumers found affordable and took up really quickly and EVs are not there yet. They may be, but they are not there yet. So there may be a little bit too much optimism in some of our official forecasts. We all hope we get there, but I think we should be pragmatic. We were on horses for 5,000 years. We may be on oil for a little longer than folks think.

Senator KING. Mr. Sadamori?

Mr. SADAMORI. As for the contribution for the EV, the central scenario of the World Energy Outlook last year, 2017, assumes that the EVs will expand rapidly to 300 million vehicles by 2040. But the displacement of oil will be limited to 3 million barrels with that per day, with that.

So we expect a lot more contribution—

Senator KING. Going to 300 million in electric vehicles would only result in a diminution of 3 million barrels a day of oil?

Mr. SADAMORI. Exactly.

And also, I need to point out that so, all in all, the personal duty, light duty vehicle oil consumption may decline a bit, but the heavy-duty trucks, ships, airplanes and also petrochemical feedstocks, all in all, we expect that it's really hard to see the oil demand peak before 2040. That's the conclusion from the real central scenario.

Senator KING. I am out of time, but just one more question.

What is the proportion of transportation versus petrochemical feedstocks in the use of oil today?

Mr. SADAMORI. At this moment, transportation is, by far, the largest demand in oil and—

Senator KING. Petrochemical, 70 percent, 80 percent, 60 percent?

Mr. SADAMORI. Excuse me, I need to go back, but it's something like 60 percent in the transportation sector and the 30 percent also in the petrochemical feedstock. I will get back to you the precise number.

Senator KING. Thank you, Madam Chair.

The CHAIRMAN. Thank you.

Senator Daines.

Senator DAINES. Thank you, Chair Murkowski and Ranking Member Cantwell. Thanks for having this hearing.

In Montana, the average price of fuel is around \$2.70, \$2.80 a gallon which is similar to, probably a little lower, than the national average. For most Montanans, fuel prices are their main interaction with global oil prices and when you are in an ag-rich state like Montana, our number one economic driver. We talk with farmers and ranchers about inputs and outputs, fuel price is a very important input, not to mention impacts on fertilizer and so forth as well.

For Montanans working at oil fields in the energy sector, global oil prices can determine if they are coming to work tomorrow or not. So this is an important issue for a state like Montana.

I am very thankful for the work of this Committee and my colleagues in the U.S. Senate as we were able to lift the crude oil export ban, finally approve leasing area 1002 in Alaska, working to reduce some burdensome and only-adding-costs kind of regulations,

as well as tax reform. All of this has led to an important boost in U.S. oil and gas production and this is moving us to a very aspirational kind of goal which is not just energy independence, but truly, global energy dominance.

As I travel around the world in the capacity I have today, as well as I used to do in the private sector, I really believe there are three long-term, competitive differentiators to allow the United States to win when we think about competition with China, Russia, the EU, and other nations as it relates to global economic competition. We win because of the rule of law, we win because of freedom, and we win because of energy.

It is a unique differential we have here where we really can be not only self-sufficient, but isn't the world going to be a much, much better place if we reduce the dependence on the Middle East and reduce the dependence on Russia where we see 30 percent of their energy needs for Europe coming from Russia, 50 percent of Germany's?

The U.S. and our European allies should not be dependent on oil from Russia. It is not a good thing that China is dependent on oil from Russia and the Middle East when we are able to produce it right here in the United States and even in places like Montana. This not only will stabilize prices, it makes the U.S. and our allies more secure.

Many of us remember growing up in the early '70s and the Arab oil embargo and what that did in shocking our economy, shocking the world's economy, to having that insular removal from those shocks because of our significant, revolutionary increase in oil production. This is a very good thing for our economic and our national security.

This hearing is focusing on the impact of global oil prices. As I look at it, I see this as more of a supply and a demand issue. We are seeing a robust economy. We are seeing more Americans traveling. They are spending more money, and that is a good thing. They have more money in their pocketbooks. This leads to more demand, and the best way to check a rising price is to produce more.

The U.S. WTI crude price is already lower than the global Brent crude price. With increased U.S. production we can continue this trend creating lower prices at the pumps for Montanans.

Mr. McNally, I am particularly interested in how the U.S. can play a larger, more beneficial role in lower oil prices, as well as geopolitical trends. Many oil-producing countries also tend to be less stable, more volatile or have ulterior political aims, sometimes adversarial aims. This can cause dramatic shifts in prices as we saw, as I mentioned earlier, in the '70s, in the '80s and even the early 2000s.

Mr. McNally, do you believe that with a more active U.S. production and exporting of oil to our allies the U.S. can play a stabilizing role in global oil prices?

Mr. McNALLY. Senator, thank you for that question.

Absolutely. The history shows, again, our windfall in natural gas which is where the shale boom first started, utterly turned around what we were looking at when I was in the White House in 2003, becoming dependent on Qatar, becoming as dependent on the Middle East foreign gas as we were oil.

That changed completely to where now, it is unfortunate that the Germans are becoming more and more captive to Russian pipeline gas, but at least our gas exports or our refusal of those imports and making them available to Europe has weakened Moscow's ability to impose prices on Europe and that is unambiguously a good thing.

Lithuania and other countries and the Obama Administration were quite powerful on this, and the Bush Administration and the Trump Administration seized those geopolitical benefits.

Same thing with oil. Again, the galloping of shale oil over the horizon in 2011–12 prevented a return to \$150, in my view, because the market was getting really tight and disrupted at that point.

And we can expect those types of things going forward as we look at confronting a dangerous actor like Iran or Russia. Our allies are more likely to support the United States if they can be reassured, not just that we have a strategic stockpile, and I hope we do not sell all that off, but that we have and we keep open a production ability and export facilities that we supply that diversity which is the key of energy security.

Senator DAINES. Thank you.

I have a quick question for Mr. Braziel.

In order for the U.S. to meet global demand I believe we need to invest more in energy infrastructure, including pipelines and refineries. Having spent a career, I studied chemical engineering and I have been involved in manufacturing and operations most of my life.

Back to constraints—you are only as good as what the constraint is as you look at a supply chain. What do you believe we need to do to get these projects up and running and relieve any of these bottlenecks that stop us from getting oil to markets, both refined and crude?

Mr. BRAZIEL. Most of the bottlenecks that exist right now actually exist for commercial reasons. There certainly are regulatory issues that could be addressed, but in fact, what really happened is that the crude oil market did not look to be nearly as strong as it turned out to be over the last two years. Remember, two years ago when we would have had to start building those pipelines, crude oil prices were a lot cheaper. So, what happened was a lot of producers just did not sign up, a lot of shippers did not sign up for those new pipelines. They did sign up, those pipelines are now being developed as we sit here today, but like in the Permian where the biggest constraints exist, it is still going to be about a year or so before those pipelines get built and there is very little that the federal or the state government can do in order to expedite that.

What we can do in the future is make sure we do not get caught in that situation again and make sure that the companies involved have the right tax incentives, have the right regulatory structure in order to be able to build pipelines as fast as possible.

Senator DAINES. Thank you.

Thank you, Madam Chairman.

The CHAIRMAN. Thank you, Senator Daines.

Senator HIRONO.

Senator HIRONO. Thank you, Madam Chair.

Earlier in this hearing there were references to the positive effects of the huge tax cuts for the richest one percent of people and corporations in our country. It was noted that most state utilities have cut costs to consumers, but they did so because they were required by the regulators to pass on the benefits of the tax cuts to their consumers. Whereas in the non-regulated entities, i.e., corporations, they have not done anything of the sort. They have not raised wages. They have bought back their stock, et cetera. I just wanted to make that note.

This is a question for Mr. Bordoff. Hawaii has the highest gasoline prices in the country. It is around \$3.78 a gallon in contrast to what Senator Daines said about the cost in his state.

I am particularly concerned with proposals to stop progress on fuel economy standards that can save drivers \$8,000 over the lifetime of a new 2025 vehicle. However, according to press reports, later this week the Trump Administration will propose to freeze vehicle fuel economy standards at the 2020 level and seek to revoke California's authority to set automobile emissions recognized in the 1970 Clean Air Act.

Mr. Bordoff, what effect would freezing fuel economy standards have on consumers in the U.S. and the overall effort to find alternatives to our national dependence on oil that you called for in your testimony?

Mr. BORDOFF. Thank you for the question, Senator Hirono.

It would slow those efforts. Rising fuel economy standards, I think the evidence to date shows, can be achieved without significant economic harm and driving up the price of vehicles beyond the benefits, both to consumers and the social benefits of reducing oil demand and greenhouse gas emissions. So it would slow that transition.

I also would just observe that I think this is, I do not think it is good for consumers, making decisions about long-term investments in where they live and what kind of car they are going to buy. These are things they think about in the long-term, not to mention automakers who need to plan for the long-term.

So we are going to move to a position where, potentially, we try to remove California's authority. I think 12 or 14 other states have joined California. There is going to be a period of litigation about the authority to do that. This creates several years of uncertainty for consumers——

Senator HIRONO. Yes.

Mr. BORDOFF. ——and for the industry about what these standards are likely to be and whether there may be two different standards across different parts of the country.

I think it would be more constructive to bring everyone together as the last Administration tried to do and try to find some compromise to figure out how, in a cost-effective way, we could continue to help reduce the oil intensity of the economy and encourage options and alternatives.

Senator HIRONO. So you would say that the Administration's proposal to freeze these standards, that's really not getting us to where we need to be?

Mr. BORDOFF. I think it is—I don't think it is a constructive course forward to roll back the fuel economy standards that have been planned.

Senator HIRONO. This is a question for the panel.

I realize that oil prices are set on the world market so in an interview with CNBC, aired on Friday, President Trump stated he was willing to place tariffs on all goods imported into the United States worth some \$505 billion last year. I think that you all have recognized the geopolitical effects of these kinds of trade decisions.

But my specific question is, what impacts would such tariffs have on the cost of construction in the oil and gas industry, the willingness of the industry to make new investments in the United States and the price faced by consumers at the gas pump? Any of you care to respond?

Mr. AUERS. I mentioned, again, as an example you mentioned on the midstream side, three quarters of all of the steel that is used comes from overseas, primarily because it is not available locally. And the refining industry is the same way, if you have a direct negative impact on project viability from tariffs on imported steel.

But the worse thing, as I mentioned, was if this led to a world trade war, you know, that carries very negative implications for economic growth both domestically and internationally and that's the biggest threat. So, yeah, it is bad news—to try to do what we can to get others to play fair but we have got to be careful on how far we go.

Senator HIRONO. Would the rest of you agree with that—that there are unintended consequences to these kinds of comments and pronouncements from the President?

