Potential Impacts on Wyoming Coal Production of EPA’s Greenhouse Gas Proposals

Using simulation data, including proprietary simulations of the United States’ energy market, this article summarizes the potential impact that market and regulatory changes could have on Wyoming coal production. Impacts are significantly higher for the U.S. Environmental Protection Agency’s recent Clean Power Plan Proposal than current potential market risks.

I. Introduction

Coal-fired production of electricity has been a cornerstone of the United States power sector over the past century. Current market conditions, however, have put coal’s dominance as a generation fuel at risk. From 1949 to 2014, electricity produced from coal averaged 50.7 percent of total U.S. net generation. Since 2007, coal-generated electricity has accounted for less than 50 percent of the United States’ total electricity output, and has fallen to less than 40 percent of total generation in two of the past three years (2012–2014). The pace of decline in coal-fired electricity production in the U.S. has been significant. Since 1949, in 43 of those 63 years coal has accounted for over 50 percent of national production, and over those years averaged 53.5 percent of production. In the remaining 23 years, excepting the years in the 2000s, coal production averaged 46.3 percent. Since 2007 though,
coal-fired production has declined at an average rate of 2.8 percent per year and in 2014 accounted for 39.9 percent of total electricity production in the country. Shares of total electricity production in the United States from 1949 to 2014 are shown in Figure 1.

From 1949 to 2007 the rise in coal-produced electricity was dramatic, increasing at an average rate of 4.9 percent per year. This rate of growth was higher than the growth in total electricity generation in the U.S., which rose over the same period at an average rate of 4.6 percent; thus, over that period, the share of electricity generation from coal was actually increasing. However, after reaching its zenith in 2007 of 1,998,390.3 GWh, annual coal-fired electricity production levels fell in each of the next five years, and in 2012 recorded a production level of 1,500,556.9 GWh, a level not seen since 1987, when total national electricity production was 51.2 percent lower. In the last two years coal-produced electricity has rebounded, increasing by 4.8 percent, but this has not significantly increased coal-fired electricity’s production share of total generation, which in 2014 was the second-lowest level recorded since 1949.

The recent decline in coal-fired electricity production is illustrated in Figure 2.

Market developments for coal-fired production have been of serious concern to policymakers in coal-producing states, particularly Wyoming. Of the 999.6 million short tons of coal produced in the United States in 2014, Wyoming produced 395.6 million short tons or 39.6 percent. Of the 858.0 million short tons of coal used in the electric power sector in 2013, the last year of complete data available, Wyoming shipped 380.3 million tons, (44.3 percent). Wyoming’s total production of coal is as much as the next six largest coal-producing states combined.

Eight of the 10 largest coal mines operating in the United States are located in Wyoming, and the two largest (North Antelope Rochelle, and Black Thunder) alone had a combined...
Wyoming coal production in 2013 of 211.7 million short tons, or 21.5 percent of the nation’s entire coal production.\(^7\) Wyoming coal was exported to a total 32 states in 2013 (Figure 3), and is essential to energy production in the country, especially states in the Midwest. Since virtually all coal produced in Wyoming is used in electricity generation, declines in coal-fired electricity generation are of serious concern for that state.\(^8\)

Wyoming coal production has become important to national electricity generation for several reasons. The most important is cost. Prior to the 1970s, Wyoming coal production accounted for 1 to 2 percent of national output (Figure 4). The opening of the Powder River Basin (PRB) in northeast Wyoming, however, allowed access to a very-low-cost reserve that has benefited a significant portion of the country. The growth of Wyoming coal production since the 1970s reflects three underlying market factors. The first was the closure of traditional underground operations for lower-cost surface mining, a process begun nationally decades earlier. The thick, shallow coal deposits in the PRB opened economies of scale to Wyoming mining, allowing mines to grow while simultaneously reducing production costs. Combined with the decline of the petroleum generation sector in the 1970s, the PRB region also benefited from national initiatives to take advantage of domestic fuel sources. The second major factor was rail-freight deregulation, which occurred in 1980 with the Staggers Rail Act. Greatly reduced transport costs between states allowed cheap PRB coal to be a competitive fuel source across the country. The third market force that stimulated production increases in Wyoming was the advent of more stringent federal regulation on sulfur emissions.

![Figure 3: Wyoming Coal Delivery Shares of total Production by State, 2013](source: Energy Information Administration (EIA)).

