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Uncertainties

1. Is a Recession Still on the Horizon?
2. Decarbonization Efforts: Balancing Cost Competitiveness and Emissions Reductions
3. What have we learned from the Russian Invasion of Ukraine?
4. Supply Restrictive Policies
5. Is Permitting the New Bottleneck?
Reached pre-pandemic employment in June of 2022.

Most recent month (October): 3% above pre-pandemic employment.

14% below pre-pandemic peak

"The stock market has predicted nine of the last five recessions."
- Paul Samuelson

Wage growth outpacing inflation
Wage growth about equal to inflation

Real Gross Domestic Product

Major World Economies

Source: Bloomberg.
Real Gross Domestic Product per Capita

Major World Economies

Source: Bloomberg.
1.1 Is a Recession Still on the Horizon?

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.
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.
- We are still in the beginning phases of the Inflation Reduction Act’s (IRA) 10-years of spending on emissions reductions.
  - IRA signed into law in August of 2022.
  - Energy & climate accounted for 84% of bill’s spending.
- Three Stylized Facts:
  1. Energy demand has been flat in the U.S. for a decade, and this is expected to continue.
  2. Energy production has increased over this time period:
     - Oil ↑ 83%; Natural gas ↑ 47%; renewable energy ↑ 51%.
  3. Energy production growth facilitated by exports.

Balancing cost competitiveness and emissions competitiveness at the top of companies minds when making investment decisions.
Industrial emissions make up ~2/3 of Louisiana’s GHG emissions, compared to ~17 percent nationally.

Industrial energy usage makes up approximately ~3/4 of energy usage in Louisiana, compared to ~1/3 nationally.
CO₂ Emissions Intensity of Real Gross Domestic Product

Source: U.S. Energy Information Administration
Real GDP is in billions of chained 2017 dollars, not seasonally adjusted
In 2021 (most recent year):

- China: 320% higher than U.S.
- India: 450% higher than U.S.
- Russia: 441% higher than U.S.
Risk or Opportunity?

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?

Source: S&P Global Market Intelligence

[Graph showing trends in Crude Oil and Natural Gas prices from 2002 to 2032, with projections for 2023 and beyond.]

- Crude Oil (WTI Historical) trends from $10 to $130 per barrel.
- Jan 2022 Futures and Oct 2022 Futures showing potential price movements.
- Natural Gas (Henry Hub Historical) trends from $0 to $15 per MMBtu.
- Jan 2022 Futures and Oct 2022 Futures showing potential price movements.
Historical Inflation Adjusted Crude Oil Prices

WTI Spot Price Adjusted to current Consumer Price Index.
Source: U.S. Energy Information Administration
1.3 What Have We Learned from Russia’s Invasion of Ukraine?

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

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.

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 ~31 million acres available for leasing.
  - ~17 million acres leased for ~$192 million.
- 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.
  - ~16 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 5-year leasing plan including 3 sales between 2024-29, lowest in the leasing program’s 70-year history.
  - Comes after substantial delay (previous plan expired in 2022).
Four sources of supply chain constraints discussed in prior years:
1. Economic recovery from COVID
2. Full employment economy + economic stimulus
3. Russian invasion of Ukraine and resulting sanctions
4. “Deglobalization”

GCEO modeling assumes that global supply chain constraints continue to attenuate, while uncertainty around permitting presents a more immediate bottleneck in project development.
What is Carbon Capture, Utilization and Storage (CCUS)?

Greg Upton, LSU Center for Energy Studies; Brian Snyder, LSU Department of Environmental Sciences; John Flake, LSU Cain Department of Chemical Engineering

What is CO₂?
Carbon dioxide (CO₂) is one of the most important gases on the planet. Plants need it to grow, animals exhale it, and many of our most important industrial processes emit it. It is what makes the gas bubbles (fizz) in sodas, beer, and champagne. CO₂ is also the product of burning anything made of carbon.

CO₂ is one of the gases that has influenced the climate for millions of years. It’s a greenhouse gas (GHG), meaning it traps heat that would normally be radiated back into space. In other words, CO₂ in the atmosphere works like the glass in a greenhouse, warming the planet by preventing heat from escaping.

