The Continuing Decline in Demand for Central Appalachian Coal: Market and Regulatory Influences

Rory McIlmoil, Evan Hansen, Nathan Askins, Meghan Betcher

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ABOUT THE REPORT


ACKNOWLEDGEMENTS

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We would also like to thank Michael Mellish, Long-term Analysis and Forecasting Expert on Coal Supply and Prices at the federal Energy Information Administration. Mr. Mellish was generous with his time in providing multiple data sets upon request, as well as with providing expert insight on factors influencing Central Appalachian coal. Finally, we would like to thank Dr. Matt Wasson of Appalachian Voices for providing data and input that was useful for conceptualizing certain sections of this report.

SUGGESTED REFERENCE

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ABBREVIATIONS

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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AEO</td>
<td>Annual Energy Outlook</td>
</tr>
<tr>
<td>BACT</td>
<td>Best Available Control Technology</td>
</tr>
<tr>
<td>CAIR</td>
<td>Clean Air Interstate Rule</td>
</tr>
<tr>
<td>CAPP</td>
<td>Central Appalachia</td>
</tr>
<tr>
<td>CCR</td>
<td>Coal Combustion Residuals</td>
</tr>
<tr>
<td>CCS</td>
<td>carbon capture and sequestration</td>
</tr>
<tr>
<td>CO₂</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>CO₂e</td>
<td>carbon dioxide equivalent</td>
</tr>
<tr>
<td>CSAPR</td>
<td>Cross-State Air Pollution Rule</td>
</tr>
<tr>
<td>CWA</td>
<td>Clean Water Act</td>
</tr>
<tr>
<td>DC</td>
<td>District of Columbia</td>
</tr>
<tr>
<td>E. INT</td>
<td>Eastern Interior</td>
</tr>
<tr>
<td>EIA</td>
<td>Energy Information Administration</td>
</tr>
<tr>
<td>EMM</td>
<td>Electricity Market Module</td>
</tr>
<tr>
<td>FGD</td>
<td>flue-gas desulfurization</td>
</tr>
<tr>
<td>FY</td>
<td>Fiscal Year</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>GHG</td>
<td>greenhouse gas</td>
</tr>
<tr>
<td>GW</td>
<td>giga-watt</td>
</tr>
<tr>
<td>IPP</td>
<td>Independent Power Producer</td>
</tr>
<tr>
<td>JISEA</td>
<td>Joint Institute for Strategic Energy Analysis</td>
</tr>
<tr>
<td>JISEA</td>
<td>Joint Institute for Strategic Energy Analysis</td>
</tr>
<tr>
<td>MATS</td>
<td>Mercury and Air Toxics Standards</td>
</tr>
<tr>
<td>met</td>
<td>metallurgical</td>
</tr>
<tr>
<td>mmBtu</td>
<td>million British thermal units</td>
</tr>
<tr>
<td>MSHA</td>
<td>Mine Safety and Health Administration</td>
</tr>
<tr>
<td>MW</td>
<td>megawatt</td>
</tr>
<tr>
<td>MWh</td>
<td>megawatt-hour</td>
</tr>
<tr>
<td>NAPP</td>
<td>Northern Appalachia</td>
</tr>
<tr>
<td>NERC</td>
<td>North American Electric Reliability Corporation</td>
</tr>
<tr>
<td>NOₓ</td>
<td>nitrogen oxides</td>
</tr>
<tr>
<td>OSMRE</td>
<td>Office of Surface Mining Reclamation and Enforcement</td>
</tr>
<tr>
<td>PRB</td>
<td>Powder River Basin</td>
</tr>
<tr>
<td>PSD</td>
<td>Prevention of Significant Deterioration</td>
</tr>
<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
</tr>
<tr>
<td>RFC</td>
<td>Reliability First Corporation</td>
</tr>
<tr>
<td>RIA</td>
<td>Regulatory Impact Analysis</td>
</tr>
<tr>
<td>RRC</td>
<td>Regional Reliability Council</td>
</tr>
<tr>
<td>SAPP</td>
<td>Southern Appalachia</td>
</tr>
<tr>
<td>SERC</td>
<td>Southeast Electric Reliability Council</td>
</tr>
<tr>
<td>SO₂</td>
<td>sulfur dioxide</td>
</tr>
<tr>
<td>tpmh</td>
<td>tons per miner-hour</td>
</tr>
<tr>
<td>tpy</td>
<td>tons per year</td>
</tr>
<tr>
<td>US</td>
<td>United States</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
<tr>
<td>W. INT</td>
<td>Western Interior</td>
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KEY FINDINGS

The Central Appalachian coal industry and the communities that depend on coal for jobs and revenues in southern West Virginia, eastern Kentucky, Virginia, and Tennessee are facing numerous challenges. These challenges include the depletion of the region’s most productive coal reserves; declining labor productivity; rising coal prices; increasing rates for coal-generated electricity; and increasing competition from other coal basins, natural gas, and renewable energy technologies.

