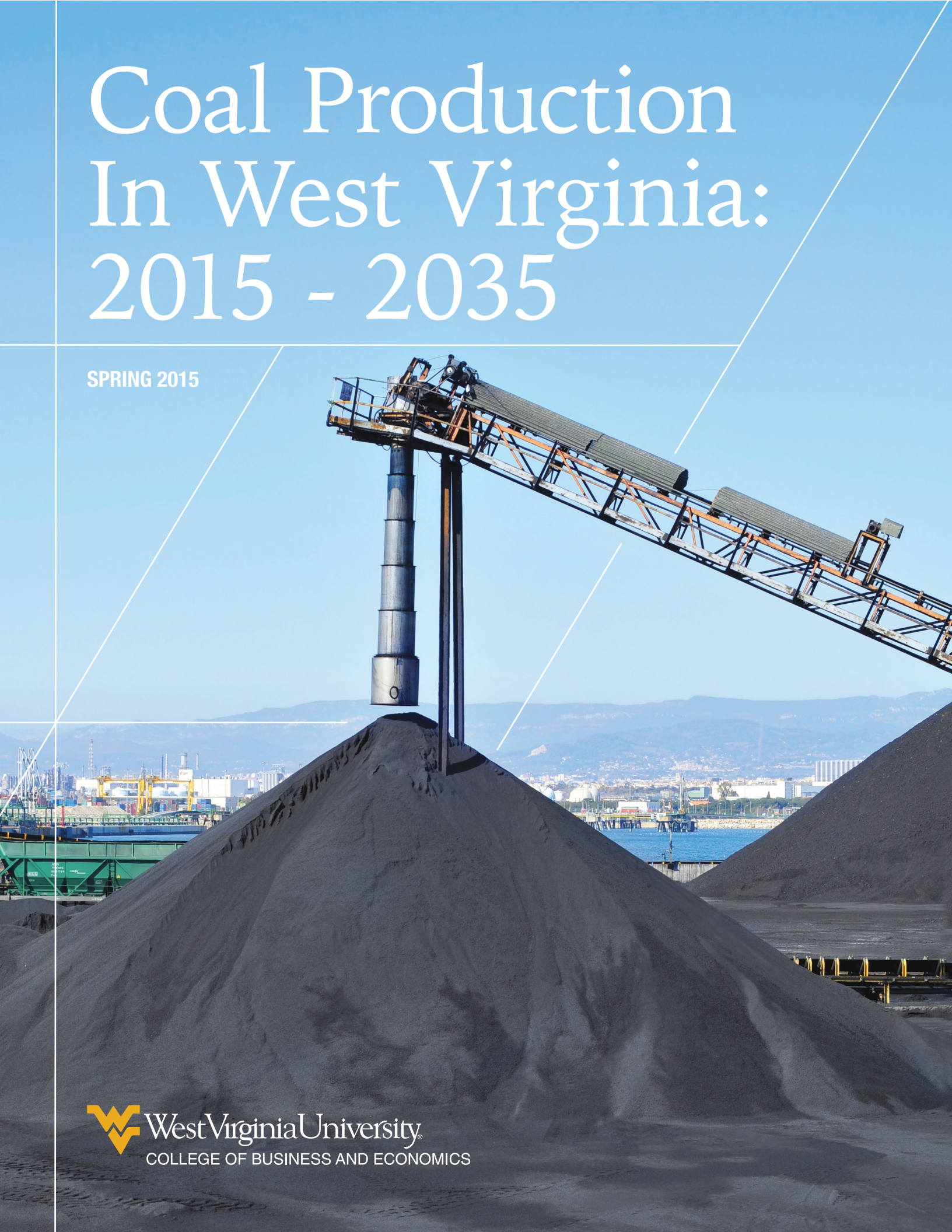
Coal Production In West Virginia: 2015 - 2035

SPRING 2015



West Virginia University
COLLEGE OF BUSINESS AND ECONOMICS

COAL PRODUCTION IN WEST VIRGINIA: 2015 - 2035

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Executive Summary

Overview: West Virginia's coal industry has seen production decline significantly over the past several years. After reaching nearly 158 million short tons in 2008, the state's coal mine output has tumbled in each successive year down to an annual total of approximately 115 million short tons in 2014. The fall-off in the state's coal production has been driven by a combination of weak export demand, declining domestic use of coal in electricity generation, changes in emissions compliance standards for utilities and increasingly challenging geologic conditions in Southern West Virginia.

West Virginia Regional Variation: While production for the state as a whole has fallen, production trends between the state's northern and southern coalfields have diverged significantly in recent years. As recently as 2011, Southern West Virginia mines accounted for 69 percent of coal produced in the state. By 2014, however, the southern coalfields account for just 54 percent of West Virginia production. Overall, coal produced by Southern West Virginia mines plunged 46 percent on a cumulative basis between 2008 and 2014, falling from nearly 117 million to less than 63 million short tons over this time period. By comparison, coal production in Northern West Virginia increased at an average annual rate of nearly 8 percent per year between 2011 and 2014, hitting an estimated 53 million short tons.

Short-Term Forecast: The baseline forecast calls for state coal production to decline to approximately 104 million short tons in calendar year 2015 before contracting further to 98 million short tons in 2016. Numerous factors are expected to weigh on West Virginia coal production over the next two years, with declines likely in both the state's northern and southern coalfields. After replenishing their coal stockpiles following an extremely cold first quarter of 2014, inventories of coal at electric utilities grew appreciably over the latter half of the year and have stayed at relatively high levels through the first several months of 2015 due to increased use of natural gas. Utilities are expected to draw down from existing stockpiles slowly in 2015, which will weigh heavily on thermal coal production. Domestic industrial use and export demand for coal are also expected to remain weak during the next two years.

Long-Term Forecast: Coal production in West Virginia is expected to rebound moderately between 2017 and 2020, rising to an annual average of nearly 105 million tons in 2020. Retirements of coal-fired generation will taper off and, while no measurable amount of capacity additions to the coal-fired fleet are likely, an expected increase in natural gas prices should allow coal to regain some share of electricity generation. For the remainder of the outlook period, statewide coal production is expected to fall, contracting to less than 96 million short tons in 2035. This will be driven entirely by losses in production in the state's southern coalfields. Northern West Virginia production will likely experience a solid rebound through 2020 that will then remain relatively stable level over the remaining portion of the forecast.

Alternative Forecast Scenario – Regulatory Policy: The forecast report analyzed scenarios that assessed the effects of significant losses in the nation's coal-fired electric generation on statewide coal output. The results indicate coal production for the state as a whole would fall to 79 million tons by 2035, an 18 percent reduction in output relative to the baseline. However, the magnitude of impact would be felt more in the state's northern coalfields. Since Northern West Virginia coal is predominantly sourced to domestic electric utilities, CO_2 emissions requirements would affect producers from this region to a much greater extent.

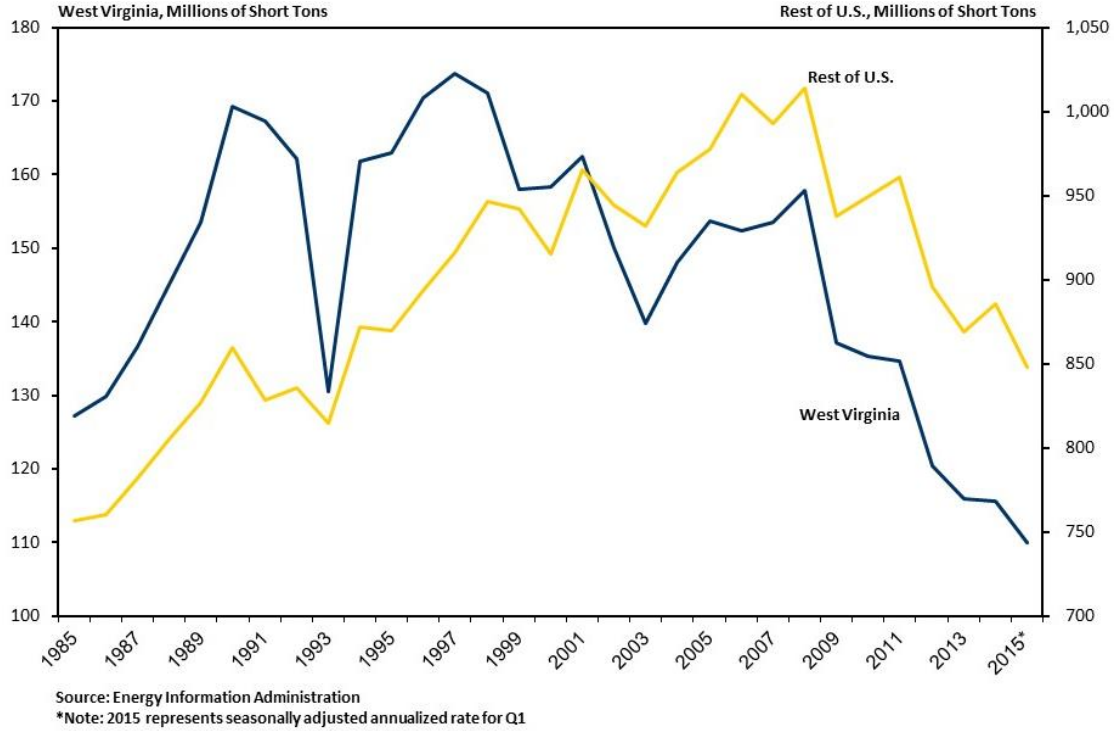
Alternative Forecast Scenarios – Export Demand: Two alternative scenarios investigating the impacts for export demand were also investigated. The weak coal export demand scenario suggested a small net effect by reducing total state coal production by less than 5 million tons from the baseline. By contrast, much stronger-than-expected growth in coal exports would result in production of nearly 110 million tons by the end of the forecast period—14 percent above the baseline and just 5 percent below 2014 levels.