I think what I get from what all of you are saying is that we are trying to go for stability here in this market as well as what is going on in our own country and that is not really what is happening now.

Thank you very much.

The CHAIRMAN. Thank you, Senator Hirono.

Mr. McNally, Mr. Braziel, both of you mentioned the IMO 2020. In fact, Mr. McNally, you said that was a whole section of your talking points that you were not able to get to due to time constraints. So I will give you that opportunity now.

I also referenced the IMO, International Maritime Organization's, low sulfur standard. This is set to take effect in January 2020. The standard will reduce sulfur limits in marine fuels, and we certainly look to the environmental impacts, the positive impacts on health. But I think the concern that is out there is that compliance is not moving along at the expected rate which could pose a burden going forward.

Since we are talking about where do we go from here, those unknown factors or perhaps those things that are out on the horizon that may have some unintended consequences—I would like an opportunity to talk a little bit about them this morning.

Can you walk us through the IMO 2020 standards, the options for compliance and what it might mean for the middle distillate markets? And then whether you share the concern that I have raised that we could potentially see some price impacts, increases where we, perhaps, might not expect it whether it is in my state,

for those who rely on diesel for heating or power or transportation, or the folks in Pennsylvania that rely on home heating fuel. Can we have a discussion about this IMO 2020?

Mr. MCNALLY. Thank you, Senator.

Yes, the oil industry and market has been preoccupied with this issue for the last several years. A subject for a whole afternoon's discussion, but in January 2020 the limit on sulfur emissions, for what we call marine bunkers, so fuel used in heavy ocean-going ships, this is across the ocean now, will fall from 3.5 to 0.5 percent sulfur, so very, very clean. There are two options to comply, really.

One is to put a scrubber on your ships. So you could still use the dirty stuff, but you scrub away the sulfur emissions. Folks agree the shipping industry has not nearly installed enough scrubbers, and it is too late to put on scrubbers. A small fraction of the ships are going to have scrubbers.

So the most likely compliance option is to get cleaner fuel in your ships. We are going to see a scramble away from what they call heavy fuel oil, what they have been using now, that bottom of the distillation column, that heavy, gunky fuel oil, 3.5 percent sulfur, 2.5 percent—they are going to stop using that and they are going to go and they are going to put lighter, much lower sulfur diesel, mainly diesel fuel, in their ships to comply. There is no phase-in. There is no credit trading. It is overnight. You have just got to comply in January 2020.

There is a concern, and I know the IEA has raised this concern in their reports, that the industry is unprepared. We have not seen the scrubbers being built and we do not have, at the global level, the equipment to make enough low sulfur fuel.

So part of the solution, unfortunately, will be the shippers coming to the folks who are currently using low sulfur distillate, home heating oil consumers, road diesel users, farmers and their tractor equipment, railroads, airlines—this is all the same kind of fuel. We have already gotten that to be really clean. And they will say, you know what, we do not have enough. We have got to comply. We need to bid it away from you, and that will cause price increases.

I think the IEA has indicated they expect a 20 to 30 percent increase in the price of distillate next year. Others have raised the concern that the actual crude price could go up because the refining industry will, sort of, scramble to run more crude through the refineries and they are already working pretty hard to make more distillate.

So while the environment will benefit, while human health will benefit from getting this sulfur off of these ships, and our complex refiners in the Gulf Coast especially, they are going to do very well because we specialize at making this high quality, low sulfur distillate.

Some folks are going to do very well. But for consumers, I think there is a real risk that for a period of years now the lack of preparedness for a January 2020 start date will lead to a substantial spike in the price of consumer fuel onshore.

The CHAIRMAN. So potential for 20 to 30 percent increase. You factor this on all of the other global uncertainty, the potential for disruptions, that is not a very cheery way to end this hearing.

Mr. Braziel or Mr. Sadamori, do you want to comment in terms of what we might be able to do to avoid these increases?

Mr. BRAZIEL. The problem is exactly as Bob mentioned. It is the fact that we are going cold turkey on a particular day. If this had been phased in, both the shipping industry and the refining industry would have been able to accommodate things.

So I think what has everyone concerned right now is they are going to wake up on January 1, 2020, and the rules are all going to be changed. If there was some way to be able to mitigate that and, frankly I think there probably will be a way to mitigate that, there is probably going to be so much non-compliance that there will have to be some sort of accommodation made.

I think that is likely, and John and I have talked about it some. I think John has numbers figured in like 25 percent non-compliance into the plans that Turner Mason has put together. We think the same thing is going to happen.

Ironically, what it does is it makes light crude, shale crude, more valuable and heavy crude, like Canadian crude, less valuable. So it is actually a good news story for U.S. producers.

The CHAIRMAN. So it helps us in the United States.

Mr. BRAZIEL. In the United States, for producers, it actually helps us.

The CHAIRMAN. Helps the producers?

Mr. BRAZIEL. Helps the producers.

The CHAIRMAN. Not necessarily helping the consumers.

Mr. BRAZIEL. If you have folks in your state driving diesel, you need to be prepared for what you need to say to them because their diesel prices are going up on January the first.

The CHAIRMAN. Well, and that is my state. People in Alaska would look at this and say, well, wait a minute, this is July 2018. You guys have plenty of time to figure it out. Figure it out.

Mr. Sadamori?

Mr. SADAMORI. I agree with the other witnesses' views. So we also understand that not enough investment is happening on the kind of ship, the scrubbers.

There is another option using LNG as the fuel for the maritime, but it takes time and also requires an enormous amount of infrastructure investments.

What will probably happen at the start of this new regulation will be, kind of, the industry of the world will rush for a limited amount of low sulfur fuel oil and also the maritime diesel.

By the way, this low sulfur fuel oil will probably have to depend upon the, kind of, same molecule as the maritime diesel. So there will be, kind of, a mismatch in terms of the refineries procurement of the certain types of crude.

There will be—so we expect that even though we have not come up with any specific kind of numbers, percentage of oil price increase, that we don't do, but we expect that there will be a very, kind of, tight supply-demand situation on the very specific types of the crude fuel. That is what we are, kind of, concerned about and we try to keep track of it.

Thank you.

The CHAIRMAN. Well, coming from three maritime states here, Washington, Maine and Alaska, we will clearly pay close attention to this.

Mr. AUERS, did you want to add anything to this? You were referenced earlier?

Mr. AUERS. Yeah, I agree with what Rusty said and what the other panelists have said. I mean, we are definitely going to have a bump in distillate prices. It will cause a bump in crude prices, but then there's headwinds that will potentially bring those crude prices down. So where crude price is at is difficult to say.

Our view and, you know, it's purely a guesstimate as to what's going to happen in 2020. This is really the first, global-wide product specification change. We have had low sulfur gasoline, low sulfur diesel in the U.S. and Europe and other countries in Asia and other places. This is a global-wide specification change that is impacting 4 to 5 million barrels a day of bunker fuel. And so, it is going to have a huge impact on the market and there are provisions for waivers. I do agree with what Rusty said that the market will work itself out when they see the problems that are going to happen, I think we are going to see use of some of that. I mean, the IMO is the one that has to, obviously, take action. And we will probably see some steps taken by the IMO. And the U.S., as a member of the IMO, certainly can have a voice in that, to help provide some sort of way of phasing this in because there is going to be a disruption unless something is done.

And some of it is going to come and, our number at 25 percent reported on non-compliance, that is a guess, you know, it could be higher, it could be a bit lower, but it is going to be substantial because there is not a real uniform enforcement mechanism in the open water.

The CHAIRMAN. Yes.

Mr. AUERS. Every country will need to enforce it on their own. It is going to be enforced by the U.S. and Europe, but who knows what is going to happen everywhere else.

So that—

The CHAIRMAN. My time is well over but, Mr. Bordoff, you wanted to jump in here real quick?

Mr. BORDOFF. Well, if I may, I was just going to say I agree in part. I think there are a few mitigating factors. First, we should not forget the significant public health benefits that come from reducing SO2 emissions. The increased demand for diesel is coming at a time of some headwinds for diesel demand globally as cities move away from diesel. And third, the industry has known about these rules for many years. Some have taken further steps than others to prepare, including many U.S. refiners and U.S. shippers. I think injecting an element of uncertainty about delaying them now could hurt the companies that have taken steps to prepare and just injects an element of uncertainty now where people are starting to get ready for this and then maybe they should wait and maybe they are not sure. That could actually worsen the transition period.

As Rusty said, if it is not the case and the rules are far more disruptive than we think, the IMO has the authority to issue waivers in case of lack of availability of low sulfur fuels. And, you know,

like with new pipelines being built in the Permian, it takes a year or two so there will be a period of adjustment, but I think history suggests that these often resolve themselves in response to price signals more quickly than we think they will.

The CHAIRMAN. Hopefully.

Senator Cortez Masto, we have done a full round and we are starting round two, but we can interrupt and go to you.

Senator CORTEZ MASTO. Thank you, thank you so much, Madam Chair and Ranking Member, for this incredible discussion.

I am bouncing between two hearings, so I appreciate the opportunity to read your comments beforehand as well.

Let me jump back to Mr. McNally. I know there was some discussion of this. In your testimony you discuss the energy impacts of widespread usage of automated vehicles with estimates ranging from a 60 percent decline in energy use to a 200 percent increase and that largely depends on which fuels AVs would use, oil or electricity. Could you elaborate on what factors contribute to such a large estimate range, and what policy recommendations would you make in this situation to keep energy costs on the low end?

Mr. McNALLY. Sure and thank you for that question.

So when we think about, sort of, robo cars or automated vehicles showing up, I think in the first instance we have to realize this will provide transportation services to people who do not have them or do not have them easily. People who are housebound who do not want to walk to the bus and so forth. It will vastly expand, probably, demand for transportation. Now it will be more efficient transportation, it will be wired, but there will probably be a big increase in demand.

So the ease and the convenience and the lower cost of travel, remarkable, I do not have it at my fingertips, but the—if you ever took a look at a chart of the percent of Americans who are of driving age but do not have a driver's license—I do not have it off the top of my head, but it is a big number. And so, we have to imagine that will be opened up.

Now the question then becomes, what will fuel these vehicles? Will they be electric, which I think most people think or hope, in which case we can expect big climate and environmental benefits as long as we are producing that electricity cleanly. But there is the real risk, and some of the researchers at NREL and other government labs and academics have looked at this and said, well, it is not a guarantee that we will figure out EVs before we figure out AVs. So if that robo car, showing up in front of your aunt's house or my aunt's house, which she's delighted to get in, is a diesel or a gasoline car—remember the oil industry and the car industry is always getting more efficient, they are not standing still, they are getting more and more efficient—then we could see that 200 percent, that explosion in fossil fuel demand. And that would, sort of, upend our consensus forecast of the, sort of, decline in oil demand and it could actually go like this because once again, like back in 1912, we discovered a new technology that made the blessing of transportation even cheaper and easier for people.

