API Industry Outlook
Third Quarter 2019

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American Petroleum Institute

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1. The U.S. energy revolution has continued to advance economic and environmental progress

Record U.S. LNG exports have helped reduce global CO₂ emissions

Strong productivity and production have underpinned abundant U.S. oil & gas supplies

Refinery expansions have enabled the U.S. to become a global supplier of finished products

2. As the U.S. approaches becoming an energy net exporter and consumers have realized benefits of natural gas, enabling the next wave of major projects is key
Global Economy and Oil Markets
Despite economic uncertainties, the global economy has needed more energy, which has mainly been supplied by the U.S.
The DEI value of -0.1 for August and three-month average of -0.1 suggests a continued slowing of industrial production.

**Graph: The API D-E-I (Distillate Economic Indicator) – August 2019**

- **Industrial production:** Percentage change year-over-year (3-month average)
- **DEI:** Percentage change year-over-year (3-month average)

**Sources:** API Monthly Statistical Report, EIA, CME Group, Moody’s, Federal Reserve Board
The consensus expects a divergence between U.S. and global economic growth, which historically has had implications.

- Bloomberg consensus expects U.S. and world GDP growth to diverge, with the U.S. to slow to only $\frac{2}{3}$rd as fast as the world in 2020 and 2021.
- Historically, relative weakness of U.S. economic growth has corresponded with a weaker U.S. dollar foreign exchange rate and higher crude oil prices.

### Real GDP growth*

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>3.5%</td>
<td>2.8%</td>
<td>3.4%</td>
<td>2.9%</td>
</tr>
<tr>
<td>2019</td>
<td>3.0%</td>
<td>2.5%</td>
<td>3.1%</td>
<td>2.6%</td>
</tr>
<tr>
<td>2020</td>
<td>2.5%</td>
<td>2.0%</td>
<td>2.6%</td>
<td>2.2%</td>
</tr>
<tr>
<td>2021</td>
<td>2.0%</td>
<td>1.5%</td>
<td>2.1%</td>
<td>1.6%</td>
</tr>
</tbody>
</table>

* Market exchange rate basis

### Relative U.S. economic performance

  - U.S. dollar exchange value (y/y%, 2006-2018)
  - Brent crude oil prices (y/y%, 2006-2018)

Sources: IMF, Bloomberg, API Team calculations.

Consensus expects the U.S. cannot keep pace with global growth.
Global economic growth has consistently required liquid fuels

- Global oil demand has grown consistently with the economy, increasing by an average of 1.3 mb/d since 2010 or roughly half the rate of global GDP growth*.

Global oil demand versus GDP

Million barrels per day

- Market exchange rate basis
- Sources: EIA, Bloomberg, IMF, API Team calculations
Prior to recent events in Saudi Arabia, EIA expected a balanced global oil market and stable prices.

EIA global supply/demand estimates as of September 2019

sources: EIA STEO (Sep. 2019), Bloomberg
The U.S. energy revolution has essentially been akin to global spare production capacity and cushioned oil prices.

- In general, greater spare production capacity has historically corresponded with lower prices.
- Recent events have added uncertainty but directionally lowered production capacity.

**Comparing historical real Brent crude oil prices with a measure of spare capacity**

- Uncertain Saudi production capacity offline.
- Uncertain return of Saudi offshore production.
- Strategic petroleum reserve release (quantity “TBD”).

Sources: EIA, IEA, OPEC, BLS, API Team analysis.
Strong productivity and cost effectiveness have continued to position the U.S. for oil and natural gas production growth.

- BTU Analytics’ estimated breakeven prices remained below WTI crude oil in major production areas, and EIA productivity estimates rose.

### Estimated breakeven prices – August 2019*

<table>
<thead>
<tr>
<th>Region</th>
<th>Breakeven Prices ($/Bbl.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakken</td>
<td>20</td>
</tr>
<tr>
<td>Permian - Delaware</td>
<td>40</td>
</tr>
<tr>
<td>Permian - Midland</td>
<td>60</td>
</tr>
</tbody>
</table>

*Half cycle breakevens assuming 10% discount factor and play-specific costs. Source: BTU Analytics.