1 Recent Trends in Coal Production

West Virginia's coal industry has seen production decline significantly over the past several years. After climbing to nearly 158 million short tons in 2008, the state's coal mine output has tumbled in each successive year to an annual total of approximately 115 million short tons in 2014[1]—or a cumulative decline of 27 percent. The overall rate of decline was much smaller during 2014, as mines in the state produced roughly 0.8 percent fewer tons of coal in comparison to 2013. Unfortunately, however, this slower rate of decline is expected to be temporary and preliminary data already indicate mine output fell 4 percent on a year-over-year basis during the first quarter of 2015 to an annualized rate of 110 million short tons.

While coal production within West Virginia has declined rapidly over the past several years, the downward trend in statewide production has been much more significant when compared to most of the nation's other major coal-producing regions. Aggregate non-West Virginia coal production in the US was estimated to have increased 1.7 percent during calendar year 2014, leaving it at about 87 percent of production levels achieved during 2008. As a result, this has caused West Virginia's market share of total U.S. coal tonnage to fall appreciably over the past several years, retreating from 13.5 percent in 2008 to 11.5 percent in 2014.

Figure 1: Annual Coal Production

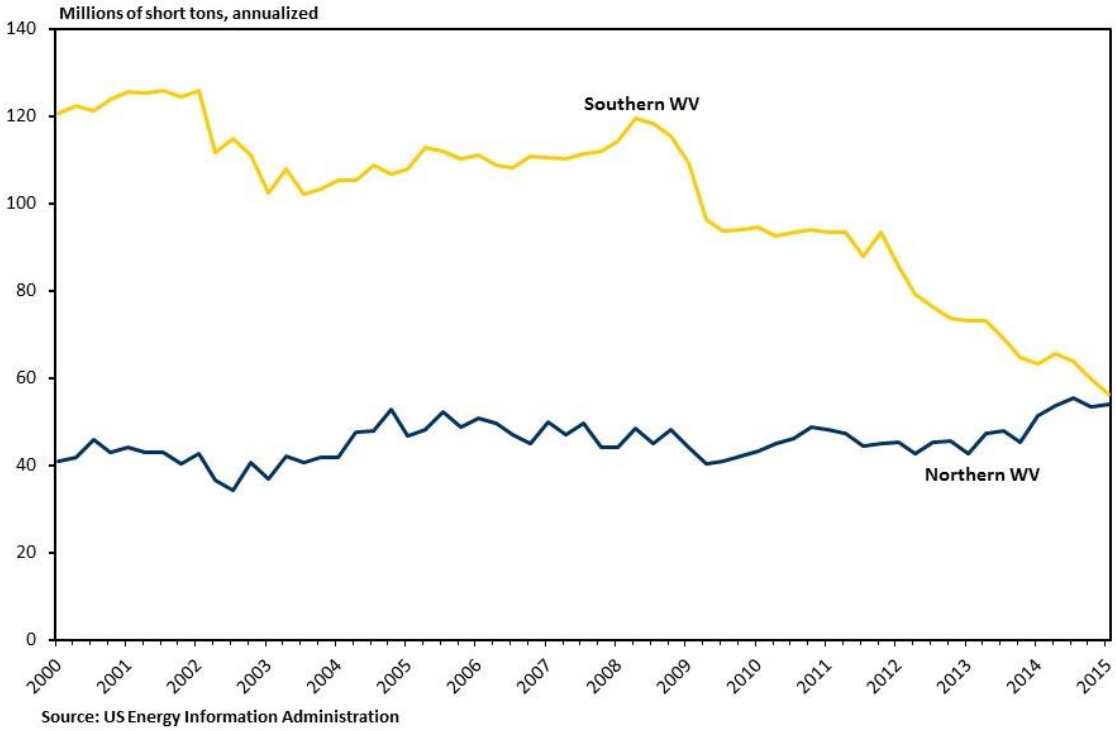


[1] The production figure for 2014 is an estimate and should not be considered final until the EIA publishes the 2014 Annual Coal Report.

The Illinois Basin, which includes Illinois, Western Indiana and part of Western Kentucky, has seen its share of domestic coal production climb 1.5 percentage points since 2008 and now accounts for 14 percent of the nation's total tonnage. Indeed, production has expanded by nearly 40 million short tons since 2008, including a 4 percent increase in 2014, due in large part to the expanded use of the region's coal by domestic coal-fired power plants. While the Powder River Basin's coal production has plunged nearly 90 million tons in the past 6 years, it still remains the most prolific producing region at nearly 419 million short tons (40 percent of national production) and managed to register a 2.6 percent gain in coal output during 2014.

Although coal production for the state as a whole has trended sharply lower since 2008, a geographic divergence in coal mining industry performance has emerged between West Virginia's northern and southern coalfields. As recently as 2011, Southern West Virginia mines accounted for roughly 69 percent of coal produced in the state. By 2014, however, the southern coalfields produced just 54 percent of coal mined within the state's borders. Overall, coal produced by Southern West Virginia mines plunged 46 percent on a cumulative basis between 2008 and 2014, falling from nearly 117 million to less than 63 million short tons over this time period. This downward trend for the state's southern mines continued during the first quarter as the seasonally adjusted annual rate of coal production dropped to approximately 56 million short tons.

Figure 2: West Virginia Regional Coal Production



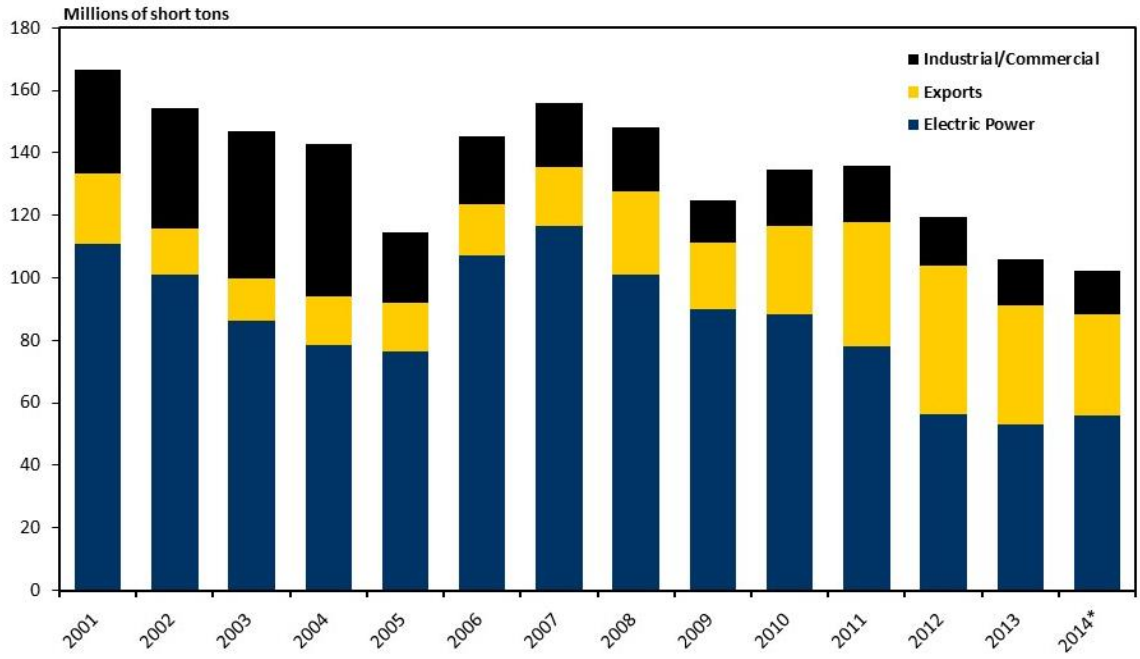
At the same time that production has declined significantly across Southern West Virginia in recent years, several of the state's northern-producing counties have recorded strong increases in coal tonnage. Indeed, coal production increased at an average annual rate of nearly 8 percent per year between 2011 and 2014, with the estimated annual total of production during 2014 (52.6 million short tons) marking the region's highest level of coal tonnage since 1991. Growth remained solid during the first quarter of 2015.

