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- **Total Energy**
- **Global Oil Markets**
- **Global and North America Natural Gas**
- **Leveraging the U.S. Energy Renaissance**
Total Energy
Energy is everything, and natural gas and oil are integral.

**Transportation**

- Motorcycle
- Car
- Train
- Truck
- Ship
- Airplane

**Heating and Cooling**

- Thermometer
- Sun
- Snowflake

**Electric power**

- Electric tower

**Materials (Industry & Manufacturing)**

- Science
- Technology
- Engineering
- Mathematics
Global economic and energy demand growth go hand-in-hand

- As the global economy grows, so does energy demand
- Since 2010, every one percent rise in global GDP has typically generated a 0.6 percent increase in energy demand

GDP (Trillion 2010$, market exchange rate basis)

Quadrillion Btu

sources: IEA, EIA IEO (2017)
Natural gas and oil accounted for more than 55% of global energy in 2017. EIA expects this to remain steady in 2040.

- Renewables should sustain the highest growth among all fuels, but even so they would represent less than 20% of global energy needs in 2040.

EIA projects:
- Global oil demand to rise by 29.3 quads (14.8 MBD) between 2017 and 2040.
- Global natural gas demand to rise by 53 quads (140 bcf/d) between 2017 and 2040.

Average annual changes (%):

- **1990-2017**
  - Oil: 1.3
  - Natural gas: 2.1
  - Coal: 2.2
  - Nuclear: 3.0
  - Renewables: 1.9

- **2017-2040**
  - Oil: 0.6
  - Natural gas: 1.5
  - Coal: 1.5
  - Nuclear: 1.0
  - Renewables: 2.4

Source: EIA IEO (2017)
While EIA expects Non-OECD economies to lead energy growth, U.S. and OECD economies continue with strong demand.

- EIA expects Non-OECD economies to lead with energy demand growth of 28% between 2015 and 2040.

Global energy demand

- Non-OECD
- United States
- Other OECD
U.S. primary energy demand in 2017 was led by natural gas & oil

- Natural gas and oil fulfill energy needs across every end use sector

Energy consumption by fuel
96.8 Quadrillion Btu

- **Natural gas, 28.5%**
- **Oil, 37.1%**
- **Coal, 14.7%**
- **Nuclear, 8.6%**
- **Renewables, 11.1%**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Oil</th>
<th>Natural gas</th>
<th>Coal</th>
<th>Nuclear</th>
<th>Renewables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
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<tr>
<td>Residential &amp; Commercial</td>
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<tr>
<td>Industrial</td>
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<tr>
<td>Electric power</td>
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</tbody>
</table>

EIA expects natural gas and oil to supply nearly 2/3rds of U.S. primary energy in 2040

- U.S. energy consumption should continue to grow in total, with natural gas, wind and solar leading growth.

Source: U.S. EIA AEO (2018)
Increased U.S. natural gas use and energy efficiencies have reduced CO₂ emissions as energy demand has grown

- Since 2005, total energy-related CO₂ emissions declined faster than total energy consumption, due largely to natural gas substitution for coal in power.
- As energy consumption grows in the future, energy efficiency improvements and increased renewables and natural gas use should restrain CO₂ emissions.

source: EIA AEO (2018)
Global Oil Markets
Oil prices relate to many uncertain factors

**Current Factors**
- Supply / Demand
- Seasonality
- Inventories
- Capacity utilization
- Value after refining
- Current market level and recent direction

**Future Expectations**
- Geopolitics
- Demand growth
- Supply growth
- Capacity growth
- Logistics availability (marine, pipelines)

**Market Prices**
- Willing Buyers
- Willing Sellers

**Financial Markets**
- Interest rates
- Foreign exchange rates
- Equity markets

American Petroleum Institute
As the global economy grows, EIA expects efficiency gains and oil demand to continue to grow.

**Oil demand and GDP by region**

- **MBD**
  - 60
  - 50
  - 40
  - 30
  - 20
  - 10
  - 0
- **GDP (Trillion 2010$)**
  - 0
  - 10
  - 20
  - 30
  - 40
  - 50
  - 60

**Oil-to-global GDP ratio**

- **Bbl/K$GDP**
  - 1.3
  - 1.0
  - 0.8
  - 0.6
  - 0.4
  - 0.2
  - 0
- **Year**
  - 1970
  - 2017

**Oil demand projections**

- **MBD**
  - 125
  - 100
  - 75
  - 50
  - 25
  - 0
- **Year**
  - 2010
  - 2020
  - 2030
  - 2040

*Source: EIA IEO (2017) – Reference case*
Low U.S. natural gas prices motivate LNG production and exports

- U.S. natural gas prices have remained less than one-third of many international levels

Global natural gas landed prices ($/MMBtu) – July 2018

sources: U.S. FERC (Aug. 2018), METI
With globalization, natural gas markets could more than double by 2040

Global natural gas by source

LNG exports

LNG imports

source: BP (2018)
Shale plays are widely dispersed globally...

- API standards could help to advance the globalization of tight oil and shale gas production
....and particularly across North America
EIA projects that U.S. tight oil and shale gas production will remain dominant sources for decades to come

- Upgraded resource assessments have driven EIA’s projections of tight oil and shale gas growth

U.S. natural gas production by type and sensitivity case

Trillion cubic feet

2017

Reference case

High oil & gas resource and technology case

EIA expects the East to dominate U.S. natural gas production

- Continued development of the Marcellus and Utica plays in the East is the main driver of growth in total U.S. shale gas production across most cases

**Shale gas production by region**

<table>
<thead>
<tr>
<th>Trillion cubic feet</th>
<th>2017</th>
<th>Reference case</th>
<th>High oil &amp; gas resource and technology case</th>
</tr>
</thead>
<tbody>
<tr>
<td>East</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gulf Coast</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rest of U.S.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: U.S. EIA AEO (2018)
EIA projects that U.S. ethane production should be sustained above 2 million barrels per day.

