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Introduction

Thank you Chairman Murkowski, Ranking Member Manchin, and Members of the Committee. It is my pleasure to appear before you today to discuss the status of the natural gas market and the work being done by the Office of Fossil Energy to support record-setting U.S. natural gas production.

U.S. oil and gas production from shale resources has led us to now be the largest producer of both natural gas and crude oil in the world. Each month, new record-setting levels of production are being achieved. The most recent estimates from the Energy Information Administration's (EIA) Short-Term Energy Outlook show daily production of dry natural gas in 2019 and 2020 at 91.4 and 92.8[1] billion cubic feet per day, respectively. These amounts are an increase of over 60 percent from 2009[2], and this year's production is on pace to exceed last year's by nearly 10 percent.

These high production rates are expected to continue, and projections from EIA show dry natural gas production will reach over 111 billion cubic feet per day by 2040 and 119 billion cubic feet per day by 2050.[3]

The Office of Fossil Energy works on both the research and development (R&D) of natural gas technologies, as well as in the regulatory space. On the R&D front, we strive to enhance U.S. economic and energy security by managing and performing research that maximizes the efficient and environmentally sound production and use of natural gas and other fossil fuels. At the same time, via our

[1] https://www.eia.gov/outlooks/steo/data/browser/
[2] https://www.eia.gov/dnav/ng/hist/n9070us2a.htm
[3] https://www.eia.gov/outlooks/aeo/data/browser/#/?id=13-AEO2019&cases=ref2019&sourcekey=0

regulatory program, we support the development of policy options that benefit the U.S. public by ensuring access to adequate supplies of affordable and clean energy.

Impacts of Unprecedented Production Gains

The impact of ongoing natural gas production gains, and the national security and economic prosperity they have ushered, should not be underestimated. We are now in our third consecutive year as a net exporter of natural gas, and projections from EIA estimate that the United States will be an overall net exporter of energy next year.[4] These exports are not only reducing our trade deficit by billions of dollars each year[5], but are also increasing our national security.

At the same time, over the last few years, natural gas has become the primary fuel used in electric generation, responsible for fueling over 35 percent of the power generated in the United States in 2018.[6] More households are using natural gas as well, with the majority of U.S. households using natural gas for their space heating needs[7]. In 2017, natural gas was delivered to over 69 million residential customers in the U.S.[8]

Last year, natural gas spot prices averaged just $3.15 per one million British Thermal Units (MMBtu), nearly two-thirds less than what natural gas sold for in 2008[9]. Prices during the first six months of 2019 are lower than last year's average spot price, and EIA is forecasting natural gas prices to be below $3.00 per MMBtu through 2020.[10]

Lower energy prices are helping domestic households and businesses, but exports of natural gas are also helping our allies and trading partners with enhanced energy and economic security. According to the International Energy Agency, Europe saved $8 billon on natural gas last year, largely due to US LNG.[11]

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[4] https://www.eia.gov/todayinenergy/detail.php?id=38152

[5] 2018 LNG Volume exported: https://www.eia.gov/dnav/ng/ng_move_poe2_a_EPG0_ENG_Mmcf_a.htm
2018 Price of LNG exported: https://www.eia.gov/dnav/ng/ng_move_poe2_a_EPG0_PNG_DpMcf_a.htm
In 2018, the U.S. exported 1,083.1 Bcf or just under 3 Bcf/d at an average price of $5.20/Mcf.
Multiplying the two together, it's $5.20/Mcf * 1,083.1 Bcf ---> $5.63 B.

[6] https://www.eia.gov/electricity/data/browser/

[7] https://www.eia.gov/todayinenergy/detail.php?id=37433

[8] https://www.eia.gov/dnav/ng/ng_cons_num_a_EPG0_VN3_Count_a.htm

[9] https://www.eia.gov/dnav/ng/ng_pri_fut_s1_a.htm

[10] https://www.eia.gov/outlooks/steo/data/browser/#/?v=16&f=A&s=0&maptype=0&ctype=linechart

[11] https://www.reuters.com/article/us-gas-iea-lng/europe-saved-8-billion-on-gas-bill-in-2018-due-to-lng-reforms-iea-idUSKCN1T80JR