Production increased 5 percent versus the first three months of 2014, rising to an estimated seasonally adjusted annualized rate of 54 million short tons. Most of these gains can be attributed to rising output at mines in Marion, Marshall, Ohio and Taylor counties. Unfortunately, these strong gains appear to be waning as the continued sluggish demand for thermal coal has led several major operations in Northern West Virginia to announce cutbacks in production or a complete idling of mining activities.

2 Electric Power Sector Demand

Demand for coal is affected by a mixture of domestic and international forces, and each of these has played a significant role in shaping not only the trend in statewide coal production, but also the diverging patterns between the state's northern and southern coalfields. Electricity generation represents the largest source of domestic demand for coal produced in West Virginia, but has been declining in importance over the past decade. According to our estimates, more than 56 million short tons of coal from West Virginia mines were distributed to electric utilities across 20 different states during 2014. As recently as 2010, 88 million short tons of West Virginia coal were distributed to coal-fired power plants in the U.S., representing a 55 percent drop in the use of coal mined within the state for domestic electricity generation.

Figure 3: Distribution of West Virginia Coal by Consumer



Source: Energy Information Administration
*Note: Figure for 2014 is an estimate

In addition to the outright decline in use of West Virginia coal by domestic electric utilities, there has also been a significant geographic shift within the state in terms of where coal sourced for electricity utilities is being actively mined. During the 2000s West Virginia's southern coalfields accounted for an average of 63 percent of the state's total tonnage distributed to electricity utilities. That share gradually began to decline in 2011 and by 2014, with Southern West Virginia accounting for less than 40 percent of the coal from the state that was distributed to domestic coal-fired power plants.

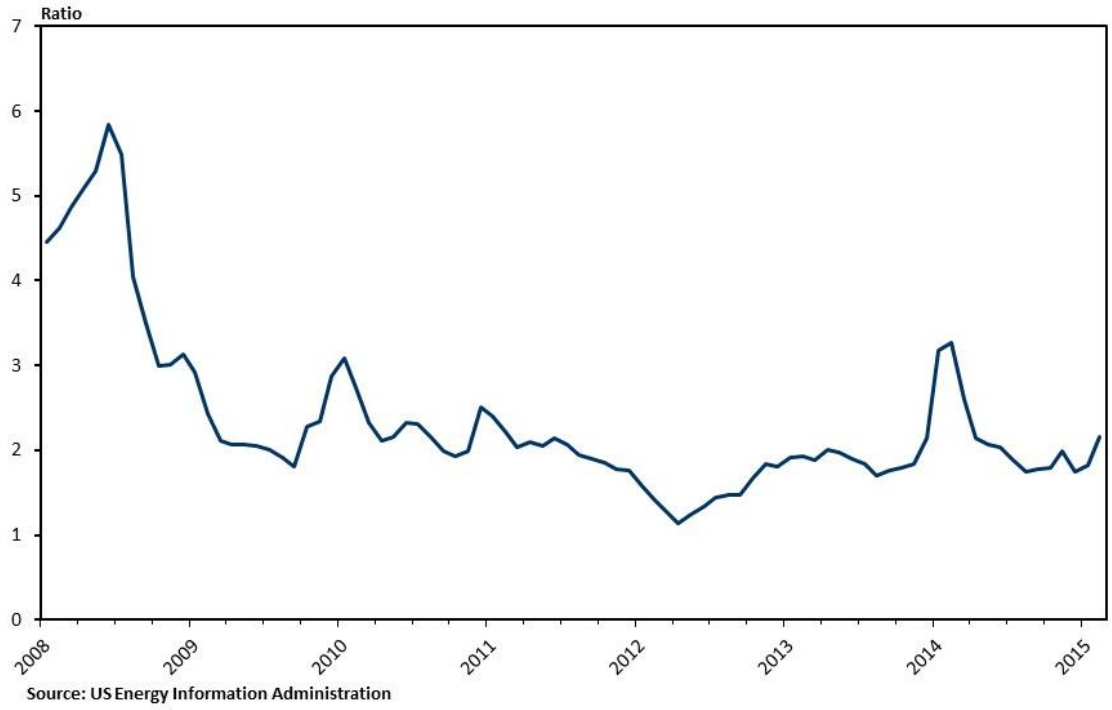
This shift in demand toward Northern West Virginia coal for electricity generation stems from a combination of geological, economic and regulatory factors. Perhaps the central cause, however, was the installation of flue gas desulfurization (FGD) “scrubbers” or dry sorbent injection (DSI) systems at coal-fired power plants to remove Sulfur Dioxide (SO_2), Nitrogen Oxides, HCl gas, Mercury and other emissions. This pollution control equipment has allowed electric utilities to burn higher sulfur coal more commonly found in Northern Appalachia (including Northern West Virginia), the Illinois Basin and other regions, where production costs are lower, yet still meet federal clean air emissions requirements.

These technologies have also allowed utilities to become compliant with the Mercury and Air Toxics Standard (MATS), which has required fossil-fuel steam electric generators to meet emissions limits for a range of toxic elements and compounds. The required compliance period began in April 2015 and extensions have been granted for one year in order to allow plants the opportunity to retrofit meet the standard. Although the standard is currently being challenged in court, utilities have already made the decision of whether or not to retire non-compliant plants due to the level of capital expenditures associated with adding retro-fitting equipment and the timeline needed to plan and perform the installation. Consequently, the combined effects of these changes have prompted a drop in domestic demand for low- to medium-sulfur coal previously sourced from mines in Southern West Virginia and other portions of Central Appalachia.

Shifting fuel choices by electric utilities have also weighed on demand for West Virginia coal in recent years. Natural gas has become an increasingly larger share of U.S. power generation thanks to a dramatic reduction in price brought about by skyrocketing production in the Marcellus, Utica and other major shale plays. Even with falling output from offshore locations and long-term declines from older vertical wells on-shore, U.S. natural gas production increased 25 percent between 2010 and 2014, with much larger percentage gains in Pennsylvania, West Virginia and Ohio.

During 2008, the price for electric power generation of natural gas per Btu was as much as 6 times that of coal. As of the first quarter of 2015, the price for electric power generation of natural gas is now only roughly 2 times that of coal. Factors such as massive increases in natural gas production, a narrowing in relative prices for natural gas versus coal, lower capital costs for combined cycle natural gas turbine plants, as well as regulatory changes that have affected coal-fired generation have all combined to cause natural gas to account for a growing share of electricity generation. Indeed, natural gas increased from less than 18 percent of generation in 2004 to nearly 28 percent in 2014, and has reached approximately 30 percent during the spring months of 2015.

Figure 4: Ratio of Natural Gas and Coal Price per Btu Paid by Utilities



3 Industrial/Commercial Demand

Aside from electricity generation, industrial and commercial uses constitute the other major domestic source of demand for West Virginia coal. Certain grades of coal mined primarily in the state's southern coalfields are used in the coking process to manufacture steel. However, the secular decline in the U.S. steel industry has weighed on domestic demand for metallurgical coal. Domestic metallurgical coal use has fallen from nearly 39 million short tons to approximately 20 million short tons between 1990 and 2014. For West Virginia, domestic metallurgical coal use has declined by 30 percent since 2008 to an estimated level of less than 11 million tons in 2014.

In addition to its uses in steel production, coal is also featured as a fuel source for combined heat and power (CHP) generation at various types of manufacturing facilities and some commercial buildings. Consumption of non-coke coal sourced from West Virginia mines for industrial, commercial and institutional uses has also been on a downward trend for many years. Higher efficiency standards for industrial machinery and equipment as well as some production facilities switching over to natural gas as the primary fuel source for CHP have driven domestic non-coke industrial use of coal lower. Since 2001, non-coke industrial and commercial coal distributed from West Virginia coal mines has dropped from 17.5 million short tons down to approximately 3.3 million short tons.

