Gulf Coast Energy Outlook: Addendum.

Addendum accompanying whitepaper. See full whitepaper here.

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The inaugural **Gulf Coast Energy Outlook** seeks to provide a broad overview of the current status of trends guiding energy markets with an emphasis on the Gulf Coast Region.

The research initiative is a collaborative effort of Louisiana State University’s **Center for Energy Studies** and **E.J. Ourso College of Business** and focuses on the energy sector of the gulf Coast Region’s economy.

This document is an **addendum** to the whitepaper that can be found on the [LSU Center for Energy Study’s website](#). The whitepaper includes a number of graphs and figures and provides readers with a general understanding of the research vision and methodology.

This addendum provides significantly more detailed figures for reader’s wanting a more supporting information.
• Lower prices **reduced upstream activity**, but a slow recovery has started given the OPEC-induced price increase.

• Natural gas experience shows that **(crude oil) price recovery will be a long time coming.**

• Recent crude oil drilling/production activity is contributing to a significant rebound in associated gas production that **will likely sink the recent, short-lived natural gas price rebound.**

• U.S. producers are **very efficient** and have reduced costs, increased capital & operating efficiencies, and increased well productivity ("the best solution for low prices is low prices.")

• Crude oil and natural gas prices likely to remain **range-bound** with lower relative **pricing volatility.**

• Continued **positive investment/development activity** in mid-stream, refining, and processing/manufacturing – as well as **energy exports.**
Natural gas production and reserves are at levels not seen since the 1970s and both U.S. natural gas production and reserves are now at an all time recorded peak.

Crude oil production and reserves are climbing back to levels not seen since the early 1980s (reserves).

Recent Market Trends
Recent energy market drivers/changes.

**Recent market changes:**

• Non-OPEC production surge.

• OPEC floods market with predatory production action.

• Post-price-crash industry restructuring and resiliency.

• Recent OPEC production cuts.

• U.S. drilling/production response.
In the last ten years, global crude oil production has increased at an average annual rate of 1.2 percent. The U.S. share has increased from seven percent to over 11 percent.

OPEC crude oil production agreements.

The recent OPEC agreements have had the largest most recent impact on supply and prices

<table>
<thead>
<tr>
<th>Country</th>
<th>Reference Production Level (MBbl/day)</th>
<th>Adjustment (MBbl/day)</th>
<th>Production Level Effective January 2017 (MBbl/day)</th>
<th>Estimated Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEC Countries</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algeria</td>
<td>1,089</td>
<td>-50</td>
<td>1,039</td>
<td>4.6%</td>
</tr>
<tr>
<td>Angola</td>
<td>1,751</td>
<td>-87</td>
<td>1,664</td>
<td>5.0%</td>
</tr>
<tr>
<td>Ecuador</td>
<td>548</td>
<td>-26</td>
<td>522</td>
<td>4.7%</td>
</tr>
<tr>
<td>Gabon</td>
<td>202</td>
<td>-9</td>
<td>193</td>
<td>4.5%</td>
</tr>
<tr>
<td>Indonesia*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iran</td>
<td>3,975</td>
<td>-178</td>
<td>3,797</td>
<td>4.5%</td>
</tr>
<tr>
<td>Iraq</td>
<td>4,561</td>
<td>-210</td>
<td>4,351</td>
<td>4.6%</td>
</tr>
<tr>
<td>Kuwait</td>
<td>2,838</td>
<td>-131</td>
<td>2,707</td>
<td>4.6%</td>
</tr>
<tr>
<td>Libya</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nigeria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qatar</td>
<td>648</td>
<td>-30</td>
<td>618</td>
<td>4.6%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>10,544</td>
<td>-486</td>
<td>10,058</td>
<td>4.6%</td>
</tr>
<tr>
<td>UAE</td>
<td>3,013</td>
<td>-139</td>
<td>2,874</td>
<td>4.6%</td>
</tr>
<tr>
<td>Venezuela</td>
<td>2,067</td>
<td>-95</td>
<td>1,972</td>
<td>4.6%</td>
</tr>
<tr>
<td>Total OPEC Adj.</td>
<td>31,236</td>
<td>-1,441</td>
<td>29,795</td>
<td>4.6%</td>
</tr>
<tr>
<td>Non-OPEC Countries</td>
<td></td>
<td>-558</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Adjustment</td>
<td></td>
<td>-1,999</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *Indonesia has suspended its OPEC membership. Non-OPEC countries include Azerbaijan, Kingdom of Bahrain, Brunei Darussalam, Equatorial Guinea, Kazakhstan, Malaysia, Mexico, Sultanate of Oman, the Russian Federation, Republic of Sudan, and Republic of South Sudan

U.S. crude oil prices and rig count.

Rig counts have fallen precipitously, but are back on the rise.