### U.S. oil productivity – monthly new well production per rig

- Barrels per day oil-equivalent
- Source: EIA Drilling Productivity Report.
EIA expects the U.S. to become an energy net exporter this year

- The U.S. is already a net exporter of coal, natural gas and natural gas liquids, and EIA projects the U.S. will become a net exporter in 2019 of total energy (including oil)
- The turning point could be a decline in petroleum net imports, which averaged 1.2 mb/d through the first seven months of 2019 (API)

**Gross energy trade**

- EIA estimates

**Energy net exports and imports**

- EIA estimates

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The U.S. is already a net exporter of coal, natural gas and natural gas liquids, and EIA projects the U.S. will become a net exporter in 2019 of total energy (including oil). The turning point could be a decline in petroleum net imports, which averaged 1.2 mb/d through the first seven months of 2019 (API).
EIA estimates that oil, natural gas and coal will have supplied more than 80% of U.S. primary energy demand in 2019

U.S. total energy consumption exceeded 100 quadrillion Btu for the first time in 2018 (EIA)
Global refiners have expanded to meet demand growth

- Refining capacity has expanded in Asia, the Middle East and North America – and is expected to grow more than 7.0 mb/d by 2025.

**Global refinery capacity**

<table>
<thead>
<tr>
<th>Year</th>
<th>Europe</th>
<th>Rest of World</th>
<th>North America</th>
<th>Middle East</th>
<th>Asia Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>1990</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>2000</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2010</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
<td>125</td>
</tr>
</tbody>
</table>

**Source:** Bloomberg, BP Statistical Review

**Global planned refinery capacity additions**

<table>
<thead>
<tr>
<th>Year</th>
<th>Europe</th>
<th>Rest of World</th>
<th>North America</th>
<th>Middle East</th>
<th>Asia Pacific</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2021</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2023</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>2025</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.1</td>
</tr>
</tbody>
</table>

**Source:** McKinsey (2019)
As refineries have expanded, the U.S. has increasingly become a supplier of finished products to the world.

- Since 2010, U.S. refining capacity has increased 6.8% while throughput rose 11.7%, yielding world-leading capacity utilization rates.
- This growth has leveraged domestic crude oil – driving imports to 24-year lows and enabling petroleum exports to reach new records.

### U.S. Petroleum Refining

**Million barrels per day**

- **Gross inputs**: Source: EIA, API
- **Operable capacity**

### U.S. Petroleum Imports

**Million barrels per day**

- **Crude oil**: Source: API
- **Refined products**: Source: API

**U.S. Petroleum Exports**

**Million barrels per day**

- **U.S. petroleum exports of 8.2 mb/d year-to-date through Aug. 2019**

Philadelphia Energy Solutions’ refinery shutdown had negligible consumer price impact

- As Philadelphia Energy Solutions’ 300,000 barrel per day refinery closed in late June, the resilient U.S. petroleum sector, infrastructure and market forces ensured products moved to serve the regional market
- Subsequently, the differences in state fuel prices from the U.S. average changed very little – and gasoline prices in PA, NJ and DE fell further below the U.S. average

Average fuel price differences in June and July, compared with the U.S. average

<table>
<thead>
<tr>
<th></th>
<th>Pennsylvania</th>
<th>New Jersey</th>
<th>Maryland</th>
<th>Delaware</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
</tr>
<tr>
<td>Diesel</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
<td>-0.25</td>
</tr>
</tbody>
</table>

sources: AAA and API Team analysis
Potential demand responses to IMO 2020 from residual fuel oil to distillates have past precedents

- For decades, global demand for distillates has grown while that for residual fuel decreased.
- Market demand changes similar in magnitude to IMO 2020 have precedents where, over three-year periods, residual fuel oil demand decreased by more than 4.0 mb/d and distillate demand rose by more than 2.0 mb/d.

Global fuel switching precedents

Million barrels per day (mb/d)

- Gas/diesel oil demand increased by 2.3 mb/d in 2002-2005 and 2009-2012.