Over the past 150 years, the concentration of CO₂ in the atmosphere has increased from about 280 parts per million to about 420 parts per million as of 2023. This has already contributed to the planet warming by about 1 degree Celsius, or about 2 degrees Fahrenheit compared to the average of the 20th century. If humanity continues to emit CO₂ at current rates, scientists believe that warming will continue. Continued warming can lead to sea level rise, increased extreme precipitation events, and other effects that will impact humans. The Paris Agreement addressing anthropogenic (human caused) GHG emissions was ratified by over 190 countries, representing 97 percent of the global population. Customers and investors worldwide are telling companies with operations in Louisiana they want the products to be made without emitting so much CO₂.

What is Carbon Capture?
Many of our industrial facilities and processes emit CO₂, including refineries, chemical plants, fertilizer plants, as well as power generation from certain sources like coal and natural gas. Louisiana industrial facilities produce products that make modern life possible and sell these products worldwide. For example, without fertilizer, we could not produce enough food for the world’s population. Likewise, polymers produced in Louisiana are used to make the detergents, clothing, tennis shoes, and packaging materials that we use every day.

Carbon capture occurs when the CO₂ emissions from an industrial facility or power plant are captured before they can be emitted to the atmosphere. This typically involves an “amine scrubber” that is used to remove CO₂ from chemicals and gasses. Amine scrubbing takes advantage of the fact that some chemicals (amines in the liquid phase) bind or “capture” CO₂. These systems, though, are expensive to install in an industrial facility, and once operational require significant energy to run. The amount of energy required depends on the CO₂ concentration in the emissions stream, among other factors. If the emissions from an industrial facility have a high concentration of CO₂, the energy required to capture the CO₂ decreases. Some industrial processes, especially fertilizer production, already produce very pure streams of CO₂. Capture from these sources is thus relatively low cost and low energy. On the other hand, capturing CO₂
Oil production just eclipsed pre-pandemic peak. Natural gas production 6% above pre-pandemic peak.

Gulf Coast oil production eclipsed pre-pandemic levels in September of 2022: currently 8.4% higher.
Natural gas production 17% above pre-pandemic peak.

United States Rig Count

Source: Baker Hughes Rig Count Overview
Historical Inflation Adjusted Crude Oil Prices

WTI Spot Price

Average Price

Plus 1 SD

Minus 1 SD

WTI Spot Price Adjusted to current Consumer Price Index.
Source: U.S. Energy Information Administration
Historical Inflation Adjusted Natural Gas Prices

Henry Hub Spot Price adjusted to current Consumer Price Index.
Source: U.S. Energy Information Administration
Natural Gas Production Forecast

Gulf Coast Share of U.S.

Share of Total(%)

2007 2010 2013 2016 2019 2022 2025 2028 2031

Gulf Coast

Total U.S.

Rest of U.S.

Source: Enverus. DrillingInfo Podcast.

LSU Center for Energy Studies
Natural Gas Production Forecast

Total United States


Source: Enverus. DrillingInfo Podcast.

LSU Center for Energy Studies
Natural Gas Production Forecast

Gulf Coast

Source: Enverus. DrillingInfo Procast.
U.S. Value of Production

Historical and Forecast

Value of Production (Millions of USD)

JKM Natural Gas Prices

Historical Comparison

Source: Bloomberg
Natural Gas Pipeline Capacity Additions

by Project Type

Capacity (Bcf)

In-service Year

2022

2023

2024

2025

2026

2027

Source: U.S. Energy Information Administration, U.S. Natural Gas Pipeline Projects
Natural Gas Pipeline Capacity Additions
by Project Status

In-service Year: 2022, 2023, 2024, 2025, 2026, 2027

Legend:
- Part Completed
- Completed
- Approved
- Applied
- Announced
- Construction

Source: U.S. Energy Information Administration, U.S. Natural Gas Pipeline Projects
Gulf Coast Industrial Electricity Sales

Share of Industrial Sales in United States

- United States
- Gulf Coast
- G.C. Share of U.S.

Source: U.S. Energy Information Administration
Only full year data available through 2022 is included.
2022 Average Industrial Electricity Rates

Source: Energy Information Administration
Hawaii ($0.36/kWh) is excluded from the figure.
CO₂ Emissions per MWh of Generation

Gulf Coast & United States

Note: The emissions data presented include total emissions from both electricity generation and the production of useful thermal output.
NO\textsubscript{x} Emissions per MWh of Generation

Gulf Coast & United States

Note: The emissions data presented include total emissions from both electricity generation and the production of useful thermal output.

