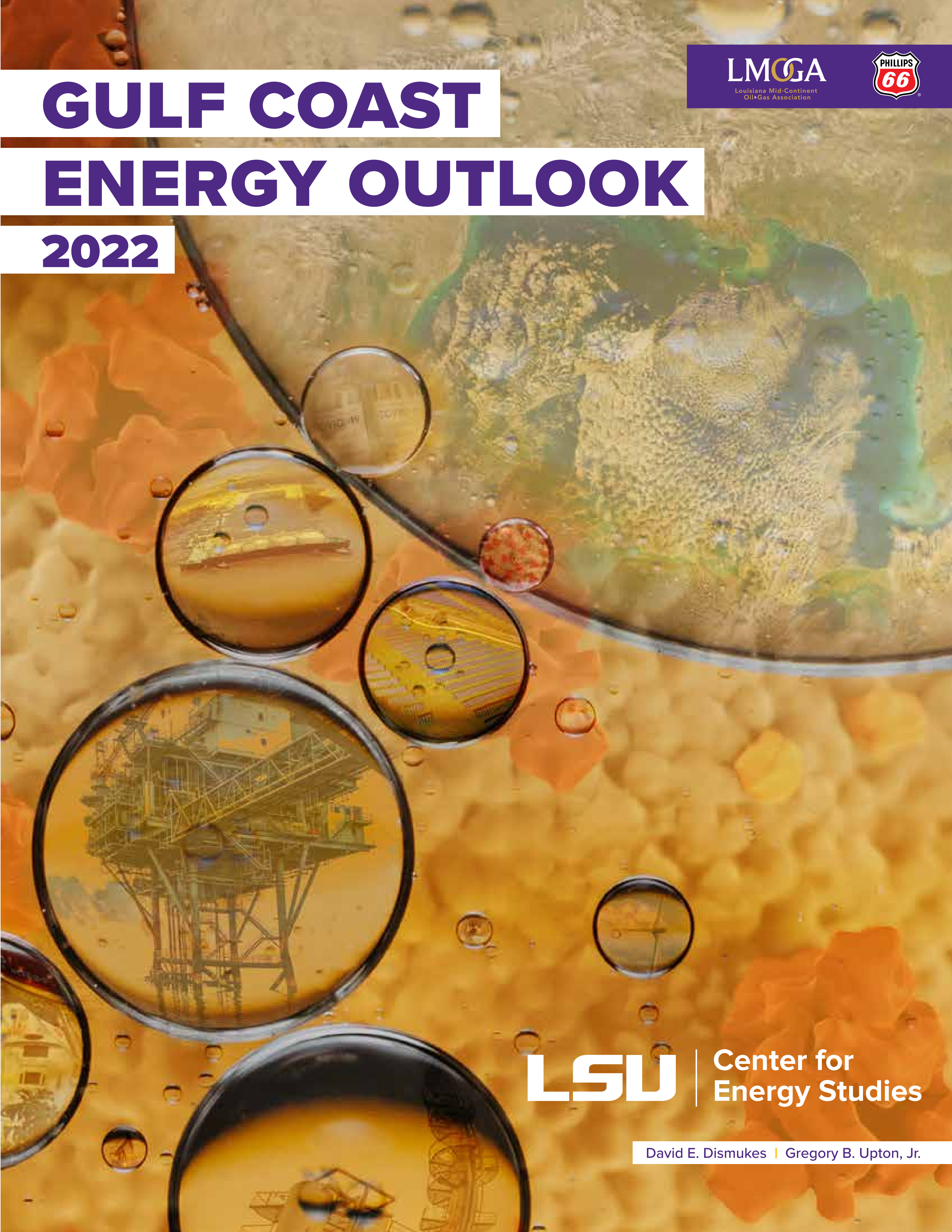

GULF COAST ENERGY OUTLOOK

2022

LMOGA
Louisiana Mid-Continent Oil•Gas Association

PHILLIPS 66

LSU | Center for Energy Studies

David E. Dismukes | Gregory B. Upton, Jr.

2022 Gulf Coast Energy Outlook

David E. Dismukes – LSU Center for Energy Studies
Gregory B. Upton, Jr. – LSU Center for Energy Studies

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1. Introduction

The annual GCEO is designed to provide stakeholders with a "one-stop" overview of the current trends and outlook for the region's energy industry and its various sectors. The GCEO is a work product of Louisiana State University's Center for Energy Studies and has been sponsored by several companies and institutions looking to assist LSU in disseminating timely information and analysis impacting the region's economy and citizenry. The GCEO is also supported by the Center's general state appropriation, which represents a generous commitment by Louisiana to support energy-related research. It would be difficult to produce the GCEO without both sources of support.

Unless stated otherwise, the "Gulf Coast" region specifically refers to the states of Texas, Louisiana, Mississippi, and Alabama. In some instances, the U.S. Department of Energy reporting conventions will require references to data collected at the Petroleum Administration for Defense District 3 (PADD 3) level, which includes Arkansas and New Mexico in addition to the Gulf Coast states. Employment forecasts will focus on Louisiana and Texas. Where not specified, the forecast horizon extends to the end of 2024, or approximately three years.

The remainder of this introduction will highlight the big picture considerations and assumptions made in subsequent analysis and forecasting.

1.1 Recovering from COVID-19

Last year's GCEO was prepared during the midst of the COVID-19 pandemic. For perspective, in January of 2020, the U.S. economy was in its 126th month of economic growth, the longest in modern history. By March of 2020, the world changed rapidly when the COVID-19 pandemic shut down entire segments of the global economy. Oil markets, which were already in a state of downward correction, were further rocked by a historical decline in demand that was unaided by a failed OPEC+ deal to curtail output. These combined factors (unusually low energy demand, high energy supplies) created the perfect storm leading to a collapse in global and domestic energy prices. At one point, West Texas Intermediate (WTI) crude oil prices touched on an unheard-of negative daily price. U.S. oil production immediately fell in response to these price signals from a record high of 12.97 million barrels per day (MMBbl/d) in November of 2019 to 9.7 MMBbl/d by May 2020: a 25 percent production free-fall in just seven months, the largest percent change in modern history.

But the good news is that this past year has brought recovery. Global, domestic, and regional oil and natural gas production have all increased from the pandemic trough. The global rebound in aggregate demand has placed upward pressure on both oil and natural gas prices. Drilling activity has not returned to pre-pandemic levels, but exports of hydrocarbon-based products have. Thus, while the industry (and world) is still not "back to normal," there have been substantial improvements.

Last year's GCEO addressed these COVID-related uncertainties and how short-term recovery may evolve. This year, the 2022 GCEO will focus on addressing several medium- to longer-term recovery questions, such as: How did companies respond operationally to a global pandemic? Will some of these temporary changes implemented persist into a post-pandemic world? Has business travel been reduced permanently, as companies find virtual meetings more efficient? Will employers embrace workplace flexibility, allowing for remote work, thus reducing commuting? While specific long-term forecasts are not presented, this year's GCEO will consider whether the fundamental relationships between energy consumption and economic activity have changed more broadly.

> **This year's GCEO modeling will assume that COVID impacts will continue to attenuate globally, and the world will slowly return to some level of normalcy over the next year. Another wave of a COVID variant, such as Delta, leading to cascading shutdowns would likely result in outcomes that differ from the base 2022 GCEO forecast. This year's GCEO, much like last year, anticipates that long-run energy demand growth will lead to increased U.S. energy exports, especially to the growing developing world.**

1.2 Decarbonization Policies

Over the past five years, major decarbonization milestones have been reached. In 2016, the Paris Agreement went into effect. This international treaty on anthropogenic greenhouse gas (GHG) emissions was ratified by 190 countries representing 97 percent of the global population. President Obama's administration participated in the negotiation of the Paris Agreement in 2015, and in 2016 the agreement was formally ratified. President Trump withdrew the United States from the agreement in June of 2017. Then, in January of 2021, one of President Biden's first actions upon assuming office was re-entering the agreement. For perspective on the increased attention on this issue, the Kyoto Protocol signed in 1997 represented just 14 percent of global emissions, compared to 97 percent for the Paris Agreement.

These GHG policy initiatives and commitments are not restricted to international activities alone. This past year, Louisiana Governor John Bel Edwards committed Louisiana to considerable GHG emission reduction targets that include GHG emissions reductions of 25 to 28 percent by 2025 and complete carbon neutrality by 2050. This makes Louisiana the only Gulf Coast state with such ambitious GHG emissions reduction targets. Further, Governor Edwards has appointed a Climate Initiatives Task Force (CTF) composed of a variety of stakeholders that include non-governmental organizations (NGOs), environmental and social justice groups, industry, state executive agencies, and trade associations, among others. The CTF has been tasked with developing a set of priorities and policies for meeting the governor's carbon neutrality goals. The final product from the CTF is anticipated in the upcoming year (2022).

Concurrent with these policy initiatives are the implementation by large international corporations of "environmental, social, and governance" (ESG) policies that include decarbonization commitments. For example, some of the largest vertically integrated oil and gas firms, many of which have large Gulf Coast footprints (ExxonMobil, BP, and Shell) have made specific decarbonization commitments. Two publicly traded utilities in Louisiana, Entergy and AEP-SWEPCO, have also made decarbonization commitments.

Increasingly, the refining and chemical manufacturing industries that process hydrocarbons are making moves to decarbonize through a variety of means that include continued end-use and process efficiencies, the use of alternative feedstocks, fuel substitution (electrification and hydrogen), and through the use of carbon capture, utilization, and storage (CCUS). For instance, Air Products recently announced a $4.5 billion clean energy facility in Ascension Parish, Louisiana, that will include one of the state's first carbon capture projects.

Although decarbonization may lead to near-term challenges for Gulf Coast industrial expansion, it also creates an opportunity for leadership in developing liquid fuels, chemicals, plastics, fertilizers, and other products, historically derived from fossil fuels, with lower, or even net zero GHG emissions. Further, industrial decarbonization has the opportunity to create a competitive advantage for Gulf Coast industries if done successfully and cost competitively. Over the forecast horizon, the GCEO sees decarbonization creating considerable opportunities for continued regional capital investment.

1.3 The Future of Offshore Leasing

In January of 2021, Joseph R. Biden, Jr., was inaugurated as the 46th President of the United States. Within weeks of the inauguration, the Biden administration announced via executive order plans to reduce greenhouse gas emissions in light of concerns about global climate change.[1] The executive order called on the Secretary of the Interior to "pause new oil and gas leases on public lands or in offshore waters pending completion of a comprehensive review and reconsideration of Federal oil and gas permitting and leasing practices."[2] This created a swift backlash from the oil and gas industry and states whose economies are impacted by oil and gas activity on federal lands and waters.[3] The executive order prompted the cancelation of an offshore lease sale in the Gulf of Mexico that had been scheduled for March of 2021. In June of 2021, a federal court preliminary injunction was granted that allowed the Bureau of Land Management (BLM) and the Bureau of Ocean Energy Management (BOEM), the agencies responsible for conducting lease sales on federal lands and waters, to continue the leasing process while the review of federal oil and gas leasing practices was completed. In October of 2021, BOEM announced a Gulf of Mexico lease sale for November 17, 2021.[4]

As of this writing, the Department of the Interior has not released its "comprehensive review" of the leasing process. Offshore activities will be negatively impacted should this review lead to more leasing delays or less favorable leasing terms.

Therefore, for modeling purposes, the GCEO will assume that offshore activity will be continued into the short term, at least over the forecast horizon. The GCEO will change negatively, however, if new leasing suspensions are initiated, or if significant changes are made to the permitting and leasing processes.

It is difficult to incorporate these offshore policy uncertainties into the forecast modeling, as it requires specific information about policy changes and the timing of these changes. Consistent with forecasting methodology in prior year GCEOs, proposed policy changes will not be incorporated into forecasts until the policy change is actually enacted. In other words, a business-as-usual assumption with regard to offshore leasing will be utilized. If significant changes restricting offshore activity are implemented by the Biden administration, forecasts for upstream oil and gas employment provided in the GCEO are likely to be too optimistic.

[1] Executive Order on Tackling the Climate Crisis at Home and Abroad. January 27, 2021.

[2] Executive Order on Tackling the Climate Crisis at Home and Abroad. January 27, 2021. Sec. 208.

[3] E.g. Texas: Executive Order by the Governor of the State of Texas. Executive Order GA-33. January 28, 2021. Louisiana: House Committee on Natural Resources and Environment and Senate committee on Natural Resources. February 10, 2021. Louisiana State Legislature.

[4] Lease Sale 257.

1.4 Hurricane Ida

Hurricane Ida made landfall as a Category 4 hurricane on August 29, 2021, at Port Fourchon, the most important port for oil and gas activity in the Gulf of Mexico. At the peak, over one million customers were out of power in the Gulf Coast region, and nine refineries in Louisiana shut down operations due to the storm, accounting for 2.3 million b/d of refining capacity, or approximately 14 percent of the total U.S. refining capacity.[5] Ida also interrupted over 90 percent of oil and gas production in the U.S. Gulf of Mexico. Phillips 66 Alliance Refinery in Belle Chase was flooded. Recent media reports have questioned whether the refinery will restart operations or be transformed into a crude terminal, which would require significantly fewer workers. Media reports at the time of this writing have indicated that Shell Norco was in the process of restarting, when a fire broke out further delaying the refinery's restart.

Not to be overlooked, last year's tropical season (i.e. 2020) included three major hurricanes: Laura, Sally, and Delta. Most notable is Hurricane Laura, which made landfall in Cameron Parish, Louisiana. The southwest region of the state has still not recovered. In fact, Lake Charles is the only MSA in Louisiana that lost jobs this past year, at least partially due to Hurricane Laura.

Hurricanes cause significant challenges for energy infrastructure, especially aging refineries and chemical plants. Once significant damage is sustained, facility owners might choose to not return to normal operations, which can reduce employment in these sectors.

> **The GCEO assumes that the majority of the effects of the 2020 and 2021 hurricanes, relative to the energy sector, are short lived and have not materially affected companies' decisions to make regional energy infrastructure investments. The GCEO assumes that all existing energy infrastructure is repaired to pre-storm conditions over the next year and is not prematurely retired in any significant fashion. While it is true that some refineries, in the aftermath of the storm season, are in a tenuous economic position relative to continued operations, these tenuous economic conditions existed prior to the tropical seasons.**

1.5 Another Round of Trade Negotiations?

Last year, the GCEO highlighted former President Trump's trade negotiations with China. Because the Gulf Coast region is a net exporter of energy products to both China and the world, and the region has been in the midst of historic investment in refining, chemicals, and export, the GCEO indicated that trade negotiations were a significant risk for the region.

As discussed in last year's GCEO, in January of 2020, the U.S. and China signed Phase 1 of a trade deal that went into effect on February 14, 2020.[6] The 91-page agreement includes six chapters covering topics such as intellectual property, technology transfer, trade in food and agricultural, financial services, and macroeconomic policies. But China is currently not on track to meet its commitments made in the trade deal.

[5] U.S. Department of Energy. Office of Cyber Security, Energy Security, and Emergency Response. Hurricane Ida Situation Reports.

[6] Economic and trade agreement between the government of the United States of America and the government of the People's Republic of China.

Currently, the Biden administration is in the process of re-entering negotiations with China. Media reports have indicated that China was perhaps expecting an incoming Biden administration to provide relief from tariffs implemented by the Trump administration, but this has not occurred to date.

In October of 2021, the Biden administration began unveiling its China trade policy following a review of import tariffs and other measures imposed by the Trump administration.[7] U.S. Trade Representative Katherine Tai confirmed that upon this review, tariffs would continue while the Biden administration would begin the process of launching new talks with Beijing.[8] This has perhaps exacerbated supply chain challenges in the U.S., but might also bring China back to the negotiating table with the new administration.

At this time, it is not clear whether President Biden is negotiating a Phase II (which was anticipated to be the final trade deal) or the extent to which he intends to hold China's feet to the fire, so to speak, on not meeting the commitments made with the prior administration. Perhaps the good news is that GCEO industry queries, interviews, and research indicate that project developers have not specifically identified these current trade discussions as a major risk when considering regional capital investment.

The current GCEO modeling assumes that trade talks with China will not deteriorate, that new tariffs will not be implemented, and that these export commitments will not have a net negative impact on the demand for Gulf Coast energy products.

[7] Josh Zumbrun. U.S. Poised to Unveil China Trade Policy. *Wall Street Journal.* October 1, 2021.

[8] Yuka Hayashi and Josh Zumbrun. Biden's China Tariff Plan Fails to Provide Enough Relief, Businesses Say. *Wall Street Journal.* October 11, 2021.

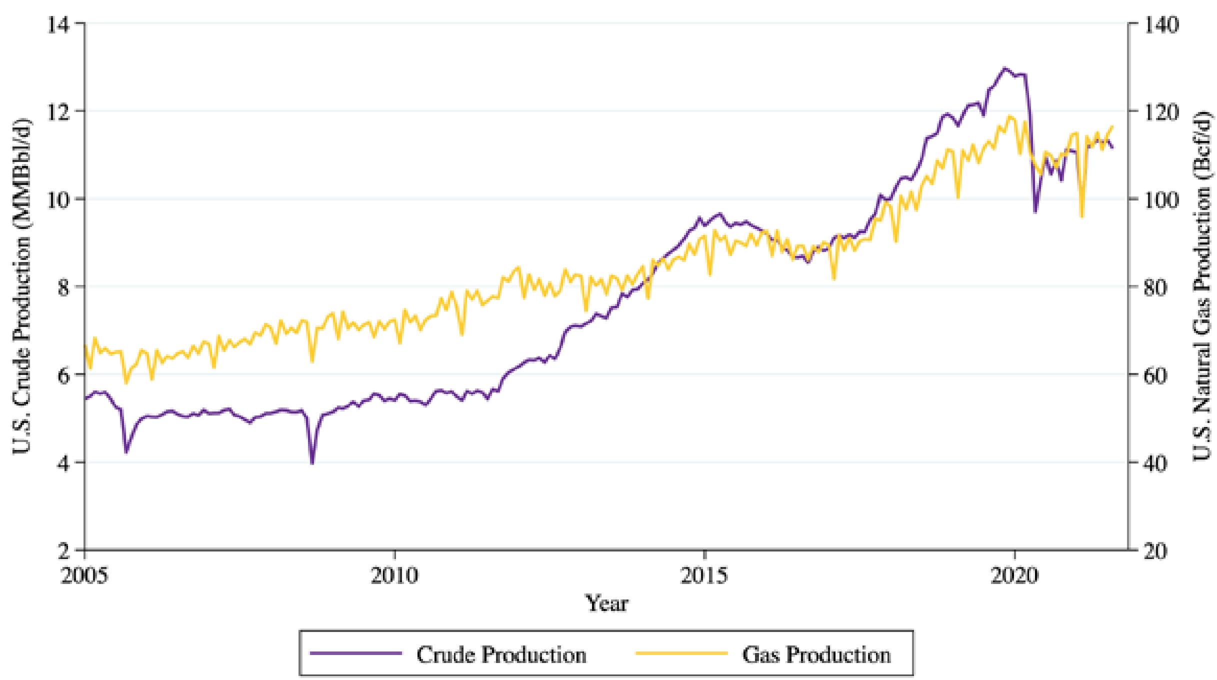
2. Crude Oil and Natural Gas Production and Prices

2.1 Recent Market Trends: Production

The shale revolution has dramatically changed the fortunes of U.S. energy across almost every sector. The energy supply and pricing changes created by this revolution continues to this day. Despite the pandemic, both crude oil and natural gas supplies are increasing, albeit at rates slower than originally anticipated.

Total U.S. crude oil and natural gas production peaked in 2019, averaging 12.3 million barrels per day (MMBbl/d) of crude oil and 112 billion cubic feet per day (Bcf/d) of natural gas (see Figure 1).[9] The pandemic, however, resulted in significant production declines throughout 2020.

