

2024

GULF COAST ENERGY OUTLOOK



LSU

Center for
Energy Studies

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Release date: Fall 2023

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1. Introduction

The annual GCEO is designed to provide stakeholders with an 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 (CES). All CES work products are supported by the Center’s general state appropriation, underscoring Louisiana’s commitment to independent energy-related research. CES is also grateful for its sustaining members looking to assist LSU in disseminating timely information and analysis impacting the region’s economy, environment, and citizenry. It would be difficult to produce the GCEO without both sources of support.

Unless otherwise stated, the “Gulf Coast” region specifically refers to the states of Texas, Louisiana, Mississippi, and Alabama. In some instances, the U.S. Department of Energy (DOE) reporting conventions 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 2026, 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 Is a Recession Still on the Horizon?

During the drafting of last year’s GCEO, many national forecasters were anticipating a recession beginning in 2023; that recession has not yet occurred. Since the pandemic induced recession, which occurred in the first quarter of 2020, the U.S. economy has continued to expand. Estimated U.S. employment in September of 2023, the most recent month available, continued to show increases and current employment levels are approximately three percent above the pre-pandemic peak achieved in February of 2020. With the unemployment rate at less than four percent, the U.S. economy is at “full employment.”

But employment growth has been paired with inflation. Last year, GCEO discussed a “perfect storm” of at least three factors driving inflation: (1) an economy already operating at full employment; (2) high energy prices facilitated by industry-related challenges and geopolitical tensions; and (3) considerable federal fiscal stimulus driven in part by two major spending programs injecting funding into an already “hot” economy. The Federal Reserve responded by raising interest rates over this past year aimed at reducing the rate of inflation. At the time of this writing, the Federal Funds rate is over five percent, up from essentially zero percent in early 2022. Last year we reported the most worrying economic data was that U.S. wage growth was not keeping up with inflation, and thus real hourly earnings had decreased by approximately three percent in the year preceding the 2023 GCEO release.

The risk of recession is not over, and some national forecasters are still forecasting a recession. At this time, we still do not know if the economy will experience a “soft landing” or if a recession is in the near future. But the good news is that, at the time of this writing, inflation is starting to slow down. In the most recent month of data, September 2023, price levels are about 3.7 percent higher than last

September, according to the Consumer Price Index (CPI).¹ But according to the Personal Consumption Expenditures (PCE) Price Index, the Fed's preferred measure of inflation, price levels have risen by 5.9 percent over the same period. For comparison, average hourly earnings have increased by 3.6 percent. Thus, depending on the preferred measure of inflation, weekly earnings have been approximately either flat or down over this past year. On a monthly basis, the rate of inflation continues to slow in both the CPI and PCE.

Internationally, economic growth has also been continuing with the U.S., China, and India all continuing to experience real GDP growth per the most recent data available at the time of this writing.² As will be discussed further throughout, we continue to see announcements for export-oriented projects, as economic opportunities for the U.S. energy sector continue to be driven by international demand. Thus, while a recession might be on the horizon, this is not the GCEO base case.

This year's GCEO modeling will assume that inflation continues to gradually slow to the Federal Reserve's target of two to three percent over the next few years. Wage growth will gradually begin to outpace inflation, and demand for energy globally will continue to rise. GCEO, much like years past, anticipates that long-run energy demand growth will lead to increased U.S. energy exports, especially to the growing developing world. If the global economy enters a recession, this will reduce demand for energy products in the short-term, making these forecasts too optimistic.

1.2 Decarbonization Efforts: Balancing Cost Competitiveness and Emissions Reductions

Decarbonization, particularly industrial decarbonization, continues to take on a new level of importance and urgency each year. The 2016 Paris Agreement addressing anthropogenic greenhouse gas (GHG) emissions has been ratified by 190 countries, representing 97 percent of the global population. 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. Last year, the U.S. passed its most comprehensive climate legislation to date; the Inflation Reduction Act (IRA). Louisiana Governor John Bel Edwards committed Louisiana to GHG emissions reduction targets of 25 to 28 percent by 2025 and complete carbon neutrality by 2050. With the election of Louisiana's new governor, Jeff Landry, who will take office in January of 2024, perhaps these policy goals will change.

We are still in the beginning phases of the prior-mentioned IRA's 10-years of spending on emissions reductions that was signed into law in August of 2022. The legislation has three core components, (1) corporate tax increases, (2) health care and (3) energy and climate. Notably energy and climate accounted for 84 percent of the bill's spending. In last year's GCEO, we highlighted some of the specific spending included in the bill.

¹ Consumer Price Index for All Urban Consumers: All Items in U.S. City Average, Index 1982-1984=100, Monthly, Seasonally Adjusted. Comparison of August 2023 to August 2022. Data obtained from FRED. CPIAUCSL

² Notably, the 27 countries within the European Union (in sum) and Japan, the other largest global economies, have experienced relatively flat real GDP over the past decade.

Three stylized facts are becoming increasingly relevant to the Gulf Coast’s decarbonization strategy when speaking with companies. All of these will be shown throughout this document in more detail but are highlighted here. First, U.S. energy demand has been relatively flat over the past decade, and this trend is expected to continue.ⁱ On one hand, economic growth increases energy demand. On the other, efficiency reduces energy demand. In net, in the U.S. these two effects are approximately in balance. Second, U.S. oil production has increased by 83 percent,ⁱⁱ natural gas production by 47 percent,ⁱⁱⁱ and renewable energy production by 51 percent over the same 10 years.^{iv} Thus, domestic energy *demand* has been relatively flat while energy *supply* has increased. Third, this increase in energy production has been facilitated by exports of these hydrocarbon-based products, including liquid fuels, chemical products, fertilizers and polymers.

Increasingly, companies are indicating that their customers from around the world are asking to (1) credibly document lifecycle emissions and (2) reduce emissions. Investors, again from all over the world, are increasingly considering the carbon intensity when deciding where to deploy capital. To attract capital and sustain demand, hydrocarbon-based manufacturers are balancing two objectives: First, companies must remain cost competitive. If they invest too heavily in reducing emissions, their products could become too expensive for the global market. But second, companies also seek competitive emissions profiles. If the manufacturing sector ignores this call to decarbonize, and exclusively focuses on cost, the sector might also find itself at a competitive disadvantage in the future.

But this decarbonization is slated to be expensive. Companies are therefore trying to utilize the federal dollars through the IRA and Infrastructure Investment & Jobs Act (IIJA) to make upfront capital investments that can assist with reduced emissions in the future. Companies are asking questions such as: *How much can I reduce emissions with a given technology? Will the global market pay a premium for lower carbon intensity products in the future? What current subsidies are available through the IRA?* GCEO views striking this balance as a challenge, thus creating both a significant opportunity but also a significant risk, to our regional economy in the long term.

Decarbonization will not only challenge existing Gulf Coast energy manufacturing but also create an opportunity for regional leadership in the development of the production capacity for liquid fuels, chemicals, plastics, fertilizers, and other products historically derived from fossil fuels, with lower, or even net zero GHG emissions. Companies are actively considering the most efficient ways to achieve meaningful emissions reductions given the subsidies that are currently available under the IRA. Over the forecast horizon, the GCEO sees decarbonization creating considerable regional capital investment opportunities. Longer-term effects of decarbonization on the region will be determined by the cost to achieve emissions reductions alongside the global market’s willingness to pay a premium for lower emission intensive products.

1.3 What Have We Learned from Russia’s Invasion of Ukraine?

Rewind to early February of 2022. West Texas Intermediate (WTI) oil prices were trading at about \$90 per barrel, and U.S. Gulf Coast natural gas was trading around \$6 per thousand cubic feet (Mcf). Both oil and gas markets were in “backwardation,” meaning futures contracts were trading below current prices. Thus, markets were anticipating that energy commodity prices would go down in the coming months. But this is not what happened.

In February of 2022, the Russian military launched an invasion of Ukraine. Before the conflict began, Russia was the second-largest producer of oil and natural gas globally (with the United States as the largest producer of both oil and natural gas).³ Also critical to note, the Nord Stream 2 pipeline, running through the Baltic Sea from Russia to Germany, was set to open in the coming weeks to greatly expand natural gas exports from Russia into European markets.

Global markets reacted immediately to Russia's invasion of Ukraine as markets experienced a sudden surge in energy commodity prices. West Texas Intermediate oil prices peaked at over \$120 per barrel, and the European-based Brent crude oil index peaked at over \$130 per barrel. At the same time, the Dutch Title Transfer Facility (TTF) natural gas price peaked at over \$70 per MMBtu. While U.S. natural gas prices did not rise by as much, Henry Hub prices did surge to levels not seen in over a decade, causing concern for American consumers as summer utility bills began to spike.

In the summer of 2023, the media was filled with stories of gasoline price hikes and historically large utility bills.⁴ It's been incredible to see how quickly markets have adjusted this past year. Natural gas, which was perhaps the largest concern in the wake of the Russian invasion of Ukraine, is trading at less than \$3 per MCF here in the Gulf Coast of the U.S. Oil prices, despite the recent runup in the weeks preceding the release of this document, are also converging to long-run norms.

International energy prices have been impacted more than U.S. prices. At the time of this writing, the European natural gas marker, the Dutch TTF, is trading at approximately \$50 per MMBtu—more than 15 times the price here in the Gulf Coast of the U.S. The Asian natural gas marker, the Japan Korea Marker (JKM), is trading at around \$18 at the time of this writing, more than five times the prices here in the Gulf Coast of the U.S.

GCEO believes that the global market will continue to increasingly rely on the U.S. as a reliable source of energy and hydrocarbon-based products. This international demand will continue to facilitate investment within our region and sustain another decade of increased production of oil and natural gas. The Russian invasion of Ukraine has increased the international importance of our region as a global energy and hydrocarbon-based product provider.

GCEO modeling will assume that the war in Ukraine continues, as does Western economic sanctions on Russia. Global commodity prices have largely already adjusted to this global supply shock, and any effects will continue to attenuate as time passes. The Russian invasion of Ukraine has increased the international importance of our region as a global energy provider.

1.4 Supply Restrictive Policies

As covered in last year's GCEO, soon after taking office, President Biden issued an executive order (EO) suspending offshore leasing and outlining plans to reduce greenhouse gas (GHG) emissions in light of concerns about global climate change.⁵ The EO explicitly directed 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."⁶

³ Data from 2021. U.S. Energy Information Administration. International.

⁴ We have experienced a trend at the Center for Energy Studies: media calls are positively correlated with energy prices. When prices spike, we receive requests for media calls at a rapid clip. When prices fall, the proverbial phone does not ring nearly as often.

⁵ Executive Order on Tackling the Climate Crisis at Home and Abroad. January 27, 2021.

⁶ Ibid. Sec. 208.

The industry's response to this EO was swift, as were the legal actions taken by several impacted states, including all of those in the GCEO region, challenging the basis of the EO and its consistency with prior congressional authorizations and legislation.⁷ The Department of the Interior cancelled a Gulf of Mexico offshore lease sale scheduled for March 2021. By June, 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 November of 2021, Lease Sale 257 was conducted with more than 80 million acres offered for \$192 million dollars. Just days after the lease sale was conducted, the Department of the Interior released its review of leasing practices. In January of 2022, the U.S. District Court for the District of Columbia vacated the results of Lease Sale 257, and in June 2022, all remaining offshore lease sales in the current 2017-2022 five-year program were cancelled, with no indication that the administration would move forward with a new five-year program, which would be required by the OCS Lands Act. Then in August of 2022, President Biden signed the IRA into law. A sometimes-overlooked component of the IRA was that Lease Sale 257, which had been previously vacated, was reinstated.

Last year, GCEO expressed cautious optimism that the uncertainty around offshore leasing had subsided. But the uncertainty continued. In February of 2023 (six months after the passage of the IRA), BOEM announced Lease Sale 259 including 73 million acres. In March, Lease Sale 259 was conducted with 1.6 million acres leased for approximately \$264 million. In August of 2023, BOEM then announced blocks available for Lease Sale 261 totaling 67 million acres. The IRA had required a minimum of 60 million acres to be available to grant leases for offshore wind. BOEM then reduced the leases available by approximately 6 million acres due to concerns over impacts to the Rice's Whale. In addition, in July of 2023, Bureau of Safety and Environmental Enforcement (BSEE) released a request for comment on a proposed rule to designate critical habitat for the Rice's Whales (0648-BL86) that some in the industry have suggested could also impact offshore oil and gas operations. Currently, the proposed BSEE rule and the removal of the acreage from the lease sale are being debated in the court system. In September 2023, BOEM announced a new 5-year lease plan including three sales between 2024-29, the fewest in the program's 70-year history. In response, Louisiana Congressman Garret Graves has introduced a bill entitled the BRIDGE Production Act of 2023 that would "mandate at least four offshore oil and gas lease sales to be held in 2024 and 2025, setting specific terms and reducing regulatory burdens to address delays by the Biden administration in publishing a five-year OCS lease plan." At the time of this writing, this bill is still in committee.

Although offshore activity is continuing, we see these actions impacting uncertainty for companies making long-term investments in the Gulf of Mexico. Some industry representatives have speculated that it will take years for this to impact production in the Gulf of Mexico due to the long planning time for these projects. But others have noted that these actions directly impact workers supporting this activity in the short term. GCEO modeling assumes that these negative impacts are relatively small over the forecast time horizon but that longer term implications of such policies are likely larger than short-term impacts due to the long-time horizon of offshore projects.

⁷ 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.

Offshore Leasing Timeline

- 2020 campaign trail: Candidate Biden said he would ban “new oil and gas permitting” on public lands and waters.
- January 2021 executive order: “pauses new oil and gas leases” on public lands and waters during “comprehensive review and reconsideration” of leasing practices.
 - ▶ March Gulf of Mexico Lease Sale cancelled.
- June 2021: Preliminary injunction granted in Federal court that the Bureau of Land Management (BLM) and Bureau of Ocean Energy Management (BOEM) continue leasing while review is completed.
- November 2021: Gulf of Mexico Lease Sales 257 conducted, with ~81 million acres available for leasing.
 - ▶ ~1.7 million acres leased for ~\$192 million.
- January 2022: Washington, D.C. Court vacated results of Lease Sale 257.
- June 2022: Department of the Interior announces that all lease sales remaining in the current five-year program are cancelled.
 - ▶ Offshore leasing in the Gulf of Mexico effectively discontinued.
- August 2022: Inflation Reduction Act signed into law.
 - ▶ Lease Sale 257 reinstated.
 - ▶ Offshore leasing resumed and tied to offshore wind developments.
- February 2023: BOEM announces blocks available for Lease Sale 259 totaling ~73 million acres.
- March 2023: Lease Sale 259 conducted.
 - ▶ ~1.6 million acres leased for ~\$264 million.
- August 2023: BOEM announces blocks available for Lease Sale 261 totaling ~67 million acres.
 - ▶ IRA had required a minimum of 60 million acres be leased for oil/gas to grant leases for offshore wind.
 - ▶ ~6 million acres trimmed from original plan following lawsuit to protect Rice’s whale.
- September 2023: Western District Court of Louisiana issues preliminary injunction reinstating whale-related acreage previously removed from Lease Sale 261.
 - ▶ 5th Circuit Court subsequently denies BOEM’s request to stay the injunction but pushes back the sale date to November.
- September 2023: BOEM announces new five-year leasing plan including three sales between 2024-29, fewest in the leasing program’s 70-year history.
 - ▶ Comes after substantial delay (previous plan expired in 2022).