Recent Trends

<table>
<thead>
<tr>
<th></th>
<th>Crude Oil Rigs</th>
<th>WTI Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 2009</td>
<td>340</td>
<td>$42.40</td>
</tr>
<tr>
<td>Jan 2016</td>
<td>514</td>
<td>$31.48</td>
</tr>
</tbody>
</table>

Source: Energy Information Administration, U.S. Department of Energy; and Baker Hughes.
Horizontal rig activity increased by 400 percent to 2015 but fell by over half during the ensuing price collapse. Current rebound is highly concentrated in the Permian basin.
U.S. crude oil production volumes are up by over 75 percent relative to historic trends. While production is down, it is still resilient and relatively strong.
U.S. natural gas production has increased 42 percent in the last 10 years.

U.S. crude oil stocks have increased at an average annual rate of two percent. Between 2014 and 2015 stocks increased eight percent; and another five percent in 2016.
Current natural gas storage levels are 16 percent above five year averages and 18 percent below the recent five year maximum.
Associated natural gas production (shale production).

Growth in associated natural gas is rebounding quickly and tanking the short-lived rebound in natural gas prices.

Associated natural gas production is starting to rebound with revived crude oil production, particularly in the Permian Basin.

Source: Energy Information Administration, U.S. Department of Energy
Drilled but uncompleted wells have increased by almost 50 percent in the last few years.

Note: Share of wells is the average of the last six months, September 2016 through February 2017.
Since 2013, the average wellhead break-even price for key shale plays has decreased from $80 per barrel to $35 per barrel, representing an average decrease of over 55 percent.

Note: Author's estimate from source. Source: Rystad Energy NASWellCube.
Most crude oil price projections for 2017 are around $55 per barrel. Prices are expected to increase in 2018, but remain below $75 per barrel.
Natural gas prices are expected to stay below $3.55 per MMBtu in 2017 and under $3.75 in 2018.
U.S. crude oil production trends and forecast.

US crude production will likely increase to over 10 MMBbls/d by 2020.
The Gulf Coast forecast, which includes all Texas Permian production, accounts for a significant share of the gain in U.S. crude oil production.
U.S. natural gas production continues to be resilient and shows continued strong growth through 2020 and beyond.
The Gulf Coast makes a significant contribution to the 80 Bcf/d U.S. market, but the Marcellus accounts for the largest relative share.
Industrial outlook
Shale-based resources have changed natural gas price volatility.

- Average 1997-2000: $2.89 (standard deviation: $1.46)
- Average 2001-2008: $6.24 (standard deviation: $2.39)
- Average post 2008: $3.52 (standard deviation: $0.93)

An estimated $240 billion in new energy-based manufacturing development is expected, most of which should occur between 2015 and 2019.

Source: Louisiana State University, Center for Energy Studies.
Of the proposed facility expansions in the Gulf of Mexico region, LNG export facilities comprise the majority of proposed capital spending.

Gulf of Mexico region: total proposed capital expenditures by sector.

- LNG Export, 59%
- Cracker/Polymer, 22%
- Methanol/Ammonia, 11%
- Other, 8%

Source: Louisiana State University, Center for Energy Studies.
The continued low natural gas price outlook has facilitated considerable development of over $142 billion: $46 billion already completed, $96 billion remaining, but heavily concentrated in LNG export facilities.

Excess global supply may start to build through 2020. The degree to which the market potentially becomes over-supplied will be function of project cancellations (if any) and continued growth.

These projections do not account for the relative competitiveness of proposed capacity additions. In most instances, US-GOM commodity chemical production ranks relatively “low” on the global supply curve (i.e., is very competitive).
Methanol demand and capacity outlook.

Excess global supply may start to build through 2020. The degree to which the market potentially becomes over-supplied will be function of project cancellations (if any) and continued growth.

These projections do not account for the relative competitiveness of proposed capacity additions. In most instances, US-GOM commodity chemical production ranks relatively “low” on the global supply curve (i.e., is very competitive).

Source: Author’s construct from previous slides.
Ethylene demand and capacity outlook.

Excess global supply may start to build through 2020. The degree to which the market potentially becomes over-supplied will be function of project cancellations (if any) and continued growth.

These projections do not account for the relative competitiveness of proposed capacity additions. In most instances, US-GOM commodity chemical production ranks relatively “low” on the global supply curve (i.e., is very competitive).

Source: Author’s construct from previous slides.
GOM LNG capacity.

Regasification
- Existing
- Under Construction
- Approved

Liquefaction
- Existing
- Under Construction
- Approved

Existing
A. Everett, MA: 1.035 Bcfd
B. Cove Point, MD: 1.8 Bcfd
C. Elba Island, GA: 1.6 Bcfd (+0.5 Expansion)
D. Lake Charles, LA: 2.1 Bcfd
E. Northeast Gateway, Offshore MA: 0.8 Bcfd
F. Freeport, TX: 1.5 Bcfd (+2.5 Expansion)
G. Sabine, LA: 4.0 Bcfd
H. Hackberry, LA: 1.8 Bcfd (+0.85 Expansion)
I. Neptune, Offshore MA: 0.4 Bcfd
J. Sabine Pass, TX: 1.0 Bcfd (+ 1.0 Expansion)
K. Pascagoula, MS: 1.5 Bcfd