I would be happy to point some studies your way, and others on the panel may have them as well, that go into more detail on this.

Senator CORTEZ MASTO. You have talked a lot, and I think all of you have, about the geopolitical risks. To lessen the geopolitical risk, is it fair to say that if we were to go down the path of electric vehicles more so than anything else, that would lessen our dependence and address some of the geopolitical risk we are seeing?

Mr. McNALLY. I don't think so, near-term. There is not a lot we can do in terms of energy transformations near-term, meaning the next weeks, months, years, unfortunately, probably decades. Energy transitions just take decades, unfortunately.

So, I think as we, for our lifetimes, in the foreseeable future, I think we have to look at other things, strategic stocks, removing—

Senator CORTEZ MASTO. But I am talking long-term. I get today.

Mr. McNALLY. Oh, long-term.

Senator CORTEZ MASTO. What we are talking about here is long-term.

Mr. McNALLY. Long-term, I'm going to bet that we will be off of oil. We will have that transformation, like we had from 1908 to 1915, but it will not be because of government policies or a winner that government picked. It will be because ingenious inventors will have figured a new energy source. It could be hydrogen, which is what we worked on in the Bush Administration, it could be electric, it could be biofuels, it could be something we have not thought of yet, and a new technology that will give us that transportation in a better way. When that happens, government will just stand out of the way, and it will flower very fast. I am not smart enough to know what it is though.

Senator CORTEZ MASTO. Thank you.

Thank you, Madam Chair.

The CHAIRMAN. Thank you.

Senator Cantwell.

Senator CANTWELL. Mr. McNally, did you want to put a date to that?

[Laughter.]

Mr. McNALLY. I hope my grandchild sees it, Senator.

Senator CANTWELL. Okay.

Well, I think the issue for us in Washington, since we are paying, I think, \$452 million more this year than last year, is the roller coaster that you have all described and how we continue to diversify from our fuel sources and get off of it.

So for us, because we have very affordable electricity as it is today and a very high percentage of our consumers driving electric cars, I think we see the transition in the Northwest, some great companies, even in the trucking industry, like PACCAR, making great energy efficiency moves. So we are definitely going to go as fast as we can.

I wanted to ask Mr. Bordoff—I asked in my opening statement about the high volume of trading that is going on and whether that is something we need to take a look at.

I think the volume of West Texas Intermediate trade has dramatically increased over the last five years. I think they have seen something like a 276 percent increase in the number of trades per minute.

Is this something that the CFTC should be looking at and just making sure that the automatic trading process is not creating some spikes in or distorting the market from true supply and demand fundamentals?

Mr. BORDOFF. Thank you for the question, Ranking Member Cantwell.

So this is not an issue that we have studied carefully. I will caveat with that. It is true that algorithmic trading activity has increased significantly in commodity markets, commodity derivative markets, since 2008 as in many other financial markets. I think the behavior of this type of trader, the implications of this type of market participation certainly merits further research. I think it has been limited to date, in part by poor data transparency. I am not aware of studies on this issue.

Anecdotally, I have heard market participants suggest a view that algorithmic trading may lead to sharper commodity price swings and volatility. There was a research note from City Group just a week or two ago noting that some of the recent sharp sell-off in crude the week before seems to have stemmed in part, at least in part, by some element of machine trading.

I will note, I think it is important to recognize that even if algorithmic trading leads to greater, very short-term price swings in traded benchmark crude prices, my colleagues may have a view on this too, that does not necessarily mean those price moves affect the price of physical barrels paid by refiners and, therefore, the price we are paying at the pump. So I think that, too, would be a question worthy of further study.

Senator CANTWELL. Well, I was just going to say before Mr. Brazier raised his hand, I will bet you he does have something to say about this because I think those who have been in the business have seen the unbelievable actions of the financial markets have grave impacts.

Mr. Brazier?

Mr. BRAZIER. Yes, I mentioned earlier I spent 15 years as a trader, so I have kind of been on the other side of this thing.

More trading volume in a futures market in any kind of electronic market is actually a good thing. It is because it creates more liquidity in that market, so the market becomes more responsive to supply and demand.

And getting back to what Jason was talking about, you want your financial markets to be reflective of what goes on in the physical markets. The higher level of volatility, the higher level of trading that you have, the more likely that will be. The volatility comes from what is going on the supply-demand scenario itself that we've been talking about all morning.

In terms of the electronic trading, the algorithmic trading, the changes that happen, happen in seconds. So whenever EIA kicks out a new statistic, the price might jump a few dollars because of the algorithms getting in there, but that impact goes away very quickly. From the CFTC's perspective, they certainly may need to look at it; but from a market perspective, like what we have been talking about this morning, it's pretty much a non-event.

Senator CANTWELL. Okay.

We will definitely follow up with the CFTC. I know they have had one case already where they had a settlement where they were concerned about somebody impacting that. I think the thing that we have learned is the tighter the markets, the more you want to have transparency to make sure that they are not affected.

Madam Chair, thanks for the hearing this morning. I definitely think there is a lot to do to continue to focus on this issue. We certainly need to make sure that we are having, I think, our colleagues have done a good job of bringing up these other issues of investment for the future. So I hope that we will look at that, maybe as a follow-up hearing.

The CHAIRMAN. I appreciate that, Senator Cantwell.

Senator King, you had a follow-on?

Senator KING. I wanted to, sort of, bring it back to why we are here.

In Maine, a \$1.00 change in oil and gas prices is \$1 billion out of our economy, and we are a relatively small state. Those are the kind of numbers that we are talking about that are really, really significant, and I just think it is important to remember that.

And I thought it interesting, Senator Daines said if the price is going up, the only thing to do is to produce more. No, actually there are two things: one is to produce more, the other is to use less and that will affect price just as surely as an increase in production. So I think that is something we need to keep focusing on.

What worries me is the roller coaster that we started with. I am not a great believer in government intervention in these things, but I think we do need to think about the policy implications and the long-term price implications of the things that we do that increase the volatility because that translates to people's ability to buy groceries rather than gasoline. I just think it is important to continue to ask those kinds of questions.

I thank the witnesses. This has been a very informative and important hearing.

Thank you, Madam Chair.

The CHAIRMAN. I thank you for that add-on, Senator King.

I think we recognize that there are some things that we can control and some things that we cannot control. You cannot control some of the volatility that you see with political issues in other nations.

There are some things that are well beyond our control, natural disasters that bring about shortages that you could never predict, but there are policies within our own government that we can look to critically.

While sometimes we are not able to accurately predict all of the consequences that are unforeseen, or unintended consequences that are out there, I think that that is part of our job to try to reduce the volatility to the extent that it is possible. Being cautious and careful and, perhaps, thoughtful and moderated in our policies is not a bad approach.

Gentlemen, thank you for your contributions this morning. I think that this has been a very informative hearing. You have helped round out our thoughts here as members of the Committee, and I appreciate what you are doing in this broader and more glob-

al discussion that has such immediate impact on our constituents, whether from Maine or up to Alaska.

With that, we thank you.

The Committee stands adjourned.

[Whereupon, at 12:07 p.m. the hearing was adjourned.]

APPENDIX MATERIAL SUBMITTED

**U.S. Senate Committee on Energy and Natural Resources
July 24, 2018 Hearing: *Factors Impacting Global Oil Prices*
Questions for the Record Submitted to Mr. Keisuke Sadamori**

Questions from Chairman Lisa Murkowski

Question 1: After listening to testimony from the hearing on July 24, there should be no question in anyone's mind about the role and significance of U.S. production in global markets.

- Can any of you comment on the level of impact that greater U.S. production has had, and is having, in terms of calming markets, restraining prices, and providing critical supplies to meet global demand? Where would we be without an increase in U.S. production?
- How does the IEA see the significance of the United States as a leading oil producer?

The growth in US production in the past decade has been an extraordinary phenomenon. Few analysts accurately forecast its growth spurt from 2008 onwards; few analysts forecast its resilience when oil prices started to fall at the end of 2014; few analysts forecast how strong the second growth spurt would be.

If there had been no growth in US production from the 5 mb/d seen in 2008, and assuming no different outcome to supply from other countries and the same level of demand growth as we have seen, global oil production capacity would have tightened considerably and increased the risk of sharply higher oil prices.

We should not forget the beneficial impact of the lifting of the crude oil export ban. This reform has allowed US crude to compete in global markets, offered greater diversity of supply to foreign customers, and benefitted the whole oil supply chain in the US. In the next few years the US will be the leading source of production and export growth in a world that will need this oil.

The oil production growth realized in the U.S. between 2014 and 2017 has not been highly geographically varied – as was pointed out in the hearings testimony, production growth has primarily occurred in the Bakken, the Anadarko, the Eagle Ford, the Niobrara, and the Permian.

- This administration has focused on the development of American energy in the OCS, NPR-A, the 1002 Area, and other federal areas. How will these developments, and the broader change in policy to push for more supply, lead to a more positive outlook for future prices?

Making new acreage available to companies could lead to more investment and production further out, but it is currently uncertain if there is industry interest to explore and develop these resources.

Question 2: The International Energy Agency and a number of analytical firms have warned that industry is underinvesting in exploration and development, which could lead to a supply crunch that significantly increases prices. IEA has warned that this could happen in the early 2020s, and another firm, Bernstein Research, recently warned that this could result in a “super spike” to \$150 a barrel.

- How real of a challenge is underinvestment in exploration and development?

The IEA calculated that each year about 3 mb/d of production capacity is lost to natural declines in mature oil fields. This is about the same as the volume of oil produced in the North Sea. So, significant investment is required merely for production to stand still, let alone to cover robust demand growth. Also, some

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countries with significant oil reserves are not easily accessible to international oil companies for a variety of reasons and their potential is unrealized (e.g. Venezuela, Iran, Libya).

In recent years, oil prices have fallen from more than \$100/bbl in mid-2014 to below \$30/bbl in early 2016 and oil companies are understandably cautious about committing significant funds to investment, even as prices have recovered and costs have fallen. Today, spare oil production capacity is estimated at just over 3 mb/d and global oil demand will grow on average by at least 1 mb/d each year for the next decade or so. There is a clear need for more investment to prevent the spare production capacity cushion being eroded and thus posing a risk of higher prices that will damage the global economy.