This report aims to provide a detailed examination of the many trends and factors influencing demand for CAPP coal on the regional, state, and county levels. Such an examination is necessary in order to understand which local and state economies are likely to be most negatively impacted from future declines in demand. This information could prove vital for both state and local officials in determining where development efforts and financial resources should be focused. Indeed, as suggested by the information and conclusions presented throughout this report, comprehensive, focused policies and investments will be needed in order to build the foundation for new economic alternatives in coal-producing counties.

Finding 1: Central Appalachian coal production has declined significantly in recent years and will continue to decline.

Central Appalachian coal production reached an all-time peak of 294 million tons in 1990 and peaked a second time at 291 million tons in 1997. Since then, production has declined by 55% in Tennessee, 44% in eastern Kentucky, 37% in Virginia, and 29% in southern West Virginia. As of 2011, regional coal production amounted to 185 million tons—17% of total United States coal production.

Figure ES-1: Trends in coal production for the four Central Appalachian states, 1985-2011
The federal Energy Information Administration projects that regional production will decline by 53% from 2011 through 2040, representing 98 million tons of annual production. Most importantly, 86% of this decline is projected to occur by 2020. This fact alone highlights the importance of identifying where the decline may have the greatest negative impact on local coal production, in order to understand which coal-producing communities face the greatest economic challenges in the coming years as a result of the decline.

**Figure ES-2: Comparison of annual projections for Central Appalachian coal production**
Finding 2: Underground mining has declined substantially, and surface and underground mining now produce approximately the same amount of Central Appalachian coal.

The share of regional coal produced by surface mining increased consistently from 1985 through 2007, as surface mining increased while underground mining decreased. Since 2007, surface and underground mines have each accounted for roughly half of regional production, and production from surface and underground mines has declined relatively equally.

Figure ES-3: Regional trends in surface and underground mine production, 1985-2011
Finding 3: Labor productivity has declined virtually every year since 2000.

Because so many of the thickest, easiest-to-access coal reserves have already been mined, more miners are required to produce each ton of coal.

Even as coal demand grew from 1985 to 1990—and then again from 1993 to 1997—the number of coal mining jobs decreased. This was the result of sharp improvements in labor productivity, which reflected a shift toward greater mechanization of the mining process, both for surface and underground mines. At the same time, production was shifting toward surface mining, which requires less labor to produce each ton of coal than underground mining. As a result of these changes, direct coal employment declined from approximately 70,000 coal miners in 1985 to 35,600 miners by 1997. This decline in employment occurred during the same period that Central Appalachian coal production increased to its peak.

Another implication of a decline in labor productivity is that CAPP coal mines are more expensive to operate compared with those in other basins and require higher coal prices in order for mines to be economical to run.

Figure ES-4: Central Appalachian coal prices and labor productivity, by state, 1985-2011
Finding 4: Employment and tax trends will not necessarily follow production trends.

In recent years, employment has grown—despite the continuing decline in production. In 2011, direct mining employment totaled 37,800 jobs. Even as coal production declines in the future across the region, coal mining jobs are projected to increase due to a decline in labor productivity.

Figure ES-5: Estimated direct Central Appalachian coal employment through 2040

Also, if future coal prices continue to increase, coal-related tax revenues may also increase in some states.

Table ES-1: Projected gross revenue from Central Appalachian coal production, 2010-2040

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual production (million tons)</td>
<td>186</td>
<td>139</td>
<td>101</td>
<td>106</td>
<td>102</td>
<td>97</td>
<td>87</td>
</tr>
<tr>
<td>Average coal price (2011 dollars per ton)</td>
<td>$79</td>
<td>$120</td>
<td>$150</td>
<td>$152</td>
<td>$167</td>
<td>$177</td>
<td>$182</td>
</tr>
<tr>
<td>Gross revenue (million 2011 dollars)</td>
<td>$14,681</td>
<td>$16,720</td>
<td>$15,162</td>
<td>$16,089</td>
<td>$17,045</td>
<td>$17,122</td>
<td>$15,907</td>
</tr>
</tbody>
</table>

However, as a result of the overall decline in coal production, the job and revenue benefits will not be spread evenly across all counties. Some coal-producing counties may experience significant declines in both jobs and revenues, while other counties may experience increases. The resulting expectation is that the benefits of coal production may become more concentrated in fewer counties.
Finding 5: Met coal exports have had a substantial impact on regional coal demand.

