West Virginia University
COLLEGE OF BUSINESS AND ECONOMICS

Bureau of Business and Economic Research

Government Incentives to Promote Demand for West Virginia Coal

Eric Bowen, Research Associate
Christiadi, PhD, Research Associate
John Deskins, PhD, Director

January 2015

bber.wvu.edu

PO Box 6527
Morgantown, WV 26506
(304) 293-7831
bebureau@mail.wvu.edu

© Copyright 2015 WVU Research Corporation

Funding for this research was provided by the West Virginia Department of Revenue. The opinions herein are those of the authors and do not necessarily reflect those of the West Virginia Department of Revenue, the West Virginia Higher Education Policy Commission, or the West Virginia University Board of Governors.

The authors thank Mark Muchow, of the West Virginia Department of Revenue, for helpful comments and suggestions, and Joana D'arc Aparecida da Costa for outstanding research assistance.

Table of Contents

List of Tables and Figures

Executive Summary

West Virginia's coal industry has faced widespread production and employment declines in recent years, and particularly in the past two years. These trends in coal production have also affected the state treasury, as coal severance taxes have fallen by more than a quarter in the past two years. Partially motivated by this loss in coal output, employment, and tax revenues, in this study we examine potential policies that can help provide support to an industry that is important to West Virginia's economy. In particular, we consider various state-level policies that have the potential to ultimately boost coal production in West Virginia by incentivizing the state's utilities and manufacturers to use West Virginia coal instead of importing coal from outside the state.

In 2013, consumers in West Virginia consumed 31 million tons of coal, of which almost 13 million tons was imported from other states, representing approximately 41 percent of the total. If West Virginia could introduce a policy that would encourage in-state utilities to replace some or all of this imported coal with West Virginia produced coal, it would potentially increase coal production in the state by as much as 11 percent over the 113 million tons produced in 2013. The policies outlined in this report have the potential to help in-state coal producers capture some of this demand.

For this report we consider two possible policies. One policy would provide a credit of $3 per ton of coal on mining companies' severance taxes. The other policy would provide a 5 percent tax credit to electric utilities' business and occupation taxes for West Virginia coal purchased by in-state consumers, such as electric utilities. In either case this credit would apply only to the amount of coal purchased above the amount a base year, which we set to be 2012 for modeling purposes. This latter provision would limit the effect of the tax subsidy on the state treasury while providing incentives for utilities to switch from out of state coal to West Virginia coal.

Table 1 summarizes the estimated economic impact of these policies on the state's economy. Relative to the baseline forecast, we find that these tax incentive policies would produce between $26 million and $34 million of additional economic activity in the state on average between 2014

and 2030. This additional economic activity would support between 150 and 196 jobs in mining and other industries with between $14 million and $18 million in income for these workers. Additionally, these policies would create between $712 thousand to $931 thousand in additional tax revenue to the state government.

Table 1: Coal Incentive Policies Economic Impact Summary

	Lower Bound Estimate	Higher Bound Estimate
Average Increase in Gross State Product	$26 million	$34 million
Average Increase in Employment	150 jobs	196 jobs
Average Increase in Personal Income	$14 million	$18 million
Average Increase in Tax Revenue	$712 thousand	$931 thousand

1 Introduction

West Virginia's coal industry has faced widespread production and employment declines in recent years, and particularly in the past two years. Coal production stood at 113 million tons in 2013, down more than one-third from its 2008 peak. Coal industry employment, including mining and support services, is down as well, falling to less than 22 thousand jobs in 2013 from almost 25 thousand in 2011, a loss of more than 13 percent. Employment in the first quarter of 2014 fell to nearly 20 thousand jobs, a drop of nearly 500 jobs from the last quarter of 2013. These trends in coal production have also affected the state treasury, as coal severance taxes have fallen by more than a quarter in the past two years.

Partially motivated by this loss in coal output, employment, and tax revenues, in this study we examine potential policies that can help provide support to an industry that is important to West Virginia's economy. In particular, we consider various state-level policies that have the potential to ultimately boost coal production in West Virginia by incentivizing the state's utilities and manufacturers to use West Virginia coal instead of importing coal from outside the state. In 2013, West Virginia coal users consumed 31 million tons of coal, of which almost 13 million tons was imported from other states, representing approximately 41 percent of the total. If West Virginia could introduce a policy that would encourage in-state utilities to replace some or all of this imported coal with West Virginia produced coal, it would potentially increase coal production in the state by as much as 11 percent over the 113 million tons produced in 2013. The policies outlined in this report have the potential to help in-state coal producers capture some of this demand.

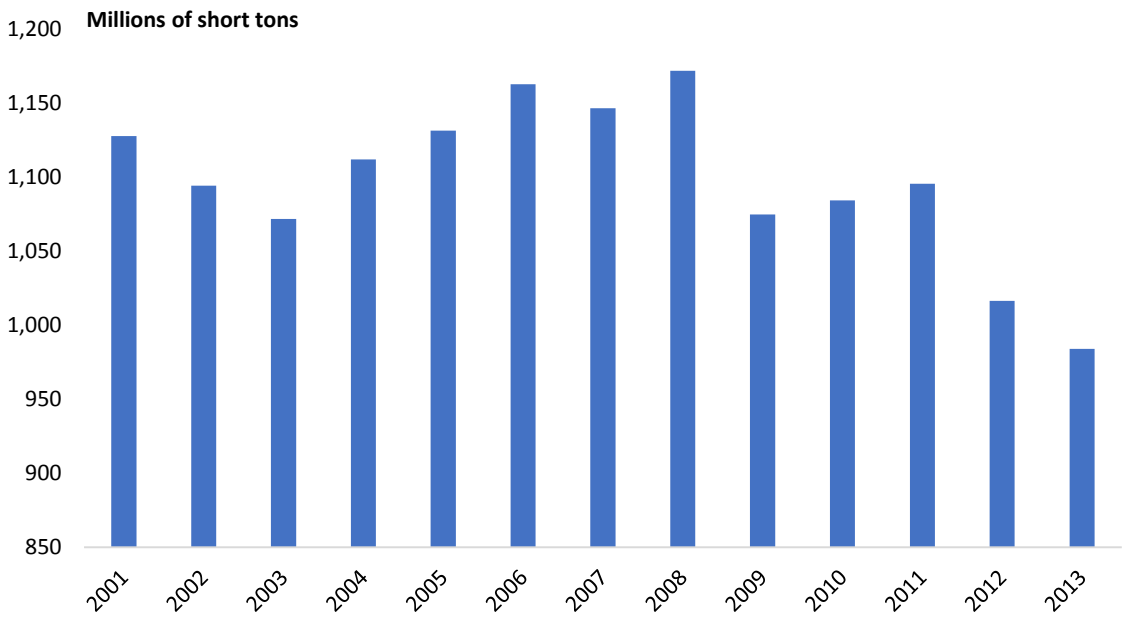
In Section 2, we provide background information on the US coal mining industry and its recent performance. In Section 3, we provide a detailed examination of West Virginia's coal industry and compare it to other coal-producing states. We also examine West Virginia's coal imports and exports, both to foreign countries and to other states. In Section 4 we describe current tax policy as it relates to the utility and coal sectors in West Virginia and contiguous states.

Lastly in Sections 5 and 6, we examine state-level policies that have the potential to increase West Virginia's coal production relative to 2012 levels. We start by comparing current tax incentive policies in West Virginia to those of neighboring states. These incentives include production tax credits for in-state coal industry, as well as demand-based policies that favor purchasing in-state coal over imported coal. We then model two specific policies to determine their potential impact on the state's economy. Next we forecast the impact of the policies on coal production and employment, and then we calculate the overall economic impact on the state of these policies over time using a sophisticated model of the West Virginia economy.

2 Overview of Coal Industry Performance in the US

Coal production in the United States fell during the recent recession and has failed to return to pre-recession levels in the six years since the recession ended. Overall coal production nationwide stood at 984 million tons in 2013, down from 1.2 billion tons in 2008, a drop of nearly 16 percent (see Figure 1). Much of the losses have occurred within the last two years. Coal production fell about 10 percent between 2011 and 2013

Figure 1: US Coal Production (2001-2013)

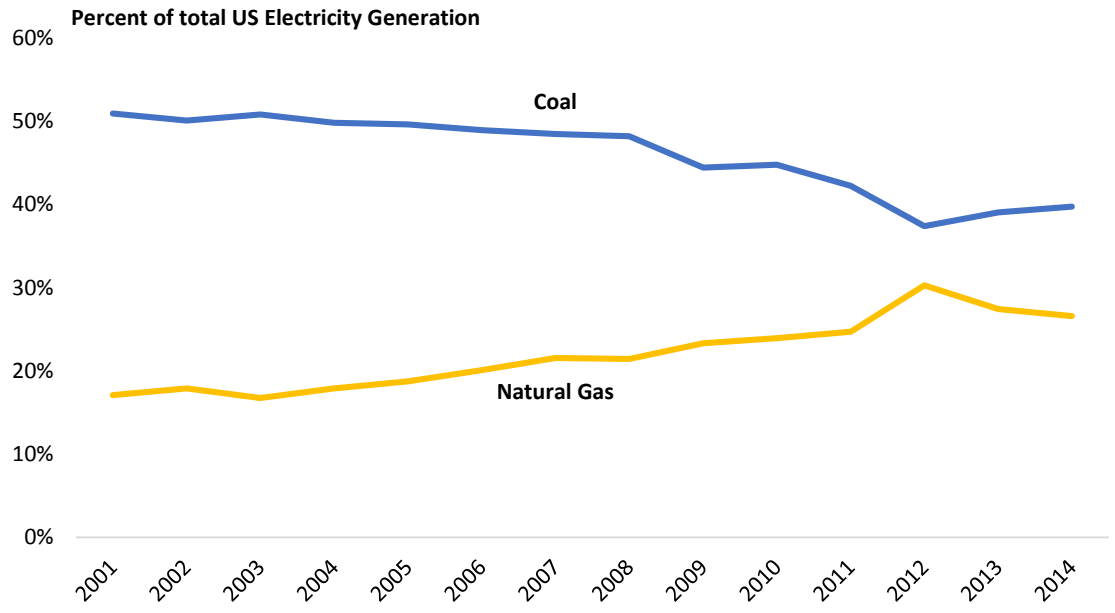


Source: US Energy Information Administration

The reduction in coal demand is due in large part to a reduction in consumption of coal in the utility sector, the primary purchaser of coal nationally. Much of this reduction has been driven by a switch to natural gas as a fuel for electricity production as natural gas prices have fallen due to a boom in production from shale gas. As Figure 2 shows, coal's share of total electricity generation nationally has fallen to under 40 percent on average in 2014, from nearly 50 percent

as recently as 2005. Natural gas fueled more than 27 percent of electricity generation in 2013, up from just over 17 percent in 2001.