- What steps can we take to promote the reversal of this trend, to ensure that future supply will be there to meet future demand?

The biggest encouragement investors can have is that prices are stable at a level that encourages them to undertake new projects. The price desired by companies varies from case to case depending on geology, technology and other factors. As well as the stability in price level, fiscal regimes play an important part.

Questions from Ranking Member Maria Cantwell

Question 1: Does IEA believe that enough effort and investment is taking place to reduce oil demand, diversify the transportation sector, and move to cleaner fuels?

Oil demand has been very robust in recent years, rising by well over 1 million barrels per day (mb/d) each year. Road transport – encompassing cars, trucks, two-and-three wheelers and buses – is the largest segment of global oil demand today, accounting for 41 mb/d out of the current 95 mb/d of total consumption. There are other important growth sectors in global oil demand, notably shipping, aviation and the use of oil in the petrochemicals sector. Almost 90% of the increase in global energy demand for transport since 1990 has been met by oil products.

The IEA believes that much more could be done worldwide to improve the efficiency of oil use for transportation and to use cleaner fuels and technologies to diversify the transportation sector. Fuel efficiency standards are an important instrument; these are increasingly widespread for passenger cars: three out of every four cars worldwide are now subject to some form of efficiency regulation. However, the same is not yet true for trucks, where only a handful of countries (including the United States) have some form of regulation in place. Sales of electric vehicles are growing rapidly, but their growth is also dependent on policies supporting electrification and the necessary recharging infrastructure. The IEA has a prominent role in a number of international initiatives that promote a cleaner and more diversified transport system, including the Electric Vehicles Initiative and the Global Fuel Economy Initiative.

Question 2: How do you think President Trump's bellicose rhetoric towards Iran and his Administration's inconsistent statements on forcing other nations to comply with new Iranian sanction affect oil prices?

The administration has made it clear that it wishes to see Iran's exports fall by as much as possible. So far, we have yet to see a major fall in Iranian shipments, although European customers have started to buy less.

As of early August, oil prices (Brent) are only slightly higher than before the US announced it would withdraw from the JCPOA. This is partly due to the fact that so far Iranian exports have not fallen sharply

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and also because other producers, e.g. Saudi Arabia and Russia have increased supply. Thus, so far the impact on prices of the Administration's change of policy vis-a-vis Iran has not been significant.

However, as we move closer to the implementation date of the sanctions in early November, we may see a bigger impact on Iranian exports. Any upward pressure on oil prices from Iranian shipments could coincide with the ongoing collapse of production in Venezuela, strife in Libya and unplanned outages (e.g. Canadian wildfires, hurricane damage).

So, later this year the oil market faces the risk of several major supply disruptions, any one of which could have a serious impact on prices. This would be damaging for all consumers.

Question 3: What do you think would happen to oil and petroleum product prices if Iran were to disrupt sea-borne tanker traffic in the Strait of Hormuz for one week? How about for a month? Is there a risk premium already baked into world oil prices associated with possibility of either reapplying sanctions on Iran or a disruption in transportation through the Persian Gulf?

Disruption to traffic through the Strait of Hormuz would be very serious as about 19 mb/d of oil passes through this vital waterway. A short disruption could probably be mitigated by healthy levels of global oil stocks, although prices could nevertheless rise sharply in the first instance. There is unused pipeline capacity in some countries that could be utilized to bypass the Strait of Hormuz, but in practice it would not come anywhere near close to offsetting the impact of a closure.

Once you look beyond the short term it is impossible to accurately forecast what would happen to oil prices as there is no precedent for a loss of global supply on this scale. For sure, prices would rise very fast and possibly beyond the high level of c. \$150/bbl seen in 2008.

It is difficult to say that there is a risk premium already built into oil prices as they are not much higher than before the US announced its withdrawal from the JCPOA. If tensions increase between the US and Iran and it is perceived that supplies are at risk even beyond that anticipated by the fall in Iranian exports, then prices could rise sharply. We should also point out that there is serious risk to supplies from other key countries e.g. Venezuela and Libya which would exacerbate the disruption caused by a closure of the Strait of Hormuz.

Question 4: How do fossil fuel subsidies distort markets? Do you believe the United States making enough progress to reduce fossil fuel subsidies? How do U.S. efforts compare to related efforts in other nations?

At the IEA we have been monitoring fossil fuel consumption subsidies for many years: these are subsidies that artificially lower the price paid by fossil fuels to end-users. These subsidies are either direct budgetary expenditures or, in some major producing countries, they represent the opportunity cost of holding end-user prices at low levels. In our estimation, the value of these subsidies worldwide in 2017 was just over \$300 billion; the largest share of this was in the Middle East. Fossil fuel consumption subsidies distort markets by encouraging wasteful consumption. They also remove or reduce incentives to invest in cleaner and more efficient technologies. The IEA has been a strong supporter of efforts to phase out these subsidies worldwide (see <https://www.iea.org/statistics/resources/energysubsidies/>)

The United States does not have fossil fuel consumption subsidies, since the prices paid for fuels are market-based. The United States has been supportive of efforts to phase out these subsidies: the G20 meeting in

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Pittsburgh in 2009 was a landmark in this respect, agreeing 'to phase out and rationalize over the medium term inefficient fossil fuel subsidies while providing targeted support for the poorest'.

In addition to consumption subsidies, there can also be measures supporting their production but not affecting end-user prices. These are monitored by the OECD and more information is available on <http://www.oecd.org/site/tadffss/data/> in relation to production subsidies maintained by the United States.

Question 5: In your opinion, could a national, government funded and managed strategic petroleum reserve for refined products including gasoline, diesel, and jet fuel, be an effective tool to moderate volatile fuel prices? What level of reserve and geographic distribution would be needed? Are there international examples of refined fuel reserves that could be useful models to consider here in the United States? Do you have additional relevant recommendations for policymakers on this issue?

Refined product stocks are an effective part of the strategic reserves of a number of IEA member countries and serve as a model for countries considering holding product stocks. However, it should first be noted that strategic petroleum reserves are not an effective tool for moderating volatile fuel prices.

Managing oil prices is not the purpose of the emergency oil stocks held to fulfil the IEA requirement. Rather, the use of these stocks is to fill the supply gap under exceptional circumstances where industry is unable to respond to disrupted supplies effectively on its own. By temporarily replacing disrupted supplies, the action helps oil markets re-establish the supply/demand balance at a lower price level than would otherwise have been the case. Moreover, the mere existence of the strategic reserves, ready to be brought to the market in a disruption, can help reduce volatility by reducing speculation on shortages. The use of emergency stocks to moderate volatile fuel prices, in the absence of a physical disruption, would likely have only a very short term dampening effect on prices while depleting the level of emergency stocks available for an actual disruption. A policy of using emergency stocks to manage prices would therefore have a counterproductive effect of greater price volatility, as it would add an additional source for speculation and foster a sense of greater vulnerability to disruptions due to the decreased strategic stock levels. Moreover, attempting to manage prices with emergency stocks risks masking important market signals, such as the need to invest in supply infrastructure or more fuel efficient technologies, which are essential to assuring supply security in the future.

While the IEA stockholding obligation does not specify whether strategic stocks should be held in the form of crude or refined oil, the decision on what amount of strategic product stocks to hold is often determined based on the relative size of the domestic refining sector. However, even for countries with a substantial refining sector, holding at least some portion of emergency stocks as product stocks makes sense, despite the higher costs of holding such stocks compared to crude oil. This is because in the event of some supply disruptions such as natural disasters, particularly those impacting refineries or import terminals, product stocks may be more rapidly available to secure quick distribution to the affected area. The IEA recommends to its member countries to hold a certain amount of refined product stocks and to ensure their timely drawdown and distribution in an emergency.

IEA member countries which are also members of the European Union have a requirement to hold at least one-third of their stocks in refined products, based on EU regulations. Currently, over 55% of all public stocks held in Europe are in the form of product. For example, Germany's stockholding agency, EBV, holds roughly 175 million barrels of strategic reserves, 70 million barrels of which is made up of diesel and gasoline, and spread out over the country's different regions. In France, the stockholding agency SAGESS holds over 117 million barrels of strategic reserves. Some 65 million barrels of this stock is diesel

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held in storage facilities throughout the country. SAGESS also holds 10% of its stock in the form of gasoline, with a good share of this being held in salt domes in the south of France.

Outside of Europe, Japan and Korea are the other IEA member countries which hold strategic reserves of product stocks. In addition to holding public stocks of over 300 million barrels of crude oil, Japan holds roughly 25 million barrels of public stocks of products, including LPG, gasoline and diesel. This is on top of its obligation on industry to hold at least 70 days of oil stocks in proportion to their imports. Korea also holds a portion of its public stocks in refined products and requires its industry to hold minimum levels of product stocks. Of its 95 million barrels of public stocks, just over 13 million barrels are in the form of products, mostly middle distillates. These are held at storage sites located throughout the country.

The use of strategic refined product stocks have proven to be critical in responding rapidly to supply disruptions, particularly in cases where refineries have been unable to operate normally. Recent examples of this include Switzerland, where low water levels on the Rhine river in 2015 hindered fuel deliveries in and out of the refinery, leading to the release of around 1.5 million barrels of emergency product stocks; and in France in 2016 (as well as in 2013 and 2010) when labor strikes shuttered the nations refineries, leading to the use of loans from strategic product stocks and allowing industry to use up to 9 days of their obligated stocks. In Japan, following the 2011 earthquake and tsunami, obligations on oil companies were temporarily lowered from 70 days to 45 days to help free up available product supplies. Past experience of disruptions in the US have also highlighted the importance of having refined products when normal supply chains are disrupted, including when Hurricane Sandy in 2012 caused widespread issues related to the availability of gasoline, as well as in 2005 where the release of emergency oil stocks of gasoline and diesel, primarily from European countries as part of the IEA collective action, was critical in responding effectively to the disruption of Gulf coast refineries.

In terms of policy recommendations for the specific case of the United States, energy policies, including emergency response policies of each IEA member country are peer reviewed on a regular basis (approximately every five years). The importance of holding strategic refined product stocks has already been highlighted in past reviews of the US, and the next review will take place in September 2018.

Questions from Senator Debbie Stabenow

Questions: There is an interest among certain industries, and it seems this administration, to approve as many LNG export terminals and agreements as possible. By doing so, we are pushing LNG markets into something that more closely resembles today's global oil market.

According to the CFTC, the U.S. natural gas industry has been relatively insulated from global forces; however, increasing U.S. LNG exports will expose it to international market dynamics, and thus potentially put upward pressure on U.S. gas prices.

