1. **Record Q1 2019 U.S. oil & NGL production:** 12.1 million barrels per day (mb/d) *(API)*

   Breakeven prices for selected oil plays*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permian - Delaware</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permian - Midland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bakken</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   EIA global supply/demand estimates as of February 2019

   Strong correlation of U.S. oil & gas production with real GDP growth

2. **Record U.S. dry natural gas production**

   89 billion cubic feet per day (bcf/d) *(EIA)*

3. **Americans saved more than**

   $300 billion annually on energy
   (reducing energy spending to $1.1 trillion in 2016 versus 1.43 trillion in 2010) *(EIA)*
Key messages - Q1 2019
Record oil and natural gas production has benefitted U.S. consumers

Record U.S. oil production in Q1 2019

12.1 million barrels per day (mb/d), plus another 4.7 mb/d of natural gas liquids (NGLs) (API)
- Lower costs, strong Permian basin production, and record-high drilled uncompleted wells (DUCs) position the U.S. for continued supply growth (EIA)
- Expectations for a global oil market surplus in 2019 and crude oil prices around $60 per barrel (EIA)

Record U.S. dry natural gas production in Q1 2019

89 billion cubic feet per day (bcf/d) (EIA)
- Prices below $3.00 per million Btu despite low inventories and record exports (4.6 bcf/d in March) (EIA)
- The U.S. energy revolution (2010-2019) cut natural gas price volatility in half versus 1997-2009, and with enabling infrastructure regional premium prices turned into discounts to Henry Hub
- Since 2010, U.S. natural gas has:
  - Grown to nearly one-third of U.S. net electricity generation
  - Helped decrease electricity generation CO2 emissions by more than 20%, and
  - Reduced average inflation-adjusted residential electricity prices by nearly 12% (EIA)

U.S. consumer benefits from the energy revolution

- U.S. energy spending dropped to its lowest share of household spending since 2007 (BLS)
- Americans saved more than $300 billion on energy, reducing energy spending to $1.1 trillion in 2016 versus 1.43 trillion in 2010 (EIA)
Global Economy and Oil Markets
Slower global economic growth and high debt come into focus

World Economic Outlook Update, January 2019: A Weakening Global Expansion
International Monetary Fund

Fed Chairman Powell says he is 'very worried' about growing amount of US debt
CNBC

Europe's Economic Outlook Goes From Bad to Worse Amid EU Warning
Bloomberg

Japan's economic sentiment hits lowest point in Abenomics era
Nikkei Asian Review

China's economy grew 6.6% in 2018, the lowest pace in 28 years
CNBC • 18 days ago

China's 'zombie' companies are a big threat to the economy — and JPMorgan says their debt pile means the country could be slowing faster than anyone thought
Business Insider

The emerging market crisis is back. And this time it's serious
CNBC

India cuts key rate in surprise bid to lift flagging economy
Arab News
The U.S. economic outlook expected to slow, with marked differences in regional performance

- On average, the Bloomberg consensus expects weakening each year to 2020
- Western and Southwestern states have outperformed

**U.S. real GDP growth – Bloomberg consensus average and range**

**U.S. real GDP growth by region**

- **Q3 2018**

sources: U.S. Bureau of Economic Analysis, Bloomberg

*Q3 2018 reflect latest available state and regional GDP data*
U.S. oil and natural gas production has closely tied with growth across the economy

Between 2015 and 2018, changes in U.S. quarterly production of crude oil, natural gas and NGLs correlated at +0.82 with real GDP growth

Quarterly change
Million barrels per day oil-equivalent (mb/doe)

Oil, natural gas and NGL production growth (q/q change)
Real GDP growth

Seasonally-adjusted annualized rate

EIA estimates

sources: EIA, BEA
The U.S. energy revolution has driven marked improvements across many industry sectors.

U.S. real value added by industry

Compound annual growth rate (CAGR)

-4 0 4 8

- Trade, transportation and warehousing
- Scientific and technical services
- Construction
- Manufacturing - durable goods
- Manufacturing - non-durable goods
- Private Industry

source: U.S. Bureau of Economic Analysis
Heat map of monthly percentage changes – February 2019 compared with January 2019*

- Crude oil prices increased in February with rising exports compensating for weakened refining activity and domestic demand
- Total inventories held steady, but those of crude oil grew while refined products shrunk

* Boldest colored increases and decreases reflect changes vs. prior month that are in the top or bottom quartile for the past five years

** CFTC long/short open interest comparisons based on month versus same month in prior year

sources: API Monthly Statistical Report, EIA, CFTC, Baker Hughes
Cost effectiveness and solid productivity have propelled production in the Permian basin and Bakken formation.

- BTU Analytics estimates Permian basin breakeven prices fell by as much as 19% y/y, while those in the Bakken formation increased 19% y/y but remain below current WTI prices.