U.S. refineries have put their plans into action for IMO 2020

- U.S. refining system is well-positioned for IMO 2020 due to our:
  - Relatively complex refineries;
  - Access to attractive crude oils;
  - Abundant and inexpensive natural gas; and,
  - The best workers in the global industry

This combination makes the U.S. refining system flexible and resilient in competing to place its products globally

**Economic variables** that are likely to affect IMO 2020 outcomes

1. Regional crack spreads
2. Heavy crude price differential, especially the WTI-WCS spread for U.S. refiners
3. Coker economics

Refinery capabilities/capacities that influence refiner optionality

1. Residual fuel oil upgrading capability
2. Capacities for sulfur treating and hydrotreating
Considerations and options for U.S. refiners under IMO 2020

Operations

- Shift to hydrocracking instead of cat cracking to emphasize distillate production over gasoline production
- Hydrocracking of residual fuel oil can produce greater yields (rather than simply processing residual fuel oil)
- Much distillate can be supplied by hydro-treating gas oil in a refinery or de-converting jet fuel, but these entail economic tradeoffs among fuels
- Importance of product placement options that enable refineries to run at high utilization rates
- Importance of reliability, which is affected by investment

Storage, export capacities, and global markets

- On the margin, residual fuel oil could flow into the power sector globally
- The capacity to trade high-sulfur fuels depends in part on U.S. tank storage and export infrastructure capacities
Prior to recent events in Saudi Arabia, EIA projected stable prices to 2020 with a wider difference between diesel, gasoline and crude oil prices, mainly due to IMO 2020.

Motor gasoline and diesel fuel prices have generally moved with crude oil, and EIA expects some impact from IMO 2020.

Crude oil, gasoline and diesel fuel prices, adjusted for consumer price inflation.

Sources: EIA, AAA, Bloomberg, BLS.
BTU Analytics estimates breakeven prices among major producing regions range from $1.06 per million Btu (mmBtu) to $2.01 per mmBtu.

Breakeven prices for selected gas plays – August 2019*

<table>
<thead>
<tr>
<th>Region</th>
<th>Breakeven Price (mmBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haynesville</td>
<td>$1.75</td>
</tr>
<tr>
<td>Appalachia - Northeast PA</td>
<td>$1.20</td>
</tr>
<tr>
<td>Appalachia - Southwest PA</td>
<td>$1.30</td>
</tr>
<tr>
<td>Appalachia - Ohio</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

*Half cycle breakevens assuming 10% discount factor and play-specific costs.

Source: BTU Analytics

U.S. natural gas productivity – new production per rig

- **Appalachia**: Increased production from 2017 to 2019
- **Haynesville**: Steady production levels from 2017 to 2019

Source: EIA Drilling Productivity Report
Global LNG prices dropped to roughly half of historical levels...

Global natural gas landed prices ($ per million Btu) – June 2019

- Mexico: $4.00
- UK: $3.33
- Spain: $3.56
- Belgium: $4.34
- Argentina: $4.31
- China: $4.44
- Korea: $4.45
- India: $4.41
- Japan: $5.30
- Lake Charles: $2.18

