NATIONAL PETROLEUM COUNCIL

PETROLEUM MARKET DEVELOPMENTS

Progress and Actions to Increase Supply and Improve Resilience

December 2022

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Alan S. Armstrong, Vice Chair
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U.S. DEPARTMENT OF ENERGY

Jennifer M. Granholm, Secretary

The National Petroleum Council is a federal advisory committee to the Secretary of Energy.

The sole purpose of the National Petroleum Council is to advise, inform, and make recommendations to the Secretary of Energy on any matter requested by the Secretary relating to oil and natural gas or to the oil and gas industries.

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Appendices

1. INTRODUCTION

In mid-June 2022, President Biden wrote to seven major refiners in the United States concerning his views on the energy situation and its impacts. In those letters, he stated that he was directing the Secretary of Energy to convene an emergency meeting and engage the National Petroleum Council (NPC). As a result, Secretary Granholm requested a meeting with the NPC's Cochairs' Coordinating Committee (CCC), given that a purpose of the CCC is to discuss emerging issues with the Secretary and to discuss whether an NPC study would be useful. The CCC had a productive meeting with the Secretary on July 1st and provided the Committee members' individual views on the then-current situation and potential actions that could be taken in response. Subsequently, by letter dated July 29, 2022, the Secretary requested the Council to provide certain information and formal advice on these topics. The Secretary's letter, in part, requested:

1. Details, within 30 days, of (a) how industry is working to supply oil and refined products to meet U.S. demand; and (b) near-term steps the administration can consider to increase U.S. supply.

2. An analysis, within 120 days, of (a) the evolving global oil market and its implications on U.S. supply; and (b) industry efforts to support a net-zero economy by 2050.

As required by the Council's Articles of Organization, the NPC Agenda Committee reviewed the Secretary's request, and recommended that the request be accepted. In a follow-up discussion, Deputy Secretary of Energy David Turk explained that implicit in both the 30-day and 120-day requests is the desire to have the NPC's views on ways to improve government and industry coordination in responding to incidents of significant supply disruptions.

Consistent with the Agenda Committee's favorable recommendation, Deputy Secretary Turk's clarification, and in accordance with the Council's Articles of Organization's provision for addressing urgent requests from the Secretary, the Council:

- Utilized the membership of the Cochairs' Coordinating Committee, expanded as necessary, to respond, and constitute an NPC Committee on Short-Term Actions and Transition Strategies.

- Appointed Vice Chairs to lead three work streams:
  - Short-term industry and government actions
  - Emergency preparedness planning
  - Evolving global markets and the transition to net zero.

Figure 1 shows the organizational structure and workgroup leaders.

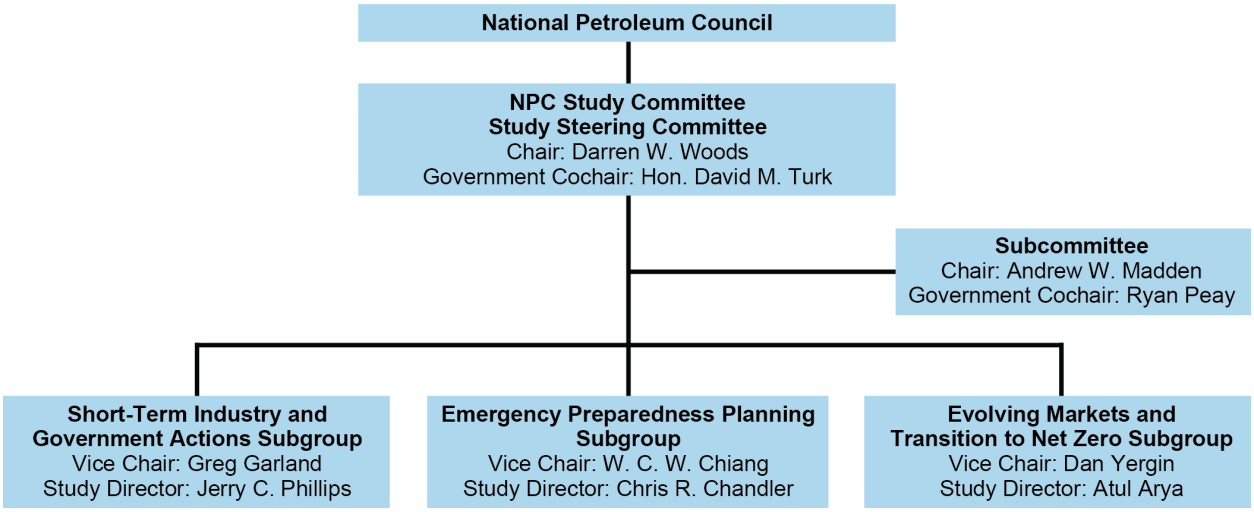


Figure 1. Organizational Structure

Appendix A provides a copy of the Secretary's July 29, 2022, letter, and a description of the National Petroleum Council. Appendix B provides rosters of the Committee on Short-Term Actions and Transition Strategies and its subgroups. Participants in this study contributed in a variety of ways, ranging from work in all study areas, to involvement on a specific topic. Involvement in these activities should not be construed as a participant's or their organization's endorsement or agreement with all the statements, findings, and recommendations in this report. Additionally, while U.S. government participants provided significant assistance in the identification and compilation of data and other information, they did not take positions on the study's recommendations. The Council is very appreciative of the commitment and contributions from all who participated in the process.

However, as a federally appointed and chartered advisory committee, the NPC is solely responsible for the final advice provided to the Secretary of Energy.

1.1 Report Objectives

Secretary Granholm requested the NPC to provide a list of (1) the ways industry is preparing to secure consistent, physical supply for the American people, and (2) near-term actionable steps the Administration can consider to help increase physical supply of oil and refined products while continuing safe, efficient operations and maintenance of production facilities. "Supply" was clarified to refer to crude oil, refined petroleum products, natural gas, and natural gas liquids.

Other questions were raised in the Secretary's letter:

- How can we increase supply? Where is there efficiency and/or opportunity to increase current supplies of crude oil and refined products?
- What are current constraints and market hurdles to getting affordable products to U.S. consumers?
- How are companies reevaluating traditional emergency preparedness? Given the current tight market, how is industry making sure inventories are well supplied should there be a critical disruption from major and/or multiple storms, a cyber-attack, or other unforeseen events that would cause refineries or pipelines to shut down? What additional actions can the government be taking in coordination with industry to help enhance preparedness?

Finally, the Secretary requested that the Council provide an analysis of the changing global crude oil supply and the impacts on U.S.-based producers, suppliers, and refiners, as well as steps being taken by the industry to be an active player in a net-zero economy by 2050.

1.2 Approach Taken

The NPC Committee on Short-Term Actions and Transition Strategies organized three work groups to help develop a proposed final report for the Council's consideration. The three groups were organized to pull together expertise to address the questions as follows:

1. Short-term industry and government actions – Compile a list of actions being taken and suggested government actions that may assist in increasing supply of crude oil, refined products, natural gas, and natural gas liquids.

2. Emergency preparedness planning – Review the NPC study from 2014 and the supplement from 2016 to assess whether the findings are still relevant and the status of implementation as well as incorporating learning from more recent supply disruptions.

3. Evolving global markets and transition to a net-zero economy by 2050 – Outline the principles to be adhered to and the steps being taken by industry to help ensure a manageable transition to a net-zero economy.

Unless otherwise noted, the sources of the data in this document are the Department of Energy's Energy Information Administration (EIA) annual and monthly production data, inputs, and utilization data, as well as import/export data and weekly product supplied data.

On November 14, 2022, a Workplan and some initial considerations were sent to the Deputy Secretary of Energy David Turk and all Council members. This final report includes the response to the Secretary's questions on petroleum markets. This report provides an analysis of the current petroleum markets and an assessment of the emergency response preparedness with recommendations on steps that could be taken to improve both supply of crude oil and

petroleum products as well as improving emergency preparedness. A second companion report of this study provides a longer-term analysis of the principles to be adhered to and the steps being taken to help ensure a manageable energy transition.

The results of this study have been divided into two distinct reports, this one covering the short-term actions and emergency preparedness and the second being the actions being taken and principles to ensure a manageable energy transition. While there was a single request from the Secretary, and the two topics do have some linkage, they were separated to directly address the different audiences and readers of the reports.

2. EXECUTIVE SUMMARY

Affordable energy is essential to help improve the quality of life for global citizens and to help economic growth. The global energy system is both large and complex. The last three years have seen dramatic changes in energy demand and supply caused initially by the COVID pandemic and resulting drop in demand following lockdowns and restrictions on travel followed by the recovery in demand as the lockdowns and restrictions were eased. The Russian invasion of Ukraine and resulting sanctions in 2022 have also had a significant impact on energy supplies and trade flows.

The changes in demand for petroleum products have resulted in large swings in energy price as the markets rebalanced. In 2020 oil prices fell to -$37.63/bbl in response to the drop in demand and then, as the demand recovered, prices rose to a high of $130.5/bbl in March 2022, also impacted by the sanctions imposed after the Russian invasion of Ukraine. Despite the dramatic changes in demand, the global energy markets have effectively responded to the market signals to initially cut supply and then to increase supply as demand recovered. The energy system has been resilient although the high prices in 2022 have had significant impacts on consumers in the United States and across the world. While allowing the markets to work is critical to enabling the energy system to respond to the dramatic changes, there are steps that can be taken to mitigate the impact on consumers.

The United States is an essential part of the global energy system. It is the largest producer of crude oil and natural gas, and also exports significant volumes of natural gas, crude oil, natural gas liquids, and refined products to the rest of the world. In addition, to balance demand it also is an importer of crude oil and refined products. The role of the United States as a producer, importer, and exporter of energy provides critical stability to the global energy system and to the United States.

While the experience of the last three years has shown the resilience of the global energy system, it has also again demonstrated the need to allow the energy markets to function as efficiently as possible to avoid disruption. There are a number of key areas where industry and the administration can continue to work together to ensure the energy markets are as efficient as possible. These include ensuring continued free access to imports and exports of natural gas, crude oil, and refined products, removing barriers to supply such as permitting of production and processing, and enabling low-cost transportation for all types of energy.

Disruptions to the energy supply do occur from time to time and there has been significant progress made by both industry and the administration in recent years to improve the resilience of the energy system and the ability to respond to disruption. Growth in crude oil production, natural gas and refined product production capacity has made the energy supply more resilient and combined with improvements in the ability of the administration and industry to respond to disruption the overall resilience of the U.S. energy system has improved. Despite the progress, there is opportunity to further improve this resilience through continued

collaboration between industry and the administration in areas such as granting waivers to fuel specifications and easing transportation constraints in times of disruption.

The recent experiences of swings in energy supply, demand, and prices have highlighted the need for a very thoughtful approach to the energy transition. The energy transition to lower emissions will be a long and complex transition. Oil and gas will continue to be an essential piece of the energy mix throughout the transition. To avoid unintended shocks to the energy system through the energy transition, there are a number of key principles that will need to underpin the approach and policy in the United States. These are:

- The transition should be targeted on reduction of net GHG and source agnostic, not the elimination of specific energy sources.
- Development of required new technologies should be enabled by enhanced technology collaboration between industry, government, and other institutions.
- Consistent and harmonized policy support should be focused on accelerating deployment of these technologies as well as ensuring ongoing resilience of the global, and by extension, the U.S. energy system.
- Policies that inadvertently cause shortages and consumer pain should be avoided.
- The oil and gas industry, other energy industries and institutions, and federal, state, and local government each has an essential role to play in reducing emissions; policy makers should establish appropriate forums to ensure appropriate collaboration to address the difficult choices to balance the “three-legged stool” of energy security, energy affordability, and climate stewardship.

There are many areas in which the U.S. industry is deeply engaged to help with the transition to lower emissions, and if these principles are applied, the United States has the resource base along with the technological and economic capability to be a continued leader in the energy transition. The energy transition is covered in the separate report.

3. SUMMARY OF RECOMMENDATIONS

1. **Support continued crude oil, gas, and petroleum products exports –** Petroleum liquids markets are global. Free, unrestricted trade is key for the efficient operation of markets and enabling lowest cost supply. Export bans would interfere with the efficient flow of crude oil, products, and natural gas, exacerbate the tight supply/demand balance, and increase prices to consumers. For these reasons, U.S. exports should not be restricted.
2. **Reform certification and permitting of energy infrastructure** – Infrastructure is essential to maintain or grow all types of domestic energy production and supply. Comprehensive permitting reform is required to ensure cost-effective energy supply both now and through the energy transition.
3. **Temporarily relax RVP standards and the RFG requirements –** While not recommended at this time because the summer ozone season has come to an end, relaxing the RVP standards for gasoline and/or the RFG requirements during times of emergency or short supply would enable additional production of gasoline by blending higher RVP components.
4. **Temporarily relax biodiesel blending labelling requirements –** Current requirements for labelling of the diesel pumps at a retail site require the specific percentage of the bio component to be noted. When switching to higher or lower percentage blends, the pump needs relabeling each time. Modifying the requirement to something like "contains a maximum of B20" would make the switching easier, enabling increased supply.
5. **Encourage industry investment** – Uncertainty in policy regarding traditional forms of energy has made it more difficult to attract investment. Policies should encourage investment in all forms of energy to avoid underinvestment in traditional forms of energy which will be needed for many years to come.
6. **Jones Act – Facilitation and broadening of waivers** – The Jones Act requires any cargo traveling by sea between two U.S. ports to be on an American owned ship, built in the United States with a crew where the majority are U.S. citizens. The limited number of Jones Act ships and these limitations means that these ships are considerably more expensive than foreign flagged ships, which are routinely used for moving cargo into or out of the United States from other countries. The Jones Act requirement therefore increases the cost of moving product, resulting in higher prices for the consumer. While removing the Jones Act would have the largest impact on ease of movement of product and hence prices, there are other drivers for the Jones Act which makes this step unlikely. An alternative is to make the use of waivers as straight forward as possible and to consider blanket waivers during, for example, hurricane season or during the winter.
    - Blanket waivers are recommended for LNG vessel movements. Regional locations in the northeast, such as Boston, are supplied primarily by LNG foreign flag vessels. Currently, due to essentially no supply of U.S. LNG vessels, the region is not able to be supplied by Jones Act and therefore should be exempt from Jones Act vessel requirements.

7. **Postpone rebuilding the Strategic Petroleum Reserve** – Consistent with the current intent, delaying refilling the Strategic Petroleum Reserve of crude in the U.S. Gulf Coast region until at least the fourth quarter of 2023 will avoid an impact on crude oil and hence refined product prices. Congress should immediately begin work to "bookout" future SPR sales.

8. **Explore options to increase further the utilization of spare refining capacity in China and to reduce emissions costs in Europe** – While there has been some increase recently, the export quotas for fuels in China have resulted in under-utilization of the refining capacity despite the strong market signals. Increases in these quotas would likely help increase the supplies of petroleum products and hence ease price pressures. In addition, the Emissions Trading Scheme in Europe impacts the cost of running refineries in Europe. As European supply is required to supply the world markets, these costs are impacting global product prices. Temporarily reducing or removing these costs would reduce the cost of petroleum products across the world, including in the United States.

9. **Continue progress on strengthening the ability of the United States to enhance emergency preparedness and respond to supply disruptions** – Progress the recommendations outlined in the Emergency Response Preparedness section of this report to build on the good progress to date and further strengthen the industry/government collaboration to improve emergency preparedness.

    - Ensure that continued progress on implementing the recommendations from the 2014/2016 NPC studies is sustained, as outlined in Appendix C.

    - Further enhance the joint government/industry sector coordinating groups:

        - It is recommended that the Department of Energy (DOE) include the ONG and DNG ISACs as they develop the requirements, scope, and remit of the Energy Threat Analysis Center (ETAC). The ETAC, which is in the pilot phase, is intended to partner with the Joint Cyber Defense Collaborative (JCDC), which coordinates DOE's response to cyber incidents impacting or potentially impacting the energy sector that require a coordinated response with industry and interagency partners.

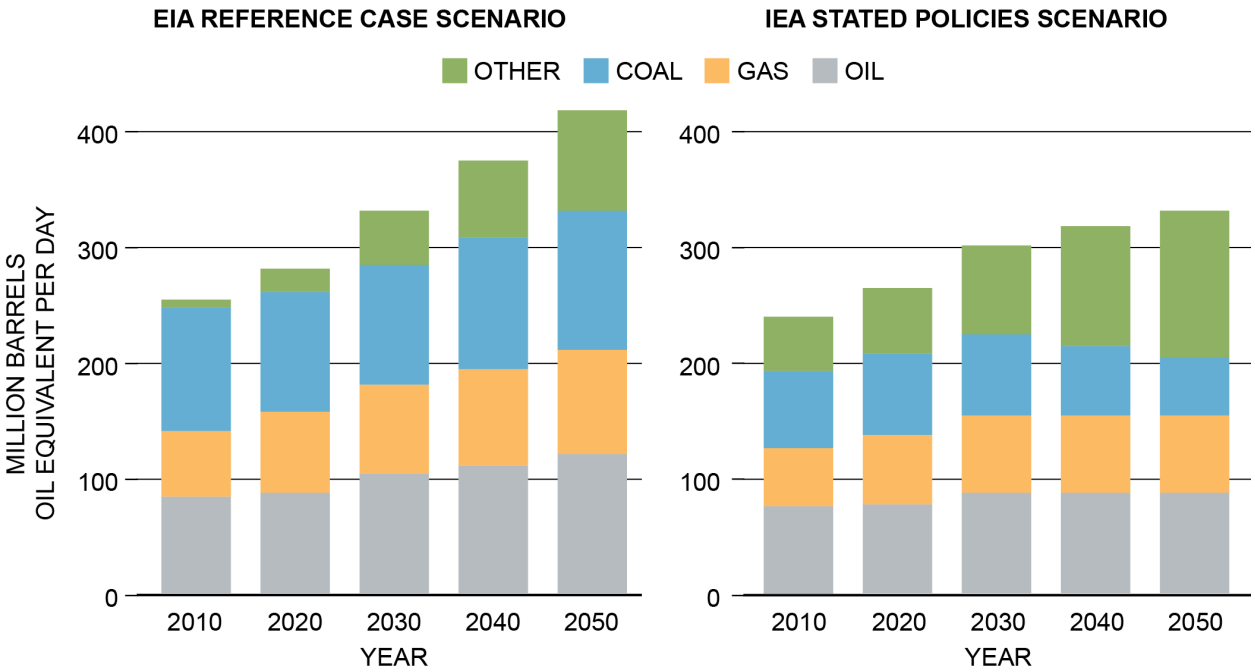
        - It is recommended that the ONG SCC establish a written process to rapidly establish a team of executive representation for each event from those companies which have operations in the impacted region and can provide the information and resources to affect a rapid recovery. This likely involves companies from the upstream, midstream, and downstream sectors including transportation and customer suppling companies.

    - Focus on increasing domestic production and enhancing infrastructure rather than the creation of a Strategic Product Petroleum Reserve or the requirement for maintaining minimum product inventories.

4. PETROLEUM MARKET OVERVIEW AND RECENT DEVELOPMENTS

4.1 Global Energy Overview and Role in U.S. Economy

Economic activity and growth require energy, which sustains and improves quality of life. The global economy's use of energy has become more efficient over time, requiring less each year to produce a dollar of economic activity. Nearly all estimates show global economic growth in coming decades will result in heightened energy needs. Global growth assumptions, demographics, environmental and energy policy objectives and technologies result in various projections for future energy demand, as shown in Figure 2. Among these, oil, natural gas, and coal continued to supply more than 80 percent of global energy in 2022. Global oil demand is expected to reach a record-high 101.5 million barrels per day in 2023 per the EIA. However, with continued challenges in the work force, supply chain, financial, and energy policies, there has been a lag in investment and drilling activities. Drilling in August 2022 was down by more than 20 percent versus the same point in 2019, per Baker Hughes.



Sources: EIA and IEA.

Figure 2. Global Growth Continues

The United States' role as a global energy producer and exporter has grown. The EIA reports during the first six months of 2022, the United States was a net importer of more than 3.0 million barrels per day of crude oil. Additionally, during this same time period the United States was a net exporter of over 4.0 million barrels per day of petroleum products, and more than 11.4 billion cubic feet per day of natural gas, making the United States the world's top

energy exporter. According to the EIA, over half of the petroleum product exports include propane and other oils, such as NGLs and unfinished oils.

The United States has successfully become the world's top energy producer and exporter while maintaining relatively low domestic energy prices. Free flows of crude oil and petroleum products within the United States and through imports and exports have enabled the development of a strong industry with improved energy security.

4.2 Overview of U.S. Petroleum Markets

The United States is currently the world's largest energy-producing country, providing crude oil and energy products across the globe.[1] Over the past two decades, the United States has become the largest crude oil producer in the world, surpassing Russia and Saudi Arabia in 2018. As the energy leader, the United States' position is key to provide global energy stability despite geopolitical challenges.

Crude oil, products, natural gas liquids, and natural gas transactions are negotiated by buyers and sellers using references from various domestic and global market hubs such as NYMEX, Brent, Dubai, etc., with thousands of participants every day. Prices can vary based on location, quality, grade, availability, and a number of other factors.

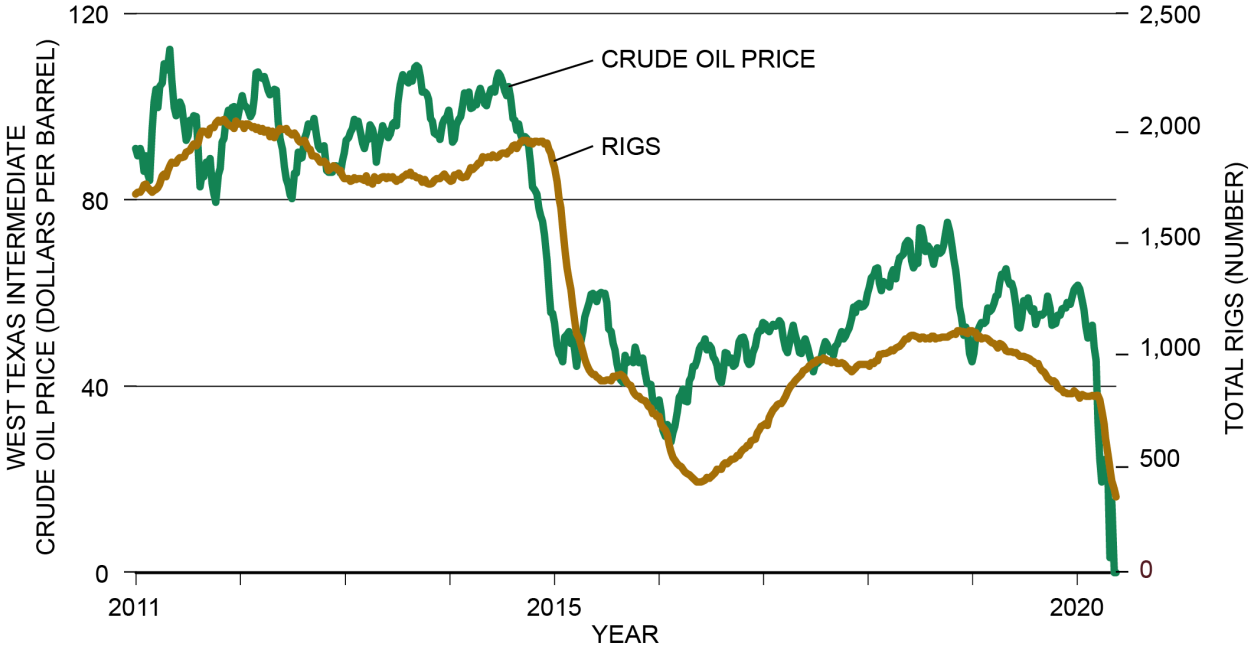
The primary drivers for commodity prices are supply, demand, and inventories. For example, when demand increases and local inventories are low, prices will typically increase. The available industry refining capacity is fixed in the short term as new refining capacity developments typically take multiple years to plan, permit, and build. As such, supply cannot typically quickly adjust and fix short-term deficits versus demand. Prices in this case, therefore, move higher to incentivize imports from other parts of the world and reduce demand until supply and demand are near equilibrium. Conversely, in times of reduced demand and oversupply, prices will fall to drive lower production. The efficient functioning of the markets has been key to managing through the extreme fluctuations in demand and supply over the last three years.

4.2.1 Crude Oil

The oil and gas industry is capital intensive. Management of producing assets and the development of new assets require years of upfront capital investment. Historically, oil and gas investment cycles followed commodity price cycles closely for companies to manage business margin and returns. During the oil price downturns of 2015-2018 and then 2020-2021, the oil and gas industry responded to market conditions and significantly reduced investment.

[1] BP, Statistical Review of World Energy – 2022, The US Energy System in 2021, https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-us-insights.pdf (accessed September 20, 2022).

Specifically, in 2020, U.S. crude oil and natural gas rig count dropped to the lowest level on record (Figure 3).



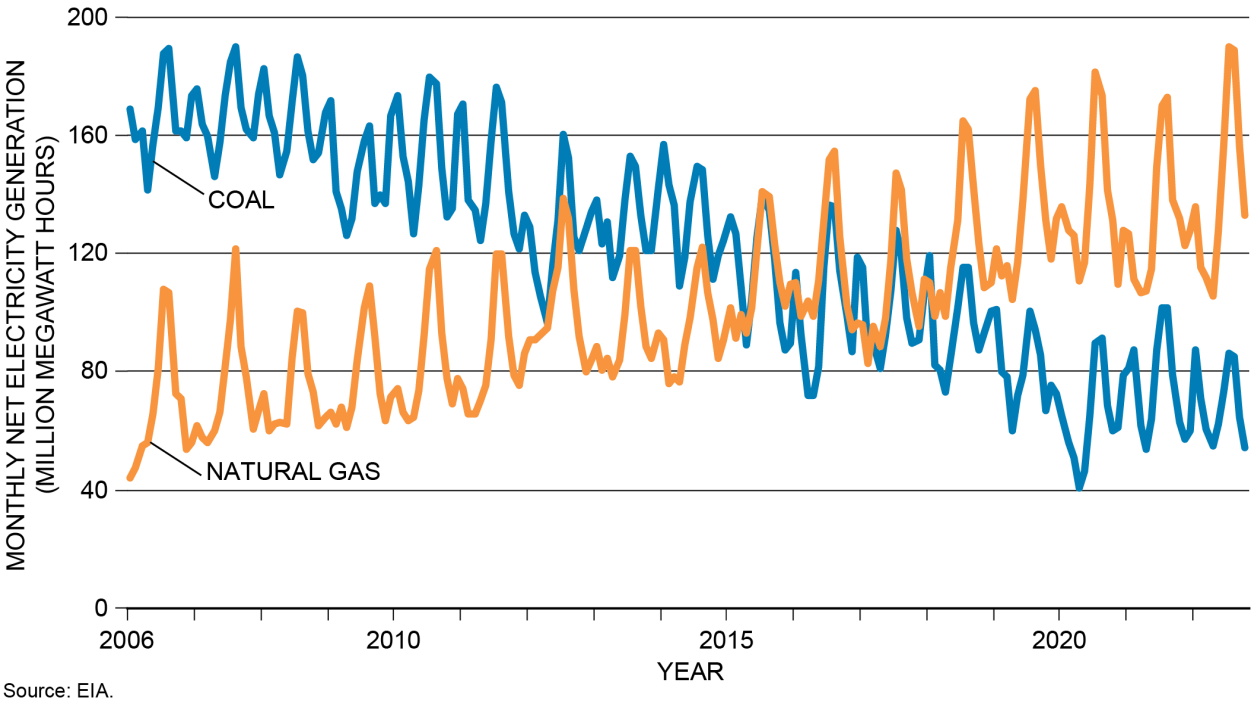
Source: U.S. Energy Information Administration, based on data from Refinitiv.

Figure 3. Crude Oil Prices Impact Capital Investment

Annual crude oil production in the United States first peaked in 1970 and had been gradually declining. In 2009, this trend was reversed due to technology breakthrough in hydraulic fracturing and horizontal drilling that unlocked cheap and abundant tight/shale oil and natural gas resources in the United States.

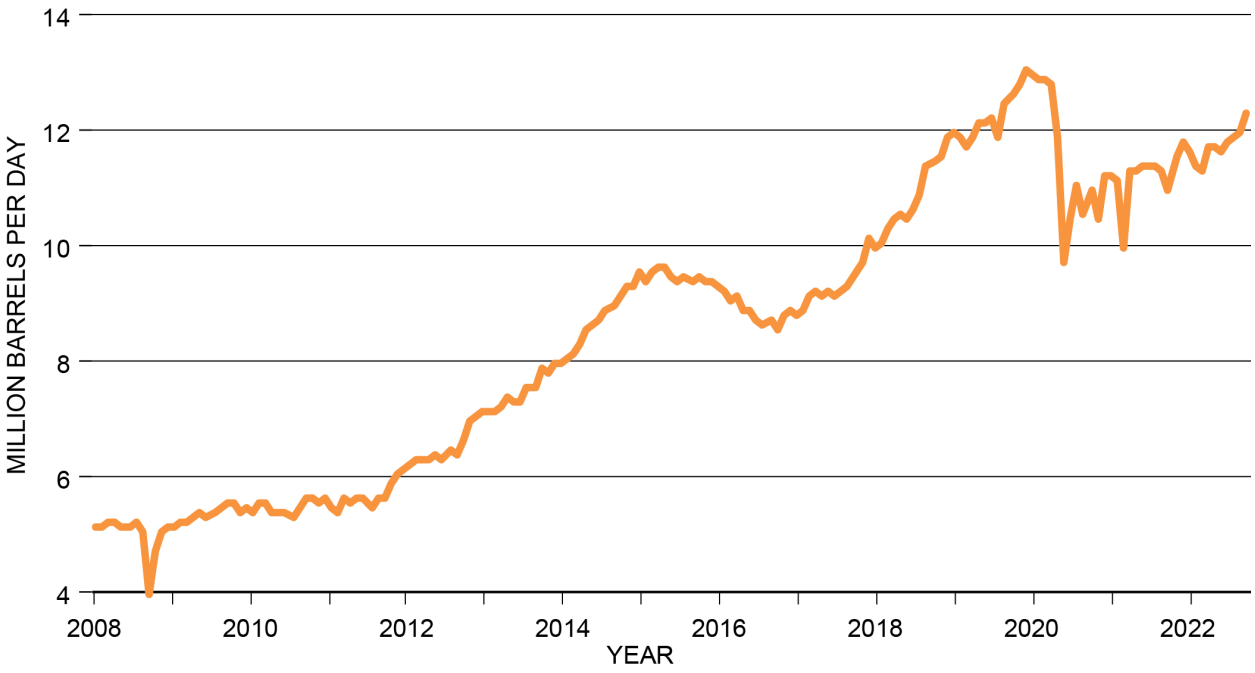
This technology breakthrough in U.S. shale and tight development fueled domestic economic growth through affordable energy as well as lowered greenhouse gas emissions by enabling cost competitive coal-to-natural gas switching (Figure 4).

Through the technology breakthroughs mentioned, U.S. crude oil production increased significantly from an annual average of 5.0 million barrels per day in 2008 to 12.9 million barrels per day in December 2019, according to the EIA. This time period is often referred to as the "Shale Revolution." In 2020, COVID-19 had a significant impact on refined products demand, which resulted in low prices for products and crude as the market responded to the oversupply. As a result, U.S. crude production fell to a low of 9.7 million barrels per day in May 2020, partially recovered through 2021 and 2022, and as of September 2022 was back up to near pre-COVID highs at 12.3 million barrels per day (Figure 5).



Source: EIA.

