Key results from the *AEO2014* Reference case

- Growing domestic production of natural gas and oil continues to reshape the U.S. energy economy, with crude oil approaching the 1970 all-time high of 9.6 million barrels per day.
- Light-duty vehicle energy use declines sharply reflecting slowing growth in vehicle miles traveled and accelerated improvement in vehicle efficiency.
- With continued growth in shale gas production, natural gas becomes the largest source of U.S. electric power generation, surpassing coal by 2035, and boosting production and natural gas consumption in manufacturing.
- Strong growth in domestic natural gas production supports increased exports of both pipeline and liquefied natural gas.
- With strong growth in domestic oil and gas production, U.S. dependence on imported fuels falls sharply.
- Improved efficiency of energy use and a shift away from carbon-intensive fuels keep U.S. energy-related carbon dioxide emissions below their 2005 level through 2040.
Growth in U.S. energy production outstrips growth in consumption leading to a reduction in net imports

U.S. energy production and consumption
quadrillion Btu

Source: EIA, Annual Energy Outlook 2014 Early Release
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

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, December 16, 2013
Transportation sector motor gasoline demand declines, while diesel fuel accounts for a growing portion of the market.

Transportation energy consumption by fuel quadrillion Btu

Source: EIA, Annual Energy Outlook 2014 Early Release

*Includes aviation gasoline, propane, residual fuel oil, lubricants, electricity, and liquid hydrogen
Shale gas leads U.S. production growth

U.S. dry natural gas production
trillion cubic feet

Source: EIA, Annual Energy Outlook 2014 Early Release
Electricity generation from natural gas surpasses coal

Source: EIA, Annual Energy Outlook 2014 Early Release
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>Year</th>
<th>Refining and related</th>
<th>Bulk chemicals</th>
<th>Food</th>
<th>Iron and steel</th>
<th>Metal based durables</th>
<th>Paper</th>
<th>Other</th>
<th>Other manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Source:** EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, December 16, 2013
U.S. natural gas gross exports exceed 5 tcf in 2025

U.S. natural gas imports and exports
trillion cubic feet per year

History 2012 Projections


5.4 tcf of exports
(14.8 bcf/day)

Pipeline exports to Mexico

Pipeline exports to Canada

Lower 48 states LNG exports

Alaska LNG exports

Pipeline imports from Canada

2.0 tcf of imports
(5.4 bcf/day)

LNG imports

Source: EIA, Annual Energy Outlook 2014 Early Release
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,
December 16, 2013
Energy-related CO₂ emissions remain below the 2005 level over the projection period

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
Petroleum and other liquid supply
U.S. dependence on imported liquids declines, particularly in the near term

U.S. liquid fuel supply
million barrels per day

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski,
December 16, 2013
Increased production of tight oil and greater fuel efficiency drive decline in petroleum and other liquids imports

U.S. liquid fuels supply
million barrels per day

- Increased production of tight oil
- Greater fuel efficiency
- Drive decline in petroleum and other liquids imports

**Projections History**

- **Natural gas plant liquids**
- **Crude oil production (excluding tight)**
- **Net petroleum and biofuel imports**
- **Tight oil production**

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

**Source:** EIA, Annual Energy Outlook 2014 Early Release
Natural gas use in the transportation sector grows rapidly with the largest share in freight trucks.

Natural gas use by mode (trillion Btu)

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

- Freight trucks: 290
- Freight rail and marine: 71
- Buses: 38
- Light-duty vehicles: 9

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, December 16, 2013
Natural gas
U.S. natural gas prices remain well below crude oil prices

energy spot prices
2012 dollars per million Btu

Source: EIA, Annual Energy Outlook 2014 Early Release

Henry Hub spot price
Brent crude oil spot price

Ratio: 7.1
Oil to gas price ratio: 3.4

Ratio: 3.2

Adam Sieminski,
December 16, 2013
U.S. becomes a net exporter of natural gas in the near future

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, December 16, 2013
Natural gas consumption growth is driven by electric power, industrial, and transportation use

U.S. dry gas consumption
trillion cubic feet

History

Projections

2005 2012 2020 2025 2030 2035 2040

Source: EIA, Annual Energy Outlook 2014 Early Release

*Includes combined heat-and-power and lease and plant fuel
**Includes pipeline fuel
Electricity
Growth in electricity use slows, but still increases by 29% from 2012 to 2040

U.S. electricity use
percent growth (3-year rolling average)