4 Export Activity

Given the overall decline in domestic use for coal from West Virginia, export markets have grown in importance as a source of demand—particularly for coal producers in the state's southern coalfields. Coal exports jumped more than three-fold between 2002 and 2012, rising from 14.5 million short tons to 47.5 million short tons over that time period. In fact, exports accounted for 40 percent of the coal from West Virginia distributed to end users.

It appears 2011 and 2012 were likely anomalous years for global demand for U.S. (and West Virginia) coal exports. Significant flooding in the state of Queensland, Australia, during 2011 caused a significant percentage of the nation's thermal and coking coal production to be shut in. With the wide majority of Australia's coal exports purchased by Asian countries, the sudden drop-off in Australian coal available for export caused a spike in demand for coal that was filled in large part by West Virginia (primarily Southern West Virginia) and several other states. Indeed, coal exports from West Virginia mines to India, China, South Korea and Japan increased more than five-fold between 2010 and 2012. In addition to the surge in Asian demand for West Virginia metallurgical and thermal coal exports during 2011 and 2012, thermal coal from the state benefited significantly from a near quadrupling in shipments to Europe over that same two-year period.

Over the past two years, however, export demand for West Virginia coal (and U.S. coal in general) has sharply declined. Since peaking in 2012, coal exports from the state have plunged at an average annual rate of more than 17 percent, falling to an estimated total of 32 million short tons during calendar year 2014. Several factors have contributed to this drop-off in demand for coal exports from West Virginia. One factor has been the reemergence of Australia, which by regaining its pre-2011 share of Asian coal demand has caused shipments of coal from West Virginia to India, China, South Korea and Japan to fall back to 2010 levels. Rising Indonesian coal exports to the rest of Asia have also weighed on demand for thermal and metallurgical coal supplies from the state.

Table 1: Top 15 Destination Countries for West Virginia Coal Exports ranked by Value in 2012

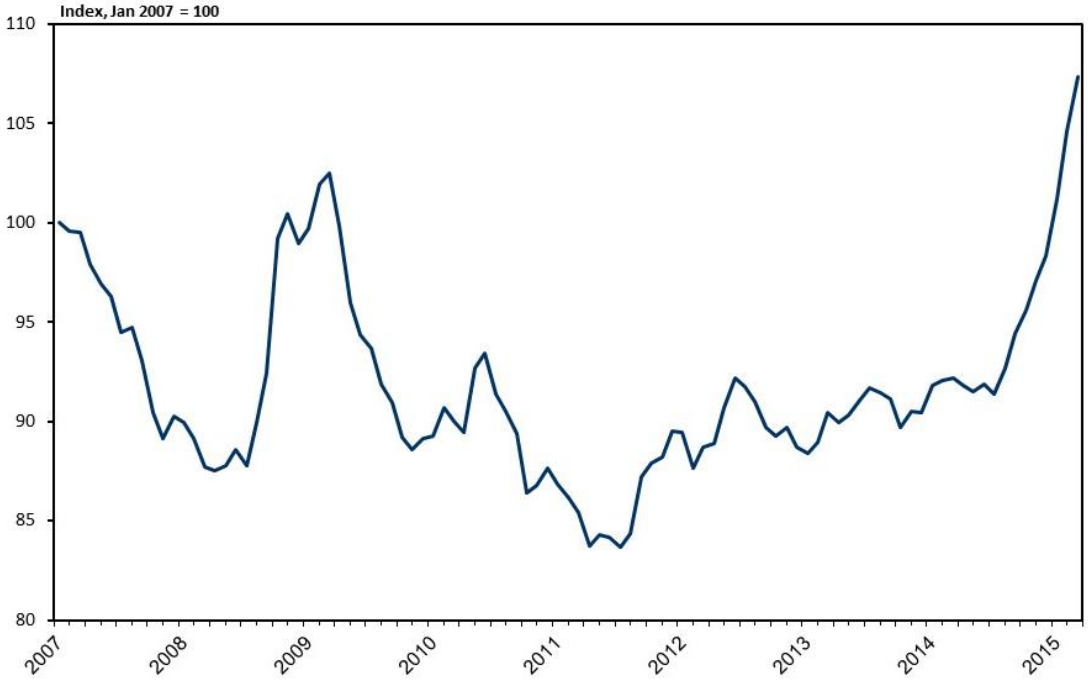
Country	2010	2011	2012	2013	2014
Netherlands	203	527	815	538	407
Italy	224	581	698	440	407
India	303	603	694	267	135
Brazil	280	547	556	374	336
South Korea	10	267	521	115	19
China	33	94	492	173	36
United Kingdom	221	288	474	400	275
Turkey	155	276	403	323	186
Japan	31	29	395	44	4
France	151	249	382	328	134
Ukraine	245	499	358	293	274
Canada	104	217	289	175	183
Morocco	0	73	190	235	189
Germany	34	136	167	143	107
Spain	112	52	152	110	64
World	2,772	5,319	7,454	4,591	3,134

Source: International Trade Administration
Note: Data are in millions of nominal dollars.

Secondly, European steam coal demand has waned somewhat since 2012 due to weak economic growth across much of the continent weighing on electricity generation. In addition, coal use by electric utilities has been on the decline in portions of Europe as a result of falling costs for other electricity generation fuel sources and attempts to reduce CO2 and other types of emissions. Just as with Asia, however, shipments of coal from West Virginia to Europe have deteriorated as traditional suppliers, in this case Russia, Colombia and South Africa, have regained some of their pre-2012 share of European demand.

The strength of the dollar has also hurt demand for West Virginia coal exports during the past year. Since West Virginia coal typically has higher production and inland transportation costs than other export competitors, the strong dollar has placed coal exports from the state in an even less competitive position on global markets. After remaining in a relatively narrow range over the course of 2012 and 2013, the real trade-weighted dollar for West Virginia jumped 16 percent on a year-over-year basis in early 2015. The state's trade-weighted dollar has appreciated at a particularly rapid in recent months, surging more than 29 percent on an annualized basis over its six most recent months. While likely not the sole cause, coal exports from West Virginia during the first quarter of 2015 registered an estimated 30 percent decline compared to the same time period a year ago.

Figure 5: West Virginia Real Trade-Weighted Dollar



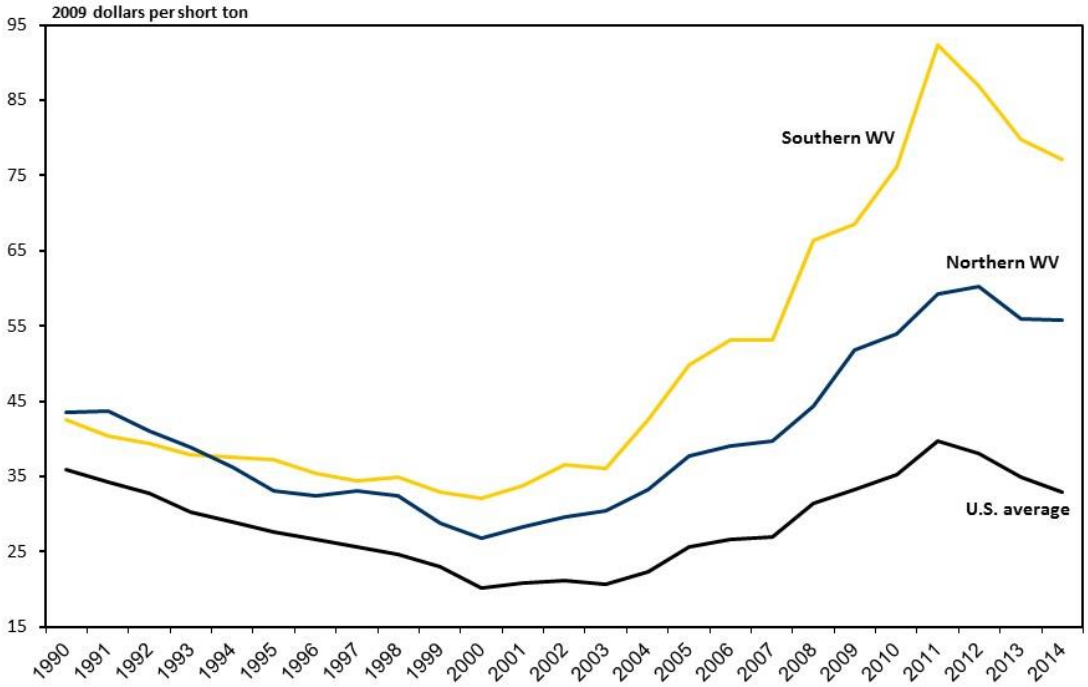
Source: Federal Reserve Bank of Dallas
Note: Based upon currencies of state's major export destinations.