Figure 1: U.S. crude oil and natural gas production



Source: U.S. Energy Information Administration. Petroleum & Other Liquids. Crude Oil Production. Natural Gas Gross Withdrawals.

For perspective, Table 1 shows monthly U.S. and Gulf Coast crude oil and natural gas production alongside the percent change from the same month in 2019—the year before the COVID-induced shutdown. Note that peak U.S. oil and natural gas production pre-pandemic occurred in November and December of 2019, respectively. Monthly data is compared to the same month in the pre-COVID year to account for seasonal variations.

Table 1 starts with a March date, since March 2020 is the date commonly associated with the U.S. pandemic shut down. March 2021 marks the pandemic's one-year anniversary where U.S. crude oil

[9] Annual averages provided by EIA listed in text. Monthly data shown in Figure.

production was at 11.2 MMBbl/d, or 6.2 percent below the pre-pandemic level. From April to July, U.S. production hovered between 4.8 and 7.4 percent below the corresponding month in 2019. August crude oil production decreased and is estimated to be 10.7 percent below prior year August levels. Thus, U.S. oil production has still not recovered entirely from the pandemic. Alternatively, Panel B of Table 1 shows that U.S. natural gas production has consistently been 2.5 to 3.2 percent above pre-pandemic levels.

Table 1: U.S. crude oil and natural gas production COVID recovery

	United States			Gulf Coast		
	2019 Production	2021 Production	Percent Change	2019 Production	2021 Production	Percent Change
Panel A: Crude Oil (MMBbl/d)						
March	11.9	11.2	-6.2%	7.0	6.7	-3.6%
April	12.1	11.2	-7.4%	7.1	6.8	-5.1%
May	12.1	11.3	-6.6%	7.1	6.8	-4.7%
June	12.2	11.3	-7.3%	7.1	6.7	-6.0%
July	11.9	11.3	-4.8%	6.8	6.8	-0.1%
August	12.5	11.1	-10.7%	7.4	6.5	-12.1%
Panel B: Natural Gas (Bcf/d)						
March	110.9	114.2	2.9%	40.0	39.9	-0.3%
April	108.7	111.8	2.8%	39.0	39.8	2.0%
May	112.3	115.1	2.5%	40.8	40.8	-0.1%
June	108.2	111.2	2.8%	39.7	39.8	0.2%
July	111.3	114.7	3.0%	41.0	41.6	1.5%
August	113.1	116.6	3.2%	42.3	41.5	-2.0%

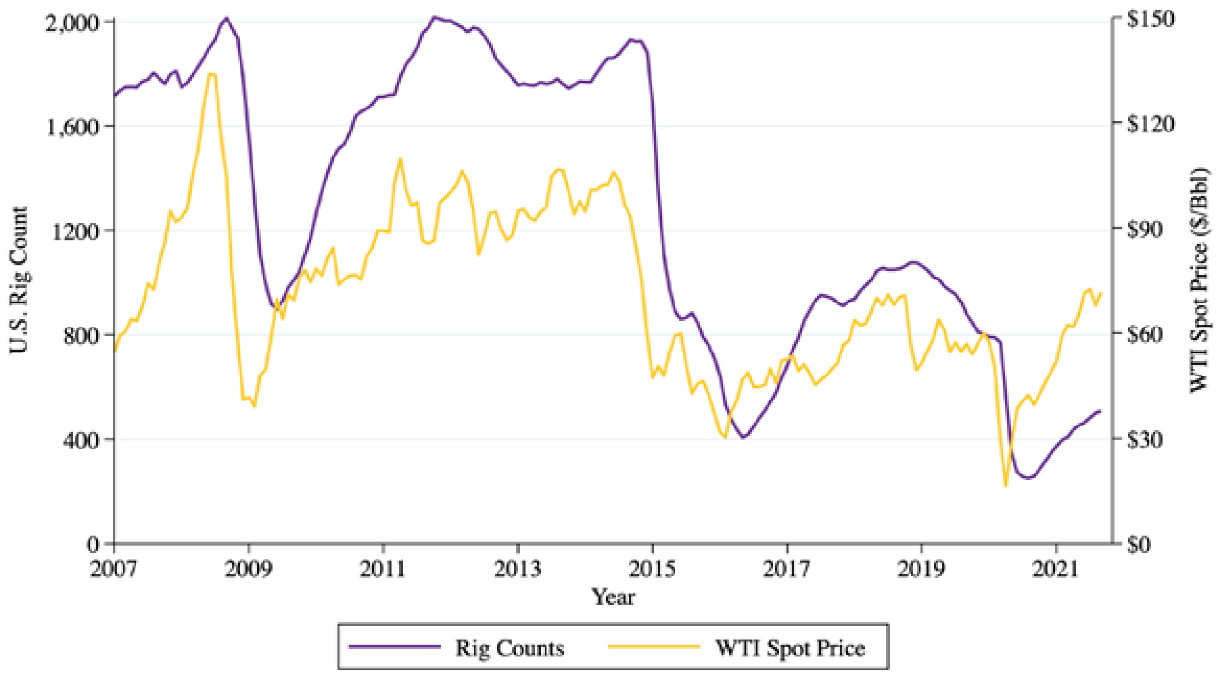
Source: U.S. Energy Information Adminstration. Petroleum & Other Liquids. Crude Oil Production. Natural Gas Gross Withdrawals.

Note: Percent change represents a percent change from the same month in 2019--the year preceeding the COVID induced recession which began in March 2020.

Figure 2 highlights the devastation that the pandemic has played on U.S. drilling activity. Baker Hughes reported 250 active rigs in August 2020, the lowest active recorded rig count that was 73 percent lower than the prior August (2019). Unsurprisingly, this rig count drop has mirrored the drop in the West Texas Intermediate spot price that bottomed out at less than $17 per barrel in March of 2020.

Fortunately, both crude oil prices and rig counts are all reporting recoveries. Baker Hughes reported 508 active rigs in September 2021. Although this is more than double the level at the time of the pandemic trough (August 2020) that rig count level is still less than half that reported in 2018 and 2019. By fall, 2021, WTI spot prices have increased to around $71 per barrel, which should presage continued increases in future drilling activity. However, the GCEO is not anticipating drilling activity to reach pre-pandemic levels over the next year. As will be discussed in Section 8, the GCEO anticipates that drilling activity will not likely return to pre-pandemic levels. Thus, the industry has once again evolved to be able to produce more hydrocarbons with fewer inputs.

Figure 2: U.S. crude oil prices and rig count

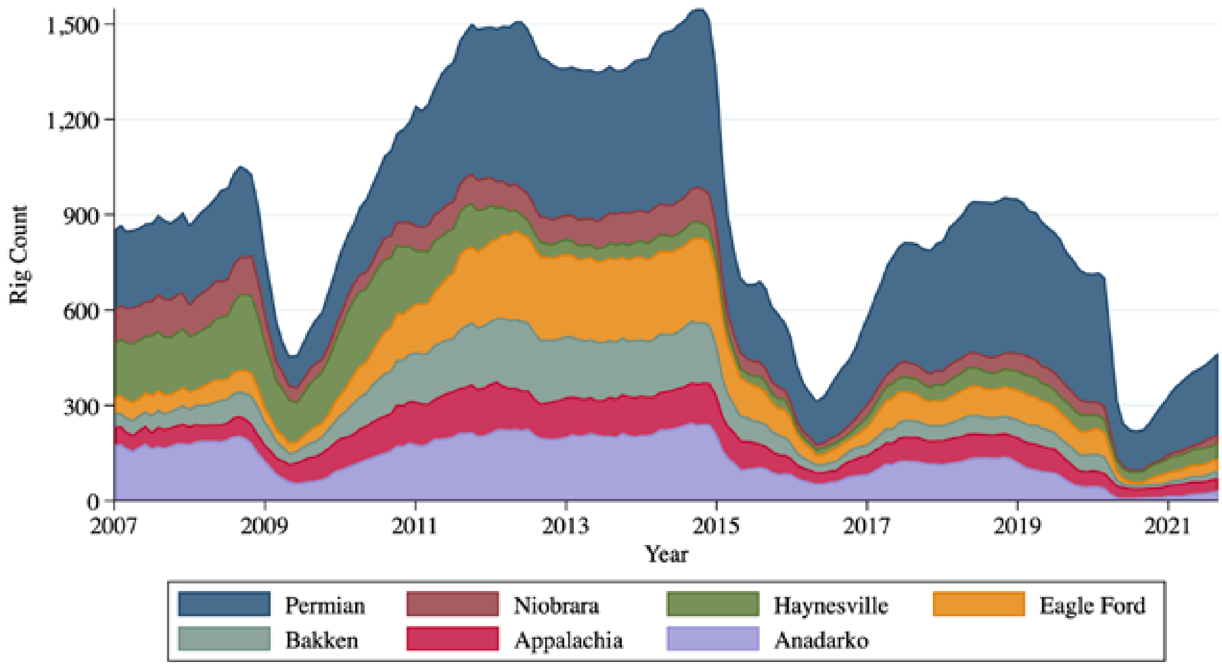


Source: U.S. Energy Information Administration. West Texas Intermediate Spot Price. Baker Hughes Rotary Rig Counts.

Figure 3 displays rig activity levels in seven major U.S. shale plays, as defined by EIA's *Drilling Productivity Report*. Last year's GCEO noted that the Permian basin has been the predominant U.S. shale play, accounting for approximately 46 percent of all active 2019 rigs. While the Permian is the premier basin, it is also the one that has experienced the largest rig count reduction, losing more than 900 rigs between the beginning of 2019 and the August 2020 post-pandemic trough.

All seven of the basins shown in Figure 3 have experienced rig count increases since September 2020, ranging from a 76 percent increase (Appalachia) to an over 230 percent increase (Anadarko). Unsurprisingly, the largest absolute increase has been in the Permian Basin, which has experienced an increase of 240 rigs over the past year.

Figure 3: Rig counts in major shale basins



Source: U.S. Energy Information Administration. Drilling Productivity Reports.

As a corollary to Figure 1, Figure 4 illustrates regional (PADD 3) crude oil and natural gas production. Table 1, provided earlier, also provides a comparison of changes in total U.S. crude oil and natural gas production to those experienced in the Gulf Coast region. The comparison provides several notable observations.

As with U.S. production, Gulf Coast oil and natural gas production were impacted differently by the pandemic. For oil, like the U.S., the Gulf Coast is still below pre-pandemic levels. In the most recent month available, August 2021, oil production was 10.7 percent and 12.1 percent below August 2019 levels for the U.S. and Gulf Coast, respectively.

Unlike U.S. natural gas production, though, that is above pre-pandemic levels, Gulf Coast natural gas production has returned to, but not exceeded, pre-pandemic levels. Gulf Coast natural gas production was within 0.3 percent of its pre-pandemic levels by March of 2021. Between March and August of 2021, Gulf Coast natural gas production has oscillated between two percent above and below the corresponding month in 2019. Nationally, natural gas production was between 2.5 and 3 percent above pre-pandemic levels from March to August 2021.

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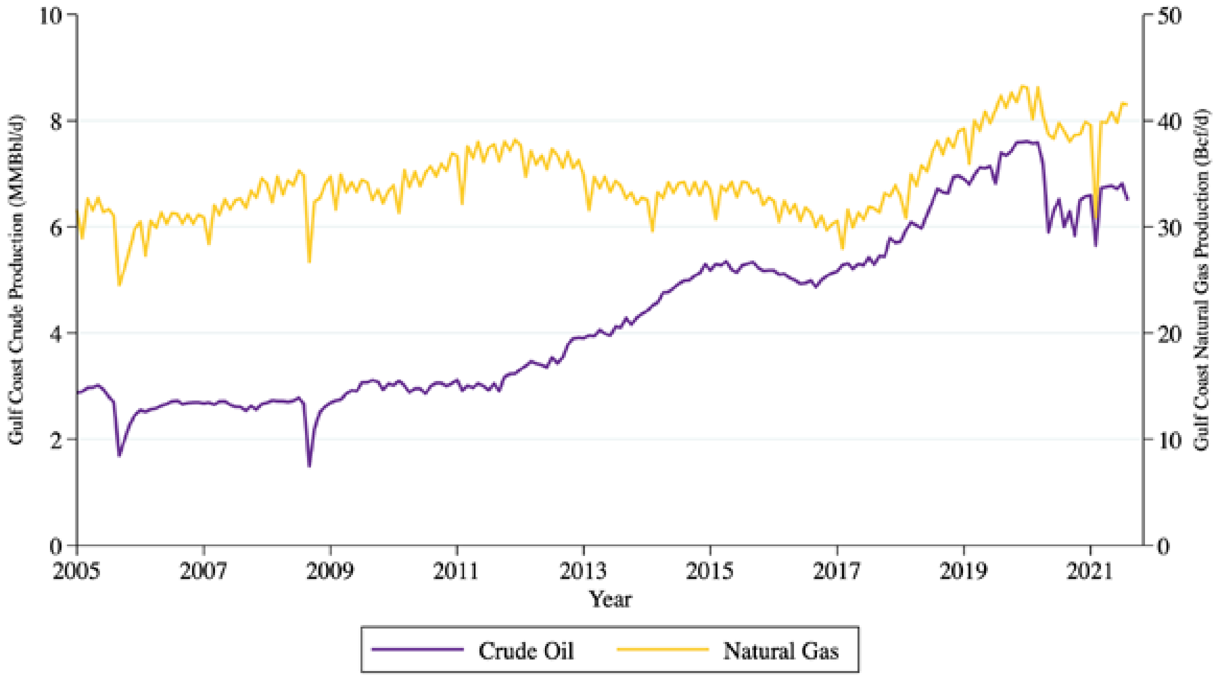
Figure 4: PADD 3 crude oil and natural gas production



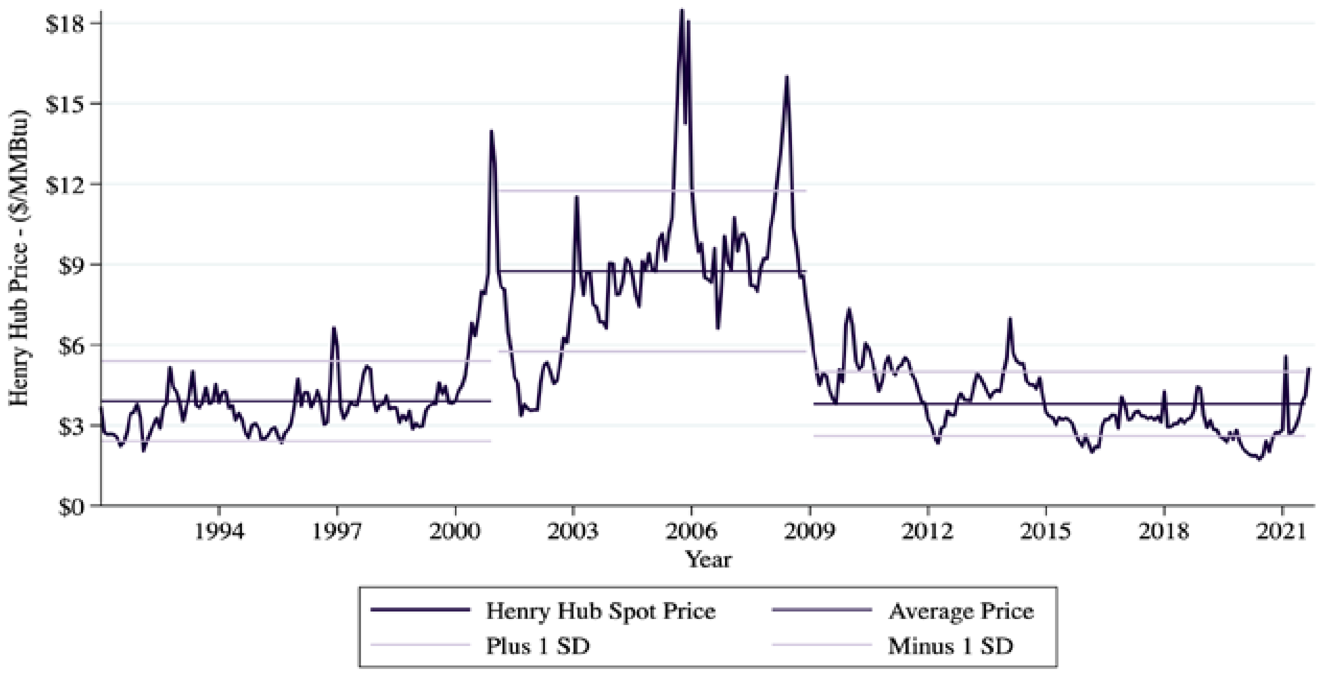
Source: U.S. Energy Information Administration. Petroleum & Other Liquids. Crude Oil Production. Natural Gas Gross Withdrawals.

2.2 Recent Trends: Commodity Pricing

Figure 5, as with prior year GCEOs, highlights three different natural gas pricing epochs: (1) the period spanning the 1990s; (2) the period starting with the natural gas supply/pricing crisis of the 2000s; and (3) the post-recession period to current. These epochs differ in both their levels and variability.[10] More recently, natural gas prices spiked during Winter Storm Uri in February 2021 but quickly returned to pre-Uri levels. As 2021 turns to a close, natural gas prices are at historically high levels. The GCEO takes the view that this most recent natural gas price run-up has more to do with (a) the rate at which natural gas production is recovering (as shown in the prior section), (b) the impact that the post-pandemic economic rebound has had on underground storage levels in North America and (c) the increasingly integrated nature of world natural gas markets that has been facilitated by U.S. LNG exports. Thus, the GCEO sees it as unlikely that U.S. natural gas markets are entering into a high price/high price volatility epoch comparable to that experienced in 2000s.

[10] Variability is shown as the standard deviation in the change in average monthly prices.

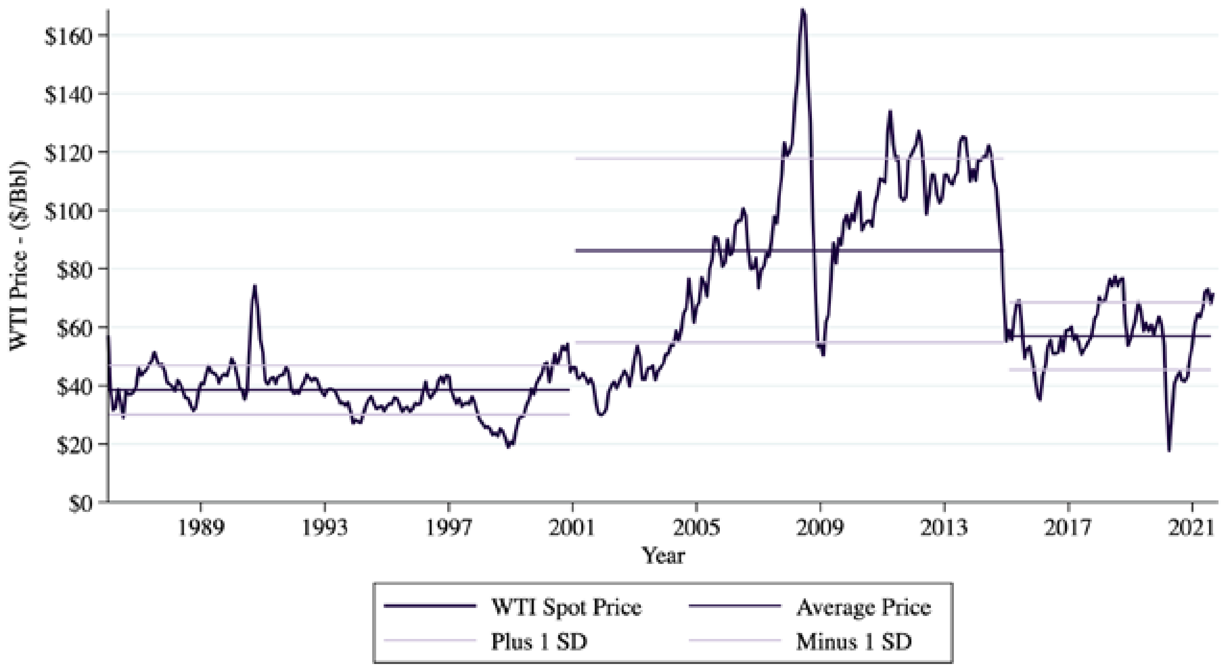
Figure 5: Historical inflation-adjusted natural gas price



Source: U.S. Energy Information Administration. Henry Hub Natural Gas Spot Price. Inflation adjustment based on U.S. Consumer Price Index sources from the Bureau of Labor Statistics.