- New well productivity remained relatively stable.

Breakeven prices for selected oil plays*:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Permian - Delaware Basin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permian - Midland Basin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bakken</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Breakeven prices for selected oil plays*:

- BTU Analytics estimates Permian basin breakeven prices fell by as much as 19% y/y, while those in the Bakken formation increased 19% y/y but remain below current WTI prices.

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

- Production in the Permian basin and Bakken formation.

*Half cycle breakevens assuming 10% discount factor and play-specific costs. Source: BTU Analytics (Dec. 2018)
EIA suggests the global oil market should maintain a surplus

EIA estimates global oil demand growth to slow in 2019 and be met almost entirely by the U.S.

EIA global supply/demand estimates as of February 2019

Million barrels per day


Supply less demand (mb/d)

Brent (2019$/Bbl)

EIA estimates

Sources: EIA STEO (January 2019), Bloomberg
Motor gasoline and crude oil prices have continued to move together

- Fuel prices have closely tracked those of crude oil because crude oil is the largest input cost.
- EIA anticipates stable prices over the next two years.

**Crude oil and gasoline prices, adjusted for consumer price inflation**

2019$ per gallon

EIA estimates

Sources: EIA, AAA, Bloomberg, BLS
U.S. household spending on energy has been at its lowest since 2007 as a percent of total spending.

**Annual U.S. household energy expenditures**

- Household expenditures on natural gas, fuel oil and electricity
- Household spending on motor fuels

Policies that increase U.S. energy costs could stress household budgets

- Decreased energy prices and spending have enabled households to cope with increased food, education and healthcare spending needs.

### U.S. household expenditures

<table>
<thead>
<tr>
<th>Category</th>
<th>% change (2007-2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household energy*</td>
<td>-10.5</td>
</tr>
<tr>
<td>Food</td>
<td>+26.0</td>
</tr>
<tr>
<td>Education</td>
<td>+57.8</td>
</tr>
<tr>
<td>Healthcare</td>
<td>+72.7</td>
</tr>
</tbody>
</table>

* Includes motor fuels, natural gas, fuel oil and electricity

Natural Gas
Low U.S. natural gas prices motivate LNG production and exports

Global natural gas landed prices ($/MMBtu) – February 2019

sources: U.S. FERC (March 2019), METI, Bloomberg
Asia’s expected demand growth is the foundation for global LNG market development in Bloomberg’s view

- Asia should account for more than three quarters of global LNG demand growth to 2030
- In Bloomberg’s view, more than one-fifth of future LNG demand growth will come from countries that do not currently import LNG

Global LNG demand

<table>
<thead>
<tr>
<th>Country</th>
<th>Changes (Bcf/d) 2018-2030</th>
<th>Changes (Bcf/d) 2000-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>-4.7</td>
<td>2.2</td>
</tr>
<tr>
<td>China</td>
<td>5.3</td>
<td>5.5</td>
</tr>
<tr>
<td>S. Korea</td>
<td>0.6</td>
<td>1.8</td>
</tr>
<tr>
<td>India</td>
<td>2.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Pakistan</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Taiwan R.O.C.</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>All others</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>E.U. 28</td>
<td>1.9</td>
<td>-3.0</td>
</tr>
</tbody>
</table>

Source: Bloomberg
U.S. LNG exports should be a predominant source of new LNG supply and a main driver of domestic natural gas production.

U.S. natural gas demand outlook – EIA Reference case

Billion cubic feet per day (Bcf/d)

Source: EIA AEO (2018)
Bloomberg anticipates about 20 Bcf/d of new North American export capacity by 2030

North American LNG projects

Billion cubic feet per day (Bcf/d)

<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</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>Unlikely</td>
<td>Under regulatory review</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>Sabine Pass Tr. 6</td>
<td>Likely</td>
<td>Planning FID</td>
<td>0.6</td>
</tr>
<tr>
<td>Golden Pass</td>
<td>Likely</td>
<td>FID taken</td>
<td>2.1</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>Calcasieu Pass</td>
<td>Highly Likely</td>
<td>Planning FID</td>
<td>1.4</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>Freeport LNG Tr. 1-3</td>
<td>In operation/definite</td>
<td>Under construction</td>
<td>2.0</td>
</tr>
<tr>
<td>Cameron LNG</td>
<td>In operation/definite</td>
<td>Under construction</td>
<td>2.0</td>
</tr>
<tr>
<td>Elba Island</td>
<td>In operation/definite</td>
<td>Under construction</td>
<td>0.3</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>

source: Bloomberg New Energy Finance (February 2019); amended for FID on Golden Pass, Calcasieu FERC approval on 2/22/2019
Since most LNG export projects require their own new supplies, U.S. natural gas prices have generally not risen with exports.