5 Price and Mine Productivity

Coal prices increased rapidly over the course of the 2000s. Between 2000 and 2011, the inflation-adjusted minemouth price of coal rose at an average annual rate of 9.2 percent per year for the state as a whole. Real minemouth prices jumped at a strong rate nationally during this time period as well, but saw relatively slower growth overall at 6.5 percent annually.

As has been the case with trends in production, there were notable differences in both the level and rate of growth in prices between the state's northern and southern coalfields. Real average minemouth prices increased at an average annual rate of 10.1 percent per year, reaching $92 per short ton (in 2009 dollars) by 2011 in Southern West Virginia. By comparison, minemouth prices jumped 7.4 percent per annum to $59 per short ton in Northern West Virginia. Since 2011, average minemouth prices have declined in both regions, but the percentage contraction has been appreciably larger in the state's southern coalfields (5.8 percent annually).

Figure 6: Average Minemouth Coal Price by Region



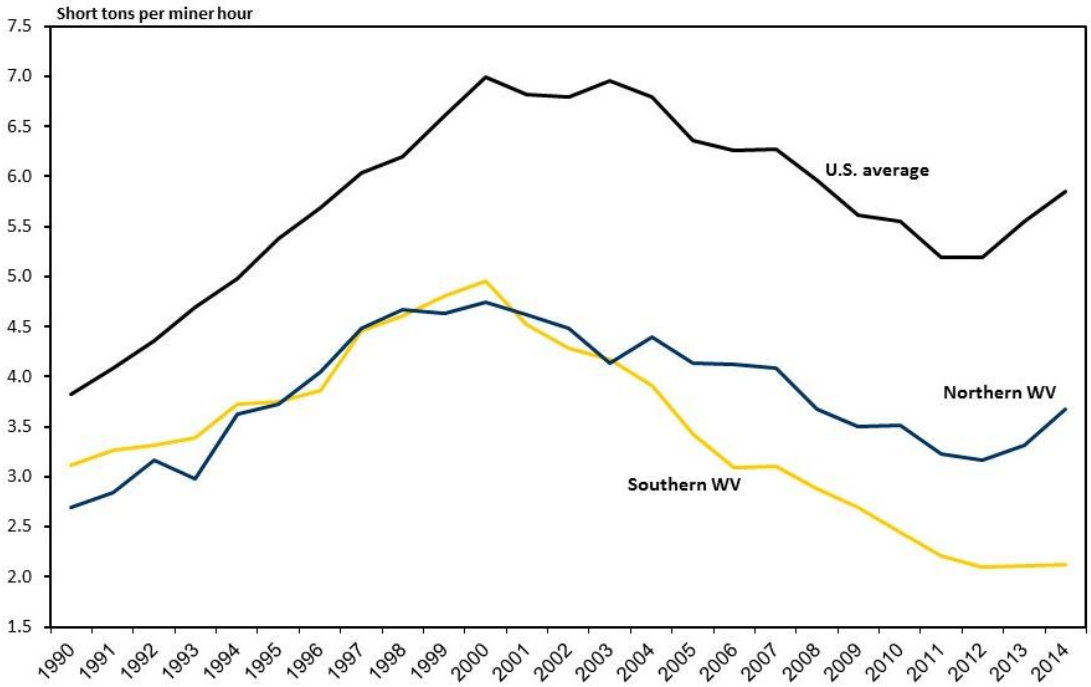
Source: Energy Information Administration
Note: Figure for 2014 is an estimate

Metallurgical coal is of premium grade and fetches higher prices relative to thermal coal both domestically and internationally. Since met coal accounts for a much larger share of production in Southern West Virginia, some of the average minemouth price differential that exists between the regions is not unexpected. However, the relative rate of growth in real minemouth prices has been affected to a much greater degree by how much productivity has changed (i.e. declined) over time within each region. Coal productivity is typically measured by short tons per miner hour. Prior to the early 2000s, West Virginia's northern and southern coalfields possessed similar rates of mine productivity, rising more than 5 percent per year between 1990 and 2000 to just below 5 short tons per miner hour.

Since 2000, mine productivity has declined by varying degrees across all of the major U.S. coal basins, but Southern West Virginia (and Central Appalachia in general) has experienced the largest percentage loss in productivity during the past 14 years. Overall, mine productivity in Southern West Virginia has plunged at an average rate of 5.9 percent per year down to roughly 2.1 short tons per miner hour—the lowest figure since 1986. Productivity within the state's northern mines has also declined, but the declines have been much less pronounced at 1.9 percent per year. Average productivity levels have actually jumped in each of the last two years across the Northern West Virginia region as a whole, reaching nearly

3.7 short tons per miner hour in 2014 thanks to strong production growth at operations in Marion, Marshall, Ohio and Taylor counties.

Figure 7: Average Mine Productivity by Region



Source: Energy Information Administration, Mine Safety & Health Administration
Note: Figure for 2014 is an estimate

The relatively larger losses in mining productivity for the state's southern coalfields have been particularly noteworthy given that more than 40 percent of the region's mining operations are surface mines, which typically have much higher average productivity levels. Both underground and surface mining operations in Southern West Virginia have experienced substantial deterioration in output per miner hour since 2000. This has occurred at least in part as a result of progressively more challenging geologic conditions that have forced both types of mines to allocate more labor in order to extract coal from seams that have become increasingly harder to access. Average productivity for underground mines in Southern West Virginia has declined from 4.2 to 1.8 short tons per miner hour between 2000 and 2014 while surface operations in the region have fallen from 6.4 down to 3.1 short tons per miner hour over that time period.

6 West Virginia Coal Production and Price Outlook

6.1 Short-Term Outlook

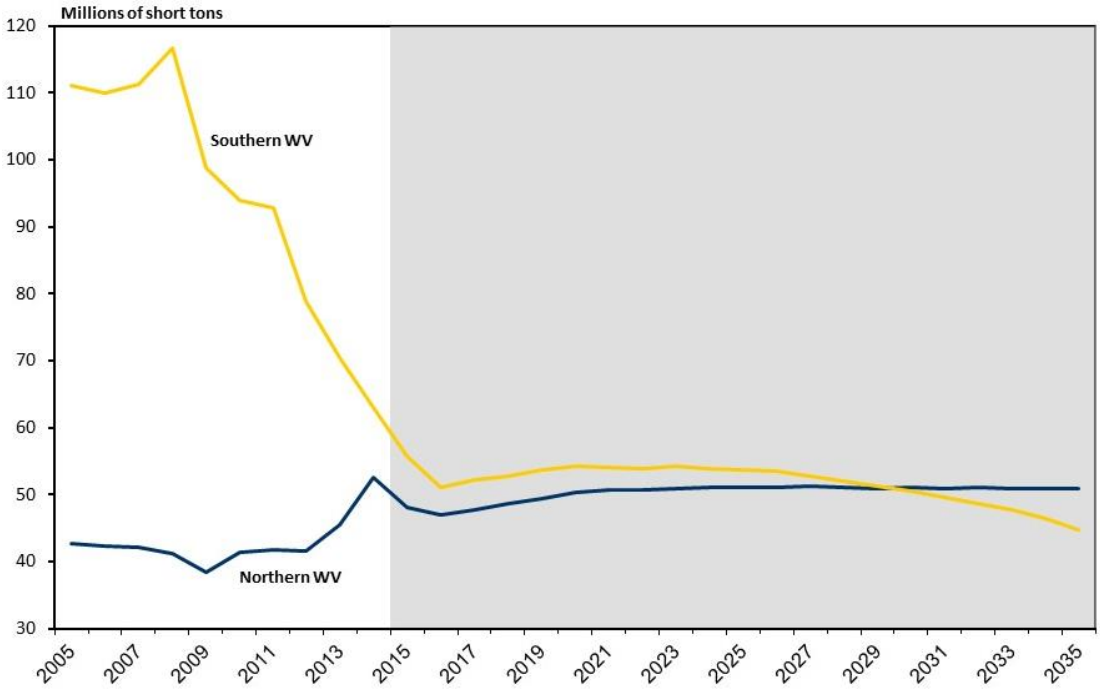
The WVU Bureau of Business and Economic Research model forecasts coal production in West Virginia through 2035, examining factors that affect the demand and supply of coal from the state's northern and southern coalfields.[2] Overall, the baseline forecast calls for state coal production to decline to

[2] For a description of the model and summary of the underlying forecast assumptions, see the Appendix.

approximately 104 million short tons in calendar year 2015 before contracting further to 98 million short tons in 2016.