Figure 2: Share of US Power Generation by Fuel Type

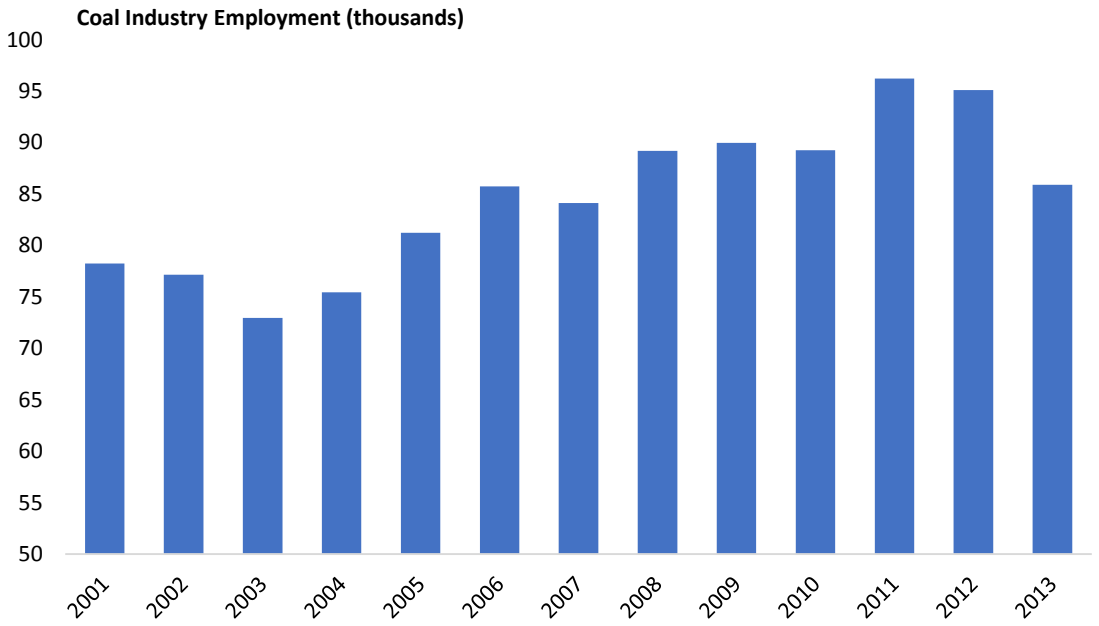


Source: US Energy Information Administration.

Despite falling production during the recession, US employment in the coal industry, which encompasses coal mining and support services for coal mining, continued to climb through the end of 2011 (see Figure 3). This trend likely reflects falling labor productivity in the nation's coal mines, indicating that the same number of workers produce less output. The last two years

have seen a reversal, however, as coal industry jobs fell from the recent high of more than 96 thousand in 2011 to less than 86 thousand jobs in 2013, a reduction of more than 10 percent.

Figure 3: US Coal Employment

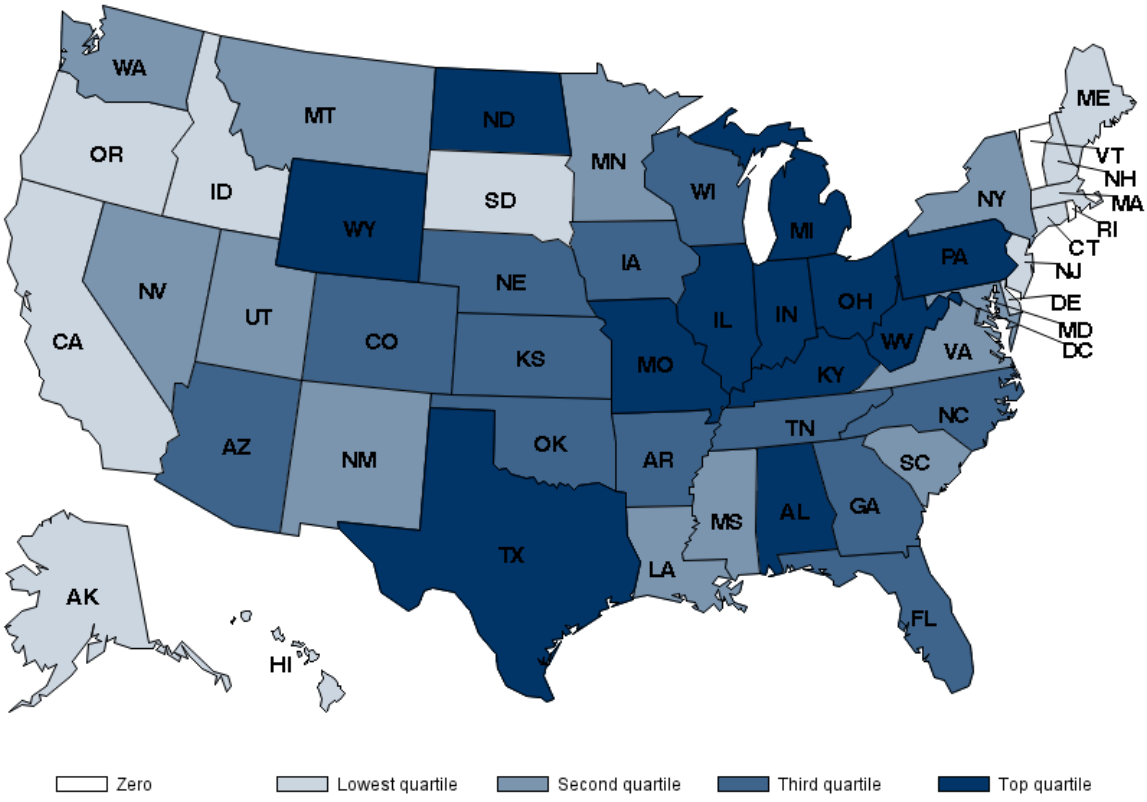


Source: US Bureau of Labor Statistics

US electric power producers consumed more than 825 million tons of coal in 2012. We illustrate the variation in coal consumption across the US states in Figure 4. In 2012, Texas led the nation in coal consumption, burning more than 97 million tons, amounting to almost 12 percent of the total US consumption. Generally states in the Great Lakes and Appalachian regions are heavy coal consumers, reflecting the prominent use of coal for power generation in and around these

coal producing regions. Coal consumption tends to be lowest in the northeast and the West Coast.

Figure 4: Coal Consumption for Electric Power Production

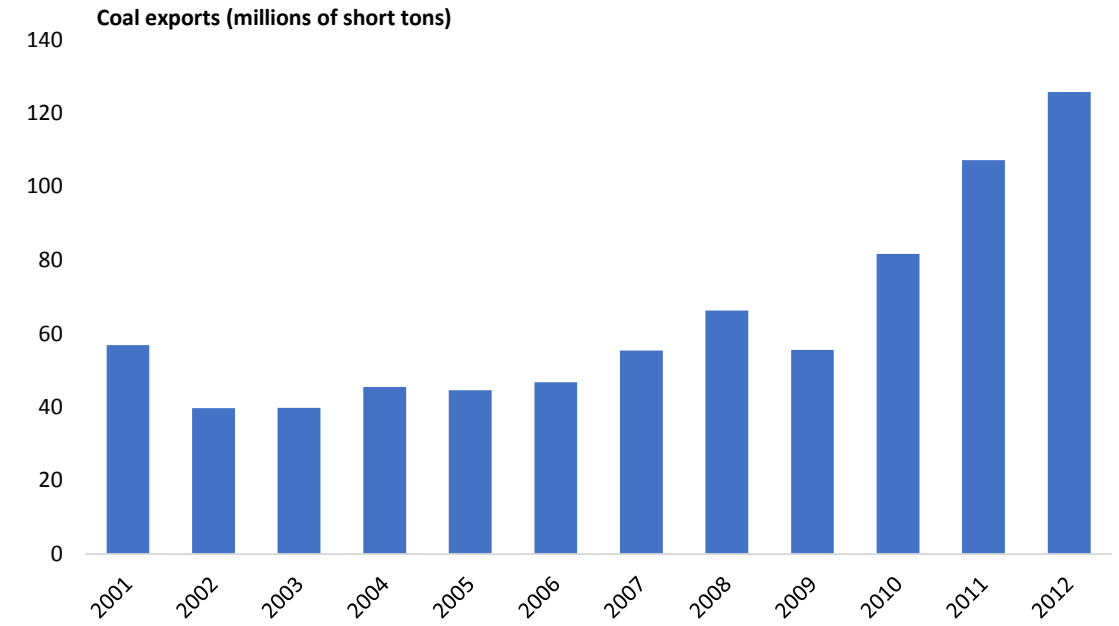


Source: US Energy Information Administration

The United States exported more than 125 million short tons of coal in 2012, nearly double the volume of 2008 before the recession (see Figure 5). The total value of exports of minerals and

ores, of which coal is a part, totaled almost $24 billion in that year. The value of minerals and ores exports fell significantly in 2013, however, dropping by 14 percent.[1]