![Figure 4: Wyoming Coal Production and National Production Share: 1970–2014](source: Energy Information Administration (EIA)).
Sulfur dioxide (SO₂) emissions. Together these three forces—continually declining mining costs, falling transport rates, and increasing environmental regulations—stimulated demand and were responsible for the eventual extent of the Wyoming coal industry today.

Despite the importance of the Wyoming coal industry to the nation, few studies have attempted to quantify its impact on the national or Wyoming economies, or document the challenges facing the coal industry in the future due to market and regulatory threats. Considine (2013) found that to replace PRB coal with an alternative fuel would require 5.5 trillion cubic feet of natural gas annually, and such a substitution would increase the cost of electricity and natural gas by $107 billion per year nationally using 2011 data. Godby et al. (2015) report the potential impacts reductions in PRB output could have on Wyoming, and find coal mining alone was responsible for 11.3 percent of the state’s total state product, and 14 percent including the wider transportation and electricity generation economies in the state that rely on coal production.

In recent years changes in the coal market suggest the potential for significant changes in coal production nationally and in Wyoming. The sources of these changes have been both market-driven and regulatory. Using the most recent simulation data available, including proprietary simulations of the United States’ energy market, this article summarizes the potential impact market and regulatory changes could have on Wyoming coal production and its prevalence as a generation fuel. Simulations draw upon the EIA’s National Energy Modeling System (NEMS) to evaluate in a consistent framework the potential impacts of market changes and proposed carbon regulations introduced by the Environmental Protection Agency’s (EPA) Clean Power Plan. Conclusions are drawn with respect to the policy choices policymakers face in dealing with these challenges while attempting to preserve mining employment and low utility prices.

II. Causes of Wyoming Coal Production Declines

Challenges to coal-fired electricity production that Wyoming coal producers currently face can be separated into two broad types: market challenges and more stringent regulation. The former cause reductions in coal’s market share through market competition, while the latter are reductions due to new mandates that both increase production costs and create greater market uncertainty regarding the future profitability of coal-fired generation, both leading to reduced coal demand.

Market competition impacts can be attributed to three factors. The first is intensified competition from other sources of electricity, especially inexpensive natural gas from shale gas plays in North America, and to a lesser extent renewable sources. This has displaced a significant portion of coal-fired generation in the United States’ electricity mix (Figure 2). Renewable penetration is also apparent, but the dominant market change has been gas-fired generation. How these trends continue will largely determine the future course of coal generation and therefore production.

Rising coal costs also pose a threat to the production of low-cost Wyoming coal. Since 1970, Wyoming coal employment has increased from less than 600 to over 6,600 jobs in 2014. Much of this growth in employment was due to increased production shown in Figure 4. Over the past decade, however, production efficiency has begun to decline in Wyoming. As shown in Figure 5,
the rise in production of Wyoming coal was accompanied by rising coal production per worker, which peaked at over 80,700 tons per job in 2004. Since then though, output per worker has fallen below 60,000 tons per worker. This period of declining productivity also corresponds to the period when inflation adjusted prices of Wyoming coal began to rise. Both observations suggest the effects of rising PRB production costs associated with declines in the quality of mined deposits. Still, Wyoming coal mines remain very competitive. As noted by Considine (2013), PRB mines averaged 40.0 tons of coal per employee per hour while other producers in the U.S. averaged 4.4 tons per employee per hour, but rising costs combined with competition from other generation sources appears to have undermined Wyoming coal demand.

The decline in coal-fired generation in the past decade can also be attributed to lower electricity demand. Electricity consumption in recent years seems to have hit an inflection point (Figure 6), with prospects of either stagnant or very slow future growth in electricity use appearing much more likely than would have been thought even a few years ago. Total final consumption of electricity declined by over 72 billion kilowatt hours (kWh), with residential use down 1.1 billion kWh, and commercial use falling by 1.2 billion kWh from 2007 to 2013. Over this period industrial consumption also declined by 73.1 billion kWh, continuing a trend that began in the late 1990s (Figure 6). Faced with rising competition from other fuel sources and rising costs of production, coal-fired generation will be squeezed more tightly by these market challenges if demand for electricity continues to be sluggish.