Will increased LNG exports expose U.S. consumer prices to the same global demand that is increasing crude oil prices? Furthermore, do you expect domestic natural gas prices will increase due to the global LNG demand?

The United States have been so far insulated from global LNG supply and demand fluctuations, having almost no exposure as an importer and with exports still being marginal compared to domestic consumption. US LNG exports are expected to grow significantly over the coming years with the commissioning of new

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export capacity currently under development, thus increasing the United States' exposure to international gas markets and price fluctuations.

Despite such rapid growth, LNG exports will remain a minor component of US natural gas production's outlets compared to domestic market needs. It is expected that US LNG exports will reach around 100 bcm by 2023 (Gas 2018 market report, IEA) or the equivalent of 12% of US natural gas consumption.

The United States' natural gas production is expected to continue to grow in the future, and US natural gas industry has shown its ability to perform under challengingly low price levels thanks to strong improvements in productivity and cost reduction, as well as its responsiveness to price recovery. US natural gas prices are not expected to increase significantly as long as competitive new supply is developed on par with new needs for domestic and export markets. Recent analysis commissioned by the US DoE¹ concludes that increasing US LNG exports under any given set of assumptions about US natural gas resources and their production leads to only small increases in US natural gas prices. Available natural gas resources have the largest impact on natural gas prices, which are therefore far more dependent on available resources and technologies to extract available resources than on US policies surrounding LNG exports.

¹ <https://www.energy.gov/sites/prod/files/2018/06/f52/Macroeconomic%20LNG%20Export%20Study%202018.pdf>

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Questions from Chairman Lisa Murkowski

Question 1: After listening to testimony from the hearing on July 24, there should be no question in anyone's mind about the role and significance of U.S. production in global markets.

- Can any of you comment on the level of impact that greater U.S. production has had, and is having, in terms of calming markets, restraining prices, and providing critical supplies to meet global demand? Where would we be without an increase in U.S. production?

The U.S. shale boom has not only supplied much needed quantities of oil to the domestic and global markets to keep up with strong demand, it has changed how we think about oil's fixity and longevity as a fuel source and quelled recent warnings of near term "Peak Oil" supply (a concern that has emerged repeatedly since the 1920s). It is hard to say where prices would be without the U.S. shale boom, but the development of vast reserves of domestic oil (through a combination of technology, American ingenuity and capital availability) has dramatically reduced U.S. concerns about reliance on foreign sources of oil and altered the foreign policy landscape.

The timing of the US shale oil boom was fortuitous. Shale oil first materially accelerated after 2010 when supply disruptions in Libya and Iran threatened to overtighten the market and preventing a bad oil price spike to above \$100 from getting much worse.

Generally, the development of the US shale sector constitutes a new and geographically diverse energy supply for global energy markets. However, it is important that the U.S. remain open to crude oil exports for our consumers and country to realize the full benefits. US shale oil is light and sweet, whereas our refiners are largely configured to process heavier and sour crude oil grades.

The oil production growth realized in the U.S. between 2014 and 2017 has not been highly geographically varied – as was pointed out in the hearings testimony, production growth has primarily occurred in the Bakken, the Anadarko, the Eagle Ford, the Niobrara, and the Permian.

- This administration has focused on the development of American energy in the OCS, NPR-A, the 1002 Area, and other federal areas. How will these developments, and the broader change in policy to push for more supply, lead to a more positive outlook for future prices?

Compared to other producing countries and the history of oil production, U.S. production is geographically diverse. There is, however, a large difference between the growth on state and private land versus the growth on federal land. The current leadership at the Department of the Interior has prioritized increasing production on federal land, but there are many obstacles to overcome. Oil companies find it easier to deal with state regulators than the BLM. Applications to drill on federal land require significantly more paperwork and process time compared with state drilling permits. Improving the effectiveness of the

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BLM will improve exploratory efforts on federal land, including in the Permian Basin, where a large portion of the acreage in New Mexico sits on federal land. This will unlock more supply and all else equal contribute to lower oil prices.

Recent US oil production growth has occurred almost exclusively in the aforementioned shale plays. Companies and providers of capital are allocating resources to these plays because they have relatively low geologic risk and because payback is short (1-2 years) and derived largely from economic and technological inputs. The investment community is rewarding the allocation of capital to shale plays over long-lived conventional resources in places like NPR-A and the OCS that have “below ground” risk.

However, the oil industry and investment community’s interest in conventional resources such as in the NPR-A, OCS, and 1002 Area will likely increase in the future given probability of higher oil prices, continually improving industry innovation and efficiency, and the fact that these resources lie in a stable, rule-of-law country outside the volatile Middle East. Especially since the “below ground” risks of these conventional resources are higher relative to shale, it is important that the federal and state governments promote investment by minimizing “above ground” risk by implementing reasonable, certain and stable policies.

Question 2: The International Energy Agency and a number of analytical firms have warned that industry is underinvesting in exploration and development, which could lead to a supply crunch that significantly increases prices. IEA has warned that this could happen in the early 2020s, and another firm, Bernstein Research, recently warned that this could result in a “super spike” to \$150 a barrel.

- How real of a challenge is underinvestment in exploration and development?

The challenge is very real, especially considered alongside the strong likelihood that oil demand will turn out much stronger than consensus believes.

Capital expenditures for large scale, conventional projects have dramatically declined since oil prices fell in 2014. The US shale sector continues to attract and utilize vast capital and remains highly dependent on it for its growth trajectory. If capital becomes much more selective and shale is viewed as less attractive, underinvestment in conventional, long-lived resources will lead to significantly higher oil prices.

Whether or not investment in supply will be enough of course must also be considered in relation to demand for oil. Medium to longer term demand for oil is likely underestimated by the consensus, which I believe subscribes to overly optimistic assumptions on policy-driven demand destruction. With spare production capacity very tight, and given the absence of an effective swing producer, underinvestment and robust demand is likely to lead to a boom price cycle in the medium term. A theme of my book

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Crude Volatility: The History and the Future of Boom and Bust Oil Prices (Columbia University Press, 2017) is that both history and oil's economic attributes show boom and bust price cycles are normal given low price elasticities of supply and demand in the short run.

- What steps can we take to promote the reversal of this trend, to ensure that future supply will be there to meet future demand?

Governments can improve the operating environment for the industry and increase the odds that producers are able to find and produce sufficient oil resources to meet demand at stable prices. They can do so by reducing “above ground” risk to oil exploration, distribution, and refining by opening their territories to responsible development and promulgating reasonable and sound policies, including stable regulations and free trade.

Question 3: I was proud to lead the effort to lift the ban on U.S. crude oil exports back in 2015. I believe that decision has helped stabilize global markets, and given us a new geopolitical advantage, without substantially increasing domestic prices. Yet, as prices have gone up, a few have been quick to blame exports as the reason why – or at least, have suggested cutting off exports as a method of lowering prices.

- How do you receive those arguments—that if we simply cut off oil exports, we would somehow go back to having cheaper oil and gas in our country?

The big run up in crude prices from about \$30 to over \$140 between 2004 and 2008 occurred before the US shale oil boom appeared. As noted above, the emergence of US shale oil after 2010 helped limit prices that would have otherwise risen due to disruptions and strong demand. Lifting the crude export ban was necessary to permit the astounding growth of the US shale oil sector given the quality mismatch noted above. Were the US to reinstitute the crude oil export ban, shale investment would fall sharply. US production would therefore fall, and our crude imports would begin rising. Global oil prices would be higher because of the removal of the world's biggest source of supply growth. Since US gasoline pump prices are largely determined by global oil prices, US motorists would pay higher prices for gasoline if the export ban was reimposed.

Question 4: In your written testimony, you stated that, “Genuine power in the oil market comes less from how much a country produces and instead whether it can stabilize prices and offset major disruptions. Spare capacity is one measure of that power.”

- Is U.S. shale oil considered our “spare capacity” because it is more responsive to price signals and has shorter lead times for production?

Shale's relative responsiveness to oil prices compared with conventional supply should not be seen as “spare capacity” akin to how OPEC manages their supply nor how the Texas Railroad Commission and the Oklahoma Corporation Commission managed supply in years past. It is crucial to distinguish between short cycle and swing production.

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Short cycle shale production, of which shale is an example, ebbs and flows faster than conventional oil production — quarters instead of years. But US shale production is comprised of many dozens of highly idiosyncratic public and private companies, each competing to maximize reserves and production. Shale's shorter cycle ebb and flow can stabilize prices, but only coincidentally and depending on prevailing, broader market fundamentals.

True spare capacity is very different from shale. Spare capacity is producible oil that is held off the market by a regulator or cartel for the sole purpose of promoting short term price stability and anchoring investors long term price expectations. Spare capacity can be produced in weeks and sustained indefinitely. Spare capacity holders are either governments or operate with government approval. US shale production is none of these things.

While it was fashionable to believe US shale would act as a price stabilizing swing producer in late 2014 and early 2015, subsequent events proved these hopes to be misplaced. Oil prices fell from over \$100 in mid-2014 to \$26 in February 2016.

- What are the estimates of global spare capacity right now – for the U.S., OPEC, and non-OPEC countries?

We define spare capacity as wellhead production curtailed by regulators solely for the purposes of price stability, available in 30 days, below the maximum efficient rate of production (MER - the maximum rate of production without damaging the reservoir nor compromising reserve recovery), and sustainable for at least 90 days. Our definition excludes production offline due to routine maintenance, accidents, geopolitics, or weather, as well as production surges beyond MER. It also excludes “drilled but uncompleted” (DUC) wells, which may be brought online within 30 days but are not managed by regulators for stabilizing prices.

Under this definition, the U.S. does not hold any production under spare capacity.

OPEC: We estimate OPEC currently holds about 1.0-1.5 mb/d in spare capacity, which is extremely low (less than 2% of world production) by historical standards and in relation to large geopolitical disruptions and disruption risks.

Non-OPEC: Zero. Russia is the only non-OPEC country to hold spare capacity because of the December 2016 Vienna Group Agreement. However, much like the OPEC Gulf countries, Russia ramped up production in June and July of this year and no longer holds spare production capacity. Unlike the Gulf Countries, we do not expect Russia to curtail production again this year. While other non-OPEC countries also joined the agreement, their contributions were mostly nominal as they either did not cut production, as was the

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case of Kazakhstan, or were already experiencing natural production declines and cannot regain their pledged “production cuts” without years of significant investment.

- If the Saudis use up their spare capacity by producing more, are there any other countries that can replace it?

