Oil and natural gas -- outlook and drivers

for

Committee on Earth Resources
National Academies of Science, Engineering, and Medicine
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by

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Global supply has consistently exceeded demand since the start of 2014; EIA forecasts a return to market balance in the second half of 2017

Source: EIA, Short-Term Energy Outlook, April 2016
EIA expects WTI oil prices to remain low compared to recent history, but the market-implied confidence band is very wide

Source: EIA, Short-Term Energy Outlook, April 2016
The U.S. has experienced a rapid increase in natural gas and oil production from shale and other tight resources

Sources: EIA derived from state administrative data collected by DrillingInfo Inc. Data are through February 2016 and represent EIA’s official tight oil & shale gas estimates, but are not survey data. State abbreviations indicate primary state(s).
Crude supply trends outside the United States (red areas below) are key to future oil market balance: geopolitical developments, exporter decisions, and the timing and magnitude of supply effects stemming from reduced investment all matter.

**2016 oil production, million barrels per day--EIA April STEO**

- Shale Regions 5.59
- Other Lower 0.85
- GOM 1.66
- AK 0.47

**2016 oil production, million barrels per day--EIA April STEO**

- Shale Regions 4.96
- Other Lower 0.80
- GOM 1.82
- AK 0.46

**Source:** EIA, Short-Term Energy Outlook and Drilling Productivity Report, April 2016; International Energy Agency

NAS | Oil market outlook and drivers, May 4, 2016
U.S. outlook
Increased production of tight oil and greater fuel efficiency drive decline in petroleum and other liquid imports

U.S. liquid fuels supply
million barrels per day

Note: “Other” includes refinery gain, biofuels production, all stock withdrawals, and other domestic sources of liquid fuels

Source: EIA, Annual Energy Outlook 2015 Reference case
Resource and technology assumptions have major implications for projected U.S. crude oil production beyond the next few years.

U.S. crude oil production
million barrels per day

History 2013

2013

U.S. maximum production level of 9.6 million barrels per day in 1970

Reference

High Oil and Gas Resource

Low Oil Price

Source: EIA, Annual Energy Outlook 2015
U.S. reliance on net imports of petroleum and other liquids is virtually eliminated by 2035 in High Oil and Gas Resource case

net crude oil and petroleum product imports as a percentage of total U.S. supply

History

2013

Projections

Low Oil Price

Reference

High Oil Price

High Oil and Gas Resource

Source: EIA, Annual Energy Outlook 2015

NAS | Oil market outlook and drivers, May 4, 2016
Takeaways – Natural gas

• North American natural gas production is more likely to be limited by demand than supply

• U.S. natural gas demand growth is likely to be concentrated in electricity and industrial uses; natural gas exports and use in the transportation sector, where little natural gas is used today, are also likely to grow

• Potential challenges to natural gas demand growth include
  – Slow growth in U.S. electricity demand
  – Competition from offshore “stranded” gas for global LNG exports and siting of gas-intensive industries.
  – Long-term cheap oil would be another significant challenge to LNG exports
  – Extent and nature of global price convergence in natural gas markets

• Future policies that target particular sources or uses of energy or energy-related emissions can really matter for future natural gas demand
Natural gas consumption growth is concentrated in electricity generation and industry; gas use rises in all sectors except residential.

Source: EIA, Annual Energy Outlook 2015 Reference case

*Includes combined heat-and-power and lease and plant fuel
**Includes pipeline fuel
Shale resources remain the dominant source of U.S. natural gas production growth

U.S. dry natural gas production

| Source: EIA, Annual Energy Outlook 2015 Reference case | NAS | Oil market outlook and drivers, May 4, 2016 | 12 |
Projected U.S. natural gas exports reflect the spread between domestic natural gas prices and world energy prices

Source: EIA, Annual Energy Outlook 2015
Global outlook
Economic activity and population drive increases in energy use; energy intensity (E/GDP) improvements moderate this trend

Average annual percent change (2012–40) percent per year

Source: Current Thinking
Renewables grow fastest, coal use plateaus, natural gas surpasses coal by 2030, and oil maintains its leading share

Source: Current Thinking
Passenger-miles per person will rise as GDP per capita grows; travel growth is largely outside the OECD

passenger-miles per capita (left-axis) and GDP per capita (horizontal-axis) for selected country groupings 2010–40

Most of the growth in world oil consumption occurs in the non-OECD regions — especially Asia

Liquid fuels supplies from both OPEC and non-OPEC producers increase through 2040

world production of petroleum and other liquid fuels
million barrels per day

Source: Current thinking
LONGER TERM PERSPECTIVE: Can OPEC cohere? – Change in world liquid fuel balances for two 12-year historical periods with EIA projections for 2013-25 from AEO2015 (million barrels per day)

<table>
<thead>
<tr>
<th></th>
<th>Actual</th>
<th>Projected AEO 2015 Reference &amp; HOGR Cases</th>
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<td>1973–85</td>
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<tr>
<td>OPEC Production</td>
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</table>

Source: EIA, Annual Energy Outlook 2015, April 2015
Non-OECD nations account for ¾ of projected growth in natural gas consumption.

World natural gas consumption
Trillion cubic feet

Source: Current Thinking
Non-OECD Asia, Middle East, and OECD Americas account for the largest increases in natural gas production

World change in natural gas production, 2012–40 trillion cubic feet

Source: Current thinking
Shale gas, tight gas, and coalbed methane become increasingly important to gas supplies, not only for the U.S., but also China and Canada

natural gas production by type
trillion cubic feet

Note: Other natural gas includes natural gas produced from structural and stratigraphic traps (e.g. reservoirs), historically referred to as ‘conventional’ production.
Source: Current thinking