In addition to market challenges, more stringent regulation, combined with proposed climate change policies, threatens the competitiveness of coal as a generation fuel. A significant challenge in the decades ahead involves the development of new technologies to further reduce emissions from
coal-fired power generation. While coal-fired electric power generators have dramatically reduced their emissions of criteria air pollutants, such as (SO$_2$) and nitrous oxides (NO$_x$) over the past 20 years, even more stringent emissions standards are being implemented over the next few years for these pollutants. There are several regulations under various stages of implementation that, if implemented, will significantly raise the cost of using coal to generate electricity in the United States. These regulations are summarized in Table 1.

For coal, the EPA’s Clean Power Plan CO$_2$ emissions proposals are potentially the most significant regulations proposed. New coal-fired power plants would have to meet an output-based standard of 1,100 lbs. CO$_2$ per megawatt-hour of electricity generated under the 111(b) proposed rules. Utilizing current technology, the most advanced coal plants emit roughly 70–80 percent more than this standard while older plants exceed 100 percent of this level. This standard alone would prohibit the construction of new coal-fired coal generation capacity in the United States without carbon capture utilization and storage (CCUS) technology, and at current costs this would make the construction of such plants cost-prohibitive. The 111(d) portion of the plan would also require emissions from existing plants to be sharply curtailed, calling for nationwide existing plant emissions to be cut by 30 percent from 2005 levels. Overall, these proposed rules could result in a significant reduction in coal-based generation nationally by the early 2020s.

Other potential or pending regulations could also increase generation costs, while new mine regulations including controls on blasting and emissions at coal mines could also significantly raise costs of coal production. Such changes in production costs, combined with other regulatory changes, could seriously undermine the cost-competitiveness of Wyoming PRB coal and therefore its demand. Furthermore, already adopted MATS (also referred to as UMACT) standards to reduce mercury and other hazardous pollutant output already are anticipated to cause a significant retirement in coal-fired power plants, which may or may not reduce PRB coal demand, depending on the analysis considered. Finally, state-driven regulations regarding increased renewable portfolio standards

Table 1: Proposed and Pending Environmental Regulations Affecting Coal Use.

<table>
<thead>
<tr>
<th>Regulation</th>
<th>Pollutant</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross-State Air Pollution Rule (CSAPR) for Eastern USA</td>
<td>SO$_2$ &amp; NO$_x$</td>
<td>Overturned on appeal. Petitions for rehearing pending.</td>
</tr>
<tr>
<td>Regional Haze for Western USA</td>
<td>SO$_2$ &amp; NO$_x$</td>
<td>Rules on hold pending final judicial action and litigation.</td>
</tr>
<tr>
<td>Ambient air quality standards</td>
<td>SO$_2$, NO$_x$, PM, O$_3$</td>
<td>Affirmed on appeal. PM2.5 proposed, not yet final. Ozone not yet proposed.</td>
</tr>
<tr>
<td>Utility Maximum Achievable Control Technology (UMACT) also referred to as MATS</td>
<td>Hazardous air pollutants</td>
<td>Rules come into effect in 2015-2016.</td>
</tr>
<tr>
<td>Solid Waste</td>
<td>Coal Ash</td>
<td>Rules proposed December 2014.</td>
</tr>
<tr>
<td>316(b) cooling water intake structures</td>
<td>Thermal Emissions</td>
<td>Rules proposed</td>
</tr>
<tr>
<td>111(b) and 111(d): GHG new source performance standards (NSPS) for power plants and existing/modified source limits</td>
<td>CO$_2$</td>
<td>Rule proposed but not yet final for new, modified and existing power plants.</td>
</tr>
<tr>
<td>State-mandated renewable portfolio standards</td>
<td>CO$_2$</td>
<td>Various state rules nationwide may be adopted in conjunction with or in addition to 111(d) regulations.</td>
</tr>
</tbody>
</table>
could also undermine the use of coal in generation.

III. Forecasts of Future Coal-Market Production Outcomes: Wyoming Coal

To identify projections of future Wyoming coal market outcomes for changes in the market conditions described above, we used a series of well-known market projections derived from the U.S. Energy Information Agency’s 2014 Annual Energy Outlook (AEO2014), generated by the National Energy Modeling System (NEMS). While the model generates forecasts, its real usefulness lies in the integrated nature of the model that allows comparison of predicted outcomes for specific market changes, and therefore the evaluation of the impacts such changes in market or regulatory conditions could have. The “reference case” provides projections utilizing current macroeconomic data, market conditions, and statutes regarding energy use and emissions. It does not include any proposed legislation and assumes only regulation currently in law. The conditions under which the reference case is computed are updated over time, resulting in changes in the resulting forecast. Figure 7 presents the reference case forecasts for total Wyoming coal production from 2010 through 2014.