Figure 4. Technology Breakthrough Enables Coal-to-Natural Gas Switching

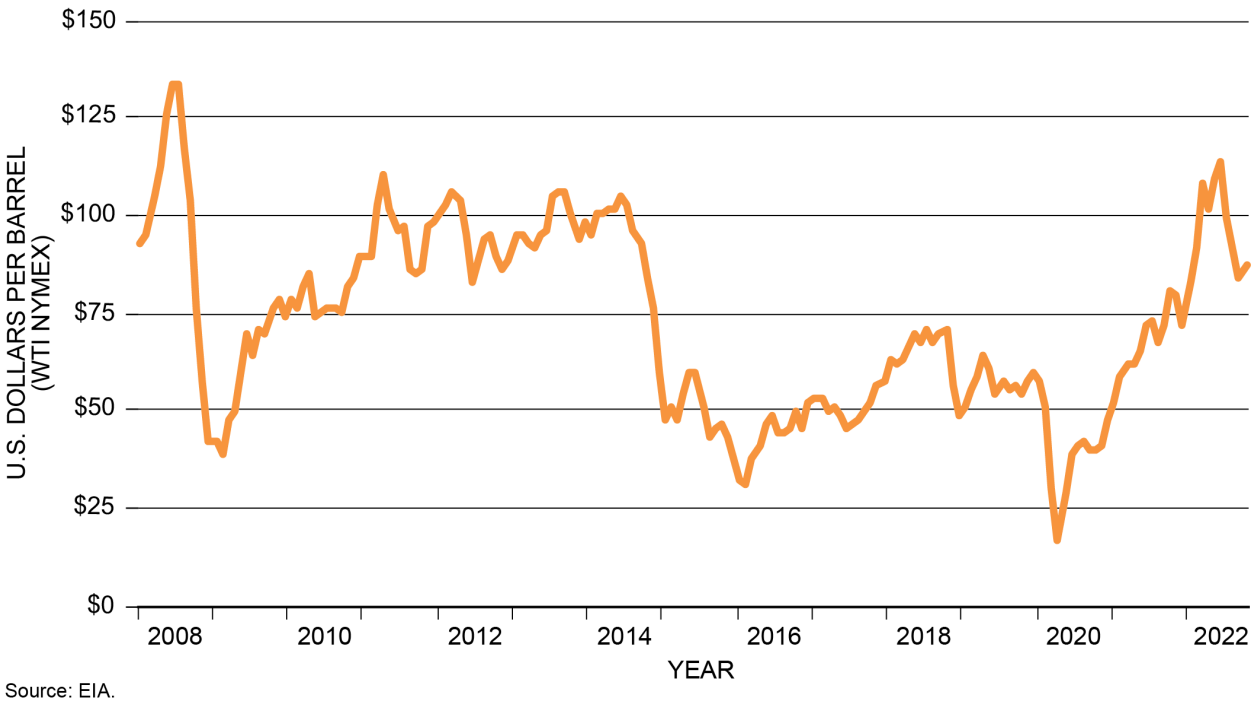


Source: EIA Crude Oil Production.

Figure 5. U.S. Crude Oil Production Growth Resumes

Despite being the world's largest crude oil producer, the United States remains a net importer. According to the EIA, the United States imported 2.9 million barrels per day on a net basis in the first half of 2022 (over 6.2 million barrels per day of typically medium and heavy sour crude imports partially offset by 3.3 million barrels per day of generally lighter, sweeter crude exports). Canada is the largest exporter of crude to the United States, supplying a net average of 3.5 million barrels per day during the January-June 2022 time period.

Crude oil prices globally have been volatile over the last two years (Figure 6), driven by changing supply and demand – first with the drop in demand caused by COVID-19 leading to high inventories and low prices, followed by an increase in demand and tighter supply/demand leading to higher prices. The global petroleum markets are linked to the United States and are a key part of global market dynamics and price fluctuations.



Source: EIA.

Figure 6. COVID Pandemic Increased Crude Oil Price Volatility

4.2.2 Refined Products

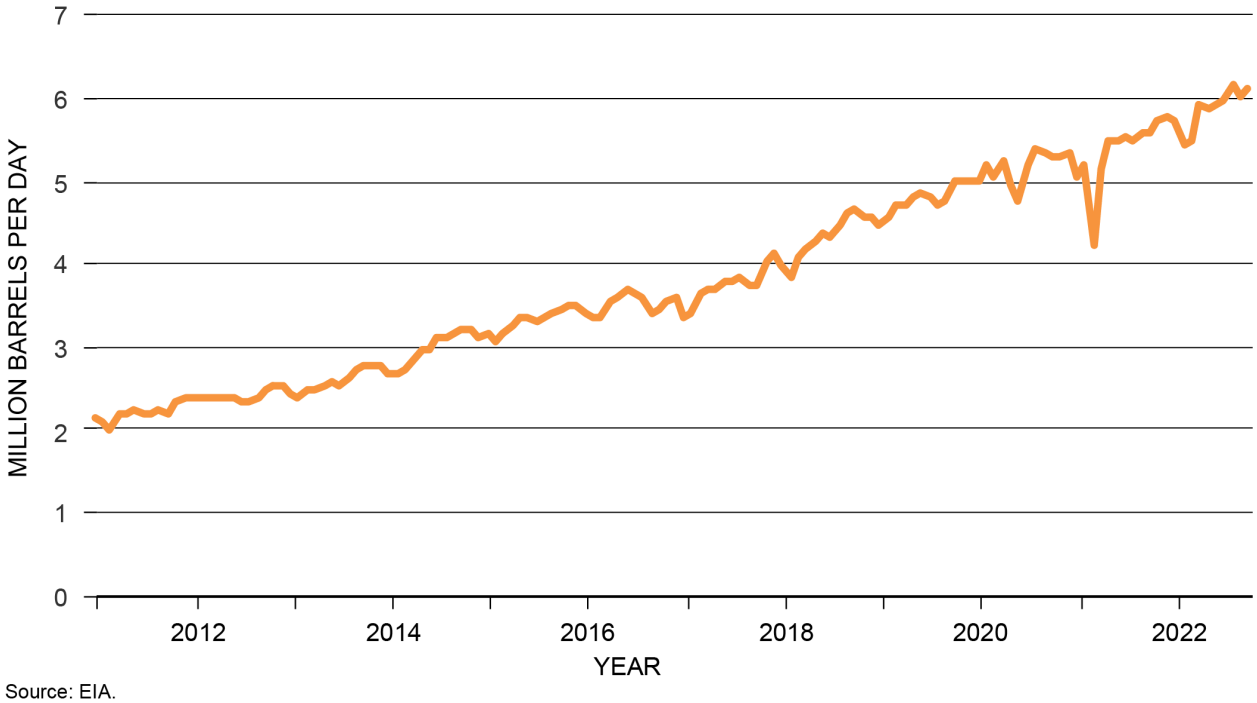
The U.S. refined product transportation system relies on product supplies from both U.S. refiners and foreign imports. An extensive logistics and infrastructure system moves products primarily from industry refining centers in the U.S. Gulf Coast and the Midwest to demand centers across the country. As necessary, marine movements of crude, products, and

natural gas liquids supplement the onshore pipeline system. Marine movements between U.S. ports require Jones Act vessels that are U.S.-built and -owned ships with U.S. crews. Meeting shipping requirements of the Jones Act is generally more expensive than international alternatives, increasing costs to consumers.

The U.S. refining industry has made significant investments over many years in the capability to cost-effectively process hard-to-refine heavy and sour crudes. Many U.S. refineries are not a good match for the growing production of U.S. light sweet crude from unconventional shale. The most cost-effective and efficient approach for the manufacturing of U.S. products requires the import of heavy, hard to refine crudes and export of some of the lighter, sweeter domestic crudes.

4.2.3 Natural Gas Liquids (NGLs)

Natural gas liquids include ethane, propane, butanes, and pentanes that are produced both as a byproduct of natural gas/crude oil production and from the refining of crude oil. Natural gas liquids produced from natural gas processing is referred to as U.S. Field Production by the EIA. Supplies of NGL products have increased over the last ten years due to the Shale Revolution. Since 2011, U.S. field production of propane, which makes up approximately one third of NGLs recovered from natural gas, has nearly tripled, from 230 to 637 million barrels annually in 2021. Additionally, this same level of growth is seen in U.S. Field Production when combining all NGLs from the EIA (Figure 7).



Source: EIA.

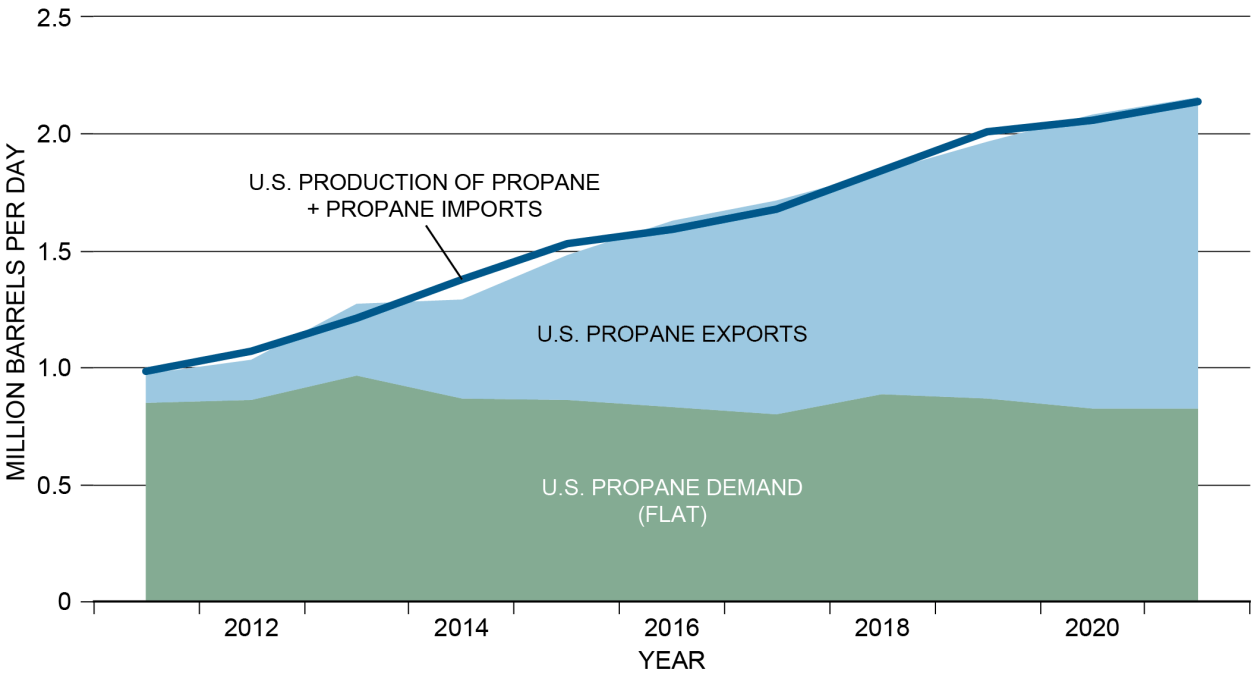
Figure 7. U.S. Total NGL Growth Roughly Threefold

The growth in production of NGLs has been made possible by significant investments across the value chain from gas processing, transportation, fractionation, storage, distribution, and export facilities. This growth in U.S. propane production has led to an abundance of this clean, reliable, stable, and affordable fuel source in excess of domestic demand.

Propane is used in various types of heating including space heating, water heating, cooking, and crop drying. Due to propane's domestic abundance, propane also plays a growing role in the petrochemical industry. Propane along with ethane and naphtha are used as a feedstock for crackers to produce ethylene, propylene, and other olefins, the building blocks of chemical products. Propane is also the world's third most common transportation fuel behind gasoline and diesel.

Excess propane production is typically stored in underground caverns, both in local markets to serve seasonal demand as well as fractionation hubs located in the Mid-Continent, Northeast, and Gulf Coast, with the Gulf Coast having the most fractionation and storage capacity in the United States. According to the EIA, propane and propylene storage in PADD 3, U.S. Gulf Coast, has made up more than 45 percent of the total U.S. stocks since 2015.

While production has grown considerably, U.S. demand has remained relatively unchanged. Increased volumes are exported mostly to Asia, Europe, and South America (Figure 8).



Source: EIA.

Figure 8. U.S. Propane Demand is Flat, Exports Increase

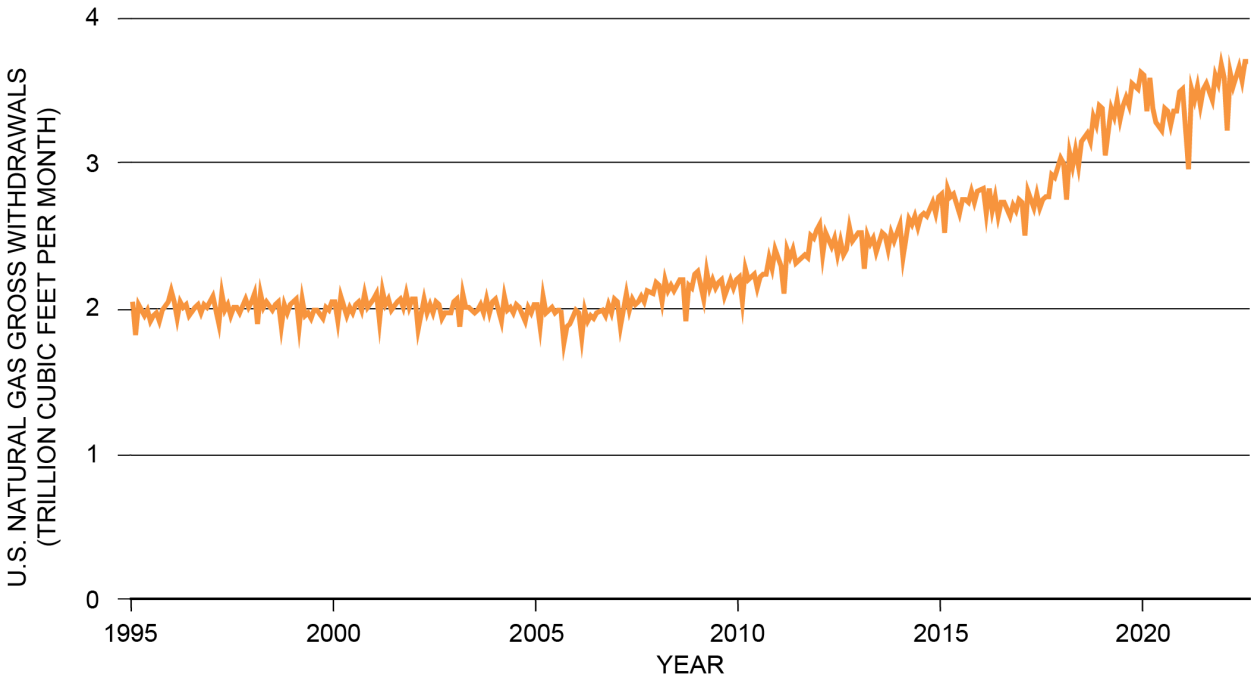
The shale revolution has not only benefited the United States, but also energy starved nations as people around the globe use propane to replace coal and other solid fuels for heating and cooking. This is a significant benefit to the U.N. Sustainability Development Goal (SDG7) providing access to cleaner energy. Propane is a clean, affordable alternative to fuels such as wood for cooking.

U.N. Sustainable Development Goal 7 (SDG7) is Affordable and Clean Energy, striving to ensure access to affordable, reliable, sustainable, and modern energy for all. Two central components of SDG7 are the expansion of access to electricity and the growth of the proportion of the population with primary reliance on clean fuels and technology for cooking. Despite significant gains on both the electrification and access to cleaner fuels fronts, the U.N. estimates that 2.4 billion people still lack access to clean cooking resources. According to the EIA, propane production from gas processing increased from about 1.5 million barrels per day in the first half of 2019, to approximately 1.8 million barrels per day during the same time period in 2022. This 18% increase (almost 280 thousand barrels per day) makes propane one of the few commodities surpassing 2019 (pre-COVID) production.

4.2.4 Natural Gas

Within the United States, natural gas is generally moved from production regions to domestic demand centers by pipeline. Additional quantities are exported by pipeline to Mexico and Canada and to other international markets in the form of liquefied natural gas (LNG) that is cooled to –260° F, via large liquefaction facilities primarily located on the Gulf Coast. The natural gas delivery system involves a transnational and cross-border pipeline system, natural gas processing, storage facilities, and LNG export and import terminals.

The United States is the world's largest producer of natural gas and has been a net exporter of natural gas since 2017, primarily due to the Shale Revolution brought about by dramatic technological improvements in horizontal drilling that make the production of natural gas from shale cost effective. In the early years of shale development, production growth took advantage of existing pipeline infrastructure to move natural gas from production areas to customers. The increase in supply brought about lower natural gas prices, providing economic incentive for the U.S. power, residential, and industrial sectors to use increasing domestic supplies (Figures 9 and 10), displacing other fuels such as coal and decreasing the need for pipeline and LNG imports. However, incremental increases in demand are surpassing infrastructure capabilities in key demand centers around the United States, constricting the flow of natural gas during peak demand times.



Source: EIA.

Figure 9. Increased Natural Gas Supply to Domestic Needs

In the United States, most natural gas use is for generating electricity (37% of natural gas usage in 2021), powering industrial facilities (33% of natural gas usage in 2021), with the balance used for heating and a small percentage for transportation and other uses.

As of January 1, 2020, the EIA estimated there were approximately 2,926 Tcf of technically recoverable resources (TRR) of dry natural gas in the United States, the fourth largest natural gas resource in the world.[2] The greatest TRR is in the eastern United States, specifically in the Marcellus play in the Appalachian Basin. Assuming the same annual production rate of 34.5 Tcf, the country currently has enough technically recoverable natural gas to meet demand for the next 80 years.

While natural gas is used throughout the United States, demand is not evenly distributed. Eight states accounted for 50% of total U.S. natural gas consumption in 2021: Texas, California, Louisiana, Pennsylvania, Florida, New York, Ohio, and Illinois.[3] The demand driver in these states is also not uniform. Residential, commercial, and large-scale industrial facilities drive consumption in California, while demand in Pennsylvania and Florida is driven by conversion from coal to combined-cycle natural gas-fired electrical generation.

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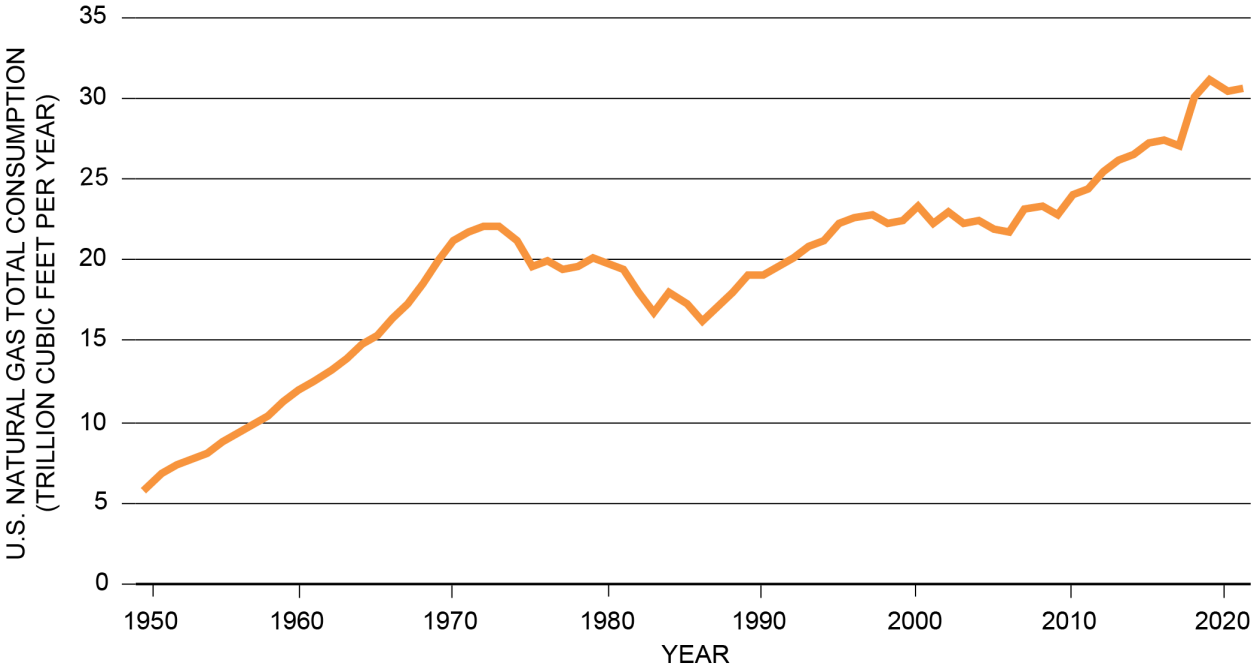
[2] U.S. Energy Information Administration, *Assumptions to the Annual Energy Outlook 2022: Oil and Gas Supply Module*, March 2022, https://www.eia.gov/outlooks/aeo/assumptions/pdf/oilgas.pdf (accessed November 12, 2022).

[3] U.S. Energy Information Administration, *Natural Gas Annual*, September 2022, https://www.eia.gov/naturalgas/annual/ (accessed November 9, 2022).



Source: EIA.

Figure 10. Increased U.S. Natural Gas Consumption

Despite a high demand for natural gas in New York to support its residential, commercial, and power generation sectors, pipeline expansion projects face strong opposition and power generators face market and structural impediments to entering into contracts necessary for pipeline capacity expansion. This has created a pipeline infrastructure bottleneck for the New York and New England region forcing the region to obtain LNG imports from the global market leaving the region more susceptible to price spikes.[4] For example, during the January 2018 winter cyclone event, the Transco Zone 6 NY trading hub, which serves the greater New York City markets, reached $140 per million British thermal units (MMBtu) on January 4, 2018.[5] Spot prices of natural gas at the Algonquin Citygate, which serves the greater Boston area, spiked to $82 per MMBtu on January 5, 2018. Within four days, Transco Zone 6 NY prices dropped to approximately $3.22 per MMBtu. During this same time, the Henry Hub Gulf Coast pricing center was $2.80 per MMBtu.

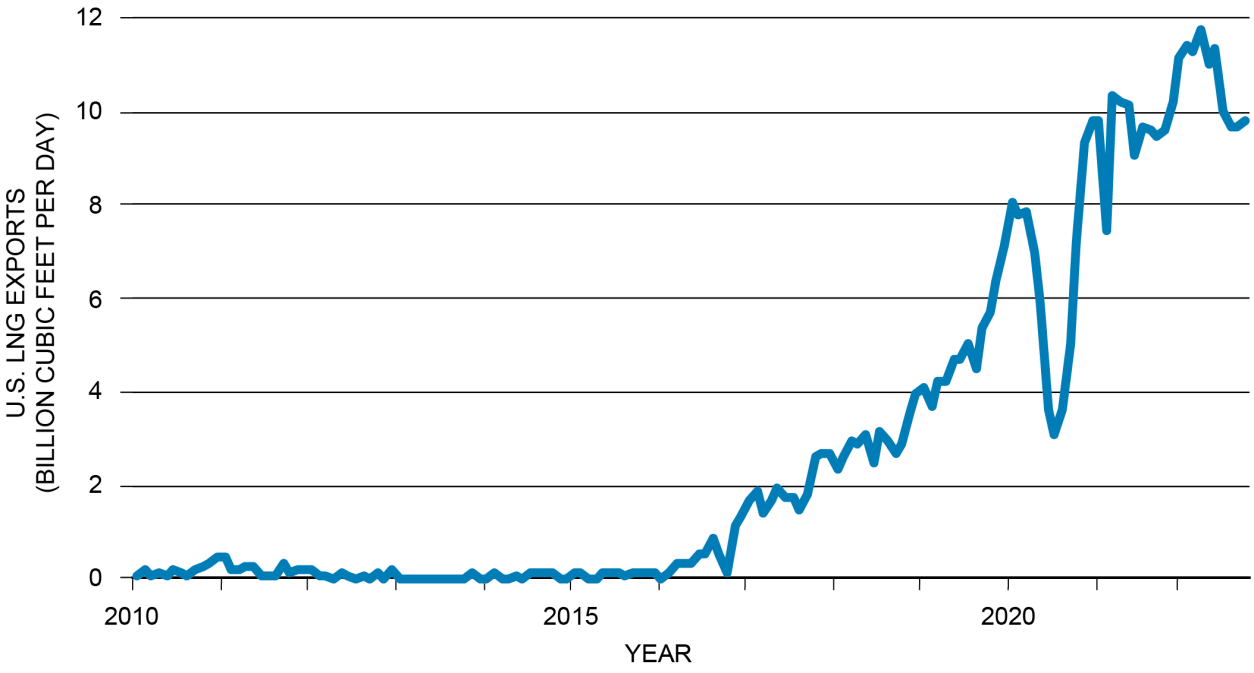
Natural gas demand in the United States is highly cyclical, peaking during the winter months when residential and commercial demand for heating is at its highest, followed by a

[4] Notably, the Everett regasification terminal near Boston, Massachusetts, receives the most U.S. LNG imports and in 2021, it received 99% of all U.S. LNG imports. U.S. Energy Information Administration, https://www.eia.gov/state/print.php?sid=MA#:~:text=Massachusetts%20Quick%20Facts,other%20state%20except%20New%20York.

[5] U.S. Energy Information Administration, Natural Gas Weekly Update for week ending January 10, 2018, https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2018/01_11/#tabs-prices-2.

smaller peak during the summer months when natural gas-fired power generation is used to supply energy for air conditioning. Pipeline infrastructure is designed and built to meet these peak demand days. Wholesale natural gas customers enter into long-term contracts for uninterruptible, agreed-upon delivery volume or capacity of natural gas. These agreements are common in the western and southern U.S. By contrast, customers with interruptible contracts can experience disruption of natural gas deliveries during peak times. On such occasions, interruptible customers pay more for delivery of natural gas, leaving them vulnerable to rapid shifts in price and natural gas supply. Interruptible contracts are more common in the northeastern states.

Natural gas exports also drive the natural gas market, primarily as liquefied natural gas (LNG). Since 2017, the United States has steadily increased its LNG export capacity from less than 1 Bcf/d in 2015 to about 10.78 Bcf/d at the end of 2021. Total peak LNG export capacity in 2021 was about 12.98 Bcf/d (Figure 11). By the end of 2022, U.S. LNG exports are expected to increase to 11.4 Bcf/d, and peak capacity will increase to 13.9 Bcf/d.

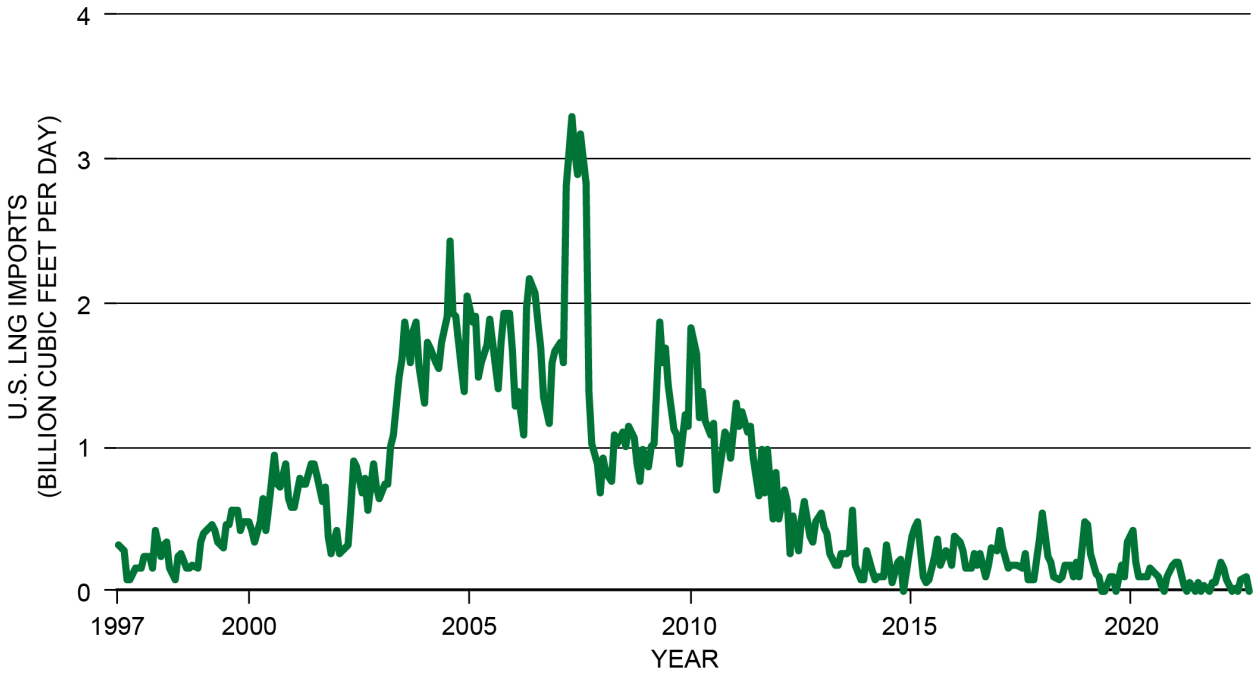


Source: EIA.

Figure 11. Increasing U.S. LNG Exports

In the first six months of 2022, U.S. LNG imports reached their lowest level in at least 15 years, averaging 77 million cubic feet per day (MMcf/d), compared with the five-year (2017–2021) average for the same period of 174 MMcf/d (Figure 12). LNG imports are usually at their highest level from October through March. During the winter of 2021-2022, LNG imports

averaged 93 MMcf/d, significantly lower than in the winter of 2006–2007, when LNG imports averaged 1.8 Bcf/d.[6]



Source: EIA.

Figure 12. U.S. LNG Imports Decline

The global energy system has undergone significant changes, in part due to the more efficient use of fossil fuels and increased use of renewables and less-carbon intensive fuels, but the most impactful change has been the switch from coal to natural gas. It should be noted that energy storage technologies are currently insufficient to provide the reliable, long-term baseload and peak electricity demands. However, future improvements in battery and other energy and storage technologies will likely dampen gas-generation demand over time.

Natural gas-fired power generators are an important part of the natural gas market and are a key component of the energy portfolio necessary for a lower-carbon energy future. Natural gas is the leading power generation source in the United States, accounting for 38% of total power generation in 2021, followed by coal at 22% and renewables at 20%. Importantly, natural gas-fired generation provides baseload power to the electric grid necessary for the grid to properly operate and provides quick demand response to complement intermittent energy sources such as wind and solar, ensuring grid stability.

[6] U.S. Energy Information Administration, Natural Gas Weekly Update (week ending September 21, 2022), https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2022/09_22/ (accessed November 11, 2022).

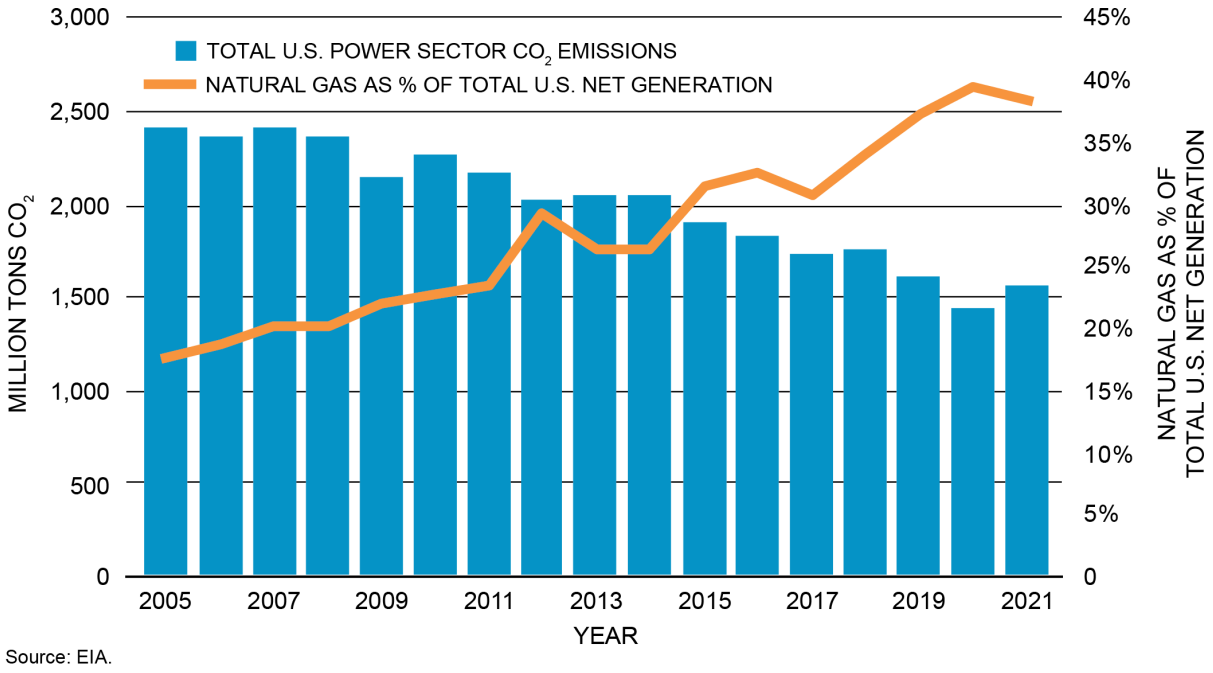


Figure 13. Increasing Power from Natural Gas Reduces CO_2 Emissions

This shift in power generation resource mix yielded environmental benefits. Although the increased utilization of renewables is impactful, the shift from coal-fired to natural gas-fired generation maintains the same grid stability and energy reliability as coal, but with significantly lower emissions (Figure 13). Emissions of CO_2 from the U.S. electric sector are 36% lower in 2021 than their peak in 2005 while GDP grew 30%.[7] The global coal-to-gas switch taking place has avoided introducing more than 500 million tons of global CO_2 emissions between 2010 and 2018, the equivalent effect of putting an extra 200 million electric vehicles running on zero-carbon electricity on the road for that same period of time.[8]

Given the leading role of natural gas in power generation in the United States and the environmental benefits that have been and continue to be realized by utilizing cleaner burning natural gas, the interdependency between the natural gas and power sectors is vitally important to the energy security in the United States. The ability of the natural gas system to meet peak demand and to remain reliable and resilient directly impacts the supply of electrical energy throughout the United States, especially as decarbonization efforts rely upon more electrification. Investments in natural gas infrastructure will bolster the reliability and resilience of the U.S. energy system and reduce this risk of energy insecurity.