A recent study commissioned by DOE and prepared by NERA Economic Consulting shows that increasing U.S. LNG exports will continue to provide benefits to the American economy and the American worker for the foreseeable future.[12]

Additionally, the increased use of natural gas throughout our Nation's economy has helped lower energy-related carbon emissions to levels not seen since the late 1980s.[13] Because natural gas is the least carbon-intensive fossil fuel, the expanded use of natural gas is reducing energy-related carbon dioxide emissions, particularly in the power sector. The most recent long-term projections from EIA show that U.S. energy-related carbon dioxide emissions will be 4 percent below their 2018 value in 2050 as the use of natural gas in the United States continues to increase.[14]

Role of R&D

The Department of Energy is focused on ensuring a reliable, affordable, and secure domestic supply of oil and natural gas through research into enhanced recovery and reduction of the risks associated with domestic oil and gas production, distribution, and storage.

The U.S. has the most extensive natural gas production, gathering, processing, storage, and pipeline delivery system in the world. DOE's Office of Fossil Energy is focused on the technologies needed to keep the national oil and natural gas system operating at the highest level of efficiency and reliability. This is done by developing next-generation pipeline materials; improving the reliability of gathering, compression, transmission and storage system components; creating sensor platforms capable of identifying and quantifying operational risks and methane emissions; advancing technologies for repairing pipeline damage without disruption of service; and developing cost-effective technologies for the capture and utilization of methane that would otherwise be flared or vented.

The Office of Fossil Energy is pursuing early-stage research on new enabling technologies for mitigating against methane emissions and enhancing the cyber-physical security and resilience of natural gas pipeline infrastructure. These methane emissions mitigation efforts are focused on a combination of

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

13 https://www.eia.gov/totalenergy/data/browser/index.php?tbl=T12.06#/?f=A&start=1973&end=2018&charted=0-1-6

developments in new sensor technologies combined with artificial intelligence for real-time operational monitoring and early fault prediction as well as advanced materials for pipelines, including liners and coatings.

In addition to ensuring security and resilience of the current pipeline infrastructure, these technologies also support the Department's vision for a more flexible and intelligent pipeline network designed to meet future challenges.

Methane Emissions

Through real-time monitoring of operational conditions, including distributed chemical monitoring within the pipeline interior, multiple types of fluids and gases can be transported safely, securely, and in an environmentally responsible manner. Examples include natural gas and hydrogen transport for power generation as well as CO_2 transport for carbon sequestration and utilization.

In areas where natural gas is produced at oil wells but is not economical to transport for sale, it is often burned at well sites. Flaring and venting during routine system operations or planned system disruptions is recognized as a significant waste of a valuable resource. Reducing the amount of methane that is released to the atmosphere during natural gas production, processing and transportation is an important objective for the Program.

Fossil Energy's long-term objectives for this research are to develop alternatives to reduce flaring and venting during the production of oil and other routine oil and natural gas system operations through the conversion of natural gas into value-added, transportable products. This will enable flared, vented, or otherwise rejected gas to be monetized instead of lost as an asset.

Fossil Energy's research on unconventional oil and natural gas development is focused on the production of hydrocarbons, natural gas and oil, from shale formations. The portfolio of projects is balanced among efforts to indirectly reduce impacts by improving recovery efficiency; developing and testing cost-effective environmental regulatory compliance technologies; and more accurately quantifying and assessing the environmental risks associated with various elements of the exploration and production process.

Unconventional Oil and Natural Gas Research

Fossil Energy's unconventional oil and natural gas research is proceeding along three parallel paths. The first path is to identify and accelerate development of

economically-viable technologies to more effectively locate, characterize, and produce natural gas and oil resources, in an environmentally acceptable manner. The second is to characterize emerging supplies of oil and natural gas at the resource and reservoir level and publish this information in a manner that supports effective development. The third is to catalyze the development and demonstration of new technologies and methodologies for limiting the environmental impacts of unconventional oil and natural gas development activities. The program advances these objectives by identifying key research questions that present a challenge to industry and identifying enabling technologies to address these questions.