Figure 5: US Coal Exports



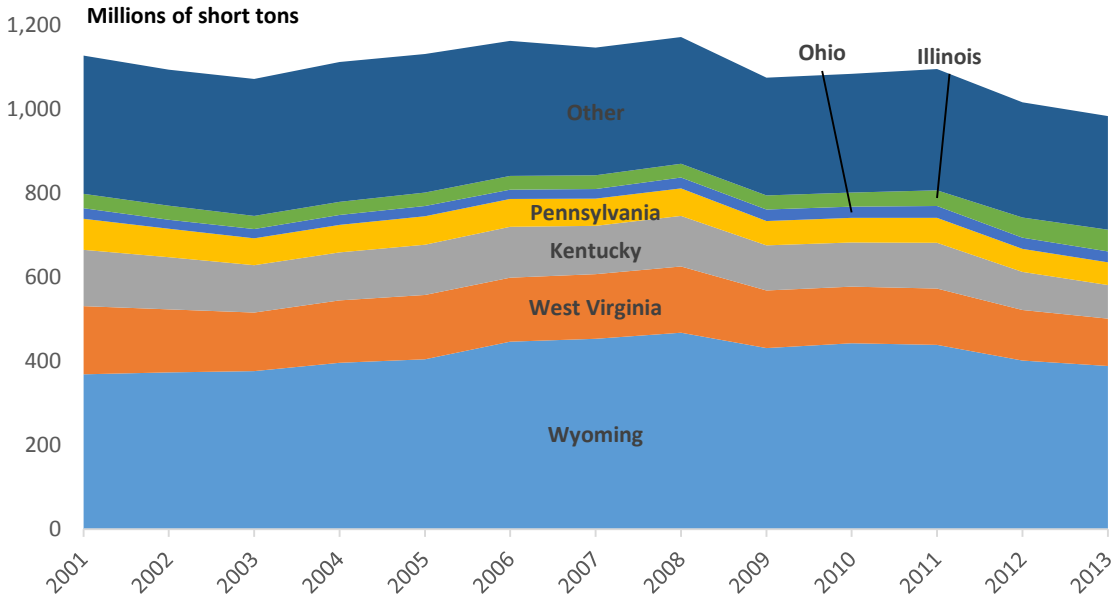
Source: US Energy Information Administration.

[1] Data on coal tonnage exports unavailable for 2013.

3 Overview of the West Virginia Coal Industry

West Virginia has long been the country's second-largest coal producer, after Wyoming, mining nearly 113 million short tons of coal in 2013. However, as illustrated in Figure 6, the state has lost market share in recent years to other coal-producing states. West Virginia's production fell by more than 16 percent between 2011 and 2013, compared with a 10-percent drop in US production.

Figure 6: US Coal Production by State (2001-2013)



Source: US Energy Information Administration

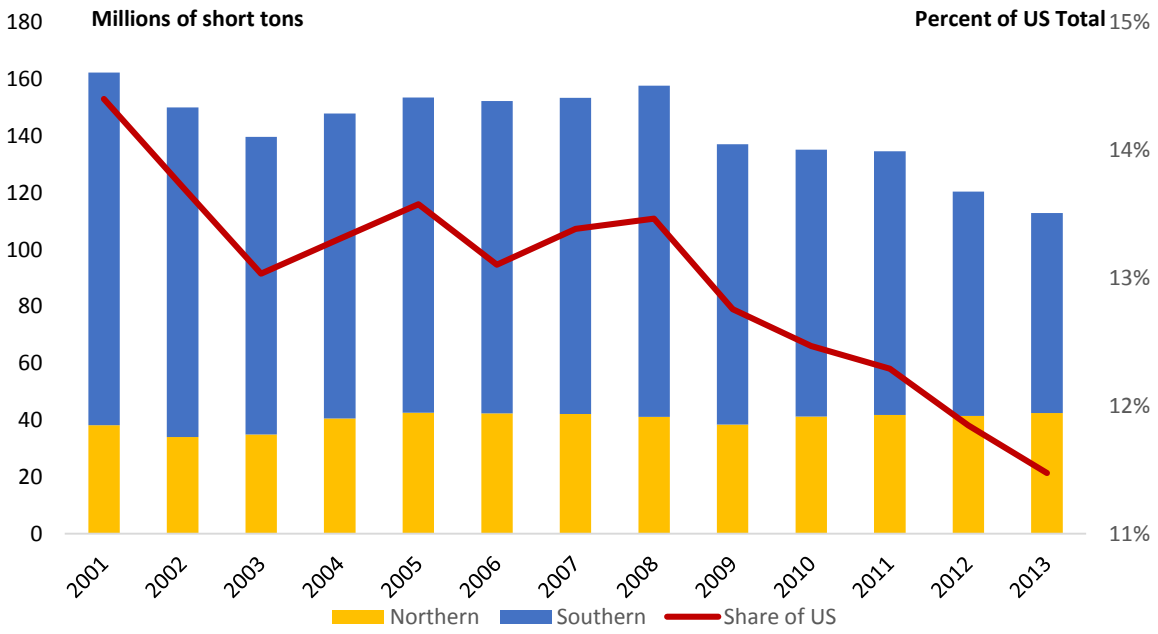
West Virginia's main Appalachian competitor, Kentucky, has also seen large declines in production over the last two years. Production in West Virginia's southwestern neighbor fell 26 percent between 2011 and 2013. Meanwhile production in the Midwest has been rising. While still small compared with West Virginia, coal production in Illinois rose by more than 38 percent in the last two years. Indiana's production also rose by about 4 percent.

A wide range of factors has contributed to the decline in the coal industry over the past two years. As in the US overall, one of the main drivers has been a reduction in the price of natural

gas as a result of the revolution in shale gas production following the advent of hydraulic fracturing techniques. West Virginia's coal mines are also seeing increased competition from mines in Illinois, which have increased production nearly 40 percent in the past two years despite a falloff in overall US coal demand.

The decline in West Virginia's coal production has not been uniform across the state. As shown in Figure 7, production in the southern part of the state, those counties that are part of the Central Appalachian coal region, fell starkly, dropping to about 70 million tons of coal in 2013 from more than 78 million tons of coal in 2012, a fall of more than 10 percent. Production in the state's northern coal counties, however, rose by nearly 3 percent in 2013 and has been stable over the past decade.

Figure 7: West Virginia Coal Production by Region



Source: US Energy Information Administration

Production declines at West Virginia's southern coal mines are tied closely to declining worker productivity, measured in short tons per worker-hour. Productivity at the state's southern mines

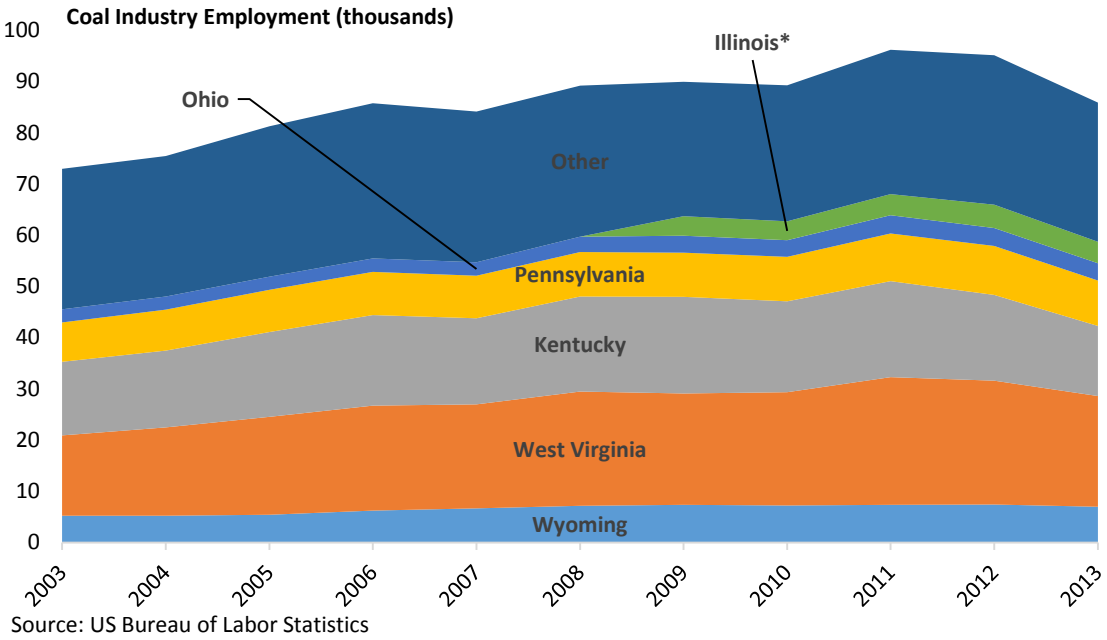
dropped by more than half to about 2 tons per worker-hour in 2014, down from nearly 5 tons per worker-hour in 2000, a decline of almost 6 percent per year on average. The decline was significantly faster than in the United States overall, where productivity fell 1.9 percent per year on average over the same period. Productivity at West Virginia's northern coal mines fell to 3.3 tons per worker-hour in 2014 from 4 tons per worker-hour in 2000, a drop of 1.3 percent per year on average.

3.1 Coal employment

Though West Virginia lags Wyoming in terms of coal production, the state has the highest concentration of coal industry employment among US states (see Figure 8). This is primarily driven by the fact that West Virginia has mostly underground mines, which exhibit a higher degree of labor intensity compared with surface mines. The state's coal industry employment, including mining and support services, totaled more than 21 thousand workers in 2013, representing more than one-quarter of all coal industry employment in the country. Because of

this concentration, West Virginia's coal industry saw more jobs losses than most of the rest of the country recently. Between 2011 and 2013, coal industry employment fell by 13 percent.