[7] U.S. Energy Information Administration, Today in Energy, "Electric power sector CO_2 emissions drop as generation mix shifts from coal to natural gas," June 9, 2021, https://www.eia.gov/todayinenergy/detail.php?id=48296 (accessed November 15, 2022).

[8] International Energy Agency, "The Role of Gas in Today's Energy Transitions," July 2019, https://www.iea.org/reports/the-role-of-gas-in-todays-energy-transitions (accessed November 9, 2022).

4.3 Petroleum Markets – Development Over the Last Three Years (Pandemic Years)

A number of factors over the last few years have set the stage for the supply, demand, and inventory fundamentals seen today. These include COVID-19, the response from the Organization of Petroleum Exporting Countries (OPEC) and additional partner countries collectively known as OPEC+, and more recently, the Russian invasion of Ukraine.

The elevated crude oil and transport fuel volumetric inventories of 2020 and 2021 had by early September 2022 reversed and moved below the 5-year averages. Generally, in periods of low inventories and increasing demand, prices tend to be higher than historical averages and this is true today.

4.3.1 Product Demand

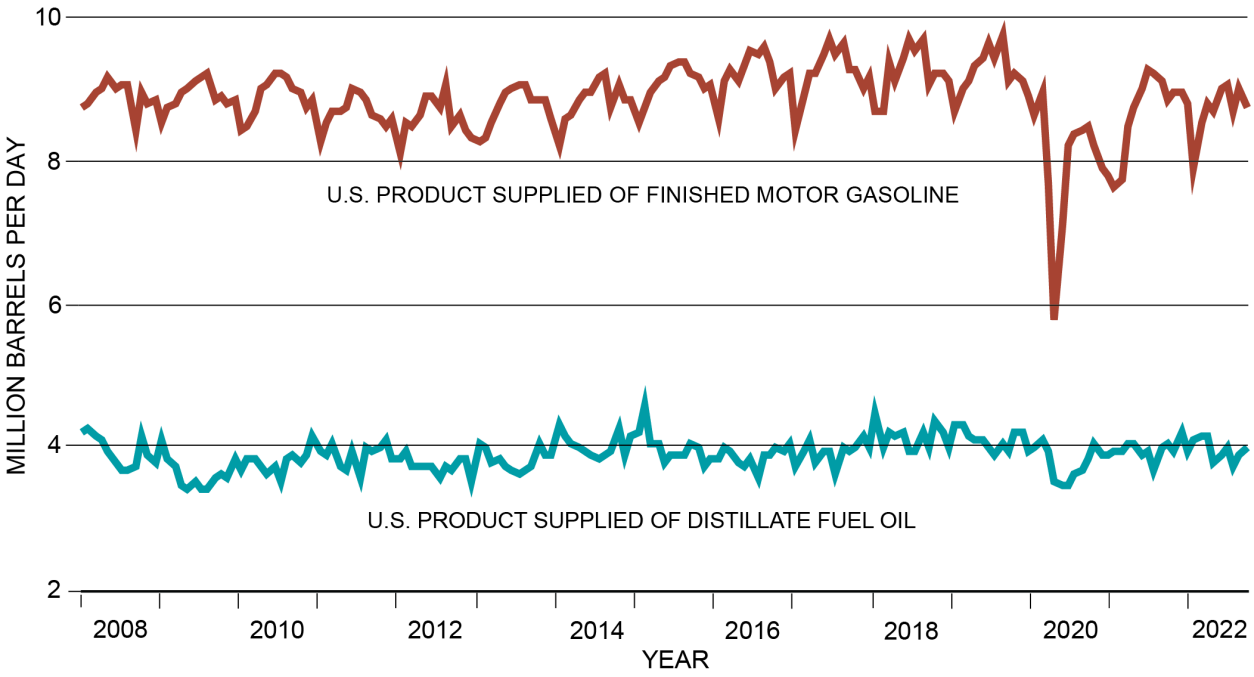
On January 20, 2020, the CDC reported the first laboratory-confirmed case of the 2019 Novel Coronavirus (COVID-19) in the United States.[9] By late February/early March 2020, U.S. energy markets were impacted. Various states began implementing shutdowns of schools, businesses, public facilities, restaurants, and travel in order to prevent the spread of COVID-19, significantly reducing product demand. Gasoline was particularly impacted, falling almost 45% according to the EIA.

The EIA Weekly U.S. Product Supplied of Finished Motor Gasoline, which reflects demand, week ending February 28, 2020, was 9.19 million barrels per day. Only a month later, week ending April 3, 2020, demand had fallen to 5.1 million barrels per day, a drop of over 4 million barrels per day (over a 43% drop).

Demand for jet fuel also dropped as airlines began shutting down domestic and international flights. Diesel demand also fell, although not as drastically as gasoline motor fuel and jet fuel. Diesel demand was less elastic than other products primarily due the necessity to power commerce and industrial activities. Most of the goods we use are transported by ships, trucks, and trains with diesel engines, and most construction, farming, military vehicles, and public transportation have diesel engines, which supported diesel demand during this period.

Although product demand has recovered since the lows of 2020, global and U.S. demand remains below pre-COVID-19 levels. EIA U.S. gasoline monthly product supplied (demand), August 2022, is approximately 7.5% below August 2019 (Figure 14).

[9] Centers for Disease Control and Prevention, CDC Museum Covid 19 Timeline, Early 2020, https://www.cdc.gov/museum/timeline/covid19.html (accessed September 20, 2022).



Source: EIA Product Supplied.

Figure 14. Motor Gasoline and Distillate Fuel Oil Demand

4.3.2 Refinery Runs (Crude Oil Demand/Product Supply)

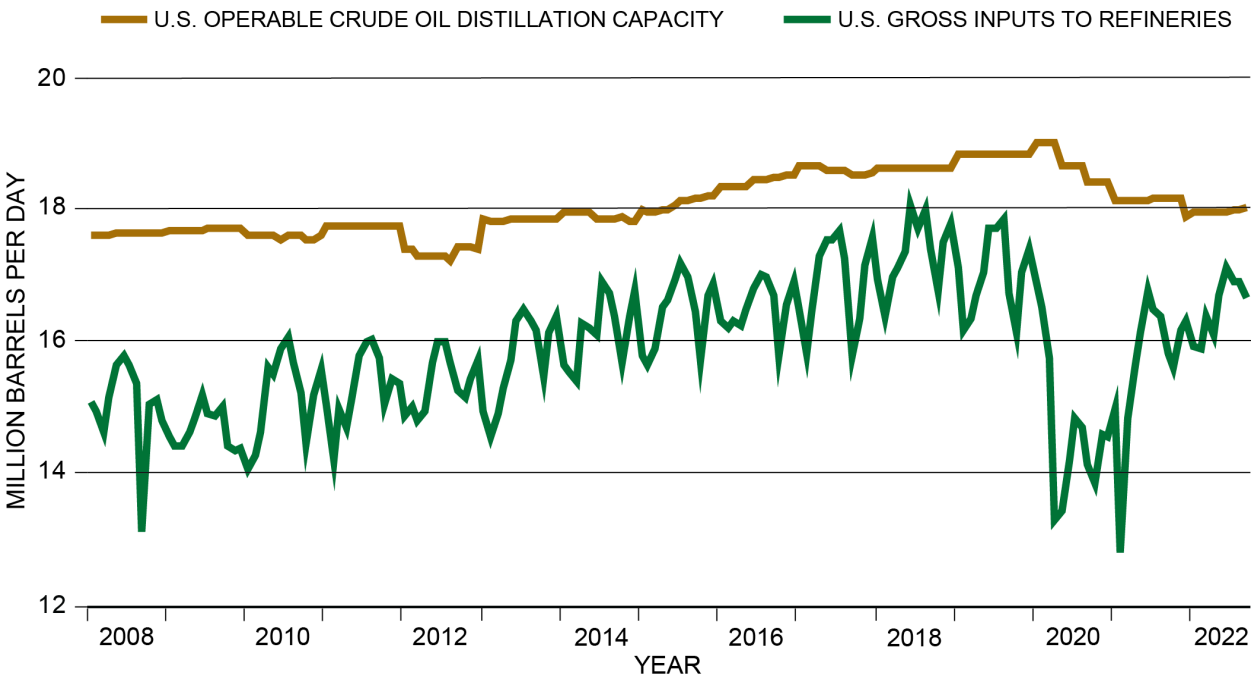
As demand for transportation fuels fell during the COVID-19 lockdowns, refinery margins dropped to the lowest sustained level in history as the available refining capacity far exceeded demand.

U.S. refiners lowered production in response. The EIA's Weekly Inputs & Utilization report, week ending December 27, 2019, reported refinery crude oil runs of 17.28 million barrels per day. However, by week ending May 8, 2020, U.S. refinery runs fell to 12.4 million barrels per day, a drop of 4.9 million barrels per day (25%). The lowest level of crude oil runs, since August 20, 1982, was reported week ending February 26, 2021, when U.S. refinery runs hit a low of approximately 9.9 million barrels per day, a drop of over 7 million barrels per day (40%), with Winter Storm Uri contributing to the reduction. Similar actions to lower production were also taken by refiners outside the United States.

In this low-margin environment, several refineries permanently shut down, globally and in the United States. According to a report prepared by ESAI Energy (July 2022), between 2019 and early 2022, the U.S. and Eastern Canada refinery system shut down approximately 1.5 million barrels a day of refinery capacity, over 8% of the December 2019 run levels. Further, Facts Global Energy Group's (FGE) Annual World Refining Outlook (June 2022), showed global refinery rationalization near 5 million barrels per day (~5% of global refining capacity) for the same time frame.

As demand recovered through 2021 and 2022, the remaining U.S. refineries, and similarly those in most of the rest of the world, quickly increased the utilization of available refining capacity to meet the transportation fuels demand recovery. A notable exception is China, where substantial refining capacity has been added but is not being utilized due to the imposition of export quotas. However, in late 2022, China announced increased product export quotas, though details are not fully known.

Global demand for crude has slowly recovered from May of 2020 to today as the world has largely learned how to live with COVID-19. According to the EIA, U.S. refining crude demand has increased from the monthly lows in April 2020 by approximately 3.6 million barrels per day as of August 2022 (Figure 15).



Source: EIA U.S. Refinery Capacity.

Figure 15. U.S. Refinery Runs versus Capacity

4.3.3 Crude Oil Production (Supply)

Globally, according to the International Energy Agency (IEA), demand for oil liquids declined by 25 million barrels per day or 25% in the 2nd quarter of 2020. However, crude oil supply was slower to respond. OPEC produced at a near record rate in April of 2020 at 30.7 million barrels per day, termed "Black April" by the IEA's May 2020 Oil Market Report.[10] After Russia and Saudi Arabia were unable to agree on actions to address the emerging global

[10] International Energy Agency, Oil Market Report, May 14, 2020, p. 3.

pandemic, Saudi Arabia produced almost 12 million barrels per day in April 2020, an increase of more than 2 million barrels per day above the prior month.

With supplies exceeding demand, inventories built at an unprecedented rate and prices plummeted, with WTI crude in Cushing posting a record low price of -$37.63 per barrel on April 20, 2020.

In the face of significant financial distress associated with the lower crude prices, exploration and production companies cut back their activity levels and associated production fell significantly. According to the Weekly U.S. Field Production of Crude Oil reported by the EIA, crude production was 13.1 million barrels per day during the week ending February 28, 2020. By the week ending August 28, 2020, production was 9.7 million barrels per day, a drop of 3.4 million barrels per day (25%).

As a result of the low demand, and falling prices, drilling activity slowed significantly in all U.S. basins. At the end of 2019, Baker Hughes' total rig count was over 800 rigs; however, by early May 2020, that count was cut in half. Rig counts continued to drop in subsequent months, going below 300 rigs at the lowest points.

OPEC+ also took steps to reduce crude oil production. On April 12, 2020, OPEC+ announced a plan to restore stability to crude markets by reducing their aggregate crude production by 9.7 million barrels per day or approximately 10% of global oil liquids supply, and then slowly increased their crude supply back to more normal levels from May 2020 through September of 2022.

For most of 2020 and 2021, Organization for Economic Co-operation and Development (OECD) commercial inventories remained elevated and crude prices remained low. In response, exploration and production companies maintained low levels of investment and production maintenance. These lower investment levels, coupled with ongoing natural field decline, left most of the world's crude producers poorly positioned to quickly increase supplies to meet recovering demand. IEA data show that global crude supply is down approximately 6% when comparing 2019 to 2021 annual averages.

Through this period, U.S. monthly crude production initially fell from a high of nearly 13 million barrels per day in 2019 to 9.7 million barrels in 2021, and subsequently increased to almost 12.3 million barrels per day (~12% of global oil liquids production) in September 2022, an increase of 2.6 million barrels per day.

Despite the increase in U.S. production and the slow but steady production increases by OPEC+, OECD crude commercial inventories remain below 5-year averages. IEA OECD crude oil inventories, July 2022, are about 14% below the 2019 highs and approximately 15% below the 5-year average.

4.3.4 Natural Gas

In 2019, the U.S. natural gas industry had record high production, consumption, and exports. Production growth was driven by increased production from the Permian and Appalachian Basins, and the Haynesville Play. Substantial new regional pipeline capacity supported the increased production, particularly in the Permian Basin. Consumption, particularly by the power sector, reached new highs due in part to a warmer than average summer and lower natural gas prices. Natural gas exports reached new highs due to strong growth of LNG exports. At the beginning of 2020, prices at Henry Hub were the lowest they had been at the start of a year since 2010 (spot price $2.00 MMBtu on January 2, 2020) and they continued to fall as the COVID-19 pandemic lockdowns began in the first quarter of 2020, reaching a historic low spot price of $1.38 MMBtu on June 16, 2020.

Consumption of natural gas to the residential, commercial, industrial, and vehicle fuel sectors decreased 2.4% in 2020, but deliveries to the electric power sector increased 2.6%, likely spurred by a milder winter and the low price of natural gas.

The high price volatility experienced in 2021-2022 is attributable to weather-driven demand fluctuations, below average working gas storage, and increased exports to meet European market demands to reduce the gap created by reduced natural gas supplies from Russia.

At the onset of the COVID-19 lockdowns, the U.S. natural gas rig count was at 106. By July 2020, rig count dropped to 68 rigs. Despite the COVID-19 driven drop in rig count, overall natural gas production was only 1.5% from the record high production volumes in 2019. Since July 2020, the rig count has steadily increased and reaching pre-COVID-19 levels in January 2022. By the end of October 2022, weekly natural gas rig count was at 155. In 2021, production increased 3.3% higher than 2020.

U.S. LNG exports also quickly rebounded from the initial pandemic lockdowns, setting export records (for that time) in November and December of 2020. These exports were driven by colder-than-normal winter temperatures in key Asian LNG-consuming markets and unplanned outages at LNG export facilities in other countries. The EIA highlighted in a recent report[11] that as of July 2022, the United States had more LNG export capacity than any other country and currently exports more LNG than any other country. U.S. LNG exports averaged 11.1 Bcf/d during the first half of 2022, and EIA expects export capacity to grow through the middle of the decade as new terminals enter service (Figure 11).

Natural gas storage facilities are an essential part of the natural gas supply system. Natural gas can be stored underground in producing fields, aquifer storage, and salt domes or

[11] U.S. Energy Information Administration, Today in Energy, "U.S. LNG export capacity to grow as three additional projects begin construction," September 6, 2022, https://www.eia.gov/todayinenergy/detail.php?id=53719# (accessed September 27, 2022).

above ground in LNG storage facilities. The EIA measures underground natural gas storage capacity in two ways: design capacity (the sum of reported working natural gas capacities of active storage fields) and demonstrated peak capacity (sum of peak monthly working natural gas volumes observed). In June 2020, following a relatively warm 2019-2020 winter and decreased net withdrawals, total working storage reached record levels, filling 87% of design capacity and nearly 96% of demonstrated peak capacity.[12]

The winter of 2020-2021 brought colder temperatures and prompted the third largest monthly net withdrawal totaling 938 Bcf between January 22 and February 19, 2021. The following week, the second largest weekly total net withdrawals occurred when net withdrawals from underground storage totaled 338 Bcf, only 21 Bcf lower than the all-time average. Net withdrawals for the 2020-2021 heating season exceeded the five-year average by 9.7%.

4.4 Current Market Conditions and Inventory Levels

After the turmoil of the last three years, the production, import and export balances have returned to be close to the position pre-pandemic with a small number of exceptions where inventories are lower than in the past, especially for diesel. In summary, as we approach the end of 2022 the situation for the key commodities is as follows.

4.4.1 Crude Oil

Crude oil production in the United States has recovered to be close to pre-pandemic levels at just below 12.3 MBD in September 2022 vs a pre-pandemic level of 12.3 MBD annual production in 2019 and a low of 11 MBD in July of 2020. Imports of heavy crude and exports of light crude have been fairly steady through the pandemic to balance the refinery needs. The United States is exporting around 3.6 MBD and importing around 6 MBD of crude oil. The increase in domestic crude oil production has been in conjunction with an increase in refinery crude runs.

The price of crude oil is set by the market based on global supply and demand fundamentals. Low levels of investment in new production during the pandemic years along with the moves made by OPEC+ to manage production are important factors impacting crude oil prices around the world and in the United States today.

4.4.2 Crude Oil Trade Flows

The growth in crude production with the shale revolution resulted in the United States being a major exporter of light crude to Europe and Asia. The United States has remained an importer of heavy crude, primarily from Canada and Latin America, to effectively utilize the sophisticated refining capacity which is ideally suited for processing heavier crude oil. Russia and the Middle East have been exporters of crude oil for many years, primarily to Europe and

[12] U.S. Energy Information Administration, Natural Gas Weekly Update for week ending June 10, 2020, https://www.eia.gov/naturalgas/weekly/archivenew_ngwu/2020/06_11/ (accessed November 12, 2022).

Asia by both pipeline and sea. Even before the invasion of Ukraine, the United States imported very little crude or refined products from Russia.

As the world has recovered from COVID, the crude flows returned to be close to pre-COVID patterns, driven by underlying economics and thereby ensuring the lowest overall cost of refined product production. The Russian invasion of Ukraine and resulting sanctions or decisions not to run Russian crude by some countries has caused some change in crude trade flows. More Russian crude is now being exported to Asian countries, which have not put any restrictions on running Russian crude, and this has been replaced in Europe with crude from the United States and the Middle East. Global trade has enabled the rebalancing to occur with the minimum cost.

Going forward, the impact of the Russian sanctions is not certain and hence the impact on trade flows is difficult to evaluate. For the United States, retaining the flexibility to export crude to countries impacted by sanctions will help stabilize world crude prices and over time ensure the minimum cost to consumers. As a major exporter of crude and with imports coming primarily from near neighbors (Canada and Latin America), the direct impacts on the United States will likely be limited.

Looking further ahead, over the coming decades the evolution of trade flows is clearly less certain and dependent on both overall product demand evolution as well as geopolitical impacts. That said, in all likely long-term demand forecasts there is still a need globally (and in the United States) for a significant level of crude oil refining. There are a number of key trends that are important for U.S. producers and refiners across the broad range of scenarios. These are:

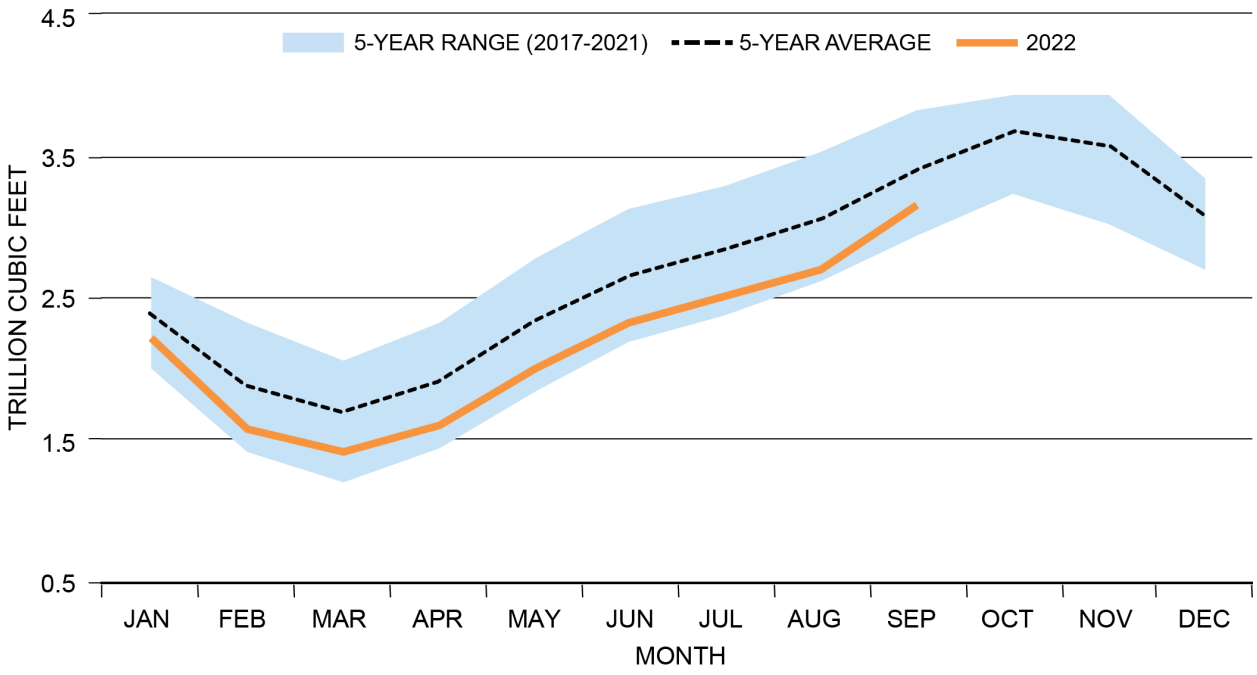
- The United States will remain an exporter of light crude to balance the refining circuit capability to process light versus heavy crude.
- The United States will remain an importer of heavy crude from Latin America and Canada.
- The United States' refining and petrochemical manufacturing system is one of the most sophisticated in the world and will be able to compete globally through exports of these products.

Remaining an active participant in imports and exports of crude and refined products will remain the most effective way to ensure a cost-effective supply of energy to the U.S. consumers and a manageable energy transition.

4.4.3 Natural Gas

On April 1, 2022, the start of the refill season, working stocks were 17% or 235 Bcf below the five-year average. This deficit grew to 367 Bcf on August 12. In the final days of the 2022 refill season (April – October), increased production and moderate temperatures allowed

for rapid injections. By November 11, 2022, working natural gas stocks reached 3,644 Bcf, only 7 Bcf below the five-year average (Figure 16).



Source: EIA.

Figure 16. U.S. Natural Gas Stocks Building

According to the November 2022 EIA Short-Term Energy Outlook, natural gas production has increased steadily throughout 2022, above pre-pandemic levels, and dry natural gas production averages 100.4 billion cubic feet per day (Bcf/d) in their November forecast. Total consumption has continued to increase year on year although it is impacted by seasonal fluctuations in demand for heating and power generation. Exports of natural gas by pipeline and as liquefied natural gas are at record levels. Imports of natural gas, primarily from Canada, have been relatively stable. Inventories of natural gas have been in line with historical levels although they do fluctuate depending on weather and the resulting demand changes.

In its annual Winter Assessment report, the Federal Energy Regulatory Commission (FERC) expects natural gas prices to remain elevated at major trading hubs across the United States, partly due to the influence of the international markets as the U.S. domestic market becomes more integrated with the international market. In particular, European countries had to significantly increase their purchases of LNG for the upcoming winter season. Additionally, because of the infrastructure constraints in the Northeast and its reliance on LNG imports to supply a portion of their natural gas fuel needs for heating and power generation, the price of natural gas in the New England region is heavily impacted by the global prices of LNG, in particular the market price in Europe.

4.4.4 Natural Gas Liquids

Production of natural gas liquids has recovered to above pre-pandemic levels at 6 MBD. Exports of NGLs have also increased to around 2.5 MBD, with propane representing around 1.5 MBD of this amount.

According to the EIA's September 2022 Short-Term Energy Outlook (STEO), Q3 propane inventories are over 5 million barrels above 2021. Further, the EIA STEO domestic demand outlook for Q4 2021 and Q4 2022 is essentially flat at approximately 960 thousand barrels per day. As U.S. production has increased, the United States has exported the excess supply to Europe and Asia.

4.4.5 Refined Products

With the recovery in demand, refinery runs have increased to around 17 MBD from a low of around 14 MBD in the middle of 2020. As a result, production of refined products has increased and is nearing pre-pandemic levels. The United States remains a very active participant in the world refined products markets, exporting and importing a full range of products. Currently the United States exports over 3 MBD of refined products including around 1.4 MBD of diesel and jet fuel and 1 MBD of gasoline. At the same time, the United States imports around 2 MBD of finished products and blending components. This balance of imports and exports is required to balance the geographic differences between where the products are produced and where there is demand, given the constraints on logistics to move product domestically.

The largest impact on refined product prices is the price of crude oil, which is the major feedstock to make them. The spreads between crude price and product prices reflect the balance of demand for the products and the availability of refining capacity to turn the crude oil into products. With the recovery in demand globally and the limitations in diesel production capability along with the restrictions on using Russian diesel in some markets, the price of diesel is currently higher than normal, even allowing for the crude price. This is a reflection of the supply and demand balance being very tight.

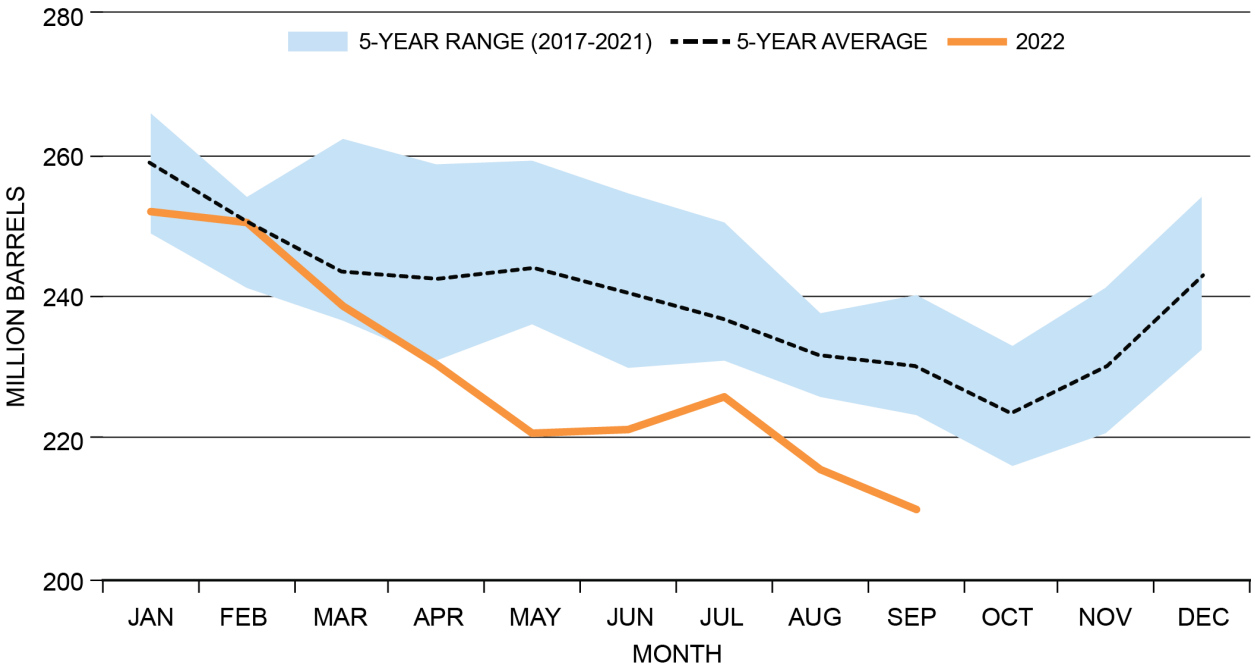
In addition, high natural gas prices and carbon taxes in Europe have increased European refiners' cost to produce refined products, reducing utilization. The world needs European refineries to run to meet global demand. Refined product prices have currently adjusted globally to cover the higher cost of European refining. As discussed earlier, global natural gas prices are also supported with anticipated shortages in Europe as Russia ceases gas pipeline flows. Europe's continued reliance on other countries for LNG supply can be expected, supporting higher prices for natural gas with a knock-on effect to refined products.

Despite the recovery in production, inventories of crude and refined products are below the historical averages in a number of geographic areas. With world demand recovery and the loss of some refining capacity as well as the impacts of sanctions post the Russian invasion of Ukraine, crude oil inventories in the United States, Europe, and OECD remain below the 5-year averages according to the IEA and the EIA. Motor fuel gasoline and diesel volumetric inventories are also below the 5-year average in the United States, Europe, and OECD. Although there are variances within the various regions, volumetric inventories have not recovered to their pre-COVID levels.

4.4.6 United States' Refined Products Inventory Levels

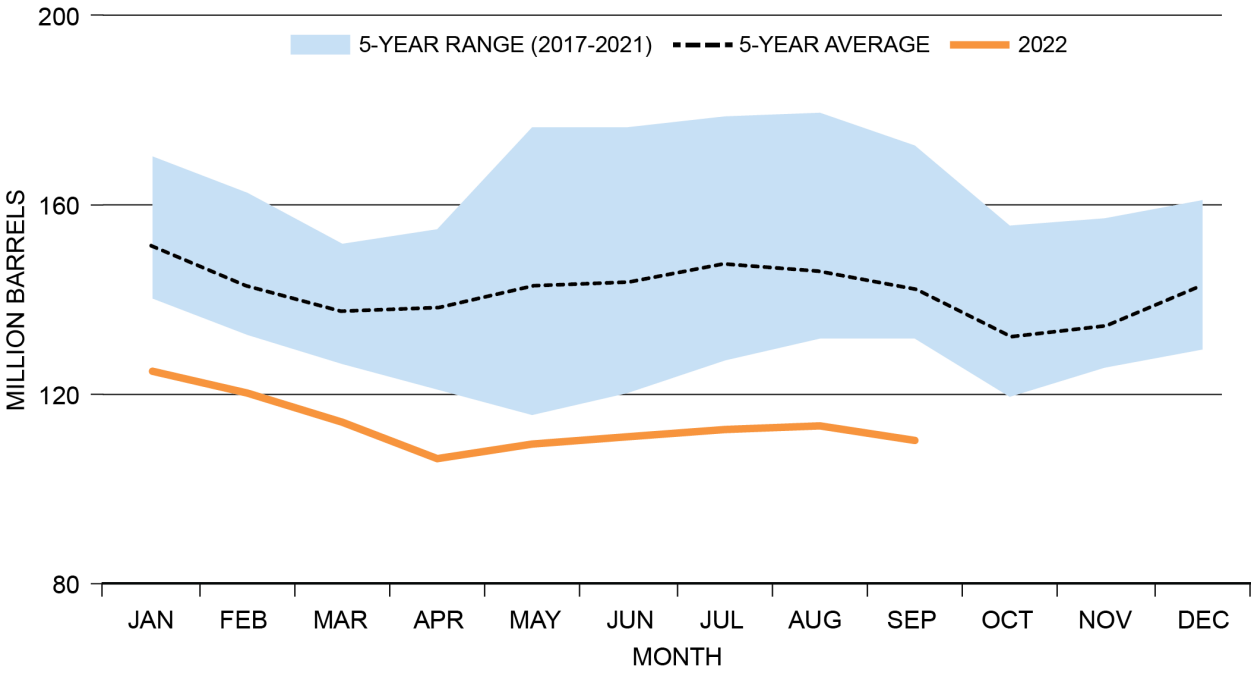
With gasoline and diesel inventories below their 5-year volumetric averages (Figures 17 and 18), policy makers have voiced concern that adequate supply may not exist to meet demand requirements across the entire United States and particularly in the Northeast, where supply is dependent on movements from the U.S. Gulf Coast and foreign imports.

The Northeast region of the United States, commonly referred to as PADDs 1A and 1B, is dependent on gasoline and diesel supply primarily from the U.S. Gulf Coast through large pipelines, inter-PADD marine movements, or foreign imports.



Source: EIA.