**U.S. natural gas liquids (NGL) production by fuel**

- Natural gasoline
- Isobutane
- Normal butane
- Propane
- Ethane

**U.S. natural gas plant liquids production by region**

- East
- Southwest
- Other U.S.

Source: U.S. EIA AEO (2018)
Leveraging the U.S. Energy Renaissance
Refining capacity has expanded at existing facilities

- Although the number of refineries dropped over time — currently at 135 — refining capacity has continued to expand through industry investment

U.S. refineries and their capacity

<table>
<thead>
<tr>
<th>Year</th>
<th>Operable Capacity</th>
<th>Refineries</th>
</tr>
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<tbody>
<tr>
<td>1990</td>
<td>15.5</td>
<td>235</td>
</tr>
<tr>
<td>1995</td>
<td>15.0</td>
<td>240</td>
</tr>
<tr>
<td>2000</td>
<td>16.5</td>
<td>230</td>
</tr>
<tr>
<td>2005</td>
<td>17.0</td>
<td>225</td>
</tr>
<tr>
<td>2010</td>
<td>17.5</td>
<td>220</td>
</tr>
<tr>
<td>2015</td>
<td>18.0</td>
<td>215</td>
</tr>
</tbody>
</table>

source: EIA
The Renewable Fuel Standard (RFS) mandate exceeds demand for ethanol that can be blended in E10 gasoline.

- RFS mandate for renewable fuel has consistently exceeded the amount of ethanol that has been blended with gasoline.
- RFS compliance has been achieved by RIN banking and blending more biodiesel into diesel fuel, above minimum requirements.

**Ethanol blending in gasoline**

Sources: EPA, EIA
Shale-driven energy production is reshaping the U.S. natural gas and oil infrastructure landscape

U.S. total capital expenditures

source: ICF, “U.S. Oil and Gas Infrastructure Investment through 2035,” April 2017
Capital spending on U.S. projects requires a long lead time, but has necessarily responded to current prices

- Large capital projects take years to plan and build, but the industry’s investments tend to follow the price cycle – it is hard to be countercyclical.

**Capital spending for U.S. projects**

Billion 2017$

<table>
<thead>
<tr>
<th>Year</th>
<th>Capital spending - exploration &amp; production, refining/marketing/pipelines</th>
<th>Brent crude oil price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>2007</td>
<td>200</td>
<td>120</td>
</tr>
<tr>
<td>2012</td>
<td>300</td>
<td>160</td>
</tr>
<tr>
<td>2017</td>
<td>200</td>
<td>80</td>
</tr>
</tbody>
</table>

sources: Bloomberg; Oil & Gas Journal
Between 1990 and 2015, natural gas systems’ methane emissions fell by 16.3% even though natural gas production rose by more than 50%.

Natural gas production and methane emissions from natural gas systems

- Natural gas production (gross withdrawals)
- Methane emissions

Sources: EPA (most recent data), EIA
The U.S. oil & natural gas industry spends billions on greenhouse gas-reducing technologies

- Between 2000 and 2016, oil & gas industry spending on carbon mitigating technologies was double that of every other individual industry

**Carbon mitigating technology investment by investor group (2000-2016)**

- Oil and natural gas Industry
- Federal government
- Automobile industry
- Electric utility
- Agriculture/food processing
- Other

Source: T2 & Associates, April 2018
Total job opportunities are split roughly 60/40 between blue collar and white collar occupations.
### Projected natural gas, oil, and petrochemical industry direct job opportunities through 2025 and 2035 (thousands)*

<table>
<thead>
<tr>
<th>Job growth, 2015 to 2025</th>
<th>African American</th>
<th>Hispanic</th>
<th>Minority</th>
<th>Total industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline growth</td>
<td>30.5</td>
<td>102.0</td>
<td>132.5</td>
<td>379.1</td>
</tr>
<tr>
<td>Capital investments</td>
<td>14.7</td>
<td>77.9</td>
<td>92.6</td>
<td>142.3</td>
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<tr>
<td>Replacement demand</td>
<td>18.2</td>
<td>39.9</td>
<td>58.1</td>
<td>282.0</td>
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<tr>
<td>Pro-development policies</td>
<td>23.5</td>
<td>137.6</td>
<td>161.1</td>
<td>478.8</td>
</tr>
<tr>
<td><strong>Total potential jobs</strong></td>
<td><strong>86.9</strong></td>
<td><strong>357.4</strong></td>
<td><strong>444.3</strong></td>
<td><strong>1,282.2</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
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<th>African American</th>
<th>Hispanic</th>
<th>Minority</th>
<th>Total industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline growth</td>
<td>37.8</td>
<td>152.1</td>
<td>189.9</td>
<td>384.0</td>
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<tr>
<td>Capital investment</td>
<td>14.6</td>
<td>99.9</td>
<td>114.4</td>
<td>105.0</td>
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<tr>
<td>Replacement demand</td>
<td>39.0</td>
<td>9933</td>
<td>138.3</td>
<td>585.1</td>
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<tr>
<td>Pro-development policies</td>
<td>39.1</td>
<td>225.2</td>
<td>264.3</td>
<td>789.8</td>
</tr>
<tr>
<td><strong>Total potential jobs</strong></td>
<td><strong>130.5</strong></td>
<td><strong>576.5</strong></td>
<td><strong>706.9</strong></td>
<td><strong>1,863.9</strong></td>
</tr>
</tbody>
</table>

*“Minority” refers to the sum of African American and Hispanic workers

source: IHS