<table>
<thead>
<tr>
<th>Period</th>
<th>Annual Growth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Electricity use</td>
</tr>
<tr>
<td>1950s</td>
<td>9.8</td>
</tr>
<tr>
<td>1960s</td>
<td>7.3</td>
</tr>
<tr>
<td>1970s</td>
<td>4.7</td>
</tr>
<tr>
<td>1980s</td>
<td>2.9</td>
</tr>
<tr>
<td>1990s</td>
<td>2.4</td>
</tr>
<tr>
<td>2000-2012</td>
<td>0.7</td>
</tr>
<tr>
<td>2013-2040</td>
<td>0.9</td>
</tr>
</tbody>
</table>

Source: EIA, Annual Energy Outlook 2014 Early Release
Over time the electricity mix gradually shifts to lower-carbon options, led by growth in natural gas and renewable generation.

Source: EIA, Annual Energy Outlook 2014 Early Release
Non-hydro renewable generation more than doubles between 2012 and 2040

non-hydropower renewable generation
billion kilowatthours per year

Source: EIA, Annual Energy Outlook 2013 Early Release
For more information


Annual Energy Outlook | www.eia.gov/forecasts/aeo

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

International Energy Outlook | www.eia.gov/forecasts/ieo

Today In Energy | www.eia.gov/todayinenergy

Monthly Energy Review | www.eia.gov/totalenergy/data/monthly

State Energy Portal | www.eia.gov/state

Adam Sieminski,
December 16, 2013
Reference case oil price initially drops and then rises steadily, but there is uncertainty about the future trajectory.

Annual average price of Brent crude oil

Real 2012 dollars per barrel

Source: EIA, Annual Energy Outlook 2014 Early Release
U.S. production grows rapidly, particularly natural gas, renewables, and liquids in the near term

U.S. energy production
quadrillion Btu

History | 2012 | Projections
---|---|---
1980 | 27 20 | 2025 | 2040
1985 | | | |
1990 | | | |
1995 | | | |
2000 | | | |
2005 | | | |
2010 | | | |
2015 | | | |
2020 | | | |
2025 | | | |
2030 | | | |
2035 | | | |
2040 | | | |

Natural gas | 31% | 34% | 38%
Renewables | 11% | 24% | 20%
Crude oil and natural gas plant liquids | 21% | 22% |
Coal | 26% | 23% | 22%
Nuclear | 10% | 8% | 8%

Source: EIA, Annual Energy Outlook 2014 Early Release
U.S. energy use grows slowly over the projection reflecting steady growth in GDP offset by improving energy efficiency

U.S. primary energy consumption (quadrillion Btu)

History Projections

- **Renewables (excluding liquid biofuels)**
  - 1980: 1%
  - 2012: 27%
  - 2025: 27%
  - 2040: 30%

- **Natural gas**
  - 1980: 8%
  - 2012: 8%
  - 2025: 9%
  - 2040: 10%

- **Coal**
  - 1980: 18%
  - 2012: 18%
  - 2025: 19%
  - 2040: 18%

- **Nuclear**
  - 1980: 37%
  - 2012: 8%
  - 2025: 8%
  - 2040: 8%

- **Liquid biofuels**
  - 1980: 1%
  - 2012: 1%
  - 2025: 2%
  - 2040: 2%

- **Oil and other liquids**
  - 1980: 37%
  - 2012: 34%
  - 2025: 34%
  - 2040: 32%

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, December 16, 2013
CO₂ per dollar of GDP declines faster than energy use per dollar of GDP reflecting the shift to lower carbon fuels.

Energy and emission intensity index, 2005=1

Source: EIA, Annual Energy Outlook 2014 Early Release
Coal regains some competitive advantage relative to natural gas over time on a national average basis.

Source: EIA, Annual Energy Outlook 2014 Early Release
VMT per licensed driver decreases until 2024 in AEO2014 and is much lower than in AEO2013 due to consideration of age cohorts.

Source: EIA, Annual Energy Outlook 2014 Early Release
Light-duty vehicle travel is lower in AEO2014 than in AEO2013

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, December 16, 2013
Light-duty vehicle liquids consumption is lower primarily due to lower growth in vehicle miles traveled

Light-duty vehicle liquids consumption (quadrillion Btu)

Source: EIA, Annual Energy Outlook 2014 Early Release

Adam Sieminski, December 16, 2013
Global liquids supply increases by almost one-third with OPEC’s share relatively stable

Source: EIA, Annual Energy Outlook 2014 Early Release
Why long-term projections might could will be wrong

- Different relative fuel prices
- Faster / slower demand growth
- Changing policies and regulations
- Changing consumer preferences
- Faster / slower technological progress
- Technological breakthroughs