Annual Energy Outlook 2013: Coal Projections

Diane Kearney
September 19, 2013 | Washington, D.C.
Legislation and regulation assumptions

• Current laws and regulations addressed in the AEO2014 Reference Case
  - Clean Air Interstate Rule (CAIR)
  - Mercury and Air Toxics Standards (MATS) by 2016
  - State Renewable Portfolio Standards (RPS)
  - California’s cap-and-trade program and the Northeast’s RGGI program
  - Uncertainty with respect to CO₂ policy addressed through a 3% higher cost of capital for new coal-fired power plants and capital investment projects at existing coal-fired power plants

• Issues not addressed in the AEO2014 Reference Case
  – CO₂ New Source Performance Standards (NSPS)
  – Cooling water intake regulations per section 316(b) of the Clean Water Act
  – Regional haze
  – Coal combustion residuals
Key results for the AEO2013 Reference case

• Coal remains the leading fuel for U.S. electricity generation, but coal’s share of total generation decreases over time to 35% in 2040 (from 42% in 2011).

• Coal producers in both the Interior and Western regions see their shares of total U.S. coal production increase over the projection period, while Appalachia's share declines. From 2011 to 2040, the Appalachian region's share of total coal production (on a Btu basis) falls from 38 percent to 32 percent.

• Nearly all of the 49 GW of coal-fired capacity retirements (28 GW planned) occur by 2016 largely because of the combination of MATS, relatively low natural gas prices, and relatively low electricity demand.
Key results for the AEO2013 Reference case

• Expanding development of shale gas resources drive increased production and competitive prices for natural gas

• Coal consumption declines by 119 million short tons between 2011 and 2016. Between 2016 and 2040, coal consumption rises due to more intensive use of remaining coal plants as natural gas prices rise, but it never reaches the record 2007 level.

• 9 GW of additions (6 GW planned)

• Delivered coal prices increase gradually through 2040 at an average rate of 0.9% per year due to declining coal mine productivity and increasing transportation costs
## Electric Net Summer Generating Capacity by Fuel, 2008-2040 (gigawatts)

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<tr>
<td>Coal</td>
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<td>318</td>
<td>301</td>
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<td>Electric Power Sector</td>
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<td>End-Use Sectors</td>
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<td>Natural Gas</td>
<td>335</td>
<td>359</td>
<td>379</td>
<td>380</td>
<td>390</td>
<td>519</td>
<td>566</td>
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<td>Petroleum</td>
<td>115</td>
<td>103</td>
<td>99</td>
<td>97</td>
<td>88</td>
<td>68</td>
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<tr>
<td>Nuclear Power</td>
<td>101</td>
<td>101</td>
<td>104</td>
<td>106</td>
<td>111</td>
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<td>113</td>
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<td>Renewable Sources</td>
<td>117</td>
<td>143</td>
<td>171</td>
<td>175</td>
<td>178</td>
<td>208</td>
<td>245</td>
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<tr>
<td>Other (includes pumped storage)</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
<td>25</td>
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<tr>
<td>Total</td>
<td>1004</td>
<td>1050</td>
<td>1079</td>
<td>1061</td>
<td>1068</td>
<td>1206</td>
<td>1293</td>
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*MATS compliance assumed to begin*
Electricity Sector Net Summer Generating Capacity by SO$_2$ Control Type and Region, 2011 and 2020 in AEO2013

Note: Scrubbed capacity includes capacity equipped with flue gas desulfurization (FGD) equipment and coal plants employing integrated gasification combined (IGCC) cycle or circulating fluidized bed (CFB) combustion technologies.

Electricity generation by fuel, 1990-2040

Billion kilowatthours

History

- Oil and other liquids
- Coal
- Nuclear
- Renewables
- Natural gas

Projections

- Oil and other liquids
- Coal
- Nuclear
- Renewables
- Natural gas

Source: U.S. Energy Information Administration, Annual Energy Outlook 2013, Reference Case
Electricity Generation by Fuel, 1980-2040

- **Coal**
- **Petroleum**
- **Nuclear**
- **Natural Gas**
- **Renewables**

**Note:** Includes generation from plants in both the electric power and end-use sectors.

**Source:**
- **History:** U.S. Energy Information Administration (EIA), *Annual Energy Review*;
Average Delivered Price of Coal and Natural Gas to the Electric Power Sector, 1980-2040

2011 dollars per million Btu

History 2011 Projections

Coal

Natural Gas

Short Term Energy Outlook, September 2013

Average Capacity Utilization Rate for Coal-Fired Generating Capacity in Five Cases, 2005-2040

Percent

History

Projections

Low Oil and Gas Resource

Low Coal Cost

Reference

High Coal Cost

High Oil and Gas Resource

Coal consumption by sector, 1970-2040

Coal production by region, 1970-2040

Coal production, 2040 (and 2012) (million short tons)

* Includes production from all mines in Wyoming’s Powder River Basin.