Figure 17. U.S. Gasoline Stocks Below the Range

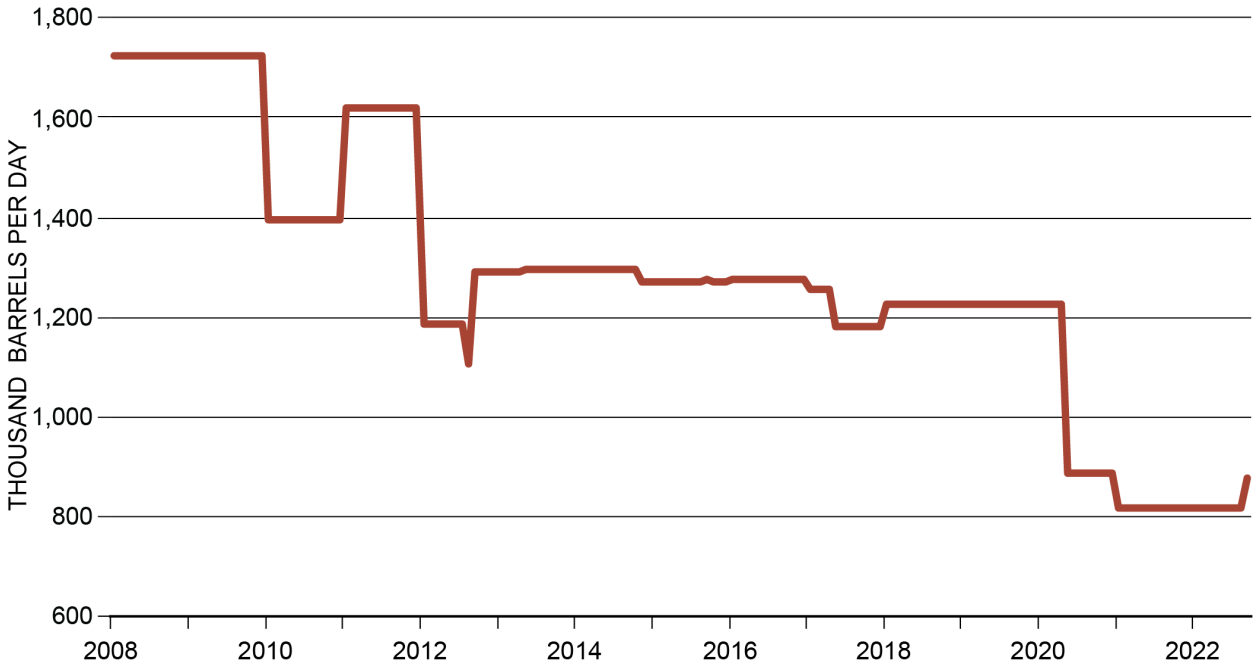


Source: EIA.

Figure 18. U.S. Diesel Stocks Below the Range

4.4.7 U.S. Northeast Supply

Over the last several years, the Northeast has experienced a decline in refinery capacity, particularly when including East Coast Canada, which translates into lower refined product production. As of August 2022, the U.S. Northeast (PADD 1) refinery crude capacity was 818 thousand barrels per day, based on EIA reports (Figure 19). PADD 1 is structurally an import market with demand exceeding local production. The reduction in refining capacity has increased the reliance on imports from outside of PADD1. According to ESAI, refinery gasoline output has dropped from approximately 750 thousand barrels per day in 2018 to approximately 550 thousand barrels per day in 2022. Diesel production has dropped from approximately 320 thousand barrels per day in 2018 to 200 thousand barrels per day in 2022. PADD 1 winter diesel demand is approximately 1.34 million barrels per day (November 2021 through April 2022), resulting in a seasonal shortage of approximately 1.1 million barrels per day.

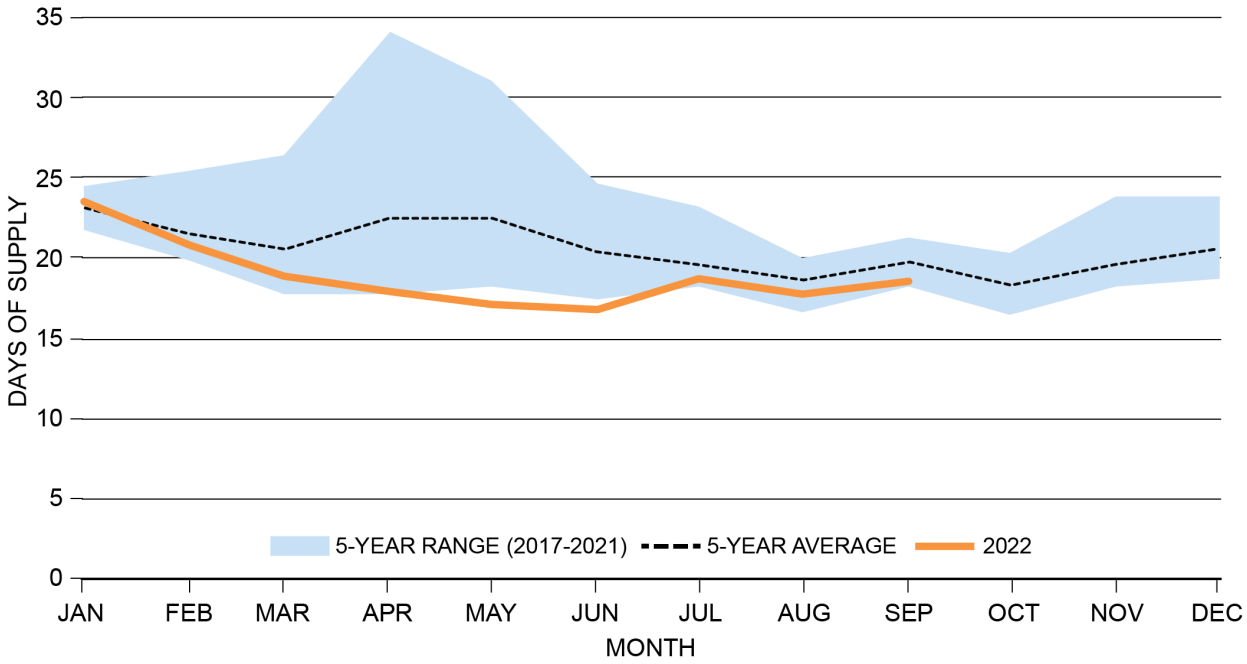


Source: EIA.

Figure 19. East Coast (PADD 1) Refinery Capacity

As a result of the regional shortfall in supply versus demand, the Northeast relies on pipeline supply from the Gulf Coast and incremental waterborne imports.

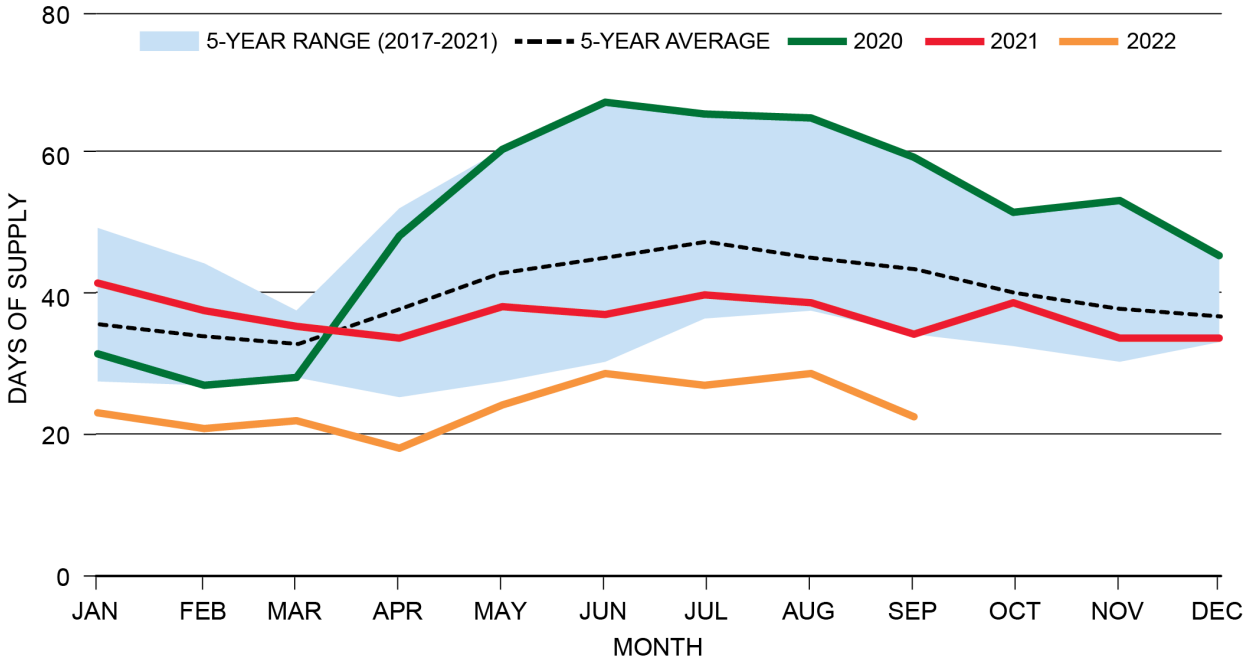
As of early September 2022, PADD 1 industry gasoline inventory is consistent with historical levels. EIA data show that PADD I inventories of total gasoline and ethanol averaged 60 million barrels during the summer and are entering September at 59.3 million barrels. While this is on the low end of the typical volumetric range, it is important to note that PADD 1 gasoline demand through June was 9% below the 2017 to 2019 average of 3.3 million barrels per day. On a Days of Supply basis, industry gasoline inventories are at near normal levels (Figure 20). A further consideration when evaluating gasoline stock levels is the seasonal change of gasoline specifications, especially from winter to summer when inventories must be carefully managed because winter spec gasoline cannot be sold in summer without an EPA waiver.



Source: EIA PADD 1 Stocks/Product Supplied.

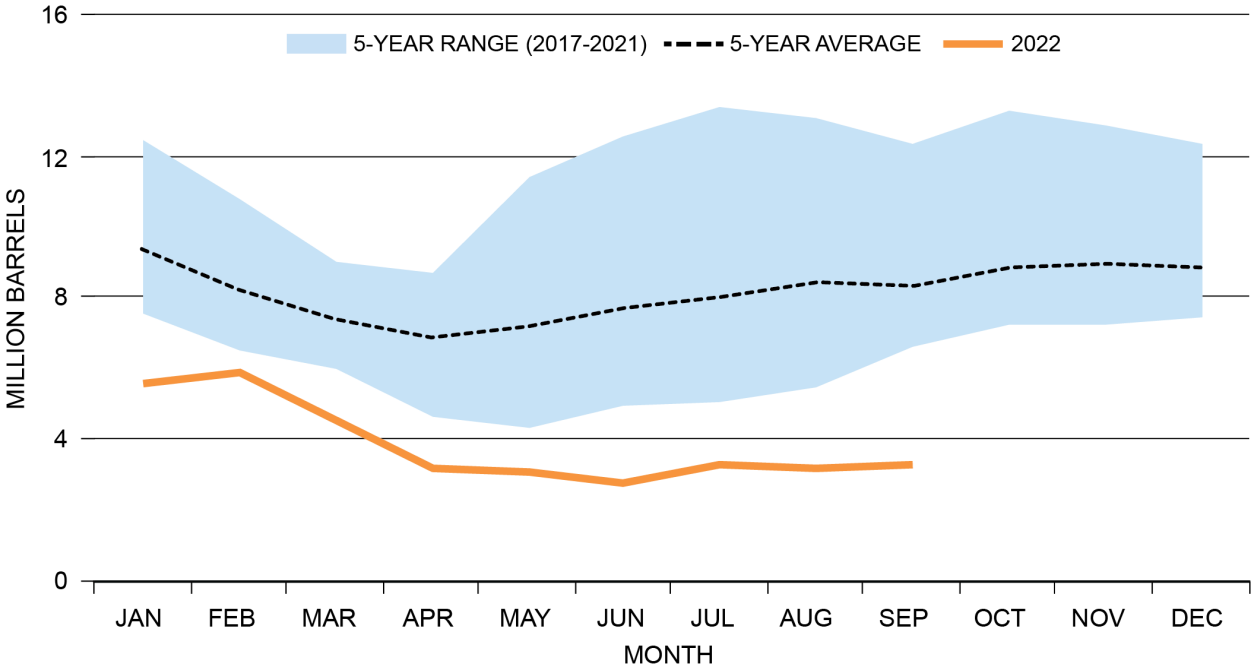
Figure 20. East Coast Gasoline Days Cover

Generally, the Northeast will build diesel inventories during the summer when gasoline demand is high and diesel demand is low; however, in 2022, this did not happen as in previous years due to tight global supplies (Figures 21, 22, and 23). As a result of low inventory, NYMEX Heating Oil prices have been volatile (Figure 24).



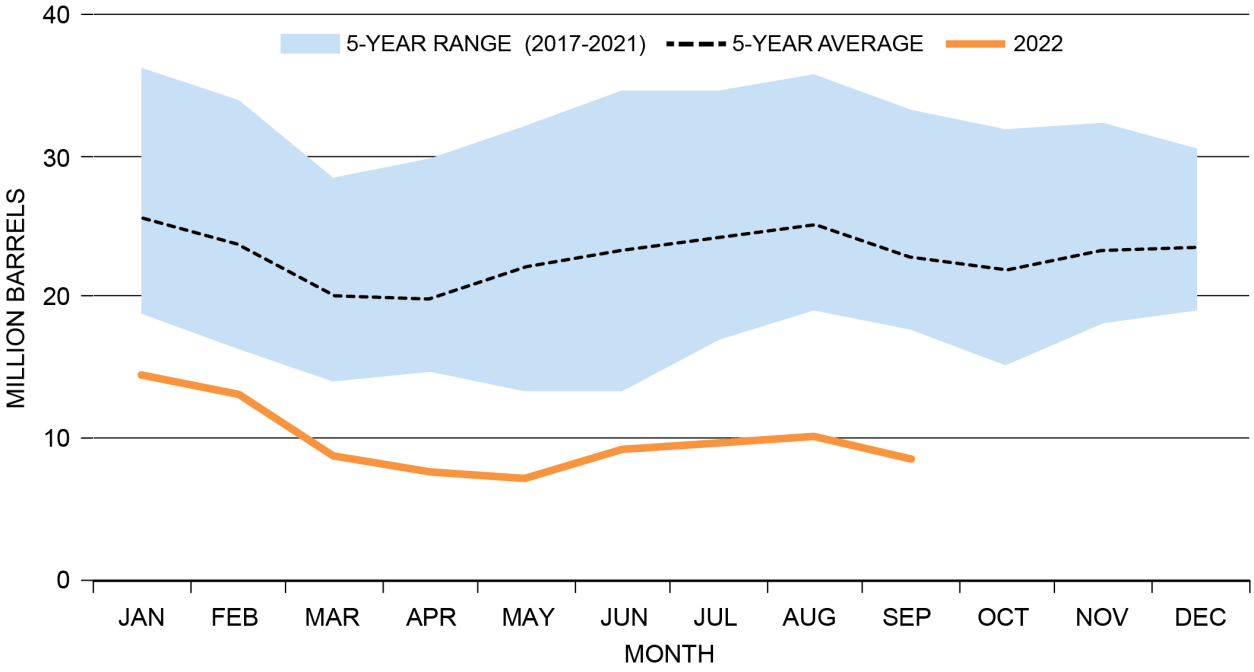
Source: EIA PADD 1 Stocks/Product Supplied.

Figure 21. East Coast Distillate Fuel Oil Days Coverage Below the Range



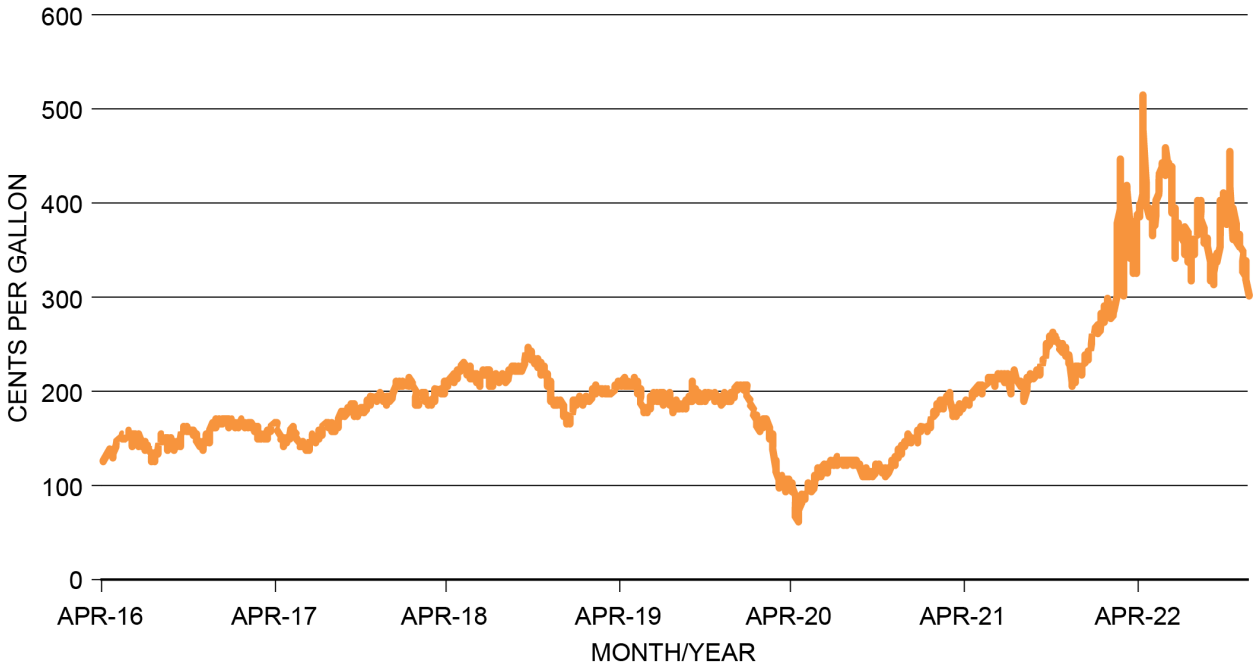
Source: EIA.

Figure 22. Boston Region Diesel Stocks Remain Low



Source: EIA.

Figure 23. New York Harbor Region Diesel Stocks Remain Low



Source: NYMEX.

Figure 24. Daily NYMEX Heating Oil Remains Volatile

Pipeline supply of diesel into the region is presently at capacity due to increased seasonal demand. Waterborne supply is sourced from both foreign imports and/or domestic inter-PADD transfers on Jones Act vessels. Although difficult to quantify, diesel demand in Europe, and to a lesser extent in the United States, has also been stronger due to natural gas to liquids switching. Elevated natural gas prices, primarily in Europe, have incentivized some industries to seek other forms of fuel supply, often increasing diesel demand.

As the international and domestic markets are connected, free market dynamics will enable the market to balance by attracting product to the regions where there is a shortage. As additional supply enters the region and/or demand falls, the market will begin to balance and prices should moderate.

Since mid-2021, PADD 1 diesel inventories have been at or below the pre-pandemic 5-year range as global diesel supplies are tight and market signals have encouraged using the available product and minimizing inventory. Total U.S. distillate fuel oil inventories going into the winter season are at approximately 26 days coverage, the lowest in over 13 years. Historically, December through February have the highest demand for distillate fuel oil in the Northeast region. With low days coverage, there is minimal reserve stocks in the event of a reduced supply event. Incremental supply will likely need to be brought into the region from other parts of the globe. Prices in the Northeast will need to rise to attract product from elsewhere.

Global diesel inventories may remain tight, with European sanctions on Russian diesel imports requiring Europe to source diesel from other sources such as the Middle East and the United States, and Russian barrels redirecting to markets other than Europe such as Africa, the Middle East, and Latin America. In the event of a disruption or shortage, allowing the market signals to drive industry response will be the most effective mechanism to ensure supply and efficient consumption. Requiring additional safety inventory to be stored would increase carrying costs, which would ultimately be paid for in higher consumer prices and would also take product off an already tight global market pushing up prices (see further considerations on strategic product reserves in the Emergency Response Preparedness section).

There is significant concern once EU sanctions go into effect against Russian product movements, primarily impacting diesel; in early February, the EU will struggle to replace supply. The European Union will need to source barrels from other global regions, such as the United States, increasing diesel prices and further reducing supply in the United States. Given that current pipeline access is limited, the U.S. will need to compete with the EU for supply. This will likely occur during the peak of the 2022-2023 winter season when supply is most needed.

While price will be the main enabler to encourage resupply in the event of a shortage, steps to make resupply as efficient and prompt as possible, such as a Jones Act waiver, may be needed in the event of a shortage in the Northeast.

While the inventories of diesel are currently low, EIA data show that in prior major storms impacting U.S. Gulf Coast refining capacity, unlike gasoline stocks, diesel inventories do not experience significant draws.

Another secondary effect impacting diesel demand and inventories in the Northeast is the logistics constraints on natural gas supply. With natural gas supply constrained, when demand for electricity increases beyond available natural gas supply, there is a need to switch to burning diesel for the incremental demand. This consumes diesel in an already tight market. Expediting permitting to alleviate the natural gas supply constraints would help ease the tight diesel and heating oil markets.

4.4.8 Russian Invasion of Ukraine

In late February 2022, Russia invaded Ukraine. In response to the invasion, several countries, including the United States, implemented various forms of sanctions. Many corporations also announced efforts to reduce or eliminate their operations in Russia.

U.S. sanctions prohibiting the import of any Russian energy commodities were issued in March 2022. Although the United States was not a large importer of Russian crude oil or finished gasoline, it was an importer of Russian diesel, residual fuel oil, and vacuum gasoil used

as feedstock for gasoline producing refinery units.[13] The loss of these feedstocks has required replacement feedstocks to be sourced from other producers, which has increased the cost of producing transportation fuels.

Although actual volumes vary month-to-month, Europe has historically been a large importer of Russian crude, diesel, and natural gas to supply their demand. European sanctions, including voluntary action to not buy Russian crude and products by companies, are impacting the global markets. Russian barrels are travelling further to reach alternative customers, and Europe and the United States are sourcing replacements that are also further away. These changes have created a less efficient global shipping market leading to higher freight rates (Figure 25). Recent product tanker rates are at the highest level for over two decades according to Clarksons Shipping Co.[14] Russian oil tanker exports are changing from regional ports in Europe to long-haul destinations such as China and India, pushing rates to higher levels according to shipping company Evercore.

With various restrictions on Russian crude oil and products, their prices have become significantly discounted versus non-Russian crude and products. Despite the restrictions, reports indicate Russian crude and refined products production is relatively unchanged, pre and post invasion, as some countries continue to import. As an example,[15] India has increased their purchase of Russian crude due to lower crude costs. However, Russian crude production could drop by 800 thousand barrels per day to 10.2 million barrels per day by December 2022 as the EU embargo comes into full effect, according to the IEA.[16]

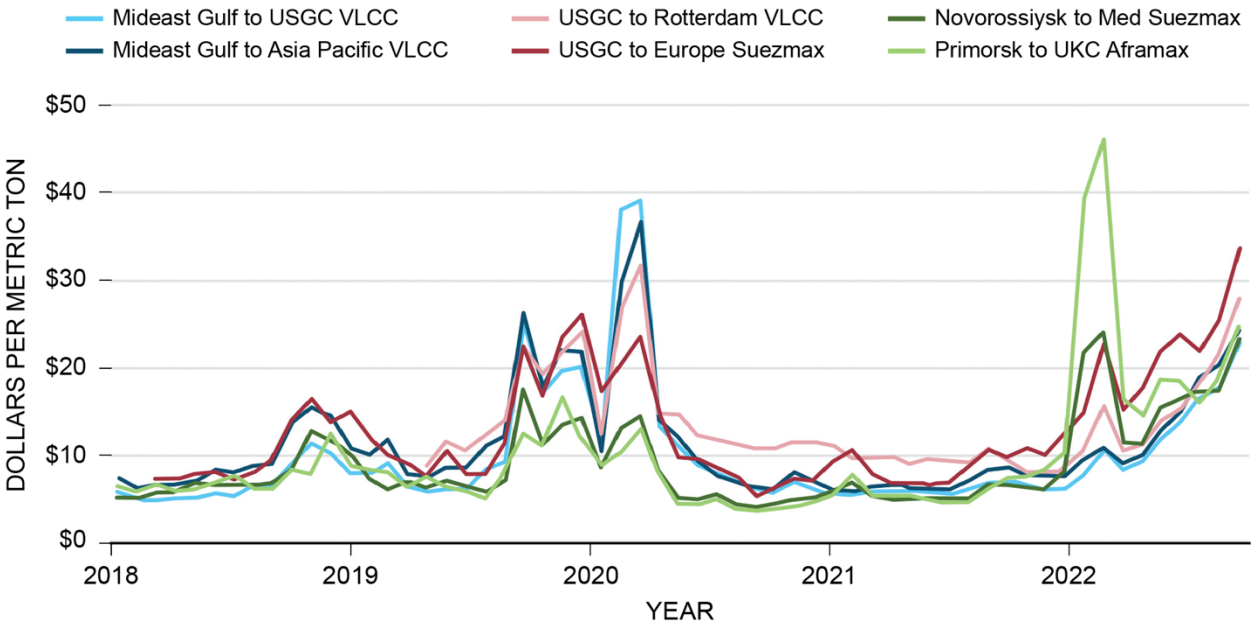
As a large importer of Russian gasoil/diesel, Europe will rely heavily on its own refinery production as well as foreign imports to meet domestic needs. Additionally, the European Union's sanctions on Russian diesel are expected to go into full effect by early February 2023 and Europe's diesel requirements will likely support higher prices in the global market as a result.

[13] U.S. Energy Information Administration, Today in Energy, "The United States imports more petroleum products than crude oil from Russia," March 22, 2022, https://www.eia.gov/todayinenergy/detail.php?id=51738# (accessed September 27, 2022).

[14] Irina Slav, "The Energy Market's Next Crisis: Oil Tanker Shortages," September 14, 2022, https://oilprice.com/Energy/Energy-General/The-Energy-Markets-Next-Crisis-Oil-Tanker-Shortages.html.

[15] Shruti Menon, BBC News, "Ukraine crisis: Who is buying Russian oil and gas," December 6, 2022, https://www.bbc.com/news/world-asia-india-60783874.

[16] International Energy Agency, Oil Market Report, September 14, 2022, p. 14.



Data source: Argus Media Group.
Source: EIA.
Note: USGC=U.S. Gulf Coast, UKC=UK Continent, VLCC=Very Large Crude Carrier, Med=Mediterranean.

Figure 25. Inefficient Trade Flows Increase Tanker Rates

Europe has long been a large importer of Russian natural gas to meet its domestic demand. According to the European Commission, imports from Russia accounted for 40% of the natural gas consumed in the European Union.[17] In particular, Germany imports natural gas from Russia via the Nord Stream 1 pipeline. Russia has curtailed flows on Nord Stream 1 throughout the year, and in late August 2022, gas flows fell to zero. As a result of Russian pipeline curtailments, global LNG prices spiked, reaching a record high of $70.50 MMBtu the week of August 26, 2022. Europe has been forced to meet much of its natural gas demand by buying LNG from the global market, increasing imports as much as 40%. European policy makers are concerned there may be insufficient natural gas to meet European demand this winter when supply is needed most. Though European gas storage is currently at a relatively healthy level, these stocks can be quickly depleted in the event of sustained cold weather, as experienced by the United States in February 2021, and the continent will continue to require significant LNG imports to meet ongoing demand while ensuring sufficient storage levels are achieved ahead of winter heating peaks.

[17] European Commission, REPowerEU Plan, published May 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A230%3AFIN&qid=1653033742483.

4.4.9 China Position

Although data from China are not widely reported, various IEA Oil Market Reports show demand was, and continues to be, impacted by China's zero-COVID policy. September's 2022 IEA Oil Market Report has Chinese refinery throughput for July 2022 at 12.8 million barrels per day versus a maximum demonstrated rate of over 15 million barrels per day.

Also, the EIA reports that China will add an additional 1.1 million barrels a day of refining capacity in 2022, bringing total nameplate capacity to 19.2 million barrels per day, in anticipation of future domestic demand.

According to FACTS Global Energy Group (FGE),[18] mid-2021, China strengthened state control of oil liquids imports and exports and concurrently reduced the export quotas for gasoline, diesel, and jet fuel. As a result of this China policy, fuel exports were cut in half between the first half of 2021 and the first half of 2022 according to FGE.

Chinese refinery utilization declined with lower domestic demand due to COVID-19 lockdowns, lower exports, and the growth in its refining capacity. According to IEA and FGE reports, China currently has the largest concentration of spare global refining capacity, assessed at more than 6 million barrels per day. While China has recently slightly increased export quotas, a recent report from FGE states that China could increase fuel exports up to 1.2 million barrels per day if they removed quota restrictions completely.

China began importing LNG in 2006 and overtook Japan as the world's largest LNG importer in 2021, averaging 10.5 Bcf/d. LNG imports account for more than half of China's natural gas imports and 30% of the country's natural gas supply. The United States became the largest supplier of spot LNG volumes to China in 2021, after China lowered tariffs on LNG imports from the United States. In 2021, natural gas accounted for 9% of total energy consumption in China, making it the third largest natural gas consumer behind the United States and Russia. The country has had an average annual natural gas demand increase of 11% since 2011, driven in part by a need to address poor air quality in urban areas, decrease availability in hydropower, and weather variations increasing residential energy demands. There is also a coal-to-gas initiative for heating, with a target of converting 7 million households from coal to natural gas.

In 2022, slower economic growth due to China's COVID-19 outbreaks and shutdown policies, and high spot prices of LNG during the summer, caused China to reduce its consumption of energy and its imports of LNG, opting to resell LNG cargoes to Europe. As gas prices declined this fall, China increased LNG imports to build up storage for the winter heating season. China also focused on long-term contracts for LNG deliveries to alleviate future impacts of price volatility on the spot market.

[18] Facts Global Energy Group, Annual World Refining Outlook 2022, June 2022, used by permission.

4.4.10 Summary

Global petroleum markets and the U.S. market have gone through very extreme fluctuations in the last three years, driven by the unprecedented demand destruction caused by COVID-19 and the subsequent recovery, as well as the invasion of Ukraine. Despite the extreme nature of the demand fluctuations, the global market has facilitated industry adjusting to rebalance. The low prices during the demand destruction resulted in production decreases and the higher prices have stimulated the response across the industry to rebuild supply. Throughout this period, the markets have remained supplied through the actions taken by industry. U.S. crude production is back to near record levels and refinery utilization is near all-time highs to meet the current demand.

While global and U.S. inventories are at the lower end of historical levels, they are at a sufficient level to meet ongoing supply. With low inventories in some geographies driven by the tight global supply and demand, especially for diesel, the most effective way to ensure reliable supply is to remove barriers for free trade, ensure that the response to disruptions is quick and easy to implement, and then to allow the market to function effectively to allow prices to drive resupply. The U.S. market is impacted by global markets and events that move supply and demand, influencing prices. Allowing the global market to function effectively has been the single most important factor in keeping the markets balanced and supplied.

5. EMERGENCY RESPONSE PREPAREDNESS

One of the key questions included in the request from the Secretary of Energy was what steps should be taken to help respond to disruptions caused by events such as hurricanes, cyberattacks, or physical attacks.

Disruption in energy supply can take various forms, from lack of feedstock to industrial facilities (crude oil to refineries, natural gas to power plants) to interruption of utilities preventing shipment or delivery of energy, to weather, accidents, or intentional acts physically or virtually disabling key infrastructure such as pipelines or tankers. The ability of government and industry to jointly respond in an efficient manner will determine how widespread a disruption is and how long a disruption lasts.

Four topics were reviewed in the area of emergency response preparedness. The resilience of the country's energy system was reappraised with the significant changes that have occurred in the domestic energy industry over the last eight years. The 2014 NPC study on Emergency Preparedness and its 2016 addendum were revisited to assess progress made since their publication. New threats since the 2014/2016 NPC studies were identified and assessed. Finally, enhancements to joint government/industry emergency response were evaluated for further consideration.