GCEO modeling considers uncertainty around reduced levels of offshore leasing. Over the forecast horizon, three years, effects on employment are likely to be small. But long-term implications on oil and gas supplies and upstream employment are likely to be larger if uncertainty around offshore leasing continues into the future.

1.5 Permitting: The New Bottleneck?

As mentioned previously, the federal government has allocated billions of dollars towards decarbonization of the energy system through the IIJA and IRA. But many of the people we speak to in both industry and government question whether permitting will be the bottleneck that ends up determining the speed in which this capital can be deployed. In prior years, GCEO discussed supply chain constraints as the potential bottleneck limiting development. While we are receiving feedback that supply chains are still not back to pre-COVID condition in terms of speed of acquiring materials, the ability to obtain permits is the more often cited limiting factor.

For example, in May of 2023, the U.S. Environmental Protection Agency (EPA) opened a Public Comment on Granting Louisiana Primacy for Carbon Sequestration. Many speculated that Louisiana would receive primacy to permit Class VI wells by the fall of 2023; as of the time of this writing, that has not occurred. Then in August, the EPA faced criticism for extending the comment period, and delaying the process.⁸

Permitting delays have not only been associated with carbon capture, utilization, and storage (CCUS), as evidenced by the Class VI primary delays. Locally there have also been disagreements over solar developments as local governments and landowners cite concerns about competing with agricultural interests. There has also been local backlash over CCUS projects, that have been prominent in the local news.

GCEO modeling assumes that global supply chain constraints continue to attenuate, while uncertainty around permitting presents a more immediate bottleneck in project development.

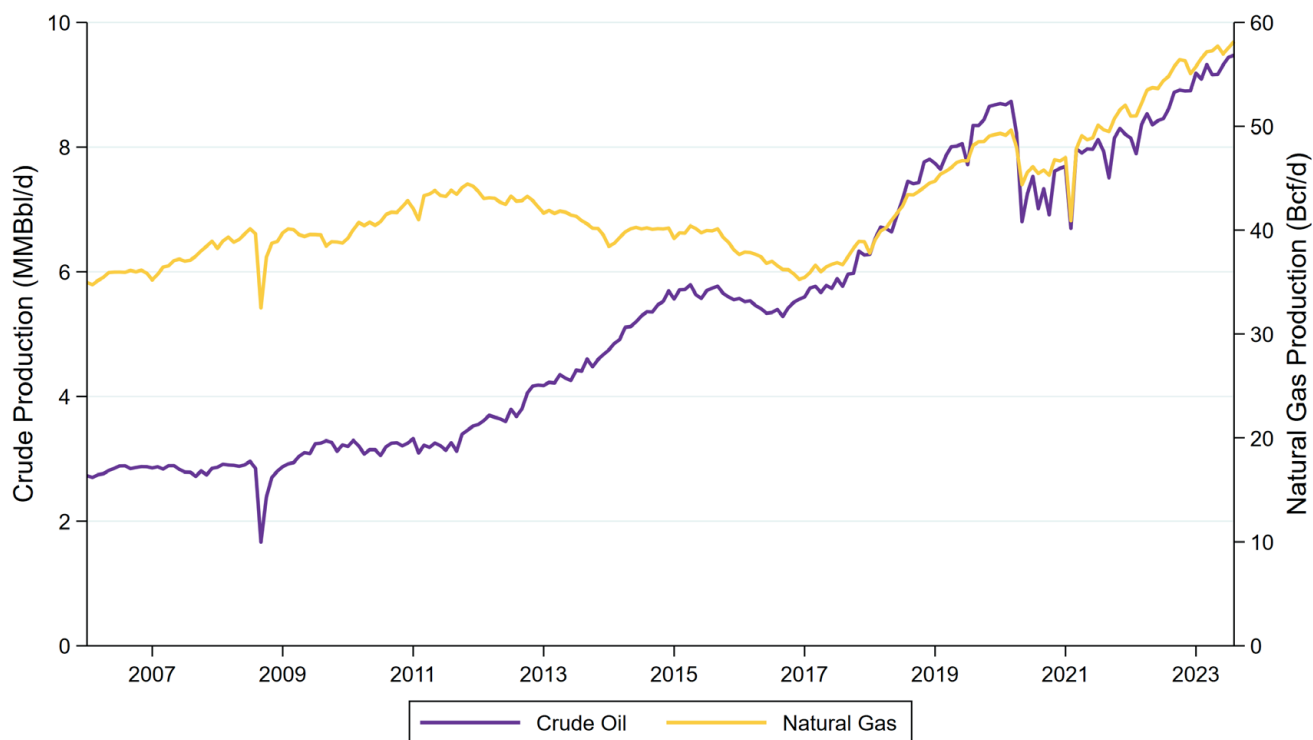
⁸ For example, on 8/17/23, Senator Bill Cassidy issued a press release titled "Cassidy Blasts Biden EPA for Delaying Louisiana's Class VI Primacy Application."

2. Crude Oil and Natural Gas Production and Prices

2.1 Crude Oil and Natural Gas Production

U.S. oil production has just recently reached its pre-pandemic peak, with current production at approximately 13 million barrels per day (MMbbl/d), almost exactly the level experienced near the end of 2019. Natural gas production continues to set new highs and is currently approximately 124 billion cubic feet per day (Bcf/d), or about six percent above the pre-pandemic peak. Gulf Coast oil and gas production are shown in Figure 1. Gulf Coast oil and gas production rebounded even more quickly than the nation as a whole post pandemic and today Gulf Coast oil production is approximately 8.5 percent above the pre-pandemic peak. Gulf Coast natural gas production is 16 percent higher.⁹

Figure 1: Gulf Coast crude oil and natural gas production



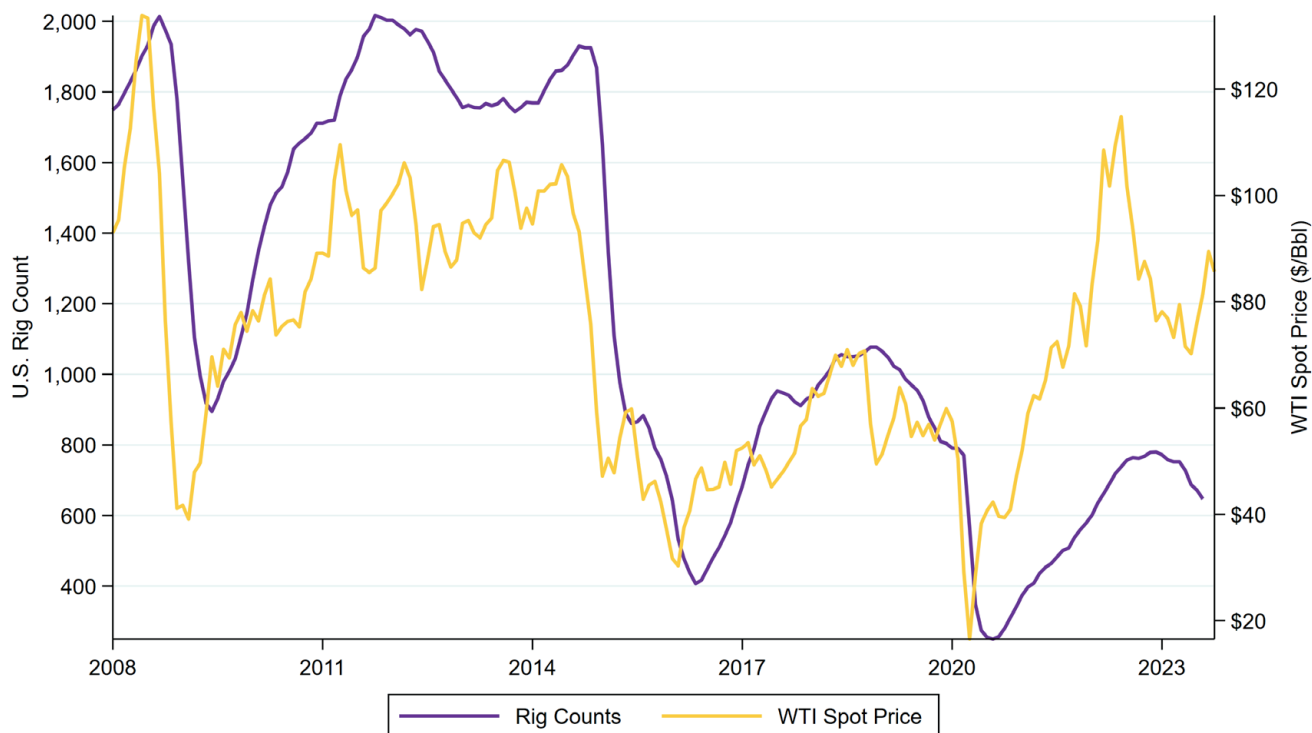
Source: U.S. Energy Information Administration. Petroleum & Other Liquids. Crude Oil Production. Natural Gas Gross Withdrawals.

Figure 2 highlights the relationship between U.S. rig counts and oil prices. Baker Hughes reported 250 active rigs in August 2020. Unsurprisingly, this rig count drop mirrored the drop in the WTI spot price that bottomed out at less than \$17 per barrel in April of 2020. Rig counts then rebounded to a peak of 780 in December of 2022. Although this was more than triple the pandemic's trough, rig counts are still significantly below the levels experienced in 2018 and 2019. Throughout 2023, rig

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

counts have gradually declined and in the most recent month at the time of this writing (August 2023), rig counts are now slightly below 650. This decline has mirrored the drop in the oil price (with a lag). As will be discussed in Section 7, the GCEO anticipates that oil and gas production will continue to increase, although fewer rig counts will be needed to produce more hydrocarbons. Thus, the industry is expected to continue producing more with fewer inputs, a sign of continued efficiency improvements. Although not shown in the figure, Gulf Coast rig counts move in tandem with U.S. rig counts and thus exhibit a similar pattern when compared with oil prices.

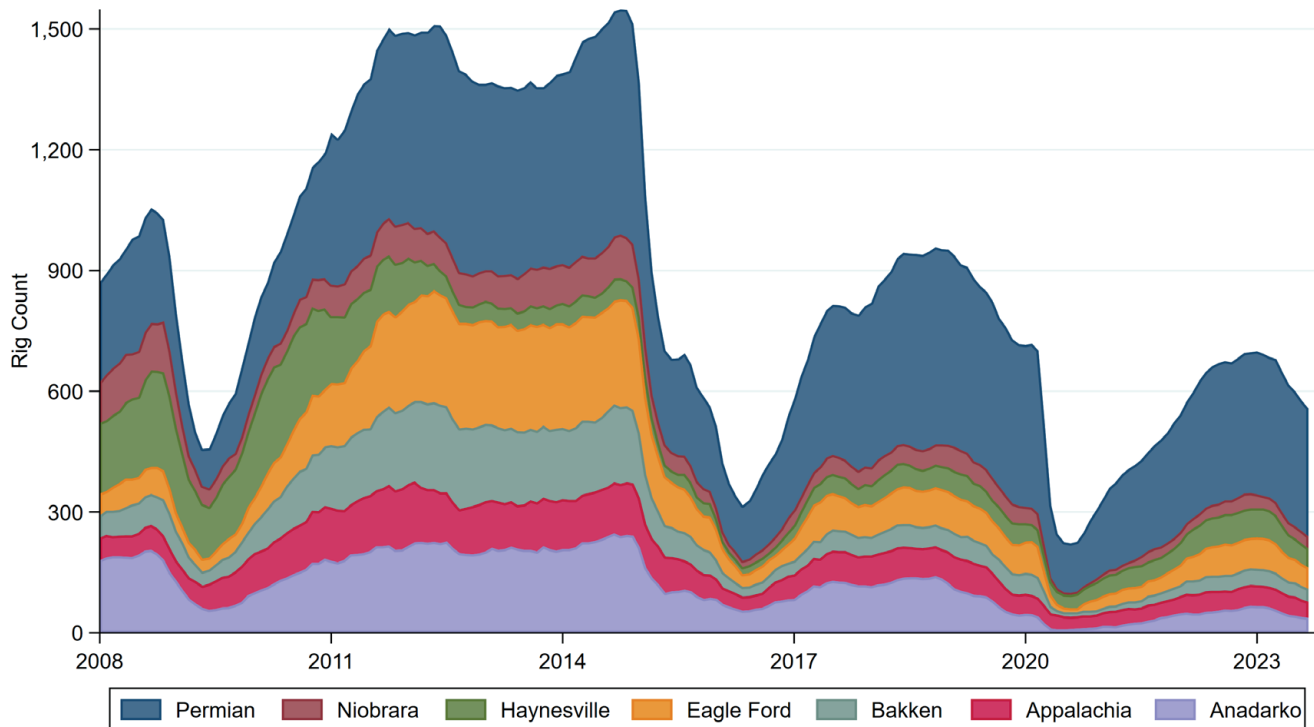
Figure 2: U.S. crude oil prices and rig count



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*. For the past several years, GCEO has noted that the Permian basin had been the predominant U.S. shale play and this continues. The Permian basin continues to account for more than half of all active rigs in shale plays. All seven of the basins shown in Figure 3 have experienced reductions in rig counts since the beginning of 2023, thus the slowing of drilling activity is a common theme across regions. More focus on Gulf Coast oil and gas production specifically will be provided in Section 2.3 below.