It is unlikely any single producer would choose to hold spare production capacity. Holding spare is expensive, since the production capacity requires large investments that are not monetized. History shows producers or regulators only agree to hold spare when they, alone or in combination with other producers, have sufficient pricing power to stabilize oil prices. While the Vienna Group could potentially and collectively hold and use spare production capacity and has shown some willingness to do so in the wake of price busts, it is far from clear it will replace OPEC or the Texas Railroad Commission as an effective long-term price stabilizing organization.

Questions from Ranking Member Maria Cantwell

Question 1: How do you think President Trump’s bellicose rhetoric towards Iran and his Administration’s inconsistent statements on forcing other nations to comply with new Iranian sanction affect oil prices?

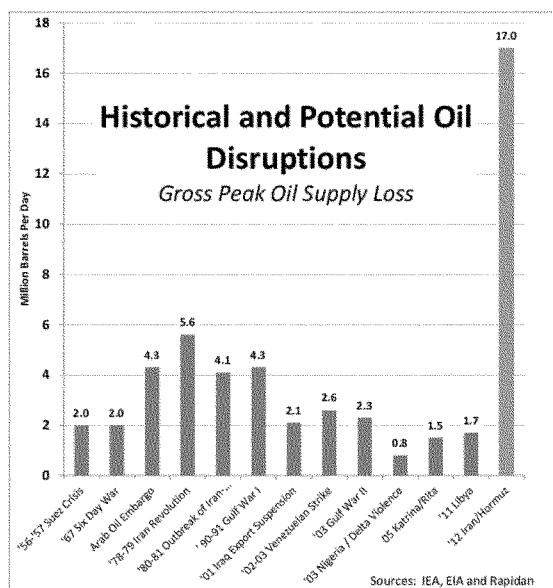
Given tight spare production capacity and a recent normalization of commercial inventories, the prospect of losing Iran’s exports adds a clear, if hard to precisely quantify, price premium on crude prices. This was the case after 2012 when President Obama imposed oil sanctions and earlier this year when President Trump decided in May to reimpose oil sanctions starting later this year. In both instances, there was and is market uncertainty about the size of export reductions and reactions by other producers and Iran itself. I would roughly estimate the current Iran premium on retail gasoline pump prices to be about 10 cents per gallon or less.

Question 2: What do you think would happen to oil and petroleum product prices if Iran were to disrupt sea-borne tanker traffic in the Strait of Hormuz for one week? How about for a month? Is there a risk premium already baked into world oil prices associated with possibility of either reapplying sanctions on Iran or a disruption in transportation through the Persian Gulf?

It is hard to overstate the importance of the Strait of Hormuz choke point, the world’s most important oil transit point through which some 18 mb/d, or about a third of seaborne traded oil, flows.

Presented below is a comparison of how a Strait of Hormuz disruption would match up to former crises which have caused severe economic harm (the Hormuz estimate is from 2012 and would be a little higher now, closer to 18 mb/d).

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A one-week disruption would likely cause a \$10-\$15 per barrel oil spike that would reverse quickly once the strait was reopened. A one-month disruption would likely trigger a release of strategic stocks, but these would not fully compensate for the loss of 18 mb/d of exports. Crude oil prices could easily double, triggering a recession that would likely then see oil prices fall.

Question 3: In your opinion, could a national, government funded and managed strategic petroleum reserve for refined products including gasoline, diesel, and jet fuel, be an effective tool to moderate volatile fuel prices? What level of reserve and geographic distribution would be needed? Are there international examples of refined fuel reserves that could be useful models to consider here in the United States? Do you have additional relevant recommendations for policymakers on this issue?

It is always useful to consider various options to protect the economy from emergency supply disruptions. Many European countries hold strategic stocks, both crude and refined products, in the form of required minima at private companies. The US and Japan utilize government owned stockpiles of crude. Under the broader International Energy Agency system, the US can benefit from Europe's refined product stocks during emergency disruptions, such as the Katrina Hurricane in 2005.

Generally, however, I believe the private sector is best equipped to manage refined product stocks. I am unaware of any evidence the federal government has superior information or ability

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to determine the size, location, or use of refined product stocks. It would be inappropriate for government to use refined product stocks or strategic crude stocks to moderate oil prices per se. If government held higher product stocks, industry might hold less. Government refined product stocks would distort market functioning and lead to politicized use of stocks, resulting ultimately in less protection against supply emergencies and more price volatility. While the downsides of refined stocks could also apply to crude oil, I believe a stronger case for federally managed crude oil strategic stockpiles arises from the fact that crude oil is more susceptible to global geopolitical disruptions and therefore bears on the federal government's lead roles in foreign and defense policy, as well as international collective action under the IEA.

As emphasized in my testimony, I strongly recommend Congress reverse recent decisions to raise non-energy security related revenue by arbitrarily selling US strategic crude oil stocks. The last time Congress did so in the mid-1990s was a mistake. The federal government had to replace those barrels at higher prices, after 9-11 and amidst Middle East conflicts. Before proceeding with budgetary sales, Congress should commission a study on the prospective need, size, and configuration of strategic crude stocks. While our imports have recently fallen sharply, history shows trends in oil can reverse. Surprises should be expected. The US economy remains vulnerable to emergency disruptions anywhere in the global oil market, and with no effective swing producer and tight spare production capacity, an argument can be made that larger strategic crude stocks are required.

Questions from Senator Debbie Stabenow

Questions: There is an interest among certain industries, and it seems this administration, to approve as many LNG export terminals and agreements as possible. By doing so, we are pushing LNG markets into something that more closely resembles today's global oil market.

According to the CFTC, the U.S. natural gas industry has been relatively insulated from global forces; however, increasing U.S. LNG exports will expose it to international market dynamics, and thus potentially put upward pressure on U.S. gas prices.

Will increased LNG exports expose U.S. consumer prices to the same global demand that is increasing crude oil prices? Furthermore, do you expect domestic natural gas prices will increase due to the global LNG demand?

On the margin, US exports will create a link between global gas prices and domestic ones. However, since natural gas, unlike oil, remains very expensive to transport, and given the enormous size of US gas resources and low cost of production, I do not expect LNG exports would create an economically harmful link between domestic and global gas prices. Moreover, and as with oil, US LNG exports offers the world - including our allies in Europe and Asia - a diverse, alternative to gas from Russia and the Middle East. This geopolitical benefit, along with the environmental benefits of increased gas use, including as a backstop for renewables, constitute economic and policy benefits that far outweigh any marginal connectivity between US and global natural gas prices arising from US LNG exports.

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Questions from Chairman Lisa Murkowski

Question 1: After listening to testimony from the hearing on July 24, there should be no question in anyone's mind about the role and significance of U.S. production in global markets.

- Can any of you comment on the level of impact that greater U.S. production has had, and is having, in terms of calming markets, restraining prices, and providing critical supplies to meet global demand? Where would we be without an increase in U.S. production?

As U.S. crude oil production has increased from 5.5 million barrels per day in 2010 to just under 11.0 million barrels per day today, most of that production growth has found its way into the global market, either directly or indirectly – via lower crude oil imports and higher exports of both crude and petroleum products.

According to EIA data, between 2011 and 2018, imports of crude oil into the U.S. fell by about 1.2 million barrels per day, effectively displacing that volume back into the global market. Said another way, if the volume does not come to the U.S., it must go somewhere else, which increases global supply. And, since 2016 the U.S. has been exporting significant volumes of crude directly into the global market, up from less than 50,000 barrels per day in 2010 (mostly to Canada) to an average of 1.8 million barrels per day thus far in 2018.

In addition, net exports of finished and unfinished barrels of gasoline, diesel and jet fuel have increased from near zero in 2010 to average 1.5 million barrels per day in 2018. These volumes have essentially the same impact as crude exports on the global market – increasing supply. Adding together the 1.2 million barrels per day of lower crude imports plus 1.8 million barrels per day of crude exports plus the 1.5 million barrels per day increase in net gasoline, diesel and jet imports, the sum is 4.5 million barrels per day.

If that incremental 4.5 million barrels per day of supply were not available to buyers, the global crude oil market would be woefully short of supply. Given all the other factors impacting the global supply/demand balance, it is difficult to estimate the consequences for crude prices. However, there is little doubt that global crude prices would be back to at least \$100/bbl, if not higher.

The oil production growth realized in the U.S. between 2014 and 2017 has not been highly geographically varied – as was pointed out in the hearings testimony, production growth has primarily occurred in the Bakken, the Anadarko, the Eagle Ford, the Niobrara, and the Permian.

- This administration has focused on the development of American energy in the OCS, NPR-A, the 1002 Area, and other federal areas. How will these developments, and the broader change in policy to push for more supply, lead to a more positive outlook for future prices?

Increases in supply, from whatever sources, will act to dampen prices. Greater production from the OCS and other federal areas will add to domestic volumes, reducing dependence on imports. However, these resources can be costly to develop – and in some cases may not be competitive with the lower per-unit cost

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of shale/tight oil and gas production. Consequently, it may take some years for these resources to make a meaningful contribution to total U.S. supplies.

Question 2: I was proud to lead the effort to lift the ban on U.S. crude oil exports back in 2015. I believe that decision has helped stabilize global markets, and given us a new geopolitical advantage, without substantively increasing domestic prices. Yet, as prices have gone up, a few have been quick to blame exports as the reason why – or at least, have suggested cutting off exports as a method of lowering prices.

- How do you receive those arguments—that if we simply cut off oil exports, we would somehow go back to having cheaper oil and gas in our country?

As noted above, U.S. exports have acted to put downward pressure on global prices. U.S. crude price levels on the Gulf Coast are primarily determined in reference to the global market price, thus exports have helped hold prices down.

The oil price increases seen over the past year have been the result of various factors in the global market, including the November 2016 OPEC and NOPEC (Russia and other non-OPEC producers) agreement to curtail production, increased Middle East tensions, production cuts in Venezuela, infrastructure problems in Canada, and other market dynamics beyond the borders of the U.S. Exports have had a negligible impact on U.S. crude prices. If fewer U.S. barrels were exported, the market would balance through adjustments in the level of imports.

Question 3: We have had many discussions in our committee about infrastructure constraints in the U.S., particularly the lack of pipelines needed to move new production to refineries and export facilities, and what we can do to overcome those constraints.

- Did the price collapse from 2014 to 2016 exacerbate the infrastructure constraints that we face, due to investor reductions in the midstream and downstream?

When crude prices collapsed in those years, crude oil production also fell in all basins besides the Permian. Thus, while there may have been some slowdown in infrastructure development, likewise there was less demand for incremental takeaway capacity at the time. As prices recovered and production ramped back up, midstream companies responded and projects were announced to accommodate the growth. While there may have been some infrastructure constraints exacerbated by investment slowdowns, this was not a significant factor in the takeaway issues facing the Permian and other regions.