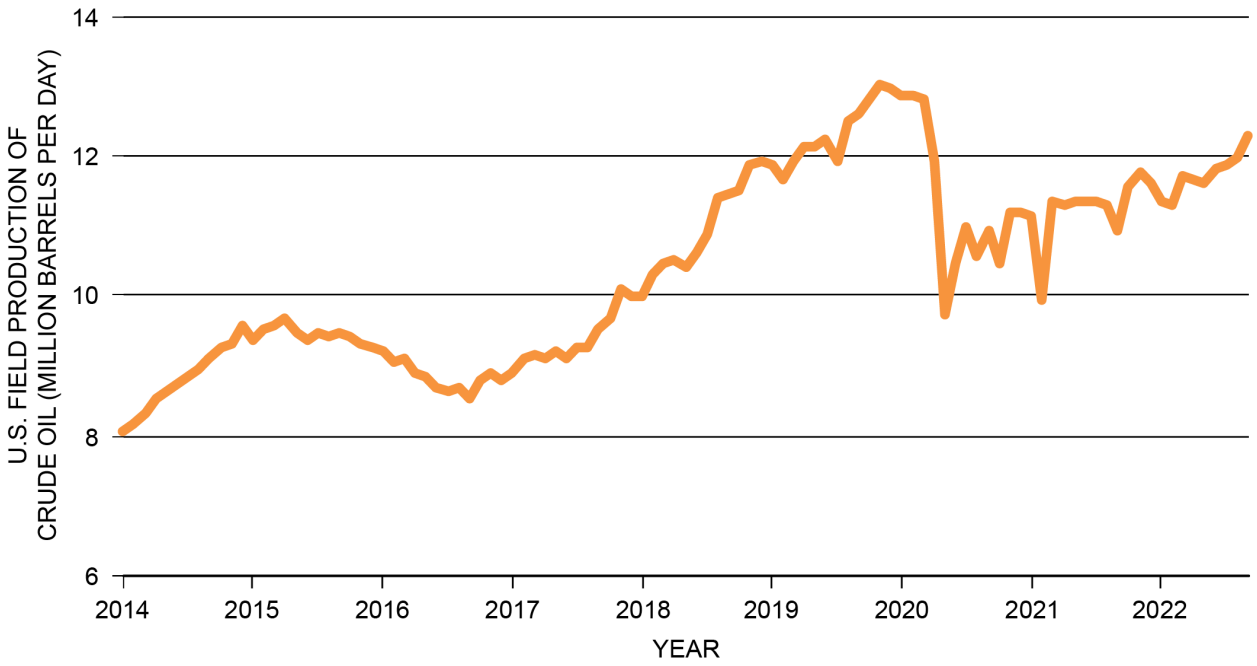
5.1 Underlying Improvements in the Resilience of the United States' Energy System

The developments in the United States' energy system over the past decade have improved the underlying resilience of the current energy supply. Increasing production of crude oil, natural gas, natural gas liquids, and refined products have resulted in increasing North American exports of these energy flows. Along with increasing production has been the installation of billions of dollars of infrastructure to support the processing and transportation of these energy flows. These increasing exports and the associated infrastructure have improved the resiliency of North America to respond to emergencies or interruptions. These growing exports also support a strong U.S. economy and support U.S. manufacturing and U.S. jobs. Finally, a reliable source of North American energy exported for the world helps contribute to global stability and meet growing global energy demand.

There have been significant changes in flows of crude oil, refined products, natural gas liquids, and natural gas since the 2014 NPC *Emergency Preparedness* report.

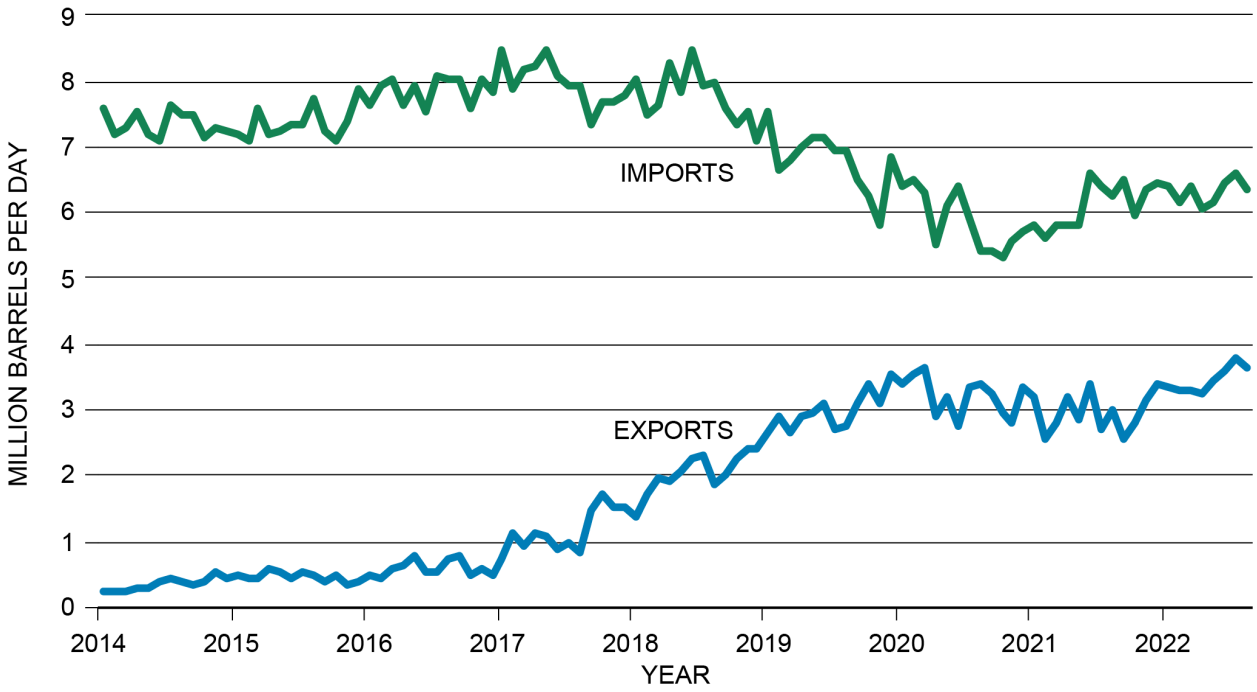
5.1.1 Crude Oil

Growth in U.S. crude oil production has resulted in less dependence on imported crude oil, resulting in less risk of disruption (Figures 26, 27, and 28).



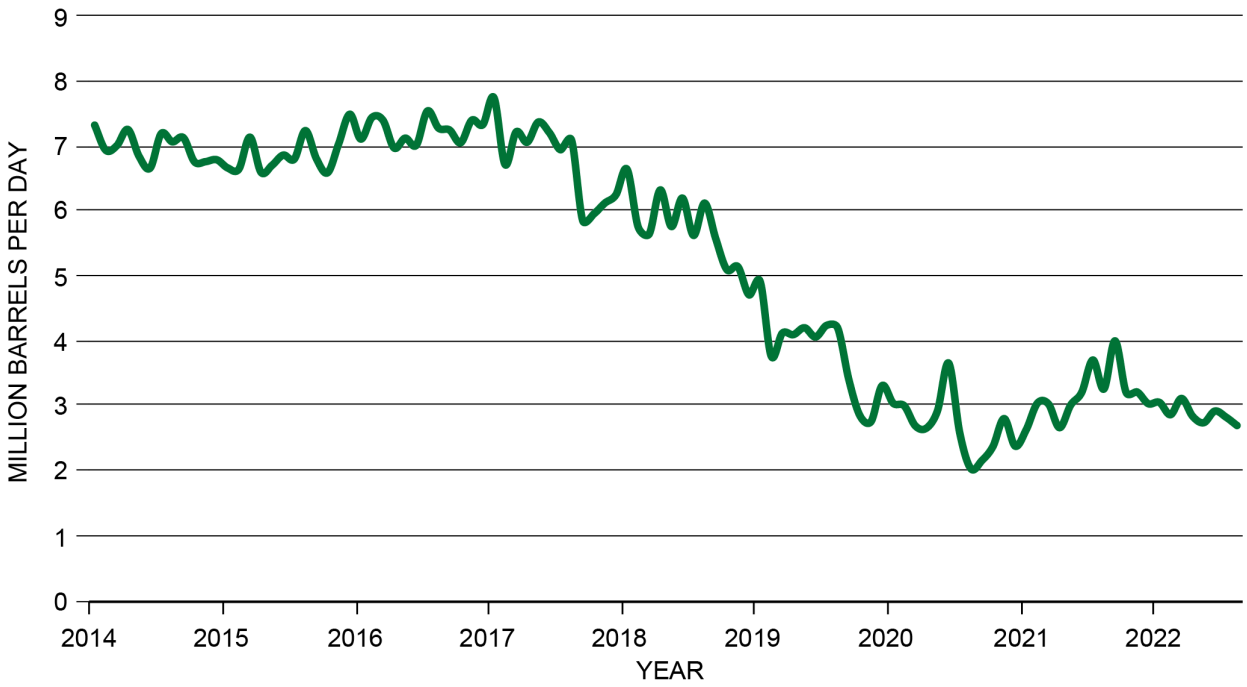
Source: EIA.

Figure 26. U.S. Crude Oil Production Growth Since 2014



Source: EIA.

Figure 27. U.S. Crude Oil Exports Growing

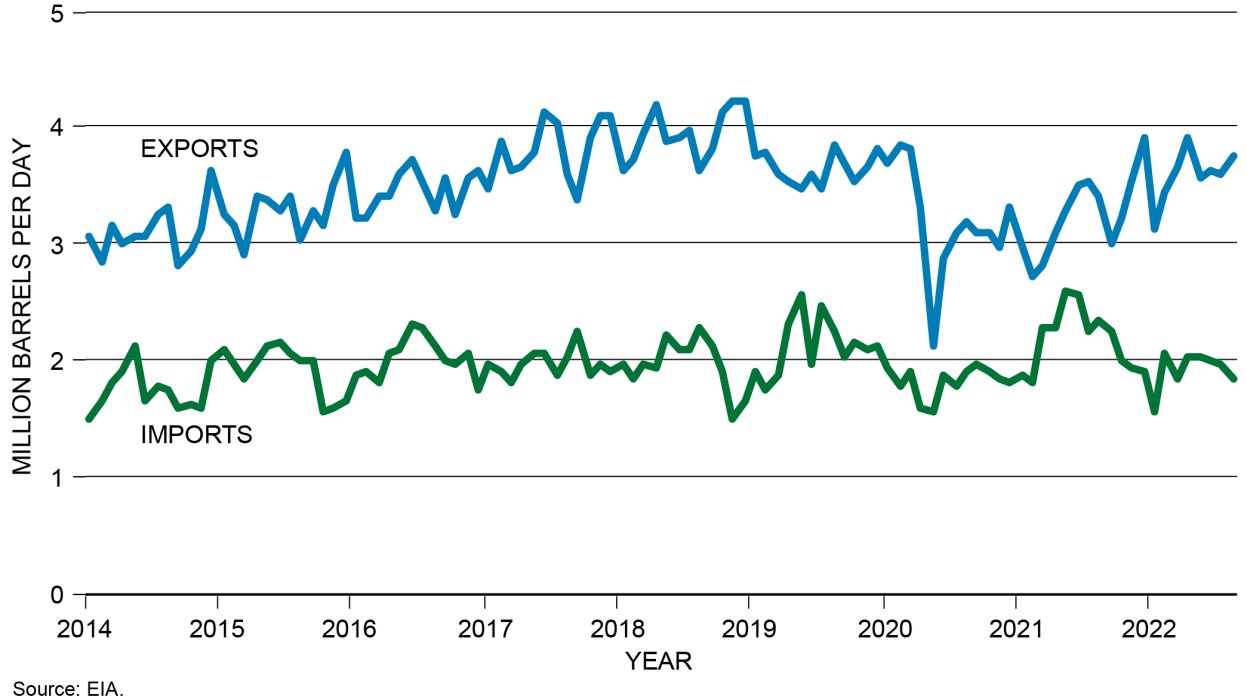


Source: EIA.

Figure 28. U.S. Crude Oil Net Imports Declining

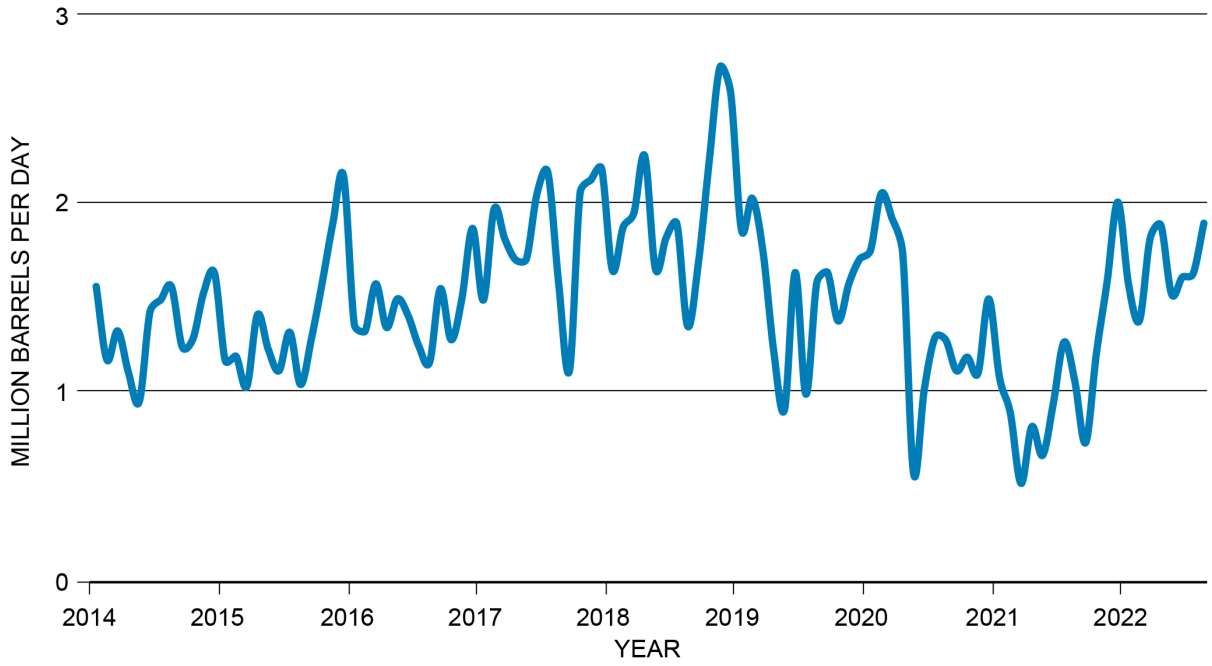
5.1.2 Refined Products

The United States has a net balance of refined product exports and imports that is positive, providing optionality in the time of disruption (Figures 29 and 30).



Source: EIA.

Figure 29. U.S. Refined Products Trends

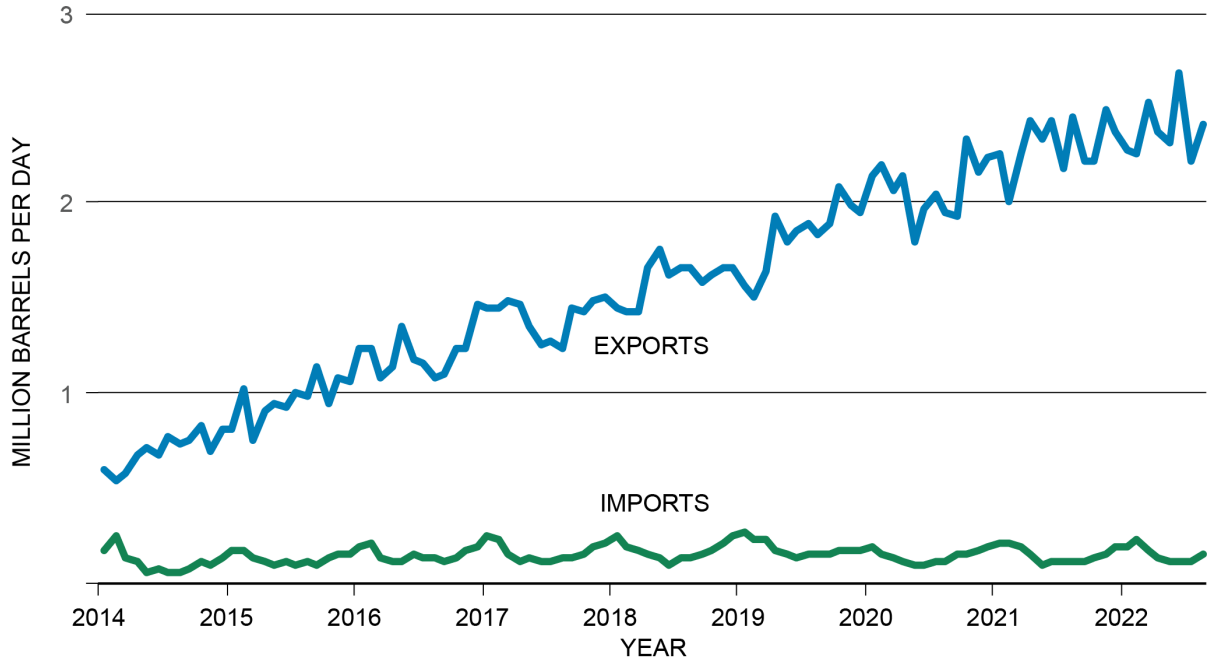


Source: EIA.

Figure 30. U.S. Refined Products Net Exports Trend

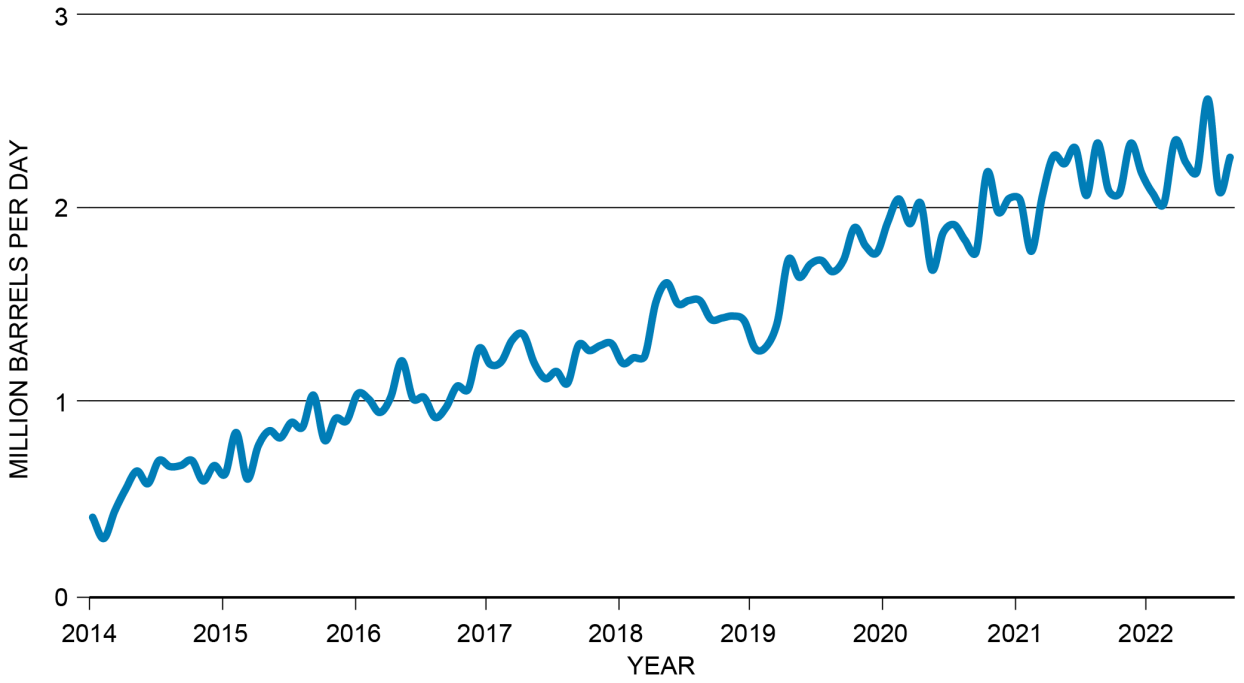
5.1.3 Natural Gas Liquids

Natural gas liquids production has increased as crude oil and natural gas production has increased. Again these exports increase resilience in times of disruption and also benefit the U.S. economy (Figures 31 and 32).



Source: EIA.

Figure 31. U.S. NGL Exports Growing

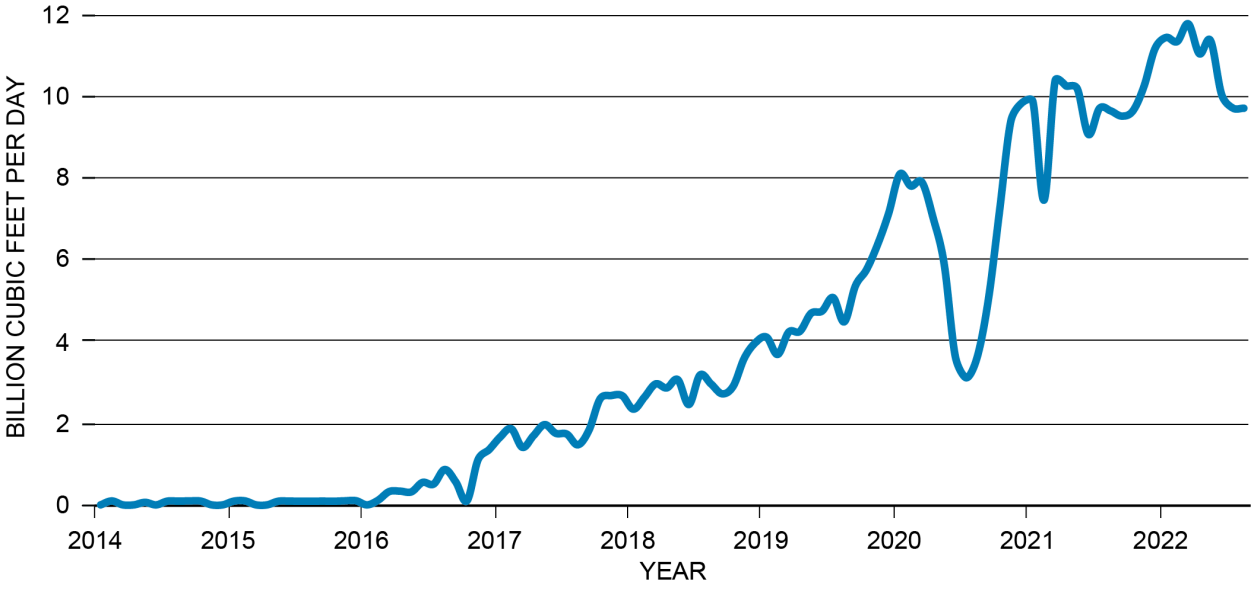


Source: EIA.

Figure 32. U.S. NGL Net Exports Growing

5.1.4 Natural Gas

With the growth in natural gas production, the United States has grown exports of liquefied natural gas for volumes not consumed in the country, providing resilience to the overall supply (Figure 33).



Source: EIA.

Figure 33. U.S. LNG Exports Growing

5.2 Progress on Recommendations from the 2014 *Enhancing Emergency Preparedness for Natural Disasters* and 2016 *Emergency Preparedness Implementation Addendum* NPC studies

There was a very extensive set of recommendations as part of the 2014 and 2016 studies to improve the ability to respond to emergencies. In response to the current request from the Secretary, this study undertook a comprehensive review of the progress made and the status of these recommendations.

Since the publication of the National Petroleum Council 2014/2016 studies, much has been accomplished toward the recommendations.

When the Department of Energy (DOE) established the Office of Cybersecurity, Energy Security, and Emergency Response (CESER) in 2018, a heightened focus was brought to understanding and preparing for emerging threats and risks to the energy sector. Recommendations from the 2014/2016 studies were utilized along with partnerships from the Oil and Natural Gas Subsector Coordinating Council (ONG SCC) and Electricity Subsector Coordinating Council (ESCC), to help align CESER with preparedness activities needed to carry out the agency's federally mandated response requirements.

After a year without a dedicated program manager focused on preparedness exercises, CESER hired in 2018 a seasoned program manager to lead training and exercise activities and further engage the sector and cross-sector partners in improving preparedness. This expertise has helped transform CESER's engagement across industry and has improved understanding of the oil and natural gas value chains throughout the community. These exercises, such as the enhancements to CESER's annual all-hazards Clear Path Exercise, have also contributed to increased coordination and has leveled expectations during real world incident responses.

CESER's response staff implemented elements of the National Incident Management System's (NIMS) Incident Command System (ICS) into its organization and its real-world incident response functions. The Emergency Support Function (ESF) 12 – *Energy* role evolved following several busy years of activations for exercises, severe storms, and the COVID-19 pandemic. DOE CESER's Emergency Response Organization (ERO), formally referred to as the Energy Response Team (ERT), remains a fully implemented ICS compliant organization. DOE CESER Response Team roles and responsibilities are codified in the All-Hazards Response Plan and ICS section standard operating procedure, and utilization of standard ICS processes and tools has improved the effectiveness of ERO. DOE's management of simultaneous events has also improved greatly with the introduction of the CESER Regional Response Team model. The response program used these opportunities to validate the evolved response model and build positive rapport with the public sector partners as well as other government entities.

Trade associations, representing company owners and operators, provided liaisons, building relationships with, and emphasizing direct communications with CESER's Response and

Restoration division. DOE CESER maintains strong relationships with designated trade representatives by directly coordinating through the ONG SCC and ESCC. In 2021, DOE migrated all emergency authorities to CESER, creating near immediate improvements as all authorities are coordinated and managed by the Response and Restoration team. Relationship building and expectation development with the Response and Restoration division as well as the EIA contributed to increased situational awareness and positive Unity of Effort coordination calls during exercises and real-world incidents. By utilizing partnerships between states and the oil and natural gas industry, DOE CESER is working to update state plans to include increased awareness at the state level regarding the complexities of the oil and natural gas value chains. State energy (assurance) security plans (SESP) have become an essential part of DOE's energy security planning. Implementation of scenario development, facilitated questions, and participant involvement continues to educate DOE CESER on the interdependencies between natural gas production and transmission with electricity generation. Since 2018, the allocation of resources and supply chain impacts following a hazard has been included in federal, state, local, and industry preparedness. DOE recommends that states and territories update SESPs annually, and technical assistance will be provided by DOE in FY23 to help states continue to improve the plans. However, many of the recommendations made in the 2014/2016 studies have seen significant progress and are meant to be actions that are continuously improved upon, in collaboration between CESER and the sector partners.

Since 2016, DOE has included industry participants in the planning and evaluating of comprehensive drill and exercise programs, and DOE has attended and participated in multiple industry-sponsored exercises. Homeland Security Exercise and Evaluation Program (HSEEP) guidance continues to be leveraged in all planning and conduct of exercises at DOE. Energy Sector Exercise programs institutionalizing the quarterly exercise forum virtual engagements have provided industry with a platform and space to share updates on upcoming planning.

In reviewing the NPC 2014/2016 studies, the status of implementation of the recommendations was found to be sufficient. DOE continues to operate successfully within the systems that have been implemented and relationships that have been fostered since 2016. Operating within an ever-changing environment, DOE emergency preparedness will continue to evolve and ensure processes stay relevant and coordinated as challenges arise.

A detailed summary of the status of the recommendations is included in Appendix C.

5.3 New Threats Since the 2014/2016 Studies

The team considered new threats since the earlier studies. The key areas identified were Cybersecurity Threats, Physical Threats to Pipeline Infrastructure, and Loss of Power Due to Extreme Weather.

5.3.1 Cybersecurity Threats

The operations of oil and natural gas infrastructure, inclusive of production, refining, and transportation heavily relies on both Informational Technology (IT) and Operational Technology (OT) systems. IT systems are used for communication, scheduling, supply chain, and business activities, while OT systems run many of the highly complex processes and machinery associated with the mechanical movements of products. A cyberattack could impact either or both of these systems for a sustained period of time, interrupting overall supply chain for energy flows. Key threat actors include nation states, ransomware gangs, individuals seeking trade secrets, and eco-terrorists or activists.

The threat of a cybersecurity attack is not a new risk for the oil and natural gas industry; however, the threat and severity of consequences have increased over the past few years. There are many of factors contributing to this increase, including an increased dependence on digital control of operations, workers more frequently conducting business outside of the office environment, and an unstable geopolitical environment. Several countries (e.g., Russia, Iran, China, North Korea) provide a safe haven for for-profit ransomware gangs, and there is an increasing sophistication of nation state hackers.

Cybersecurity attacks can impact any element of the oil and natural gas supply chain from a wellhead to a pipeline or from refining to electricity generation. Various segments and operations in the supply chain are regulated by different entities, including the Coast Guard at marine facilities, the Transportation Security Administration (TSA) for pipelines, and Cyber-security and Infrastructure Security Agency (CISA) for chemical facilities. Outside of regulatory authority, there is also collaboration and information sharing between the Department of Energy, the Federal Bureau of Investigation, information sharing and analysis centers (ISACs), and others for information sharing between government and the private sector.

Industry standards provide a framework for continuous improvement, standardization, and benchmarking between companies. Examples of standards include API 1164 (Pipeline Control Systems Cybersecurity) and 780 (Security Risk Assessment Methodology), INGAA Control Systems Cyber Security Guidance, and the NIST Cyber Security Framework. While these (and other) guidance documents provide best practices, cybersecurity threats and the risk environment are constantly changing.

The 2021 cyberattack of the Colonial Pipeline system is an example of the scope and consequence of a cyberattack in the oil and natural gas sector. A criminal ransomware attack against Colonial's IT infrastructure caused the company to voluntarily shut down the operations of 5,000 miles of pipeline to ensure that their OT system was not impacted. As a result of a 5-day operational shutdown, the U.S. East Coast experienced significant fuel shortages. This event highlights the wide-ranging impact of a cyberattack on critical infrastructure.

TSA regulates security – both physical and cyber – for oil and natural gas pipelines. Prior to the Colonial Pipeline cyberattack in 2021, TSA relied on voluntary guidelines and

partnerships with pipeline operators to manage cybersecurity issues. These relationships were built on critical facilities reviews and voluntary inspections.

Several weeks after the Colonial Pipeline attack, TSA released mandatory security directives for the top 100 critical systems (as defined by TSA) in the pipeline sector that required operators to: disclose cyber incidents within 12 hours; conduct cybersecurity assessments; and appoint a coordinator in the event of incident. A second security directive was subsequently released mandating specific security policies and network segmentation between the IT and OT segment. Following these initial security directives, TSA conducted compliance reviews on oil and natural gas pipelines, further refined its guidance, and is in the process of codifying its security directives via the regulatory process. The agency is taking a performance-based approach to the directives (and forthcoming regulations) and acknowledges that the cybersecurity threat landscape, technologies, and protective measures are constantly evolving.

Cybersecurity discussions are at the forefront of enterprise risk discussions throughout the oil and gas industry. With increasingly sophisticated cybercriminals, nation-states, and the increased impact and attention associated with cyberattacks, this threat is predicted to continue to increase. Collaboration between industry and its government partners is increasingly important and has been critical to combat this heightened risk.

5.3.2 Physical Threats to Pipeline Infrastructure

In October of 2016, five individuals coordinated the shutdown of interstate crude pipeline systems in four U.S. states by illegally breaching remote valve sites, turning shut-off valves, and effectively halting the transportation capacity of nearly 70 percent of the daily crude oil imported to the United States from Canada.[19] The companies operating the pipelines, Kinder Morgan, Transcanada, and Enbridge, shut down their lines for between five and seven hours, according to Reuters estimates and company representatives. These activists' tactics characterized as "non-violent direct action" are now commonly used by individuals supporting the anti-fossil fuel movement. These activities threaten the lives of the attackers and pipeline workers, could cause environmental damage, and could disrupt critical energy supplies.

As opposition to fossil fuels continues into the next decade and beyond, government and industry need to be prepared for the use of similar tactics. A traditional response to sabotage and trespassing is to reduce visibility, harden perimeters, and remove the target object from public view/access. However, this is not practical for the pipeline industry due to the commercial, operational, and regulatory realities and the sheer mileage of pipelines in the United States (2.7 million miles).

[19] Michelle Nijhuis, "I'm just more afraid of climate change than prison," The New York Times Magazine, February 2018.

The domestic pipeline network co-exists with industry partners, neighbors, and other public infrastructure to ensure efficient delivery of critical energy. Pipelines cannot practicably be unapproachable at all times by a member of the public. By necessity, there are hundreds of thousands pipeline road and rail crossings, extensive mileage on private lands, and co-location with other public infrastructure, like electric transmission, water, and telecommunications lines, all of which, by their nature, are accessible to certain members of the public under normal operating conditions.

By regulation, below- and above-ground hazardous pipelines must be clearly marked, and the local community needs to know where they are located. According to U.S. DOT PHMSA's annual pipeline mileage report, the inventory of operating U.S. onshore hazardous liquid and gas transmission pipelines exceeded 500,000 miles in 2021.[20] Similar rules apply for above-ground pipelines and gas transmission pipelines. Although a reliable accounting of the number of pipeline markers currently installed is not available, a conservative estimate would put no fewer than several million markers currently in place onshore in the United States. The benefit of these markers undeniably outweighs their risks, but they represent one of the most straightforward challenges operators confront when it comes to maintaining discreet operational security vs. promoting public awareness and damage prevention.

While much of pipeline security efforts has been focused on hardening infrastructure against cyber-threats, events have led to a greater emphasis on preventing physical threats as well. Government-industry cooperation has been important in addressing the risk that activism and tampering represent to the nation's critical infrastructure.

