1. With strong productivity and a competitive low cost structure, the U.S. is poised for a continuation of record oil, natural gas and NGL production

Breakeven prices below recent prices

Strong productivity driving growth

Enabling Permian Basin oil infrastructure

2. Critical infrastructure growth is enabling natural gas demand stimulation

New Permian gas pipelines

LNG and U.S. industrial natural gas demand should be main growth drivers

Global LNG prices have decreased
Global Economy and Oil Markets
Despite a moderation in global economic growth, solid energy demand has continued.

- Global economy enters ‘synchronised slowdown’
  Financial Times

- Global economy may still defy the pessimists this year
  Financial Times

- JP Morgan: The US-China tariff battle is just the start of a global trade reordering
  CNBC

- US Shale Is Upending Crude Flows In This Oil Frontier
  OilPrice.com
Although the global economic outlook is expected to slow, oil markets appear to be balanced.

- EIA translates this into a balanced oil market with prices above $60 per barrel in 2019.

**Global real GDP growth**

- **Bloomberg consensus range Q2 2019**

**EIA global supply/demand estimates**

- **Supply less demand (mb/d)**
- **Brent (2019$/Bbl)**

**Source:** Bloomberg, EIA
Cost effectiveness and strong productivity position the U.S. for continued production growth

- BTU Analytics estimates breakeven prices among major producing regions range from $35 per barrel to $50 per barrel – well below recent WTI prices
- Productivity has continued to improve in the Permian, Bakken and DJ Basin

**Estimated breakeven prices for selected oil plays***

<table>
<thead>
<tr>
<th>Oil Play</th>
<th>Breakeven Price ($/Bbl.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eagle Ford - West</td>
<td>45</td>
</tr>
<tr>
<td>Bakken</td>
<td>30</td>
</tr>
<tr>
<td>Eagle Ford - East</td>
<td>30</td>
</tr>
<tr>
<td>Permian - Delaware</td>
<td>45</td>
</tr>
<tr>
<td>Permian - Midland</td>
<td>45</td>
</tr>
<tr>
<td>DJ Basin</td>
<td>45</td>
</tr>
</tbody>
</table>

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

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

- Productivity has continued to improve in the Permian, Bakken and DJ Basin for continued production growth

*source: BTU Analytics*
150 kb/d of Bakken crude oil flows by rail through Washington State. New state legislation threatens to curtail the flow to Puget Sound refineries.

**Bakken Formation pipeline infrastructure**

**Bakken pipeline capacity balance**

Million barrels per day (mb/d)

- Refinery capacity
- Enbridge Line 26
- Enbridge Line 81
- Enbridge Line 83
- Bakken Expansion
- ETP Bakken Pipeline
- Keystone XL
- Bakken production
- Rail capacity

**Sources:** EIA, PennWell, National Geographic, ESRI, Garmin, HERE, UNEP, USGS, WCMC, NASA, ESA and API Team analysis.
The expansions, including the Grey Oak, Cactus II and Seminole Red pipelines, should more than accommodate expected production growth.
Pipeline infrastructure constraints in the Permain drove a record 8,500 drilled but uncompleted wells per EIA estimate.

The nationwide backlog of drilled but uncompleted wells (DUCs) equates to more than 6 months of drilling activity by EIA estimates.

Drilled but uncompleted wells

- Permian
- Anadarko
- DJ / Niobrara
- Haynesville
- Eagle Ford
- Bakken
- Appalachia

source: EIA Drilling Productivity Report
U.S. crude oil export capacity has been sufficient, but some capacity estimates suggest some urgency to plan forward

- Estimates of U.S. crude oil export capacity vary between 4.0 mb/d and 5.0 mb/d and depend on local conditions, including weather, ship availability and congestion.
- With U.S. energy leadership, crude oil exports exceeded 3.0 mb/d in April and could grow in line with EIA’s projections and approach the lower end of the export capacity range this year.

**U.S. gross crude oil exports**

Million barrels per day (mb/d)

<table>
<thead>
<tr>
<th>Year</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>0.5</td>
<td>0.8</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Uncertain range (4.0 mb/d to 5.0 mb/d) of U.S. crude oil export terminal capacity

Source: API Monthly Statistical Report
Strong productivity – greater production with fewer rigs – has fueled the U.S. energy revolution

Shale production typically shows a rapid decline in early production followed by stable rates for an extended period – building a foundational “brick” of production in the aggregate.

U.S. natural gas and oil production across seven key regions*

Wellhead production (billion cubic feet per day natural gas-equivalent)  
Wells (hundreds), Rigs

1. Each curve represents new production by year and its decline in subsequent years
2. As shale production has made up the majority of U.S. production, the relatively low but stable long-term production helped slow the decline of total production on average over the past three years

* Includes the Anadarko, Appalachia, Bakken, Eagle Ford, Haynesville, Niobrara and Permian Basin regions as defined by EIA source: EIA Drilling Productivity Report and API Team calculations
Natural Gas
Global LNG prices dropped to roughly half of historical levels...