sources: U.S. FERC (Sep. 2019) and METI

### North American LNG projects

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Bloomberg view of likelihood</th>
<th>Final Investment Decision (FID) Status</th>
<th>2030 capacity (Bcf/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corpus Christi Mod. 1-7</td>
<td>Unlikely</td>
<td>Under regulatory review</td>
<td>3.0</td>
</tr>
<tr>
<td>Plaquemines Mod. 1-20</td>
<td>Unlikely</td>
<td>Planning FID</td>
<td>2.6</td>
</tr>
<tr>
<td>Freeport LNG Train 4</td>
<td>Unlikely</td>
<td>Planning FID</td>
<td>0.7</td>
</tr>
<tr>
<td>Alaska LNG</td>
<td>Unlikely</td>
<td>Planning FID</td>
<td>2.6</td>
</tr>
<tr>
<td>Lake Charles</td>
<td>Unlikely</td>
<td>Planning FID</td>
<td>2.0</td>
</tr>
<tr>
<td>Delfin FLNG</td>
<td>Unlikely</td>
<td>Planning FID</td>
<td>1.7</td>
</tr>
<tr>
<td>Kitimat LNG</td>
<td>Unlikely</td>
<td>Planning FID</td>
<td>1.3</td>
</tr>
<tr>
<td>Goldboro LNG</td>
<td>Unlikely</td>
<td>Planning FID</td>
<td>1.3</td>
</tr>
<tr>
<td>Rio Grande LNG Tr. 3-6</td>
<td>Unlikely</td>
<td>Under regulatory review</td>
<td>2.4</td>
</tr>
<tr>
<td>Monkey Island (SCT&amp;E)</td>
<td>Unlikely</td>
<td>Under regulatory review</td>
<td>1.6</td>
</tr>
<tr>
<td>Port Arthur LNG</td>
<td>Likely</td>
<td>Planning FID</td>
<td>1.8</td>
</tr>
<tr>
<td>LNG Canada Tr. 3-4</td>
<td>Likely</td>
<td>Planning FID</td>
<td>1.6</td>
</tr>
<tr>
<td>Magnolia LNG</td>
<td>Likely</td>
<td>Planning FID</td>
<td>1.1</td>
</tr>
<tr>
<td>Rio Grande LNG Tr. 1-2</td>
<td>Likely</td>
<td>Planning FID</td>
<td>1.2</td>
</tr>
<tr>
<td>Driftwood</td>
<td>Likely</td>
<td>Planning FID</td>
<td>3.6</td>
</tr>
<tr>
<td>Texas LNG</td>
<td>Likely</td>
<td>Planning FID</td>
<td>0.5</td>
</tr>
<tr>
<td>Calcasieu Pass</td>
<td>Highly Likely</td>
<td>Planning FID</td>
<td>1.4</td>
</tr>
<tr>
<td>LNG Canada Tr. 1-2</td>
<td>Likely</td>
<td>FID taken</td>
<td>1.6</td>
</tr>
<tr>
<td>Woodfibre LNG</td>
<td>Likely</td>
<td>FID taken</td>
<td>0.3</td>
</tr>
<tr>
<td>Sabine Pass Tr. 6</td>
<td>Likely</td>
<td>Under construction</td>
<td>0.6</td>
</tr>
<tr>
<td>Golden Pass</td>
<td>Likely</td>
<td>Under construction</td>
<td>2.1</td>
</tr>
<tr>
<td>Corpus Christi Tr. 1-3</td>
<td>In operation/definite</td>
<td>Under construction</td>
<td>1.8</td>
</tr>
<tr>
<td>Elba Island</td>
<td>In operation/definite</td>
<td>Under construction</td>
<td>0.3</td>
</tr>
<tr>
<td>Freeport LNG Tr. 1-3</td>
<td>In operation/definite</td>
<td>Operational (T1); Under construction (T2-3)</td>
<td>2.0</td>
</tr>
<tr>
<td>Cameron LNG</td>
<td>In operation/definite</td>
<td>Operational (T1); Under construction (T2-3)</td>
<td>2.0</td>
</tr>
<tr>
<td>Cove Point</td>
<td>In operation/definite</td>
<td>Operational</td>
<td>0.7</td>
</tr>
<tr>
<td>Sabine Pass Tr. 1-5</td>
<td>In operation/definite</td>
<td>Operational (Tr. 1-4); Construction (Tr. 5)</td>
<td>3.6</td>
</tr>
</tbody>
</table>

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source: Bloomberg New Energy Finance (June 2019), amended for Sabine Pass T6 FID; Golden Pass construction; Port Arthur regulatory approval and commercial HOA with Saudi Aramco; and, Cameron and Freeport T1 completions
U.S. LNG exports have helped reduce global CO₂ emissions while bolstering global gas market depth and liquidity.

- Between 2014 and 2018, about 50% of U.S. LNG exports went to Asia and another 20% to Mexico.
- In 2019 so far, U.S. LNG exports have served 35 countries with roughly 40% going to Europe and another 35% to Asia despite China trade frictions.