Figure 6 provides a comparable analysis for crude oil pricing, underscoring again the dramatically reduced volatility that current period prices are experiencing relative to past pricing epochs. Pre-pandemic crude oil prices are shown in the middle range of the third epoch. The pandemic, quite simply, crashed crude oil prices in ways never experienced in the past. Crude oil prices bottomed out at a monthly average of less than $17 per barrel in April 2020, but quickly rebounded. The recovery of global crude oil demand, coupled with tight supplies and continued OPEC+ discipline, has put upward pressure on prices, which are now at the upper end of the range. Thus, like natural gas, and despite the global economic activity of the past year, the 2022 GCEO takes the view that crude oil prices will continue within this third epoch reflected by relatively low levels and low variability.

Figure 6: Historical inflation-adjusted oil prices



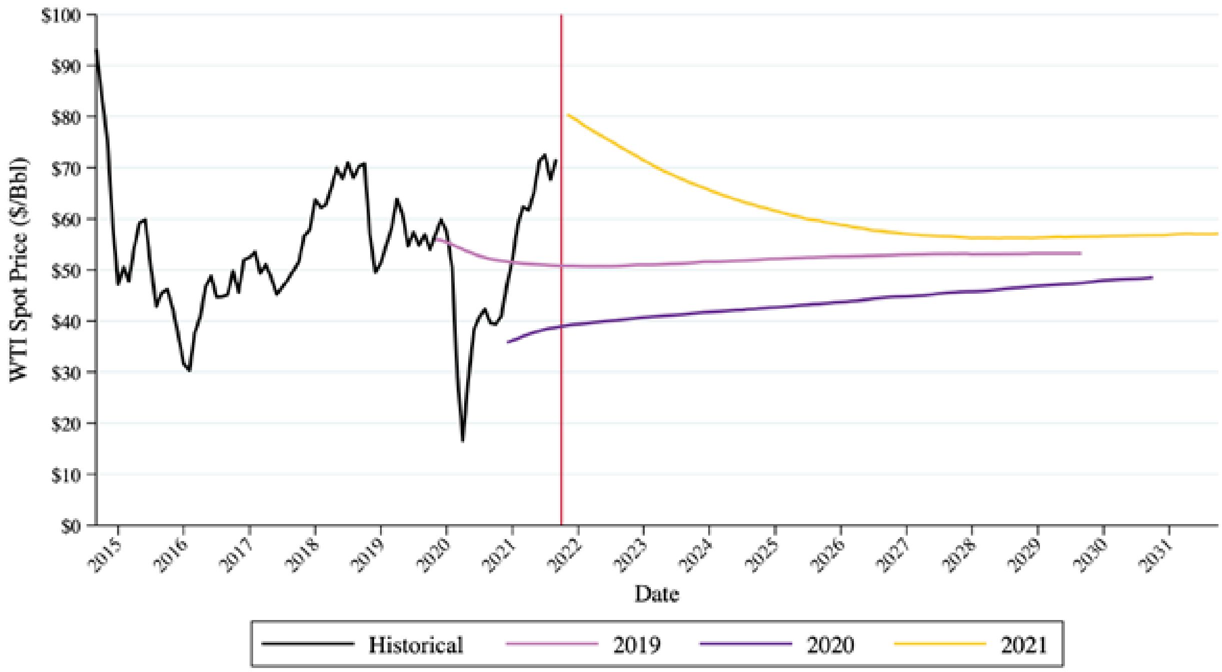
Source: U.S. Energy Information Administration. West Texas Intermediate Spot Price. Inflation adjustment based on U.S. Consumer Price Index sources from the Bureau of Labor Statistics.

2.3 Outlook: Commodity Pricing

Futures markets are indicating downward pressure on both crude oil and natural gas prices. Figure 7 and Figure 8 show current futures prices for oil and natural gas alongside the futures prices from the last two years' GCEOs. Examination of not only the current futures price, but also how expectations have changed, is instructive for understanding market trends.

Figure 7 shows the crude oil futures prices. Last year, oil markets were in *contango*—meaning that prices were anticipated to increase in coming years. As it turns out, prices did indeed increase over the past year, but at a much faster clip than anticipated by futures market. Oil futures markets are now in *backwardation*—meaning that prices are expected to fall in the future. Although futures markets are predicting downward crude oil price pressure, markets are also predicting higher prices over the next five years or more which differs from trends over the past two years' GCEOs. Thus, higher crude oil prices are anticipated to put upward pressure on drilling activity and eventually crude oil production. Price-induced increases in drilling activity will, in turn, impact upstream oil and gas employment forecasts, which will be discussed in greater detail in Section 8.

Figure 7: Crude oil price outlook

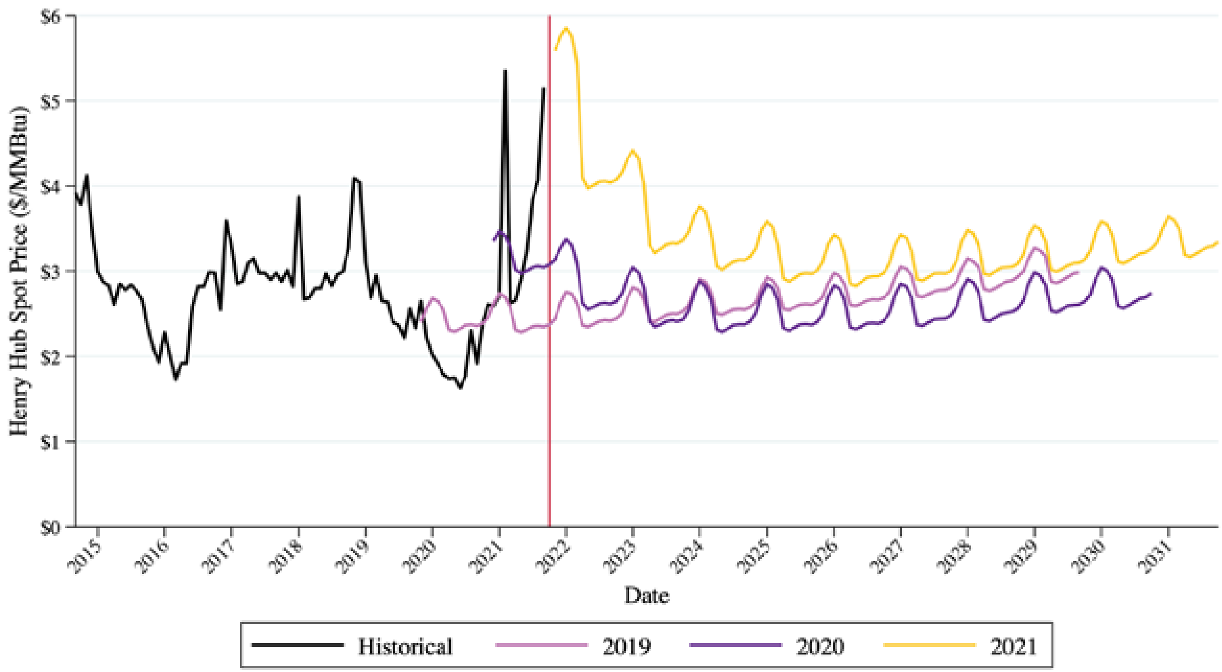


Source: New York Mercantile Exchanged West Texas Intermediate Futures Price. Sources from S&P Global Market Intelligence. Most recent future price as of August 31, 2020.

Figure 8 shows the corollary for natural gas futures prices. Like crude oil, natural gas prices have increased above levels predicted by futures markets over this past year. Natural gas prices are anticipated to increase through the heating season, but then be reduced in 2022 and then again in 2023.

Although prices have increased significantly over the past several months, the GCEO continues to take the view (as it has for the past several years) that these natural gas prices are a good balance between being high enough to support increased drilling activity in natural gas-based plays such as the Haynesville and Appalachia, but low enough to continue to attract investment in chemical manufacturing and LNG export in the Gulf Coast region, as will be discussed in Section 5.

Figure 8: Natural gas price outlook



Source: New York Mercantile Exchanged Henry Hub Futures Price. Sources from S&P Global Market Intelligence. Most recent future price as of August 31, 2020.

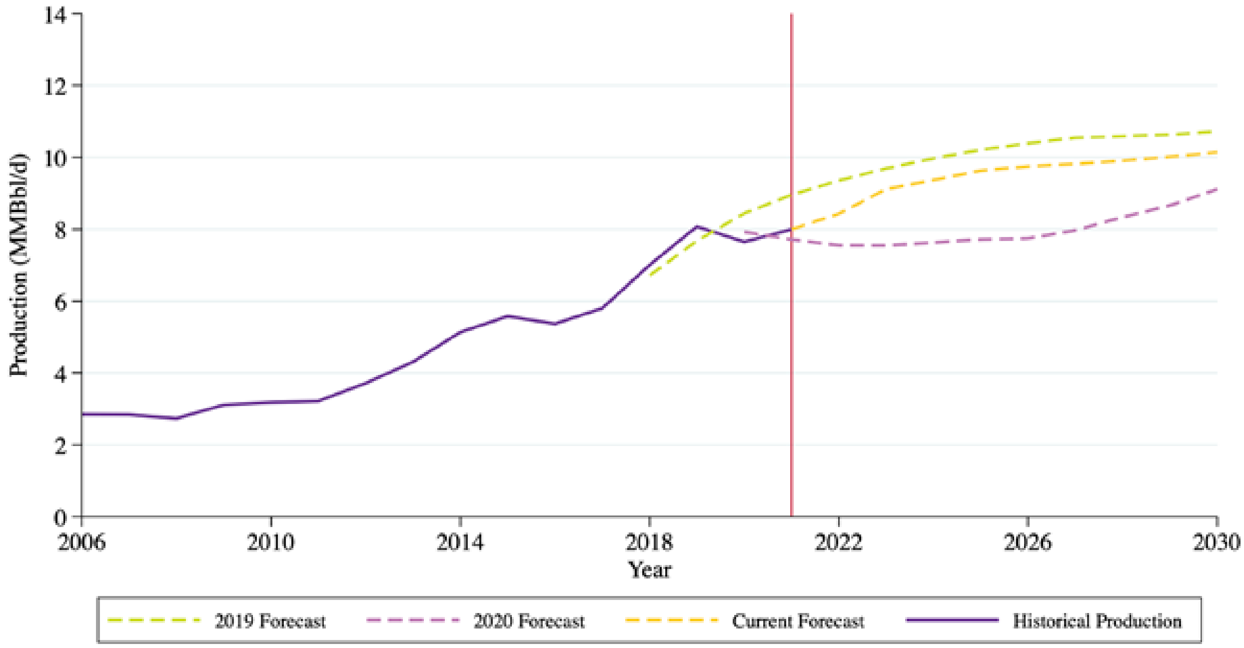
2.4 Outlook: Crude Oil and Natural Gas Production

Figure 9 and Figure 10 provide the 2022 GCEO crude oil and natural gas production forecasts for the Gulf Coast based on the Enverus ProdCast model. Both figures show the current forecast as well as those in the past two years' GCEOs.

Figure 9, provides the Gulf Coast crude oil production forecast, which is anticipated to increase over the forecast horizon.[11] Pre-pandemic 2020 regional crude oil production averaged 7.6 MMBBl/d. The GCEO forecasts that year-end 2021 crude oil production will average 8.0 MMBBl/d, just below the prior 2019 high. By 2030, the GCEO estimates regional crude oil production of 10.1 MMBBl/d. Interestingly, and impressively, this 2030 regional crude oil production forecast is at a level equal to that produced by the entire U.S. back in 2017. Thus, market prices and global demand will likely be the constraints that limit regional crude oil production over the next decade. Simply put, there is plenty of oil in the ground to sustain a decade of production growth.

[11] Note that the definition of the Gulf Coast region in the Enverus Prodcast model differs slightly from political boundaries, due to the inherent geological nature of the model. Thus, model outputs levels cannot be directly compared to Table 1 and Figure 4.

Figure 9: Gulf Coast oil production forecast

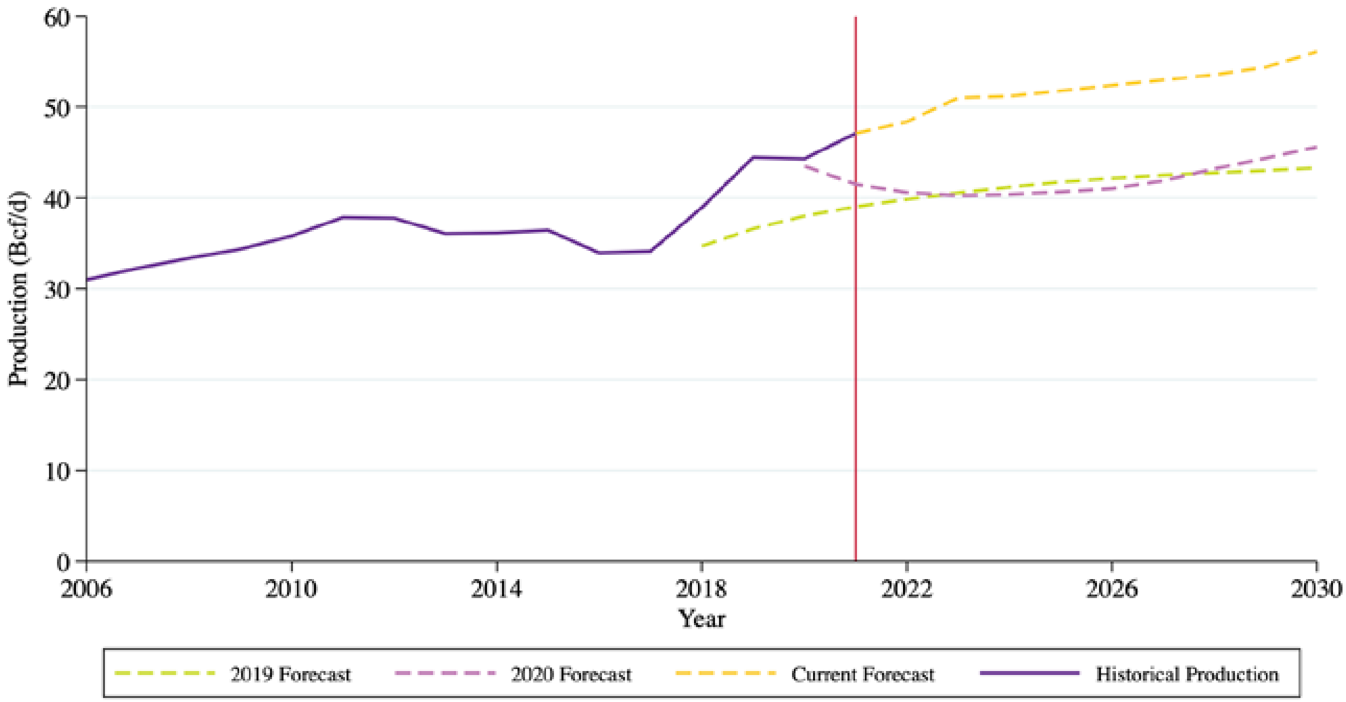


Source: Enverus ProdCast.

Figure 10 shows that Gulf Coast natural gas production is also anticipated to continue to grow over the next decade.[12] In 2020, Gulf Coast natural gas production was about 44.3 Bcf/d, and anticipated to increase to 45.7 Bcf/d, on average, in 2021. Remarkably, current natural gas production levels, if they continue at their current pace, will be approximately 3 percent ***above*** pre-pandemic 2020 natural gas production levels. This forecast outcome is even more interesting considering that last year's GCEO forecast flat Gulf Coast natural gas production until approximately 2025, at which point production would increase marginally. In fact, current year natural gas production is at levels higher than each of the annual natural gas production levels projected in the 2021 GCEO.

[12] Ibid.

Figure 10: Gulf Coast natural gas production forecast



Source: Enverus ProdCast.

3. Midstream Constraints and Pipeline Activity

Geographic differences in crude oil and natural gas prices often drives pipeline development. If prices at "Point A" are higher than "Point B" at a given time, firms have the incentive to develop transportation resources to capture this price differential (or "basis").

Figure 11 compares differences in prices of West Texas Intermediate (WTI) and Louisiana Light Sweet (LLS). Three vertical lines are drawn. The first vertical line marks pricing levels as of January 2007, the date at which the EIA began tracking crude oil and natural gas unconventional production in its *Drilling Productivity Report*. The second line marks pricing levels as of May 2012, when the Seaway pipeline was reversed. Seaway initially moved crude from Freeport, Texas, on the Gulf Coast, to Cushing, Oklahoma, where WTI is priced. After Seaway was reversed, the pipeline carried crude produced in the Mid-Continent to Gulf Coast refineries. This line divides a regime of increasing internal shipping constraints from a regime where those constraints were relieved. The third line marks pricing levels as of December 2015, when the U.S. government lifted the crude oil export ban.

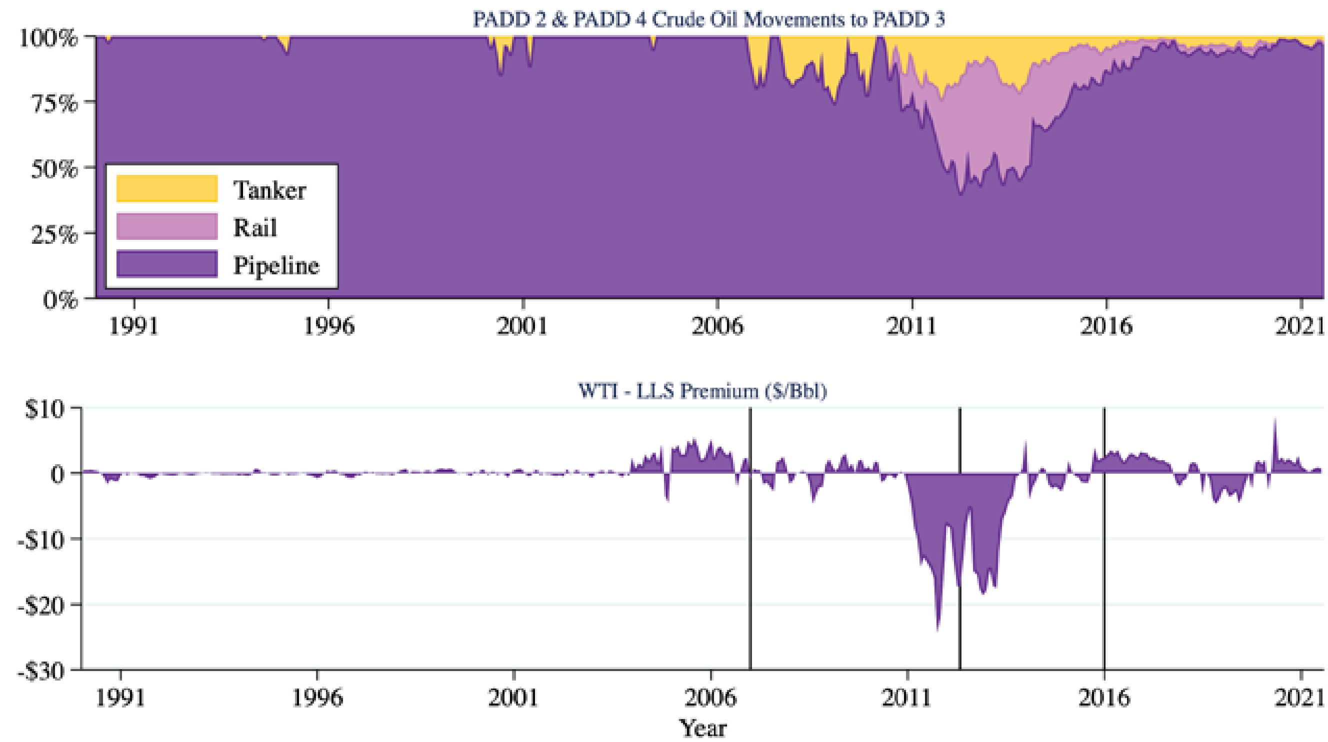
The top panel of Figure 11 shows the share of crude oil transported from PADD 2 to PADD 4 in the Mid-Continent (states in the Rocky Mountain and Midwestern regions) to PADD 3 on the Gulf Coast. From 1990 to 2007, almost all crude was transported from the mid-continent to the Gulf Coast via pipeline. Shippers used pipelines because rail and tankers were more expensive on the margin. During this time WTI and LLS moved in lockstep. In fact, by April 2012, more than half of the crude shipped from the mid-continent to the Gulf Coast went via high-cost barge and rail, as pipelines were at full capacity. Almost immediately after the reversal of the Seaway pipeline, this trend stopped, and the share of crude shipped via pipeline began to recover.

