U.S. Senate Committee on Energy and Natural Resources hearing to examine the status and outlook for US and North American energy and resource scarcity

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Chairman Murkowski, Ranking Member Cantwell, and members of the Committee, I appreciate the opportunity to testify before you today on the current status and outlook for US and North American energy and resource scarcity. I appear before you in my role as a Senior Director of Boston Consulting Group's Center for Energy Impact. I am also a Fellow at the Columbia Center on Global Energy Policy. In both roles I focus on the trends and expectations in oil and gas for the world and the United States in particular.

The United States is undergoing an energy revolution that is expanding US oil and gas capabilities in all ways, from production, to pipelines, refineries, storage facilities and export terminals. This has impacted the global supply/demand balance, changed trade relationships, and lowered prices for US consumers. This increased energy security has allowed the United States to take a leading role as a global energy supplier.

The expansion--first in natural gas and then oil production--in the United States has been nothing short of impressive. The US Energy Information Administration (EIA) has noted that the country has recorded its 5th year as the biggest natural gas and oil producer in the world[1]. US natural gas production began to rise strongly in late 2006, spurred by high prices and aided by technology breakthroughs and the benefits of the US system, to include infrastructure, a ready workforce, and mineral rights ownership. In light of this, US energy security concerns about a lack of sufficient natural gas in light of waning Canadian natural gas imports and the need for substantial LNG imports soon vanished. US natural gas production, as measured by gross withdrawals, have risen from 66 billion cubic feet per day (bcf/d) to 89 bcf/d[2] over the past 10 years. This glut resulted in lower prices causing some producers to turn towards the more lucrative business of tight oil production. The United States, formerly a powerhouse in global crude oil production had experienced continuous declines for more than 20 years. Thanks to shale, US production began to rise, eventually recording one of the highest growth years for a country ever recorded when in 2014, more than 1.5 million barrels per day (mmb/d)[3] was added to the country's already growing supplies.

The success in renewed natural gas and oil production has caused an oversupply in both markets, depressing prices. For natural gas the price decline began in late 2008 and Henry Hub natural gas prices have never sustainably risen above $5/mmBtu[4] since that point. US producers adjusted in several ways to this market change, allowing natural gas production growth to continue—it is now about 30% higher than when prices fell.

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[1] https://www.eia.gov/todayinenergy/detail.php?id=26352
[2] https://www.eia.gov/dnav/ng/ng_prod_sum_a_EPG0_FGW_mmcf_m.htm
[3] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFPUS2&f=M
[4] https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm

The resiliency of US producers was aided by finding new markets, with US LNG now being offered for sale on a global basis. Far from imperiling US energy security, these rising exports are actually increasing energy security for both the US and the world[5]. The ready export outlet will allow producers to keep natural gas flowing into homes and power plants, and at less cost. Exports of LNG are providing consumer countries with another choice of energy supplier, allowing them to negotiate for better pricing, and increasing global energy security. US LNG, with its pricing usually tied to the Henry Hub in Louisiana is also reshaping how natural gas is priced, increasing liquidity and pushing what was once a local or regional market, into a globalized market for an increasingly vital fuel for economic development

This renewed capability to serve domestic and international consumers with reliable supply has been supported by an expansion in US infrastructure. The most notable example of this is the development of the Marcellus shale, a natural gas play that extends from New York to West Virginia[6]. This development is allowing the northeast to morph from the highest cost region in the country, dependent on natural gas from the Gulf Coast and Canada, into a producing giant expected to provide more natural gas than the rest of the entire United States. Since 2006 US natural gas pipeline capacity, as measured by state inflow, has increased by 112 Bcf/d, a 27% increase. Mush of this increase has occurred in the northeast and the Mexican border area as that country has increased its energy relationship and dependence on reliable and economic US natural gas supplies.

The US restarted exports of LNG in early 2016, and is now expected to be one of the top three global natural gas exporters by 2020. To meet this, the EIA expects LNG export capacity of more than 11 Bcf/d by 2020, with proposed projects on the East, Gulf and West coasts. The ability to store natural gas, important for operational, seasonal and energy security issues, has also expanded in recent years in tandem with the growth in production. Storage capacity is up more than a trillion cubic feet over the past 10 years, with more than 20 new fields added.

Oil from the shale regions only increased sharply after natural gas prices fell, ramping up beginning in 2009, and arguably had its first significant international impact in 2011 when US light sweet crude oil began to replace imported barrels from OPEC member Nigeria. This was an important energy security turning point as blunted the risk of production outages from the country. Nigerian production outages, caused by strife in the Niger Delta region were a key factor in raising global oil prices above $100/b in 2008. That summer US drivers paid as much as $4.72 for a gallon of gasoline[7]. US oil production has largely displaced Nigerian oil imports, which have dropped from 1.1 mmb/d in 2010 to just 0.2 mmb/d[8] today.