Foreign exports of Central Appalachian met coal increased by approximately 16.3 million tons since 2008, and met coal accounts for virtually all regional coal exports. Because demand for Central Appalachian steam coal is in decline, met coal increased from approximately 13% to 26% of total demand from 2008 to 2011. Without met coal exports, the decline in CAPP coal production would be considerably greater than that already experienced.

The four Central Appalachian coal states have a different reliance on exports. West Virginia accounted for most foreign exports of regional met coal from 2008 through 2011 (nearly 70%), followed by Virginia (20%) and eastern Kentucky (10%). Tennessee did not export any coal over this time period.

Table ES-2: Central Appalachian met coal exports by state, and percent of total demand, 2008-2011

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Met coal exports (in million tons)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Kentucky</td>
<td>2.1</td>
<td>1.2</td>
<td>4.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Tennessee</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Virginia</td>
<td>5.9</td>
<td>5.6</td>
<td>7.2</td>
<td>10.8</td>
</tr>
<tr>
<td>Southern West Virginia</td>
<td>21.2</td>
<td>19.4</td>
<td>23.4</td>
<td>29.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>29.2</td>
<td>26.3</td>
<td>34.9</td>
<td>45.5</td>
</tr>
<tr>
<td><strong>Total demand (in million tons)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Kentucky</td>
<td>90.2</td>
<td>74.9</td>
<td>67.2</td>
<td>62.1</td>
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<tr>
<td>Tennessee</td>
<td>1.5</td>
<td>2.1</td>
<td>1.8</td>
<td>1.4</td>
</tr>
<tr>
<td>Virginia</td>
<td>26.3</td>
<td>19.8</td>
<td>22.3</td>
<td>25.2</td>
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<tr>
<td>Southern West Virginia</td>
<td>105.6</td>
<td>88.1</td>
<td>91.9</td>
<td>89.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>223.6</td>
<td>185.0</td>
<td>183.2</td>
<td>177.7</td>
</tr>
<tr>
<td><strong>Met coal exports as percent of demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Kentucky</td>
<td>2%</td>
<td>2%</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>Tennessee</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Virginia</td>
<td>22%</td>
<td>28%</td>
<td>32%</td>
<td>43%</td>
</tr>
<tr>
<td>Southern West Virginia</td>
<td>20%</td>
<td>22%</td>
<td>25%</td>
<td>33%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>13%</td>
<td>14%</td>
<td>19%</td>
<td>26%</td>
</tr>
</tbody>
</table>

Central Appalachia is the nation’s primary domestic source for met coal. In fact, it accounted for over 80% of all coal shipped throughout the United States for metallurgical purposes between 2008 and 2011.
Finding 6: Coal-fired power plants are the most important purchasers of Central Appalachian coal.

In 2011, more than half of Central Appalachian coal was sold for domestic electricity generation, and approximately one-quarter was exported to foreign end-users. The remaining production was sold to coke/steel plants, other industrial plants, and the commercial and residential sectors.

Figure ES-6: Dependency of Central Appalachian states on the various coal markets, 2011
Finding 7: Average mine prices and transportation costs for Central Appalachian coal are the highest among the four major coal basins.

While the average mine price of Central Appalachian coal used to be similar to those for Northern Appalachian and Eastern Interior coal, it is now noticeably higher. The price differential between Central Appalachian and Powder River Basin coal remains considerable. These differences are due in part to greater production costs in Central Appalachia, but are also related to the increase in met production and exports because met coal commands a higher price than steam coal. Transportation costs for Central Appalachian coal have been highest among these four regions since at least 2001. The delivered price of Central Appalachian coal—which incorporates the cost of mining and transporting the coal—also continues to be highest in the United States.

Figure ES-7: Average delivered price of coal from the four major coal basins, 2001-2010
Finding 8: Demand for Central Appalachian coal by the electricity sector dropped precipitously from 2006 to 2011.

As more unconventional natural gas is produced and burned to generate electricity, less coal is used for this purpose. Also, as coal-fired electric power plants install pollution control equipment, they can shift from more-expensive low-sulfur coal—like that produced in Central Appalachia—to less-expensive high-sulfur coal produced elsewhere. Collectively, North Carolina, Georgia, South Carolina, and West Virginia received more than one-half of all Central Appalachian coal burned for electricity generation in 2011.