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

- Mexico: $4.75
- Lake Charles: $2.48
- Spain: $4.88
- UK: $4.61
- Belgium: $4.99
- Korea: $5.03
- Japan: $5.20
- India: $5.00
- China: $4.99
- Argentina: $5.03

sources: U.S. FERC (May 2019) and METI
...driven largely by strong recent global LNG capacity additions

The U.S. and Australia have led global LNG capacity growth that Bloomberg estimates will exceed 29 million tons per annum (mmtpa) or 9 percent y/y in 2019

LNG liquefaction capacity by region

Million tons per annum (mmtpa)

- U.S.
- Australia
- Russia
- West Africa
- Other
- Qatar
- North Africa
- Malaysia
- Indonesia

source: EIA Drilling Productivity Report

### 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>Freeport LNG Tr. 1-3</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>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>

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 T1 completion.
Solid productivity and cost effective production underpin continued U.S. natural gas production growth

- BTU Analytics estimates breakeven prices among major producing regions range from $1.17 per million Btu (mmBtu) to $1.96 per mmBtu – well below recent Henry Hub prices

**Breakeven prices for selected gas plays***

<table>
<thead>
<tr>
<th>Gas Play</th>
<th>Breakeven Price (mmBtu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haynesville</td>
<td>$1.41</td>
</tr>
<tr>
<td>Appalachia - Northeast PA</td>
<td>$1.75</td>
</tr>
<tr>
<td>Appalachia - Southwest PA</td>
<td>$1.82</td>
</tr>
<tr>
<td>Appalachia - Ohio</td>
<td>$1.96</td>
</tr>
</tbody>
</table>

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

**U.S. natural gas productivity – new well production per rig (quarterly avg.)**

- Haynesville
- Appalachia

source: EIA Drilling Productivity Report
U.S. natural gas exports and industrial demand should be the main drivers of domestic natural gas production growth

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

Billion cubic feet per day (Bcf/d)

<table>
<thead>
<tr>
<th>Year</th>
<th>Residential / Commercial</th>
<th>Transportation</th>
<th>Electricity generation</th>
<th>Industrial</th>
<th>Net exports</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>-0.9</td>
<td>0.4</td>
<td>1.5</td>
<td>5.0</td>
<td>11.0</td>
</tr>
<tr>
<td>2030</td>
<td>-0.9</td>
<td>0.4</td>
<td>1.5</td>
<td>5.0</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Changes (Bcf/d) 2019-2030

- Residential / Commercial: -0.9 Bcf/d
- Transportation: 0.4 Bcf/d
- Electricity generation: 1.5 Bcf/d
- Industrial: 5.0 Bcf/d
- Net exports: 17.0 Bcf/d

Source: EIA AEO (2019)
Permian Basin 5.0 bcf/d of new pipeline capacity additions are expected by the end of 2019 (Q4 19 vs. Q4 18)

The project slate suggests relief for bottlenecks by late 2019, but not all projects shown are likely to be constructed.

Permian Basin – recent natural gas pipeline expansions

Permian Global Access Pipeline
Gulf Coast Express
Permian Highway
Pecos Trail
Permian-Katy
Whistler

Permian Basin gas pipeline utilization
Billion cubic feet per day (bcf/d)

source: Permian Texans for Natural Gas

sources: RBN Energy, Permian Texans for Natural Gas, EIA
About half of Northern Border Pipeline’s 2.4 bcf/d of capacity serves the Bakken, while the remainder and most Alliance Pipeline capacity transports Canadian gas, resulting in a relatively tight natural gas supply/demand balance for the Bakken region.

Gas processing capacity has expanded, helping to move supply to market in different forms.

### Bakken – natural gas pipelines

### Bakken gas pipeline utilization

- Billion cubic feet per day (bcf/d)
- Sources: RBN Energy, EIA, Bloomberg

**Legend:**
- North Bakken Expansion
- Demicks Lake to Northern Border Pipeline
- Current Bakken egress on Northern Border and Alliance pipelines
- Demand
- Production

*Source: RBN Energy*
The energy revolution has made ethane abundant and, in turn, U.S. petrochemical production globally competitive.

U.S. ethylene prices, margins and ethane feedstock costs through March 2019

1. Prices of ethylene (the main product made from ethane) generally follow those of crude oil but decoupled in 2018 with strong ethylene supply growth.

2. Ethane feedstock prices recently fell toward the point of indifference about whether to extract it from natural gas.

3. Despite lower ethylene prices, ethylene margins held up because ethane feedstock prices decreased.
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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