** Includes production from mines in both Alaska and Washington.


Diane Kearney
Washington, DC, September 19, 2013
## Average annual growth in coal mining labor productivity for selected supply regions (percent)

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<tbody>
<tr>
<td>Northern Appalachia</td>
<td>5.4</td>
<td>5.5</td>
<td>-2.5</td>
<td>-1.2</td>
<td>-3.6</td>
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<td>Central Appalachia</td>
<td>7.3</td>
<td>4.4</td>
<td>-6.1</td>
<td>-3.6</td>
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<tr>
<td>Eastern Interior</td>
<td>4.8</td>
<td>3.7</td>
<td>-1.4</td>
<td>-0.6</td>
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<td>Gulf Lignite</td>
<td>2.6</td>
<td>2.4</td>
<td>-2.7</td>
<td>-2.3</td>
<td>-4.2</td>
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<tr>
<td>Dakota Lignite</td>
<td>6.0</td>
<td>1.0</td>
<td>-3.3</td>
<td>-0.9</td>
<td>-4.5</td>
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<tr>
<td>Western Montana</td>
<td>4.6</td>
<td>2.0</td>
<td>-3.0</td>
<td>-1.7</td>
<td>-11.7</td>
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<tr>
<td>WY, Northern Powder River Basin</td>
<td>7.5</td>
<td>3.2</td>
<td>-3.0</td>
<td>-1.7</td>
<td>-5.8</td>
</tr>
<tr>
<td>WY, Southern Powder River Basin</td>
<td>7.2</td>
<td>4.9</td>
<td>-2.7</td>
<td>-1.7</td>
<td>-6.6</td>
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<tr>
<td>Rocky Mountain</td>
<td>7.8</td>
<td>5.5</td>
<td>-3.3</td>
<td>-1.9</td>
<td>2.9</td>
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<tr>
<td>U.S. Average</td>
<td>7.1</td>
<td>6.2</td>
<td>-2.7</td>
<td>-1.4</td>
<td>0.1</td>
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</table>

**Source:** History: U.S. Energy Information Administration (EIA), *Annual Coal Report*; and Mine Safety and Health Administration, Form 7000-2, “Quarterly Mine and Employment and Coal Production Report;”

**Projections:** EIA, *Annual Energy Outlook 2013*, Reference Case
Average minemouth coal price by region, 1980-2040

Note: Historical price data for Wyoming's PRB is represented by data for Campbell county.

Source: History: U.S. Energy Information Administration (EIA), Annual Coal Report;
Projections: EIA, Annual Energy Outlook 2013, Reference Case
U.S. Coal Exports, 1995-2040

Coal exports by major coal-producing region, 2010-2040

Uncertainty is explored with numerous alternative cases
## Key differences between alternate cases

<table>
<thead>
<tr>
<th>AEO2013 Reference</th>
<th>Low Economic Growth</th>
<th>High Economic Growth</th>
<th>Low Coal Cost</th>
<th>High Coal Cost</th>
<th>High Oil and Gas Resource</th>
<th>Low Oil and Gas Resource</th>
<th>GHG15 (CO2 fee of $15 in 2014 increasing to $53 in 2040)</th>
<th>GHG25 (CO2 fee of $25 in 2014 increasing to $89 in 2040)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP growth (avg. annual change from 2011)</td>
<td>2.5%</td>
<td>1.9%</td>
<td>2.9%</td>
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<tr>
<td>Electricity demand (avg. annual change from 2011)</td>
<td>0.9%</td>
<td>0.6%</td>
<td>1.2%</td>
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<tr>
<td>Delivered natural gas price to the electricity sector, 2040 (2011 dollars per million Btu)</td>
<td>$8.38</td>
<td>$5.13</td>
<td>$10.55</td>
<td>$11.01*</td>
<td>$11.10*</td>
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<tr>
<td>Delivered coal price to the electricity sector, 2040 (2011 dollars per million Btu)</td>
<td>$3.20</td>
<td>$1.88</td>
<td>$5.68</td>
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<td>Minemouth coal price, 2040 (2011 dollars per short ton)</td>
<td>$61.28</td>
<td>$33.90</td>
<td>$128.09</td>
<td></td>
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<tr>
<td>Western coal transportation rates (percent change from 2011, constant dollar basis)</td>
<td>0.0%</td>
<td>-24%</td>
<td>27%</td>
<td></td>
<td></td>
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<tr>
<td>Coal mining productivity (avg. annual change from 2011)</td>
<td>-1.4%</td>
<td>0.9%</td>
<td>-4.3%</td>
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<tr>
<td>Coal with CCS in power sector, 2040 (gigawatts)</td>
<td>0.9</td>
<td></td>
<td></td>
<td>2.6</td>
<td>3.9</td>
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<td>NGCC with CCS in power sector, 2040 (gigawatts)</td>
<td>0.0</td>
<td></td>
<td></td>
<td>5.8</td>
<td>49.9</td>
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</tbody>
</table>

*Includes CO₂ fee
U.S. Coal Production, 2020 and 2040

Coal production by region, 2040

2040 electricity generation shares

Cumulative coal-fired capacity retirements, 2012-2040

Cumulative coal-fired capacity additions, 2012-2040

For more information

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