Basin-Specific Research

The Department is also pursuing basin-specific research through the establishment of field laboratories via public-private partnerships and in coordination with the National Labs. The Department currently has seven field laboratories in the Marcellus, Permian, Alaska, Tuscaloosa Marine, and Eagle Ford. These field labs are addressing ways to increase recovery of unconventional oil and gas resources and to improve operational efficiency. These projects are researching ways to improve recovery of light and heavy oil, using natural gas for enhancing oil recovery, and investigating the potential for multi-play production of unconventional reservoirs. Recently, we announced the selection of four additional field lab projects. Our goal is to have a field laboratory in every major basin in the United States.

Department of Energy's Statutory Authority

The Department of Energy's (DOE) authority to regulate the export of natural gas arises under section 3 of the Natural Gas Act (NGA), 15 U.S.C. § 717b. This authority is vested in the Secretary of Energy and has been delegated to the Assistant Secretary for Fossil Energy.

Section 3(a) of the NGA sets forth the standard for review of most LNG export applications:

> [N]o person shall export any natural gas from the United States to a foreign country or import any natural gas from a foreign country without first having secured an order of the [Secretary of Energy] authorizing it to do so. The [Secretary] shall issue such order upon application, unless after opportunity for hearing, [he] finds that the proposed exportation or importation will not be consistent with the public interest. The [Secretary] may by [the Secretary's] order

> grant such application, in whole or part, with such modification and upon such terms and conditions as the [Secretary] may find necessary or appropriate.

The Department has consistently interpreted section 3(a) as creating a rebuttable presumption that a proposed export of natural gas is in the public interest. Under this provision, DOE performs a thorough public interest analysis before acting on applications to export natural gas to non-free trade agreement countries. In addition, DOE must give appropriate consideration to the environmental effects of its proposed decisions under the National Environmental Policy Act (NEPA). Typically for LNG facilities planning to export to non-FTA countries, DOE acts as a cooperating agency to the Federal Energy Regulatory Commission who leads the preparation of environmental impact statements or environmental assessments for proposed LNG export facilities under NEPA.

In the Energy Policy Act of 1992, Congress enacted section 3(c) to the NGA. Section 3(c) created a different standard of review for applications to export natural gas to those countries with which the United States has in effect a free trade agreement requiring national treatment for trade in natural gas. Section 3(c) requires such applications to be deemed consistent with the public interest and granted without modification or delay.

The Federal Energy Regulatory Commission (FERC) has jurisdiction under the Natural Gas Act over the siting, construction, and operation of onshore LNG export terminals. For offshore LNG export terminals, this authority resides with the Maritime Administration (MARAD) in the U.S. Department of Transportation (DOT).

DOE Authorizations to Export Natural Gas

Since January 2017, DOE has granted authority to export natural gas to all non-sanctioned countries to several export projects including five new domestic large-scale liquefied natural gas (LNG) projects – Golden Pass and Port Arthur in Texas, Delfin LNG, which is proposed for offshore Louisiana; and Venture Global's Calcasieu Pass as well as the Driftwood LNG project, both proposed in Louisiana. DOE has also authorized exports from Eagle LNG's small-scale project in Maxville, Florida, authorized additional capacity at the Freeport LNG project in Texas as well as the proposed Lake Charles LNG project in Louisiana, and also authorized the re-export of U.S. natural gas as LNG from two LNG export projects proposed for siting in Mexico.

Since DOE began authorizing exports of LNG from the lower 48 states, 32.99 billion cubic feet per day of natural gas has been authorized under section 3(a) of the Natural Gas Act for export to anywhere in the world not prohibited by U.S. law or policy. These non-free trade agreement authorizations are primarily spread across 13 large scale export projects in the United States, seven of which are in various states of construction and operation in Texas, Louisiana, Georgia, and Maryland. One facility in the lower 48 states, Cheniere Energy's Sabine Pass facility in Louisiana, has been exporting LNG since February 2016. A second large-scale facility, Dominion Energy's Cove Point facility in Maryland, began exports in March 2018. Cheniere's Corpus Christi began exporting in December 2018, and the Cameron LNG project in Louisiana just exported its first cargo at the end of May. Two additional export projects, Freeport LNG and Elba Island, are expected to come online this year. And the Golden Pass project, which announced its final investment decisions earlier this year, plans to be online in 2024. At the time all seven projects online or under construction are completed, the U.S. will have approximately 14 billion cubic feet of export capacity, positioning the U.S. as the top global LNG exporter in the world.