- If various levels of government refuse to allow pipelines to be built, or make it cost substantially more and take substantially longer to do so, what impact will this have on prices, both locally and globally?

The impact is quite dependent on the commodity, the region and the timeframe. However, as a general statement, anything that constrains the development of

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new supply will act to increase prices. Since lack of pipeline capacity certainly restricts supply development, the consequence is higher prices than they would otherwise be.

- Is there a window of opportunity that we have to build out our exports capacity in order to meet global demand?

Greater export capacity provides more attractive market opportunities for U.S. oil, gas and NGL production. As global demand for all these energy commodities grows, the ability to meet this demand secures market share for U.S. volumes. Said another way, anything that constrains the ability for U.S. production to meet market demand effectively cedes market share to others. This window of opportunity exists today, and will remain open as long as global demand continues to increase.

Question 4: The shale revolution has truly been just that, a revolution. It has not only revolutionized the supply market, but also the nature of investment in new production.

- Are you concerned that industry is focusing too much effort on low-risk, short-term shale plays and neglecting investments in larger fields and conventional exploration that could provide for better long-term stability?

Shale produces oil and gas directly from source rock, which is far more ubiquitous than conventional reservoirs. The ability to extract oil and gas from this resource has and will continue to be driven by technological developments. These resources are low risk, and on a per unit of production basis – are also low cost. Consequently, I am not concerned about the industry's focus on shale basins. After all, U.S. production was in decline in the years before shale, and since shale technologies were proved up and deployed, U.S. crude production has doubled. That kind of performance will provide better market stability for many years into the future.

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Questions from Senator Debbie Stabenow

Questions: There is an interest among certain industries, and it seems this administration, to approve as many LNG export terminals and agreements as possible. By doing so, we are pushing LNG markets into something that more closely resembles today's global oil market.

According to the CFTC, the U.S. natural gas industry has been relatively insulated from global forces; however, increasing U.S. LNG exports will expose it to international market dynamics, and thus potentially put upward pressure on U.S. gas prices.

Will increased LNG exports expose U.S. consumer prices to the same global demand that is increasing crude oil prices? Furthermore, do you expect domestic natural gas prices will increase due to the global LNG demand?

The CFTC is correct in that the U.S. natural gas market has been less exposed to global forces than has crude oil. While more gas exports in the form of LNG will mean a stronger linkage between U.S. and global prices, the situation is quite different than that for crude oil prices. The U.S. still imports about 8 million barrels per day of oil from the global market (about 40% of U.S. refinery demand), which is the source for most of the exposure of U.S. oil prices to those in the global market.

The situation for gas is completely different – with U.S. imports near zero. Even after all of the current wave of LNG export facilities are completed, only about 10 Bcf/d of production is likely to be exported in the form of LNG. By that time, Lower-48 U.S. dry gas production could increase from 83 Bcf/d today to over 100 Bcf/d, implying LNG exports of only 10% of U.S. gas production. Given that U.S. productive capacity is well in excess of 100 Bcf/d even over the short term (the next five years), it is unlikely that domestic natural gas prices will experience a material increase due to global LNG demand.

Regarding approvals of new LNG facilities to be developed over the longer term, regardless of the number of facilities that receive regulatory approval, not all will be built. This is due to the extremely high cost of the facilities, and the limits on demand from global gas markets. Considering the number of facilities that are likely to be constructed, it is likely that U.S. natural gas production can increase to meet that demand without a material impact on domestic gas prices. Of course, at any point in time, a combination of market factors could converge to result in higher prices on a short-term basis.

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Questions from Chairman Lisa Murkowski

Question 1: After listening to testimony from the hearing on July 24, there should be no question in anyone's mind about the role and significance of U.S. production in global markets.

- Can any of you comment on the level of impact that greater U.S. production has had, and is having, in terms of calming markets, restraining prices, and providing critical supplies to meet global demand? Where would we be without an increase in U.S. production?
- Answer: While it is impossible to quantify precisely the impact that the recent growth in U.S. production has had on crude markets and prices, we can be certain that prices are significantly lower and have been less volatile than they would have been without this growth. The almost 6 million BPD increase in crude production in the U.S. since 2008 (from 5 million BPD to almost 11 million BPD) composes about 60% of the total global increase in production during that same period and has been the most important factor in causing crude prices to decline and stay below \$100 per barrel. As such, U.S. production growth has been instrumental in supporting both U.S. and global economic growth and meeting growing product demand. It has also been critical in allowing the world to weather supply outages in key producing countries, including Libya, Nigeria, and Venezuela (among others) and will be critical in replacing Iranian barrels lost during impending sanctions.

The oil production growth realized in the U.S. between 2014 and 2017 has not been highly geographically varied – as was pointed out in the hearings testimony, production growth has primarily occurred in the Bakken, the Anadarko, the Eagle Ford, the Niobrara, and the Permian.

- This administration has focused on the development of American energy in the OCS, NPR-A, the 1002 Area, and other federal areas. How will these developments, and the broader change in policy to push for more supply, lead to a more positive outlook for future prices?
- Answer: All of these policies will be beneficial in supporting and maintaining U.S. crude production growth and therefore contribute to moderating absolute prices. I am supportive of other similar policies to provide access to promising crude and gas resources in a safe and environmentally friendly way.

Question 2: We've had many discussions in our committee about infrastructure constraints in the U.S., particularly the lack of pipelines needed to move new production to refineries and export facilities, and what we can do to overcome those constraints.

- Did the price collapse from 2014 to 2016 exacerbate the infrastructure constraints that we face, due to investor reductions in the midstream and downstream?
- Answer: Overall market conditions will always influence investment decisions. The drop in prices between 2014 and 2016 certainly led to lower levels of investment in the upstream and downstream. However, perhaps the biggest market related reason that has led to the current infrastructure constraints out of the Permian Basin has actually been the

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outperformance of producers in the lower price environment, which caught the market by surprise and allowed production to exceed pipeline capacity. Midstream investment is proceeding in response to the constraints and resulting market incentives and the Permian situation should be remedied by late next year. The constraints out of Western Canada have arisen more due to government actions that have delayed multiple pipeline projects, most prominently the Keystone XL pipeline.

- If various levels of government refuse to allow pipelines to be built, or make it cost substantially more and take substantially longer to do so, what impact will this have on prices, both locally and globally?
- Answer: Such actions will certainly result in higher prices on a global basis as they will lead to lower production from areas which are logistically constrained. Regional prices will be impacted to a greater degree, with areas directly affected seeing the greatest price impacts.
- Is there a window of opportunity that we have to build out our exports capacity in order to meet global demand?
- Answer: It is always better to build capacity before it is critically needed; especially considering the fact that many infrastructure projects require significant project timelines. We are likely approaching sustainable export capacity limits, so the “window of opportunity” is now. Companies and Port Authorities, particularly along the U.S. Gulf Coast, are already developing plans and making investments in anticipation of the approaching constraints and the best Federal actions would be to support these moves.

Questions from Senator Debbie Stabenow

Questions: There is an interest among certain industries, and it seems this administration, to approve as many LNG export terminals and agreements as possible. By doing so, we are pushing LNG markets into something that more closely resembles today’s global oil market.

According to the CFTC, the U.S. natural gas industry has been relatively insulated from global forces; however, increasing U.S. LNG exports will expose it to international market dynamics, and thus potentially put upward pressure on U.S. gas prices.

Will increased LNG exports expose U.S. consumer prices to the same global demand that is increasing crude oil prices? Furthermore, do you expect domestic natural gas prices will increase due to the global LNG demand?

Answer: The huge U.S. natural gas resource base means that incremental demand from LNG exports will have a negligible impact on domestic prices. Also, LNG export facilities are necessary to maintain the incentive to continue to invest in the production of domestic natural gas and lacking this outlet for production, investment will decrease, resulting in lower production and ultimately perhaps actually higher domestic prices for domestic consumers. In addition, the increased volume of U.S. LNG on world markets will lead to lower overall global prices and significant benefits to global economic growth (not to mention the positive geopolitical impacts of providing alternatives to Russian and Middle East gas).

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Questions from Chairman Lisa Murkowski

Question 1: After listening to testimony from the hearing on July 24, there should be no question in anyone's mind about the role and significance of U.S. production in global markets.

- Can any of you comment on the level of impact that greater U.S. production has had, and is having, in terms of calming markets, restraining prices, and providing critical supplies to meet global demand? Where would we be without an increase in U.S. production?

In the last decade, the U.S. has more than doubled oil production, a staggering increase. A decade ago, there was much concern that oil supply might peak and start to decline and that high oil prices would persist. In 2014, John Watson, the CEO of Chevron at the time, noted that new oil supply was so expensive that "\$100 per barrel is becoming the new \$20." Global oil prices collapsed shortly thereafter, and only recovered gradually in recent years as a result of an unprecedented supply cut by OPEC, Russia and a few other producers. Many factors contributed to the oil price collapse of 2014, but perhaps the most important was the dramatic surge in U.S. shale production, at the time the largest increase in oil output over a five-year period of any country in history. Since oil prices recovered in 2016, U.S. oil production has risen 2 million b/d, helping to restrain prices from rising higher. Absent the shale revolution, world oil prices would be higher, as would consumer pump prices and US import dependence.

It is hard to say what would have happened without the US shale revolution, given the uncertainties inherent in such counterfactuals. But it is worth remembering that many prominent analysts just over decade ago were predicting oil prices of \$150 or even \$200 per barrel.

The oil production growth realized in the U.S. between 2014 and 2017 has not been highly geographically varied – as was pointed out in the hearings testimony, production growth has primarily occurred in the Bakken, the Anadarko, the Eagle Ford, the Niobrara, and the Permian.

- This administration has focused on the development of American energy in the OCS, NPR-A, the 1002 Area, and other federal areas. How will these developments, and the broader change in policy to push for more supply, lead to a more positive outlook for future prices?

The exploration and development of new deepwater areas or the Alaskan Arctic requires higher prices than the most prolific shale plays (and the prevailing oil price today). These areas would only be likely to be developed if the industry believed in a sustained high oil price environment, which is far from assured, especially in light of the past few years' boom and bust cycles and concerns about oil demand over the longer term. Thus, any contribution of these areas to lower oil prices would likely be over the long-term and in a higher price environment than today's.

Moreover, a careful balance must be struck between the economic benefits of increasing domestic production and the environmental risks associated with drilling operations in especially sensitive ecosystems.