Figure 3: Rig counts in major shale basins



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

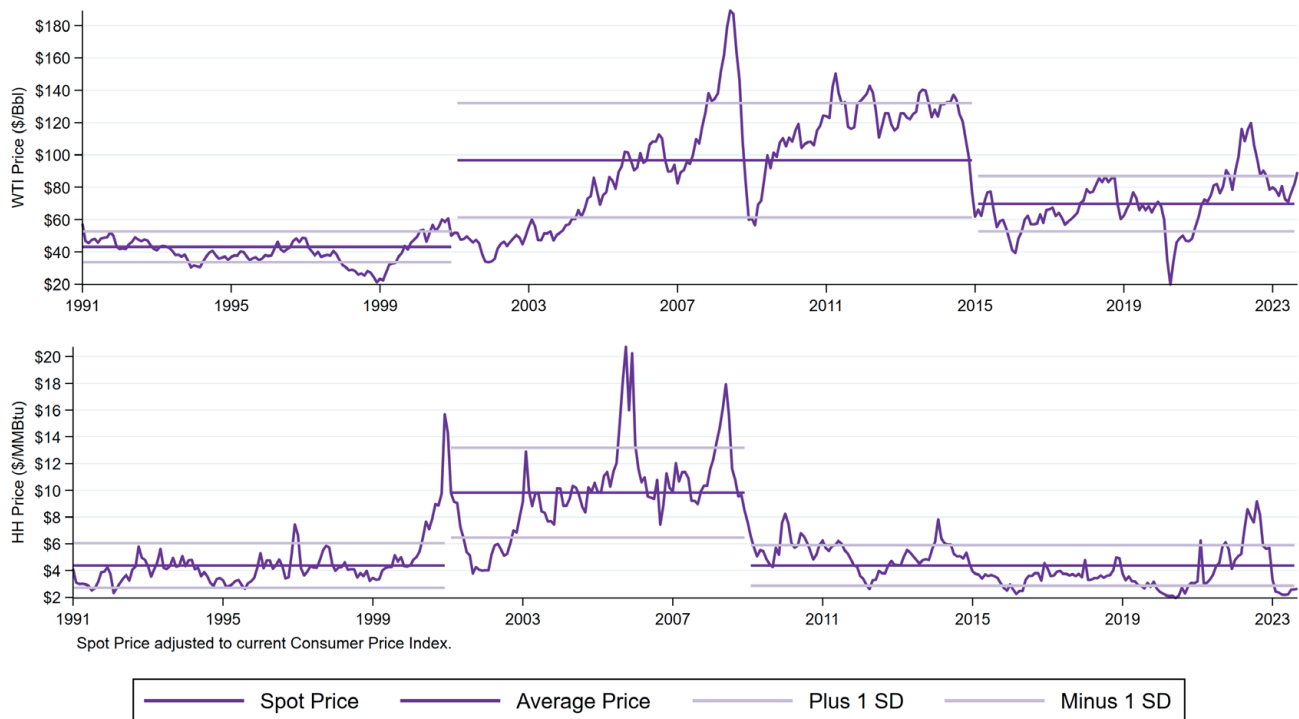
2.2 Commodity Pricing

Figure 4 shows recent trends in both crude oil and natural gas commodity pricing. The top panel shows crude oil historic trends, and pricing “epochs,” whereas the bottom panel presents historic trends for natural gas pricing.

Historic natural gas pricing shows three separate 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 The relevant question that was posed in last year’s GCEO was whether natural gas prices had entered into a new epoch that reflects a greater integration of U.S. natural gas markets to global markets. Prior to the advent of Liquefied Natural Gas (LNG) exports, U.S. markets faced limited pricing exposure to changes in global markets. Last year GCEO commented that the Russo-Ukrainian war and the resulting sanctions on Russian natural gas alongside the fact that the U.S. is now the largest producer and exporter of natural gas would have likely resulted in substantially more, but still not total, integration. Interestingly, we have not observed to date a departure from this third “epoch” of natural gas prices, with current natural gas prices actually lower than average throughout this third epoch.

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

Figure 4: Historical inflation-adjusted oil and natural gas price

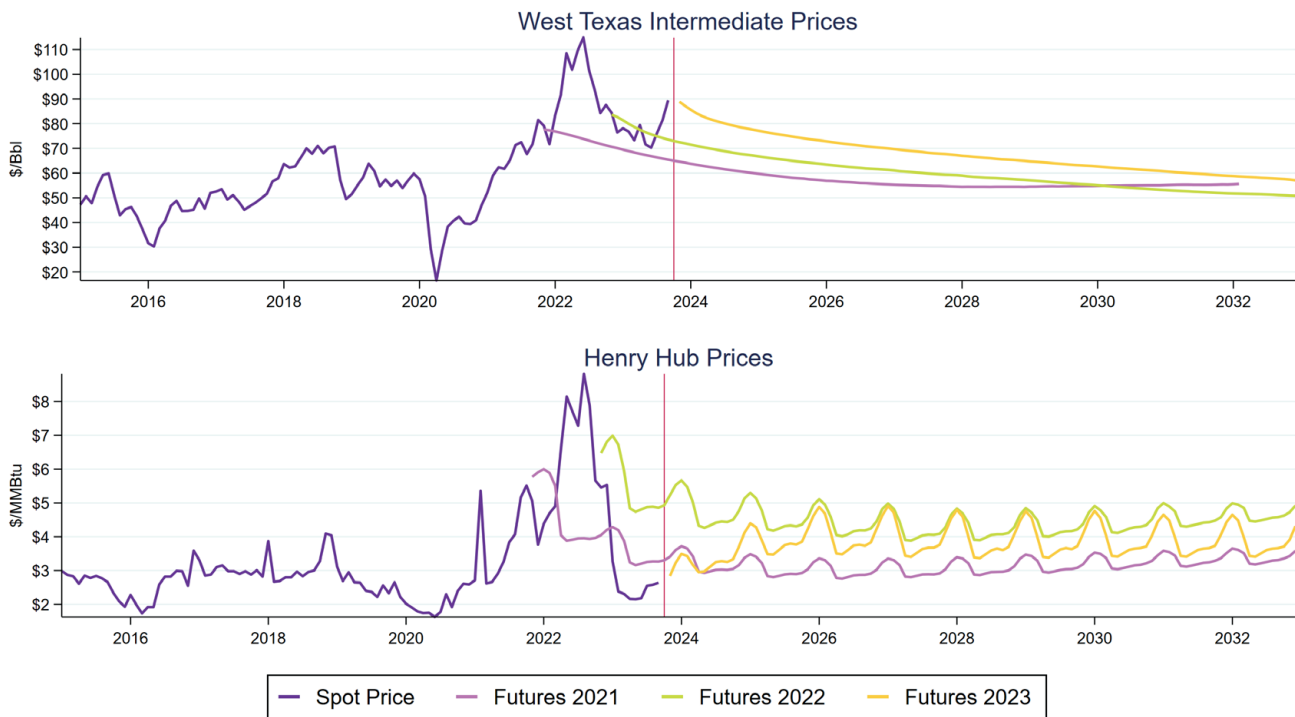


Source: U.S. Energy Information Administration. Henry Hub Natural Gas Spot Price (top) and West Texas Intermediate Spot Price (bottom). Inflation adjustment based on U.S. Consumer Price Index sources from the Bureau of Labor Statistics.

The trends in inflation-adjusted crude oil pricing continue to underscore how the unconventional revolution has led to dramatically reduced volatility 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. But like natural gas, the global economic recovery alongside the war in Ukraine put significant upward pressure on oil prices in 2022. Although oil prices have climbed a bit over the past several months, they are still within the range of this third epoch and, as will be discussed next, are anticipated to decline into the future.

Figure 5 compares historical prices and futures for both the WTI crude oil price (top panel) and Henry Hub natural gas price (bottom panel). Unlike Figure 4, both energy commodity prices are shown in nominal dollars (i.e., no inflation adjustment). Also, futures prices are shown for the most recent data available, alongside the futures prices listed in the prior two editions of the GCEO to illustrate how futures markets have evolved over the last several years.

Figure 5: Oil and natural gas price outlook



Source: New York Mercantile Exchange Henry Hub Futures Price. Sources from S&P Global Market Intelligence. Red vertical line represents August of 2023. Most recent futures price as of October 1, 2023.

There are several notable observations based on Figure 5. First, markets continue to anticipate that oil prices converge in the long run to below \$60 per barrel. When prices shift outside of this range due to a shock (e.g. pandemic, geopolitical tensions, etc.), markets continue to anticipate convergence to a similar long-run price. At the time of this writing, oil prices are in backwardation, with prices anticipated at about \$78 per barrel by the end of 2024.

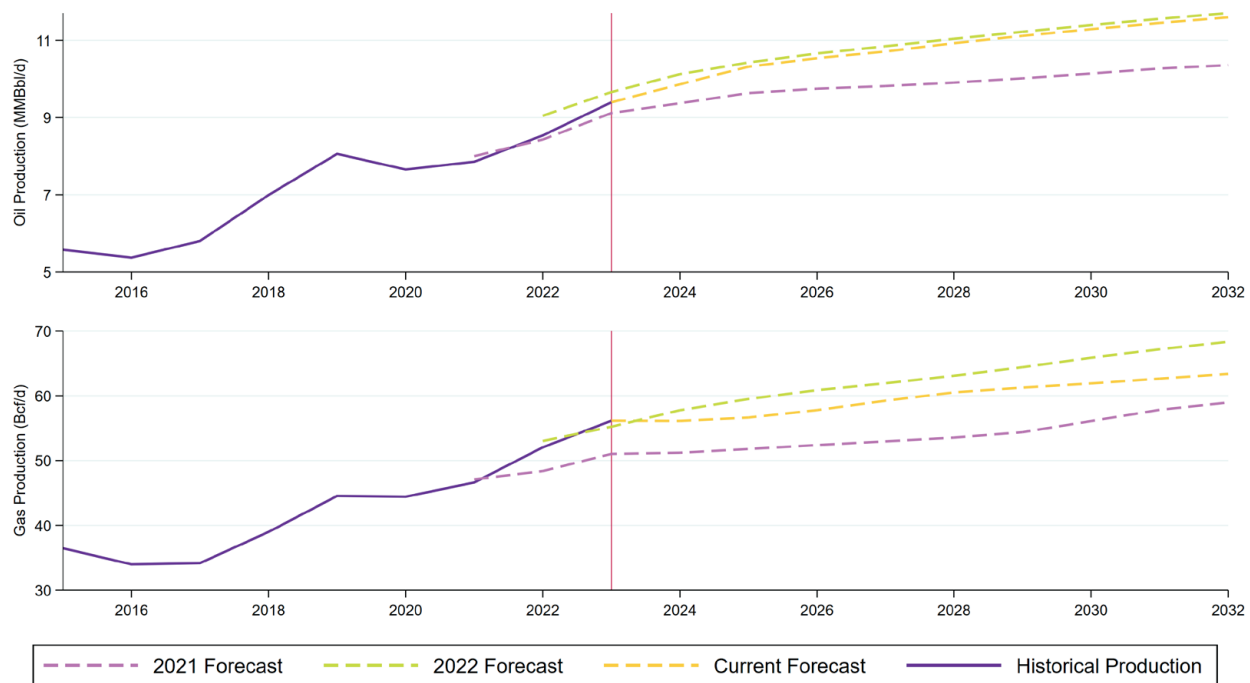
Natural gas prices are illustrated in the bottom panel of Figure 5. Interestingly, natural gas prices are significantly lower than anticipated last year at this time, and as shown in Figure 4 natural gas prices are at the low end of the prices experienced over the past decade. It is incredible to see how quickly U.S. natural gas prices have converged back to long-term norms in the wake of the global supply disruption that came from the Russian invasion of Ukraine and resulting sanctions. In the long run, futures markets anticipate natural gas prices to oscillate between about \$3.50 to \$5 per MMBtu. As will be discussed later, European and Asian markets have not experienced the same rapid convergence to pre-Russian invasion of Ukraine norms, and this has created a comparative advantage for the Gulf Coast in attracting capital for projects in the processing and exporting of hydrocarbon-based products from the Gulf Coast region.

2.3 Outlook: Crude Oil and Natural Gas Production

Figure 6 shows crude oil and natural gas production forecasts for the Gulf Coast based on the Enverus ProdCast model.¹¹ Following tradition, both figures show the current forecast as well as those in the past two years' GCEOs.

Gulf Coast crude oil production forecast is anticipated to increase over the forecast horizon.¹² For perspective, in 2022 regional crude oil production averaged 8.5 MMbbl/d. In calendar year 2023, which at the time of this writing is partially completed, ProdCast estimates Gulf Coast oil production to average 9.3 MMbbl/d, or an increase of approximately 9 percent. By 2032, Gulf Coast oil production is forecasted to reach 11.6 MMbbl/d. This oil production forecast has been downgraded slightly since the last year's GCEO. As with prior years, there is plenty of oil in the ground to sustain a decade of production growth. Although not shown here, Prodcast also estimates U.S. oil production to increase over the next decade.

Figure 6: Gulf Coast oil and natural gas production forecast



Source: Enverus ProdCast.

Figure 6 also shows that Gulf Coast natural gas production is also anticipated to continue to grow over the next decade.¹³ In 2022, Gulf Coast natural gas production was about 52 Bcf/d. Prodcast is estimating natural gas production to increase to 56.2 Bcf/d in 2023, or a 7 percent increase. By 2032, Prodcast estimates Gulf Coast natural gas production to reach over 63 Bcf/d. Thus, both oil and natural gas production in the region are anticipated to experience a decade of growth despite the fact that oil and natural gas prices are both in backwardation. Although not shown graphically, both U.S. oil and natural gas production are also anticipated to grow over the coming decade.

¹¹ We thank Enverus for providing access to this model.

¹² Note that the definition of the Gulf Coast region in the Enverus Prodcast model differs slightly from political boundaries, due to the inherently geological nature of the model.

¹³ Ibid.

3. Midstream Constraints and Pipeline Activity

Geographic differences in crude oil and natural gas prices often drive 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”).

As in prior year GCEOs, Figure 7 compares differences in prices of 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.