Figure 8: US Coal Industry Employment by State (2003-2013)



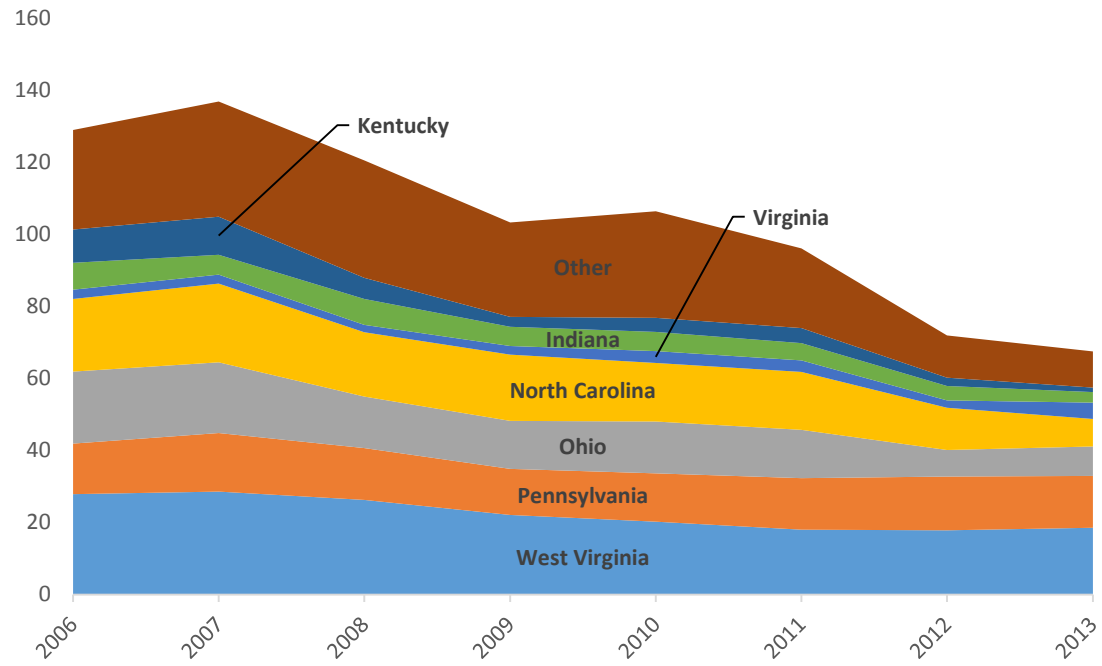
West Virginia outperformed Kentucky over the last two years, however. Kentucky's coal industry employment fell by 27 percent between 2011 and 2013. Employment in other major producing states, such as Wyoming, also fell but at a slower pace. Wyoming's coal industry employment fell by about 5 percent in the last two years, which is similar to the reductions in Pennsylvania and Ohio. Despite large gains in production, Illinois coal industry employment was essentially unchanged from 2011 to 2013.

3.2 Coal Sales

West Virginia sold its coal in nearly half of the US states and in 41 countries in 2013. The state's primary market in 2013 was inside the United States, where it sold about 68 million tons out of the 113 million tons produced in 2013. Figure 9 depicts the destination US states for West

Virginia coal. The state's biggest market was West Virginia itself, with about 18 million tons of West Virginia coal consumed within the state, constituting more than a quarter of the state's domestic sales. Other major consumers of West Virginia coal include Pennsylvania, Ohio, North Carolina, and Virginia, which together comprise more than half of the remaining coal volume. Overall, the large majority of West Virginia's coal is sold either to contiguous states or within the nearby region. Very little of the state's coal is sold in the western half of the United States, where Wyoming coal tends to dominate.

Figure 9: West Virginia Domestic Sales by State

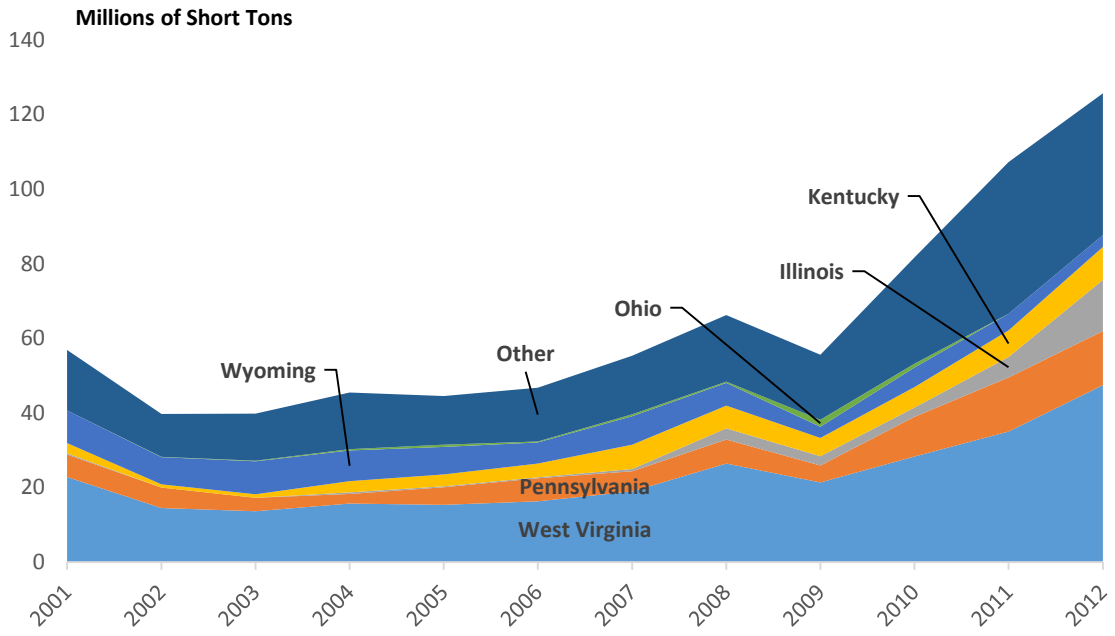


Source: US Energy Information Administration

Foreign sales of West Virginia coal totaled 47 million tons, making the state the largest foreign exporter of coal in the United States, accounting for nearly 40 percent of the nation's coal exports (see Figure 10). West Virginia coal has represented the largest share of US exports for several years, and that share has risen since 2009. West Virginia exports all over the world, with the Netherlands and Italy typically ranking first and second in export volume. In recent years, however, West Virginia has seen increased exports to several rapidly growing countries such as

India, Brazil, and China. In 2012, India received nearly 10 percent of West Virginia's export volume, making it the third-highest receiving country.

Figure 10: US Coal Foreign Exports by State of Origin (2001-2012)



Source: US Energy Information Administration

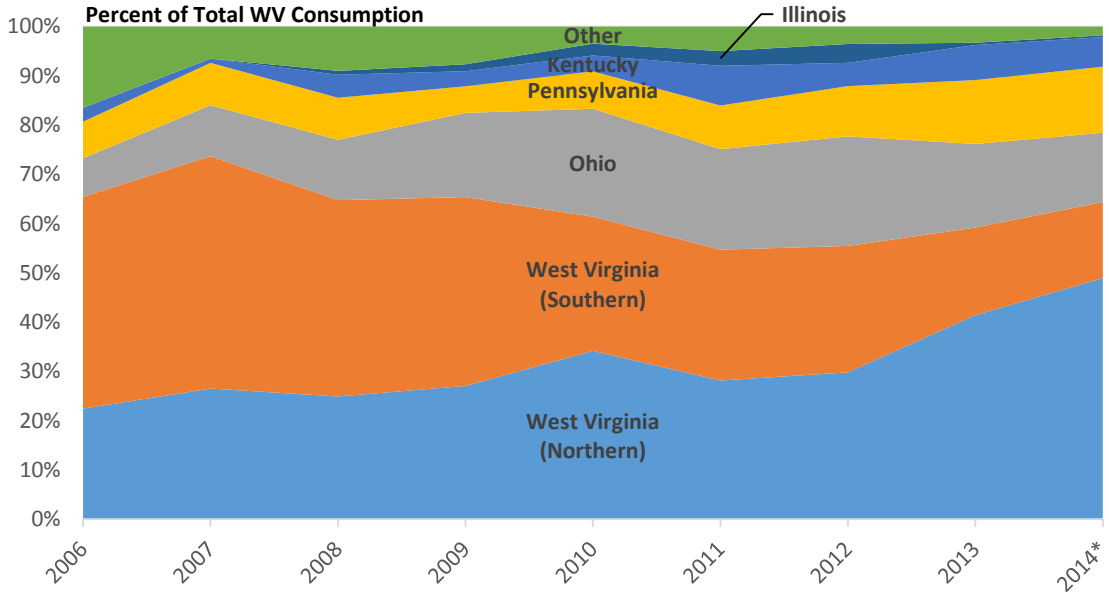
Although tonnage statistics are not available for 2013, trade data indicates that foreign exports from West Virginia fell in that year. The value of West Virginia's minerals and ores exports, of which coal is a part, dropped nearly 40 percent in 2013 from 2012 levels. The falloff in foreign exports contributed to an overall slide in coal production in the state. Pennsylvania and Kentucky both saw increases in the value of their minerals and ores exports, rising 62 percent and 15 percent, respectively, during the same period.

3.3 Coal Imports

Despite West Virginia's role as a coal exporter, electric utilities in the state, seemingly paradoxically, actually import a large portion of the coal they consume from other states. In 2013, out of approximately 31 million tons of coal consumed in the state, 12.8 million tons of

coal, or more than 40 percent, came from outside West Virginia. In Figure 11, we illustrate the state of origin for all coal consumed in West Virginia. Most of this imported coal came from Pennsylvania and Ohio, with smaller shares from Kentucky, Illinois, and Maryland, among other states.