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Question 2: I was proud to lead the effort to lift the ban on U.S. crude oil exports back in 2015. I believe that decision has helped stabilize global markets, and given us a new geopolitical advantage, without substantively increasing domestic prices. Yet, as prices have gone up, a few have been quick to blame exports as the reason why – or at least, have suggested cutting off exports as a method of lowering prices.

- How do you receive those arguments—that if we simply cut off oil exports, we would somehow go back to having cheaper oil and gas in our country?

Restricting exports would not lower oil and gas prices in the U.S. If anything, it might marginally push them up by causing a curtailment of U.S. production triggered by the fact that U.S. crude oil would likely be forced initially to trade at a greater discount to world crude prices. Because it is more economically challenging for U.S. refiners to absorb the very light oil being produced in the U.S. as a result of the shale revolution, the U.S. is exporting large volumes of light oil and importing large volumes of heavier oil. This current practice allows refiners to optimize their operations and keep consumer costs lower.

Restricting exports and thus forcing U.S. producers to sell their oil to domestic refiners that are not optimized for that type of crude would force U.S. producers to discount their oil. But those savings would accrue to refiners not consumers, as refiners will simply pocket the difference between the lower domestic and higher international price. Gasoline and diesel produced in the United States can be freely traded in the global market, and thus the price at the pump is determined by the world price of refined petroleum. If the US price of crude is discounted, that lowers the cost to refiners of buying crude oil to produce gasoline, diesel and other products. But there is no reason why the domestic refiners would pass those savings along to consumers. US refiners will have access to global product markets and the ability to sell gasoline and diesel abroad at prevailing global prices.

Questions from Ranking Member Maria Cantwell

Question 1: Can you please elaborate on the benefits of pursuing policies to reduce oil demand, with an emphasis on which policies you believe could be most impactful and cost-effective in lowering oil prices in the short, medium, and long-term?

Reducing oil demand in the U.S. would help lower prices on the margin, but oil prices will still be set in a global market of around 100 million b/d and inevitably will still rise and fall. To the extent the shift away from oil were to happen more globally, that would have a larger impact on prices.

Nonetheless, oil prices will inevitably still rise and fall in the future, as they have in the past. Reducing how much oil the U.S. economy and households use would help insulate against future

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oil price shocks by reducing oil intensity—oil as a share of GDP or oil as a share of household income. Moreover, using less gasoline and diesel through cost-effective policies will help consumers save money.

Continuing with planned fuel economy increases through CAFE standards is one effective way to reduce the oil intensity of the economy and mitigate the adverse impact of future oil price increases on American drivers. Continuing to invest in R&D in alternative transportation fuels and technologies can also help reduce our society's oil use. In addition to protecting consumers from price volatility, such policies are also needed to address the threat of climate change.

Question 2: How do you think President Trump's bellicose rhetoric towards Iran and his Administration's inconsistent statements on forcing other nations to comply with new Iranian sanction affect oil prices?

The prospects of pulling Iranian oil supply off the market through the reimposition of sanctions has added a risk premium to oil prices. Oil prices spiked by several dollars per barrel, for example, after an unnamed State Department official speaking to reporters recently said that the Administration would take the hardest line possible on sanctions implementation, not offer any exceptions, and require all buyers of Iran crude oil to zero out imports by November, the end of the 180-day implementation period. This translates into pump prices for American drivers that are higher than they would otherwise be.

Question 3: What do you think would happen to oil and petroleum product prices if Iran were to disrupt sea-borne tanker traffic in the Strait of Hormuz for one week? How about for a month? Is there a risk premium already baked into world oil prices associated with possibility of either reapplying sanctions on Iran or a disruption in transportation through the Persian Gulf?

There is certainly a risk premium in the market for the possibility that reapplied sanctions will disrupt Iranian oil sales. There is increasing concern that Iran might disrupt tanker traffic in the Persian Gulf, especially following the announcement by Saudi Arabia that it would temporarily halt tanker traffic through the Strait of Bab el-Mandeb, but the market generally places the possibility of a disruption to the Strait of Hormuz as a lower risk possibility. If the Strait of Hormuz, through which nearly one-fifth of the world's oil supplies flow, were to be disrupted, oil prices could once again shoot up to triple digits in response. The U.S. Strategic Petroleum Reserve could only replace a fraction of the volume that passes through the Strait (and only temporarily) due to the withdrawal capacity limitations of the SPR.

Question 4: Have you done any analysis on the scope and cost of subsidies for domestic oil and natural gas producers? How do fossil fuel subsidies distort markets? Do you agree with the argument that fossil fuel subsidies help lower energy prices for consumers or pay for themselves by inducing additional domestic production?

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Fossil fuel subsidies are harmful both economically and environmentally as they strain the fiscal resources of countries and encourage inefficient and wasteful consumption.

In the U.S., evidence suggests that production subsidies have only a modest impact on output levels, which are determined far more by other factors like price, technological improvements, and infrastructure and service costs.

Question 5: The recent tax reform bill provided three generous tax breaks for domestic oil companies, including the 1) “Lonestar loophole,” which allows tax free distributions from master limited partnerships, 2) a provision eliminating foreign base company oil related income as a category of foreign base company income, and 3) the overall cut in the corporate tax rates. Did you think U.S. taxpayers received any tangible benefits in the form of lower energy prices from these billions of dollars of tax breaks included in last year’s tax reform bill?

I have not done analysis of the recent tax bill. As a general matter, in the U.S., evidence suggests that production subsidies have only a modest impact on output levels, which are determined far more by other factors like price, technological improvements, and infrastructure and service costs.

Question 6: In your opinion, could a national, government funded and managed strategic petroleum reserve for refined products including gasoline, diesel, and jet fuel, be an effective tool to moderate volatile fuel prices? What level of reserve and geographic distribution would be needed? Are there international examples of refined fuel reserves that could be useful models to consider here in the United States? Do you have additional relevant recommendations for policymakers on this issue?

The case for replacing strategic crude stocks with refined product reserves is not straightforward in the United States. Managing variations in product demand may be best left to market participants in America, although there is a case for product reserves in certain regions of the country that are particularly vulnerable to fuel supply disruptions, such as the Southeast. I discuss this issue further beginning on page 42 of this recent report I co-authored with colleagues at the Center on Global Energy Policy. The study is available under the link below:
https://energypolicy.columbia.edu/sites/default/files/pictures/CGEP_New%20Realities_%20New%20Risks_%20Rethinking%20the%20Strategic%20Petroleum%20Reserve.pdf

Question from Senator Ron Wyden

Question: My colleagues, Senators Smith and Hirono, expressed their concerns about the EPA’s plan to roll back fuel economy standards for light-duty vehicles in model years 2022-2025. In your responses, you highlighted some benefits of the existing standards, such as greater resiliency to oil price shocks, lower greenhouse gas emissions, and greater certainty for long-term planning for both industry and consumers. I believe the President’s plan to roll back these

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standards will harm the U.S. economy and Americans struggling to get by, especially since the average price of gasoline increased by over 20 percent since last year.

What quantitative impact do you think the proposed rollback of the EPA 2022-2025 light-duty fuel economy standards will have on Americans at the pump?

As I explained in a recent paper (<https://energypolicy.columbia.edu/research/report/making-sense-trump-administrations-fuel-economy-standard-rollback>), gasoline consumption would begin declining after 2020 if the originally-planned fuel efficiency standards were implemented, according to the EIA. Relative to that projected decline, rolling back the 2022–2025 standards entirely would lead to 249,000 bpd higher fuel consumption in 2025, rising gradually to 626,000 bpd in 2030; 923,000 bpd in 2035; 1.1 million bpd in 2040; 1.3 million bpd in 2045; and 1.4 million bpd in 2050. That increased consumption would most likely lead to higher consumer gasoline expenditures, with the extent of that increased spending dependent on future gasoline prices. In an analysis conducted in 2016, the EPA and the NHTSA also concluded that the economic and societal benefits of the 2022–2025 standards—which include fuel cost savings to consumers and greenhouse gas reductions, among others—far exceed the costs.

Questions from Senator Debbie Stabenow

Questions: There is an interest among certain industries, and it seems this administration, to approve as many LNG export terminals and agreements as possible. By doing so, we are pushing LNG markets into something that more closely resembles today's global oil market.

According to the CFTC, the U.S. natural gas industry has been relatively insulated from global forces; however, increasing U.S. LNG exports will expose it to international market dynamics, and thus potentially put upward pressure on U.S. gas prices.

Will increased LNG exports expose U.S. consumer prices to the same global demand that is increasing crude oil prices? Furthermore, do you expect domestic natural gas prices will increase due to the global LNG demand?

Creating a more integrated, flexible, liquid, and competitive global gas market benefits the U.S. as well as our allies around the world. An integrated market improves energy security by reducing the leverage of dominant pipeline gas suppliers. Moreover, increased LNG supply enables gas to respond to changing market conditions more easily, such as Japan's demand surge following the Fukushima disaster, enhancing energy security through more interconnected markets. One of the greatest actions taken to improve public health last year was China's crackdown on the use of coal-fired boilers, which was made possible, in part, by its access to a more competitive and liquid global spot gas market. Indeed roughly a third of China's spot purchases were of U.S. LNG.

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Even in the U.S., we are more secure, not less, when energy markets are interdependent, as we see when a hurricane strikes the Gulf Coast and we need to depend on greater imports, but our credibility to participate in global markets depends on our not restricting energy trade in other cases. Given the volumes of associated gas expected to be produced in conjunction with booming oil production in the Permian basin, that volume of gas is greater than domestic demand, so restricting exports would simply require shutting in more domestic production.

While increased demand from exports may push up U.S. prices slightly, those impacts are modest in light of the large volumes of inexpensive gas in the U.S., and are exceeded by the economic and geopolitical benefits of natural gas exports, as several analyses have found. The ability for global gas prices to transmit to the U.S. through the export channel is also limited by the nature of the contracts that have been signed.

Indeed, the projections in these studies are playing out today, as the U.S. is exporting LNG and has become a net exporter of gas, yet high global gas prices are not being reflected in domestic prices, which remain exceptionally low.

If U.S. gas prices were to rise significantly, whatever the reason, U.S. LNG exports would have difficulty competing in the global market, so there is a self-limiting extent to which exports can push up U.S. prices. A robust government permitting process, based in sound and rigorous analysis, ensures the public is engaged and allows investors and buyers to enter contracts with confidence. Increased uncertainty about the U.S. LNG export approval process makes it more challenging for project developers to deploy the billions in capital needed and undermines the confidence of potential LNG buyers in the sanctity of contracts with U.S. firms.