The LLS-WTI premium closely mirrors changes in the mode of transport over the 2007-to-2015 time period. This close correlation between shipping and prices can explain between half to three-quarters of relative price movements. Prior empirical research has investigated the degree to which refinery composition, captured by API crude oil gravity, can explain these differentials.[13] Evidence of shipping constraints, but not refining constraints, is observed.

This analysis provides strong evidence that shipping constraints between the Mid-Continent and Gulf Coast were the culprit for the price discount. The good news is that at the time of this writing, crude markets are approximately in balance, with a slight premium for LLS. The GCEO anticipates a small premium will persist over the forecast horizon and that more than 95 percent of crude shipped from the Mid-Continent to the Gulf Coast will continue to come from pipelines. Although oil production is anticipated to increase, due to the investment in pipeline infrastructure over the past decade, the need for increased barge and rail shipments is unlikely at this time. Thus, significant investment in crude oil pipelines is likely not needed at this time to continue moving crude from the Mid-Continent to the Gulf Coast region for refining and/or export.

[13] Agerton & Upton, 2019. Decomposing Crude Price Differentials: Domestic Shipping Constraints or the Crude Oil Export Ban? *The Energy Journal*, Vol. 40, No. 3.

Figure 11: PADD 3 crude oil movements by transportation type



Source: U.S. Energy Information Administration, West Texas Intermediate Spot Price and Light Louisiana Sweet First Purchase Price. Movements between PADD Districts, by pipeline, tanker and barge, and rail

Recent natural gas constraints over the past several years have been focused in differing areas. The relevant natural gas transportation constraint is not between the mid-continent and the Gulf Coast region (as has been the case for crude oil), but instead moving natural gas out of the Permian Basin to other consuming or export locations.[14] The Permian exhibits three specific transportation-oriented constraints. The first is characterized by limited in-field gathering system capabilities in some areas. The second is defined by limited natural gas processing, while the third includes the need for additional longer-haul transmission pipeline capacity to move natural gas out of the Permian to Gulf Coast markets.[15]

Collectively, these three constraints can lead to two outcomes: (1) wellhead flaring of natural gas and (2) inter-region natural gas pricing discounts, as seen in the Henry Hub/Waha pricing. Figure 12 illustrates both trends, focusing on the Permian basin and comparing Henry Hub and Waha natural gas prices. Pre-2018, these two hubs traded at very similar prices, with Henry Hub receiving a small premium, on average, due to its proximity to many large sources of natural gas demand. Also, flaring in the Permian basin was consistently less than 0.1 bcf/d; however, as Permian basin production ramped up, markets began to experience the emergence of significant Waha price discounts relative to Henry Hub. On some days, natural gas at Waha has traded at negative prices. These price

[14] Note that while there is natural gas flaring in the Bakken, natural gas volumes from that region are much less likely to end up in the Gulf Coast region, and therefore the focus will be on constraints coming from the Permian basin.

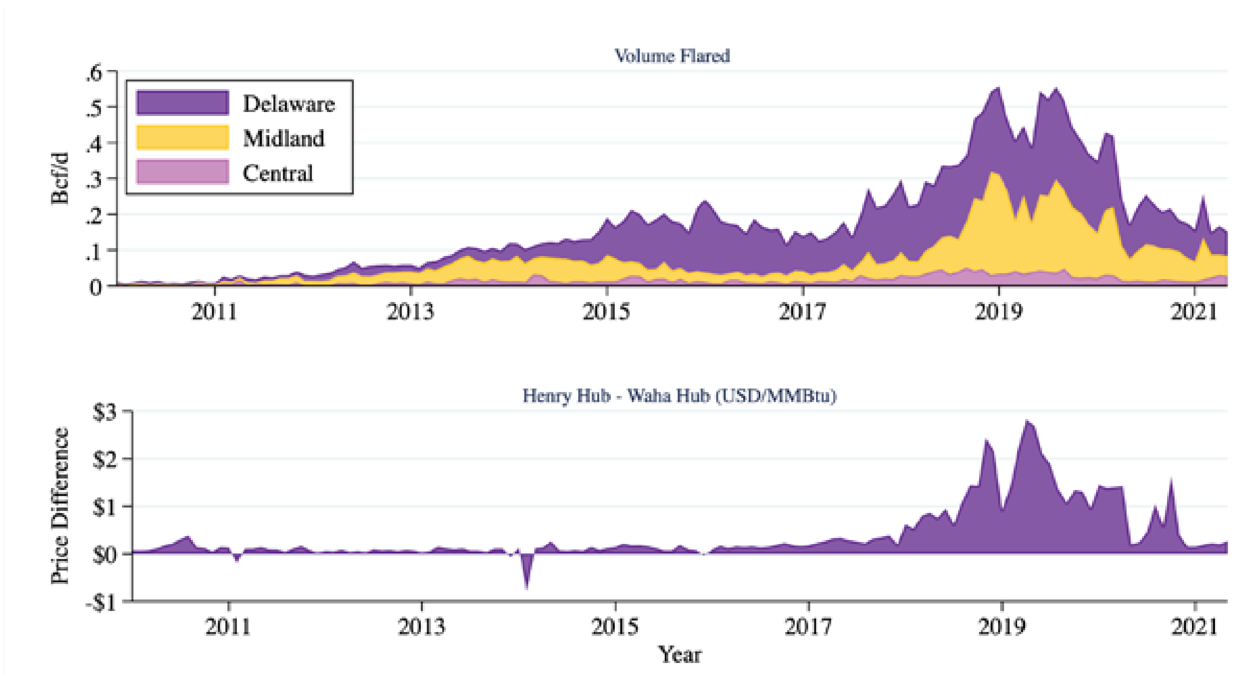
[15] For a detailed discussion of the value chain moving natural gas from wellhead to market, see recent research. Agerton, Gilbert & Upton, 2020. The Economics of Natural Gas Flaring in U.S. Shale: An Agenda for Research and Policy. Rice University's Baker Institute for Public Policy Working Paper. USAEE Working Paper No. 20-460.

discounts moved in lockstep with flaring in the Permian, and at its peak the Permian basin was flaring more than one-half billion cubic feet of natural gas per day.

Fortunately, both flaring and price differentials have been declining over the past few years. But at the time of this writing, still more than 150 million cubic feet of natural gas is being flared or vented in the Permian basin per day. According to EIA, in 2020, more than 417 Bcf of natural gas was flared or vented in the United States. This level of flaring, for perspective, represents about one percent of current U.S. natural gas production.[16] If the flared natural gas volumes were instead used to generate electricity, those volumes would have generated enough to power 7.2 million households for a year.[17] If this flared natural gas had gotten to market, it would have had a value of $1.65 billion dollars in 2020.[18] This represents an economic incentive to, instead of flaring, invest in pipeline capacity.

During the past two years, the GCEO has forecast that pipeline investments would alleviate much of this constraint, and that Waha prices would likely converge with Henry Hub. Interestingly, while prices have converged for the most part, with a price difference at less than 30 cents per Mcf, flaring levels have not dropped off as steeply over the past year. With increased oil and natural gas production forecasted from the Permian basin, it is therefore likely that additional natural gas gathering, processing, and transmission pipeline investment will continue as the global economy recovers. In fact, some energy analysts are anticipating that the Waha Hub natural gas prices may experience deep basis discounts over the next year.[19]

Figure 12: Henry Hub and Waha natural gas prices



Source: Texas Railroad Commission.

[16] Source: Natural Gas Gross Withdrawals and Production. Gross Withdrawals compared to Vented and Flared in Annual-Million Cubic Feet. Accessed Oct 2020.

[17] See Agerton, Gilbert & Upton (2020) for more discussion and calculations.

[18] Using a market price of $3 per MCF.

[19] E.g. RBN Energy, LLC. “Play It Again – Permian Natural Gas Markets Singing a Familiar Tune as Constraints Loom.” 10/25/2021.

The constraints discussed above have led to the current planning of approximately 40 Bcf/d of regional natural gas pipeline capacity expansions through 2024 (almost entirely in Texas).[20] These transmission pipeline projects, alongside continued investment in gathering and natural gas processing, should help to alleviate current incentives for Permian Basin flaring. But whether increased flaring and Waha basis discounts are exacerbated or relieved over this next year will be determined by the speed in which production comes back online relative to these infrastructural investments coming online.

Other things equal, the GCEO anticipates that some level of flaring and price discounts could persist in the long run if the capital cost of pipeline investments is considerably larger than the benefits of moving this flared natural gas to the market. Further, continued flaring could have negative implications for Gulf Coast LNG exporters who are increasingly attempting to quantify the life-cycle emissions of their products to market their exports as low carbon. This could also create challenges for electricity generators that are switching from coal to natural gas in hopes of reducing their system-wide carbon footprint. Thus, the implications flaring has for decarbonization should not be overlooked.

Lastly, changes in environmental regulations could significantly modify future flaring incentives. The EPA has recently announced its intention to conduct a rulemaking addressing a wide range of wellhead methane releases and flaring. The outcome of the rulemaking will likely also impact the degree to which pipeline development progresses.

[20] Source: U.S. Energy Information Administration. Natural Gas Pipeline Projects. Includes natural gas pipelines in the construction or planning phase.

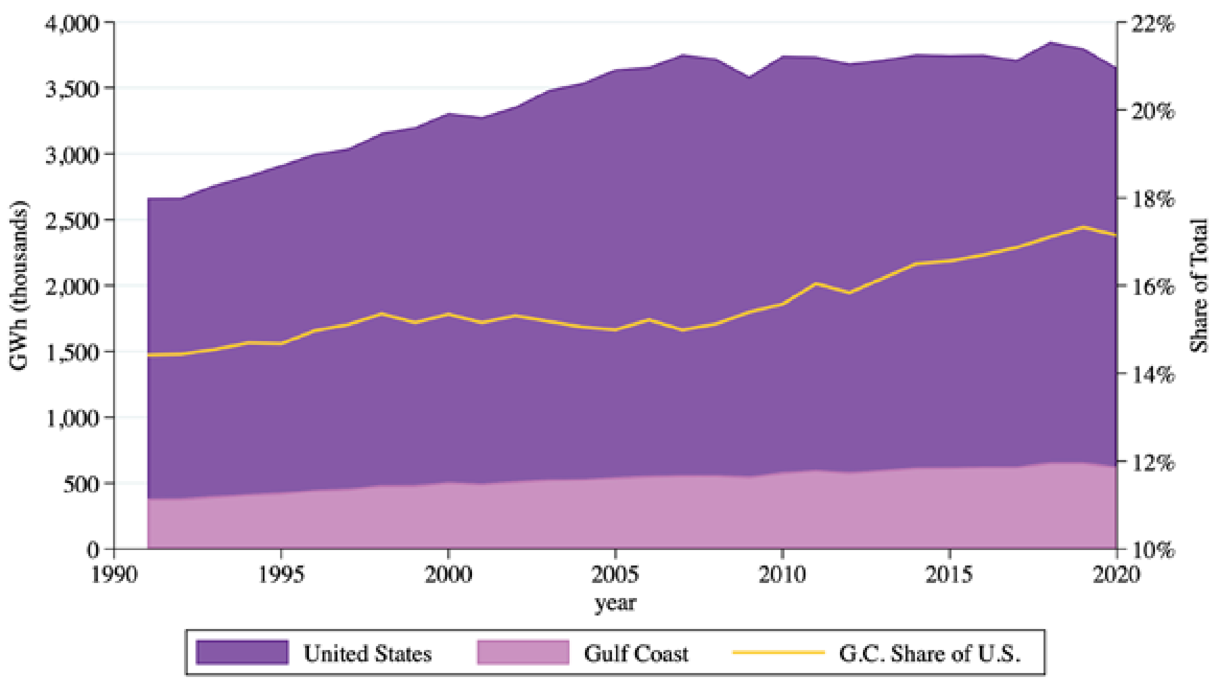
4. Power Sector

4.1 Recent Trends: Load Growth

Figure 13 shows a number of interesting trends in both U.S. and regional electricity sales. First, U.S. electricity sales growth has been relatively flat over the past decade. For instance, compare total sales in MWhs to all customers in the United States in 2007 (the highest load year before the Great Recession) to the most recent full year available (2020). In fact, current (2020) electricity sales are 2.6 percent lower than those reported in 2007 (the last highest annual sales level). The Gulf Coast, however, has seen differing trends with electricity sales increasing by 11 percent over this same time period. Gulf Coast retail electricity sales, as a share of total U.S. electricity sales, has increased from 15 percent to 17 percent over this time period.

Focusing on the most recent full year of data, 2020, which coincided with the pandemic, electricity demand is down by 3.9 percent nationally and 4.9 percent along the Gulf Coast. Thus, the Gulf Coast experienced a larger relative reduction in electricity sales relative to national averages; however, as will be discussed later, current regional electricity sales are now back to pre-pandemic levels.

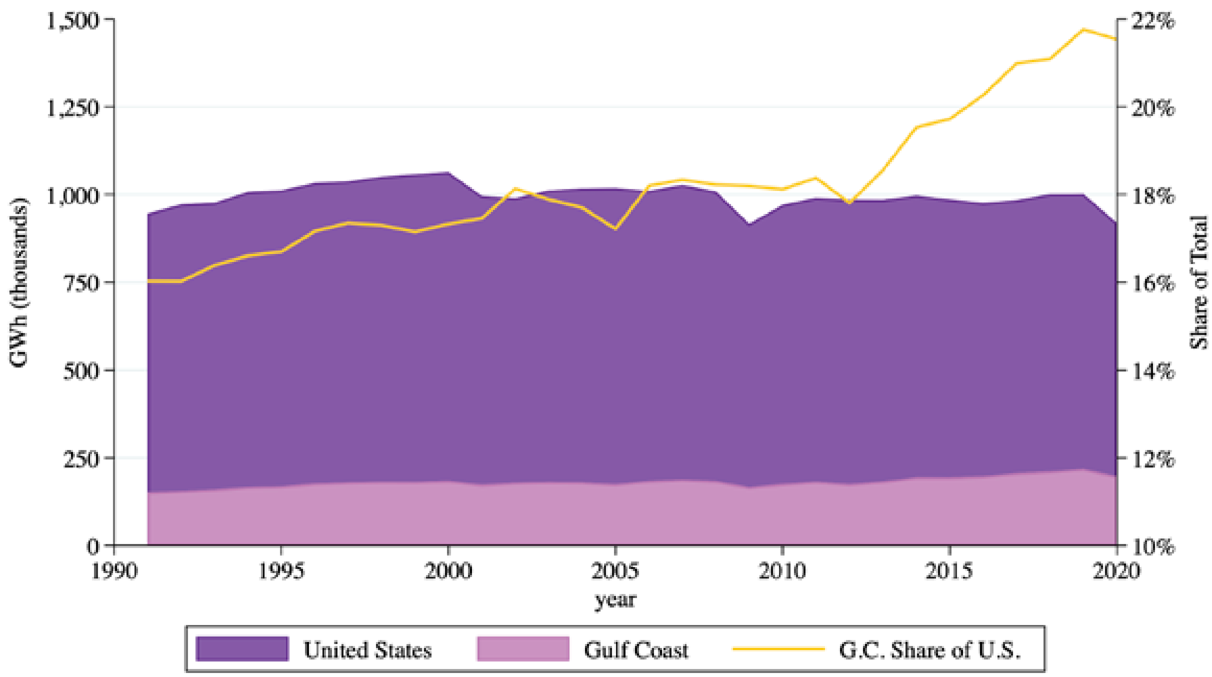
Figure 13: U.S. and Gulf Coast electricity sales



Source: U.S. Energy Information Administration. Retail sales of electricity to ultimate consumers.

Figure 14 focuses specifically on industrial electricity sales for both the U.S. and Gulf Coast region. U.S. industrial electricity sales are down by 11 percent over the 2007-to-2020 time period, while Gulf Coast industrial demand is up by five percent, increasing the region's relative share of total industrial electricity sales. These relative increases are largely the result of the rapid expansion of energy manufacturing along the Gulf Coast starting around 2008.

Figure 14: U.S. and Gulf Coast industrial electricity sales



Source: U.S. Energy Information Administration. Retail sales of electricity to ultimate consumers.

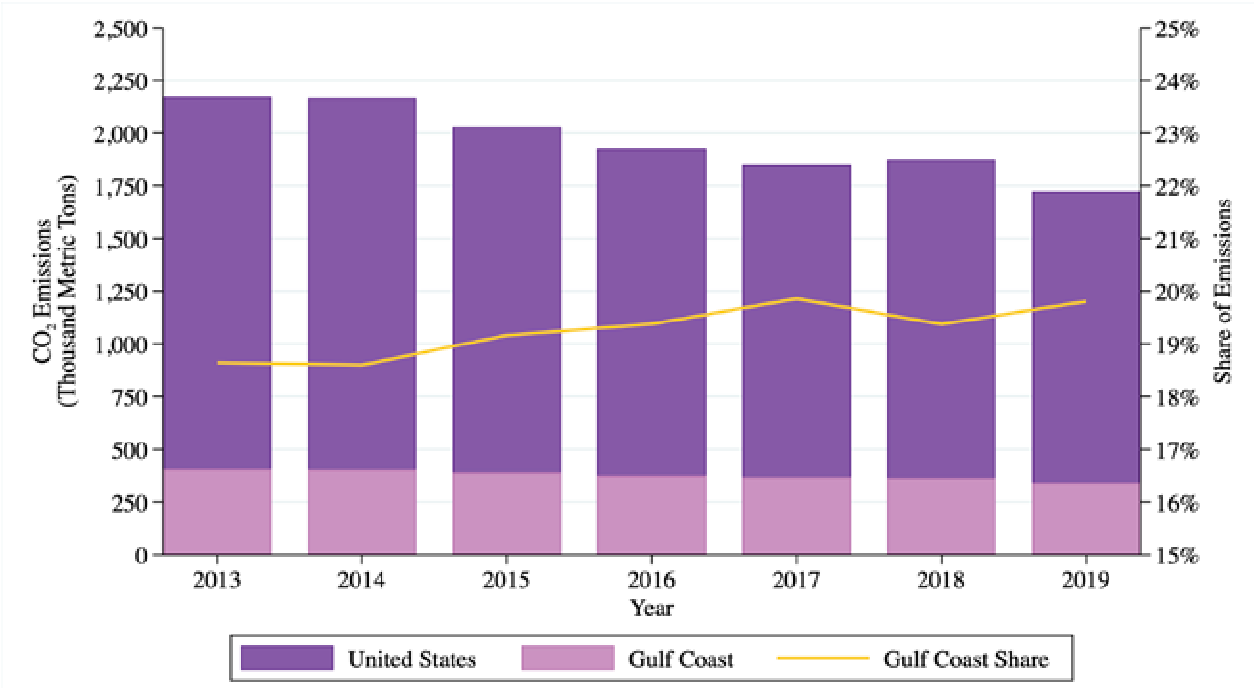
4.2 Recent Trends: Carbon Emissions

Greenhouse gas (GHG) emissions associated with power generation are provided in Figure 15. Since 2013, U.S. and Gulf Coast power generation related GHG emissions are down 20.7 percent and 15.8 percent, respectively.[21] These decreases are attributable, in part, to the development of a greater level of renewable energy, and, more importantly, considerable thermal efficiency gains by the region's utilities, particularly in Louisiana. These power generation related GHG emission trends are addressed in greater detail in CES' recent GHG inventory report.[22]

[21] Note that this only includes data to 2019, and thus emissions are likely significantly lower in 2020 due to the recession. Due to data lags, 2019 is the most recent year of data currently available.