Figure ES-8: Domestic demand for CAPP coal by the electricity sector, by state, 2001-2011
Finding 9: A number of new federal regulations have been proposed or implemented recently that will likely have a general impact on demand for coal as a source of fuel for electricity generation, or on the mining of coal.

Many of the regulations that may have potentially significant impacts on coal demand are pending final publication or the resolution of litigation. However, as the majority of coal-fired generating capacity in the United States is located in eastern states, the regulations are expected to have a greater impact on coal-fired generation in the regions that have traditionally consumed most of the Central Appalachian coal distributed for electricity generation. Key regulations likely to impact the cost of or demand for coal include:

1. Cross-state Air Pollution Rule;
2. Mercury and Air Toxics Standards;
4. carbon pollution standards;
5. regulation of coal combustion residuals;
6. Stream Protection Rule; and
7. USEPA involvement in permitting surface coal mines in Appalachia.

Figure ES-9: Fort Martin coal-fired power plant, West Virginia

Photo: Evan Hansen.
Finding 10: Central Appalachian coal production is already being impacted by coal plant retirements and fuel switching.

Many coal-fired power plants that have purchased Central Appalachian coal in recent years are scheduled to retire, adding to the vulnerability of counties that mine this coal. Others plan to switch from burning coal to natural gas. Between 2007 and 2011, approximately 8.7 gigawatts of coal-fired capacity was retired across the country; of this, 2.5 gigawatts was retired in the 12-state region that imports the majority of Central Appalachian coal for electricity production. Within this region, Ohio, Pennsylvania, and North Carolina retired the most capacity.

Coal plant retirements and fuel switching will continue into the future. According to one study, an additional 50 gigawatts of coal-fired capacity is expected to be retired by 2022 across the United States. Another study predicts that coal plant retirements will total between 59 and 77 gigawatts by 2016. If natural gas prices remain low, coal plant retirements could be significantly greater. But even if natural gas prices are high in the future, coal plant retirements would still total between 21 and 35 gigawatts by 2016.

Figure ES-10: Decline in coal-fired generation among largest customer states for Central Appalachian coal, 2001-2011
Finding 11: The region will be impacted significantly as plants that burn Central Appalachian coal retire.

Central Appalachian coal mines shipped coal to 137 coal-fired plants in 2011, with a combined net summer capacity of 109.5 gigawatts; 30 of these plants are scheduled for retirement by 2016. The combined capacity of the generators scheduled to be retired at these plants amounts to approximately 21.5 gigawatts. Eastern Kentucky is most vulnerable to the retirements, with approximately 12% of total production dependent on shipments to the retiring plants in 2011. Approximately 60% of all Central Appalachian coal shipped to retiring plants in 2011 originated in eastern Kentucky.

Figure ES-11: Shipments of Central Appalachian coal to retiring and non-retiring coal-fired power plants in the US, 2011
Finding 12: The Central Appalachian basin is also vulnerable to plants that have installed emission controls or that can switch to burning natural gas.

Together, eastern Kentucky and southern West Virginia account for 89% of Central Appalachian coal sold to plants that have installed emissions controls. Southern West Virginia is most vulnerable to plants with fuel-switching capacity. Overall, 94% of Central Appalachian coal distributed for electricity generation was shipped to coal-fired power plants that either are scheduled for retirement, have installed emission controls, and/or have fuel-switching capability.

Figure ES-12: Percent of domestic Central Appalachian coal demand for electricity generation vulnerable to market and regulatory changes, 2011
Finding 13: Central Appalachian counties are vulnerable to different degrees.

Four neighboring Central Appalachian coal-producing counties are classified as highly vulnerable: Knott, Letcher, and Pike counties in eastern Kentucky and Wise County in Virginia. An additional ten are classified as moderately vulnerable: Bell, Harlan, and Martin counties in Kentucky; Claiborne County, Tennessee; Lee County, Virginia; and Boone, Kanawha, Lincoln, Mingo, and Nicholas counties in West Virginia. The remaining coal-producing counties were found to be either marginally or not immediately vulnerable to the factors examined in this report.

Figure ES-13: Vulnerability of Central Appalachian counties to influences on demand, by category

These findings are vital for both state and local officials in determining where development efforts and financial resources should be focused. Indeed, comprehensive, focused policies and investments will be needed in order to build the foundation for new economic alternatives in coal-producing counties—especially those in which coal-related jobs will decline.