Numerous factors are expected to weigh on West Virginia coal production over the next two years and declines are expected to occur in both the state's northern and southern coalfields. After replenishing their coal stockpiles following an extremely cold first quarter of 2014, inventories of coal at electric utilities grew appreciably over the latter half of the year and have stayed at relatively high levels as natural gas has garnered a growing share of the domestic electricity generation portfolio during the first several half of 2015. As a result, this will likely cause utilities to draw down from existing stockpiles slowly over the course of 2015 and early 2016, which will in turn weigh on thermal coal production over the next several quarters.

Figure 8: Baseline Coal Production Forecast



Sources: Energy Information Administration, WVU BBER Coal Production Forecast
Note: Forecast period designated by shaded area.

In addition to the re-balancing of coal inventories, natural gas is also expected to retain a large share of electricity generation into 2016 due to low prices, strong supply growth from the Marcellus and Utica Shale plays and MATS-related retirements of coal-fired generating capacity. Estimates of the impact of the MATS rule indicate that roughly 4-5 GW of coal-fired capacity nationally will be retired by 2016, which is the equivalent of 10 percent of total capacity retirements. Domestic use of coal in the industrial sector is also expected to remain below 2014 levels during the next two years. Sluggishness in the steel industry, created by a combination of a strong dollar and slow growth in Europe and Asia, will hurt demand for metallurgical coal while the high likelihood of industrial CHP consumers switching over to natural gas due to low prices will also affect industrial demand for coal in the near term.

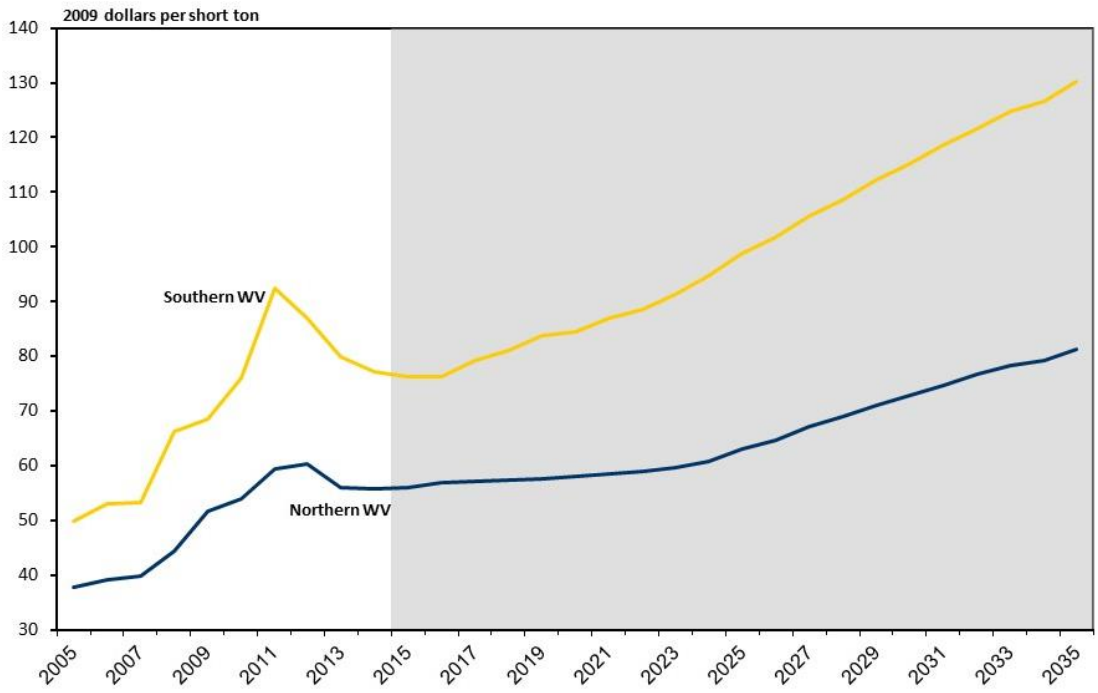
Export demand for coal from West Virginia is also expected retrench further through the end of 2016, with a projected drop of roughly 20 percent from 2014 levels. Low export prices, strong competition from other

major producers (chiefly Australia), a strong dollar and high production costs will all combine to weigh on the volume of metallurgical coal shipped overseas from Southern West Virginia mines. Many of these same factors will affect thermal coal exports from the state, but the anticipated rate of decline will likely be smaller as demand should remain steady in several of the traditional destination markets for West Virginia thermal coal.

Unfortunately, risks to production over the next two years remain biased to the downside. Should the recent production cutback/mine idling announcements made at several operations in Northern West Virginia be repeated at more mines, output will likely fall even further. In addition, while exports from the state are already expected to decline through 2016, economic growth in Europe and Asia could fail to meet expectations. This, in turn, would cause the global excess supply in coal markets to persist and weigh even further on West Virginia coal exports.

Reflecting weaker international and domestic demand for coal, as well as the idling (or potential closure) of high production cost mines, inflation-adjusted minemouth prices are expected to drift lower during 2015 and 2016. The forecast calls for prices to average less than $76 per short ton (in 2009 dollars) for Southern West Virginia coal and approximately $56 per short ton in Northern West Virginia. For the nation as a whole, the EIA 2015 Annual Energy Outlook assumes minemouth prices will average nearly $33 per short ton over the next two years.

Figure 9: Average Coal Price by Region Forecast



Sources: Energy Information Administration, WVU BBER Coal Production Forecast
Note: Forecast period designated by shaded area.

6.2 Long-Term Outlook

While the EPA and Office of Surface Mining have various regulatory proposals under consideration that will significantly affect (directly and/or indirectly) coal production in West Virginia, these rules and

standards have not been formally adopted and will likely be subjected to administrative changes and/or legal challenges once they are released. Since the actual implementation of these rules and what their impacts will be remains uncertain, the baseline forecast will only consider the impacts of laws that are currently on the books and subject to enforcement.[3]

Coal production in West Virginia to rebound moderately between 2017 and 2020, rising to an annual average of nearly 105 million tons in 2020 and remain close to this level into the latter half of the decade. Retirements of coal-fired generation will taper off as the compliance period for MATS ends, and while no measurable amount of capacity additions to the coal-fired fleet are expected, an expected increase in natural gas prices should allow coal to regain some share of electricity generation. This factor will be blunted to some degree by the cost premium for coal from Northern and Southern West Virginia relative to that mined in the Powder River and Illinois basins, which cost much less to mine on a per ton basis.

Firming global demand for metallurgical and thermal coal, along with rising world prices for both types of coal, should allow some shut-in production in Southern West Virginia at mines with more favorable costs and geologic conditions to re-start. Domestic industrial and commercial demand should fall somewhat over the latter half of this decade. Gains in industrial output are expected to be offset by CHPs and other non-utilities converting to natural gas as well as new rules on boilers and process heaters that restrict MACT emissions. Energy efficiency for integral horsepower motors and other industrial machinery will likely rise as well thanks to new rules regulating efficiency standards take effect.

For the remainder of the outlook period, statewide coal production is expected to fall, contracting to less than 96 million short tons in 2035. This will be driven mostly by waning output from the state's southern coalfields, where output is expected to decline nearly 29 percent from 2014 levels. Export demand for metallurgical, and to a lesser extent thermal, coal will alleviate some of the downward pressure on the region's production, but increasingly fragmented reserves, further anticipated declines in domestic use of Southern West Virginia coal from the electric power and industrial/commercial sectors will prove too difficult to overcome.

Production in Northern West Virginia will generally be somewhat below 2014 levels by the end of the forecast horizon. Steady domestic use of the region's high-sulfur coal for electricity generation is expected to drive the outlook, but export demand for metallurgical coal will also support production activity. In addition, due to its projected steady pace of output after 2020 and the anticipated declines in Southern West Virginia, northern mines will consistently account for a majority of statewide coal production during the latter portion of the outlook period.

Inflation-adjusted prices are expected to increase in both Northern and Southern West Virginia between 2020 and 2035, climbing at an average annual rate of nearly 3 and 2.3 percent, respectively. Minemouth prices will grow at a faster rate in Southern West Virginia for several reasons. First, an increasingly larger share of the region's production will be allocated to more valuable metallurgical coal. At the same time, while both areas will likely see prices increase as a result of declining average mine productivity levels, Southern West Virginia mine productivity levels will fall even faster due to geological issues (fragmented or marginal reserves) and regulatory constraints on more productive surface mine operations. Consequently, this will cause the region's coal to average more than $130 per short ton in 2009 dollars by the end of the outlook period, compared to $81 per short ton in Southern West Virginia.