The National Infrastructure Protection Plan (NIPP) created a framework for government and industry to improve the security of critical infrastructure, such as pipelines. The NIPP identified several critical sectors requiring public-private action, including Energy and Transportation. Pipeline security topics are covered by both. Within the Energy Sector, the Oil and Natural Gas Subsector Coordinating Council (ONG SCC) meets with the Energy Government Coordinating Council (EGCC), cochaired by the Department of Energy and the Department of Homeland Security, at least three times a year to discuss issues critical to the nation's energy security objectives. The ONG SCC has seven working groups including groups that focus on Pipelines and Law Enforcement Engagement.

Within the Transportation Sector, the Pipeline Modal Subsector Coordinating Council is the counterpart to the Pipeline Modal Government Coordinating Council, led by TSA and PHMSA. TSA and PHMSA work together to integrate pipeline safety and security priorities, as measures installed by pipeline owners and operators often benefit both safety and security.

[20] U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration, "Annual Report Mileage for Hazardous Liquids or Carbon Dioxide Systems," https://www.phmsa.dot.gov/data-and-statistics/pipeline/annual-report-mileage-hazardous-liquid-or-carbon-dioxide-systems.

The Pipeline Sector Coordinating Council (PSCC) also works as the Pipeline Working Group (PWG) for the ONG SCC to avoid duplication of efforts. The PSCC/PWG provides a primary point of entry for industry representatives to discuss a range of pipeline security strategies, policies, activities, and issues with the relevant government agencies.

As a result of some of these efforts, TSA published a revised set of Pipeline Security Guidelines in 2021 to account for the advancement of security practices and the evolving threats facing the sector.

The ONG SCC's Law Enforcement Engagement Working Group also allows industry to raise security issues with federal law enforcement and agency officials who enforce the laws that prohibit the tampering with critical infrastructure.

States have taken the lead in progressing legislation that seeks to deter direct action protest that can physically imperil pipeline operations. In 2017, following the 2016 valve turning incidents, three state legislatures introduced bills designed to deter protests at pipelines and other oil and gas facilities. The bills failed in two states, Georgia and Colorado, but passed in a third state, Oklahoma. Since 2017, bills related to the protection of critical infrastructure have been introduced in a total of 24 states. Seventeen have passed these bills into law: Alabama, Arkansas, Indiana, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, North Dakota, Ohio, Oklahoma, South Dakota, Tennessee, Texas, West Virginia, and Wisconsin.

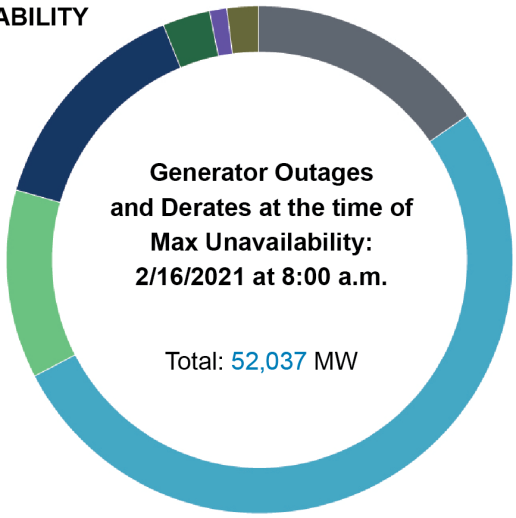
Industry has made strides recognizing these emerging threats and securing their assets against them. According to the ONG SSC, the private sector has taken actions in the areas of Identify, Protect, Detect, and Respond/Recover. These actions are expected to enhance protection of critical energy infrastructure. Progress has been made over the years involving public-private efforts to identify pipelines as critical infrastructure and to develop plans to deter and prevent physical tampering. Although much focus is rightly placed on cybersecurity, attention must remain on the threat of physical attacks on critical infrastructure. Ongoing efforts, including enhancing legal deterrence and information sharing remain as critical elements of defense, allowing operators to prepare for emerging threats.

5.3.3 Loss of Power Due to Extreme Weather

The reliability of oil and natural gas production and transportation and electric power generation are interconnected. Threats to the reliability of one can affect the other. This relationship was demonstrated in February 2021 by Winter Storm Uri, which caused a prolonged deep freeze that resulted in the failure of several energy delivery systems, including the Texas power grid managed by the Electric Reliability Council of Texas (ERCOT). As demand outstripped supply, the power grid was close to collapse, which ERCOT said would have led to a statewide blackout for weeks.

GENERATOR OUTAGES AND DERATES: MAXIMUM UNAVAILABILITY

- The highest amount of unavailable capacity during the period of February 14-19, 2021 occurred on February 16 at ~8:00 AM and was 52,037 MW.
- The chart shows the MW of the generator outages or derates that were occurring at that point in time by cause category.
- Note that the total outaged and derated capacity at this time is different than what was previously reported (52.277 MW) due to the additional information received in response to the RFIs.



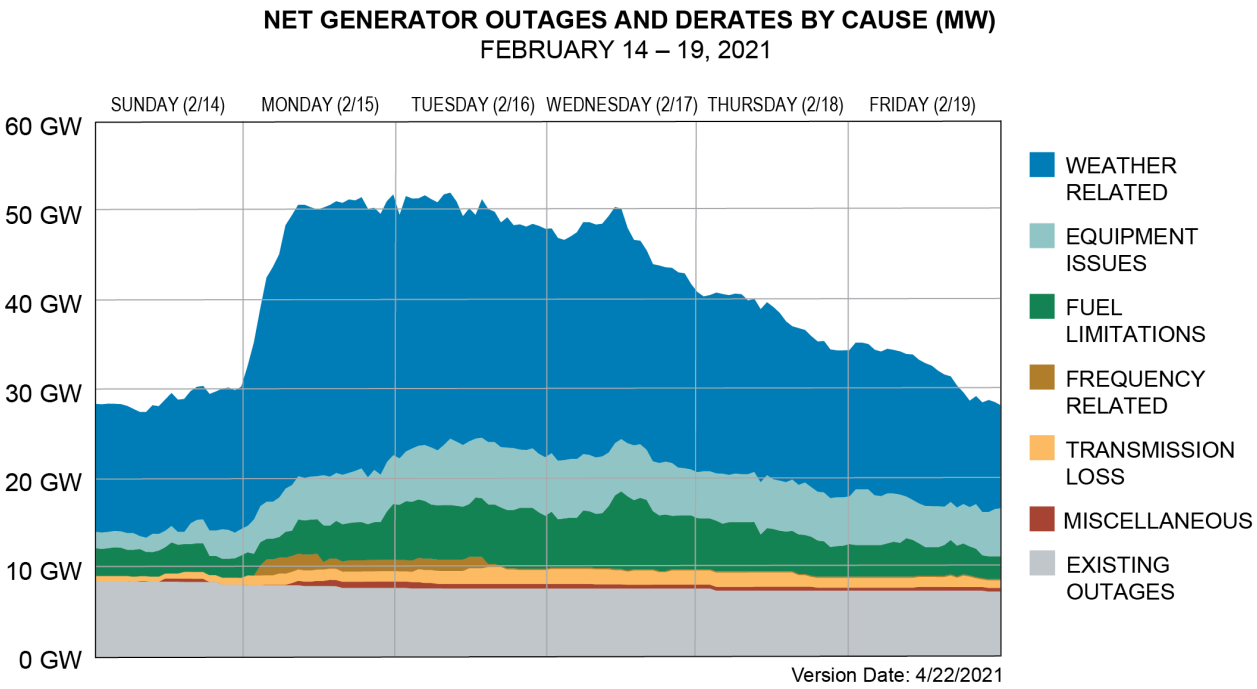
EXISTING OUTAGES (7,650 MW, 15%)
FUEL LIMITATIONS (6,130 MW, 12%)
MISCELLANEOUS (512 MW, 1%)
FREQUENCY RELATED (1,262 MW, 2%)
WEATHER RELATED (27,567 MW, 53%)
EQUIPMENT ISSUES (7,457 MW, 14%)
TRANSMISSION LOSS (1,459 MW, 3%)

Source: ERCOT.

Figure 34. Winter Storm Uri Generator Outages

The freezing temperatures began creating challenges for the Texas power generation industry and led to significant outages and derates during the storm (Figure 34). In April 2021, ERCOT issued a report,[21] "Report on Causes of Generator Outages and Derates During the February 2021 Extreme Cold Weather Event," indicating that weather-related problems were the biggest reason – causing more than half of the outages and derates. "Weather-related problems" included but were not limited to frozen equipment—including "frozen sensing lines, frozen water lines, and frozen valves—ice accumulation on wind turbine blades, ice/snow cover on solar panels, exceedances of low temperature limits for wind turbines, and flooded equipment due to ice/snow melt." Existing outages, other equipment issues, and fuel limitations, mostly natural gas, were distant second, third, and fourth leading causes (Figure 35).

[21] ERCOT, *Update to April 6, 2021 Preliminary Report on Causes of Generator Outages and Derates During the February 2021 Extreme Cold Weather Event,* April 27, 2021, https://www.ercot.com/files/docs/2021/04/28/ERCOT_Winter_Storm_Generator_Outages_By_Cause_Updated_Report_4.27.21.pdf.



Note: Net generator outages at the beginning of each hour on February 14-19, 2021, by cause category.
Source: ERCOT.

Figure 35. Winter Storm Uri Generator Outage Causes

A study by Enverus,[22] commissioned by the Texas Oil and Gas Association, found that once power outages began, natural gas production was affected because natural gas production's surface facilities and infrastructure rely heavily on electric power for operations, which then exacerbated the diminishing ability of power generators to receive natural gas supplies. Even with these challenges, Texas natural gas production exceeded Texas demand during the storm; however, matching supply with demand proved difficult.

The common denominator that caused most disruptions to both upstream and midstream sectors was the loss electricity. Upstream survey responses focused on loss of power (65%), wellhead and equipment freeze offs (13%), and not being able to get production out due to issues with third-party facilities (8.7%) as the main causes that influenced operations. Midstream survey responses focused on loss of power and lack of production from upstream as the main causes of downtime for infrastructure.

A joint report by the Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Corporation (NERC) found that of the unplanned outages and derates of gas generating units, 44.2% were caused by freezing issues and 21% by mechanical/

[22] ENVERUS, *Winter Storm Uri – Natural Gas Analysis,* Prepared for Texas Oil & Gas Association, April 2021, https://docs.txoga.org/files/2644-4-22-21-enverus_txoga_winter-storm-uri-natural-gas-analysis.pdf.

electrical issues. Two-thirds of the outages and derates were caused by problems at the plants themselves.

Improvements in communications have been made among all stakeholders since Winter Storm Uri to better prepare the natural gas supply chain for the winter season in Texas. The oil and natural gas industry is working closely with state regulators to implement Senate Bill 3, which calls for: 1) more clarity in the "critical load" designation process, 2) mapping of natural gas facilities that are directly tied to power generation, and 3) weatherizing those facilities.

Texas' vast supply of natural gas in storage also plays an important role in helping power generators better prepare for emergency weather events. Having firm supply, storage, and transportation contracts in-place, ahead of storms, can help balance any production declines associated with extreme cold weather events.

The ERCOT critical load designation form[23] has been revised to include, "individual premises (meters) that provide electricity to natural gas production, saltwater disposal wells, processing, storage, or transportation, such as a natural gas compressor station, gas control center, or other pipeline transportation infrastructure."

Identifying natural gas facilities directly tied to power generation is well underway. There are hundreds of thousands of natural gas facilities in the state, and not all of them supply natural gas for power generation. Industry is working with the Public Utility Commission (PUC), Railroad Commission (RRC), and Texas Department of Emergency Management to determine which facilities are directly linked to power generators to ensure those facilities weatherize and are prioritized during load shedding events to maintain consistent and reliable power during an emergency. Mapping hundreds of thousands of assets will take time, and many operators are charting their assets internally to assist in the process. Both the RRC and PUC are working to expedite the process ahead of statutory deadlines.

Given that reliability of oil and natural gas systems and the power generation sector are interconnected, communication and coordination between sectors are essential to bolster the reliability of both. Lessons learned from Winter Storm Uri are applicable to various scenarios where the goal is to increase grid reliability and to sustain power to critical infrastructure that directly serves power generation. Appropriate designation of facilities deemed to be critical and a plan to reasonably maintain power to those facilities should be prioritized. Executing firm contracts for fuel and/or onsite fuel storage can further enhance power generators' reliability and ability to perform during a weather event.

[23] ERCOT, Application for Critical Load Serving Natural Gas-Fired Electric Generation, https://docs.txoga.org/files/3077-ercot-application-for-critical-load-designation-feb-2021-and-earlier.pdf.

5.4 Enhancements to Joint Government/Industry Emergency Response

Joint government/industry response has successfully managed the impact of regional emergencies over the years. Several specific joint response topics were revisited based on requests in the initial letter from the Secretary of Energy and subsequent discussions. The role of joint government/industry sector coordinating councils (SCC) was reviewed for potential enhancements. The Oil and Natural Gas SCC was benchmarked against the Electricity SCC. Adequacy and coverage of emergency pre-planning was evaluated. The process to obtain regulatory relief during emergencies was reviewed. Finally, the creation of a Strategic Petroleum Product Reserve was revisited.

The oil and natural gas industry has a long history of regulation by federal and state governments, but that regulation has also come with cooperation and coordination. The relationships formed between operators and various agencies at various levels of government are the result of cooperation during events, such as storms, national emergencies, or other events that require information sharing or coordination. After 9/11 and the formation of the Department of Homeland Security, President Bush published HSPD 7 in 2003, which established the importance of partnering with critical infrastructure and the need for a formal structure to do so.[24]

> "In accordance with applicable laws or regulations, the Department and the Sector-Specific Agencies will collaborate with appropriate private sector entities and continue to encourage the development of information sharing and analysis mechanisms. Additionally, the Department and Sector-Specific Agencies shall collaborate with the private sector and continue to support sector-coordinating mechanisms:
>
> - to identify, prioritize, and coordinate the protection of critical infrastructure and key resources; and
> - to facilitate sharing of information about physical and cyber threats, vulnerabilities, incidents, potential protective measures, and best practices."

In the 20 years since HSPD 7, critical infrastructure sectors, including the oil and natural gas subsector, have built strong cooperative relationships across all levels of government, through formal structures, like sector coordinating councils or information sharing and analysis centers, or through less formal means, like drills and exercises, industry conferences, or classified briefings. Events such as the Deepwater Horizon oil spill, Super Storm Sandy, and the Colonial Pipeline ransomware attack, have all tested and strengthened these relationships, processes, and structures. Industry and government participate together and separately in

[24] Cybersecurity & Infrastructure Security Agency, "Homeland Security Presidential Directive 7: Critical Infrastructure Identification, Prioritization, and Protection," https://www.cisa.gov/homeland-security-presidential-directive-7.

after action reviews to ensure learnings are captured and improvements are implemented, which has led to significant enhancements to joint government/industry emergency response.

5.4.1 Joint Government/Industry Sector Coordinating Groups

The Sector Coordinating Councils[25] (SCCs) are self-organized and self-governed councils that enable critical infrastructure owners and operators, their trade associations, and other industry representatives to interact on a wide range of sector-specific strategies, policies, and activities. The SCCs coordinate and collaborate with sector-specific agencies (SSAs) and related Government Coordinating Councils (GCCs) to address the entire range of critical infrastructure security and resilience policies and efforts for that sector. An overview of the organizational structure for joint energy sector / government emergency response coordination is shown in Figure 36.

SCCs serve as the sector's voice and also facilitate the government's collaboration with the sector for critical infrastructure security and resilience activities. In addition, the SCCs are encouraged to establish voluntary practices to ensure that sector perspectives are included. Other primary functions of an SCC may include:

- Serve as a strategic communications and coordination mechanism between owners, operators, trade associations, suppliers, and the government during emerging threats or response and recovery operations, as determined by the sector.
- Identify, implement, and support appropriate information-sharing capabilities and mechanisms in sectors where no information-sharing structure exists.
- Encourage representative sector membership.
- Participate in planning efforts related to the revision of the National Infrastructure Protection Plan, the development and revision of Sector-Specific Plans (SSP), and the annual submission to DHS on sector activities.
- Facilitate inclusive organization and coordination of the sector's policy development regarding critical infrastructure security and resilience planning and preparedness, exercises and training, public awareness, and associated implementation activities and requirements.
- Identify, develop, and share information with the sector (both public and private sector members) concerning effective cybersecurity practices, such as cybersecurity working groups, risk assessments, strategies, and plans.
- Provide input to the government on sector research and development efforts and requirements.

[25] Cybersecurity & Infrastructure Security Agency, "Sector Coordinating Councils," https://www.cisa.gov/sector-coordinating-councils.

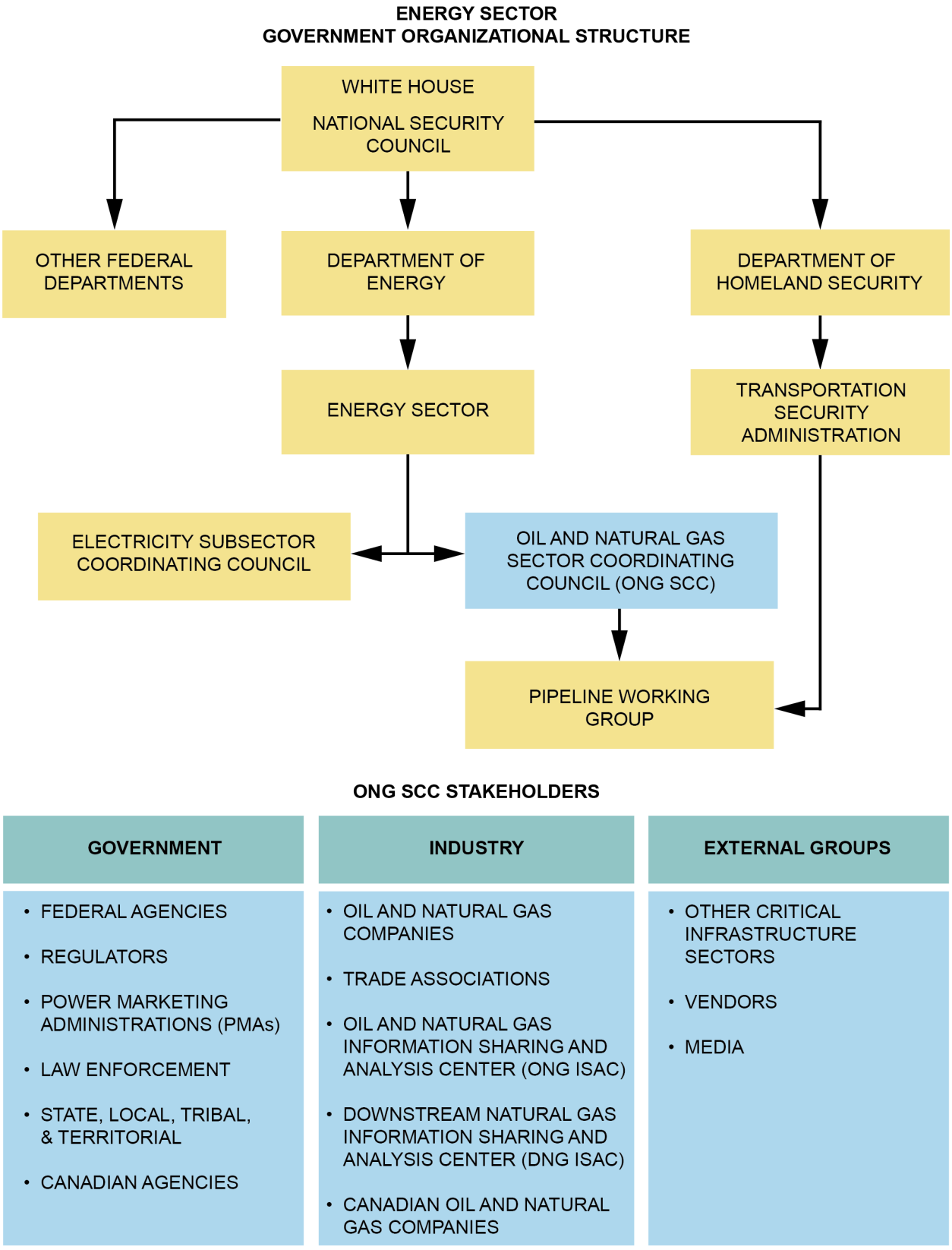


Figure 36. Energy Sector/Government Emergency Response Organizational Structure

The Oil and Natural Gas Sector Coordinating Council (ONG SCC), not unlike some other sectors, established its membership requirements to include only trade associations as voting members. Due to the complexity of the industry, the varied and sometimes competing aspects of the supply chain, and the restrictions of anti-trust laws, the trades can provide more perspectives than individual operators would be able to. The trade associations can reach back into their membership to provide expertise in many areas of concern or collaboration. Individual member companies are also able to participate in the ONG SCC and serve as chair and cochair.

The ONG SCC continues to discuss internally, and with the Energy Government Coordinating Council, how best to communicate effectively with the various parts of the sector as issues arise. With the diversity of the sector, the council, the companies, and the issues, it can sometimes be unclear how to reach the right experts and leaders. While the roles of chair and vice chair are held by industry representatives, the membership is primarily composed of trade associations. Each unplanned event or emergency will involve different parts of the industry and different companies. It is recommended that the ONG SCC establish a written process to rapidly establish a team of executive representation for each event from those companies which have operations in the impacted region and can provide the information and resources to affect a rapid recovery. This likely involves companies from the upstream, midstream, and downstream sectors including transportation and customer suppling companies.

The Oil and Natural Gas Information Sharing and Analysis Center (ONG-ISAC) serves as a central point of coordination and communication to aid in the protection of exploration and production, transportation, refining, and delivery systems of the ONG industry, through the analysis and sharing of trusted and timely cyber threat information, including vulnerability and threat activity specific to ICS and SCADA systems.

The Downstream Natural Gas Information Sharing and Analysis Center (DNG-ISAC) exists to improve cybersecurity and physical security of the North American energy infrastructure by:

- Providing accurate and timely intelligence on cyber and physical threats, vulnerabilities, and attacks on the natural gas industry and industrial control systems.
- Providing a community forum where natural gas industry participants can collaborate with peers on cyber and physical threats and related mitigations and other techniques for responding to them.
- Providing a trusted, secure environment for participants to share threat and incident data, alerts, attack information, remediation solutions, analysis, and situational awareness.

It is recommended that the Department of Energy (DOE) include the ONG and DNG ISACs as they develop the requirements, scope, and remit of the Energy Threat Analysis Center

(ETAC). The ETAC, which is in the pilot phase, is intended to partner with the Joint Cyber Defense Collaborative (JCDC), which coordinates DOE's response to cyber incidents impacting or potentially impacting the energy sector that require a coordinated response with industry and interagency partners. The ETAC has coordinated with the ONG, DNG, and Electricity ISACs in the pilot phase and this coordination should continue as the ETAC matures.

The Pipeline Sector Coordinating Council (PSCC) serves as the subject matter expert advisory group to the ONG SCC as the Pipeline Working Group (PLWG). The PSCC serves as the counterpart to the Transportation-Pipeline Modal Government Coordinating Council and Sector Coordinating Councils. The efforts of the PLWG/PSCC are designed to foster collaboration and facilitate improvements in pipeline safety, security, and resilience.

5.4.2 Benchmark ONG SCC against the Electricity SCC

The ONG SCC, through the ONG SCC Cross Sector Working Group, participates in the Electricity Sector Coordinating Council (ESCC) to ensure that information has a path to flow both ways. Many members of trade associations on the ONG SCC, are also members of the ESCC, and can directly share their learnings and processes in discussions of preparedness and response operations. The sectors are interdependent, which makes coordination and cooperation important when an event affects either subsector. As an example, during Hurricane Ida, natural gas transmission pipelines from the Gulf of Mexico lost utility power to their pump stations. The pipelines natural gas supply was feeding various power generation facilities. The ONG SCC was able to work with the ESCC to identify the issue and prioritize restoration through the existing relationships. That said, the differences between the oil and natural gas subsector and the electric subsector make benchmarking difficult. The linear nature of the supply of electricity to customers is incomparable with the fungible nature of oil and natural gas products, which are part of a global market and supply chain. The competitive aspects of the oil and natural gas subsector also create challenges that do not exist in the electric subsector. Mutual aid for both people and equipment, as used in the electric subsector, is not often possible in the oil and natural gas subsector due to the unique complexities, engineering, and operations of individual facilities. That said, oil and natural gas operators have various venues to share lessons learned to help them prepare for and respond to all hazards. Some of these include:

- API-LEPA Pipeline Emergency Response Working Group
- Internal company exercises and drills, to include Spills of National Significance exercises and those required by OPA '90, and overserving other companies' exercises
- Real world events
- Association working groups/subcommittees/committees

- Conferences and events, such as the International Oil Spill Conference, Clean Gulf, International Pipeline Security Forum, API Hurricane Harvey After Action Conference.

5.4.3 Emergency Pre-Planning

Much of the pre-planning work to address the initial stages of a disruption has already been completed. The 2014 NPC study (Chapter 4 – Emergency Response in Action) provides examples of how the emergency response frameworks should be applied in different emergency scenarios. The study describes hypothetical emergency situations of different scale and complexity, including single-company, multiple-company, and large-scale, long-duration events. The study provides specific actions that should be taken in each scenario, based on the incident command system at the company and regional level up to and including the National Response Framework. These hypothetical scenarios can provide the basis for pre-planning and response in the initial phases of a disruption.

Depending on the scope and complexity of the disruption, smaller scale events can be managed initially at the company and state or regional level. Companies implement their emergency response plans and utilize their incident command systems to initiate action. The 2014 study gives examples (e.g., Table 4-2, page 80, Example of Phased Preparedness Plan for a Refinery) of detailed plans and timelines for company response.

For more complex events, the National Response Framework can be activated. A schematic flow diagram of the National Response Framework Operational Model is shown in Figure 4-3, page 84, of the 2014 study. These scenarios reinforce the existing lines of communication that have been established between industry, government agencies, and affected states.

Note that most of the examples in the 2014 study are focused on natural events like hurricanes and winter storms. Additional scenarios to address cyberattacks and terrorism could be developed but would follow the same general response plan and timelines. Additional drills and exercises would be helpful to ensure that existing response plans are well understood and for training of new personnel.

5.4.4 Regulatory Waivers During Emergencies

The Oil and Natural Gas Industry Preparedness Handbook[26] has an extensive section describing "Potential Waivers" on page 27. It can be difficult to "pre-write" waivers due to the individual nature of each emergency event. However, EPA and DOE maintain a database (15+ years) of previous waivers and actions taken in different situations. This database, along with the general guidelines in the handbook, provide templates for the typical waivers that will likely need to be granted.

[26] American Petroleum Institute, *Oil and Natural Gas Industry Preparedness Handbook*, updated June 2022, https://www.api.org/~/media/files/policy/safety/ong-industry-preparedness-handbook.pdf.

The fuel market is evolving with new renewable fuel blends and emerging low-carbon products. This diversity of fuel types increases the supply complexity and reliance on additional supply chains of specialty fuels. Additional waivers may be required to address state and regional blending regulations, product transfer documentation, and consumer labeling for these new products.

The EPA and DOE databases of previous waivers should continue to be used as a resource and to provide a template for new waivers. As fuel regulations change, the Oil and Natural Gas Industry Preparedness Handbook will be updated accordingly. Contingency plans for new fuel supply chains, e.g., renewable diesel and ethanol, will be developed as these play a larger role in supplying future transportation fuels.

5.4.5 Strategic Petroleum Product Reserve

The concept of utilizing a strategic petroleum product reserve (SPPR) has been discussed as a protective measure to increase supply reliability during an emergency event. In the context of short-term actions to address current supply reliability issues, establishing a new SPPR would be neither quick nor inexpensive and therefore should not be a realistic option for consideration.

In the longer term, careful thought should be given to utilizing the SPPR concept to provide additional supply reliability. The SPPR concept has been studied several times in the past, and significant obstacles have been identified. The major concerns include: initial cost, quantity of reserve supply, the diversity of products to be stored, SPPR location, logistics for supply and withdrawal, and ongoing maintenance costs.

Strategic product reserves for gasoline (the Northeast Gasoline Strategic Reserve – NGSR) and heating oil (Northeast Home Heating Oil Reserve – NEHHOR) currently exist in the Northeast. The NEHHOR was established in 2000 by Congress, and the NGSR was established in 2014 by DOE. Both the NGSR and the NEHHOR are currently maintained by DOE. Approximately 1 million barrels each of gasoline and heating oil are stored in leased tankage at different locations. A separate smaller fuel reserve has been established in New York state for emergency response. While the NGSR has been storing gasoline since 2014, no releases from the reserve have occurred since its creation.

There are several studies and references that discuss the issues related to an SPPR. An early study from 2002 was conducted by Stillwater Associates on behalf of the California Energy Commission, to analyze an SPPR for the state of California. The study is comprehensive in discussing the costs and complexities of establishing and maintaining the reserve.

DOE discussed an SPPR in its Quadrennial Energy Review (QER) in 2014, which led to the creation of the NGSR. The QER recommended additional consideration of an SPPR in PADDs 1, 3, and 5, and recommended procedures to streamline the release of products from the reserve.

More recent studies from GAO and DOE have conflicted about the recommendations for and against the SPPR concept.

In summary, there is not a clear record on the desirability or the feasibility of creating and maintaining an SPPR. The costs of procuring and storing the initial volume of fuel are high, especially if capital costs are incurred to build new storage facilities. Leasing of existing facilities would avoid capital costs but would result in a loss in distribution efficiency due to tankage that would not be available to manage daily inventories. To be effective at buffering supply disruptions, the stored volume of fuel would need to be much greater than the amount currently stored in the NGSR. There would need to be multiple storage locations to ensure fuel is available when and where it is needed. There are also challenges with the number and diversity of different products that are stored in the reserve. The reserve inventory must be actively managed to ensure that fuel does not degrade over time. These are some of the many challenges that have been identified with the SPPR concept.

The SPPR concept fundamentally interferes with market signals for supply, demand, pricing, and inventory management. A preferred option over the SPPR would be to enhance supply through increased domestic production and by increasing redundancy in existing infrastructure. A robust fuel marketplace can address the challenges of supply reliability more effectively than a mandated SPPR.

5.5 Permitting of Infrastructure

While the underlying resilience of the U.S. energy system has improved due to the increased production of oil and gas, infrastructure remains critical to ensuring the whole system remains efficient and resilient to disruption.

The U.S. Congress and the state legislatures have passed numerous laws to ensure that energy is delivered safely and efficiently. Congress has also mandated many other societal priorities, from the assurance of clean air and water, to the protection of species, to the preservation of culture and history. Cooperative federalism—where the federal government enacts laws and sets minimum compliance standards, and states may enact more restrictive standards, as long as consistent with the constitution or not preempted—posits the national and state governments as partners in the exercise of governmental authority.

The resulting system of regulations is both extensive and complex. The challenge is to meet these multiple and often conflicting interests in a way that does not sacrifice public safety, the economy, reliable and affordable energy supplies, environmental protection, and other social priorities.

If the necessary infrastructure is not built or is not maintained, affordable and reliable energy, national security and income, jobs, and the deployment of intermittent sources of power generation, such as wind and solar, as required by state Renewable Portfolio Standards (RPS), will be sacrificed. If new infrastructure is not built and current infrastructure is not

maintained, the United States will jeopardize valuable national interests—economic development, job creation, environmental goals, domestic energy security, and reliable and affordable energy. A recent U.S. Chamber of Commerce study found that completing an environmental review in the United States for major infrastructure projects takes 3.7 to 5 years on average. Global economic competitors, including Germany and Australia, complete environmental permitting reviews in fewer than 2 years, while providing environmental protections equaling or exceeding those in the United States.

The NPC Dynamic Delivery report in 2019 identified a number of specific steps that would improve the permitting processes in the United States. They remain relevant and are included in Appendix D.

6. DETAILED RECOMMENDATIONS

As the United States faces lower crude oil and product inventories, the administration has requested short-term recommendations from industry to mitigate potential supply shortages and higher prices. The government will need to weigh the benefits of some of these proposals versus potentially higher emissions that may accompany them. The following list is recommended steps to be taken by the administration.

6.1 Support Continued Crude Oil and Product Exports

Petroleum liquids markets are global. Free, unrestricted trade is key for the efficient operation of markets and enabling lowest cost supply. Export bans would interfere with the efficient flow of crude oil, refined products, and natural gas, exacerbate the tight supply/ demand balance, and increase prices to consumers. For these reasons, U.S. exports should not be restricted.

6.1.1 Crude Oil

The United States is a net importer of crude oil, dependent on other countries for approximately 2.9 million barrels per day of crude supply.

Initially, a crude oil export ban would likely drive global crude prices higher. The United States exports crude, primarily light, sweet crude, to global markets because these crudes are generally more suitable for use in less complex overseas refineries. If these exports are halted, global prices would likely escalate due to limited re-supply options for those refiners to meet their overseas demand.

Conversely, the U.S. system has limited ability to economically process incremental volumes of light, sweet crudes. If exports are not permitted, U.S. sweet crude inventories could build, and U.S. crude production and refinery capacity would likely be reduced.