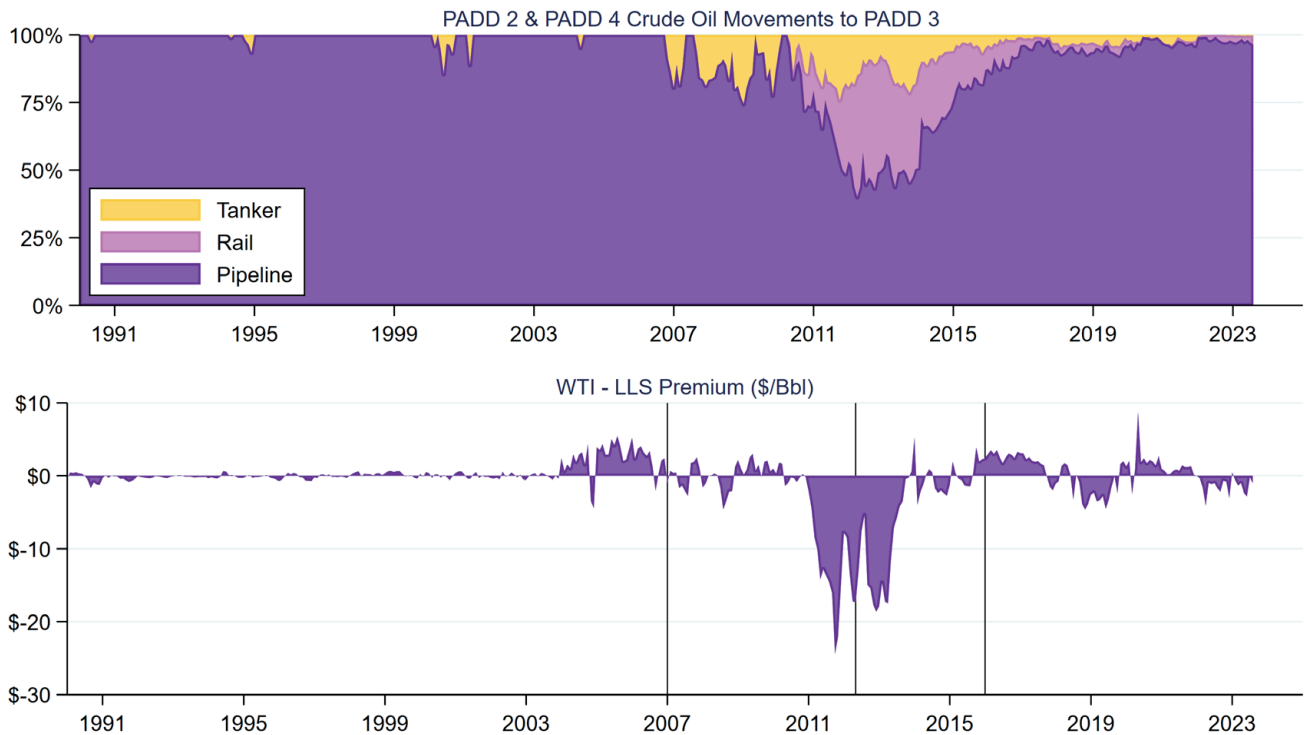
The top panel of Figure 7 shows the share of crude oil transported from PADD 2 and PADD 4 in the Mid-Continent (states in the Rocky Mountain and Midwestern regions) to PADD 3 on the Gulf Coast. From 1990 to 2007, almost all crude was transported from the mid-continent to the Gulf Coast via pipeline. 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 one-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.¹⁴ Evidence of shipping constraints, but not refining constraints, is observed.

For the past five years or so, crude markets have continued to be approximately in balance with a small premium to 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. Last year’s GCEO questioned whether pipeline additions could become necessary once U.S. oil production reached pre-pandemic levels. Given oil production has just recently eclipsed pre-pandemic levels and is currently experiencing historical highs, albeit by a small margin, time will tell whether pipeline constraints will become prevalent in the future. But as of today, markets appear to be in balance, with a small share of oil shipped via tanker and rail and price differences being minimal across space. If oil production continues to grow, GCEO will keep watch on whether price differentials emerge sending the price signal for additional pipeline capacity.

¹⁴ Agerton and Upton, 2019. Decomposing Crude Price Differentials: Domestic Shipping Constraints or the Crude Oil Export Ban? *The Energy Journal*, Vol. 40, No. 3.

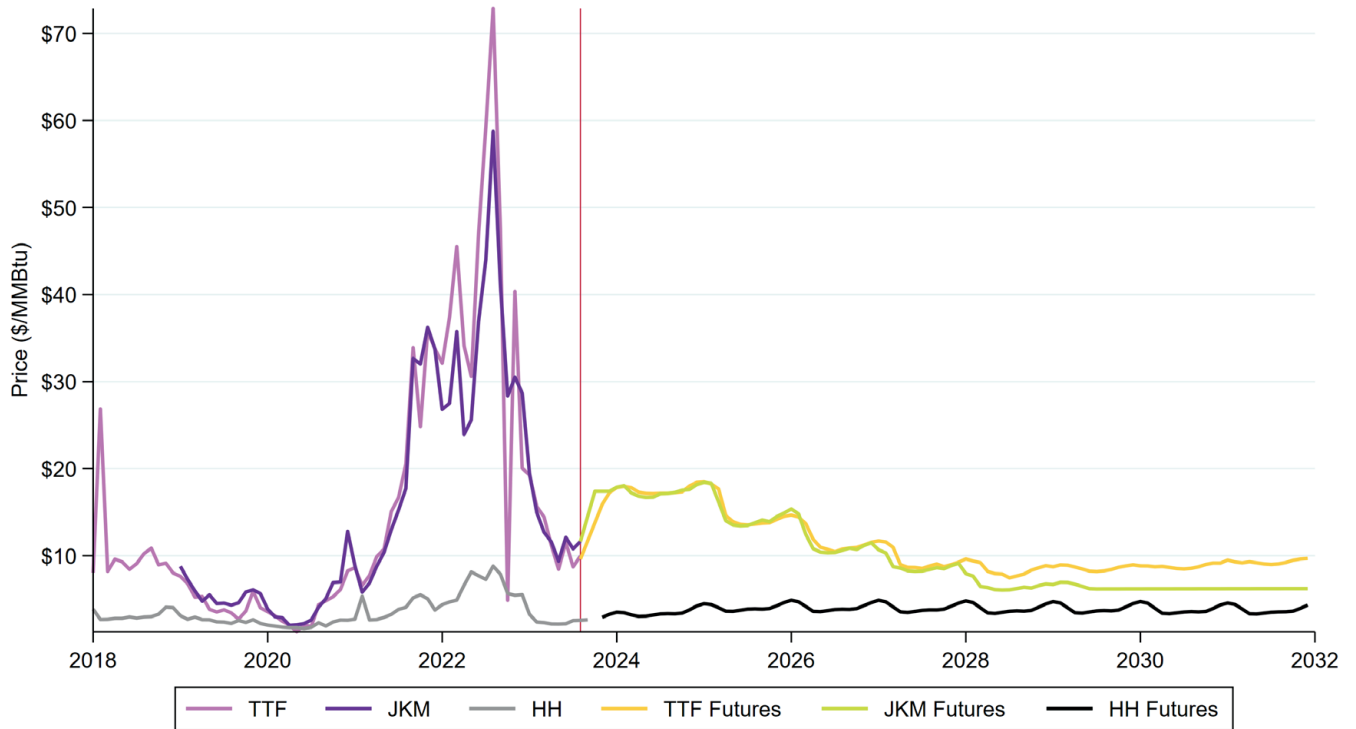
Figure 7: PADD 3 crude oil movements by transportation type



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.

The more notable spatial price differences instigating mid-stream investment are natural gas prices internationally. Figure 8 shows historical series for Henry Hub (Gulf Coast of U.S.), Title Transfer Facility (TTF—European benchmark), and the Japan Korean Marker (JKM—Asian benchmark). As recently as 2020, natural gas was trading at a similar price (within ~\$0.50 per MMBtu) in the U.S., Europe, and Asia. But this has changed dramatically over just a few years. In the most recent full month of data available, August of 2023, natural gas prices in Asia (represented by JKM) were approximately 350 percent more expensive than the Gulf Coast, while natural gas prices in Europe (represented by TTF) were approximately 290 percent more expensive. Thus, the mid-stream constraints for natural gas are between *international* locations; not as much within the U.S. While not shown here, international oil prices do not vary nearly as much as natural gas, with Brent (in Europe) trading at less than \$5 per barrel more than WTI (in the U.S.).

Figure 8: Henry Hub (HH), Japan Korean Marker (JKM) and Title Transfer Facility (TTF) natural gas prices



Source: Bloomberg Terminal.

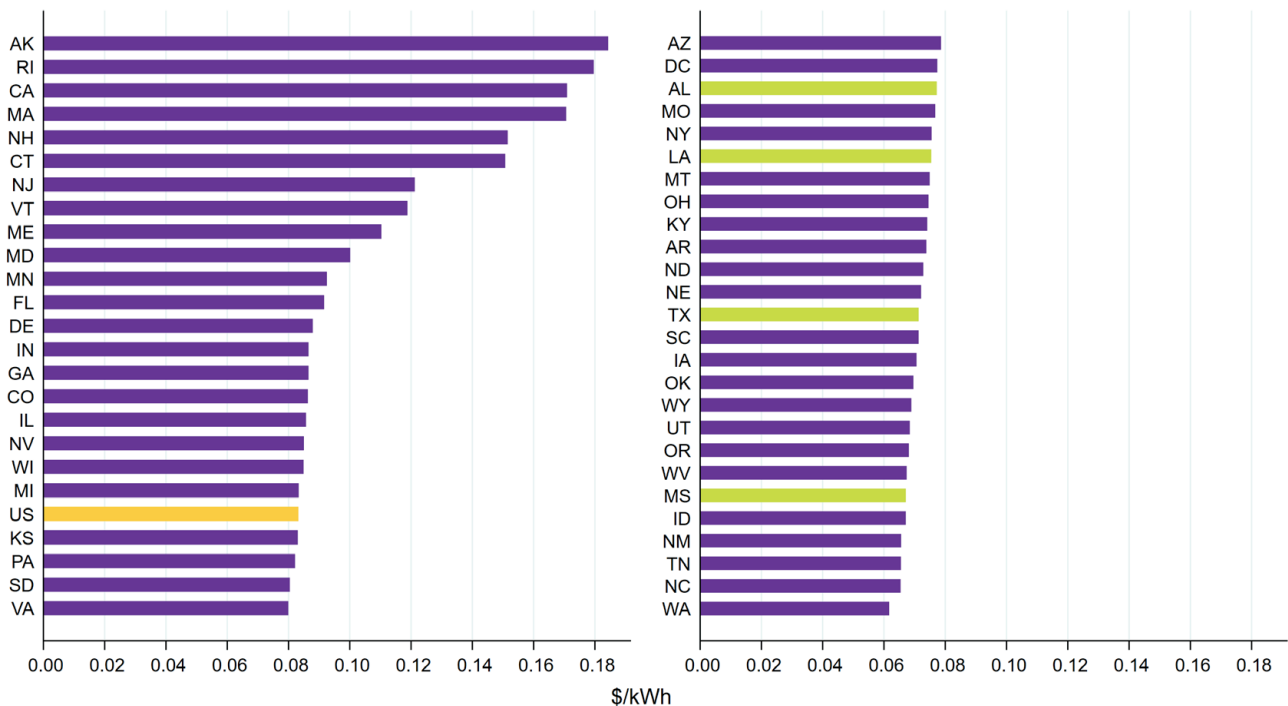
4. Power Sector

4.1 Retail Prices

Electricity is an important input for energy manufacturing that can comprise as much as 75 percent of total variable operating costs. Thus, regional electricity price competitiveness is important in regional economic development. The Gulf Coast continues to be a region with competitive industrial retail electricity rates. Figure 9 shows recent (2022) industrial retail electricity prices for the U.S. and each state.

National average industrial electricity rates, at around \$0.08 per kilowatt-hour (“kWh”), are considerably higher than the Gulf Coast composite regional average of about \$0.07 per kWh, which gives the region about a 14 percent electricity cost advantage. All Gulf Coast states, on an individual basis, are below the national average industrial retail price, with Mississippi leading the pack in regional retail electricity industrial price competitiveness. Texas has industrial retail rates that are lower than Louisiana by about five percent.

Figure 9: Retail industrial electricity prices



Hawaii (\$0.36/kWh) is excluded from the figure.

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

Although not shown in the figure the Gulf Coast has been competitively priced relative to the national average for the last decade. During the period of between 2014 to 2020, the Gulf Coast saw industrial retail price differences that actually grew more favorable relative to the overall U.S. average. This

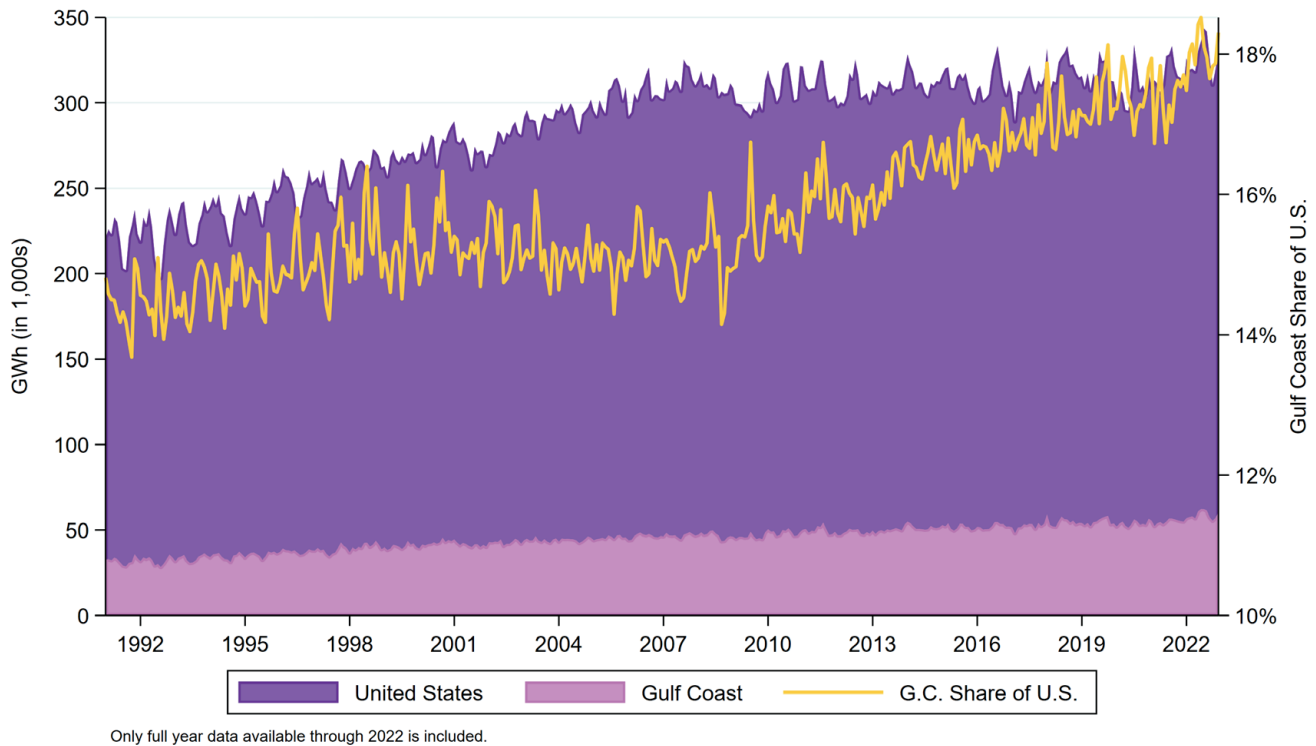
differential has tightened in recent years, despite improving thermal generation efficiencies in the region, particularly for utilities in the MISO region. Prices were up in 2021 and 2022, in large part due to the surge in natural gas prices occurring during the 2021-2022 heating season. However, while natural gas price changes explain increased prices both in the Gulf Coast and nationally, it does not explain the compression in the differential between the two. The adoption of policies promoting more expensive, but less emissions-intensive, power generation (such as renewables), or non-load growth dependent capital investment (such as those investments aimed at resiliency and modernization), could be one explanation for this increasing compression.