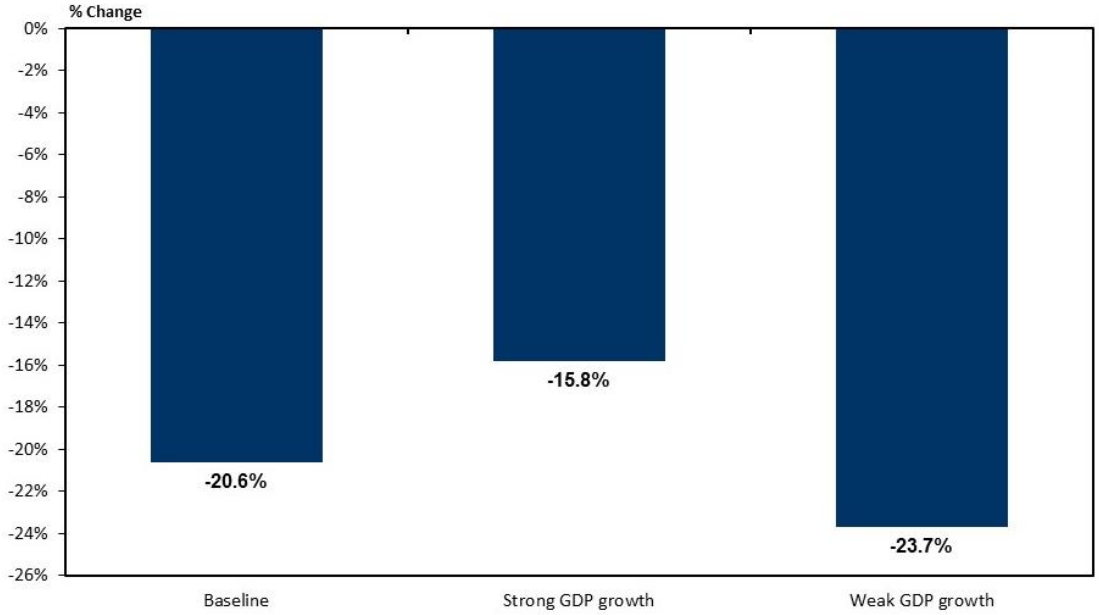
[3] A subsequent section will present several scenarios that analyze the net impacts on statewide coal production, including the effects of additional losses in the nation's coal-fired generating fleet.

6.3 Alternative Coal Production Scenarios

The baseline forecast was built upon a series of assumptions that can have significant impacts on the state's coal production outlook. These assumptions include domestic and global economic growth, the competitive and regulatory environments and how each interact with costs to the mining industry and fuel choices for the electric power and industrial sectors. The impact of these assumptions on the forecast can be substantial and by consequence creates uncertainty for future coal production in West Virginia, causing it to deviate to an unknown extent from the baseline forecast.

Economic growth represents a key determinant to electricity demand and steel production, which in turn drive demand for coal. Real GDP is expected to see average annual growth of roughly 2.4 percent between 2015 and 2035, which is well below typical rates of output growth observed during the post-WWII era. Under the baseline forecast, statewide coal production is expected to decline 20.6 percent from 2012 levels. A stronger assumption for national economic growth of 3.0 percent per year reduces the cumulative rate of decline to 15.8 percent. By contrast, assuming a more pessimistic scenario with real GDP growth of 1.8 percent per year will leave coal production nearly 24 percent below 2012.

Figure 10: Net Percentage Change in West Virginia Coal Production by Scenario (2012-2035)



Source: Bureau of Economic Analysis; IHS Global Insight; WVU BBER Coal Production Forecast

Aside from the impacts of economic growth varying from the baseline, we also analyzed the effects of significant losses in the nation's coal-fired electric generation on statewide coal output. This scenario uses some inputs from results found in the EPA's Clean Power Plan Regulatory Impact Analysis, but it should serve as a guideline rather than a strict interpretation of the rule's potential impact. Overall, the effect of this rule would likely be similar to MATS, in that it would accelerate the retirement of less efficient coal-fired generation over time but the impact would occur on a larger scale since it targets CO2 emissions. However, since the mandate would apply to system-wide reductions in CO2 emissions, more efficient coal-fired plants would not necessarily need to close or install carbon capture and sequestration technology so long as a state's overall carbon intensity declines.

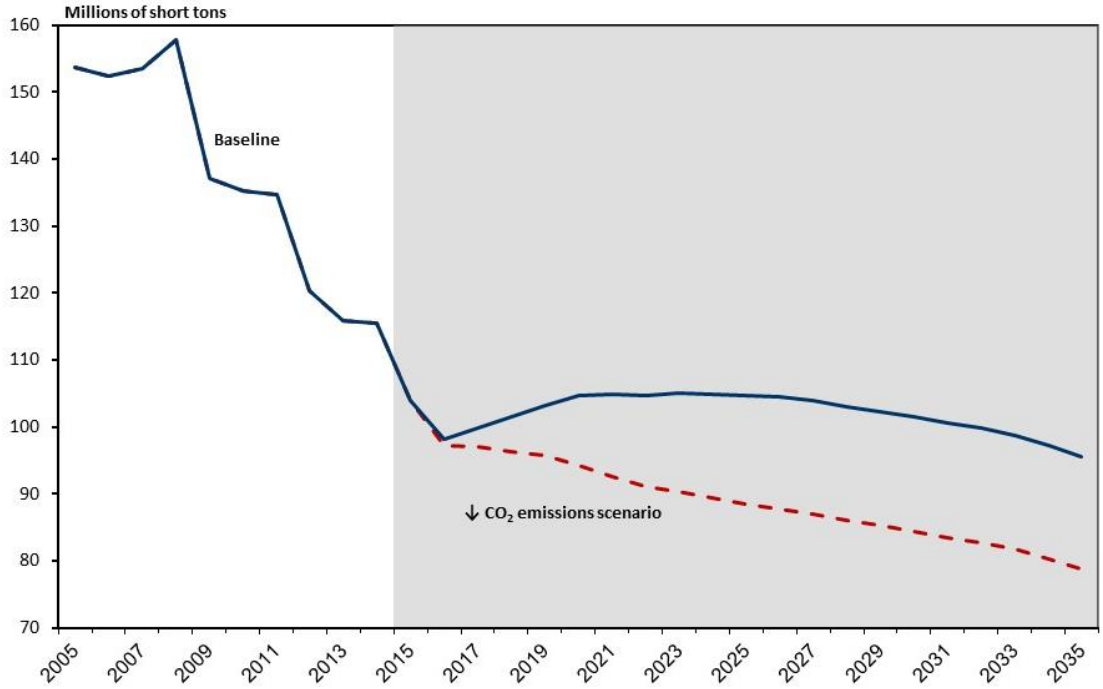
To simulate the effect of this rule, we reduced the size of the domestic coal-fired fleet expected to purchase coal from Northern and Southern West Virginia by 15 percent by 2025, which would be somewhat smaller than the reduction outlined under Option Two[4] of the Clean Power Plan proposal. Since the rule has not yet been finalized and the ultimate timeline for compliance could change due to legal challenges or administrative changes, we assumed existing coal-fired capacity would be retired at accelerating increments between 2018 and 2025. Compliance would force utilities with coal-fired generators to install emissions control technologies in some cases to meet emissions targets or retire these units and replace them with natural gas or renewables. These compliance costs would ultimately raise the price of coal relative to other fuels, particularly natural gas for electricity generated by utilities in the Eastern U.S. In order to reflect this likely shifting dynamic in relative prices, the scenario also includes a 10 percent discount on the price utilities pay for natural gas relative to coal between 2018 and 2035.

The scenario results indicate coal production for the state as a whole would fall to less than 79 million tons by 2035, an 18 percent reduction in output relative to the baseline. However, the magnitude of impact would be felt much differently between the state's northern and southern coalfields. Indeed, since Northern West Virginia coal is predominantly sourced to domestic power plants, CO2 emissions requirements would disproportionately affect demand for coal from northern coal mines. Rather than seeing relatively stable production during the outlook period, production is projected to be 26 percent below its baseline figure in 2035 and down 28 percent from levels observed in 2014.

By comparison, Southern West Virginia will have already endured a sizable reduction in demand from coal-fired generators and other domestic users. This factor, along with the fact that a growing share of the region's coal will likely be intended for metallurgical uses and/or exported, thus shielding it to some extent from these policy changes, Southern West Virginia is projected to see production fall just 9 percent below 2035 levels anticipated under the baseline forecast.

[4] Option 2 of the EPA's Clean Power Plan will allow states to implement plans that allow for smaller reductions in CO2 emissions, but at the same time will require them to achieve these reductions over a shorter time frame. See http://www2.epa.gov/sites/production/files/2014-06/documents/20140602ria-clean-power-plan.pdf for full details of the proposed rule and its impact as determined by the EPA.