Figure 11: Share of WV Coal Consumption by State of Origin



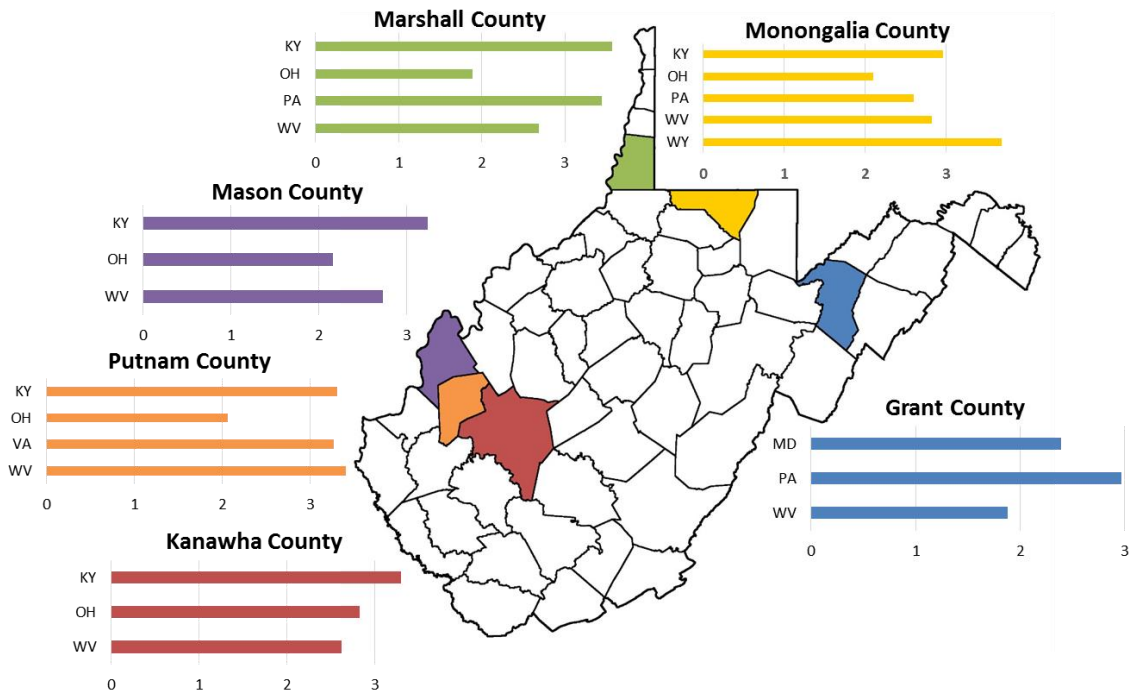
Source: US Energy Information Administration
* Note 2014 data is complete through first quarter.

The figure also illustrates an interesting dynamic over the past several years. While coal from West Virginia has represented around 60 percent of total production over the entire period, Northern West Virginia coal has taken on a larger share of the state's consumption over time. Northern West Virginia coal rose to more than 40 percent of total coal consumption in 2013, up from 30 percent in 2012, while Southern West Virginia's share of coal consumption declined to 18 percent in 2013 from 26 percent in 2012.

3.4 Coal prices

Price is one factor in explaining why West Virginia utilities import coal from out of state. In Figure 12 we illustate the price of coal, by state of origin, for each of the six counties in West Virginia with substantial electric generation, and thereby, substantial coal consumption. As illustrated, in several cases West Virginia coal is more expensive than that of other states. Prices for West Virginia coal delivered to power plants in the state average about $2.92 per million BTU. This is 8 percent above the average price of all coal consumed in the state, and nearly 40 percent higher than the average Ohio price.

Figure 12: Delivered coal prices by origin state and destination county (2012)



Note: Data is mean delivered price of coal to WV power plants by origin state ($/MMBtu).
Source: US Energy Information Administration Form-923. Some county data unavailable.

Some of the price differentials are even higher for utilities served by barge transportation. In Putnam County, for example, the John Amos Power Station gets most of its coal from a single

mine in Belmont County, Ohio. There the delivered price of the Ohio coal was nearly 40 percent lower than West Virginia coal delivered to the same plant in 2012. The Ohio mine, Powhatan Number 6, is a very efficient surface mine that is able to sell its coal for significantly less than other mines in the area. As we discuss in Section 6, below, this large price differential has important implications for how effective we can expect the state's incentive policies to be in driving demand for locally produced coal.

4 Taxes

Many of the policy options readily available to state government that could potentially affect the market for coal operate through the tax system. This section details the tax policies that relate to the coal industry and likely their affect coal outcomes. There are two primary taxes that impact the coal industry: the natural resources severance tax, which directly impacts mining, and the state business and occupation (B&O) tax, which is levied on utilities.

4.1 Severance taxes

Severance taxes are levied on the gross receipts of businesses that engage in the extraction of natural resources within the state. They are designed to provide revenues to the state in exchange for the right to "sever" these resources from the land under the state's jurisdiction.

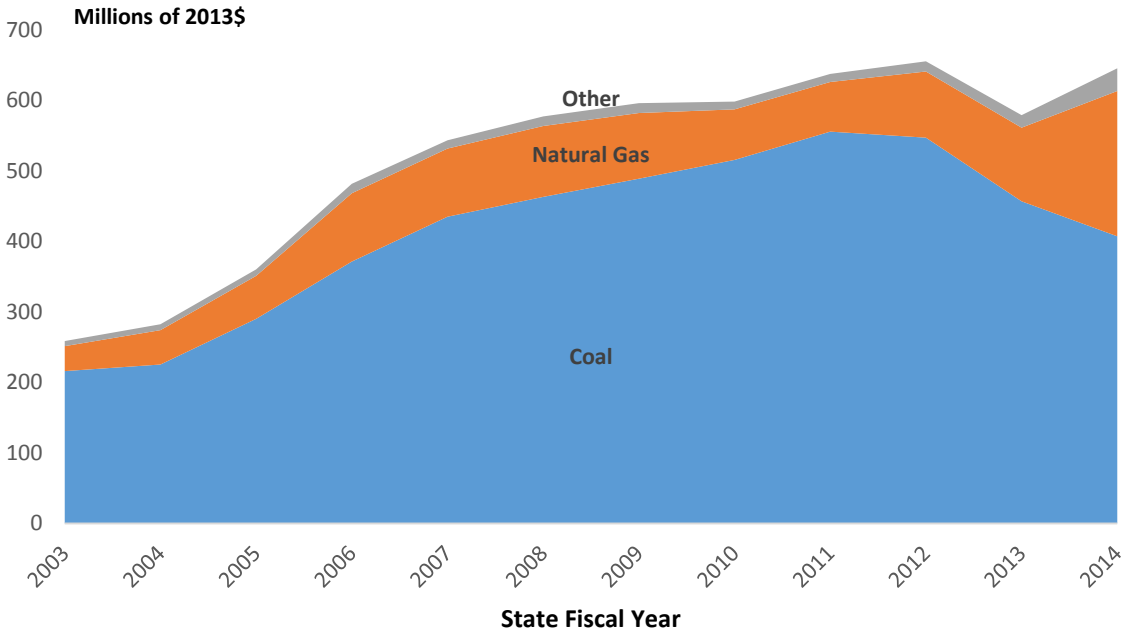
In West Virginia the baseline severance tax rate for coal is 5 percent of the gross receipts of companies that engage in mining activities within the state, with a minimum tax rate of 75 cents per ton of coal. An additional surtax of 56 cents per ton is levied to pay down debt in the West Virginia Workers' Compensation Debt Reduction Fund incurred when the system was privatized in 2006. This tax is time limited to expire when the debt is repaid, currently estimated in 2017.[2] Severance taxes are also levied on other types of natural resources, including oil and gas, logging, and other minerals and ores. Because the severance tax is based on the market value of the severed resource, revenues can fluctuate due to variations in both production and price.

After rising steadily for a decade, severance tax revenues (including oil and gas) peaked in 2012 at more than $655 million in inflation-adjusted terms (see Figure 13). Revenues then fell about 12 percent in fiscal year 2013, but were up again in fiscal year 2014 by about the same percentage, ending slightly lower than in 2012. Coal severance tax revenues, however, were down significantly over the last two years, falling to $407 million, which represents a decline of

[2] "West Virginia Comprehensive Annual Financial Report." Charleston, WV: West Virginia Department of Administration Finance Division, 2013. http://www.wvfinance.state.wv.us/CAFRGAP.HTM

more than one-quarter from the 2012 level. Natural gas severance tax revenues made up most of the slack created by coal tax revenues, more than doubling to more than $206 million in 2014 from $94 million in 2012. Severance tax revenues from other sources, such as timber, oil, and other minerals, also increased to $32 million in fiscal year 2014, up more than 81 percent from 2013.

Figure 13: West Virginia Severance Tax Revenues (2013$)



Source: Federation of Tax Administrators

4.2 Business and Occupation Taxes

West Virginia's electric utilities are subject to the state Business and Occupation Tax. Utilities pay a tax of $22.78 per kilowatt (kW) of taxable generating capacity (or $20.70 per kW for units with desulfurization systems) that they operate within the state. The taxable capacity is defined according to the nameplate capacity of the generating units multiplied by the plant's average capacity factor in the first four years of operation (or 1991-1994 for those plants in operation before the tax was introduced). As an incentive for new capacity construction, new electric generation capacity built after 1995 is taxed on only 40 percent of its taxable capacity.

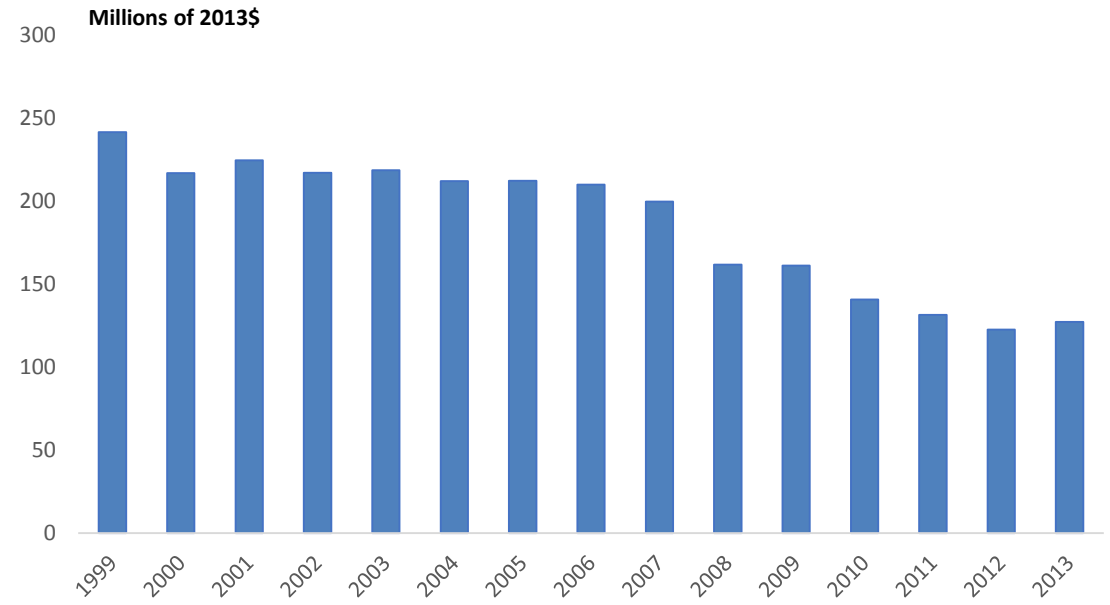
Prior to 1978, West Virginia levied a gross receipts tax on all electricity sold in-state at a tax rate of 5.25 percent of the value of the electricity. Electricity exports were taxed at the manufacturing rate of 0.88 percent. This structure changed in 1978, when the B&O tax rate was reduced to 4 percent and applied to all electricity generation. In 1989, the state Legislature changed the B&O tax from a gross receipts tax to a tax on electric power generation. The tax rate was 0.2 cents per kilowatt hour (kWh) generated, and rose to 0.26 cents per kWh in 1990. Beginning in 1995, the B&O tax was changed to its current system of taxing capacity.