[22] Dismukes, DE. *Louisiana 2021 Greenhouse Gas Inventory*. Prepared on behalf of the Governor's Office of Coastal Activities. October 2021. LSU Center for Energy Studies.

Figure 15: U.S. and Gulf Coast carbon dioxide emissions from electricity generation



Source: U.S. Energy Information Administration. Electricity. Emissions by plant and by region.

4.3 Outlook: Capacity Investment

Figure 16 shows historic and projected power generation capacity by fuel source for the Gulf Coast region. Projections are developed by S&P Global Market Intelligence.[23] Interestingly, over 45,000 MW of solar generating capacity is currently in the planning phase or under construction in the Gulf Coast region according to S&P. While not shown in this Figure, in MISO alone, Louisiana currently has over 6,000 MW of solar capacity in the interconnection queue. For perspective, solar capacity was less than 100 MW in the Gulf Coast region as recently as 2011.

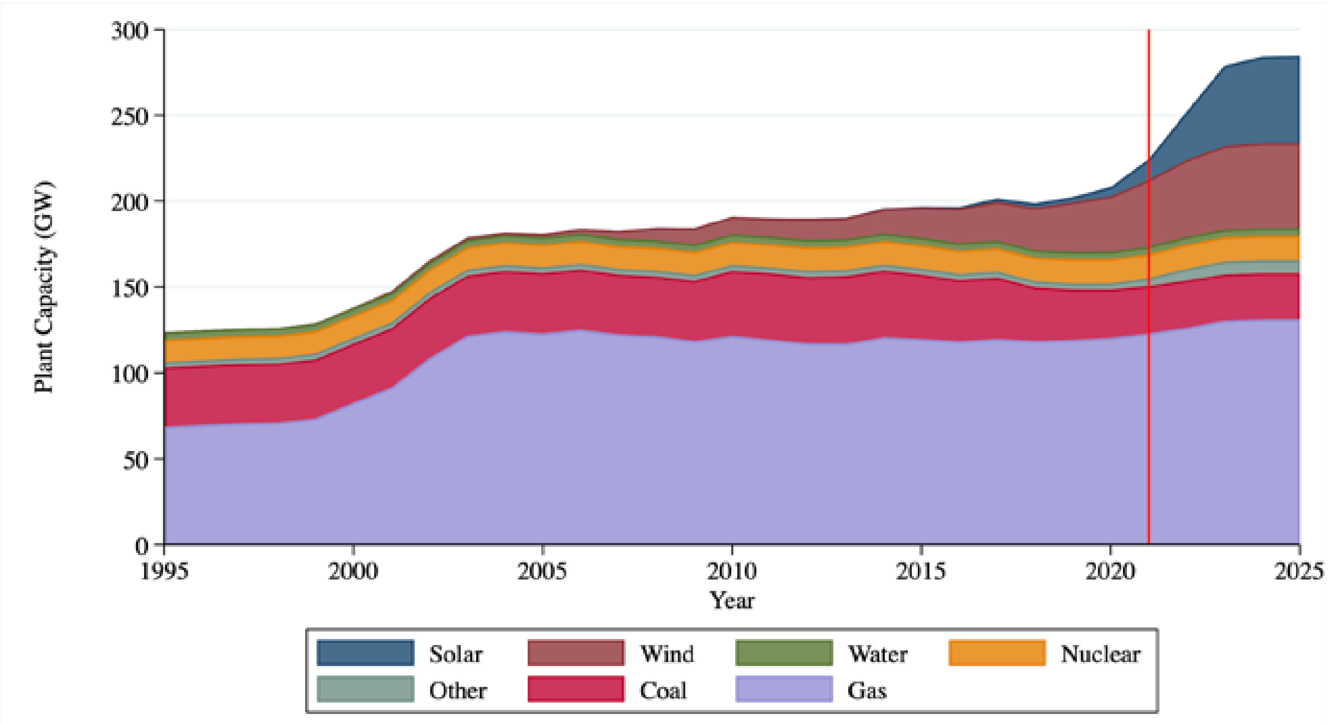
Figure 16, also shows as much as 17,000 MW of wind capacity in the planning phase. In third place, natural gas has approximately 11,000 MW of capacity currently being planned in the region.

Note that while solar capacity will likely experience significant growth, in 2020 solar PV nationally had a capacity factor of approximately 25 percent, compared to 35 percent for wind and 57 percent for combined-cycle natural gas.[24] Thus, although solar *capacity* might very well grow over the next five years or so, this is still anticipated to be a small share of total electricity *generated* for the fore-seeable future.

[23] Future capacity is based on actual planned and under construction projects, and not based on any projections of unreported new developments or retirements.

[24] U.S. Energy Information Administration. Electric Power Monthly. Table 6.07.B. Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels. Table 4.08.A. Capacity Factors for Utility Scale Generators Primarily Using Fossil Fuels.

Figure 16: Gulf Coast power generation capacity and outlook



Source: S&P Global Market Intelligence, Historical and Future Power Plant Capacity.

5. Energy Manufacturing Activity

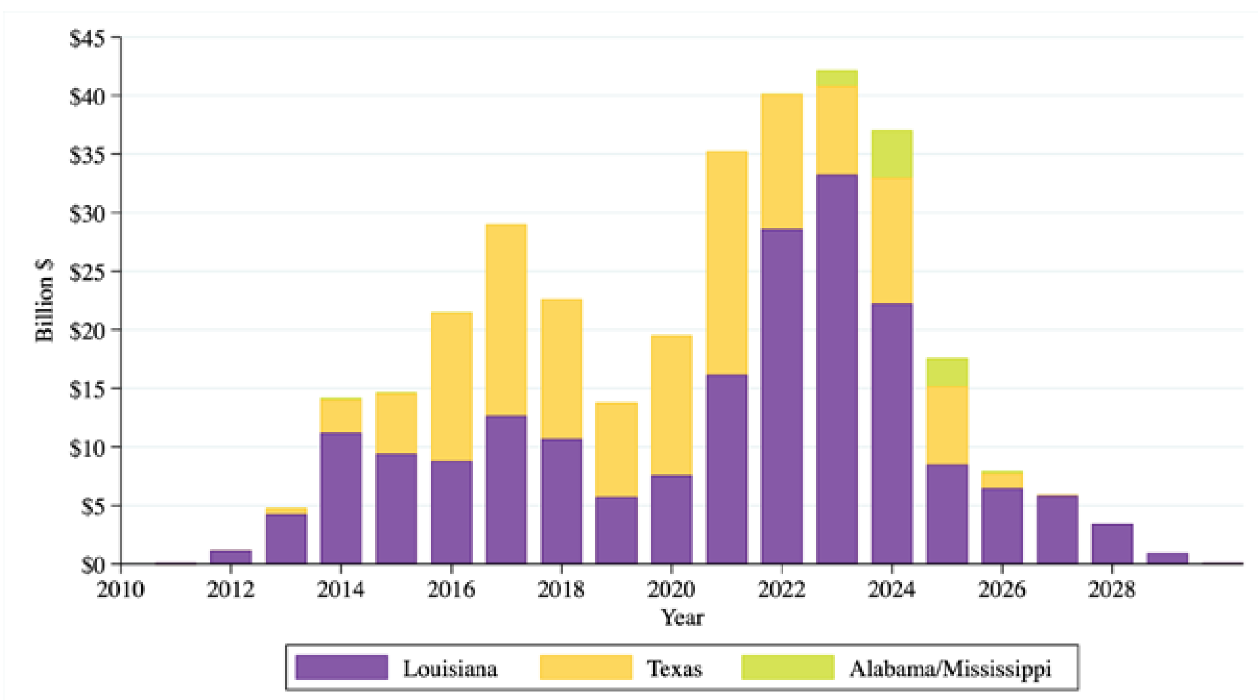
5.1 Energy Manufacturing Recent Trends

While the recent pandemic slowed regional industrial development, it has certainly not halted that development. In fact, regional capital investment continues to show resiliency despite the global economic slowdown. The Gulf Coast remains an important location for energy manufacturing given its proximity to low-cost and abundant hydrocarbon feedstocks and the ability to leverage a wide range of supporting energy infrastructure; however, an increasingly large part of this industrial development is dedicated to supporting energy exports, particularly liquefied natural gas (LNG).

Figure 17 updates a regular GCEO chart highlighting regional capital investment trends by Gulf Coast state. Since 2011, the Gulf Coast has supported over $141.5 billion in capital investments. These investments have been close to equally shared between Texas (49 percent) and Louisiana (50.5 percent), with much smaller shares allocated to Mississippi and Alabama (0.5 percent). Most of the historic investments have leaned towards traditional chemical sector activities (at $81.6 billion) with a smaller, yet significant amount in LNG (at $59.8 billion).

As anticipated in last year's GCEO, and despite the pandemic, 2021 represented a year in which a backlog of capital investments came on-line, reversing a 2018-to-2020 relative lull in capital investment activity. Investments in 2021 were strong relative to the prior two years, even though they were slightly off announced levels.

Figure 17: GOM energy manufacturing investments by state

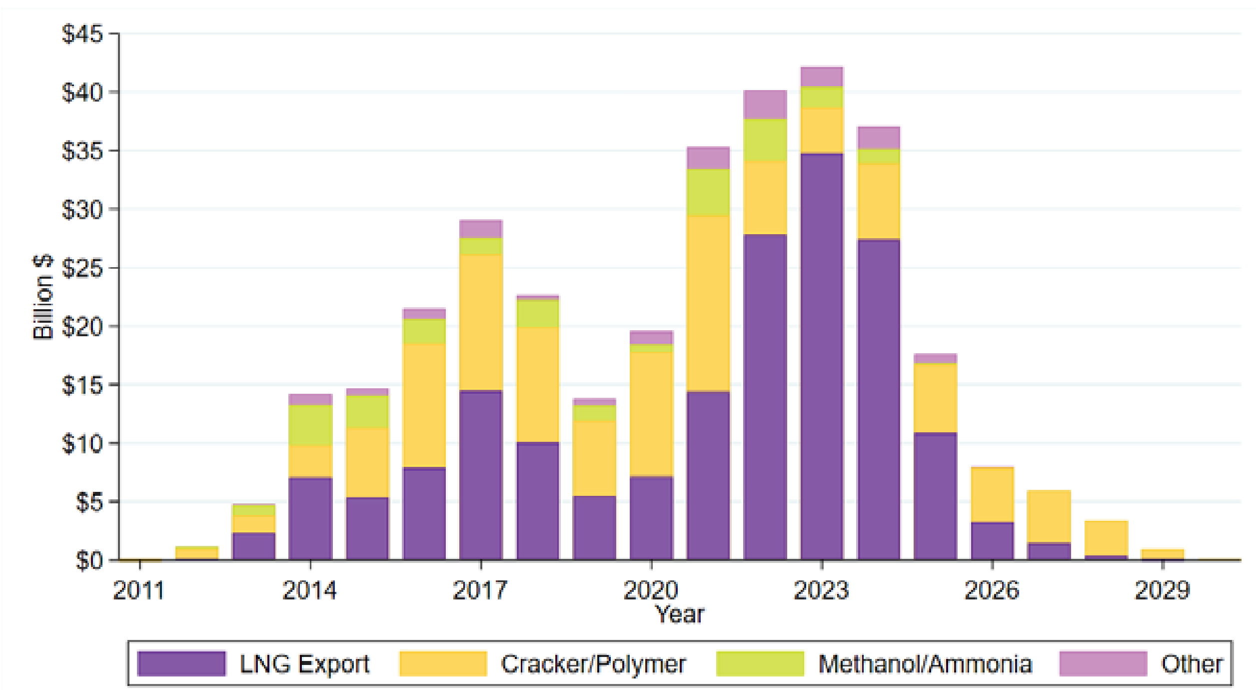


Source: Center for Energy Studies, authors' construct from publicly reported data.

Last year's GCEO noted $38.2 billion in new 2021 capital investment based on publicly available project announcements. The 2021 GCEO handicapped this publicly announced level down to $21.7 billion due to the uncertainty about the pandemic – about $16.5 billion below the publicly-announced 2021 level. Actual 2021 energy manufacturing investments, however, were more resilient than anticipated in last year's GCEO and reported in at $35.2 billion. Therefore, the bad news is that while actual investments were down by $3 billion relative to prior announced levels, those investments were considerably higher than last year's GCEO ($13.5 billion over forecast).

This past year's capital investments also reveal an important and gradual shifting of priorities across energy manufacturing investment types, as shown in Figure 18. Prior to 2021, there was a slight bias in favor of chemical industry investments (crackers, methanol, ag chemicals) relative to LNG export facilities. This past year, LNG investments began to dominate the data and are anticipated to continue to dominate investment trends in future years.

Figure 18: GOM energy manufacturing investments by sector



Source: Center for Energy Studies, authors' construct from publicly reported data.

5.2 Energy Manufacturing Outlook

The 2022 GCEO estimates as much as $190 billion in capital development up to 2029. The relative shift in potential capital investments away from chemical industry activities, and towards LNG export facilities is expected to continue into the near future (see Table 2). Total LNG related investments, for the region, are anticipated to surge to $120 billion, whereas non-LNG investments (mostly chemical-related) are anticipated to grow by $70 billion across the entire region.

Table 2: Total projected GOM energy manufacturing investment

Year	Texas		Louisiana		Other GOM		Total GOM	
	LNG	Non-LNG	LNG	Non-LNG	LNG	Non-LNG	LNG	Non-LNG
	(million $)							
2021	4,221	14,864	10,165	6,014	-	-	14,386	20,878
2022	5,529	6,004	22,245	6,343	33	-	27,806	12,347
2023	5,241	2,334	28,198	5,072	1,321	-	34,760	7,406
2024	7,142	3,614	16,198	6,049	4,038	-	27,378	9,663
2025	3,825	2,870	4,659	3,844	2,394	-	10,878	6,714
2026	336	936	2,719	3,754	213	0	3,268	4,690
2027	-	68	1,450	4,399	-	0	1,450	4,467
2028	-	-	412	3,015	-	-	412	3,015
2029	-	-	29	923	-	-	29	923
2030	$-	$-	$-	$66	$-	$-	$-	$66
Total	**$26,294**	**$30,691**	**$86,073**	**$39,412**	**$8,000**	**$0**	**$120,368**	**$70,103**

Louisiana leads the region in total energy manufacturing capital investment potentials with as much as $125.6 billion by 2029. Most of these announced energy manufacturing investments are allocated to LNG export facilities ($86.1 billion). A smaller yet significant level of investment is associated with the chemical sector ($39.4 billion). Equally important, and as discussed earlier, is the fact that a growing number of these investments will be dedicated to industrial decarbonization activities such as blue ammonia, blue hydrogen, and other biofuels.

Texas holds a distant second place to Louisiana in projected energy manufacturing investment announcements. The 2022 GCEO estimates as much as $57 billion in new Texas energy manufacturing investments with a close to even distribution between LNG-export related investments ($26.3 billion) and new chemical/refining related investments ($30.7 billion).

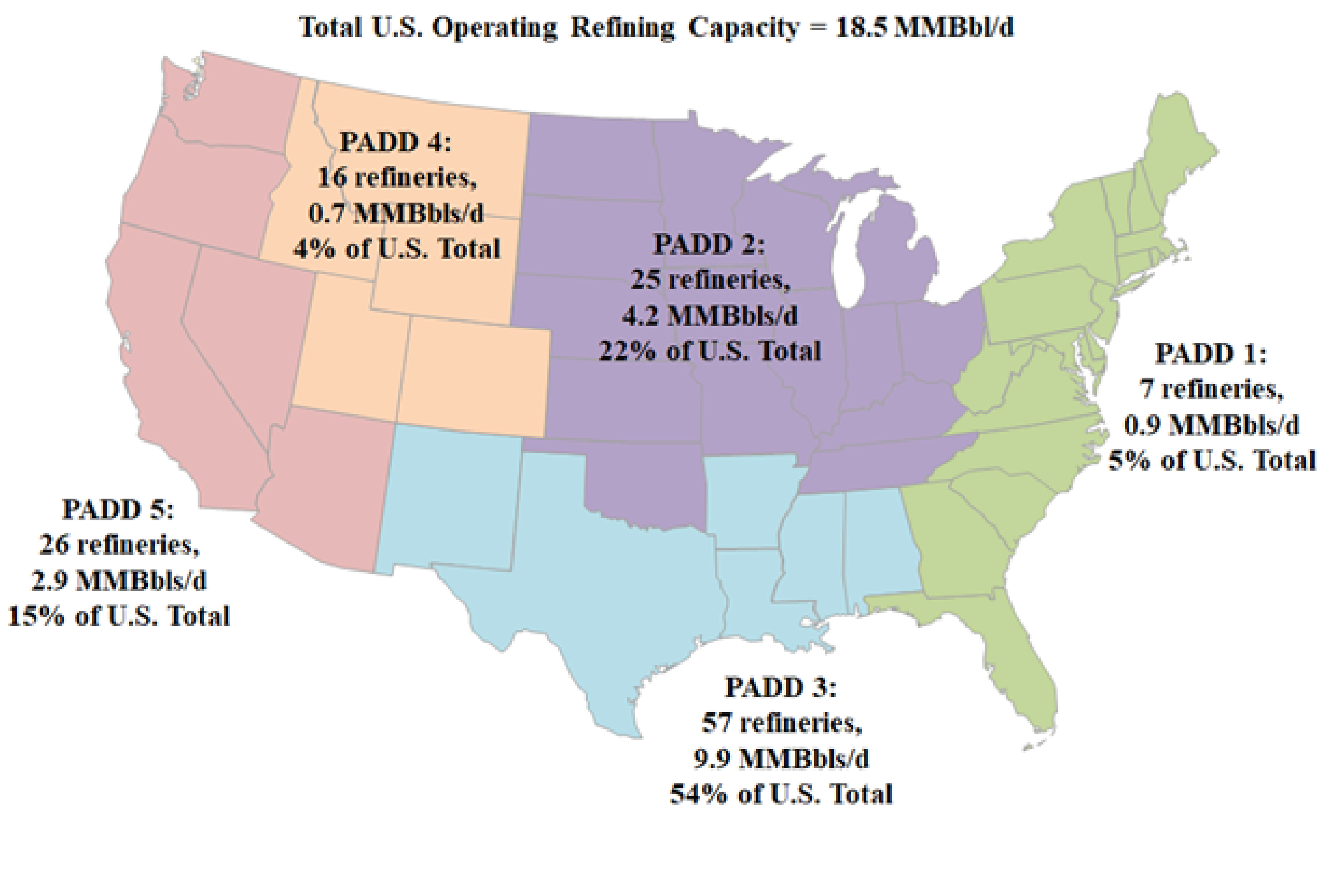
There is also about $8 billion in LNG related investments announced for the Mississippi and Alabama region.