Conditions in the U.S. domestic coal market have become more difficult in recent years, and are projected to continue to be difficult. Forecasts have typically predicted growth over time in Wyoming coal output; however, this growth rate has been declining, and the most recent forecast indicates little growth in state production. To compare the potential and relative impacts on Wyoming coal production of changes in natural gas prices, coal costs, and slower electricity demand growth, the corresponding side-case projections were utilized from the AEO2014 report.

Conditions in each scenario are identical except for the following assumptions:

- **Annual economic growth rate**: All scenarios not related to economic growth presume an annual national economic growth rate of 2.4 percent, the average rate of growth observed in the national economy since 2011. Low economic growth scenarios assume the annual economic growth rate falls to 1.9 percent, while high growth economic scenarios increase this growth rate to 2.8 percent, the average national rate of economic growth observed since 1984.

- **Wyoming coal mining costs**: Coal cost scenarios alter the reference assumptions by allowing mine productivity to increase at a rate 2.3 percent higher or lower than the reference case (reference case assumes a 1 percent decline in annual labor productivity). Additionally, wages paid to miners, equipment and transport costs are all altered to grow at faster or slower rates than those in the reference case, resulting in either relatively cheaper or more expensive coal production costs than the reference projection.

![Figure 7: EIA Annual Energy Outlook Reference Projections: Comparison over Time](image-url)
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- **Natural gas prices**: Natural gas scenarios alter gas recovery in shale gas, tight gas, and tight oil to be 50 percent higher (lower gas prices) or lower (higher natural gas prices) than the rates assumed in the reference and non-gas resource cases.

A comparison of projected coal production changes relative to the actual level in 2012 (401 million tons) is shown in Figure 8. Under the assumptions used, the only case projected to cause a decline in coal production relative to 2012 levels is the high coal cost case. By 2030 in this scenario, coal production in Wyoming is forecast to decline by 20.5 percent (to 319 million tons of production annually) relative to 2012 output. The low coal costs case has the opposite effect, increasing forecast output to 489 million tons annually by 2030. All other cases show far less sensitivity for the assumptions used. Overall, EIA AEO2014 simulations indicate the greatest risk to Wyoming coal production, and by extension to coal-fired electricity generation fueled by Wyoming PRB coal, is posed by rising production costs in the mining sector, especially if they were to rise faster than they have historically. Recent Wyoming mine productivity has fallen at a rate of almost 3 percent annually.

Consideration of potential regulatory impacts focused on those posed by proposed EPA 111(d) rules released on June 2, 2014, since they could impact all existing coal-fired power plants in the country. These rules proposed a unique target carbon-dioxide emissions rate per MWh for 49 states by 2030, with interim targets beginning in 2020. Figure 9 shows a map of the proposed reductions the plan entails for each state. Proposed statewide targets for existing power plants were established by the EPA using a “building block” approach based on the types and inventory of generation in each state, and whether states had already implemented energy efficiency and renewable generation targets within their borders. The building blocks the EPA defines that a state might employ to achieve these targets are:

(i) increasing efficiency at fossil-fueled plants (EPA assumes a 6 percent improvement is possible),

(ii) replacing some coal generation with gas-fired generation (“dispatch substitution”),

(iii) increasing renewable or, where applicable, nuclear generation in each state, and

(iv) energy efficiency programs that reduce electricity demand (and therefore the need to produce fossil-fired electricity).

Of these methods, the decision to allow the use of energy efficiency programs will be a policy choice states will need to make.

To allow greater flexibility, the EPA is also encouraging states to cooperate to reduce the cost of emissions reduction collectively where possible. Since states have different targets, there are likely to be potential gains from trade and cooperation, for example, by allowing a regional cap-and-trade system to meet the EPA-imposed overall target emissions rates across several states. Such programs have been demonstrated to be effective and lowered control costs for other pollutants, notably SO2 (see Schmalensee et al., 1998 for a description). Participation in such a program is a second state policy choice in the implementation of the proposed rules.