### 35 U.S. LNG export destinations in 2019
(May year-to-date)

### U.S. LNG gross exports
- 0.04 bcf/d 2014
- 0.08 bcf/d 2015
- 0.5 bcf/d 2016
- 1.9 bcf/d 2017
- 3.0 bcf/d 2018
- 5.2 bcf/d Jul 2019

Sources: EIA, API Team graphics.
With their contestable gas markets, Europe and Asia have been successful destinations for U.S. LNG

- EIA’s regional natural gas demand projections depend first from the market share gas wins versus other fuels and second on the outcome of gas-on-gas competition.

- LNG so far in 2019 has shown an ability to win versus the other gas sources.

**North America**

- Billion cubic feet per day (Bcf/d)

**Europe**

- Billion cubic feet per day (Bcf/d)

**Asia Pacific**

- Billion cubic feet per day (Bcf/d)

Sources: EIA, BP Statistical Review.
Furthering the U.S. energy revolution will require industry leadership to achieve unprecedented mega-project execution.

- Outside of steel tariffs, cost escalation has been modest with the first wave of mega-projects.
- With a mounting project queue, active cost containment measures will be key to execute the next wave of projects which are critical to advance the U.S. energy revolution.

**U.S. existing and proposed LNG export projects**

<table>
<thead>
<tr>
<th>Terminal Type</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>5.4 Bcf/d</td>
</tr>
<tr>
<td>Under Construction</td>
<td>8.3 Bcf/d</td>
</tr>
<tr>
<td>Approved</td>
<td>13.1 Bcf/d</td>
</tr>
</tbody>
</table>

**Cost containment measures**

- Advance workforce planning/training
- Contracting strategy to promote competition, including:
  - Well-defined work packages
  - Global project management
  - Diverse sourcing/procurement
  - Yard selection/supervision
  - Construction management
  - Flexible contract types (reimbursable, lump-sum, or hybrid)
- Consideration of alternate delivery models, including modularization, mid-scale LNG, Floating LNG

Sources: Bloomberg, EIA, API Team graphics
Between 2010 and 2018, U.S. coal-fired electricity generation fell by 38%, while that of natural gas increased by 49% and renewables by 64%.

National average U.S. electricity rate decreased by 6.5% over the same period.

**U.S. electricity net generation**

**Real electricity prices versus natural gas prices - all sectors**

- 2019 cents per kWh
- 2019 dollars per million Btu

**Source:** EIA
States that added relatively more natural gas-fired electricity generation have tended to see lower electricity prices

- U.S. real electricity prices decreased among 78% of states that added more natural gas than solar & wind between 2010 and 2018
- Among states where real electricity prices increased between 2010 and 2018, 76% added more wind & solar than natural gas into their generation mix

Changes in real electricity prices and generation share (natural gas vs. wind & solar)*

- **16 states** with higher electricity prices and a net share gain by wind & solar
- **5 states** with higher electricity prices and a natural gas net share gain
- **18 states** with natural gas net share gain and lower electricity prices
- **11 states** net share gain by wind & solar and lower prices

*Share of elec. net generation for natural gas less solar and wind combined. Sources: EIA, BLS, API Team calculations
Cost-effective and reliable energy affects consumers and state competitiveness. In 2018, 41 of the 50 states lined up up into the expected upper left and lower right quadrants.

### 2018 electricity prices and state GDP share in energy-sensitive sectors*

- **13 states** with a below-average energy-sensitive GDP share and above-average electricity prices
- **4 states** with an above-average electricity price and an above-average energy sensitive-GDP share
- **28 states** with an above-average energy-sensitive GDP share and below-average electricity prices
- **5 states** with a below-average energy-sensitive GDP share and below-average electricity prices

* Share of 2018 nominal GDP in agriculture, construction, mining, manufacturing, trade, transportation and utilities.
API'S ECONOMIC INDUSTRY OUTLOOK

The API Industry Outlook, developed by API's Chief Economist, Dr. R. Dean Foreman, is a quarterly report that provides an overview of the natural gas and oil industry as it relates to the U.S. and global economies.

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