At present, there are nine export projects with over 15 billion cubic feet per day of additional export capacity under review at both FERC and DOE. DOE remains committed to taking prompt final action following its thorough assessment of LNG export applications once FERC completes its review. This year, DOE has completed review and has taken final action on all projects that have received FERC approvals within two weeks of FERC's order.

U.S. LNG Exports – Current and Projected

Since LNG exports from the lower 48 began in February 2016, over 2.4 trillion cubic feet of U.S. natural gas has been exported as LNG. To put that into context, just last year, the U.S. exported enough LNG to supply all of Poland and Hungary's natural gas needs for the year.[15] U.S. exported cargos have landed in Europe, Asia, Africa, the Middle East, South America, North America, and the Caribbean – 36 different countries in all. Europe has been the top destination for U.S. LNG so far in 2019, receiving 55 cargos through April of this year. And, led by imports into South Korea and Japan, Asia has been the top importing region of

[15] 2018 US LNG Exports were 1,083 Bcf or 30 bcm. Per I H S, Poland's estimated 2018 NG demand was 19 bcm, and Hungary's was 10 bcm.

U.S. LNG over the last three years that the U.S. has been exporting LNG from the lower 48 states.

Along with the increased export capacity coming online, increased exports of U.S. LNG are expected to continue to grow. EIA's most recent Short-Term Energy Outlook shows that LNG exports will be 4.84 billion cubic feet per day in 2019 and are expected to rise to 6.86 billion cubic feet per day in 2020[16]. Looking long-term, EIA's Annual Energy Outlook 2019 projects that U.S. LNG exports will reach an average of 14.4 billion cubic feet per day by 2029. EIA's long-term projections show that U.S. LNG net exports will remain at approximately 14 billion cubic feet per day through 2040.[17]

Appalachian Petrochemical Industry

As mentioned earlier, the U.S. energy renaissance has transformed communities across the country. Through April of this year, natural gas production in the Appalachian Basin has represented 35[18] percent of total U.S. natural gas production, and that number is expected to increase.[19] With this surge in natural gas production throughout the Appalachian Basin comes the opportunity to foster a petrochemical industry renaissance in the region. Natural gas – especially the wet gas found in the Appalachian region – is a vital feedstock for the manufacturing of a wide array of consumer products that Americans use every day.

Industry has estimated that promoting an Appalachian petrochemical industry can support a total of five crackers, 100,000 jobs and contribute to the revitalization of the region.[20] Shell is currently constructing an ethane cracker plant in the Appalachian region, which is currently supporting more than 5,000 union construction jobs and will support 600 permanent jobs when it is finished. In addition to Shell's facility, one in Ohio is on the cusp of a final investment decision.

These ethane cracker plants support both direct and indirect jobs throughout the region, bring in tax revenues to communities, provide opportunities for

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[16] https://www.eia.gov/outlooks/steo/data/browser/#/?v=15&f=A&s=0&ctype=linechart&maptype=0

[17] U.S. Energy Info. Admin., *Annual Energy Outlook 2019* (Jan. 24, 2019), *available at*: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=76-AEO2019&cases=ref2019&sourcekey=0.

[18] Sum of YTD Appalachian production from Drilling Productivity Report divided by total U.S. dry production https://www.eia.gov/petroleum/drilling/#tabs-summary-2 and https://www.eia.gov/naturalgas/monthly/pdf/table_01.pdf

[19] https://www.eia.gov/todayinenergy/detail.php?id=38652

[20] https://www.americanchemistry.com/Appalachian-Petrochem-Study/

hardworking Americans to fundamentally transform their lives and give our Nation the opportunity to diversify its energy and petrochemical production. DOE remains committed to working with stakeholders at all levels of government, industry and academia to promote these developments.

Conclusion

Natural gas has transformed our Nation and the world for the better. The increased use and production of natural gas has grown our economy, created countless American jobs, and made our air cleaner. Further, increasing exports of domestically produced natural gas to 36 countries around the world has given our allies a stable, reliable and secure source of clean energy. Natural gas has proven to be, and will continue to be, a vital part of this administration's commitment to an all of the above approach to energy.

Thank you for the opportunity to appear before you today and I look forward to your questions.