Taxing the capacity of the utilities has two unusual impacts. One, because the majority of electricity generated in West Virginia is sold out of state, the tax generates revenue from power that is exported to other states. Second, utilities face the same tax liability regardless of how much electricity they produce because the tax does not take into account the current capacity factor of the plant.

B&O taxes have fallen consistently since they were enacted in their current form (see Figure 14). Inflation-adjusted B&O tax revenue fell from more than $241 million in fiscal year 1999 to about $127 million in fiscal year 2013, a drop of nearly half. The biggest drop came during the

2007-2009 recession, when B&O taxes fell more than 19 percent between 2007 and 2008, and have yet to recover.

Figure 14: Business and Occupation Tax Revenue (1999-2013)



Source: WV Budget Office

The falloff in B&O tax revenue is largely attributable to the installation of environmental control equipment at West Virginia's power plants. The installation of sulfur dioxide scrubbers and other technologies affected revenue through two channels.[3] The first was that utilities claimed up to 10 percent credit on the installation cost of these systems under the Industrial Expansion and Revitalization Credit (IERC). IERC claims rose to $52.6 million in 2013, from $17.6 million in 1999. Secondly, utilities with desulfurization systems also pay a lower tax rate on generating capacity. By 2013, all major coal-fired power generating units had desulfurization technologies, and were paying the lower rate outlined above.

[3] Tax credit data provided by the West Virginia Department of Revenue.

4.3 Other Types of Taxes

In addition to the taxes above, all corporations that have a physical presence in West Virginia are subject to the Corporation Net Income Tax (CIT) of 6.5 percent of taxable income apportioned to the state. Corporations also currently pay a 0.1 percent business franchise tax on capital. However, this tax is set to be phased out in 2015.

4.4 Comparison with Nearby States

West Virginia and neighboring states levy a variety of taxes on natural resource extraction and electricity generation. Table 2 provides details on the types of severance taxes and utility taxes in West Virginia and contiguous states. Four of the six states levy some form of severance tax on coal extraction. Taxes are utilities are more varied. West Virginia levies a tax on capacity, while others states levy taxes on gross receipts or on electricity sales volume.

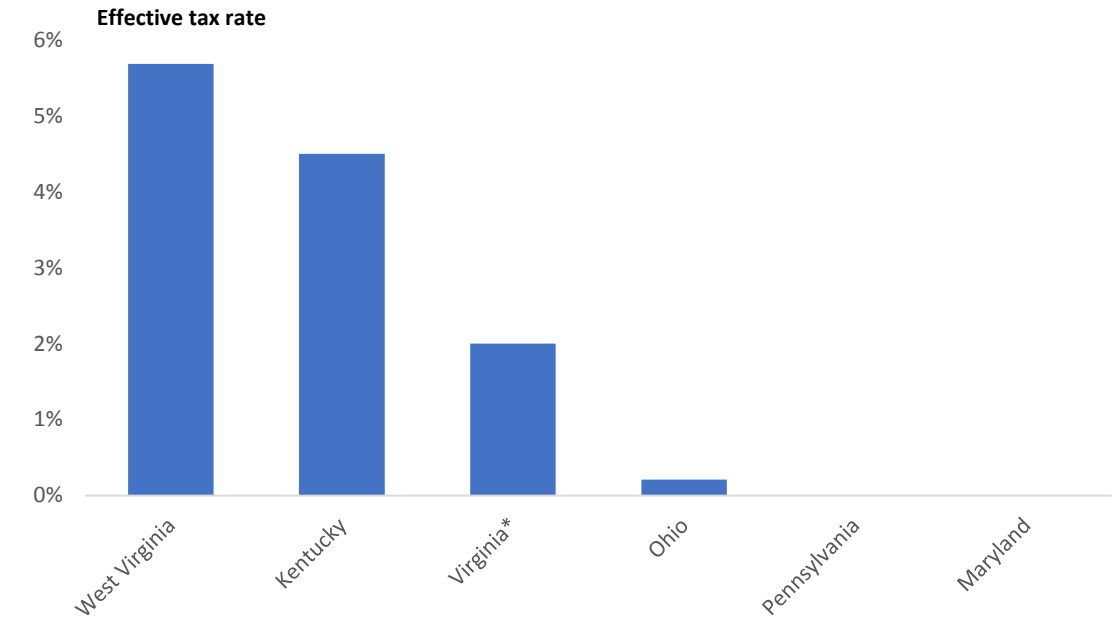
Table 2: Base Tax Rates for WV and Contiguous States

	Severance Taxes	Utility Taxes
West Virginia	5 percent of gross value plus 56 cents per ton	Business and Occupation tax: $22.78 per kW of generating capacity
Pennsylvania	None	Gross receipts tax: 4.5 percent
Ohio	10 cents per ton	Kilowatt hour tax: 0.465 cents per kWh (residential)
Kentucky	4.5 percent of gross value (minimum 50 cents per ton)	Gross receipts tax: 3 percent
Virginia	Maximum of 2 percent levied by 8 local governments	Electricity consumption tax: 0.152 cents per kilowatt hour (residential)
Maryland	None	Franchise tax: 0.062 cents per kilowatt hour

Figure 15 depicts the effective severance tax rates for West Virginia and contiguous states. Both Kentucky and Ohio levy severance taxes, though their rates differ from West Virginia. At 4.5 percent of the gross value of coal, Kentucky's severance tax is similar to West Virginia's. Ohio's is considerably lower, at 10 cents per ton, which amounts to an effective rate of approximately 0.2 percent, based on the average market price of Ohio coal. Pennsylvania does not levy

severance taxes. Virginia does not have a statewide severance tax, but does allow local governments to levy severance taxes. As of 2013, one independent city and seven counties in Virginia levied the maximum tax of 2 percent, yielding a total severance tax revenue of $2.1 million.

Figure 15: Effective Severance Tax Rates by State

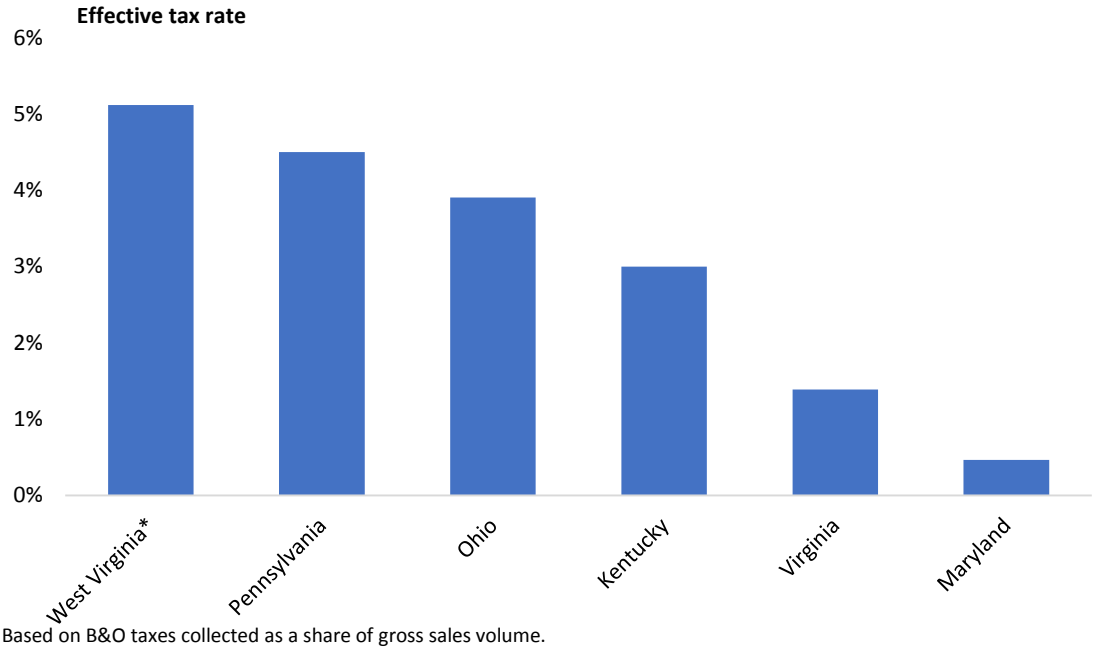


Source: Author calculations based on individual state tax codes.

Taxes directly affecting utilities also vary by state (see Figure 16). Pennsylvania taxes the gross receipts of utilities at 4.5 percent, while Ohio has a specific property tax rate for public utilities

of 7.7 percent. Kentucky, Virginia, and Maryland do not have specific taxes for utilities, though they pay other business taxes not specifically aimed at electric power generation.

Figure 16: Effective Utility Tax Rates by State



* Based on B&O taxes collected as a share of gross sales volume.

5 Existing Policy Incentives for Coal Production

West Virginia and neighboring states have various policies in place to incentivize the consumption of locally produced coal. Many of these policies act by lowering production costs for coal mines, allowing them to reduce the price they charge for coal and thus providing incentives for utilities and other buyers to switch suppliers to locally produced coal. These supply-side policies could be enacted through various taxes, but in West Virginia the most common has been through the severance tax code, as this likely has the most direct impact on coal production.