4.2 Load Growth

Figure 10 shows 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 GWhs to all customers in the United States in 2007 (the highest load year before the Great Recession) to the most recent full year available (2022). Current (2022) electricity sales are within four percent of those reported in 2007 (the last highest annual sales level). There have been some speculations that electricity demand nationwide might begin to increase if a trend towards electrification of vehicles, heat pumps, stoves, and other appliances catch on. But to date, U.S. electricity load growth continues to be flat.

The Gulf Coast, however, has seen differing trends with electricity sales increasing by 21 percent over this same time period. Although not shown here, the Gulf Coast's growing share of electricity sales is driven by industrial sales. The Gulf Coast region accounted for over 18 percent of U.S. industrial sales in 2007, and at the time of this writing accounts for over 21 percent of nationwide industrial sales. This growth in industrial sales has been spurred by energy manufacturing activity, which will be discussed further in Section 5.

Figure 10: U.S. and Gulf Coast electricity sales

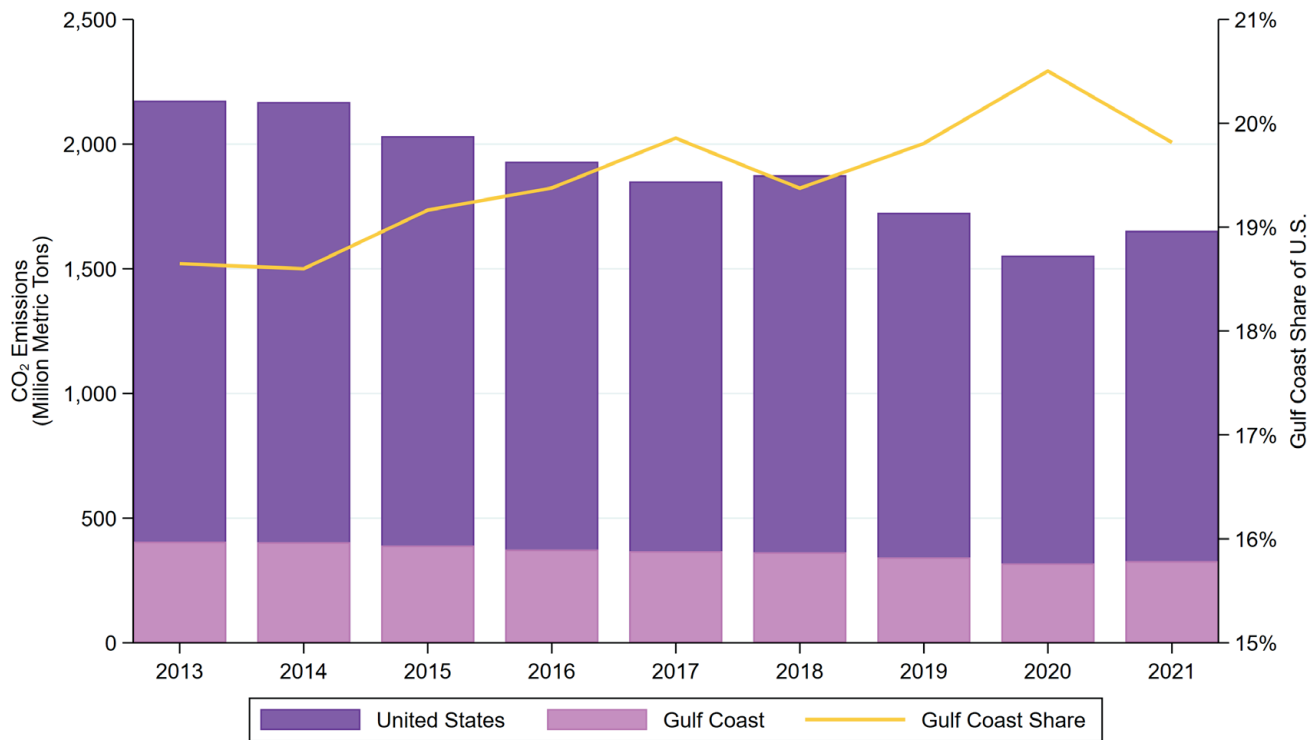


Source: U.S. Energy Information Administration. Retail sales of electricity to ultimate consumers.

4.3 Carbon Emissions

GHG emissions associated with power generation are provided in Figure 11. Note that this data is available with a lag, and thus is only available until the calendar year 2021. Between 2013 and 2020, U.S. and Gulf Coast power-generation-related GHG emissions are down 29 percent and 21 percent, respectively. These decreases are attributable to the development of a greater level of renewable energy and considerable thermal efficiency gains by the region’s utilities. Emissions did increase both nationwide and in the Gulf Coast between 2020 and 2021, largely attributable to high natural gas prices and therefore shifting load toward coal power plants. Despite this past year’s increase in CO₂ emissions, GCEO anticipates a continued trend of reduced power related emissions. This is due to (1) increased penetration of renewables and (2) more efficient combustion, especially for natural gas, as older plants are retired and new plants come online.

Figure 11: U.S. and Gulf Coast carbon dioxide emissions from electricity generation



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

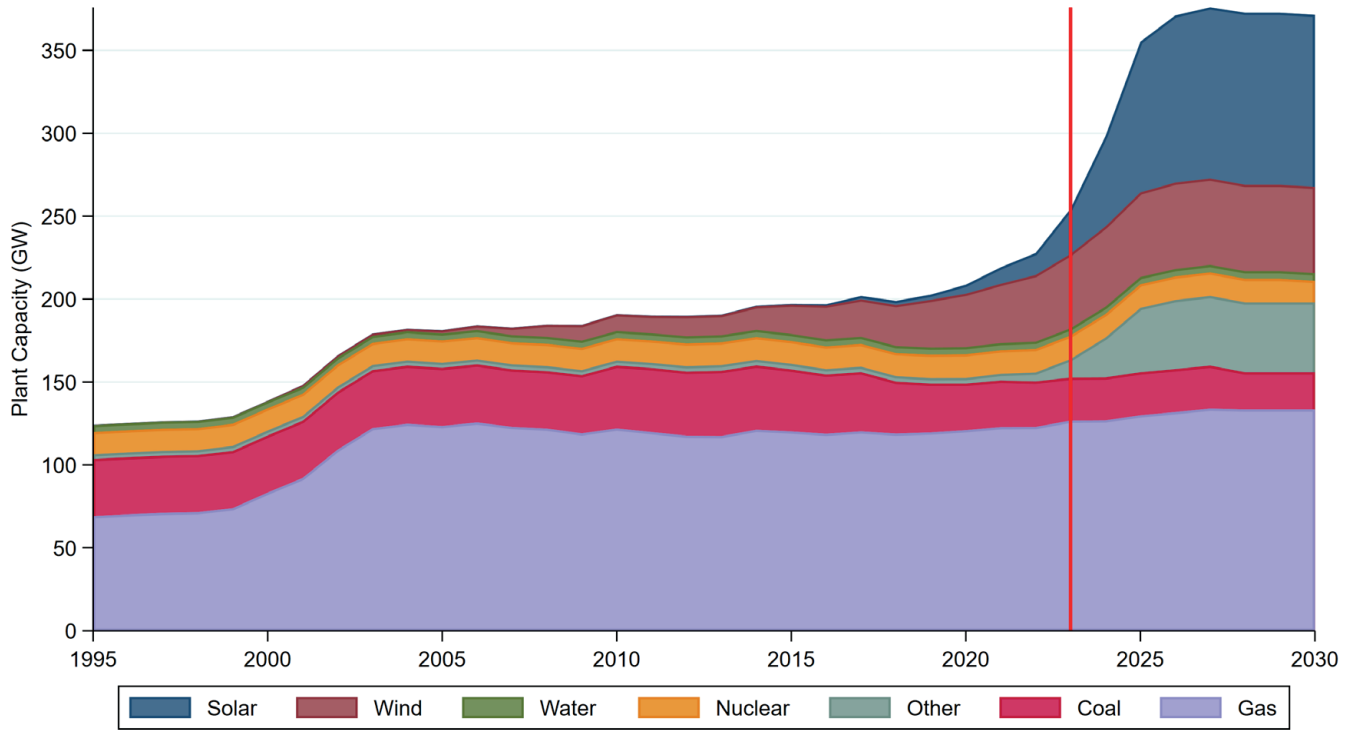
4.4 Capacity Investment

Figure 12 shows historic and projected power generation capacity by fuel source for the Gulf Coast region. Projections are developed by S&P Global Market Intelligence. Interestingly, approximately 65,000 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 approximately 21,200 MW of solar capacity in the interconnection queue. This number is almost double the approximately 11,500 MWs reported in last year’s GCEO. For perspective, solar capacity was less than 100 MW in the Gulf Coast region as recently as 2011. Figure 12, also shows about 12,000 MW of wind capacity in the planning phase. In third place, natural gas has approximately 10,000 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. Thus, although solar capacity might very well grow over the next five years or so, readers should be aware that this figure shows installed capacity, not share of electricity generated. For perspective, in 2022 (the most recent full year of data available), natural gas accounted for 40 percent of electricity generated nationwide, wind for 10 percent, and solar for less

than 4 percent.¹⁵ Renewables share of electricity generation are likely to increase, but natural gas is likely to be the largest fuel source for some time.

Figure 12: Gulf Coast power generation capacity and outlook



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

¹⁵ U.S. Energy Information Administration. "What is U.S. electricity generation by energy source?" U.S. utility-scale electricity generation by source, amount, and share of total in 2022.

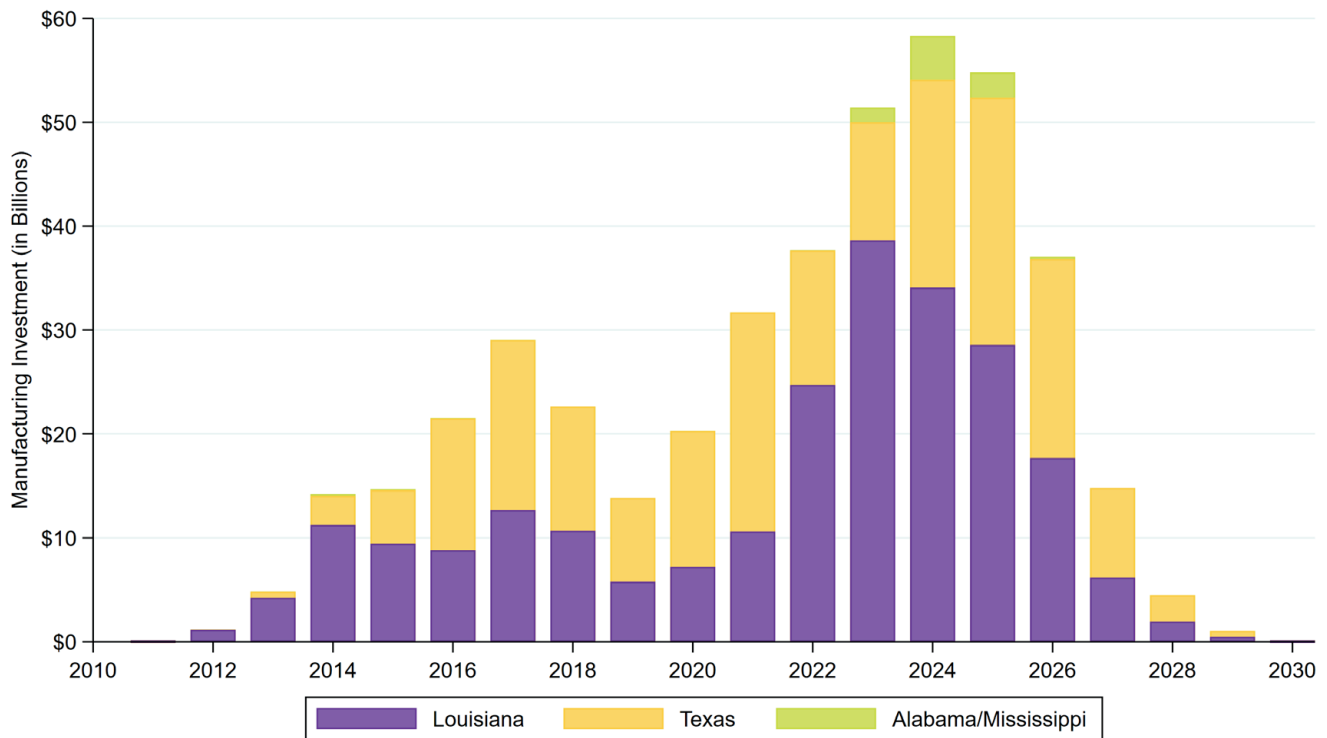
5. Energy Manufacturing Activity

5.1 Energy Manufacturing

Recent trends in regional energy manufacturing underscore the investment resilience of Gulf Coast energy development as illustrated in Figure 13. The years during and after the pandemic slowed overall development. There were \$40 billion in announced projects for 2021, while the final tally came in around \$31 billion, or 22 percent below. Likewise, there were \$43 billion in announced regional investments for 2022 in last year's GCEO, where the actuals have come in around \$38 billion: again, lower, but not at variances that should give regional economic developers any concern, particularly in an environment seeing increasing finance costs.

Focus on the variances, though, misses the bigger mark of the magnitude of the investments in the region. Since 2013, the allocation of energy manufacturing investment dollars has slightly benefited, on a relative basis, Louisiana (\$144 billion, or 55 percent), Texas (\$116 billion, or 44 percent), and the rest of the Gulf region (\$1.8 billion, or less than one percent).