SO₂ Emissions per MWh of Generation
Gulf Coast & United States

Note: The emissions data presented include total emissions from both electricity generation and the production of useful thermal output.
Historical & Future Power Plant Capacity
United States

- 167 GW of solar
- 80 GW of wind
- 25 GW of coal retirements
- 28 GW of Natural gas
77 GW of solar
3.5 GW of coal retirements
7 GW of natural gas
7 GW of wind
If all Louisiana solar were built out, it would be enough to power 3 million Louisiana households!
PADD 3 Refining Capacity and Utilization

- Operating Capacity (MMBbl/d)
- Utilization (% of Total Capacity)

Legend:
- Operating Capacity
- Utilization

Data from 2000 to 2021
US Gulf Coast Gasoline
WTI Crack Spread

Source: EIA and Bloomberg.
U.S. Crude Oil Trade

Source: U.S. Energy Information Administration
Gulf Coast Exports to World
by NAICS

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

LSU Center for Energy Studies
Emissions Intensity of GDP
Including Land Use, Land-Use Change, and Forestry

Kg of CO₂ eq. / $ of Real GDP

Source: GDP data from Bloomberg. Emissions data from the IMF.
Emissions Intensity of GDP
Excluding Land Use, Land-Use Change, and Forestry

Kg of CO₂ eq. / $ of Real GDP

Source: GDP data from Bloomberg.
Emissions data from the IMF.
36% of announcements energy transition related investments
~Half of investments through 2022 in LA.
~57% of announcements in LA.
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.

Table 1: Total GOM investments

<table>
<thead>
<tr>
<th>Year</th>
<th>Texas</th>
<th>Louisiana</th>
<th>Other GOM</th>
<th>Total GOM</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>LNG</td>
<td>Non-LNG Transition</td>
<td>Total</td>
<td>LNG</td>
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<tr>
<td>2023</td>
<td>5,274</td>
<td>2,986</td>
<td>3,133</td>
<td>11,393</td>
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<tr>
<td>2024</td>
<td>8,517</td>
<td>5,413</td>
<td>6,066</td>
<td>19,997</td>
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<tr>
<td>2025</td>
<td>10,010</td>
<td>4,941</td>
<td>8,851</td>
<td>23,803</td>
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<td>2026</td>
<td>9,292</td>
<td>1,742</td>
<td>8,116</td>
<td>19,151</td>
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<tr>
<td>2027</td>
<td>4,103</td>
<td>1,139</td>
<td>3,387</td>
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<td>2028</td>
<td>347</td>
<td>505</td>
<td>1,698</td>
<td>2,550</td>
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<tr>
<td>2029</td>
<td>-</td>
<td>118</td>
<td>473</td>
<td>591</td>
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<tr>
<td>2030</td>
<td>8</td>
<td>30</td>
<td>38</td>
<td>86</td>
</tr>
</tbody>
</table>

Total $37,544 $16,852 $31,754 $86,151 $69,195 $11,177 $47,161 $127,533 $7,967 $ - $ - $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.
2023: flat
2024: ~1,000 (~4%) jobs gained
2025: ~300 (~1%) jobs gained
2026: flat
2023: ~1,900 (~1%) jobs lost
2024: ~8,000 (~4%) jobs gained
2025: ~2,500 (~1%) jobs gained
2026: flat
Louisiana Share of Upstream Employment

2023: ~1,000 (2.8%) jobs gained
2024: ~700 (1.7%) jobs gained
2025: ~650 (1.6%) jobs gained
2026: ~400 (1%) jobs gained
2023: ~2,600 (2.5%) jobs gained
2024: ~900 (0.9%) jobs gained
2025: ~1,400 (1.3%) jobs gained
2026: ~1,200 (1%) jobs gained
## Broader Economic Implications

<table>
<thead>
<tr>
<th>Industry</th>
<th>Multiplier</th>
</tr>
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<tbody>
<tr>
<td><strong>Upstream Oil and Gas</strong></td>
<td></td>
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<tr>
<td>Oil and Gas Extraction</td>
<td>2.3</td>
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<tr>
<td>Support Activities for Mining</td>
<td>3.1</td>
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<tr>
<td><strong>Oil and Gas Manufacturing</strong></td>
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<tr>
<td>Petroleum and Coal Products Manufacturing</td>
<td>4.4</td>
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<tr>
<td>Chemical Manufacturing</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Source: RIMS II Multipliers

Note: Multipliers represent the total change in number of jobs in all industries for each additional job in the industry corresponding to the entry.
GULF COAST ENERGY OUTLOOK

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