Additionally, many trade partners could place retaliatory bans on the United States, limiting imports of the heavier sour crudes into the United States needed to maximize yields of gasoline, diesel, and other products, potentially driving further price escalation.

6.1.2 Refined Products

An export ban on U.S. refined products would likely lead to higher prices for consumers and lower supply. Currently, prices and margins are incentivizing refiners to produce at maximum rates. A ban of exports would likely reduce domestic refinery utilization and hence production of products, reducing global supply and likely causing world prices to rise.

The United States currently exports approximately 1.5 – 2.1 million barrels per day of gasoline and diesel, with the majority going to Latin America. The United States supplied 12.1 percent of refined oil exports globally, making it the top refined product exporter in

2021.[27] There are several countries (e.g., Mexico, Canada, Brazil, and Chile) that rely on U.S. product exports.[28] Initially, a product export ban may push domestic prices down in exporting regions like the U.S. Gulf Coast as refiners would not be able to run full with limited outlets for the product. There is insufficient infrastructure to move the excess product that would be trapped in PADD 3 (the U.S. Gulf Coast) to PADD 1 (the U.S. Northeast) where it would be needed, absent prompt waiver of the Jones Act. Regions dependent upon imports, like the U.S. East Coast, would need a substantial price increase to attract imports. The overall loss of production of products would result in higher prices globally and hence in most parts of the United States.

A product export ban would result in the lower utilization, or potentially closure of those U.S. refineries with significant export demand, reducing overall product supply and pushing global product prices up; leading to higher product prices for most U.S. fuel consumers, a net loss of U.S. GDP, and U.S. jobs.[29]

Once European Union sanctions on Russian oil product imports are fully in place in February 2023, U.S. exports to Europe will likely be needed to meet European Union demand. Rather than creating additional barriers to trade, working with global trade partners to break down existing barriers will result in more resilient energy markets and the lowest cost to consumers.

6.1.3 Liquefied Natural Gas (LNG)

As the largest exporter of LNG, the United States is a vital part of the global LNG market. The United States is the largest supplier of LNG volumes to China, the EU, and United Kingdom (UK). U.S. LNG volumes to the EU and UK tripled in the first six months of 2022, averaging 7.3 Bcf/d and accounting for 49% of total LNG imports. The EU and UK are poised to expand their total LNG import capacity by 34%, or an additional 6.8 BCF/d by 2024, placing an even higher demand on the global LNG market.

Given the world's need for U.S. LNG, a ban on LNG exports would likely result in significant drop in utilization of U.S. LNG export facilities, cause natural gas oversupply in the United States, and prompt retaliatory bans on other U.S. products by countries who depend on U.S. LNG.

Policy makers should ensure that future federal rulemakings continue to allow the U.S. refineries to use existing critical process technologies to produce fuels needed for the global markets.

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[27] American Council for Capital Formation, "Economic Impacts of a Potential Ban on U.S. Refined Product Exports," July 2022, page 37.

[28] Ibid, p. 36.

[29] Ibid, p. 3.

6.2 Reform Certification and Permitting of Energy Infrastructure including LNG Export Facilities

Recent discussions at the federal level have occurred and legislation has been proposed to pursue "comprehensive permitting reform." This magnitude of reform is believed to be necessary to enable infrastructure development of both traditional and renewable energy sources. This infrastructure is necessary to maintain or grow domestic energy production, providing cost-effective and reliable energy to the country, responding to natural disasters or other interruptions, and enabling the energy transition. This report recommends that "comprehensive permitting reform" be pursued with priority. The 2019 NPC Dynamic Delivery report includes analysis and detailed recommendations in Chapter 3, which identify potential opportunities for improvement.

6.3 Temporarily Relax Diesel and Marine Diesel Sulfur Standards

Diesel volumetric inventories across the majority of the U.S. system are low with winter demand season approaching. Initial recommendations included the relaxation of sulfur specifications for diesel to help increase diesel supply; however, upon further review, it is anticipated this would have minimal impact on increasing supply. The diesel fuel and heating oil pools have largely been converted to a 15 ppm Ultra-Low Sulfur specification. Switching to higher sulfur fuels would likely result in damage to vehicles and equipment designed to use Ultra-Low Sulfur fuels and would have minimal additional supply benefits.

Additional geographical marine sulfur restrictions in Emission Control Areas (ECAs) in the United States and Europe could be relaxed to allow higher quality diesel to be directed to meet domestic demand, but again, the impact is expected to be minimal and therefor no longer recommended. In recent years, the waiver of diesel sulfur regulations has been focused on emergency response situations, to enable first response and essential goods movement vehicles following a supply disruption. Waivers should be reserved for those events and not broadly used to increase diesel fuel supply.

6.4 Temporarily Relax RVP Standards and the RFG Requirements

Temporarily relaxing gasoline standards would increase the available supply of gasoline during summer months. During summer (June 1-September 15), the Reid Vapor Pressure (RVP) of the gasoline is lowered to manage air quality. The RVP is lowered furthest in the more densely populated areas, which are required to use reformulated gasoline (RFG). During times of emergency, increasing the RVP of the gasoline supplied would enable additional production of gasoline by blending higher RVP components such as butane. This can be achieved by either waiving the need for RFG in the RFG areas and allowing conventional gasoline with a higher RVP to be supplied or by temporarily increasing the RVP of the gasoline. The government will need to weigh the benefits of these proposals versus potentially higher emissions that may accompany them.

Immediate changes at this time are not recommended because summer ozone season has come to an end and U.S. markets have transitioned to winter specifications.

6.5 Temporarily Relax Biodiesel Blending Labeling Requirements[30]

Temporarily relaxing all biomass-based diesel blending labeling requirements during winter months may allow an increase of diesel supply. Under the FTC Fuel Rating Rule, retail diesel pumps must meet specific labeling requirements. The specific blending percentage of biodiesel or renewable diesel content must be listed; for example, a pump labeled as "B-20 Biodiesel Blend" must contain that level of blended material. If a retail site wishes to increase from a B5 to a B20 blend, they must relabel their pumps and if the blend changes, must again relabel. If rules were changed to something like "contains a maximum of B20," the retailer could modify their purchases as product was available without relabeling. This would potentially allow for increased supply as retail sites, and wholesalers, would have increased flexibility.

Additionally, consider broadening to all biomass-based diesel labeling requirements, not just biodiesel. To varying degrees, all the labels for biodiesel (>B5), renewable diesel (>R5, >R20), and blends containing RD/BD (e.g., R80B20) provide artificial restrictions within the supply chain that limit efficient distribution/sale.

6.6 Encourage Industry Investment

Over the last few years, due to market uncertainty, inflation, and increasing investor requirements, industry is significantly more disciplined with major capital investments. Investors, including benefit and pension funds, are requiring continued disciplined capital investment. Clear and consistent policies help boost investor confidence, attract workforce to the energy industry, and encourage production growth to meet demand. Policy makers are sending inconsistent messages to the investment community, driving less support for required capital expenditures.

Policies such as the Fracking Ban Act (Senate Bill S.3247), calling for phase out and ban of hydraulic fracturing by 2025, reduce investment in drilling activity in many of the U.S. basins with tight formations. The same basins where most of the production growth has occurred in recent years and hold world-class oil and natural gas reserves.

In some cases, permits have been granted; however, without a clear forward view leading to a return for investors, companies will be forced to reduce or redirect investments to other opportunities.

[30] Federal Trade Commission, "Complying with the FTC Fuel Rating Rule," https://www.ftc.gov/business-guidance/resources/complying-ftc-fuel-rating-rule (accessed November 10, 2022).

Policies that encourage the development of resources required to maintain cost-effective energy supply of both oil and gas and renewable sources of energy are necessary to ensure the investment required in all sources of energy. Policies that discriminate against one source of energy vs another are likely to lead to under investment and instability in the energy markets through the energy transition. Both oil and gas and renewable sources of energy will need significant capital investment over the decades to come, and effective policies that recognize the need for all sources of energy along with effective permitting processes will be required.

6.7 Jones Act – Facilitation and Broadening of Waivers

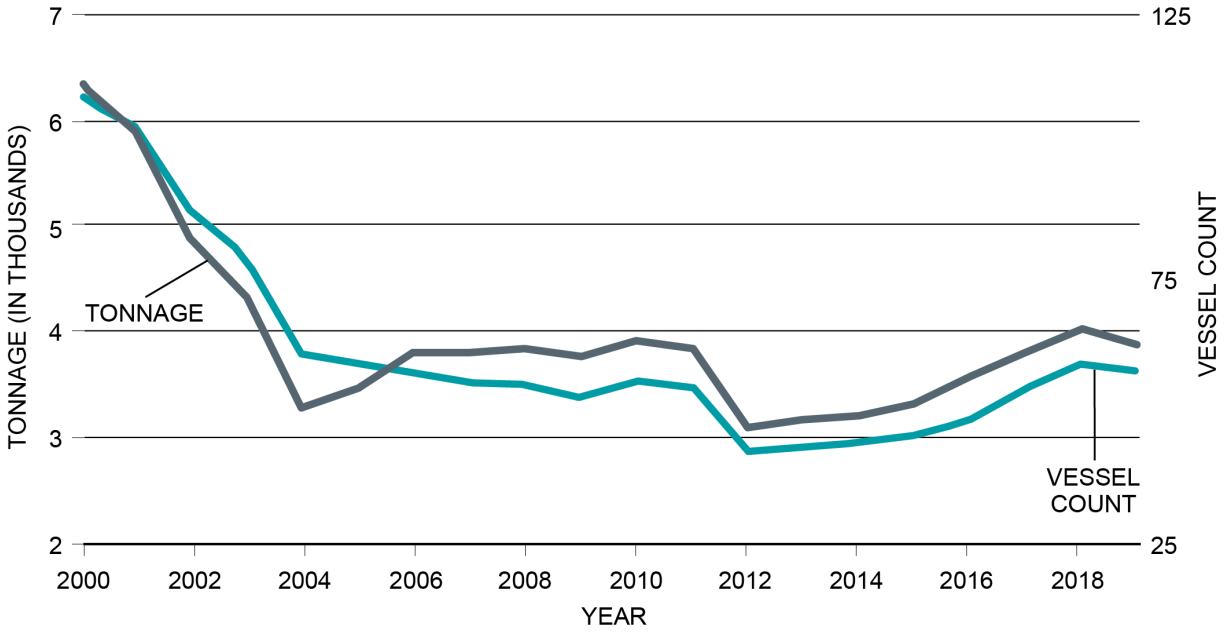
The Merchant Marine Act of 1920, better known as the Jones Act, regulates maritime shipping in the United States. The Jones Act requires that any cargo traveling by sea between two U.S. coastwise points must sail on an American-owned ship, built in the United States, and have a crew where the majority are U.S. citizens.

The number of American-built, -owned, and -operated vessels has shrunk by half (tonnage is down 28%) since 2000 (Figure 37) and is now relatively small compared to the global supply of ships. During the same period, U.S. crude production has more than doubled and distillate fuel oil production has grown by more than 25%. This creates a scenario where Jones Act shipping costs are at substantially higher rates than foreign flag ships. These increased costs, which can be over 3x the cost of foreign flag vessels, are passed on to consumers. Further, with fewer Jones Act vessels available to transport increasing crude and product supply, the incremental domestic movements that would often be the most efficient and timely response to supply disruptions are limited to the prompt constraint of existing pipelines, rail, and trucking infrastructure.

The option to request a Jones Act waiver exists; however, the general standard for waiving the Jones Act is if doing so is “necessary in the interest of national defense.” This is a high standard to achieve. There are two types of Jones Act waivers that can be requested (Figure 38). One, requested by the Secretary of Defense, is granted automatically by the Department of Homeland Security (DHS), generally without further review. The other may be granted at the discretion of the Secretary of the Department of Homeland Security. The DHS may also consult with other government agencies to evaluate requests.

During 2022, two Jones Acts waivers were granted to Puerto Rico, one waiver permitting the movement of a cargo of diesel to run generators needed for electricity and the functioning of critical facilities after Hurricane Fiona. The second waiver was required to move liquefied natural gas (LNG) because there are no Jones Act LNG tankers.

Figure 38 provides more detail for the Jones Act waiver process.



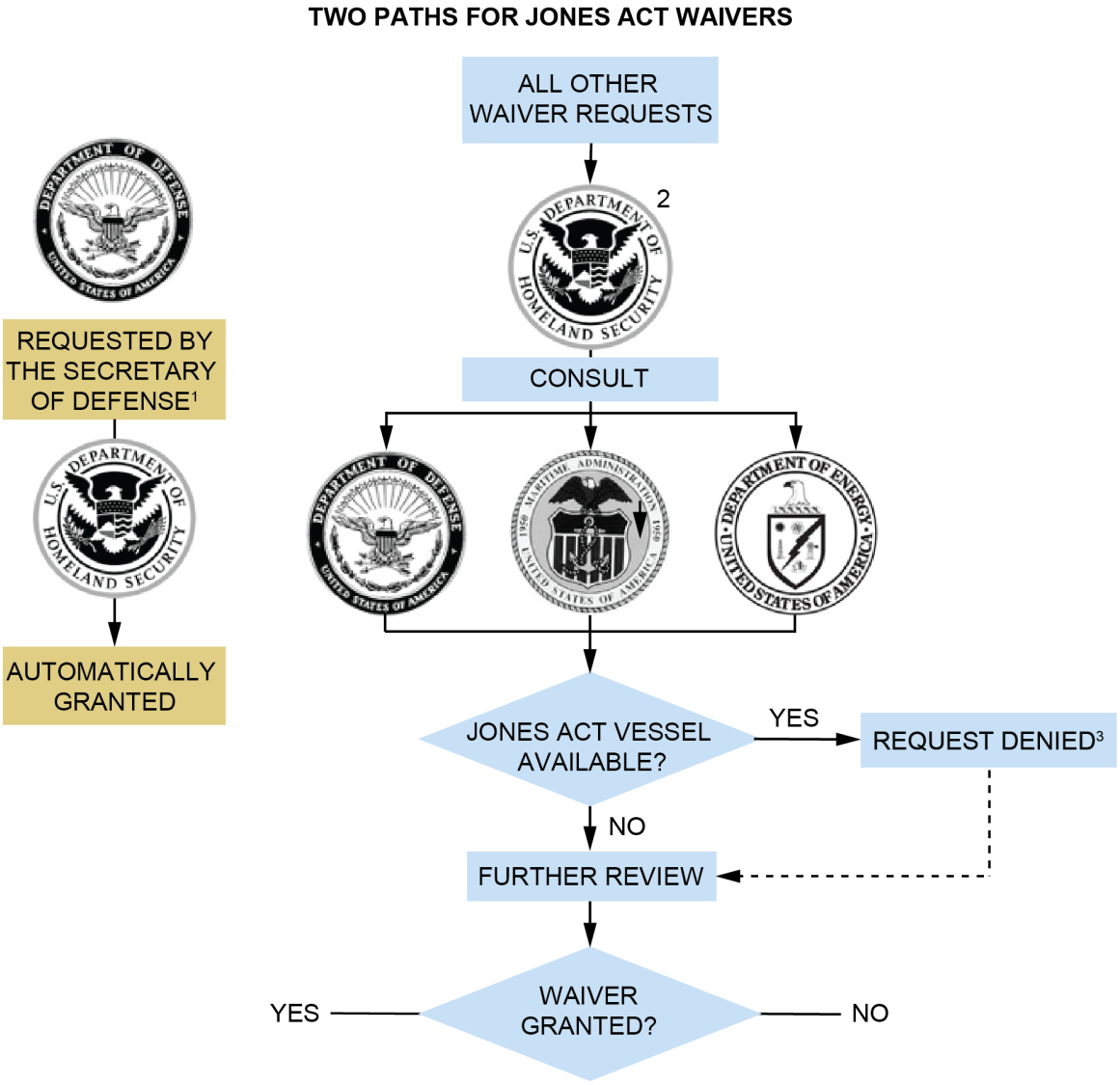
Source: U.S. Department of Transportation.
Oceangoing Self-Propelled, Tanker Vessels of 1,000 Gross Tons and Above

Figure 37. Decreasing Jones Act Tonnage but Crude Oil and Product Demand Remains

With product inventories below the 5-year ranges, and limited pipeline capacities serving parts of the United States, marine vessels will be increasingly called on to provide needed supply. Supply will likely be sourced from foreign fleets with limited availability of Jones Act vessels.

The United States already receives foreign imports using non-Jones Act vessels. Establishing a clear and flexible process for industry-wide Jones Act waivers in advance of an emergency would provide the ability to quickly waive Jones Act requirements in times of supply disruption. Waiving the Jones Act requirements would help improve emergency flows from supply regions, such as the U.S. Gulf Coast, to demand centers like the U.S. East Coast and the U.S. West Coast.

Policy makers have indicated blanket waivers can expect considerable opposition; however, a "seasonal" waiver may provide a better solution. In periods with low inventories, a seasonally limited waiver would allow increased supply to a limited supply market. It is of paramount importance that any implementation of "seasonal" waivers provide clarity as to regions, product, and timing. Since industry will need to schedule dock access, labor and secure vessel contracts, sufficient time must be provided to assure compliance and achieve specified goals, minimizing unintended consequences.



[1] In cases where moves are under Department of Defense contracts, request may be made directly through the Department of Defense.
[2] U.S. Customs and Border Patrol are part of DHS.
[3] Some denied requests may be submitted for further review.

Figure 38. Jones Act Waiver Process

Blanket waivers are recommended for LNG vessel movements. Regional locations in the Northeast, such as Boston, are supplied primarily by LNG foreign flag vessels. Currently, due to essentially no supply of U.S. LNG vessels, the region is not able to be supplied by Jones Act and therefore should be exempt from Jones Act vessel requirements.

6.8 Postpone Rebuilding the Strategic Petroleum Reserve

According to the EIA, the U.S. Strategic Petroleum Reserve (SPR) is the world's largest supply of emergency crude oil established primarily to reduce the impact of disruptions in

supplies of petroleum products and to carry out obligations of the United States under the international energy program.

The SPR is centrally located along the Gulf Coast, and is connected by pipeline to approximately 25 Gulf Coast refineries and 6 Midwest refineries. Additionally, the SPR is connected to 4 marine terminals, providing marine access to domestic and international markets. The location is key to supply the U.S. refinery system in times of disruption or in events of national emergency. The Gulf Coast SPR is limited to crude and does not include the storage of any refined products. A refined products SPR in the Gulf Coast would be inefficient as movements would be subject to pipeline limits and not able to immediately benefit the Northeast portion of the U.S., the largest national demand center.

SPR oil is sold competitively when the President finds, pursuant to the conditions set forth in the Energy Policy and Conservation Act (EPCA), that a sale is required. Such conditions have been relatively rare, until 2022 when over 180 million barrels of crude were released in efforts to manage U.S. product prices.

Recent releases from the U.S. SPR temporarily reduced product prices; however, the underlying product inventory challenges remain. Although during September through October, weekly EIA refinery utilizations were averaging over 90% utilization, the highest since 2018, absolute refinery product production is lower due to refinery closures and lower investment.

The Department of Energy's intent is to minimize disruptions to the U.S. and global crude markets. It is understood that although the Gulf Coast SPR is expected to be refilled, planned maintenance will delay the refilling process until at least the fourth quarter of 2023. Additionally, although the SPR can discharge at a maximum rate of 4.4 million barrels per day, refill rates are much lower, approximately 10 – 15% of the discharge rate.

Given the low refill rate, it is anticipated that the process will require several years to replenish inventories and therefore have limited immediate market pricing impact. The slow refill rate will also potentially help relieve upward price pressure by allowing commercial inventories to improve, as discussed earlier, versus pulling on already low inventories.

Further, with Congressional approval, there exists the option to offset future planned SPR sales, hence increase the SPR without the movement of physical barrels. It is recommended that policy makers immediately seek Congressional approval to offset ("bookout") future sales against sales already made. Implementing the "bookout" process would limit the operational strains on physical movement, which has inherent inefficiencies as inbound barrels compete with commercial movements. These transactions would also have minimal impacts on the market as physical barrels or purchases are not being made in the market, likely minimizing volatile price reactions.

To avoid impacting the global crude supply/demand balance and potentially the global crude market pricing, it is recommended that the DOE maintain its current approach to refilling

the SPR. This approach contemplates refilling no earlier than the fourth quarter of 2023, refilling at a slow rate, and ensuring a stable market environment before commencing any refill activities.

6.9 Explore Options to Increase Further the Utilization of Spare Refining Capacity in China and Reduce Emissions Costs in Europe

While there has been some increase recently, the export quotas for fuels in China have resulted in under-utilization of the refining capacity despite the strong market signals. Increases in these quotas would likely help increase the supplies of petroleum products and hence ease price pressures.

The Emissions Trading Scheme in Europe impacts the cost of running refineries in Europe. As European supply is required to supply the world markets, these costs are impacting global product prices. Temporarily reducing or removing these costs would reduce the cost of petroleum products across the world, including in the United States.

6.10 Continue Progress on Strengthening the Ability of the United States to Enhance Emergency Preparedness and Respond to Supply Disruptions

Progress the recommendations outlined in the Emergency Response Preparedness section of this report to build on the good progress to date and further strengthen the industry/government collaboration to improve emergency preparedness.

- Ensure continued progress on implementing the recommendations from the 2014/2016 NPC studies is sustained, as outlined in Appendix C.
- Continue enhanced collaboration between government and industry to identify and respond to emerging threats.
- Fully implement recommendations developed following Winter Storm Uri and apply lessons learned to other regions where the goal is to increase grid reliability and to sustain power to critical infrastructure that directly serves power generation.
- Further enhance the joint government/industry sector coordinating groups:
    - It is recommended that the Department of Energy include the ONG and DNG ISACs as they develop the requirements, scope, and remit of the Energy Threat Analysis Center (ETAC). The ETAC, which is in the pilot phase, is intended to partner with the Joint Cyber Defense Collaborative (JCDC), which coordinates DOE's response to cyber incidents impacting or potentially impacting the energy sector that require a coordinated response with industry and interagency partners.

    - It is recommended that the ONG SCC establish a written process to rapidly establish a team of executive representation for each event from those companies which have operations in the impacted region and can provide the information and resources to affect a rapid recovery. This likely involves companies from the upstream, midstream, and downstream sectors including transportation and customer suppling companies.

- Continue to hold joint industry/government emergency drills and exercises to test effectiveness of response plans.
- Continue to utilize the EPA and DOE databases of previous waivers as a resource and to provide a template for new waivers. Utilize the Oil and Natural Gas Industry Preparedness Handbook as needed during disruptions.
- Focus on increasing domestic production and enhancing infrastructure rather than the creation of a Strategic Petroleum Product Reserve or the requirement for maintaining minimum product inventories.

Appendices

Appendix A: Request Letter and Description of the NPC

Appendix B: Study Group Rosters

Appendix C: Findings of the 2014 and 2016 NPC *Enhancing Emergency Preparedness* Studies with Status of Recommendations

Appendix D: Recommendations Excerpted from the 2019 NPC *Dynamic Delivery* Study

The Secretary of Energy
Washington, DC 20585

July 29, 2022

Mr. Darren W. Woods
Chair, National Petroleum Council
Chairman and Chief Executive Officer
Exxon Mobil Corporation
5659 Las Colinas Boulevard
Irving, Texas 75039

Dear Mr. Woods:

Thank you for arranging an administrative meeting with the National Petroleum Council (NPC) at my request on July 1. In this meeting I shared my deep concern over the current crude oil and refined products supply and demand imbalance caused by multiple factors, underscoring the outsized impact from the unprecedented invasion of Ukraine. This imbalance continues to create upward pressure on oil prices, resulting in significant financial pain at the pump for the American people. President Biden is committed to alleviating this burden and taking steps to shore up supply, including calling on industry to increase private inventories to protect the American people. I appreciated your perspectives on how the NPC could help provide expert recommendation and analysis to help prepare and address this ongoing challenge.

As we focus on increasing the financial pressure on Vladimir Putin, we are dually focused on mitigating the negative impacts on the domestic economy. We recognize that U.S. refiners, producers, and the full supply chain are experiencing constraints, and as we look at the situation comprehensively, I informed you of the following areas that I am interested in receiving formal advice:

- How can we increase supply? Where is there efficiency and/or opportunity to increase current supplies of crude oil and refined products?

- What are current constraints and market hurdles to getting affordable products to U.S. consumers?

- How are companies reevaluating traditional emergency preparedness? Given the current tight market, how is industry making sure inventories are well supplied should there be a critical disruption from major and/or multiple storms, a cyber-attack, or other unforeseen events that would cause refineries or pipelines to shut down? What additional actions can the government be taking in coordination with industry to help enhance preparedness?

- Where is industry taking steps and grasping opportunities to prepare for a net-zero economy? Right now, we are seeing impacts from an unmanaged transition.

What actions are being taken by industry to move to a more managed energy transition? What actions can the government take to support a more managed transition?

I request the NPC to:

1. Provide within 30 days a written list of: (i) the ways industry is preparing to secure consistent, physical supply for the American people; and (2) near-term actionable steps the Administration can consider to help increase physical supply of oil and refined products while continuing safe, efficient operations and maintenance of production facilities.

2. Conduct analysis and issue a report within 120 days examining and providing an analysis of the changing global crude supply and how it will positively and/or negatively impact U.S.-based producers, suppliers and refiners; note expected supply challenges in the near term and medium term that should be evaluated further; and provide an update on ongoing work related to the steps the industry is taking to be an active player in a net-zero economy by 2050.

For the purposes of the study, I am designating Deputy Secretary David Turk as the official to whom the NPC reports and to represent me at NPC meetings. The Assistant Secretary for Fossil Energy and Carbon Management, Brad Crabtree, will work with Deputy Secretary Turk to provide the NPC with the information it needs to expedite the analysis and advice from the NPC.

In order to receive advice from the NPC in a time frame that will allow for consideration and action, I appreciate your written response to the near-term recommendations, and I will request the convening of a full NPC meeting following the 120 days to brief me on the results of this study.

Sincerely,

Jennifer Granholm

DESCRIPTION OF THE NATIONAL PETROLEUM COUNCIL

In May 1946, the President stated in a letter to the Secretary of the Interior that he had been impressed by the contribution made through government/industry cooperation to the success of the World War II petroleum program. He felt that it would be beneficial if this close relationship were to be continued and suggested that the Secretary of the Interior establish an industry organization to advise the Secretary on oil and natural gas matters. Pursuant to this request, Interior Secretary J. A. Krug established the National Petroleum Council (NPC) on June 18, 1946. In October 1977, the Department of Energy was established and the Council was transferred to the new department.

The purpose of the NPC is solely to advise, inform, and make recommendations to the Secretary of Energy on any matter requested by the Secretary, relating to oil and natural gas or the oil and gas industries. Matters that the Secretary would like to have considered by the Council are submitted in the form of a letter outlining the nature and scope of the study. The Council reserves the right to decide whether it will consider any matter referred to it.

Examples of studies undertaken by the NPC at the request of the Secretary include:

- *Principles, and Oil & Gas Industry Initiatives and Technologies for Progressing to Net Zero* (2022)
- *Petroleum Market Developments – Progress and Actions to Increase Supply and Improve Resilience* (2022)
- *Meeting the Dual Challenge: A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage in the United States* (2019)
- *Dynamic Delivery – America's Evolving Oil and Natural Gas Transportation Infrastructure* (2019)
- *Supplemental Assessment to the 2015 Report – Arctic Potential: Realizing the Promise of U.S. Arctic Oil and Gas Resources* (2018)
- *Enhancing Emergency Preparedness for Natural Disasters* (2014)
- *Advancing Technology for America's Transportation Future* (2012)
- *Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources* (2011)
- *Facing the Hard Truths about Energy: A Comprehensive View to 2030 of Global Oil and Natural Gas* (2007)
- *One Year Later: An Update On Facing the Hard Truths About Energy* (2008)
- *Observations on Petroleum Product Supply* (2004)
- *Balancing Natural Gas Policy – Fueling the Demands of a Growing Economy* (2003)
- *Securing Oil and Natural Gas Infrastructures in the New Economy* (2001)
- *U.S. Petroleum Refining – Assuring the Adequacy and Affordability of Cleaner Fuels* (2000).

The NPC does not concern itself with trade practices, nor does it engage in any of the usual trade association activities. The Council is subject to the provisions of the Federal Advisory Committee Act of 1972.

Members of the National Petroleum Council are appointed by the Secretary of Energy and represent all segments of the oil and gas industries and related interests. The NPC is headed by a Chair and a Vice Chair, who are elected by the Council. The Council is supported entirely by voluntary contributions from its members.

Additional information on the Council's origins, operations, and reports can be found at <*www.npc.org*>.

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Appendix B

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Participants in this study contributed in a variety of ways, ranging from work in all study areas, to involvement on a specific topic, or to reviewing proposed materials. Involvement in these activities should not be construed as a participant's or their organization's endorsement or agreement with all the statements, findings, and recommendations in this report. Additionally, while U.S. government participants provided significant assistance in the identification and compilation of data and other information, they did not take positions on the study's recommendations.

As a federally appointed and chartered advisory committee, the NPC is solely responsible for the final advice provided to the Secretary of Energy. However, the Council believes that broad and diverse participation informs and enhances its study and advice. The Council is very appreciative of the commitment and contributions from all who participated in the process.

This appendix lists the individuals who served on this study's Committee, and its Subcommittee and Subgroups, as a recognition of their contributions.

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APPENDIX C

Findings of the 2014 and 2016 NPC *Enhancing Emergency Preparedness* Studies with Status of Recommendations

DOE Progress & Next Steps regarding the National Petroleum Council Recommendations:
2014 Enhancing Emergency Preparedness for Natural Disasters &
2016 Emergency Preparedness Implementation Addendum

Role of Government and Industry

As one of the three working groups the National Petroleum Council's Committee on Short-Term Actions and Transition Strategies put together to address the request on what steps should be taken to help ensure a manageable transition to a net-zero economy, the working group reviewed the NPC study from 2014 and the supplement from 2016 to assess whether the findings are still relevant and the status of implementation, as well as incorporating learning from more recent supply disruptions. The detailed findings can be found below.

2014 Recommendation #1: Harmonize DOE's energy response team structure with the National Incident Management System (NIMS) Incident Command System (ICS).

Progress:

DOE CESER's Emergency Response Organization (ERO), formally referred to as the Energy Response Team (ERT), was restructured to conform to the NIMS ICS structure after the 2014 Report, which was again reinforced in the 2016 Addendum. Today, the ERO remains a fully implemented ICS compliant organization.

The 2016 Addendum to 2014 Recommendation #1 stated that roles and responsibilities of response team positions need to be clearly understood by all; documentation of roles and responsibilities must be described sufficiently in the Energy Response Plan. At present, DOE CESER Response Team roles and responsibilities are codified in the All-Hazards Response Plan and ICS section SOPs. Annual after-action reviews are conducted to ensure roles and responsibilities are up to date. Further, roles and responsibilities are refreshed annually during training, and new personnel continue to be trained and mentored in new roles.

The 2016 Addendum to 2014 Recommendation #1 stated that standard ICS work processes and tools should be fully used to improve the effectiveness of DOE's response team; adherence to these processes and tools, throughout the event, will enable DOE to quickly align with and work effectively in a real response with other public and private organizations. Currently, DOE CESER ERO employs WebEOC at FEMA's Coordination Centers and at state EOCs/FEMA JFOs. The DOE Headquarters based ERO employs a Microsoft Teams channel for

internal communication and file sharing. During an incident, the ERO conducts staff level Unity of Effort and Message calls with industry partners to discuss any federal assistance needed to overcome barriers inherent to energy system restoration. Numerous interagency partners use the EAGLE-I platform to maintain a common operating picture and situational awareness. There are over 500 interagency subscribers for the DOE CESER situation reports that are developed during an incident.

The 2016 Addendum to 2014 Recommendation #1 stated that DOE's Energy Response Plan should include sufficiently trained staff to cover Incident Command roles and EOC operations for a scenario that extends 24/7 operations over an extended period. At the time, the EOC staffing during the exercise appeared to be inadequate to handle this specific exercise scenario. Today, DOE maintains a 24/7 Watch Office managed by NNSA that also supports CESER and the Emergency Support Function #12 (ESF#12) program, allowing DOE to staff the FEMA Coordination Centers and state EOCs with 24/7 support. In the last five to six years, there has not been a strong need to staff the CESER Emergency Response Center for 24/7 operations. If a 24/7 requirement developed, DOE would need to identify new resources to meet that requirement. CESER continues to hire additional federal employees for the Response Team, and experienced contractor support remains strong, which provides the staffing depth that is needed generally and in the eventuality of a 24/7 staffing need. CESER is also working on developing a 24/7 Watch Office to fill this need not only in steady state, but during active response.