5.1 Severance tax policies

West Virginia currently has three primary policies in place that reduce severance taxes as a way to promote coal production. As detailed above, the baseline severance tax rate on coal is 5 percent of the sale price. None of these policies relates to whether the purchaser is in-state versus out-of-state, however, so they do not provide any incentive for in-state utilities to favor West Virginia coal. The policies are as follows:

- **Thin Seam Preference**: Mines that tap thin seams smaller than 45 inches in width can receive a severance tax reduction. The tax varies by thickness, with seams between 37 and 45 inches being taxed at a rate of 2 percent, and seams less than 37 inches being taxed at a rate of 1 percent. This law is intended to provide an incentive for coal producers to extract less-productive coal seams. This incentive is estimated to reduce severance tax revenue by approximately $75 million per year, assuming no change in behavior on the part of coal producers.
- **Waste coal tax rate preference**: Coal produced from gob and coal waste is subject to a tax reduction of 2.5 percentage points, thus reducing the severance tax by half. This credit is intended to provide an incentive to utilize coal that would otherwise be a by-product of the production process.

- **Coal loading facilities credit**: West Virginia also provides a credit to coal companies on their severance tax of 10 percent of the cost of new coal loading facilities. The credit must be spread over 10 years, with coal companies receiving one-tenth of the credit each year. The tax can only offset up to 50 percent of the total B&O tax in that year.

One proposal for a type of tax deduction that would provide additional benefits for coal sold within the state was introduced in the 2014 legislative session as the West Virginia Coal Employment Enhancement Act (Senate Bill 604/House Bill 3072). Though the bill was not passed into law, it would have created a new tax incentive for sale of coal mined within West Virginia to power producers and industries that consume the coal within the state. This tax incentive is similar to an inactive policy that was in place in Ohio until 2010, which provided a severance tax reduction for the use of Ohio coal in coal-fired generating units. The major provisions of the West Virginia bill were:

- Reduce the state's severance tax by up to $3 for every ton of coal sold to eligible consumers (utilities and industries) above the amount sold in the base year of 2013. This would amount to approximately a 4.8 percent tax credit based on the 2012 average market price for coal delivered to the state's power plants of $62.50 per ton.[4]
- Regulated utilities purchasing coal at the reduced price would be obligated by the Public Service Commission to pass along those reduced prices to end consumers.

5.2 Utility Taxes

While severance taxes are based on the supply of coal, another possible avenue for stimulating coal production would be to provide incentives for utilities to buy more in-state coal. Currently West Virginia does not have any policy in place that directly affects the purchase of in-state coal. However, the state does offer utilities a tax credit for new generating capacity. Any capacity built after 1995 is taxed at 40 percent of the usual B&O tax rate. This tax incentive applies to any type

[4] Average market price data provided by the West Virginia Public Service Commission.

of capacity, and does not require the utility to purchase fuel from within the state, so it does not necessarily increase demand for local coal. But it does provide incentives to build new generating capacity that could use local resources.

Three neighboring states offer tax credits that directly incentivize local coal demand. Maryland and Virginia offer a $3 per ton tax credit for utilities buying in-state coal. Kentucky offers a $2 per ton credit for any amount of coal above the level purchased in the base year when it was enacted. West Virginia could implement a similar tax that would be deducted from the in-state utilities' B&O tax liability. Establishing an incentive similar to Kentucky's would also be revenue-neutral.

6 Policy Impact

In this section we examine the potential impact of two policy options to stimulate demand for West Virginia coal from utilities in the state. We begin by discussing the two potential policies in detail. We then discuss the maximum potential impact we could expect given logistical constraints in the electric power sector. We then provide an overview of the modeling techniques we used to determine the expected impact of the policies.[5] Finally, we estimate the likely impact of each policy on the state's economy through 2030.

6.1 Potential Policies

This section details two specific policy options West Virginia could enact to promote the use of in-state coal over that produced in other states. For this report, both of the tax incentives that we consider would apply only to coal that is sold or purchased above the level of a base year, which can be set as the legislature deems appropriate.[6] By limiting the tax incentive to coal sold above the level in a base year, the tax policies would not lower taxes on coal that is already being purchased or sold in the market. The tax incentives would only incentivize new coal sales or purchases that would not have taken place were the tax credit not in effect.

Though the policies have been structured to minimize potential reductions in state tax revenues, these policies are not necessarily revenue neutral. The choice of the base year is likely to have a significant impact on the magnitude of the tax incentive. Coal demand fluctuates from year to year based on a wide range of factors unrelated to state tax policy. If the level of coal consumption in the chosen base year is too low, the state could subsidize demand gains that would have happened without the benefit of the subsidy. Secondly, retaliatory policies in other states could lower total demand for West Virginia coal even as the policies increased in-state demand. Lastly, as these policies likely would be implemented by individual utilities, tax

[5] For a more detailed explanation of the coal market model used, please see the Appendix.

[6] The policy model assumes a base year of 2012; required data for 2013 are not yet available.

planning strategies could result in some companies increasing their consumption of West Virginia coal and claiming a tax credit, while others reduce their demand, leaving the total consumption the same or lower. Because of these considerations, the results of the coal demand model described in the next section reflect only those impacts relative to a baseline case that assumes no changes in the market other than the considered policies.

6.1.1 Option 1: Fixed Dollar per Unit Tax Credit

One possible way to structure a tax credit would be a tax deduction based on a fixed dollar amount per ton of coal. This incentive could be implemented as either a severance tax deduction or as a credit to utilities on their B&O taxes. Under several important assumptions, economic theory suggests that whether the tax credit ultimately applies to the coal producer or the coal consumer is irrelevant in determining the resulting change in the quantity of coal produced.

Specifically, we consider a per-unit tax incentive similar to the West Virginia Coal Employment Enhancement Act proposed to the state legislature in 2014. We model a $3 per ton credit to the severance tax for coal producers. This credit would constitute approximately a 4.8 percent reduction in the price of coal at the average 2012 market price of $62.50 per ton. As in the 2014 proposal, this credit would apply only to the amount of coal purchased above the amount in the base year, which we set to be 2012 for modeling purposes. As discussed above, a $3 per ton subsidy for utilities would likely produce virtually identical results.

6.1.2 Option 2: B&O Tax Credit Equivalent to 5 Percent of the Cost of Coal

The second policy we consider is designed to increase demand for West Virginia coal from utilities, the primary consumers of the state's coal. Specifically, this credit would provide a tax credit equal to 5 percent of the cost of West Virginia coal purchased by the utility. The tax would be applied to utilities' B&O taxes, again with the stipulation that the credit applies only to units of coal above that purchased in the base year of 2012. We chose 5 percent in order to compare the impact of this policy with the severance tax reduction in Option 1.

6.2 Potential Policy Impact

As mentioned above, West Virginia imported about 13.6 million tons of coal in 2012, which represented approximately 45 percent of total coal consumption in the state that year. The amount of coal imported to West Virginia utilities represents the potential market for policies designed to increase consumption of West Virginia coal within the state. If West Virginia could introduce a policy that would encourage in-state utilities to replace some or all of this imported coal with West Virginia-produced coal, it would potentially increase coal production in the state by as much as 11 percent. However, it is unlikely that West Virginia coal producers could capture this entire upper bound for several reasons, as outlined below.

In some cases it is unlikely that a policy change would entice some West Virginia coal consumers to switch from out-of-state coal providers because their decision to buy coal from a particular source is primarily driven by logistical reasons, rather than price considerations. Consider the following examples:

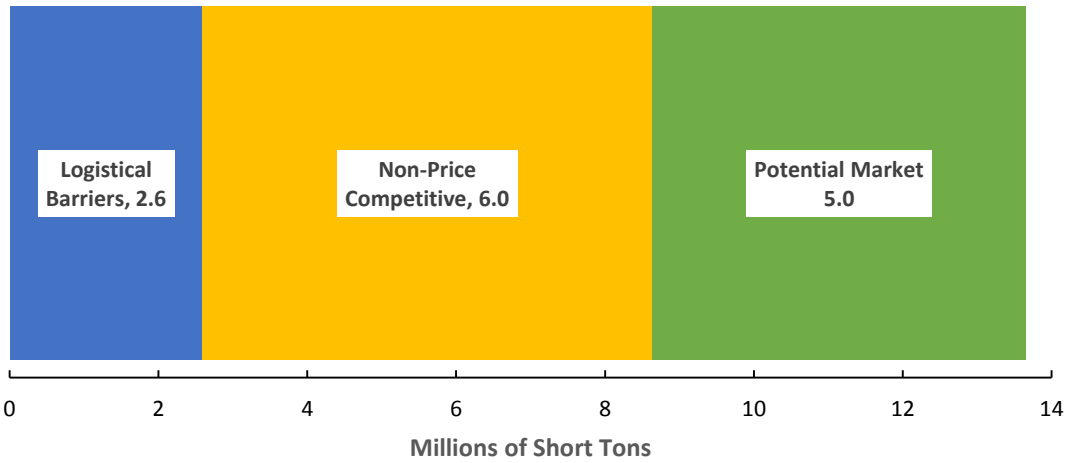
- About 1.7 million of the 3.3 million tons of coal imported from Pennsylvania in 2012 was transported by conveyor to the Longview Power Plant in Monongalia County. This power plant buys coal exclusively from mines that are also owned by its parent company First Reserve Corporation through its subsidiary Mepco Holdings. Because of this relationship, it is unlikely that any reasonable tax incentive would induce Longview to switch to an in-state provider.
- Mount Storm power plant in Grant County has a similar supplier situation. The plant is largely supplied by the Mettiki General processing plant in neighboring Garrett County, MD. Of the more than 3.2 million tons of coal used at the plant in 2012, about 885 thousand tons from Maryland, was processed at the Mettiki plant and then transported by truck to the power plant.