Figure 11: Coal Production Forecast- Baseline vs Reduced Coal Generation Scenario



Sources: Energy Information Administration, WVU BBER Coal Production Forecast
Note: Forecast period designated by shaded area.

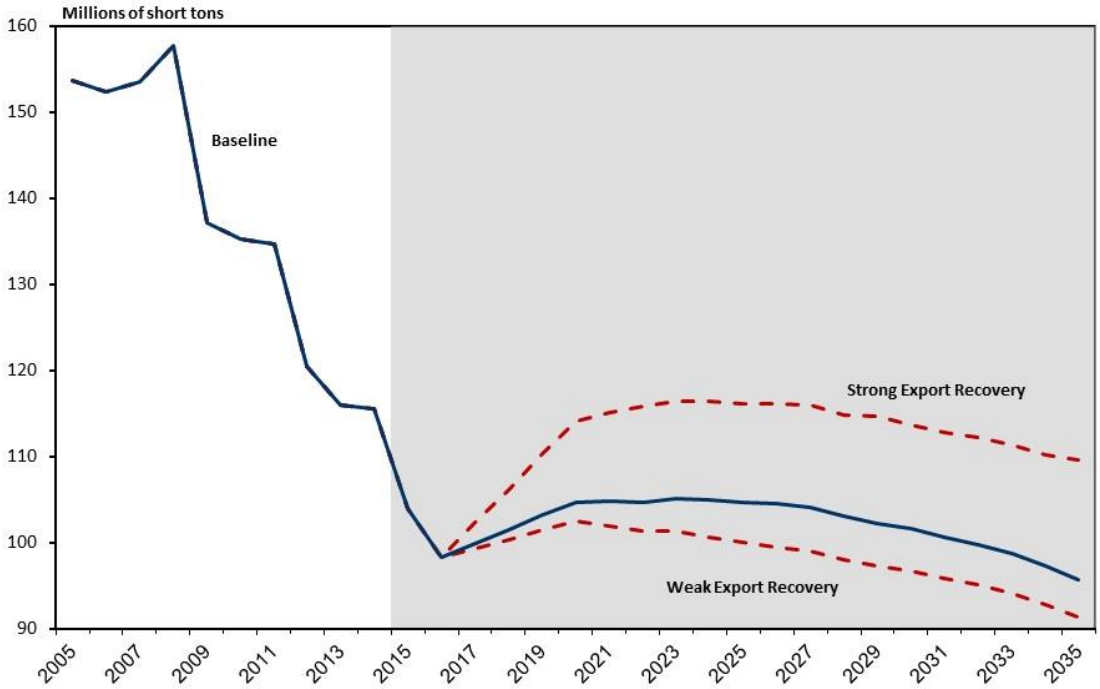
Since a high share of the state's coal production is exported, differing outcomes for the global coal trade could have a positive or negative impact on West Virginia coal production. The baseline forecast assumes West Virginia coal exports will increase 14 percent from 2014 levels by 2035. Even with the increase in export tonnage, the state is expected to see a modest decline in its overall share of U.S. coal exports as the Powder River and Illinois basins moderately expand shipments to Asia and Europe.

We examined two alternative scenarios for state coal exports. The first analyzed the effects of the state losing a significantly larger share of U.S. coal export activity, reflecting larger inroads being made into the global coal trade by producers in the Powder River and Illinois basins thanks to the construction of new export terminals along the Gulf Coast and in the state of Washington. The net effect of this scenario would generally be small by reducing total state coal production by just above 4 million tons versus the baseline. While ramped up exports from these two competing regions would likely displace a portion of higher production cost thermal coal exports from Southern West Virginia, the region's metallurgical coal exports would feel only limited impacts.

For an upside scenario, we consider the potential of West Virginia to maintain its current share of U.S. coal exports throughout the forecast horizon, thereby pushing exported coal tonnage 50 percent above the state's 2014 levels. Maintaining this current share of the national coal export trade would likely require several events to take place. First, this scenario assumes the transportation bottlenecks that currently exist for Powder River Basin coal in the Northwest U.S. would persist and that the recent spate of challenges by environmentalists and other groups are successful, thereby preventing capacity expansion of coal export terminals along the Gulf Coast to handle greater amounts of PRB coal shipments.

In addition, global metallurgical and thermal coal prices would need to recover significantly and remain at high levels in order to allow many mine operations in Southern West Virginia to sustain economic viability over the long term. Even then, however, unfavorable geologic conditions would serve as a capacity constraint and force producers to leave coal in the ground since some reserves would become too depleted or fragmented to recover at nearly any price. Stronger global demand for West Virginia coal would also likely bolster exports from the state's northern coalfields. Exports account for less than 15 percent of the coal distributed from Northern West Virginia, but would likely expand due to rising margins for coal sold overseas given that it shares a similar transportation cost structure and access to export terminals in Baltimore and Norfolk as Southern West Virginia, along with lower production costs.

Figure 12: Coal Production Forecast- Baseline vs Alternative Export Scenarios



Sources: Energy Information Administration, WVU BBER Coal Production Forecast
Note: Forecast period designated by shaded area.

Based upon this scenario, coal production within the state would bounce back significantly stronger and push output to approximately 116 million short tons by the early 2020s. Although export demand would not arrest the longer-term downward trend in coal production, it would significantly lessen the rate of this decline by offsetting the waning use of Southern West Virginia coal for domestic electricity generation. Overall, a production level of 110 million tons would be expected under this scenario by the end of the forecast period, or 14 percent above the baseline and just 5 percent below 2014 output.

Appendix: Model Description and General Forecast Assumptions

Publication: West Virginia University BBER Coal Production Forecast 2015

Date: May 2015

Forecast Horizon: 2015-2035

Regions: Northern and Southern West Virginia

The WVU Bureau of Business and Economic Research Coal Production Forecast is an econometric model based upon changes in factors that affect the demand and price for coal sourced from mines in Northern and Southern West Virginia between 1985 and 2014. Historical data on coal prices, production and other energy-related data are obtained from a variety of Energy Information Administration reports. Forecasts for the model's U.S. level explanatory variables were taken from combination of the IHS Global Insight April 2015 forecast and the 2015 Annual Energy Outlook from the Energy Information Administration. Region-specific explanatory variables, such as exports, were projected by the BBER based upon historical relationships. Key assumptions for the model include:

Macroeconomic Growth: Real Gross Domestic Product is expected to increase at an average annual rate of 2.4 percent per year through 2035.

Coal Prices: Inflation-adjusted coal prices are expected to increase in both regions, reaching $130 per short ton (in 2009 dollars) in Southern West Virginia and $81 per short ton in Southern West Virginia—averaged for metallurgical and thermal coal. The U.S. average price is expected to rise to $42 by 2035.

Natural Gas Prices: Real natural gas prices (2009 dollars) paid by utilities are expected to increase at an average annual rate of nearly 2 percent per year, reaching $5.52 by 2035.

Electricity: Total U.S. electricity generation is expected to increase nearly 1 percent per year between 2015 and 2035. Coal and natural gas are expected to account for very similar shares of electricity generation (approximately one third) by the latter half of the outlook period.

Industrial/commercial use: Total commercial/industrial demand for West Virginia coal is expected to decline 23 percent over the forecast horizon. Most of this decline will be driven by non-coke coal C&I use due to energy efficiency gains and natural gas conversion.

Export Demand: The baseline forecast assumes 2012 was an all-time peak for West Virginia coal export activity, and both metallurgical and steam coal exports from the state will remain below these levels throughout the outlook period. Total exports are expected to increase 37 percent between 2015 and 2035, with Southern West Virginia continuing to account for a majority of the state's coal exports.

Environmental: Baseline forecast assumes only laws that are in place and not currently subject to legal challenges. Retirements of coal-fired generation not compliant with the MATS rule will continue through 2016. Rules stemming from the Clean-Air Interstate Rule (CAIR) will remain in place until the U.S. Court of Appeals in DC makes a determination on the EPA's Cross-State Air Pollution Rule (CSAPR). The rule was remanded following the Supreme Court's decision in April 2014 to uphold the rule but send it back to the lower court for review on several major components. The Clean Power Plan is not considered in the baseline, but a variation of the rule and its impact on West Virginia coal production is addressed in an alternative scenario.

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Since the 1940s, the BBER's mission has been to serve the people of West Virginia by providing the state's business and policymaking communities with reliable data and rigorous applied economic research and analysis that enables the state's leaders to design better business practices and public policies. BBER research is disseminated through policy reports and briefs, through large public forums, and through traditional academic outlets. BBER researchers are widely quoted for their insightful research in state and regional news media. The BBER's research and education/outreach efforts to public- and private-sector leaders are typically sponsored by various government and private-sector organizations.

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