The 2016 Addendum to 2014 Recommendation #1 stated that guidelines should be developed for managing response to simultaneous events. DOE's management of simultaneous events has improved greatly with the introduction of the CESER Regional Response Team model. In 2016, in the wake of Hurricane Matthew, the CESER Response Team moved to a Regional Response Team model to leverage recently recruited and trained volunteers. Teams are aligned to the 10 FEMA regions, and each is led by an experienced Regional Coordinator. This structure was first tested during the 2017 hurricane season and allowed the team to move seamlessly between Hurricane Harvey in Texas, Hurricane Irma in PR/USVI then Florida, and Hurricane Maria in PR/USVI. The ability to manage multiple, simultaneous, and back-to-back incidents was further demonstrated during the 2018 hurricane season. The Maria ESF#12 response lasted about nine months, and there was only one day between the last responder leaving PR and the first responder going to Hawaii for Hurricane Lane. In total, there were 735 days of continuous ESF#12 activation. In September 2018, ESF#12 was simultaneously activated to five separate locations ranging from Guam/CNMI to the Carolinas.

The 2016 Addendum to 2014 Recommendation #1 stated that the Emergency Operations Center (EOC) logistics should accommodate a wide variety of internal and external participants supporting unified command, including reliable communications, sufficient space, redundant systems, and other EOC design best practices. In response, CESER has invested in ERC improvements, various products, and tools to aid in developing and maintaining situational

awareness, and to improve internal coordination. Although space can be an issue, the post-COVID virtual/hybrid environment when supported by robust collaboration tools such as Microsoft Teams has alleviated some of the space needs. CESER has purchased and maintains several deployable Satellite Phone kits that include a Wi-Fi hotspot and laptop computer.

Next Steps:

DOE plans to prioritize sustainment of processes and procedures to combat high level of personnel turnover. Over the last five years, the ERO has had consistent leadership and team membership, but that stability cannot be assumed. Sustainment of this continuous improvement cycle is key to program stability and growth.

Continued growth in situational awareness tools and products will be critical to the growth and viability of the ESF#12 program. DOE will continue to focus on the regional model. Potential expansion of the model could reduce the dependence on volunteers and provide more full-time CESER federal employees focused on developing and maintaining regional and state relationships that will be vital during a response. Lastly, DOE will continue investment in emerging technology and capabilities to sustain program efficacy and growth.

2014 Recommendation #2: Leverage the Energy Information Administration's (EIA) subject matter expertise within DOE's energy response team to improve supply chain situation assessments.

Progress:

The ERO Planning/Situational Awareness Team developed and maintains a strong relationship with EIA. EIA data are often integrated into the CESER situation reports, and EIA personnel consistently support Unity of Effort/Message calls with industry, often directly supporting supply chain conversations and challenges.

Next Steps:

The recommendation is to continue work in sustainment, as discussed under 2014 Recommendation #1.

2014 Recommendation #3: Establish company liaisons and direct communication with DOE's energy response team to improve situation assessments.

Progress:

DOE CESER maintains strong relationships with company representatives directly, through the SCCs and various trade associations. The 2016 Addendum to the 2014 Recommendation #3 is no longer relevant as the ONG SCC now coordinates successfully between designated trade representatives and DOE CESER.

Next Steps:

The recommendation is to continue cross-DOE efforts to develop and maintain critical industry relationships.

2014 Recommendation #4: Streamline and enhance processes for obtaining temporary regulatory relief to speed up recovery.

Progress:

DOE migrated and consolidated all emergency authorities to CESER from various parts of the Department in 2021. All authorities are coordinated and managed by the Response and Restoration team, creating near immediate improvements in efficiency. The authorities include not only direct authorities, such as waivers to Federal Power Act 202c, but also concurrence on waivers managed by other agencies, such as Department of Transportation's Hours of Service waiver. During a response, this efficiency allows DOE CESER to move faster at critical times. Further, CESER has developed standard operating procedures (SOP) to manage the processes and procedures for each authority.

Next Steps:

The recommendation is to continuous improvement based on after-action review to keep processes and procedures current.

2014 Recommendation #5: States should increase engagement with the oil and natural gas industry in their energy assurance plans, and industry members should assist the states in such efforts.

Progress:

State plans will be updated in FY23 to include new requirements for coordination. Oftentimes, states require additional support during the planning process and come across challenges with identifying the appropriate contacts at a local level. This is an area that could be improved in FY23.

The 2016 Addendum to 2014 Recommendation #5 stated that discussions during Clear Path IV Day 1 of the exercise highlighted that federal, state, local, and industry stakeholders had not sufficiently discussed the cause and effect of interdependent energy systems as they relate to planning, allocation of resources, and potential supply and demand concerns during an energy disruption event. Presently, scenario development, facilitated questions, and participant involvement have provided more opportunities for progress in subsequent Clear Path exercises. The implementation of these tools has clarified and educated DOE CESER on

the interdependencies between natural gas production and transmission with electricity generation.

The 2016 Addendum to 2014 Recommendation #5 stated that federal, state, local, and industry preparedness should be enhanced to address allocation of resources and cascading supply and demand implications during a disruption event. At present, DOE's exercise has incorporated either by design or by participant conversation, the allocation of resources and supply chain impacts following either natural or manmade hazards since Clear Path VI (2018). Clear Path VII (2019), Clear Path VIII (2020), and Clear Path IX (2021) specifically explored issues surrounding limited resourcing and the determination and distribution of those limited resources. This issue was further stressed by scenarios that impacted multiple states and regions, creating a demand that would need strategic collaboration for ensuring restoration of the energy sector was pursued. Further, DOE took lessons learned from the COVID-19 pandemic, specifically the impacts on supply chain, and implemented those issues into Clear Path X's Functional Exercise's (2022) scenario and injects. The supply chain concern further exacerbated the supply/demand for infrastructure used in the energy sector. The oil and natural gas industry partners, along with federal and state government partners, participated in the functional exercise.

The 2016 Addendum to 2014 Recommendation #5 stated that state energy plans should require routine review and updating. In response, state energy (assurance) security plans (SESP) have become an essential part of energy security planning. SESPs describe how a state, working with energy partners, can secure their energy infrastructure against physical and cybersecurity threats; mitigate the risk of energy supply disruptions to the State; enhance the response to, and recovery from, energy disruptions; and ensure that the state has secure, reliable, and resilient energy infrastructure. The Infrastructure Investment and Jobs Act (IIJA) established new requirements for state energy security plans (section 40108), requiring plans to be submitted to DOE, specifying elements that must be included in a SESP and adding a requirement for the Governor to certify the plan. Technical assistance will be provided by DOE in FY23 and beyond to help states continue to improve the plans. DOE recommends that states and territories update their plan annually to reflect any changes in energy infrastructure, personnel contacts, or division responsibilities as well as continue to strengthen the plan.

Next Steps:

To account for new partners, transitioning staff and evolving needs, DOE recognizes the importance of education regarding the cause and effect of interdependent energy systems as they relate to planning and allocation of resources. Exercises, such as Clear Path, will be essential in this effort and will ensure the topic is covered. DOE also recognizes opportunities for natural gas partners to provide appropriate education across the energy sector.

Clear Path exercises have propagated the issue of limited resources and the determination of their allocation due to regional impacts. The exercises have discussed the

process by which federal emergency management coordinators would address high-demand, limited-resource distribution. However, this issue can be extremely unique to regional catastrophic incidents and should be considered for continuous evaluation during the development of future exercises, such as Clear Path.

2014 Recommendation #6: Both DOE and states should establish routine education and training programs for key government emergency response positions.

Progress:

CESER supports extensive training through SLTT partners including state ESF-12 training, Cybersecurity Training for regulators, and exercise support. CESER piloted a Regional Petroleum Collaborative effort with Northwest states to share insights for enhanced state emergency fuel plans, and to develop a fuel response framework and a peer network that can be leveraged for future regional planning initiatives and during real-world events. This NEMA-NASEO support technical assistance activity will be launched for the Midwest and Southeast in FY23. Discussions on how to engage industry partners in the Collaboratives is underway.

The 2016 Addendum to 2014 Recommendation #6 stated that government personnel turnover and management-of-change process remain a continuing concern. DOE has significantly increased hiring in its emergency response function, has documented SOPs to ensure quick and efficient training of new staff, and continues to reduce any turnover impacts through continuity plans.

The 2016 Addendum to 2014 Recommendation #6 stated that as DOE more clearly adhered to its role and response structure under ESF-12, it should work with states to educate them on DOE's role and how they interact with the states. Also, continuing education and training of DOE and state staff should be an ongoing priority in the face of expected staff turnover. In response, CESER conducted state/ESF#12 training in 2020 to expand DOE and state relationships, understanding of energy security concerns, and expectations during response. In 2021 and 2022, DOE continued to develop essential relationships by inviting state representatives to the ESF#12 Annual Refresher Training and exercise. The training is well attended, and has proven invaluable in states, such as Louisiana, where an incident took place after the joint training.

Next Steps:

The recommendation is for DOE to continue to include states in ESF#12 training and plans to adapt, modify, or expand as needed to meet state needs and further enhance essential response relationships.

2014 Recommendation #7: Both DOE and states should improve their comprehensive drill and exercise programs and include industry participation. Reciprocal invitations extended by companies to DOE and states are recommended.

Progress:

Since at least 2016 (Clear Path IV), DOE has not only included industry participants in the Clear Path exercise series, but also the planning, ensuring that accurate equities and opportunities to test, evaluate, and prompt industry interests are included. Since 2018, DOE's cyber-focused exercise Liberty Eclipse, has also included industry planners. Additionally, there have been several other issue-specific exercises that have involved industry in both planning and typically the focused participants in the exercise itself.

The 2016 Addendum to 2014 Recommendation #7 stated that when using Homeland Security Exercise and Evaluation Program (HSEEP) guidance, DOE should include industry partners in the multi-year training and exercise planning process. HSEEP guidance continues to be leveraged in all planning and conduct of exercises at DOE. In addition to multi-year planning, DOE sponsors and conducts a quarterly exercise forum opportunity for industry and partners to share exercise opportunities, eliminate conflict and synchronize where possible. DOE provides an overview of a shared two-year projected calendar of exercises for industry's consumption. Additionally, during the forum call, DOE provides updates on the exercises, the program overall and for the participants (nearly 600 invited), a platform to speak about their sponsored exercises to a captive and interested crowd. At the end of the year, the Energy Sector Exercises program develops an annual report summarizing the exercises either sponsored by DOE or participated in by CESER. A public version of this document is shared to the same energy community invited to the quarterly forums.

The 2016 Addendum to 2014 Recommendation #7 stated that DOE should consider using ICS coaches (such as Coast Guard strike teams or industry subject matter experts) with the response team during exercises to provide more direction in their roles and responsibilities. Currently, the DOE exercise planning team is comprised of emergency managers that are very familiar with ICS. During planning meetings and discussions, the exercise planning team will inquire with industry planners on ICS/ICS-like response structures for context. During exercise conduct, the facilitators are proficient in ICS and as necessary, could leverage DOE's Energy Response Organization (ERO) members in attendance, for ICS subject matter expertise.

The 2016 Addendum to 2014 Recommendation #7 stated that the ONG SCC should formalize a process within the ONG SCC and the Energy GCC for gathering and sharing information on upcoming industry exercises to facilitate DOE and other government agency participation. Today, Energy Sector Exercise programs institutionalizing the quarterly exercise forum virtual engagements have provided industry with a platform and space to share updates on upcoming planning. This opportunity also provides the opportunity to synchronize and deconflict exercises across the sector.

The 2016 Addendum to 2014 Recommendation #7 stated that government representatives should expand participation and consider serving as participants in industry exercises, rather than observers, to gain the most benefit from the experience. Since 2016, DOE has been invited and participated in multiple industry-sponsored exercises. Although a vast majority of exercises in which DOE is invited are federal or state sponsored exercises, on average 3-5 exercises annually are sponsored by a company or a trade association partner. Of those exercises, DOE participants are considered players versus observers. However, DOE will request observation seats for additional federal and contract staff as appropriate.

Next Steps:

In 2018, CESER's exercise program was redesignated as the "Energy Sector Exercise" program, denoting the shift from primarily DOE response-focused programs to a more inclusive industry-driven exercise program. Since that designation, nearly two-thirds of the exercises sponsored and/or developed by the Energy Sector Exercise program are inclusive of industry participants in the planning and participation, as well as typically the primary focus of the exercise goal and objectives.

DOE and industry partners should continue to collaborate on exercise opportunities. The Energy Sector Exercises program will continue to incorporate industry partners in the planning and conduct of DOE sponsored exercises. A reliance upon industry companies and trade associations to assist in ensuring exercises are challenging assumptions and engaging industry's policy, plans and procedures.

Continue Energy Sector Exercises' quarterly exercise forums. If not already, include exercise snapshot updates (in read ahead or summary/newsletter) to SCC meetings, regardless of if the agenda speaks to an upcoming exercise.

The recommendation is to encourage more industry-sponsored exercises and subsequent inclusion of DOE offices and subject matter experts and further encouragement of more cross-sector exercise opportunities sponsored by other sectors, but inclusive of energy sector and federal participants.

APPENDIX D

Recommendations Excerpted from the 2019 NPC *Dynamic Delivery* Study

VI. SUMMARY OF FINDINGS AND RECOMMENDATIONS

This chapter has highlighted the challenges with the permitting processes—from siting, to construction, operations and maintenance to closures of an asset—and the recommendations to improve the efficiency, safety, environmental performance, and resiliency of the energy system. The following is a compendium of recommendations of solutions for all stakeholders—federal and state agencies, local governments, tribal governments, private citizens and public interest groups, as well as industry—to accomplish the regulatory objective more effectively.

Findings	Recommendations
II.B.1. NEPA: The Magna Carta of Federal Environmental Law	
A 6-year statute of limitations has been applied to federal agency decisions including NEPA. However, for projects subject to the FAST-41 Act, the statute of limitations is 2 years. NEPA creates a single environmental framework that is implemented in many ways by different agencies. While CEQ is responsible for guiding NEPA activities across federal agencies and issues regulations and guidance to agencies to comply with NEPA, each federal agency is directed by CEQ to develop its own NEPA procedures in conjunction with CEQ based on the agency's mission, and authorizing statutes. This process has long been a source of complexity which can often lead to unnecessary delay. EIS development timelines and document lengths have grown beyond what was originally intended by the NEPA regulations. Litigation on the NEPA assessments has also increased. Federal agencies' use of environmental collaboration and conflict resolution (ECCR) has avoided litigation and saved time and money, creating more certainty in the siting and permitting processes.	CEQ should issue in a timely manner regulations or guidance that improves collaboration across cooperating agencies, improves the use of ECCR and reinforces original NEPA regulations calling for concise NEPA assessments. Congress should extend the 2-year statute of limitations enacted in FAST-41 for claims against covered project NEPA assessments to all energy infrastructure projects and include other FAST-41 claim conditions such as the requirement that claimants have participated in the NEPA review process and submitted sufficiently detailed commentary so the lead agency has been notified of the issue that they seek to be reviewed by the court. Project developers and federal agencies should continue to use ECCR as a means to avoid litigation and shorten infrastructure permitting timelines. CEQ should incorporate into its NEPA regulations elements from the Memorandum of Understanding implementing One Federal Decision (OFD MOU) to improve early and timely interagency coordination to elevate delays and dispute resolution by proving a mechanism for resolving disagreements among agencies that requires initial elevation through the chain of command of each relevant federal agency encourages resolution of disputes in a consistent manner.

Findings	Recommendations
II.B.3.a. Single Statute Gives Oversight to Multiple Agencies	
CWA 401 decisions are being made on elements unrelated to water quality. The U.S. Army Corps of Engineers (USACE) and EPA play indispensable roles in the infrastructure permitting process, including coordination among governments, agencies, and companies. Because states can condition their Section 401 water quality certificates or impose conditions on regional or other general permits to be issued by the Army Corps under Section 404, conditions vary from state to state, or within a watershed, and as a result there is no nationwide predictable set of standards.	The U.S. Army Corps of Engineers and EPA, when engaging the states on the implementation of CWA Sections 401/404, should exercise their authority to ensure that the statute is properly construed and enforced. EPA should: • Finalize and update regulations, published for public comment August 22, 2019, to clarify the scope of federal/state water quality standards. • Convene a Federal Advisory Committee with representatives of industry, state governments, affected local communities, and NGOs to develop consensus recommendations for how to improve states' Section 401 certification processes. The U.S. Army Corps of Engineers should: • Implement rulemaking to provide procedural consistency among NWP programs, potentially requiring pre-application to identify Lead Districts, points of contact, and variations in requirements across watershed and political boundaries. • Continue working and implementing One Federal Decision process initiatives to improve the efficiencies of the USACE regulatory processes, including a lead district for projects crossing multiple districts and for a single point of contact for One Federal Decision, and any project crossing district boundaries. • Clarify when the preconstruction notifications requirements for use of NWP 12 are required (e.g., when there are public water supply intakes downstream of the activity, or when the activity may affect listed species or officially designated critical habitat). • Implement consistent approaches to permit interpretation among its field offices to minimize variation of NWPs.

Findings	Recommendations
II.B.3.b. Multiple Statutes Convey Overlapping Oversight	
Overlapping and duplicative regulatory requirements, inconsistencies across multiple federal and state agencies, and unnecessarily lengthy administrative procedures have created a complex and unpredictable permitting process. • States approach permit coordination in varying ways for energy infrastructure projects. • In federal-led permitting projects, states vary in initiating their permitting reviews. Sequential rather than concurrent reviews can create delays.	The federal government should leverage the Federal Permitting Improvement Steering Council (FPISC) to encourage concurrent review by the states during the federal permitting process. FPISC has authority to enter into MOUs with states to accomplish concurrent review under FAST-41. For federal permits or decisions delegated to the states (CZMA, CWA, CAA), states should be incentivized to comply with FAST-41 and One Federal Decision and make decisions in conjunction with federal NEPA process timeline. EPA should: • Finalize and update regulations to clarify the scope of federal/state water quality standards. • Convene a Federal Advisory Committee with representatives of industry, state governments, affected local communities, and NGOs to develop consensus recommendations for how to improve states' 401 certification processes.
II.B.3.c. Greater Focus on and Adherence to Interagency Coordination	
Coordinated and streamlined NEPA review among multiple federal agencies is essential to the timely development of infrastructure required to meet the public need for natural gas.	CEQ should incorporate into its NEPA regulations elements from the OFD MOU to improve early and timely interagency coordination: • Roles and Responsibilities of Lead and Cooperating Agencies: The One Federal Decision MOU provides expanded guidance on the roles of each of the agencies. which is helpful in ensuring the efficient coordination among parties. • Permitting Timetable and Concurrence Points: Preparing a single multiagency permitting timetable with specific concurrence points ensures early and continued interagency coordination at key points during the process.
II.B.4. Agencies Have Multiple Interests	
Regulatory approvals of cooperating agencies can conflict with approvals of the lead agency.	To harmonize multiple permitting processes at the federal and state level, Congress should provide sufficient staffing for and authorize the lead federal agency implementing NEPA regulations to ensure that NEPA analyses fully encompass and support permit decisions of other federal and state agencies.

Findings	Recommendations
II.C.3. State Environmental Policy Acts	
Some states allow the federal NEPA review to substitute for completion of their program, similar to when federal agencies adopt a lead federal agency's NEPA analysis. In other states, the federal and state reviews must run side by side and the state agencies cannot issue any permits until their state review is completed. As a result, these state programs can add time to a project timeline.	States should focus SEPA or other environmental reviews on analyses necessary to satisfy state law or delegated federal decisions not required by federal law.
Interstate Oil and Gas Compact Commission (IOGCC) and Environmental Council of the States (ECOS) can convene task groups to address multistate general issues.	States should consider utilizing ECOS's relationships with state officials and knowledge of the federal process, to facilitate a common agreement between federal and state jurisdictions when there are potential conflicts between a NEPA review and a SEPA review to avoid delay, confusion, and legal vulnerability. Industry, a national organization made up of state regulatory agencies such as the IOGCC or ECOS, representatives of local governments and communities, and interested NGOs should collaborate to develop a model master structure for state permitting and coordination of approvals for infrastructure, to provide for efficient collaboration with operators and better coordination with federal agencies. States should adopt a single point of contact within a state for permit coordination.
II.E. Examples of Energy Infrastructure Projects Delayed, Denied, or Cancelled	
State and local policies, state denials of infrastructure projects, and state restriction of movement of particular forms of energy fragment the infrastructure network. Fragmentation has significant consequences on interstate commerce by restricting the ability of one state to obtain or transport energy from one state to another. Solutions are inherently political, difficult, and complex.	To mitigate negative impact on interstate commerce, all levels of government should have constructive dialogue, through forums like the former Advisory Commission on Intergovernmental Relations, about the overall economic benefits from the nation's energy resources while effectively engaging stakeholders and minimizing local impacts and risks. Additionally, the Federal Energy Regulatory Commission, in consultation with the U.S. Department of Energy, North American Energy Standards Board, market participants, and stakeholders, should continue to study and advance policy updates that alleviate current impediments to contracting and infrastructure expansion between natural gas-fired power plants and pipeline operators.
III. Public Engagement for Infrastructure Projects	
Successful infrastructure projects depend upon early, effective, and continuous stakeholder engagement and collaboration. Following this model can lead to positive outcomes for partner communities, project sponsors, and consumers.	Industry should adopt community engagement best practices to enhance outreach and to raise prospects for successful project permitting and implementation. In states where stakeholder engagement requirements are lax, companies should take a voluntary approach to implement best practices.

Findings	Recommendations
III.A. Soliciting Public Input to the Regulatory Process	
Public notice and awareness of energy infrastructure projects would be enhanced if there were a consistent, easy-to-use website and hearing format that accommodated English and non-English speaking stakeholders. Agencies have different public meeting formats.	The lead federal agency needs to have a consistent and inclusive public comment process with full transparency of scoping meeting locations, dates, maps, timelines, etc. CEQ should update guidance for agencies to develop a simple, intuitive, easy to understand and use format for public involvement in infrastructure project permitting, public hearings, and notice and comment stages.
III.C.1.b. Air and Water Quality	
	Infrastructure companies should continue to adopt technologies and practices that minimize air emissions, including methane.
III.C.1.d. Wildlife and Vegetation	
Conservation groups have expressed concern about lack of inclusion in planning and development processes to ensure species that are not necessarily protected under the Endangered Species Act, Migratory Bird Treaty Act, or other state and federal laws are considered and managed to conserve their habitats and populations.	To ensure best practices, infrastructure companies should solicit input from local, regional, and national stakeholders regarding habitat impacts early in their planning and development processes, and engage collaboratively with stakeholders on cooperative solutions. Companies should also adopt innovative approaches to mitigating these impacts.
III.C.1.e. The Relationship Between Climate Change, NEPA, and Litigation	
The nation faces the dual challenge of providing affordable energy to support economic growth and human prosperity while addressing the environmental effects including the risks of climate change. Industry shares the public's concerns that climate change is a serious issue that must be addressed. Litigation of individual projects to address global climate concerns is an ineffective approach.	All infrastructure companies should strive for an outstanding environmental compliance record and to reduce the intensity of greenhouse gas emissions from their operations. Emissions reduction programs, such as One Future, the Methane Challenge, the Environmental Partnership, and EPA's Natural Gas Star Program, are all means of demonstrating a company's efforts to reduce methane emissions.
The permitting and construction of numerous energy infrastructure projects has been challenged, delayed, or stopped as a result of litigation by stakeholders concerned about climate change and the associated policy debate.	Congress should: • Clarify that GHG assessments under NEPA, for oil and natural gas infrastructure projects, are confined to emissions that are (i) proximately caused by the Federal action (see Dep't. of Transportation v. Public Citizen, 541 U.S. 752 (2004)), and (ii) are reasonably foreseeable. • Enact a comprehensive national policy to reduce GHG emissions and seek to harmonize federal, state, and sectoral policies to enhance efficiency and effectiveness. Congress should ensure that the enacted national policy is economy wide, applicable to all sources of emissions, market-based, transparent, predictable, technology agnostic, and internationally competitive.

Findings	Recommendations
III.C.3. Economic Interests and Skilled Labor Need	
While the economic benefits from infrastructure development are often welcomed by local communities and stakeholders, they often do not completely offset the challenges experienced as a result of this development. Also, benefits of job creation in the skilled trades may not accrue to local residents and tribal members due to a lack of local job training and apprenticeship programs. It is becoming increasingly challenging to keep pace with hiring and developing a well-qualified workforce to build and maintain existing and future infrastructure. A skilled labor shortage exists in the United States and will continue to grow as the current workforces continue to retire.	Industry should recognize the economic, social, and environmental concerns of the agricultural, hunting, and recreational stakeholders as well as the concerns of local government regarding roads and bridges and increased demands for services. Industry should collaborate with local communities to develop strategies to capture benefits of infrastructure development and to mitigate economic, social, and environmental challenges for stakeholder groups such as local government, farmers, tribal members, recreation, and hunting/fishing interests. Industry should adopt a stance of endorsing accredited apprenticeship programs as a community good and an economic engine for the community. Industry should collaborate with labor unions to develop labor feeder pools and training programs to maintain a sustainable skilled labor workforce required to construct, operate and maintain the infrastructure by utilizing a national network of accredited apprenticeship programs. The U.S. government, states, local communities, secondary schools, and industry should promote vocational career education and technical training of their constituents, members, and communities. Industry, along with secondary and technical schools should support registered and accredited apprenticeship programs to ensure an adequate supply of skilled industrial construction, operations, and maintenance workers.
III.C.4. Eminent Domain	
The Third Circuit's decision that pipeline condemnation lawsuits under the Natural Gas Act against states are barred by the state's Eleventh Amendment immunity could have a significant impact on the siting of some new pipeline infrastructure and will result in significant state-level control over federally approved natural gas infrastructure projects crossing state lands. Eminent domain disputes with landowners lead to delays and complexities in implementing projects.	Because the Natural Gas Act (NGA) does not differentiate between privately held and state-owned property, Congress should enact the necessary changes to the NGA to expressly clarify that all property (whether privately owned or state-owned) are subject to an NGA certificate holder's right of eminent domain and that pipelines are not barred by Eleventh Amendment immunity in bringing eminent domain actions against a state. Where a proposed route would cross state land, the pipeline project developer and the state should work proactively and cooperatively with each other to develop a process for joint input to FERC on the siting. Industry should follow stakeholder engagement best practices, whether required or not, to engage all landowners affected by eminent domain early in the project design process. Companies should work with industry groups, habitat researchers, and landowner groups to establish restoration best practices that provide new, native habitat for pollinators and other species.

Findings	Recommendations
III.D. American Indians and Alaska Natives and Government-to-Government Consultation	
Creating workforce training and employment programs is an effective method in building relationships with tribes during the development of energy infrastructure projects. Collaborative pre-apprenticeship labor training programs for American Indians and Alaska Natives hold promise to build an indigenous, growing work force of skilled trade unions on reservations and in nearby towns to be ready to work on energy infrastructure projects.	The federal government should, after consultation with tribes, construction companies, and trade schools, support American Indian and Alaska Native workforce development through labor pre-apprenticeship training programs for American Indians and Alaska Natives of trades involved in the construction, maintenance, or operation of energy infrastructure. In addition, the NPC encourages energy companies and labor unions to initiate agreements with tribes to provide work and training opportunities relative to energy infrastructure projects.
American Indians and Alaska Natives tribes are a special class of stakeholder, due to their sovereign status. Federal agencies have developed extensive regulations and guidelines, although different at each agency, for meaningful consultation. Tribes have several concerns about siting and permitting decisions, as well as the consultation process itself.	The federal government should continue to enhance nation-to-nation consultation with American Indian and Alaska Native governments regarding energy infrastructure development. Agencies should develop project-specific plans to document the steps they will take to coordinate public and tribal participation and complete the required environmental reviews and authorizations. American Indians and Alaska Natives tribes and industry operators should strive for meaningful dialogue in areas of mutual interest and needs of tribes and industry, such as preservation of sacred sites, workforce development, and infrastructure development.
III.E. Best Practices for Stakeholder Engagement	
Inconsistent and insensitive land and right-of-way acquisition practices, insufficient communication and lack of transparency about project implementation plans, and inadequate stakeholder or tribal engagement practices can result in avoidable project delays.	Infrastructure companies should consistently: • Implement existing best practices (FERC, Interstate Natural Gas Association of America, American Petroleum Institute, Association of Oil Pipe Lines) for early and effective engagement with local governments, communities, private citizens, public interest groups, and American Indians and Alaska Natives to understand and address stakeholder concerns. Infrastructure companies should strive to incorporate stakeholder input into the proposed action wherever practicable and collaborate on finding solutions or conveying reasons in those circumstances where an interest is difficult to accommodate. • Engage in educational and awareness efforts with communities and stakeholders to increase understanding of the need for infrastructure, the steps to be taken to construct and operate it safely, and how they will be engaged throughout the siting and development process. • Work collectively toward more effective engagement practices regarding energy, environmental and related public policies that encourage responsible energy development and transport.

Findings	Recommendations
IV.B.2. LNG Storage	
Since multiple agencies supervise LNG plant construction, consideration and approval of plans are rarely done jointly and can result in conflicting requirements, causing delay. For example, FERC, PHMSA, and the U.S. Coast Guard inspect the site during construction. The industry has all three agencies inspecting the facility at intervals during construction and operations. These inspections overlap in their scope and the agencies can contradict each other and what was agreed during permitting.	The regulatory requirement for review by FERC and PHMSA on the construction of the facility should be reviewed and the process better coordinated and streamlined. It is imperative that the agencies either coordinate the review or review concurrently, and that the scope of the reviews be defined and jurisdictions identified.
API standards for pressure relief device testing are applicable to LNG facilities. Having a regulation with a prescriptive time interval for testing, especially as short as 1 year, over-exposes the facility and personnel to elevated risk and hazards and reduces safety and reliability. Said another way, removing and testing these devices will increase the potential for failure and therefore will reduce safety and reliability.	The most appropriate and safest route for addressing inspection and testing of pressure relieving devices is for PHMSA to adopt API 576 and 510 by reference for pressure relief device testing and/or the adoption of the requirements in the 2019 NFPA 59A (18.10.10.7.2). In addition, PHMSA should consider updating all standards to their current version, annually reviewing and updating Part 193 to the current version of all standards identified in the standard, allowing a facility to opt into risk-based analysis either in their application or for operations and let facilities opt into operations using process safety management.
V.B.1. FAST-41	
Bipartisan actions by Congress and the Executive Branch, including mechanisms to expedite the permitting process for large infrastructure projects, represent positive steps; however, more improvements are necessary. Utilization of FAST-41 by affected agencies is not fully realized. More can be done to accelerate investment in energy infrastructure and ensure energy security in a manner that ensures early and robust landowner and stakeholder engagement and in an environmentally sound manner.	A federal agency should consult with FAST-41 project sponsors and other stakeholders to obtain feedback to improve FAST-41 before reauthorization. Taking due consideration of the feedback from consultation, Congress should reauthorize FAST-41 for an additional 7 years, and include the following improvements: • Expand FAST-41 to include eligibility for all federal energy infrastructure projects and continuing staffing of FPISC. • For federal permits or decisions delegated to the states (CZMA, CWA, CAA), states should be incentivized to comply with FAST-41 and One Federal Decision and make decisions in conjunction with federal NEPA process timeline. • FPISC should be leveraged to drive concurrent review by the states during federal permitting processes. Further reauthorizations by Congress of FAST-41 consider eliminating sunset provisions.

Findings	Recommendations
V.B.2. Litigation Cycle Reform	
Reducing the time within which stakeholders can sue still preserves the opportunity to challenge an agency decision and can improve project timeline certainty. Early and effective stakeholder and landowner engagement in the design, review, and development phases of an energy project reduces the probability of litigation.	Where consistent with existing federal laws that protect public participation in agency permitting and environmental reviews, Congress should consider extending FAST-41 litigation reform to all federal agency decisions pertaining to infrastructure siting, permitting, construction, or maintenance. CEQ should ensure that revisions to the implementing regulations address common issues that are frequently litigated.
V.C.2. Executive Order 13868: Promoting Energy Infrastructure and Economic Growth	
	Federal land managers, in the interest of promoting energy infrastructure, should strive to identify potential "energy crossing corridors" for key crossing areas and conduct a single NEPA analysis. Agencies should consider developing a streamlined permitting process for critical infrastructure where a cluster of projects can be anticipated.
V.D. Agency Staffing and Training	
Adequate, trained inspectors to enforce regulations are important.	The Executive Branch should assign dedicated staff in all federal agencies to review energy infrastructure projects similar to the model that the Department of Transportation uses for highway infrastructure projects. Congress should provide all federal and state agencies involved in energy infrastructure permitting sufficient, experienced staffing for permitting reviews and analyses. Where it would not result in a loss of critical agency expertise to regulate the industry, agencies should have the flexibility to consider the enhanced use of contractors, experienced professionals, and retention allowances for experienced persons who can reduce unnecessary delay as a consequence of declining budgets for staff. Further, the agencies could consider the "Strike-Team" approach employed by the Bureau of Land Management (BLM), which the BLM used to clear a backlog of applications for permits to drill in 2012.

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