Under Construction
L. Corpus Christi, TX: 2.14 Bcfd

Approved
M. Fall River, MA: 0.8 Bcfd
N. Port Arthur, TX: 3.0 Bcfd
O. Logan, NJ: 1.2 Bcfd
P. Port Lavaca, TX: 1.0 Bcfd
Q. Port Baltimore, MD: 1.5 Bcfd
R. LI Sound, NY: 1.0 Bcfd
If all of the LNG export applications currently filed with the Department of Energy were to come online, U.S. liquefaction capacity would exceed 50 Bcf per day by 2025. Most of this capacity would come online in 2020.
If all of the LNG export applications currently filed with the Department of Energy were to come online, the GOM liquefaction capacity would exceed 45 Bcf per day by 2025. Most of this capacity would come online in 2020.
Operable capacity at U.S. refineries has increased nearly 20 percent since 1995 while utilization has remained stable at 90 percent.

The Gulf Coast region became a net exporter of petroleum products at the end of 2008. Since then net exports have increased at an average annual rate of 40 percent.

In 2011, the U.S. became a net exporter of petroleum products. Net exports have increased 360 percent since then.

GOM refinery capacity outlook.

GOM refinery capacity has been increasing annually at an average rate of 1.5 percent per year.

![Graph showing refinery capacity from 2005 to 2025. The graph displays existing capacity and additional capacity, with the capacity increasing steadily over time.](image)
Energy Employment Outlook
Key Industries

• Oil and Gas
  • NAICS 211: Oil and Gas Extraction
  • NAICS 213: Support Activities for Mining

• Refinery and Chemical Manufacturing
  • NAICS 324: Petroleum and Coal Products Manufacturing (refineries)
  • NAICS 325: Chemical Manufacturing
Relative energy sector sizes as measured by employment.

<table>
<thead>
<tr>
<th>Region</th>
<th>Percent of State Total Employment</th>
<th>Percent of Industry Employment in US</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oil and Gas</td>
<td>Refining and Chemical Manufacturing</td>
</tr>
<tr>
<td>Alabama</td>
<td>0.1%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Florida</td>
<td>0.0%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>2.3%</td>
<td>1.9%</td>
</tr>
<tr>
<td>Mississippi</td>
<td>0.4%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Texas</td>
<td>2.2%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Gulf Total</td>
<td>1.3%</td>
<td>0.7%</td>
</tr>
<tr>
<td>US Total</td>
<td>0.4%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Relative energy sector sizes as measured by GSP.

<table>
<thead>
<tr>
<th>Region</th>
<th>Percent of State Total Employment</th>
<th>Percent of Industry Employment in US</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Oil and Gas</td>
<td>Refining and Chemical Manufacturing</td>
</tr>
<tr>
<td>Alabama</td>
<td>0.5%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Florida</td>
<td>0.0%</td>
<td>0.9%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>7.7%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Mississippi</td>
<td>1.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Texas</td>
<td>14.3%</td>
<td>6.0%</td>
</tr>
<tr>
<td>Gulf Total</td>
<td>8.4%</td>
<td>5.1%</td>
</tr>
<tr>
<td>US Total</td>
<td>2.4%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

Source: U.S. Bureau of Economic Analysis.
Louisiana oil and gas employment forecast
Texas oil and gas employment forecast

Employment

Jobs

Jan-01 Jan-03 Jan-05 Jan-07 Jan-09 Jan-11 Jan-13 Jan-15 Jan-17 Jan-19

100,000 150,000 200,000 250,000 300,000

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Louisiana refinery and chemical sector employment forecast
Conclusions
• Crude oil and natural gas markets continue to be resilient. Prices anticipated to remain affordable and less volatile.

• Natural gas supply growth increasingly driven by “associated” natural gas – a byproduct of increasing production coming from higher hydrocarbon-based production (Permian, Eagle Ford, Bakken). Crude production developments will continue to have implications for natural gas markets.

• Economic growth is likely the only near-term factor that will burn-off excessive commodity storage levels. Likely to continue to crude oil and natural gas prices to be range-bound with likely lower relative pricing volatility.

• Continued positive investment/development activity in mid-stream, refining, and processing/manufacturing – as well as energy exports.
Acknowledgement: The E.J. Ourso College of Business and the Center for Energy Studies appreciate the financial support provided by Regions Bank in the development of this inaugural *Gulf Coast Energy Outlook*. 
Addition Employment Forecasts
Florida Oil and Gas Employment Forecast
Gulf Total Oil and Gas Employment Forecast
Mississippi Refinery and Chemical Manufacturing Employment Forecast

- Jobs: 8,000 to 10,000
- Employment graph from Jan-01 to Jan-19
Gulf Total Refinery and Chemical Manufacturing Employment Forecast

Employment

Jobs

Jan-01 Jan-03 Jan-05 Jan-07 Jan-09 Jan-11 Jan-13 Jan-15 Jan-17 Jan-19