Figure 13: GOM energy manufacturing investments by state



Source: Center for Energy Studies, authors' construct from publicly reported data; capex for announced projects with missing information were estimated using available data from average/typical facility type/cost.

Since 2013, the Gulf Coast has seen over \$262 billion in energy manufacturing investment, or as much as \$23.8 billion per year. The evolution of this investment has changed materially starting, in

the 2008 time period, with major upgrades and expansions at existing facilities, to new and significant capacity expansions and greenfield projects during the post-2013 time period (including those associated with developing energy export capabilities), and, today, a new focus on transforming existing energy manufacturing facilities to be more conscious of their carbon intensity. The 2024 GCEO anticipates that as time progresses, energy transition investments will account for over half of all regional energy manufacturing investment, particularly in the later time horizon.

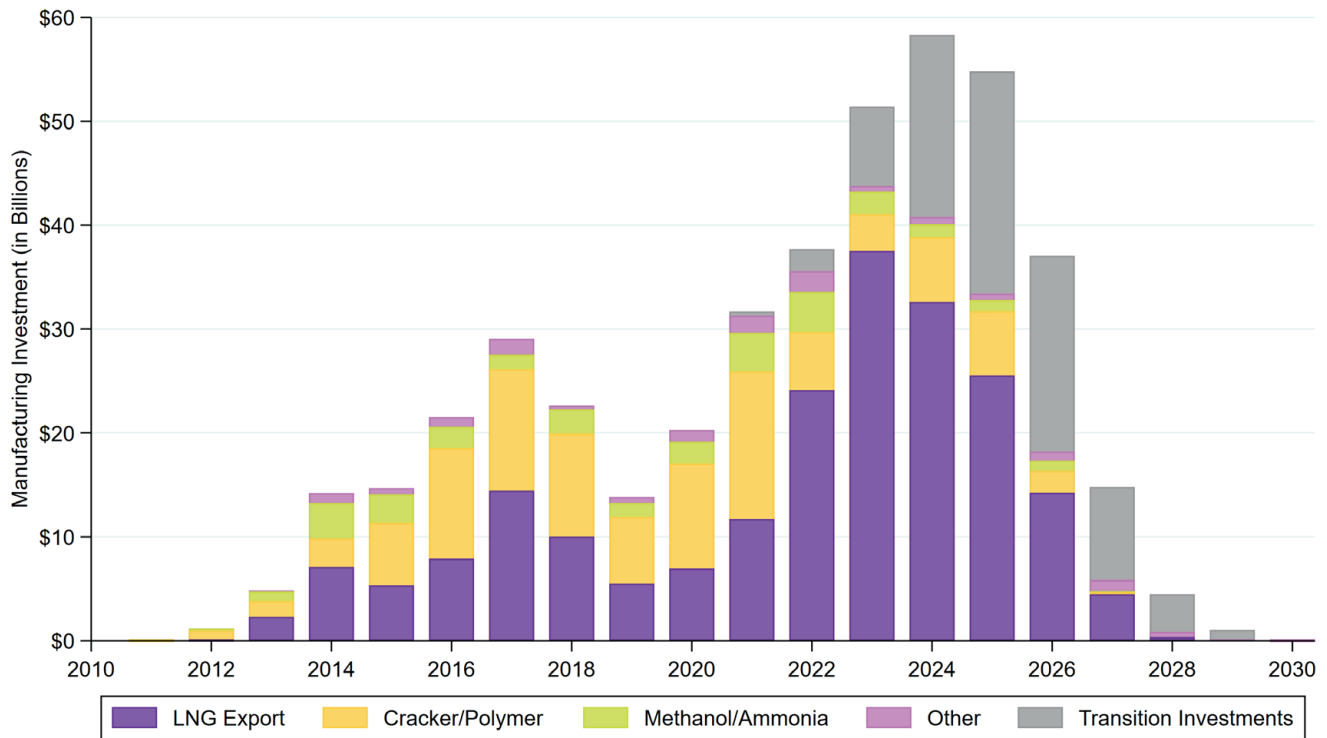
The current regional energy manufacturing announcements are considerably higher than reported in last year's GCEO, which identified around \$175 billion in new capital expenditure announcements. This year's outlook identifies \$222 billion in announced investments out to 2030, a number that is 26 percent higher than the 2023 GCEO.

The 2023 GCEO identified as much as 69 percent of all energy manufacturing investment to be located in Louisiana, driven in large part by LNG export investment. This year, Louisiana's relative share of announcements has fallen to around 57 percent, while Texas has increased to a more proportional share of regional capital investment. The surge in Texas investment is being driven, in large part, by several significant energy transition projects in the greater Houston area, particularly those associated with carbon capture and storage (CCS).

Last year's GCEO noted that "energy transition" investments, or those dedicated to reducing future industrial carbon emissions, are becoming an increasingly more important form of regional industrial investment. In this 2024 GCEO, we identify announced regional energy transition investments at a sizable \$79 billion or 36 percent of all energy manufacturing investments over the next decade. Last year, announced energy transition investments, accounted for \$29 billion, or 16 percent of the announced energy manufacturing investment. Thus, both the size and share of energy transition announcements has increased.

Of particular interest in the energy transition has been CCS projects announced for the Gulf Coast region. These CCS facilities are being designed to capture carbon emissions from industrial facilities, or, in some instances, directly from the atmosphere in what are referred to as "direct air capture" (DAC) facilities. To date, there are a considerable number of large CCS facilities announced for the Gulf Coast region, most of which are anticipated to come online between the 2027-to-2029 time period. If these projects come to fruition, by 2028, the region could see close to 200 million metric tons of annual storage capability, a level that could have a considerable positive impact on the carbon neutrality goals of many industries and policy makers along the Gulf Coast.

Figure 14: GOM energy manufacturing investments by sector



Source: Authors' construct; capex for announced projects with missing information were estimated using available data from average/typical facility type/cost.

Gulf Coast Manufacturing

- Between 2011 and 2022, there was approximately \$212 billion of investment in refining, chemicals, and hydrocarbon export across the Gulf Coast region.
- Approximately \$106.5 billion, or 50 percent is within Louisiana.
- Currently, there are an additional \$170.5 billion in announcements, with approximately 52 percent of these announcements in Louisiana.

5.2 Energy Manufacturing Outlook

As shown in Figure 14, the 2024 GCEO identifies \$222 billion in new energy manufacturing announcements from 2022 through 2030. This represents a \$47 billion, or 26 percent growth in total regional capital investment relative to last year's GCEO over a comparable period of time. While overall investment dollars are down, what differs in this outlook relative to prior years is the surge in new "energy transition" investments. Table 1, for instance, breaks out investments across four primary categories: (a) LNG investments; (b) non-LNG/chemical industry investments; (c) energy transition investments; and (d) "other" investments. These energy transition investments collectively, account for \$79 billion

and include a wide range of new and innovative plans and processes to avoid GHG emissions, including CCS, “green” hydrogen, “green” ammonia, and various “blue” hydrogen/ammonia processes. Note that utility-scale renewable energy generation is not included in this category and has been discussed earlier in the electric capacity outlook. While not readily apparent from Table 1, the 2023 GCEO envisions energy transition-related investments to continue to grow in outlying years and ultimately catch up with, or even rival, more traditional LNG and non-LNG investment levels.

Table 1: Total GOM investments

Year	Texas				Louisiana				Other GOM				Total GOM			
	LNG	Non-LNG	Transition	Total	LNG	Non-LNG	Transition	Total	LNG	Non-LNG	Transition	Total	LNG	Non-LNG	Transition	Total
----- (million \$) -----																
2023	5,274	2,986	3,133	11,393	30,910	3,190	4,513	38,613	1,321	-	1	1,322	37,506	6,277	7,646	51,429
2024	8,517	5,413	6,066	19,997	20,049	2,609	11,426	34,085	4,038	-	21	4,060	32,604	8,171	17,514	58,290
2025	10,010	4,941	8,851	23,803	13,113	2,946	12,507	28,566	2,394	-	29	2,423	25,517	7,887	21,387	54,791
2026	9,292	1,742	8,116	19,151	4,750	2,200	10,735	17,684	213	-	3	217	14,255	3,942	18,854	37,052
2027	4,103	1,139	3,387	8,629	373	232	5,558	6,163	-	-	-	-	4,477	1,371	8,945	14,792
2028	347	505	1,698	2,550	-	-	1,935	1,935	-	-	-	-	347	505	3,633	4,484
2029	-	118	473	591	-	-	457	457	-	-	-	-	-	118	930	1,048
2030	-	8	30	38	-	-	31	31	-	-	-	-	-	8	61	69
Total	\$37,544	\$16,852	\$ 31,754	\$86,151	\$69,195	\$11,177	\$ 47,161	\$127,533	\$7,967	\$ -	\$ 55	\$8,022	\$114,706	\$28,279	\$ 78,970	\$221,955

Source: Authors’ construct; capex for announced projects with missing information were estimated using available data from average/typical facility type/cost.

Louisiana leads the Gulf Coast region in total energy manufacturing investment announcements with as much as \$127.5 billion by 2030 (57 percent of total). Much like last year’s GCEO, LNG investments dominate the energy manufacturing investment outlook with as much as \$114.7 billion in total investment in the outlying years of the outlook period, most of which are earmarked for Louisiana. Non-LNG investments (\$28.3 billion), mostly associated with chemical and refinery upgrade investments, are estimated to be around 12.7 percent of total regional investment and are more evenly balanced between Texas and Louisiana.

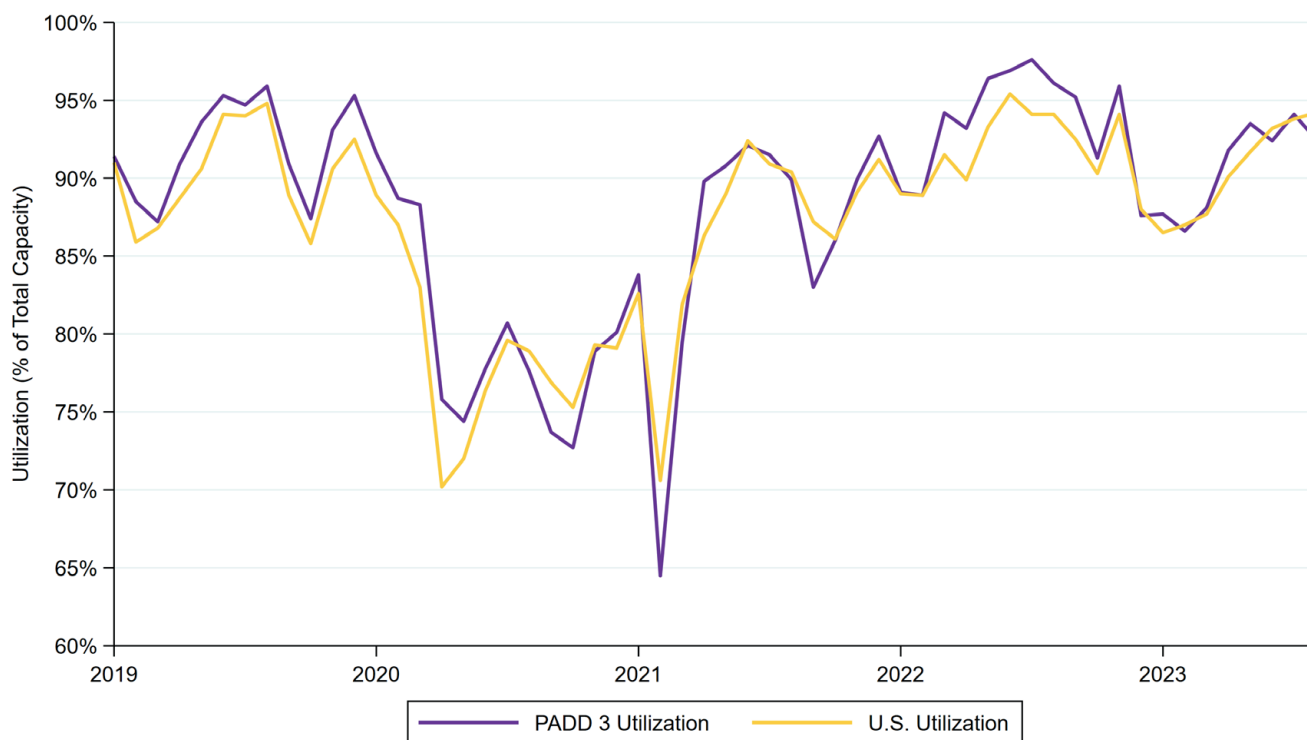
6. Energy Exports

6.1 Refined Products

The Gulf Coast region's refining sector continues its post-pandemic economic rebound, driven in by export opportunities arising, in part, from the geopolitical uncertainties in Eastern Europe, and increasingly, the Middle East. Both U.S. and regional refining capacity utilizations have increased since a pandemic-induced low in the spring of 2021. The one exception, as noted in last year's GCEO, was the tropical activity of 2021, which had operational impacts on refineries in coastal Texas and southwestern Louisiana.

As shown in Figure 15, this year refinery utilizations are reaching levels not seen since 2019, approaching the mid- to upper 90 percent range. A further trend is the fact that last year's concerns about the continued economic viability of smaller regional refineries seem to have been quelled, at least in the short run. The 2023 GCEO expressed concern about recent refinery shut down announcements and the fact that several refineries had not been rehabilitated since the 2021 tropical season. However, no new shut-down announcements have been made over the past year and for now, all seems relatively calm on the refinery shut-down front, likely a function of continued strong global demand for refined product, the region's increasingly important role in meeting global energy export requirements, geopolitical uncertainty, and the resulting increase in crack-spreads or regional refinery profitability.

