Outlook for U.S. shale oil and gas

IAEE/AEA Meeting
January 4, 2014 | Philadelphia, PA

By
Adam Sieminski, EIA Administrator
Key insights on drilling productivity and production trends

• The U.S. has experienced a rapid increase in natural gas and oil production from shale and other tight resources

• Six tight oil and shale gas plays taken together account for nearly 90% of domestic oil production growth and virtually all domestic natural gas production growth over the last 2 years

• Higher drilling efficiency and new well productivity, rather than an increase in the rig count, have been the main drivers of recent production growth

• Steep legacy production decline rates are being offset by growing production from new wells

• Of the six plays, the Bakken and Eagle Ford plays account for about 67% of oil production growth; the Marcellus play accounts for about 75% of natural gas production growth
Six key plays account for nearly all recent growth in oil and natural gas production

Source: EIA, Drilling Productivity Report
The U.S. has experienced a rapid increase in natural gas and oil production from shale and other tight resources.

Note: Dry shale gas production data are based on LCI Energy Insight gross withdrawal estimates as of June 2013, converted to dry production estimates with EIA-calculated average gross-to-dry shrinkage factors by state and/or shale play.

Source: EIA based on DrillingInfo and LCI Energy Insight
U.S. crude oil and natural gas production is up dramatically since 2010 and will continue to grow rapidly; this has strategic implications for the United States:

- Refinery operations/investment
- Logistics infrastructure investment
- Exports of petroleum products
- Exports of crude oil and natural gas (LNG)
- Management of Strategic Petroleum Reserve
Natural gas
U.S. natural gas prices remain well below crude oil prices

energy spot prices
2012 dollars per million Btu

History
2012

2018

2028

2040

Brent crude oil spot price

Henry Hub spot price

Ratio: 7.1

Ratio: 3.4

Oil to gas price ratio:

3.2

Source: EIA, Annual Energy Outlook 2014 Early Release
Shale gas leads growth in total gas production through 2040 to reach half of U.S. output

U.S. dry natural gas production

trillion cubic feet

billion cubic feet per day

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, IAEE/AEA
January 4, 2014
Natural gas consumption growth is driven by electric power, industrial, and transportation use.

U.S. dry gas consumption (trillion cubic feet)

Source: EIA, Annual Energy Outlook 2014 Early Release

*Includes combined heat-and-power and lease and plant fuel
**Includes pipeline fuel

Adam Sieminski, IAEE/AEA
January 4, 2014
Manufacturing output and natural gas use grows with low natural gas prices, particularly in the near term.

Manufacturing natural gas consumption

<table>
<thead>
<tr>
<th>quadrillion Btu</th>
<th>billion cubic feet per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>- 24</td>
</tr>
<tr>
<td>8</td>
<td>- 20</td>
</tr>
<tr>
<td>7</td>
<td>- 16</td>
</tr>
<tr>
<td>6</td>
<td>- 12</td>
</tr>
<tr>
<td>5</td>
<td>- 8</td>
</tr>
<tr>
<td>4</td>
<td>- 4</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, IAEE/AEA
January 4, 2014
Natural gas use in the transportation sector grows rapidly with the largest share in freight trucks.

**Natural gas use by mode**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Trillion Btu</th>
<th>Billion cubic feet per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight trucks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freight rail and marine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light-duty vehicles</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Approximate crude oil equivalent, (thousand barrels per day) 2040**

<table>
<thead>
<tr>
<th>Mode</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freight trucks</td>
<td>290</td>
</tr>
<tr>
<td>Freight rail and marine</td>
<td>71</td>
</tr>
<tr>
<td>Buses</td>
<td>38</td>
</tr>
<tr>
<td>Light-duty vehicles</td>
<td>9</td>
</tr>
</tbody>
</table>

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, IAEE/AEA
January 4, 2014
U.S. natural gas gross exports exceed 5 tcf in 2025

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, IAEE/AEA
January 4, 2014
U.S. becomes a net exporter of natural gas in the near future

U.S. dry natural gas
trillion cubic feet per year

Consumption
Domestic supply
Net exports

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, IAEE/AEA
January 4, 2014
Petroleum
Growing tight oil and offshore crude oil production drive U.S. output close to historical high

U.S. crude oil production
million barrels per day

History 2012 Projections

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

Tight oil

Lower 48 offshore

Alaska

Other lower 48 onshore

Source: EIA, Annual Energy Outlook 2014 Early Release
Transportation sector motor gasoline demand declines, while diesel fuel accounts for a growing portion of the market.

Transportation energy consumption by fuel quadrillion Btu

**History**

- 1990: Motor gasoline 59%
- 2012: Motor gasoline 59%
- 2020: Motor gasoline 47%
- 2030: Motor gasoline 44%
- 2040: Motor gasoline 44%

**Projections**

- 2030: Motor gasoline 47%
- 2040: Motor gasoline 44%

**Other**

- 1990: 3%
- 2012: 12%
- 2020: 13%
- 2030: 13%
- 2040: 13%

**Ethanol**

- 1990: 4%
- 2012: 4%
- 2020: 5%
- 2030: 5%
- 2040: 5%

**Diesel**

- 1990: 22%
- 2012: 22%
- 2020: 30%
- 2030: 30%
- 2040: 31%

**Jet fuel**

- 1990: 1%
- 2012: 1%
- 2020: 1%
- 2030: 3%
- 2040: 3%

**CNG/LNG**

- 1990: 1%
- 2012: 1%
- 2020: 1%
- 2030: 1%
- 2040: 3%

*Includes aviation gasoline, propane, residual fuel oil, lubricants, electricity, and liquid hydrogen.

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, IAEE/AEA
January 4, 2014
U.S. maintains status as a net exporter of petroleum products

U.S. petroleum product imports and exports
million barrels per day


Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, IAEE/AEA
January 4, 2014
U.S. dependence on imported liquids declines, particularly in the near term

U.S. liquid fuel supply
million barrels per day

Consumption
Net imports
Domestic supply

Source: EIA, Annual Energy Outlook 2014 Early Release
Energy-related CO₂ emissions remain below the 2005 level over the projection period

![Graph showing energy-related carbon dioxide emissions (in billion metric tons) from 1990 to 2040. The graph indicates that in 2020, emissions are 9% below the 2005 level, and in 2040, they are 7% below the 2005 level. The graph includes a note stating: "Energy-related carbon dioxide emissions are 9% below the 2005 level in 2020 and 7% below the 2005 level in 2040."}

Source: EIA, Annual Energy Outlook 2014 Early Release
For more information


Annual Energy Outlook | www.eia.gov/aeo

Short-Term Energy Outlook | www.eia.gov/steo

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

Today in Energy | www.eia.gov/todayinenergy

State Energy Profiles | http://www.eia.gov/state

Drilling Productivity Report | http://www.eia.gov/petroleum/drilling/