6. Energy Exports

6.1 Recent Trends: Refined Product Exports

The Gulf Coast has the largest refinery capacity in the U.S. As shown in Figure 19, the region accounts for 54 percent of all refining capacity and is interconnected into a variety of input and refined product pipelines. In addition, these refineries are integrated either directly or indirectly with various hydrocarbon pipelines (such as liquefied petroleum gas or LPG) that move these commodities to chemical plants, where they are converted into a number of intermediate commodity chemicals that, in turn, are shipped around the world. Hence, the refineries in the Gulf Coast region are some of the most efficient and profitable in the U.S. and in some instances around the world. Unfortunately, this region has increasingly been subject to a number of significant weather-related events over the past two years.

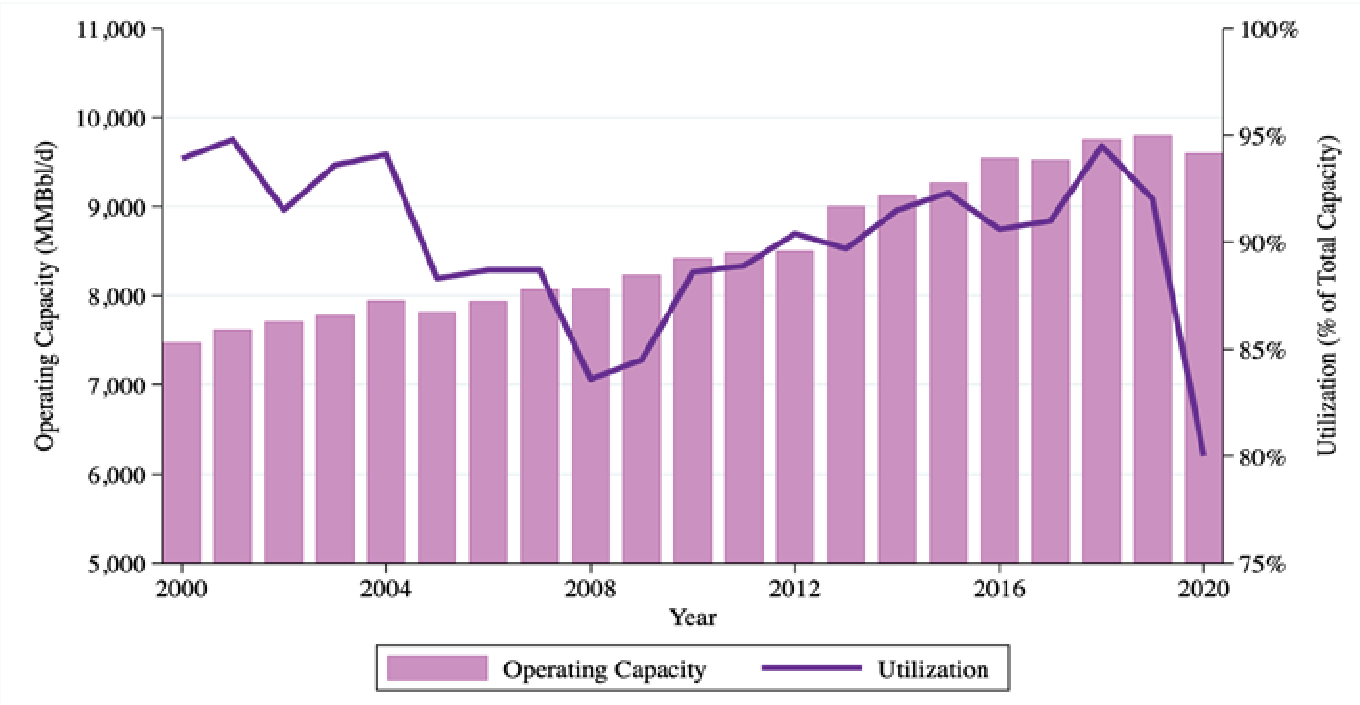
Figure 19: Number and capacity of U.S. refineries



Source: U.S. Energy Information Administration. Authors' calculations from Form EIA-820.

The last year has been particularly hard on U.S. refineries, including those located along the Gulf Coast. Figure 20 provides the annual refinery capacity and utilization trends that underscore the devastating impact of the pandemic on the region's refineries. Overall utilization has plummeted to recent percentage lows (on an annualized basis).

Figure 20: PADD 3 annual refining capacity and utilization



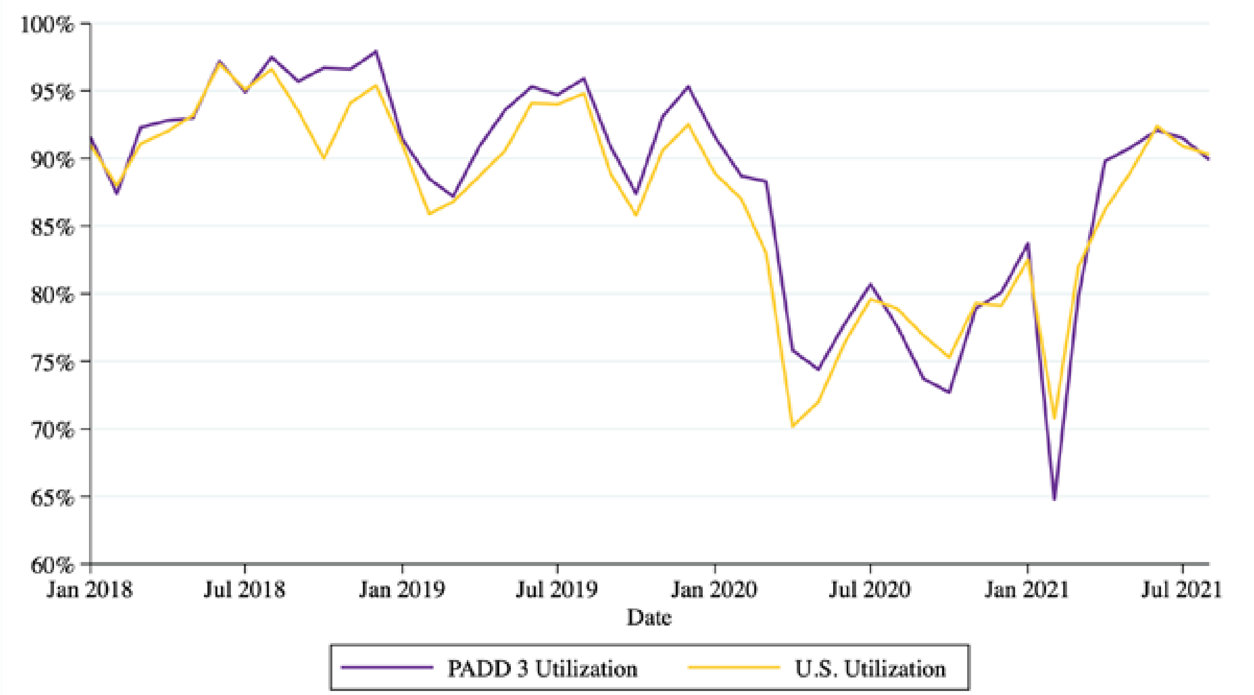
Source: U.S. Energy Information Administration. Petroleum & Other Liquids. Refinery Utilization and Capacity.

Annual numbers, however, conceal some of the more recent and important trends facing the region's refineries. Figure 21 provides the monthly trends in utilization. As noted in last year's GCEO, 2019 was a "down" year in utilization given a slowdown in Asian economies and the U.S.-Sino trade imbroglio. The onset of the 2020 pandemic tanked the refining industry early in the year.

By mid-year (July 2020) a relative recovery was underway, as refinery utilization bottomed out and actually started to rise. Then, in late summer 2020, Hurricane Laura slammed East Texas and the Lake Charles region of Louisiana. A large number of PADD 3 refineries were negatively impacted by this event; however, by year end, and as the new year emerged, a second refinery sector recovery was well underway.

February brought about an unusual new weather event, Winter Storm Uri, and with it, a tremendous amount of destruction in the refinery sector, particularly in Texas. Refinery activity rebounded throughout 2021 until the summer, when Hurricane Ida delivered a second regional blow. However, a new recovery in the refinery sector is underway, and it seems likely that utilization will hover around levels comparable to those experienced before the pandemic.

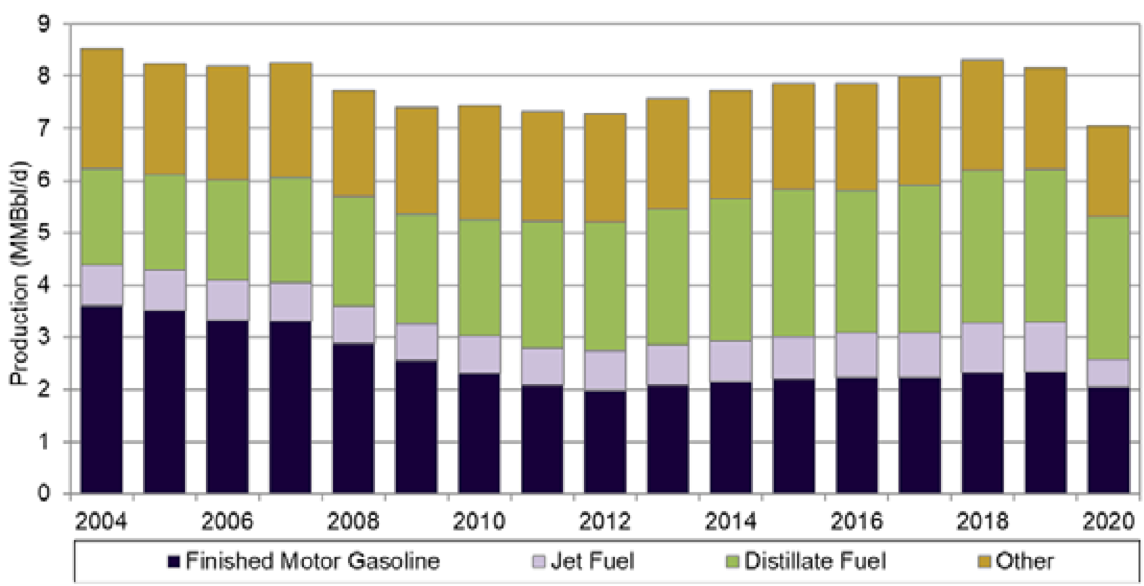
Figure 21: U.S. and PADD 3 monthly refining utilization



Source: U.S. Energy Information Administration. Petroleum & Other Liquids. Refinery Utilization and Capacity.

Refined product slates have also been impacted by the pandemic and the series of weather-related events that have rocked the Gulf Coast. Figure 22 charts annual refined product production trends that show a noticeable decrease in 2020, the year of the pandemic. The chart also underscores the continued regional trend, noted in last year's GCEO, toward increasing shares of middle distillates and other higher-end liquid fuel relative to finished gasoline.

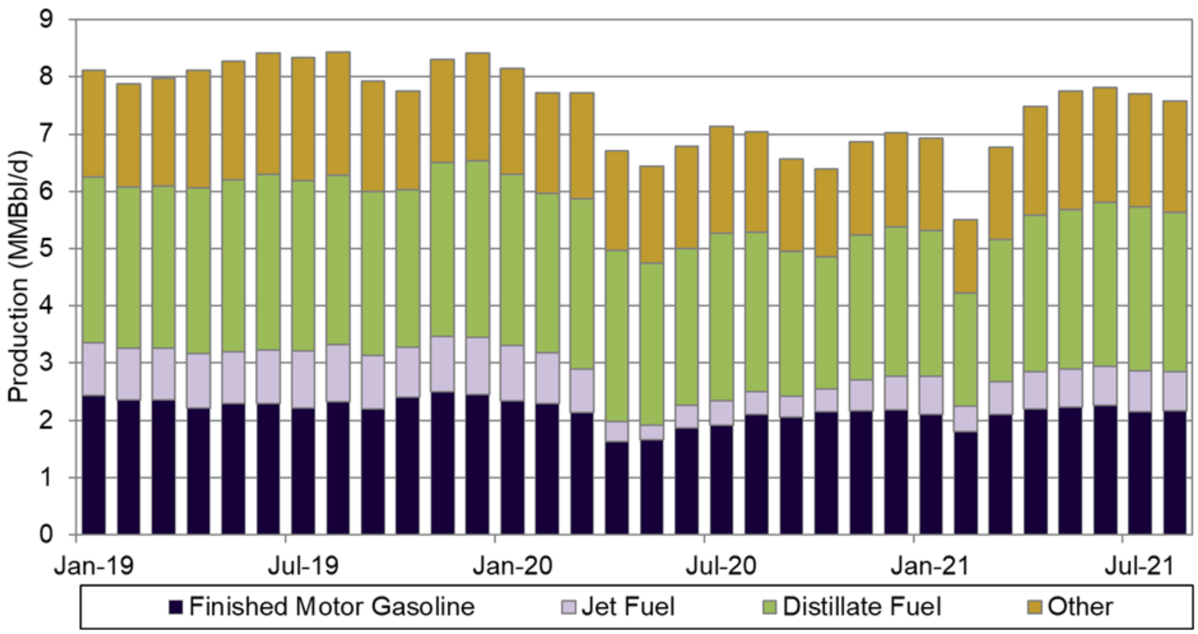
Figure 22: PADD 3 annual petroleum product supplied



Source: U.S. Energy Information Administration. Petroleum & Other Liquids. PADD 3 Refinery & Blender Net Production.

Annual trends, however, conceal a number of significant seasonal events (shown in Figure 23) that have had dramatic impacts on the region's refining infrastructure. First, as noted earlier, the pandemic reduced overall refined product production from a monthly average of around 8 MMBbl/d to below 7 MMBbl/d in mid-2020. Second, by the end of 2020, and into early 2021, a recovery across all refinery production was underway, particularly in distillates. Finished motor gasoline, however, continued to lag as commuting patterns and other passenger vehicle movements changed due to the pandemic. Third, weather rocked refining output in the late summer of 2020 (Laura), the winter of 2021 (Uri), and in the summer of 2021 (Ida). Despite the disruptions, the relative allocation of product remained relatively the same, heavily biased towards distillates.

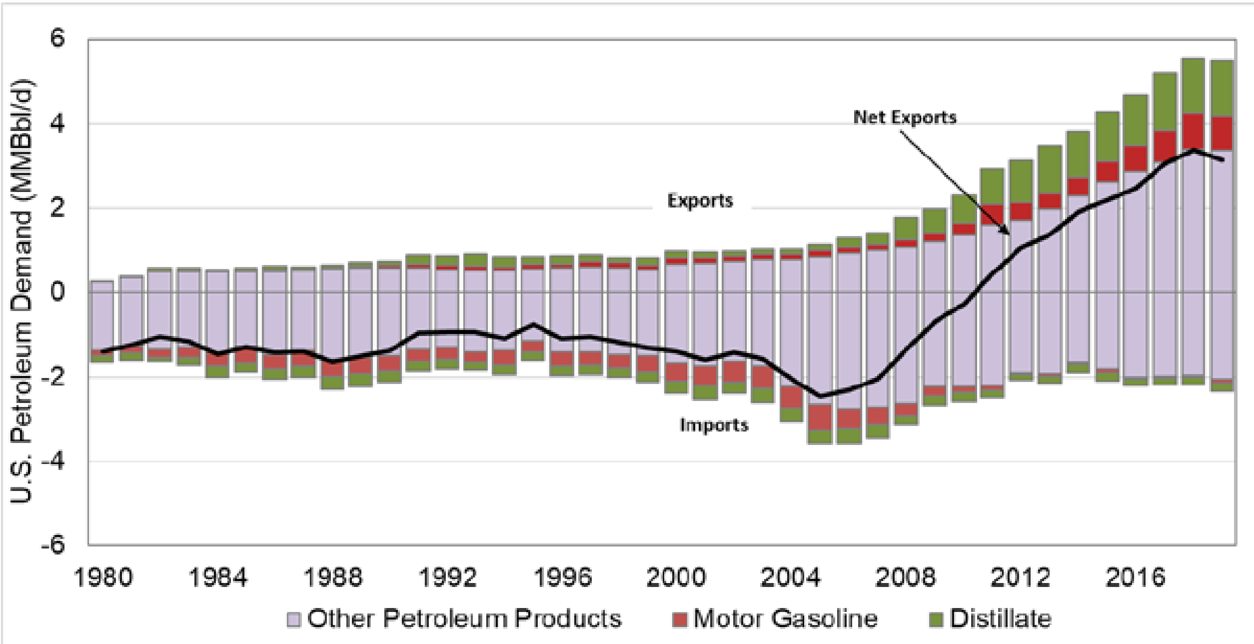
Figure 23: PADD 3 monthly petroleum product supplied



Source: U.S. Energy Information Administration. Petroleum & Other Liquids. PADD 3 Refinery & Blender Net Production.

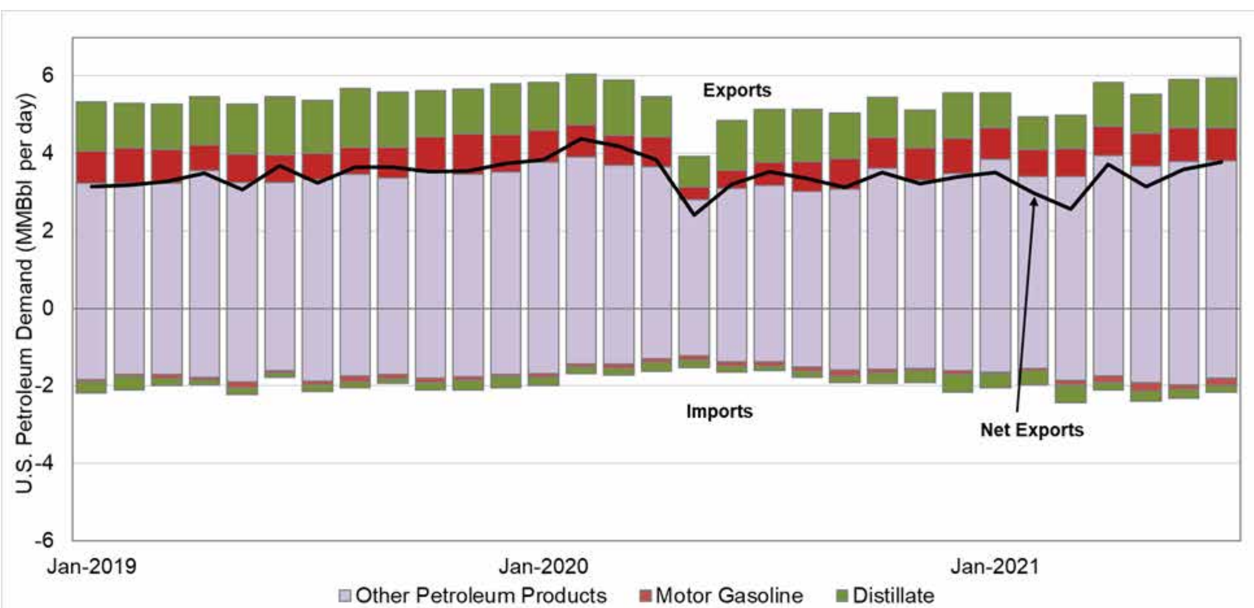
The Gulf Coast continues to see growth in refined product exports, mostly attributable to growth in middle distillates and other petroleum products. Figure 24, shows that U.S. refined product exports have been growing rapidly since the U.S. became net exporter in the 2011-2012 time period. These trends continued through the end of the decade but started to slow prior to the pandemic given earlier-discussed U.S. trade disputes with China. Monthly trends are provided in Figure 25 and show many of the same pandemic and weather-related shocks discussed earlier.