![Figure 8: Coal Production Comparison by Scenario Relative to 2012 Output Level](Image)
To define a set of projections consistent to those EIA projections previously presented, the Rhodium Group, one of the few non-governmental operators of the EIA’s NEMS model, agreed to provide a set of proprietary simulations to estimate the impact of the EPA’s proposed greenhouse gas (GHG) regulations. Simulations were defined by combination of state policy choices over energy efficiency use and the extent of state cooperation, where we assumed cooperation was limited to regional electricity markets, or that a national cooperation mechanism was employed, as described in Table 2.17

Figure 10 illustrates the potential significance of the EPA’s proposed 111(d) rule on Wyoming coal production based on the Rhodium-provided simulations using NEMS. The AEO2014 reference case suggests that without the proposed GHG limits, Wyoming coal production could be expected to remain strong over the next several decades, with production levels increasing slightly over time from the current 400 million ton per year level to 450 million tons in the late 2020s. The imposition of GHG regulations like those envisioned in the EPA’s CPP proposal, however, would result in declines in Wyoming coal output of between 32 percent and 51 percent from 2012 levels, depending on the policy scenario assumed.

From the differences in projected outcomes shown in Figure 10, the potential impact of allowing energy efficiency and wide cooperation in limiting the effects of EPA’s proposed regulations on Wyoming are clear.18 Allowing GHG reductions to be accomplished by a wider set of sectors in the economy, as is the case for the 111(d) rule, does result in much smaller reductions in production. From the potential impact of allowing energy efficiency and wide cooperation in limiting the effects of EPA’s proposed regulations on Wyoming are clear. Allowing GHG reductions to be accomplished by a wider set of sectors in the economy, as is the case for the 111(d) rule, does result in much smaller reductions in production.

Table 2: Design of Regulatory Policy ‘Scenarios Considered’.

<table>
<thead>
<tr>
<th>Type of Cooperation</th>
<th>Energy Efficiency efforts allowed</th>
<th>Energy Efficiency efforts not allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regional cooperation</td>
<td>Scenario 3: Regional Cooperation with Energy Efficiency (EE)</td>
<td>Scenario 4: Regional Cooperation without Energy Efficiency (EE)</td>
</tr>
</tbody>
</table>

Figure 9: EPA Clean Power Plan State Emission Rate Targets
Source: SNL Financial.

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case when energy efficiency is included as a policy response, reduces the pressure to reduce emissions from coal. Energy efficiency allows more cost-effective CO₂ reductions to occur elsewhere in the industrial and household sectors of the economy, thereby reducing the impact of the proposed rules on coal generation and therefore coal production.

Implementing wider cooperation among states to meet the standards also has a similar effect. Carbon reductions are then made collectively where they are most cost-effective. Electricity would be produced where it is cheapest and most efficient. This too reduces the amount of coal generation curtailed by the proposed rules. For Wyoming, maximum cooperation combined with the use of energy efficiency nationally minimizes the impact the proposed standards cause PRB coal. Comparatively, based on the simulations presented, energy efficiency has a larger impact nationally on coal generation and Wyoming coal production outcomes than wider cooperation.¹⁹

Figure 11 summarizes 111(d) scenario changes in Wyoming coal production in 2016 through 2030, relative to 2012. Total coal production in 2012 was approximately 401 million tons. Production projections suggest that output declines begin to occur immediately after regulations are finalized in 2016 as the generating industry increases coal-plant retirements beyond those that would otherwise occur in anticipation of the rules. When the compliance period begins in 2020 through 2030, production declines accelerate, continuing through 2030 in three of the four regulatory scenarios.

Comparison of the coal production scenarios presented in Figures 10 and 11 to the market competition outcomes previously described (Figure 8) suggests the regulatory impact of the EPA’s 111(d) proposal on coal generation, and by implication Wyoming coal production, would be much more severe than any of the market risk scenarios considered. This occurs for two reasons. Coal production declines are much larger in the regulation

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**Figure 10:** Coal Production Projections across 111(d) Regulatory Scenarios

**Figure 11:** Coal Production Changes across 111(d) Scenarios Relative to 2012 Levels
scenarios, and they occur much more swiftly. In the worst market competition scenario, high coal costs resulted in a decline in Wyoming coal production of 82 million tons annually relative to the 2012 production level. This decline, however, was not fully realized until 2030. In the regulatory scenarios shown, the least harmful case with respect to coal production outcomes (national cooperation and energy efficiency allowed) results in an annual coal production decline of 127 million tons annually relative to 2012, and this primarily occurs between 2020 and 2025. This scenario projects a 55 percent worse production outcome occurring five to 10 years sooner than in the worst of the market risk scenarios. In the worst case regulatory scenario (regional cooperation with no energy efficiency used), coal production falls by 193 million tons annually by 2030, a decline 135 percent worse than the high-coal-cost case, occurring sooner, by 2027.