An example of this increased energy security was seen in 2011, as increased production of US light sweet crude oil helped to offset some of the barrels and quality differentials caused by the loss of Libyan barrels as that country's civil war raged and its oil production fell from 1.6 mmb/d to nearly zero[9]. This prevented already high prices from rising higher.

Turning to the ongoing low oil price environment, it was the growth of US and other production in 2014 amid temporarily weak demand that catalyzed the price decline beginning in the third

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[5] https://blogs.wsj.com/experts/2017/05/25/how-liquefied-natural-gas-will-transform-global-energy-markets/
[6] https://www.eia.gov/maps/pdf/MarcellusPlayUpdate_Jan2017.pdf
[7] Per Patrick DeHaan at gasbuddy.com
[8] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRIMUSNI1&f=M
[9] http://www.jodidb.org/TableViewer/tableView.aspx

quarter, with WTI dipping below $100/b at the end of July 2014. Prices continued to fall to as low as $26/b in early 2016, a price not seen since the early 2000s. However, in the wake of sustained low prices since then US producers have remained resilient. In response to low prices, US producers cut costs, streamlined processes and utilized new techniques to get more oil out for less resources and time. 8% of drilling companies shuttered their doors[10], but the capacity of the industry was largely undamaged. A rig brought on today delivers 2.5 times the production of a rig in 2014, and more than 3 times for a rig in the Permian basin in West Texas[11]. Production out of the shale regions is now an estimated 0.4 mmb/d higher than it was when prices began to collapse.

There are concerns about the longer-term durability of North American energy security despite the continued production growth, particularly around oil. Most of these stem from the fact that the analytical community is still learning about shale as its production evolves, and how it will fit into the global picture. These risks include:

- **High decline rates**. Oil production in the shale regions currently declines by as much as 0.3 mmb/d[12] every month, requiring substantial activity and investment to both offset this decline and deliver growth. Any sharp curtailment of drilling in core areas could allow decline rates to overcome the underlying growth of new wells.
- **Drilled but uncompleted wells.** Drilled but uncompleted wells in the Permian basin have risen by an estimated 80% in the past year, but oil and gas extraction employment is only up 0.4% and hourly pay is down 2.1%. If shale is choked back because of insufficient manpower or other inputs, production growth could decline.
- **A dependence on the Permian.** Oil from shale and tight formations has changed from a growing resource in many regions, to only one. Since the OPEC cut in November 2016, more than 60% of increased production has come from the Permian, placing additional pressure on a region that has had difficulty bringing on sufficient frac crews.
- **Sufficiency in the global context.** The oil in the US shale regions produce an estimated 5.4 mmb/d, or ~6% of global production, while all the US produces 13.1 mmb/d, ~13% of production[13]. This relatively small quantity of US production helped bring prices down in 2014, but a sharp potential rebound in price could occur as waning investment in conventional production impacts the roughly 60% of global non-OPEC supplies.

The story of the renewal of US oil and gas production is increasingly well known. Less well known is the increased capacity that is supporting it, increasing energy security for the United States but also the world. The Permian basin, the source of most of US shale's current production growth, would be nowhere without the supporting, existing pipeline infrastructure in place. This light sweet crude would not find its way into the gas tanks of US automobiles, without the world class refining system centered on the US gulf coast. US refining capacity has reached 18.6 million barrels per day (mmb/d), up more than 1 mmb/d in the last 5 years[14]. Aided in part by cheap natural gas, these refineries can efficiently deliver a variety of economical fuels to vehicles and other end users.

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[10] https://data.bls.gov/timeseries/ENUUS000205211?amp%253bdata_tool=XGtable&output_view=data&include_graphs=true

[11] BCG CEI analysis with raw data from EIA and Baker Hughes

[12] https://www.eia.gov/petroleum/drilling/pdf/dpr-full.pdf

[13] IEA Oil Market Report, EIA Drilling Productivity Report

[14] https://www.eia.gov/todayinenergy/detail.php?id=32012

The capacity to store oil and refined products has also expanded. In the last 5 years crude storage capacity has increased by more than 100 million barrels[15]. The ability to store oil is crucial for the expanded operational needs of the producers and refiners and has proven useful during the global oil market oversupply of the past several years, allowing crude and refined products to be ready for use when the market requires it. This expanded storage capacity will also support the operational needs of the rapidly expanding crude export capabilities, made possible in part by the efforts of some of the members of this committee. US crude oil is now reaching more than 26 countries, decreasing prices and increasing energy security around the world.

The advantage to increased production, pipeline, refinery and storage capacity in the United States is an expansion of not just our own energy security, but the ability to extend that to other countries. Add to this impressive mix the fact that the US has the most transparent, frequent and capable energy data system in the world. This allows the benefits of the US to be known and transmitted to all market participants.

[15] https://www.eia.gov/petroleum/storagecapacity/