Figure 24: U.S. annual petroleum product imports and exports



Source: U.S. Energy Information Administration. Petroleum & Other Liquids. U.S. Imports and Exports of Crude Oil and Petroleum Products

Figure 25: U.S. monthly petroleum product imports and exports

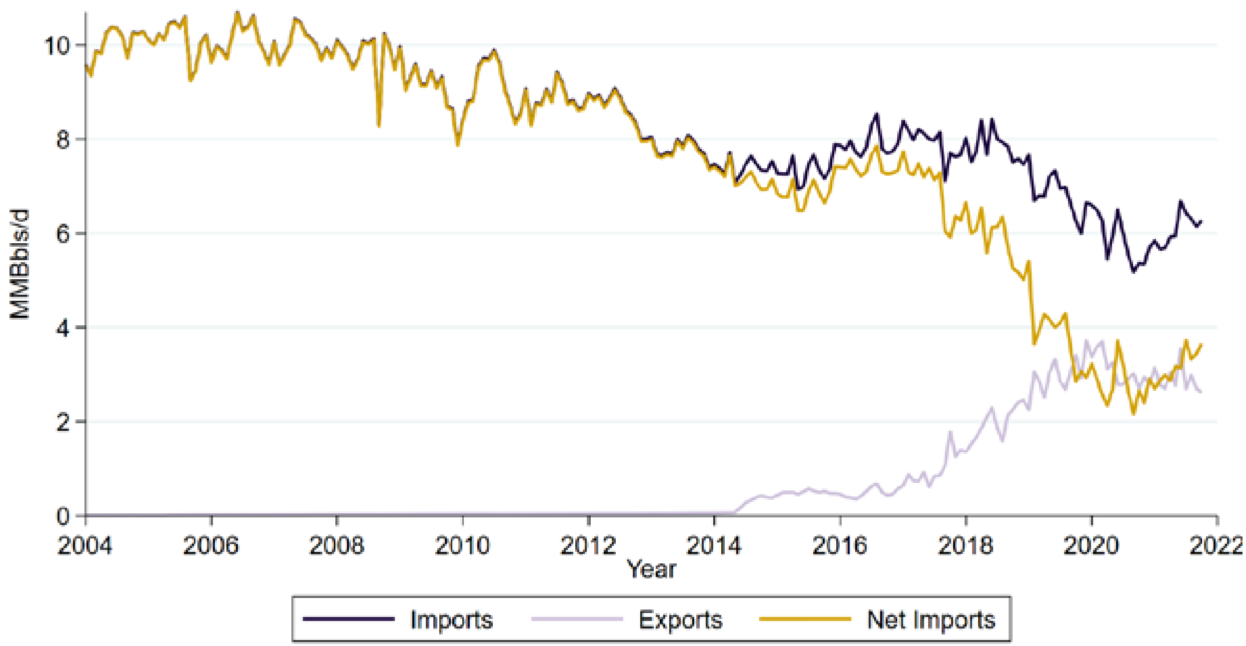


Source: U.S. Energy Information Administration. Petroleum & Other Liquids. U.S. Imports and Exports of Crude Oil and Petroleum Products

6.2 Recent Trends: Crude Oil Exports

The end of the oil export ban in 2015 created opportunities to expand regional energy exports. Over the past several years, close to 85 percent of all crude oil exports have departed Gulf Coast ports. Prior GCEOs have noted the considerable economic opportunities these energy exports create for the region. Prior to the pandemic, crude oil exports were anticipated to provide a continued growth opportunity for several coastal areas in Louisiana and Texas. The pandemic, however, reversed what was a growing trend of crude oil exports.

Figure 26: U.S. crude oil exports and imports



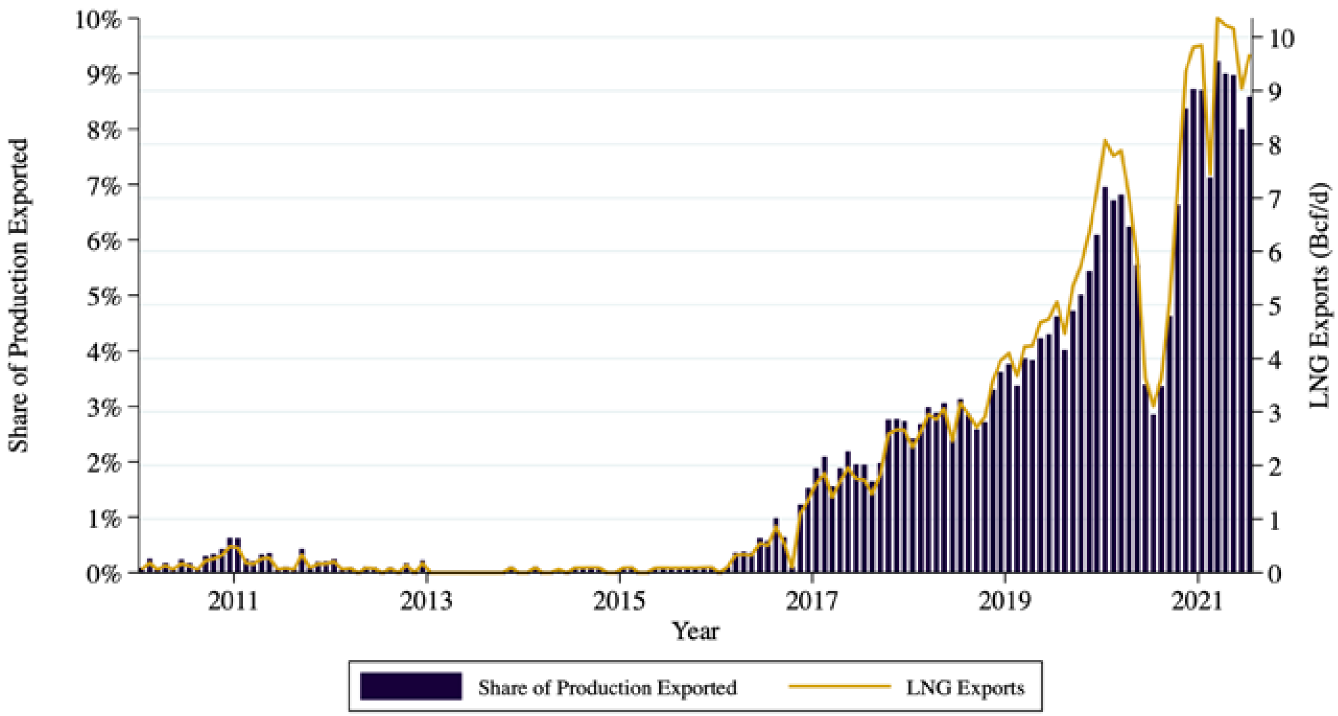
Source: U.S. Energy Information Administration. Petroleum & Other Liquids. U.S. Imports and Exports of Crude Oil

Figure 26 shows the rapid pre-pandemic growth in U.S. crude oil export volumes. The 2021 GCEO anticipated that these trends would continue into 2022 and beyond; however, the decrease in domestic crude oil production discussed earlier, and slow oil field recovery, has pumped the brakes on the opportunities for crude oil exports. While crude oil exports are still considerable, at over 2 MMBBl/d, they have been falling, not growing, since mid-year 2020. Likewise, while net imports (exports minus imports) have been growing, not contracting since mid-2020 and are now at their highest level in two years (over 3 MMBBl/d).

6.3 Recent Trends: LNG Exports

Natural gas represents a considerable growth opportunity for Gulf Coast energy exports and, unlike crude oil, continues to see relatively positive movement. Figure 27 charts recent monthly U.S. LNG export cargoes, most of which leave a Gulf Coast port. While exports did contract during the pandemic, they quickly rebounded as world energy supplies became challenged during the post-pandemic recovery period. Today, LNG exports are growing at much higher-than-average levels due in large part to Chinese energy demand.

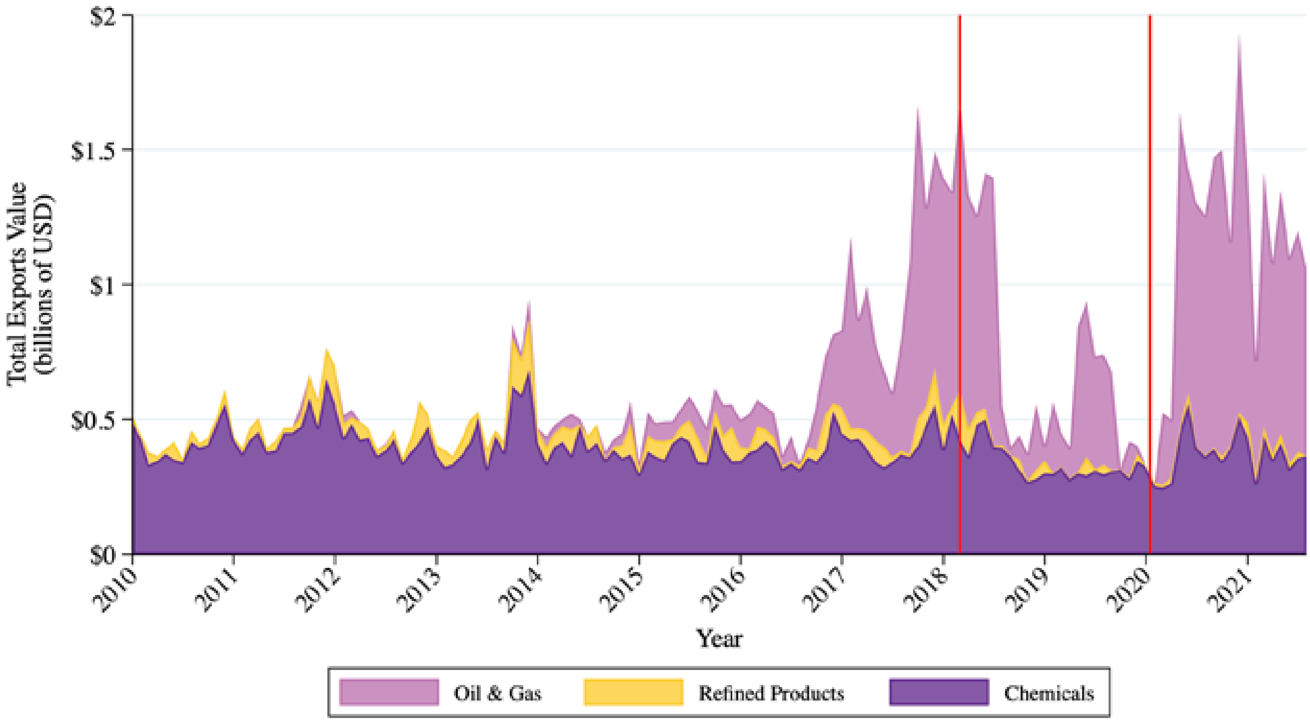
Figure 27: U.S. liquified natural gas exports



Source: U.S. Energy Information Administration.

Demand growth in China cannot be emphasized enough. Figure 28 underscores these trends. While chemical and refined product exports are relatively comparable to pre-pandemic levels, the growth in oil and natural gas exports, which includes LNG, has been considerable since the pandemic. The current run-up, while as large as the one in 2018, is much more sustained and likely to remain this way into the near future.

Figure 28: Gulf Coast energy exports to China

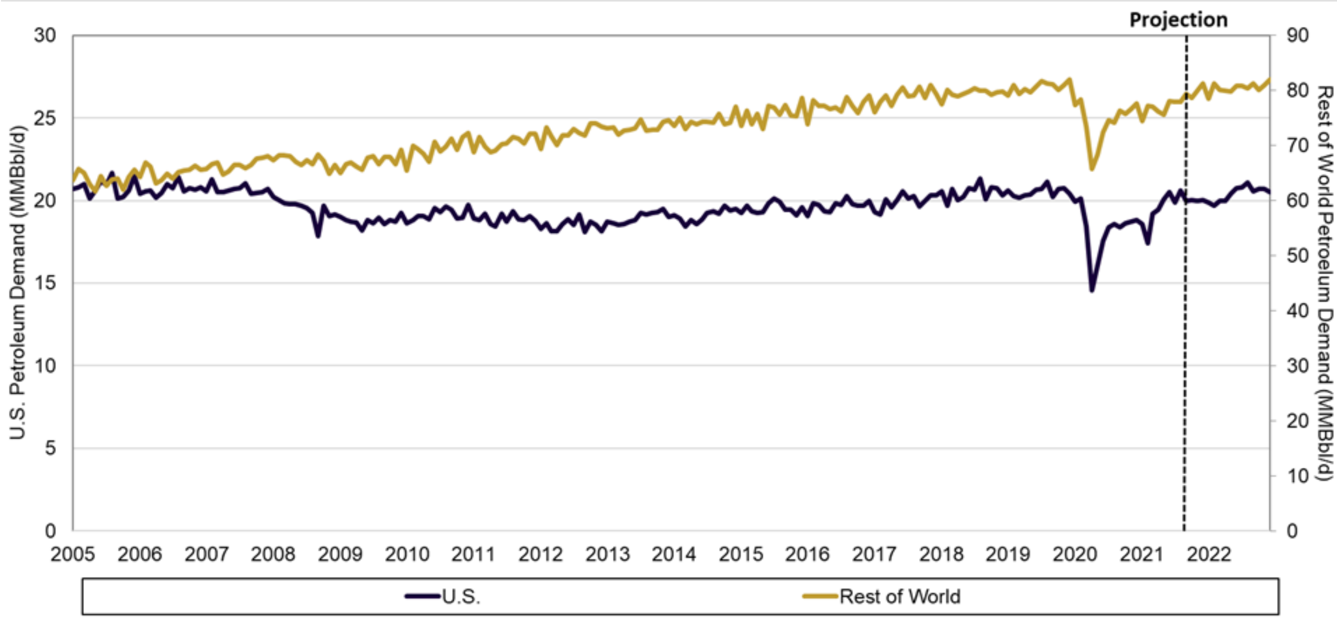


Source: U.S. Census Bureau. Economic Indicators Division. USA Trade Online.

6.4 Outlook: Refined Product Exports

The refined product outlook for the Gulf Coast is positive, although the levels associated with both domestic and global liquid fuels demand are not likely to return to pre-pandemic levels soon. The EIA, for instance, anticipates that domestic petroleum demand will hover around 20 MMBbl/d in 2022, and only grow slightly through 2025 (see Figure 29). Likewise, the EIA anticipates that global petroleum demand will grow to around 25 MMBBl/d, a level comparable to pre-pandemic levels, but level-off at original pre-pandemic trajectories.

Figure 29: Domestic and world petroleum demand outlook



Source: U.S. Energy Information Administration. Short-Term Energy Outlook, October 2021.

The 2022 GCEO anticipates a number of headwinds that will likely temper global and domestic liquid demand forecasts as provided by the EIA. First, environmental pressures both domestically and globally will continue to favor fuel substitution, particularly electrification, in the transportation sector. This will be particularly true in developed countries and increasingly the case in the developing world. Second, it is likely that Asian demand, particularly demand in China, will be tempered as overall economic growth slows due to new domestic priorities.

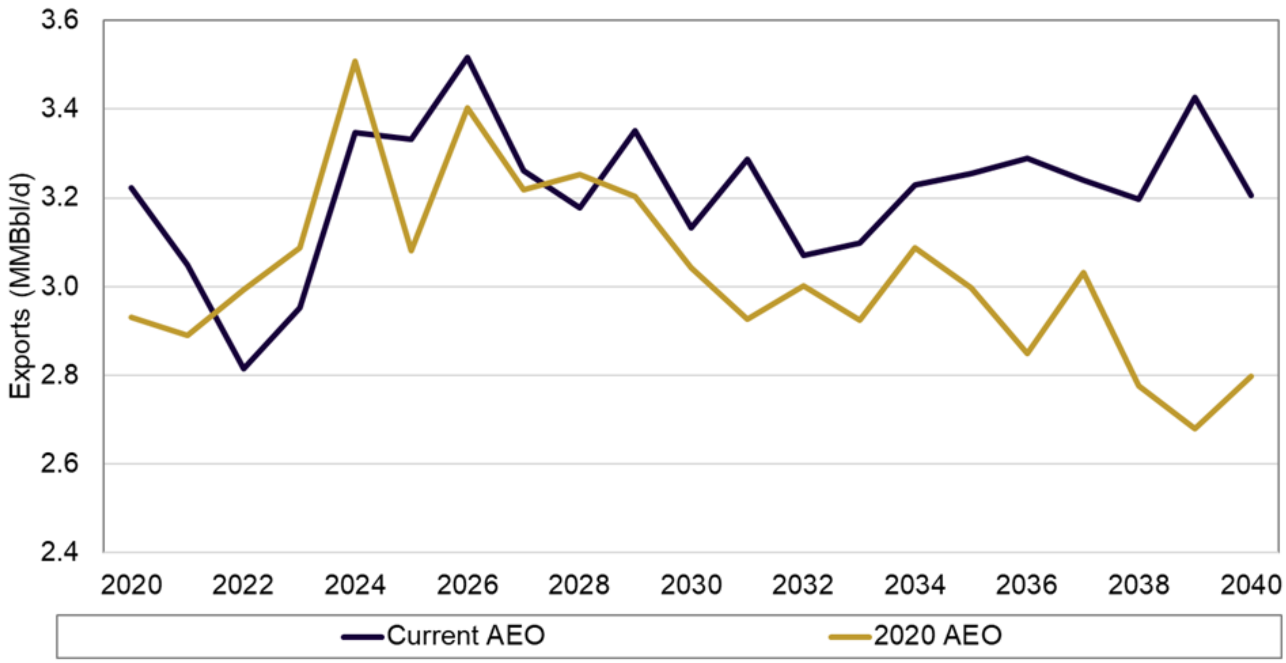
For instance, it is anticipated that Chinese GDP will grow at less than recent trends, around eight percent annually. This reduced economic growth will reduce fuel demand. Further, the impacts of the pandemic continue, primarily due to new variants, that prevent a complete and full return to normal. These ongoing and continued pandemic threats will lead to both cyclical and structural changes in petroleum demand.

Cyclical changes include reduced transportation fuel demand because of variant-induced reductions in economic activity much like that seen over the latter half of 2021. Structural changes will be those associated with changing transportation patterns and preferences influenced by the pandemic.

6.5 Outlook: Crude Oil Exports

Crude oil exports over the past several years have been highly influenced by domestic crude oil production. In fact, it is the surge in U.S. crude oil production that motivated the removal of the oil export ban in late 2015; however, as noted earlier, U.S. crude oil production is down relative to prior projections. The 2022 GCEO anticipates that while crude oil production will grow, it will likely be 1 MMBBl/d lower than original 2019 GCEO projections. This reduction in growth will have implications for anticipated crude oil export volumes.

Figure 30: U.S. crude oil exports



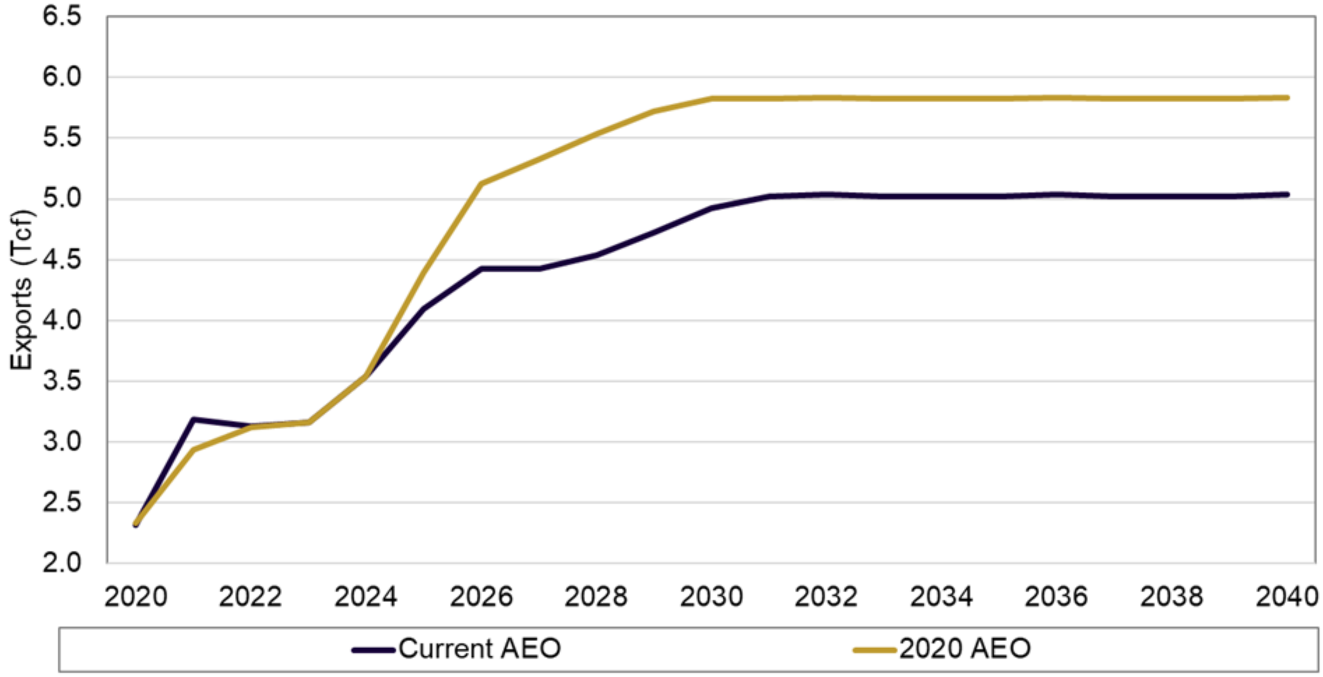
Source: U.S. Energy Information Administration. Annual Energy Outlook 2020 and 2021. Petroleum and Other Liquids Supply and Disposition. Liquid Fuels: Crude Oil: Domestic Production.