An alternative set of GHG reduction policies are shown in Figure 10. We use three potential carbon tax scenarios from AEO2014. They include results for a $10 per metric ton carbon tax beginning in 2015 (rising at a rate of 5 percent annually) and a second scenario imposing the same tax conditions combined with the conditions used in the low natural gas price case. They also include a third $25/tonne carbon tax scenario (rising annually at a rate of 5 percent), assumed to be imposed in 2015.

The impact of the EPA 111(d) proposal on coal is roughly similar to the outcomes in the $10/tonne GHG carbon tax scenarios. Production outcomes in the 111(d) energy efficiency scenarios are bracketed by the $10/tonne GHG tax projections, and the outcomes in cases without energy efficiency result in slightly lower coal production than the $10/tonne carbon tax cases. None of the projected 111(d) outcomes is as severe as the impact on coal production a $25/tonne carbon tax would have, where, by 2030 coal production falls by 90 percent from 2012 levels.

IV. Conclusions

Coal-based electricity generation has suffered a significant decline in output since 2008. This has in part been due to increased competition from other fuel sources, particularly natural gas, from increases in coal mining costs, and due to very slow load growth over the period. Future generation outcomes will depend on whether these trends continue. Simulation results indicate the most problematic challenge coal generation faces in the future is rising coal costs, and absent changes in regulation from current law, would be the only market challenge in which coal generation is significantly reduced.

Regulatory conditions, however, are unlikely to remain static. Changes in regulation are likely to impact coal production and generation costs and therefore given the previous result, potentially could result in significant impacts. The most serious regulatory challenges to coal come from proposed GHG regulations. Simulations presented here suggest three conclusions. First the impact that such policies could have is more significant than any market competition impact foreseen. Second, how such regulations are implemented across states will be very important with respect to the cost of such regulations and their impact on the coal generation industry. Results suggest that coal-based generation would benefit most from the use of widespread energy efficiency initiatives, and wider cooperation among states to achieve GHG emission reductions. Economic efficiency would suggest that the more widely spread such

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reductions are made over the economy, the less costly they will be to society. Still, even the least-cost policy results in significant coal-generation and production declines. Third, proposed 111(d) rules appear to have similar impacts on coal generation, or at least with respect to Wyoming coal production, as a $10 carbon tax, with the differences depending on how 111(d) is implemented and conditions in the natural gas sector.

References


Endnotes:


2. These years are from 1969 to 1979, as other fossil fuel and nuclear power gained production share. The reduction in petroleum-fueled generation after 1978 was primarily replaced by additional coal-fired generation.

3. The lowest was in 2012 when coal-fired electricity production’s share was 38.6 percent of output.

4. EIA, Quarterly Coal Report (Abbreviated), April 2015, Tables 1 and 2.

5. EIA Annual Coal Report 2013, April 2015, Table 26, and EIA Annual Coal Distribution Report, April 2015, Table OS-30.

6. These states are (production in millions of short tons): West Virginia (112.8), Kentucky (80.4), Pennsylvania (54.0), Illinois (52.1), Texas (42.9), and Montana (42.2). EIA Annual Coal Distribution Report, April 2015, Table OS-30.

7. EIA Annual Coal Report 2013, April 2015, Table 9.

8. In 2013, 7.7 million tons (2.0 percent) of Wyoming coal shipped was not used in the electricity sector. EIA Annual Coal Distribution Report, April 2015, Table OS-30.


10. Some analysts suggest that, after implementation, MATS rules could increase demand for PRB coal due to higher utilization of PRB-coal burning plants. Such a surge is predicted in the NEMS simulations described but did not appear in production statistics through 2014.


12. None of these forecasts include the potential impact of a major expansion in international exports.


14. Vermont does not have any fossil-fuel generating facilities within its borders.

15. The Regional Greenhouse Gas Initiative, in operation since 2008, is an example of such a program.

16. These simulations were part of a larger study. See Larsen et al. (2014). In our simulation results we refined outcomes further to determine specific Wyoming coal market outcomes.

17. EPA’s ability to suggest states use energy efficiency as a compliance strategy is likely to be litigated.

18. The projections do not assume carbon capture being utilized significantly.

19. See also Larsen et al. (2014) regarding the impact of energy efficiency policies at the national level.