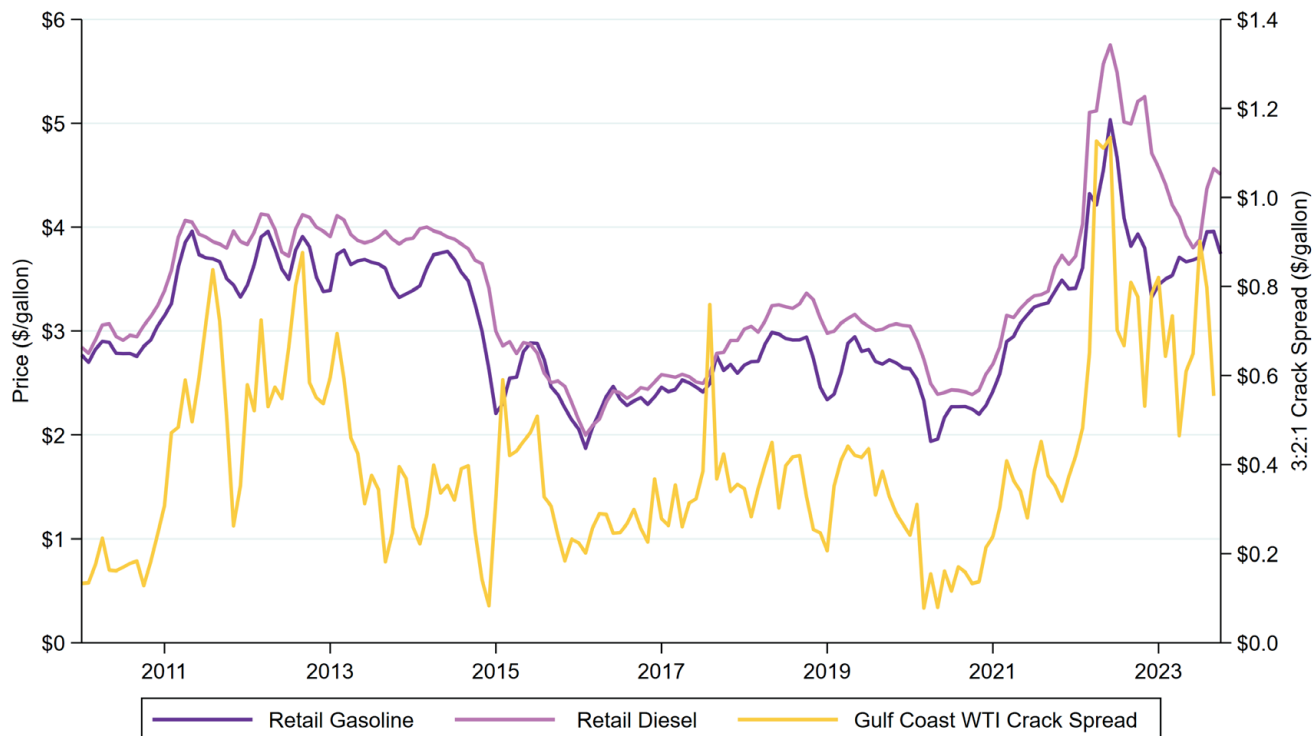
Figure 15: U.S. and PADD 3 monthly refining utilization



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

Overall refining profitability has also improved from last year as crack spreads across all major refined product types have increased, as illustrated in Figure 16. Last year, the 2023 GCEO noted that regional spreads were on the rise, and likely to continue. This year, those same trends hold and are likely to continue to hold as the possibilities of a global, and particularly U.S., economic slowdown fall. Broader markets are all indicating continued relative economic strength: that, coupled with new geopolitical concerns in an already supply-constrained energy market are likely to buttress near-term refining margins and profitability.

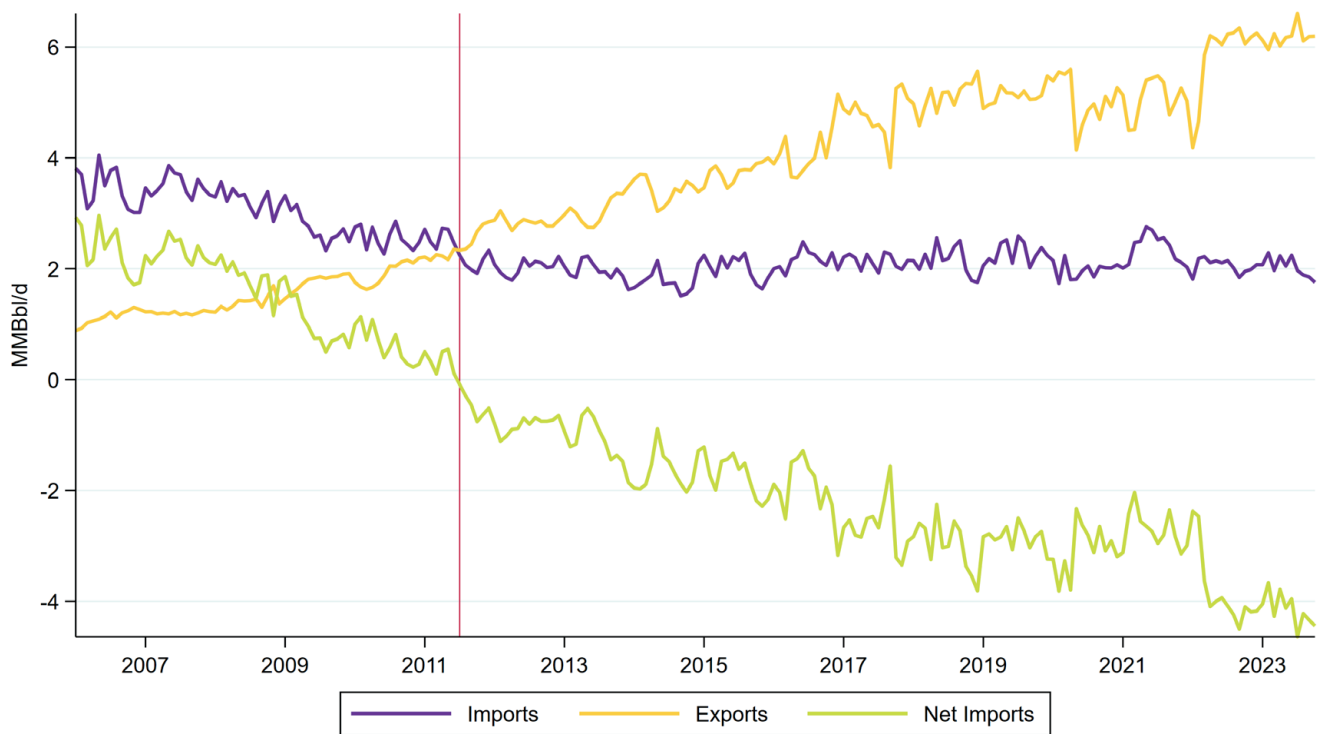
Figure 16: Retail gasoline, diesel prices, and refinery crack spread



Source: EIA, Bloomberg Terminal, and authors' calculations. Gasoline prices are for all grades and all formulations, and diesel is based on U.S. No. 2 retail price.

Lastly, refined product trade: past trends seen in last year's GCEO are likely to continue as the U.S.' position as a global energy exporter strengthens. Disruptions and uncertainties in global energy markets, including refined product markets, will likely see a buttressing of current strong relative U.S. export positions in global markets, if not some smaller opportunities for growth. As shown in Figure 17, U.S. refined product net exports continue to grow.

Figure 17: U.S. refined products trade

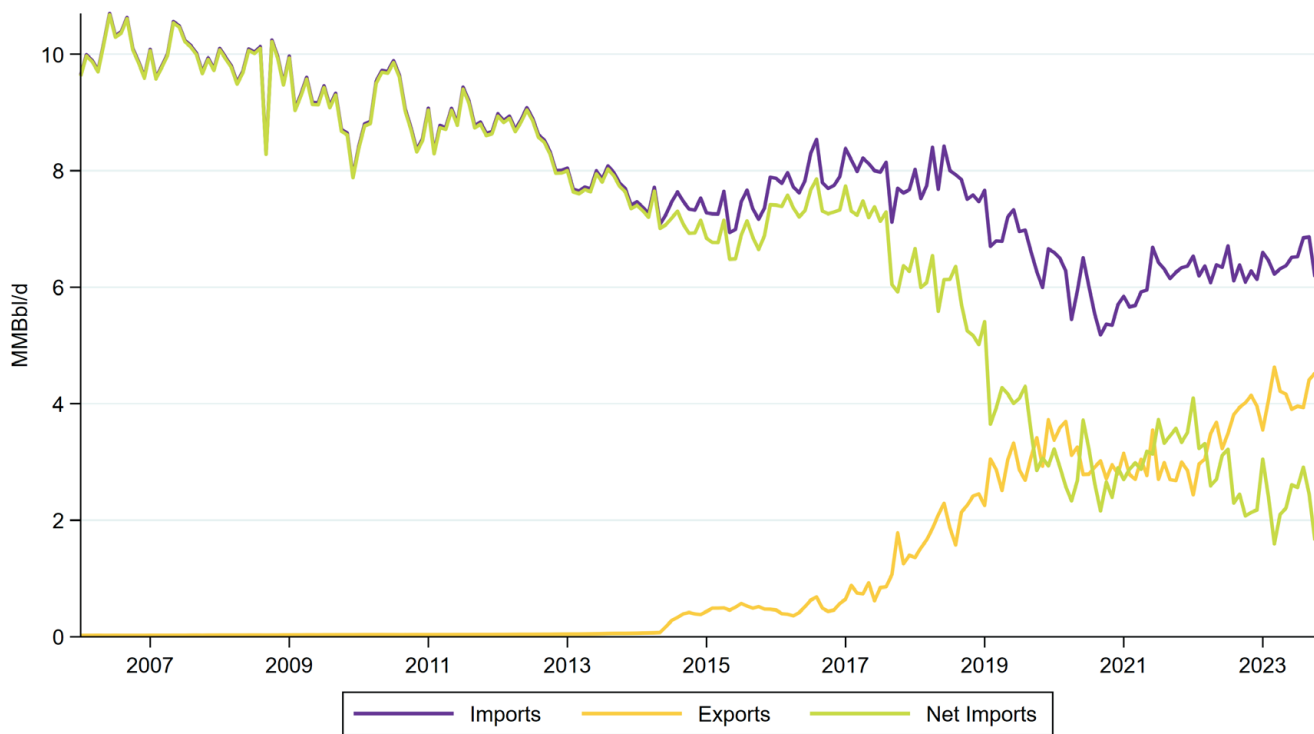


Source: U.S. Energy Information Administration

6.2 Crude Oil

U.S. crude oil exports are shown in Figure 18. While the U.S. is still a net importer of crude oil, it has been expanding its position in global crude oil trade dating back to the middle part of the last decade, when U.S. exports surged from around six percent of total global crude oil supply, to as much as 12 to 14 percent. U.S. crude oil trade has expanded rapidly since the lifting of the oil export embargo in 2015, particularly along the Gulf Coast which accounts for almost all crude oil leaving U.S. shores. The supply sources for a good part of these crude oil exports also originate from the region, particularly the Permian basin, and to a much lesser extent the Eagle Ford. Crude oil exports continue to grow from an average of around 3 MMBbl/d to levels that now average 4 MMBbl/d. The 2024 GCEO sees this trend continuing with 4 MMBbl/d likely being the new “floor” on overall imports levels.

Figure 18: U.S. crude oil exports and imports

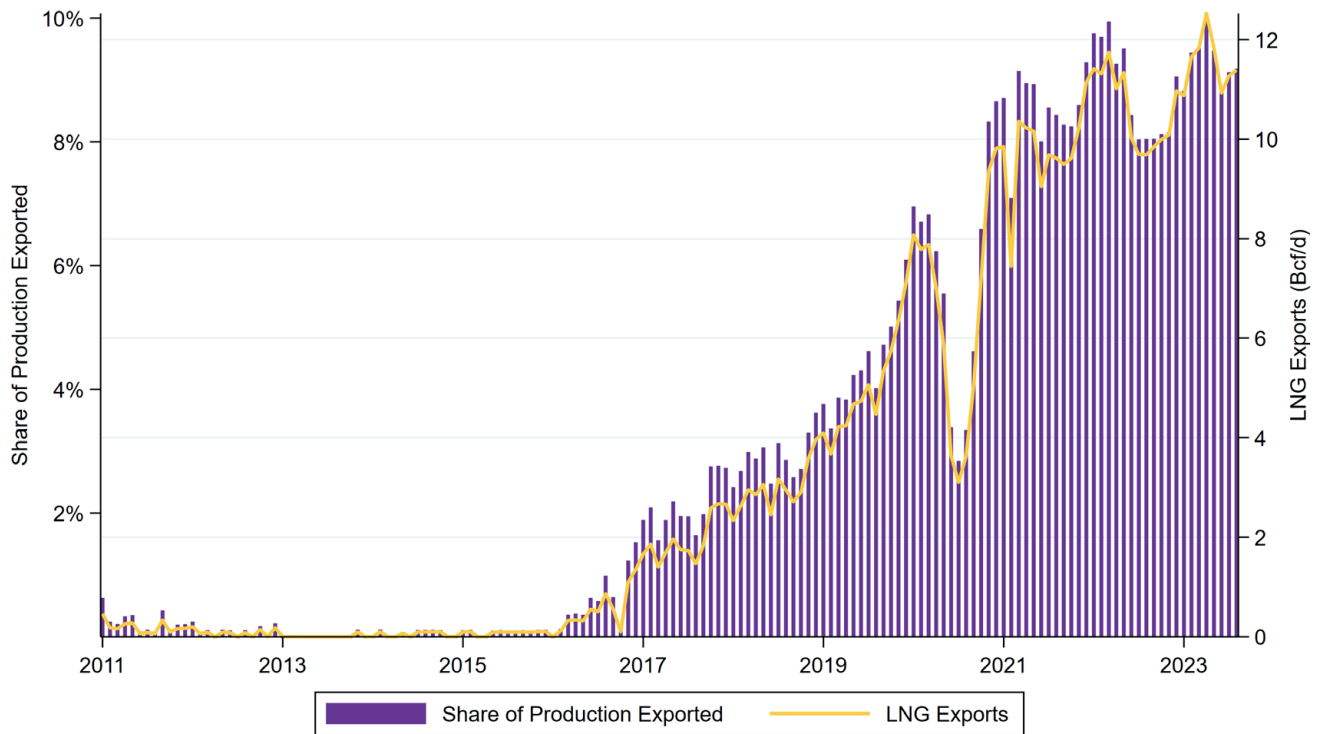


Source: U.S. Energy Information Administration. Petroleum & Other Liquids. U.S. Imports and Exports of Crude Oil.

6.3 Liquefied Natural Gas Exports

Global liquefied natural gas (LNG) trade has benefited considerably from the geopolitical uncertainties and conflicts that are ongoing in Eastern Europe. Natural gas volumes leaving U.S. shores continue to expand with regional export availability and capacity. Events over the last two years (2022-2023, inclusive) have shown how vulnerable these export volumes can be to capacity availability. In June 2022, for instance, Freeport LNG in Texas, the second largest export facility along the Gulf Coast at 2 Bcf/d, experienced a fire, shutting down the facility for a good part of a year. Figure 19 shows the significant deterioration this had on export volumes. The facility is back online, and total U.S. LNG export volumes are back to their pre-fire levels of 11.3 Bcf/d.