Figure 30 shows the EIA's Annual Energy Outlook (AEO) for crude oil exports and compares 2020 projections to the current forecast. The current forecast sees crude oil exports falling through 2022 and then rising to a level that is above the 2020 outlook. The 2022 GCEO finds this outlook to be optimistic since, as noted earlier, U.S. crude oil production, while recovering, will likely remain about 1 MMBBl/d lower than original projections. Thus, while a recovery in exports is likely, it is also unlikely that those crude oil export levels will be above earlier projections. The 2022 GCEO anticipates crude oil exports will likely be anywhere between 250 to 500 MBbl/d lower than the current AEO forecast.

6.6 Outlook: LNG Exports

LNG exports, shown in Figure 31, have been resoundingly resilient since the pandemic. The short-term AEO anticipates considerable growth in LNG export volumes after 2026. The current AEO forecasts LNG export volumes that are as much as 750 Bcf per year below last year's forecast.

Figure 31: U.S. LNG exports



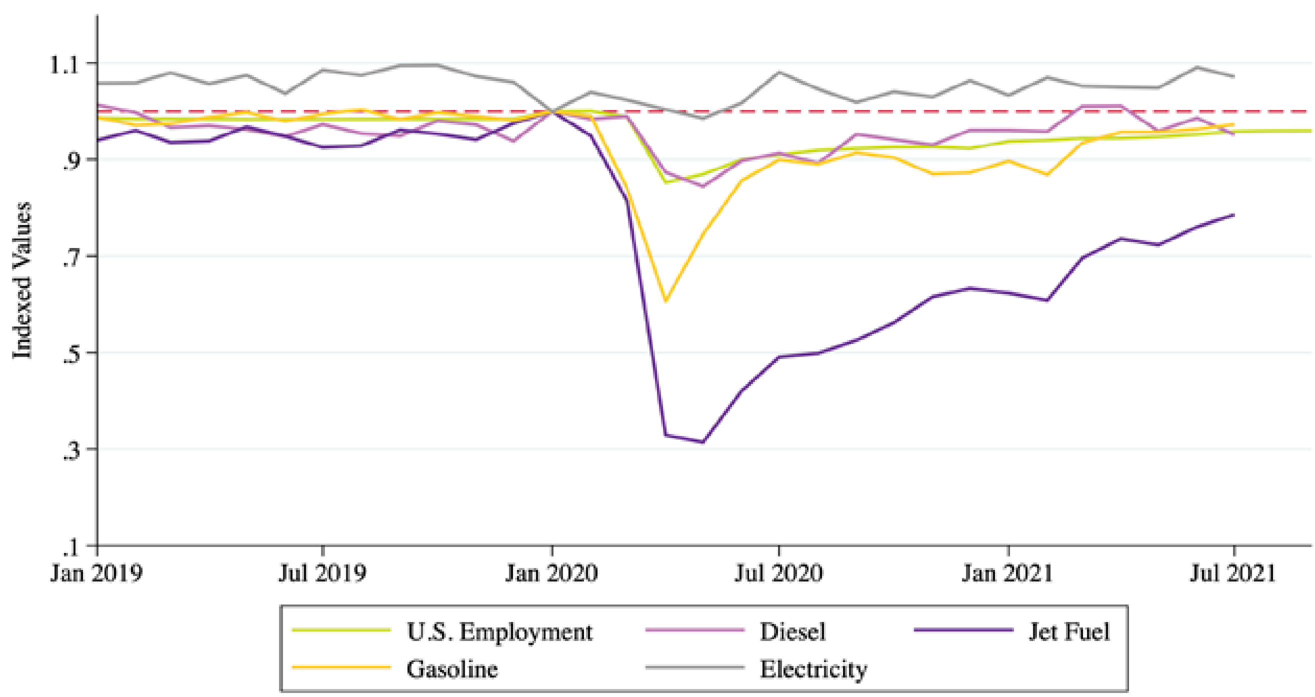
Source: U.S. Energy Information Administration. Annual Energy Outlook 2020 and 2021.

7. COVID Impacts on Domestic Energy Demand

As highlighted throughout, both the global economy and all sectors of the energy industry were impacted precipitously by the COVID-induced global recession. To illustrate the extent to which energy demand has rebounded with economic activity, Figure 32 shows U.S. employment alongside four sources of domestic energy demand: (1) gasoline; (2) diesel; (3) jet fuel; and (4) electricity. Each series has been seasonally adjusted to remove seasonal components and then indexed to January of 2020 for side-by-side comparison. Note that these include only domestic (i.e., U.S.) employment and energy demand.

Notably, electricity demand has been relatively stable throughout the recession. Liquid fuel demand was negatively impacted in the initial months of the recession (early 2020) but has rebounded in all three categories. Gasoline and diesel demand has rebounded as employment has recovered, but jet fuel demand is still significantly below pre-COVID levels. In future years, it will be interesting to see if jet fuel demand will have been permanently impacted relative to gasoline and diesel, as firms have made permanent adjustments allowing for increased use of webinars and virtual meetings in lieu of in-person meetings that might require costly travel. While difficult to predict, interviews with companies outside of the energy industry have revealed that business plane travel is unlikely to return to pre-COVID levels over the forecast horizon. This highlights the importance of export-oriented demand growth for the region.

Figure 32: Energy demand and U.S. employment



Source: U.S. Bureau of Labor Statistics, Current Employment Statistics. U.S. Energy Information Administration.

8. Employment Outlook

8.1 Employment Forecasts

In this final section of the GCEO, all prior sections are synthesized into employment forecasts for the regional energy industry. Employment is forecast within two broad sectors: (1) upstream oil and gas extraction and services and (2) refining and chemical manufacturing. Sectors are identified based on the North American Industry Classification System (NAICS). Upstream oil and gas is defined as including oil and gas extraction (NAICS sector 211) and support activities for mining (NAICS sector 213). Refining and chemical manufacturing employment includes petroleum and coal products manufacturing (NAICS sector 324) and chemical manufacturing (NAICS sector 325).[25] Employment forecasts are produced for each of these aggregated sectors for Texas and Louisiana. Note that recent historical data is subject to future revisions by the U.S. Bureau of Labor Statistics (BLS).

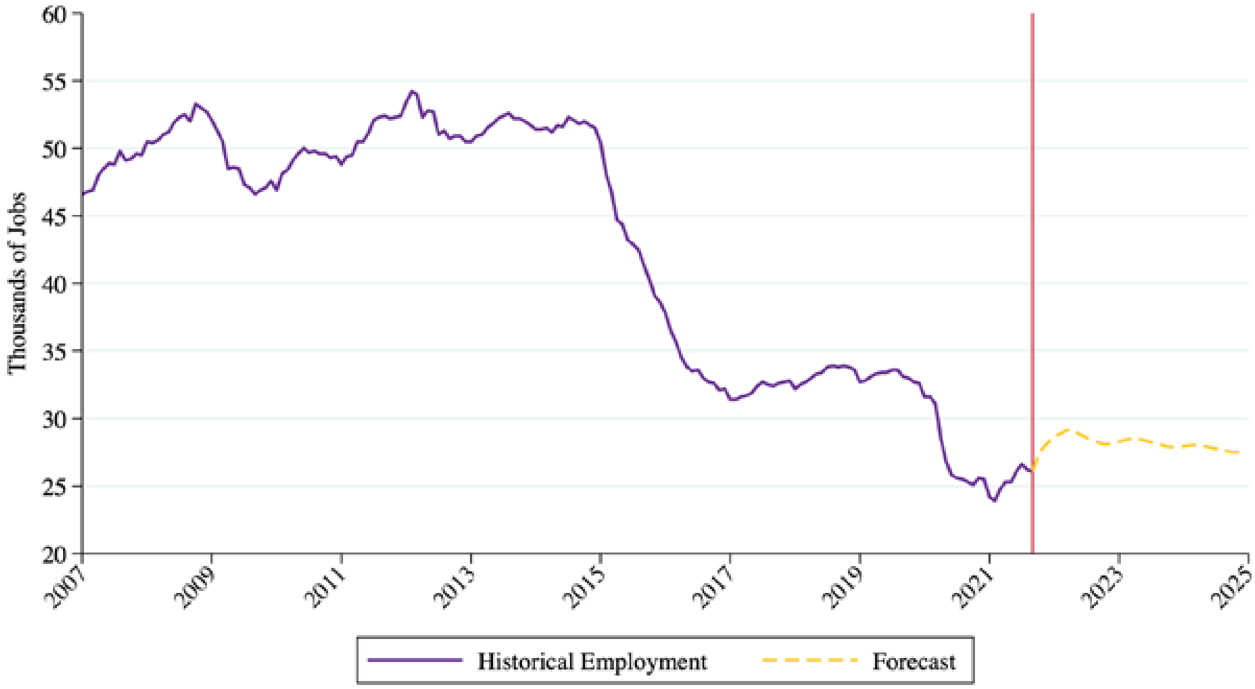
Upstream oil and gas employment for both Louisiana and Texas exhibit three key patterns in historical data shown in Figure 33 and Figure 34. The first key pattern is that Louisiana employment growth, pre-2015, was modest relative to the rapid growth in Texas employment. Both states, however, saw a collapse in upstream employment in 2015 when crude oil prices also collapsed, as did rig counts (see Figure 2 in Section 2.1). During the 2015 crash, Texas lost more than 100,000 upstream jobs from peak to trough. Louisiana lost about 18,000 over the same time period. After the 2015 crash, Texas employment climbed back slowly through approximately the end of 2018 before beginning a modest decline. Louisiana upstream employment was approximately flat over this period.

The third shock began in early 2020 in response to the COVID-induced economic downturn. Between January and September of 2020, Texas lost ~63,100 jobs, and Louisiana lost ~7,700 jobs.[26] On a percentage basis, Texas and Louisiana lost 28.6 percent and 24.4 percent, respectively. Thus, not only did Texas lose more jobs, but it also experienced a larger percentage drop relative to Louisiana. Fortunately, both Louisiana and Texas have experienced their troughs in upstream employment, but neither has approached pre-COVID employment levels.

[25] Chemical manufacturing includes many product types, including resins, pesticides, pharmaceuticals, paints, soaps, and others.

[26] Comparison of employment in December of 2019 to the current estimated employment in August of 2020.

Figure 33. Louisiana upstream employment forecast



Source: U.S. Bureau of Labor Statistics, Current Employment Statistics. Authors' forecast.

Figure 34. Texas upstream employment forecast

Source: U.S. Bureau of Labor Statistics, Current Employment Statistics. Authors' forecast.

Figure 33 and Figure 34 also show the forecasted employment in the upstream oil and gas sectors for Louisiana and Texas, respectively. Econometric forecasts are based on a combination of both the futures markets for oil and natural gas shown in Figure 7 and Figure 8, alongside the Enverus ProdCast model outputs shown in Figure 9 and Figure 10.

Over the next year, the GCEO anticipates both states to continue to gain back some of these COVID-induced job losses. By the end of 2022, Louisiana is expected to gain back about 4,300 jobs relative to the trough in February of 2021. Texas is forecasted to regain 32,800 upstream jobs from its trough in September of 2020. It is important to note that although employment is expected to increase over the forecast horizon, these model results are not anticipating employment in either state to reach pre-COVID levels over the forecast horizon. In 2023 and 2024, upstream employment is forecasted to be relatively flat in both states. This is driven by a combination of projected increases in oil and gas production alongside futures market prices that are currently in backwardation (i.e. expected to decline over the forecast horizon). The net effect is employment not reaching levels seen pre-pandemic in either state. Discussions with those in the upstream oil and gas industry almost unanimously corroborated this view that although the trough is behind us, employment is unlikely to reach pre-COVID levels in coming years.

Historical data on refining and chemical manufacturing employment are shown in Figure 35 and Figure 36. Both states exhibit two notable trends. First, pre-COVID, both states experienced approximately a decade of growth in these sectors. The GCEO attributes this employment growth to the investment in these sectors that has facilitated the exporting of products around the globe. But second, both states experienced reductions in refining and chemical manufacturing employment due to the COVID induced recession, but these employment losses were not as large, both in terms of total numbers and as a share of employment, as experienced in the upstream sector. From peak to trough, Louisiana and Texas lost approximately 1,500 and 3,500 jobs. This is less than a 4 percent reduction in both states (compared to more than 20 percent job losses in upstream employment in each state). Note, though, that last year's GCEO was predicting employment to be flat in these sectors over this past year; unfortunately, last year's forecast was too optimistic as the sectors in both states experienced job losses.

Figure 35 and Figure 36 also show the forecasted employment in the refining and chemical manufacturing sectors. For both Louisiana and Texas, the GCEO forecast is based on the historical relationship between capital expenditures and employment growth alongside our baseline capital expenditures presented in Section 5.[27]

For Louisiana, the GCEO anticipates employment to first recover from the recession and then modestly increase over the rest of the forecast horizon. Specifically, the GCEO envisions employment to increase by about 1,350 jobs by the end of 2022, or about a 3.7 percent increase. This increase approximately accounts for the job losses experienced over this past year, associated with the recession. Employment growth is expected to slow, gaining approximately 600 jobs in 2023 and 1,000 jobs in 2024. This employment growth is due to the anticipated continuation of capital expenditures in these sectors.

[27] Novel to this year's forecast, we also adjusted for growth in national refining and chemical manufacturing employment estimates that is available with a shorter lag. Thus, some of this growth comes from the COVID recovery, with additional growth due to continued investment.

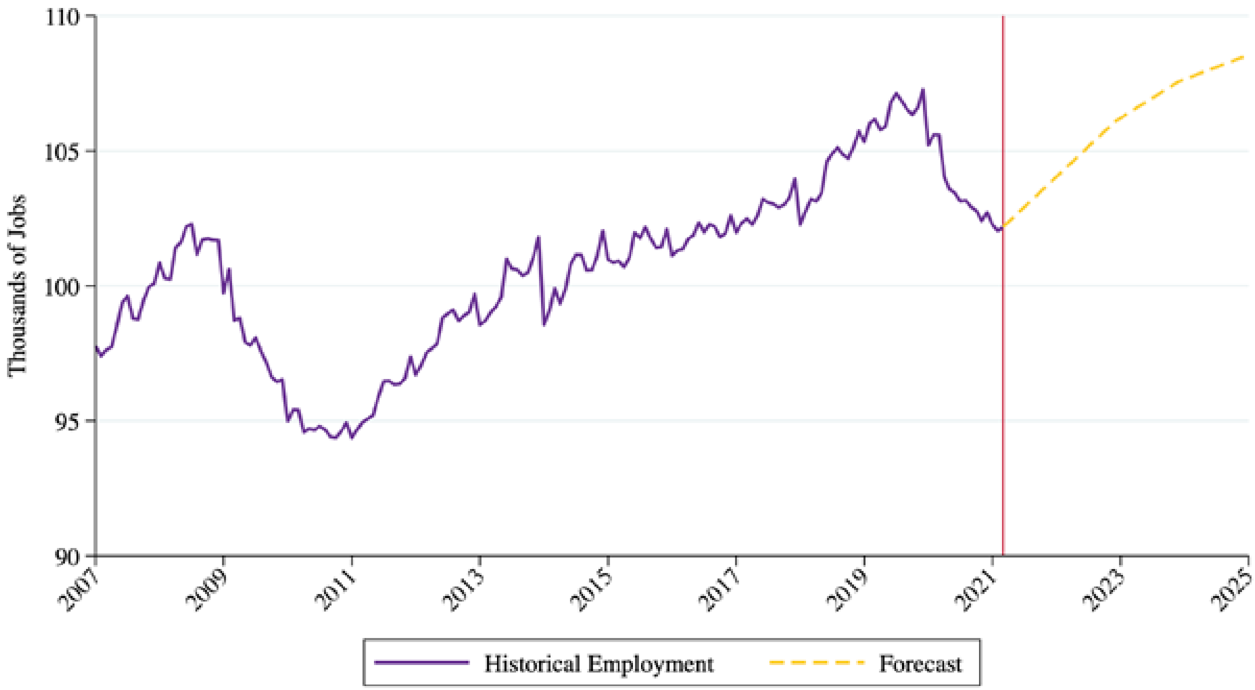
Figure 35. Louisiana refining and chemical manufacturing employment forecast

Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages. Authors' forecast.

As shown in Figure 36, Texas refining and chemical manufacturing employment exhibits a similar pattern to Louisiana. It is expected to increase by approximately 3,900 jobs by the end of 2022, or about 3.8 percent. Note that this will still be slightly below the pre-pandemic peak by the end of 2022. In 2023 and 2024, we anticipate Texas refining and chemicals sectors to gain approximately 1,500 jobs and 900 jobs, respectively.

Both Texas and Louisiana are anticipated to reach new highs in refining and chemical manufacturing employment over the forecast time horizon, which extends through the end of 2024.

Figure 36. Texas refining and chemical manufacturing employment forecast



Source: U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages. Authors' forecast.

Conclusions

The past two years have been difficult for the energy industry along the Gulf Coast and globally. Energy demand was reduced due to COVID-19 across energy types, including electricity, liquid fuels, and natural gas. These demand reductions cascaded through the economy, reducing employment by tens of thousands of jobs in the select sectors highlighted here alone. But the good news this past year is that the industry has reached its trough, and employment growth is likely in coming years. The GCEO takes the view that this growth will be driven by continued economic development globally, primarily in Asia.

Also notable, decarbonization discussions fundamentally changed over these past two years. The United States has re-entered into the Paris Agreement. Companies are increasingly implementing "environmental, social, and governance" (ESG) policies that include decarbonization commitments. Further, Europe is in the midst of considering a carbon border adjustment tax. Thus, companies across not only the energy sector, but the supply chain more broadly are increasingly focusing on both quantifying and reducing the greenhouse gas emissions throughout their supply chain. This creates significant opportunities for the Gulf Coast region to make investments in technologies such as carbon capture and sequestration (CCUS) and bio-petrochemicals. But this can also create risks, especially if the region finds it is difficult and costly to achieve decarbonization.

Looking into the future, the 2022 GCEO recognizes that Louisiana will continue to play an increasingly important role in the manufacturing of energy and chemical products, while Texas will continue to be at the forefront of the upstream oil and gas extraction industry. While upstream employment is expected to continue its rebound over the next year or so, forecasts do not suggest returning to levels seen before the 2015 oil price crash, or even back to pre-COVID-19 levels over the forecast horizon. Although refining and chemicals have experienced job losses in both states over the past year, we anticipate these jobs to be regained and experience new highs over the forecast time horizon, with this employment growth being driven by global demand.

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