Since the U.S. became a net exporter in 2017, domestic prices have not responded significantly despite a ten-fold increase in natural gas net exports, because LNG projects have largely required new gas supplies to be developed (not cannibalizing domestic supply).

Sources: Bloomberg, EIA
American Petroleum Institute

While costs in Appalachia have continued to fall, those in the Haynesville rose year-on-year according to BTU Analytics.

**Breakeven prices for selected gas plays***

<table>
<thead>
<tr>
<th>Region</th>
<th>Month</th>
<th>Breakeven Price ($/MMBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachia - OH</td>
<td>Jan. 2018</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Jan. 2019</td>
<td>2</td>
</tr>
<tr>
<td>Haynesville</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

*Half cycle breakevens assuming 10% discount factor and play-specific costs source: BTU Analytics (Dec. 2018)

**Shale gas production by play type**

- **Appalachia**
- **Haynesville and other dry gas production**
- **Associated gas from liquids plays**

*Source: EIA Drilling Productivity Report*
The U.S. energy revolution has significantly reduced natural gas prices and price volatility.

- Although natural gas prices are highly seasonal, price volatility* from 2010 to 2018 fell by half relative to that of the period from 1997 to 2009.

* source: EIA daily spot prices at Henry Hub. Price volatility measured as standard deviation relative to average prices.
Where enabled by pipeline connectivity, the energy revolution has especially lowered prices across the eastern United States.

- In 2010, before the energy revolution, prices at most natural gas hubs were greater than those at Henry Hub, Louisiana.
- As Pennsylvania and Ohio became major gas producers, prices fell across the eastern U.S. except in New England, which largely failed to expand its pipeline infrastructure.

### Natural Gas Spot Price Differences from Henry Hub (annual averages)

**Paid a premium above Henry Hub:**
- Chicago
- Florida Gas Transmission Zone 2
- Rockies Express Pipeline (East) into Midwestern

**Received a discount below Henry Hub:**
- 2010
- 2018

**2010 vs. 2018:**
- Chicago: Paid a premium above Henry Hub
- Florida Gas Transmission Zone 2: Paid a premium above Henry Hub
- Rockies Express Pipeline (East) into Midwestern: Paid a premium above Henry Hub
- Dominions South Point: Paid a premium above Henry Hub
- Dawn: Received a discount below Henry Hub
- Algonquin: Paid a premium above Henry Hub

**New England:** A higher premium due to a lack of infrastructure.
Greater propane production and lower prices have moved in tandem with natural gas market development

Since 2015, U.S. spot propane prices have averaged nearly half of what they did between 2010 and 2014.

**U.S. natural gas and propane production**

- Billion cubic feet per day
- Million barrels per day

**U.S. natural gas and propane prices**

- Dollars per million Btu
- Dollars per gallon

source: EIA
*Refiner, blender and gas plant net production of propane and propylene

source: EIA spot prices at Henry Hub and Mt. Belvieu
Low U.S. natural gas prices spurred increased use in electricity generation

- More than 40% of U.S. primary energy demand is used for electricity generation.
- Between 2010 and 2017, U.S. electricity net generation decreased by 2.6%, yet the share of natural gas increased to 32% in 2017 from 24% in 2010.

U.S. shares of primary energy

- Residential/Commercial
- Industrial
- Transportation
- Electricity generation

U.S. electricity net generation

- Million megawatt hours

- Source: EIA SEDS (2018)
- Source: EIA
Increased U.S. natural gas and renewables use have reduced CO₂ emissions in electricity generation

Between 2010 and 2018, EIA estimates electricity generation-related CO₂ emissions declined 21.8% while primary energy consumption in the sector fell 5.1%, due largely to natural gas and renewables substitution for coal.

source: EIA AEO (2018)
Between 2010 and 2017, U.S. inflation-adjusted residential electricity prices decreased by 11.6%, compared with natural gas which was down by 39% over the same period – roughly proportionate given natural gas grew to 32% of the generation mix.

**Residential electricity prices versus natural gas prices**

Sources: EIA, BLS
Americans spent $1.1 trillion on energy in 2016, compared with $1.43 trillion in 2010.

Over the same period, transportation fuel expenditures decreased by $182 billion, followed by residential and commercial and industrial energy spending down in total by $135 billion.

Source: EIA SEDS (2018). To avoid double-counting with electricity spending by end use sector, energy input costs in power generation are not included in the total.
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.

READ THE BLOG:
Chief Economist's Posts on Energy Tomorrow

READ THE NEWS RELEASES:
Chief Economist's News Releases, 2017
Chief Economist's News Releases, 2018

DOWNLOADS
- Monthly Statistical Report
  File Size: 8 MB
- API Quarterly Industry Outlook (June 2019)
  File Size: 11 MB