Figure 19: U.S. liquefied natural gas exports



Source: U.S. Energy Information Administration.

The outlook for LNG export volume growth is challenged. On the one hand, tight global energy markets, continued economic growth, and geopolitics suggest considerable LNG export opportunities from the U.S. However, to date, few proposed LNG export facilities, whose capacity will be needed to meet any regional LNG export volume growth, have secured longer-term offtake contracts. Uncertainty appears to be the culprit for this lack of commitment. Surprising European natural gas usage resilience, the availability of unexpected natural gas substitutes (coal, fuel oil), mild weather and economic conditions have taken near-term pressure off some European buyers. In addition, the future of natural gas use, in Europe as well as North America, continues to be uncertain as fossil fuel supply and demand reducing policies, and new restrictions on natural gas appliance uses, continue. Thus, at least in the near term, it would appear “more of the same” is likely in store for natural gas use. This could all change with a cold European winter, unexpectedly strong economic growth (particularly in Asia), or new and unexpected geopolitical tensions.

7. Employment Outlook

7.1 Employment Forecasts

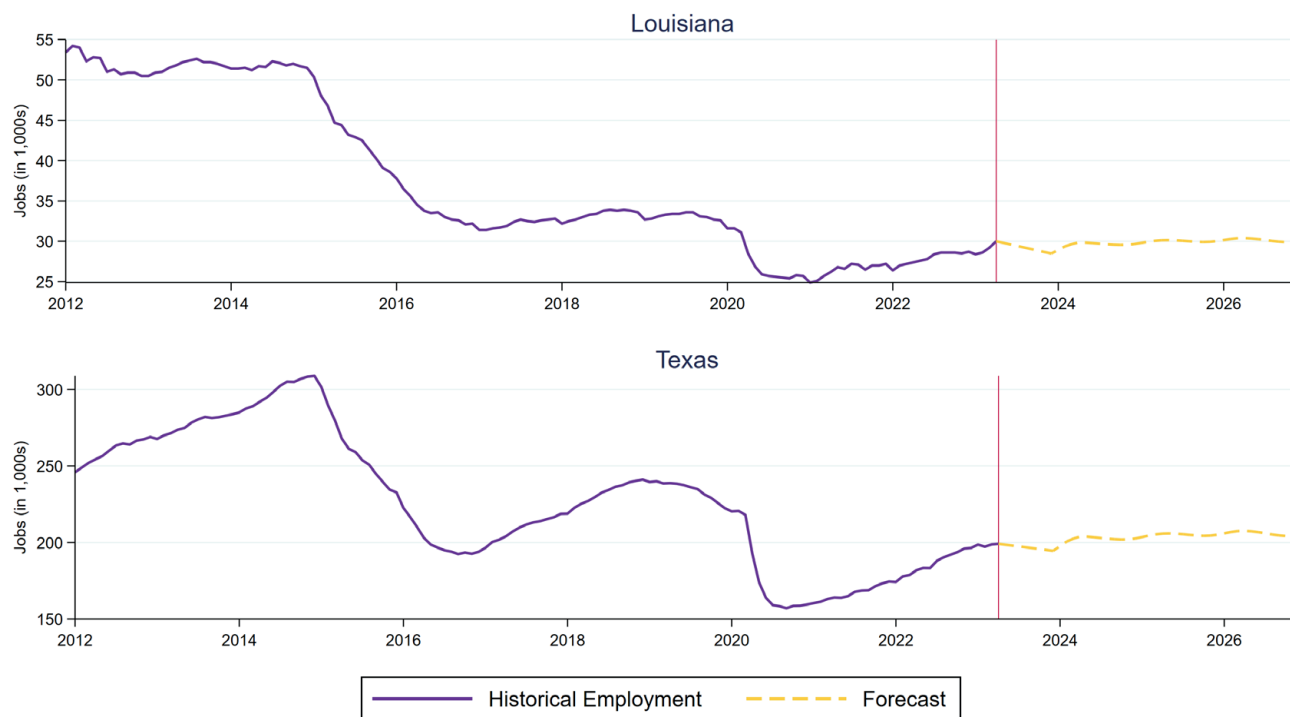
In this final section of the GCEO, all prior sections are synthesized into employment forecasts. Employment is forecast within two broad sectors: (1) upstream oil and gas extraction and services and (2) refining and chemical manufacturing. Sectors are identified based on the North American Industry Classification 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).¹⁶ 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). Also note that each data series comes out with a lag. The most recent month of complete data available is March of 2023. Thus, part of the “forecast” has already occurred, we just have not observed the labor market data. Please also note that past data is revised, and so historical observations themselves can change as revisions become available.

Upstream oil and gas employment for both Louisiana and Texas exhibit three key patterns in historical data shown in Figure 20. 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. Comparing the peak employment experienced in 2019 relative to the post COVID-trough, Louisiana lost ~8,700 jobs in total while Texas lost ~83,000 jobs. On a percentage basis, Louisiana and Texas lost 26 percent and 35 percent, respectively. Thus, not only did Texas lose more jobs, but it also experienced a larger percentage drop relative to Louisiana. Based on the most recent monthly estimate (March of 2023), Louisiana and Texas have gained back ~5,000 jobs and ~42,000 respectively. Thus, Louisiana has gained back 59 percent of the jobs lost, while Texas has gained back 50 percent.

¹⁶ Chemical manufacturing includes many product types, including resins, pesticides, pharmaceuticals, paints, soaps, and others.

Figure 20. Upstream employment forecast



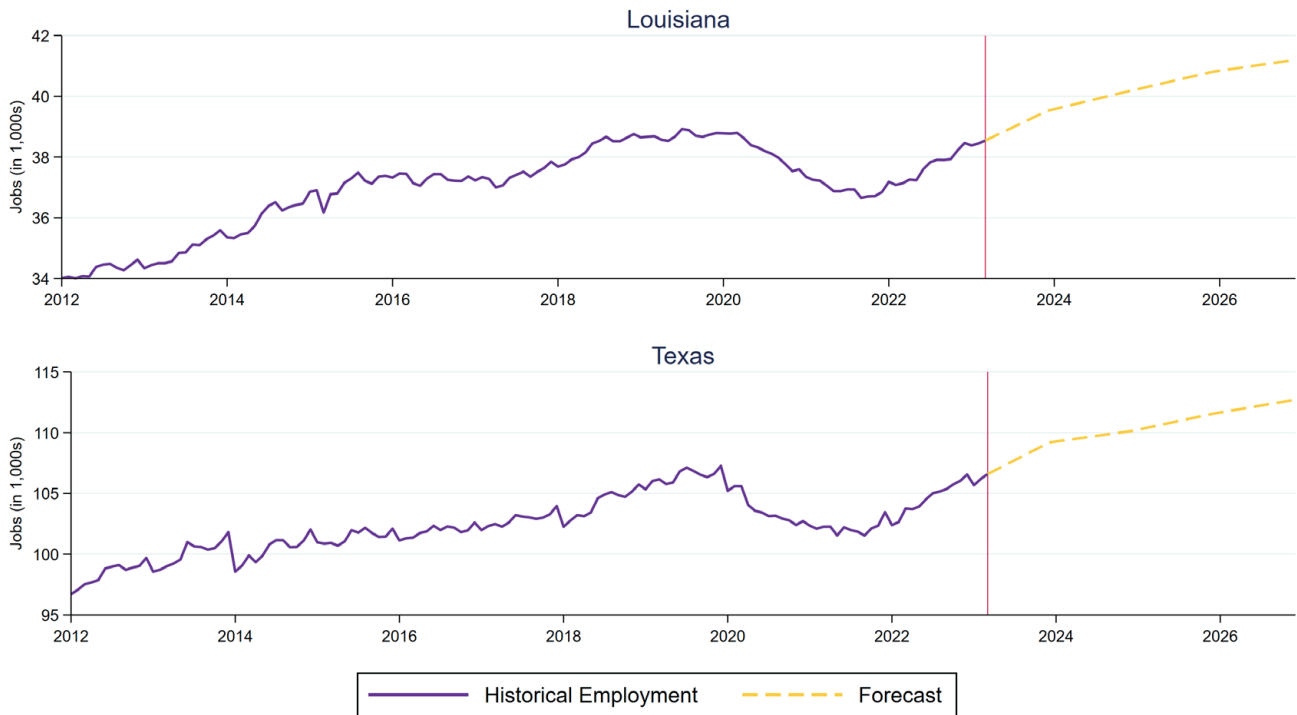
Source: U.S. Bureau of Labor Statistics, Current Employment Statistics. Authors' forecast.

Figure 20 also shows the forecasted employment in the upstream oil and gas sectors for Louisiana and Texas, respectively. Econometric forecasts are based on a combination of the futures markets for oil and natural gas shown in Figure 5, alongside the Enverus ProdCast model outputs shown in Figure 6.

Note that with rig counts declining and oil and gas prices both in backwardation, we anticipate employment flattening off in 2023. Specifically, comparing year-over-year employment (i.e. Dec 2022 to December 2023), Louisiana upstream employment is estimated to be within one half of one percent. Models estimate that Texas will lose approximately 1,900 upstream jobs in 2023; a reduction of approximately 1 percent. This modeling result is consistent with the prior mentioned observation that Texas upstream employment responds more on a percentage basis than Louisiana upstream employment to price shocks.

Louisiana is forecasted to gain approximately 1,000 upstream jobs in 2024, or about 4 percent due to the current lagged effect of relatively high prices, and then levelize in 2025 and 2026. Texas is forecasted to gain approximately 8,000 upstream jobs in 2024, or about 4 percent, then gain 2,500 jobs in 2025 (a 1.2 percent increase) and then flatten out 2026. Neither Texas nor Louisiana upstream employment are forecasted to reach pre-COVID levels over the forecast horizon.

Figure 21: Refining and chemical manufacturing employment forecast



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

Historical data on refining and chemical manufacturing employment are shown in Figure 21. Both states exhibit two notable trends. First, pre-COVID, both states experienced approximately a decade of growth in these sectors. As discussed throughout, GCEO attributes this employment growth to the investment in these sectors that has facilitated the exporting of products around the globe. 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 (or the economy overall). From peak to trough, Louisiana and Texas lost approximately 2,300 and 5,700 refining and chemical manufacturing jobs. This is about a 5-to-6 percent reduction in both states (compared to more than 25 percent job losses in upstream employment in each state).

Figure 21 also shows 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.

For Louisiana, GCEO anticipates refining and chemical manufacturing employment continue its upward trajectory. Specifically, we estimate 1,060 new jobs will be gained in 2023, an increase of about 3 percent. Note that part of this is still due to post pandemic recovery, while another part is due to continued investment. By the end of 2024, GCEO estimates that Louisiana refining and chemical employment will have rebounded back to the pre-pandemic peak and have added approximately 700 additional jobs above the pre-pandemic peak. From 2024 to 2026, GCEO estimates between a

1 and 2 percent increase in jobs each year; thus, continued growth but at a slower clip than experienced this past year once full post-pandemic recovery is complete.

Texas refining and chemical manufacturing employment exhibits a similar pattern to Louisiana. In 2023, Texas refining and chemicals employment is also forecasted to surpass the pre-pandemic peak, increasing by 2,600 jobs or approximately 2.5 percent. Texas refining and chemical employment is forecasted to increase by approximately 1,000 jobs in 2024, 1,400 jobs in 2025, and 1,200 jobs in 2026.

8. Conclusions

Perhaps the most interesting takeaway from this past year is the resilience of the Gulf Coast energy system in responding to the effects of Russia's invasion of Ukraine on global energy markets. Last year, GCEO stated that the prior year (i.e. 2022) would be remembered for Russian's invasion of Ukraine and its implications for energy markets globally. A year ago, many national forecasters believed that a recession was imminent, and that high and volatile energy prices would ensue. Neither of these has occurred. While a risk of recession is still in the cards, to date no such recession has occurred. Oil and natural gas prices, and price volatility, in the U.S. are within ranges that would have been reasonably observed before the Russian invasion.

Last year GCEO noted that the energy policy discussion had shifted toward energy security in the short term as consumers experienced higher prices. While decarbonization was indeed an important topic of discussion a year ago, energy security was front and center. This year, investments in industrial decarbonization re-emerged as perhaps the most discussed topic in GCEO phone calls with stakeholders.

This is not to say that geopolitical risks are over. In the weeks leading up to the release of this 2024 GCEO, geopolitical tensions again reared their head in the Israel-Hamas conflict that is ongoing. Further, Russia's invasion of Ukraine continues. Despite these tensions, Gulf Coast energy markets have adjusted and are functioning with relative normalcy at the time of this writing.

In the long-term GCEO still sees the Gulf Coast as well positioned as a net exporter of energy. In fact, political instability in other parts of the world can solidify the Gulf Coast of the U.S. as a reliable source of hydrocarbon-based products such as liquid fuels, chemical products, fertilizers, and polymers. GCEO continues to see longer-term opportunities for investment and employment growth in the energy manufacturing sectors, while upstream oil and gas employment is forecasted to be relatively flat.

Decarbonization will play an increasingly important role in corporate strategy. This is accelerated by the fact that the U.S. is still in the beginning phases of the most ambitious legislation to date regarding the energy transition: the Inflation Reduction Act (IRA). There are still questions about permitting constraints that might reduce the effectiveness of the IRA over our forecast horizon, but nonetheless the IRA is anticipated to accelerate investment in lower-carbon energy. GCEO continues to believe that one important factor in determining the region's continued energy expansion is to continue the longer-term goals of decarbonizing the energy sector in cost competitive ways to ensure global competitiveness in decades to come.

Endnotes

ⁱ U.S. Energy Information Administration. Annual Energy Outlook 2023. Table 1. Total Energy Supply, Disposition, and Price summary. Total consumption (in quads) in 2032 is anticipated to be within one percent of 2022 total consumption (in quads).

ⁱⁱ U.S. Energy Information Administration. U.S. Field Production of Crude Oil (Thousand Barrels per Day). Sourcekey: MCRFPUS2. Comparison of 2022 and 2002.

ⁱⁱⁱ U.S. Energy Information Administration. U.S. Natural Gas Gross Withdrawals (MMcf). Sourcekey: N9010US2. Comparison of 2022 and 2002.

^{iv} U.S. Energy Information Administration. U.S. energy facts explained. U.S. Primary energy production by major sources, 1950-2022. Renewables accounted for 8.9 quadrillion British Thermal Units in 2012 and 13.4 quadrillion British Thermal Units in 2022, an increase of 50.6 percent.



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