Additionally some mines in other states, particularly in eastern Ohio, enjoy significant cost advantages over their competitors in West Virginia. Coal from American Energy's Powhatan

surface mine in Belmont County, OH, cost the John Amos power plant in Putnam County and the Mountaineer plant in Mason County about $2 per MMBtu in 2012, which is as much as 40 percent lower than other mines that served those plants. These two power plants purchased nearly 3.3 million tons of coal from the Powhatan mine in 2012. The FirstEnergy Pleasants Power Station in Pleasants County purchased the remaining 2.7 million tons of coal imported from this mine, but prices were not available for this plant. Any change in state tax policy is unlikely to be of the magnitude needed to make West Virginia's coal cost-competitive with this particular Ohio mine.

After taking into account these market conditions, we have identified more than 8.6 million tons of coal imports that are unlikely to be displaced by a statewide policy intervention. As depicted in Figure 17, this leaves approximately 5 million tons of coal as the target for tax incentives. If the state were able to capture this entire amount, it would potentially increase total state production by about 4 percent per year.[7]

Figure 17: Share of Imported Coal Potentially Captured by WV Producers (2012)



Source: Author Calculations based on data from the US Energy Information Administration

[7] These numbers are for illustrative purposes only. We did not constrain the coal market model to limit the impact to this potential market.

6.3 Impact Model

In order to calculate the economic impact of the policies that we consider, we first establish a model of the state's coal market.[8] This partial-equilibrium framework uses standard supply and demand curves to characterize the coal market in the state. We then introduce a change in the effective price for coal that would result from the tax incentives described above and calculate the change in demand for West Virginia coal relative to coal from other states. The coal market model uses standard assumptions common in economic models. In particular, we assume that there are no market imperfections that would prevent buyers and sellers from meeting a new equilibrium once the subsidy is introduced.

We also assume that the supply and demand equations are defined by constant elasticity equations. Elasticity is an economic concept that measures how a percent change in one variable – usually the price – is related to a percent change in another – in this case quantity. In other words, it represents the responsiveness of the quantity demanded or supplied to a change in the price. A constant elasticity curve assures that the same percentage change in price at any point along the curve results in the same percent change in quantity.

A market model requires two measures of elasticity: elasticity of supply and elasticity of demand. The elasticity of supply for our model was derived from the long-run estimate of elasticity in a study of the Australian coal market.[9] Based on the results in this study, it is assumed to be 1.9, meaning that a 10 percent increase in the price of West Virginia coal leads to a 19 percent increase in the quantity of coal supplied. This elasticity indicates that coal suppliers are highly responsive to changes in the price of coal.

The elasticity of demand was more difficult to determine, as there were no published measures of elasticity of substitution between coal produced in West Virginia and coal produced outside the

---

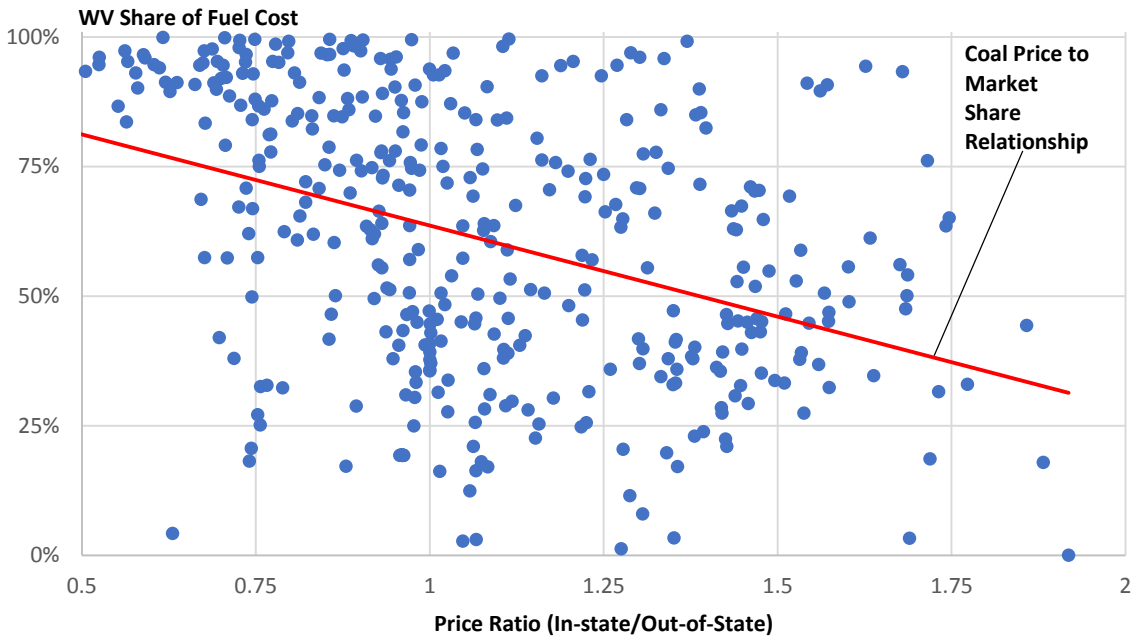
[8] See the Appendix for more information on the supply and demand model used for this report.

[9] http://data.daff.gov.au/brs/data/warehouse/pe_abarebrs99000210/tp91.1_black_coal.pdf

state. Instead we derived the elasticity of demand used in the model using regression methods. We gathered power plant data from the US Energy Information Administration for the years 2008 to 2013,[10] and then estimated several econometric models to determine how responsive the share of coal demand served by West Virginia mines was to a change in the price of in-state coal.

Figure 18 depicts the relationship between the relative fuel price of in-state coal vs. out-of-state coal, and the share of coal demand served by West Virginia mines. What is apparent from the chart is that utilities are not very responsive to price changes in the market. Even large changes in the relative price result in relatively small changes in the market share for WV coal mines.

Figure 18: Relationship of Coal Price to WV Share of Coal Consumption



Source: Author calculations based on data from the US Energy Information Administration

Our results produced a small range of reasonable elasticity estimates based on slightly different empirical methodologies. The elasticity estimates derived from our model range from -0.32 to -

[10] http://www.eia.gov/electricity/data/eia923/

0.44, meaning that a 10 percent decline in the price of West Virginia coal leads to an increase in the quantity of coal demanded of between 3.2 and 4.4 percent. The economic impact results found in this study are highly dependent on these elasticity estimates. A higher estimate of elasticity of either supply or demand would result in a larger economic impact.

We have structured the model assuming that any policy impact will only affect new demand or supply of coal. This ensures that existing demand will be taxed at the same rate as it has in the past. Also, in each case we assume that the price and supply relationships in the demand and supply curves will remain the same once the policies are implemented. This assures that the market for any new coal behaves the same as existing coal, which is important for our quantity and price forecasts.

Using the coal market model we estimate the expected gain in West Virginia coal production from each of the policies we consider in this report. This increase in coal production will directly increase the state's economic output in the affected industries. This part of the impact is called the direct impact. However, it is not the only economic benefit generated for the state as a result of this policy. As coal production increases, the companies supplying inputs for coal production will also increase production. Similarly, as these suppliers increase production, their subsequent suppliers will increase production, and so on. Finally, some of those increases in the workers' income will be spent back into the state economy, generating more output, income, and employment impact. These secondary impacts together form what is known as the "multiplier effect." The original stimulus to the economy from the tax subsidy is re-spent multiple times through the rest of the economy. The combined direct impact and secondary impacts together constitute the total economic impact of the policy.

To estimate the total economic impact of each policy, we employ the REMI PI+ model of the state's economy[11] to forecast the potential economic gains from the tax subsidies. REMI is a

[11] For more on the REMI model see the web page for Regional Economic Models, Inc.: http://www.remi.com/

widely used structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric analysis, and economic geography methodologies. The input-output components define the inter-industry relationships, which specifies what and how many inputs are required to produce one unit of certain output. The model accounts for the feedback effects that come from the market once the initial impact runs through the goods-services market and resources (capital and labor) market. This represents the dynamic aspect of the model as it allows the impact to evolve over time as it responds to the market forces. The model also takes into account agglomeration effects, which recognize the effect of output or firm size to accessibility to resources. This will affect the average production costs, and in turn the amount of outputs produced. In short, this model offers a more comprehensive, and accordingly more realistic, method of measuring an economic impact than the stand-alone model such as input-output, general equilibrium, or econometric model.

6.4 Direct Impact of the Policy Options

This section outlines the direct impact of the two policy options modeled in our coal market model and REMI. For each of the modeled policies, we consider two primary impacts: the impact on coal production, and the impact on electricity rates.

For coal production we forecast the increase in demand we can expect if the policy is implemented using our coal market model. We then calculate the direct impact of the policy as the increase in production multiplied by the new equilibrium price for coal in that market.

To calculate the impact on electricity rates, we assume that the entire benefit of each policy is passed along to consumers in the form of lower utility rates.[12] However, a reduction in fuel costs does not necessarily translate into an equivalent reduction in electricity rates. Utilities have a number of costs other than fuel that are figured into the price of electricity, such as labor costs,

[12] As outlined above, this is one of the requirements of the severance tax reduction legislation in 2014.

maintenance, and financial costs. We estimate that approximately 41 percent of the total utility costs will be represented by fuel.[13]

Also, fuel prices are determined in a market, so the subsidy will impact both buyers and sellers in the transaction. Thus even if the statutory incidence of the subsidy falls on utilities, some of the economic benefit of the subsidy will flow to coal mines in the form of higher prices. Lastly, according to our policy assumptions, the subsidy will be applied only to the portion of coal above the baseline demand. We arrive at our electricity price reductions based on these calculations.

As outlined in the previous section, the first policy we consider would provide a $3 per ton – approximately 4.8 percent at the average 2012 price – severance tax credit for West Virginia mines selling to in-state consumers. The second scenario we consider would provide a tax credit equal to 5 percent of the cost of West Virginia coal for to in-state utilities. As these policies have a similar effect on the price of coal in the state, they provide direct impacts that are nearly identical to one another.

Table 3 summarizes the direct impact results from our coal market model. Depending on the elasticity used in the model, we estimate that either type of credit would result in an additional 433 to 564 thousand tons of West Virginia coal sold in the state. This would result in an output gain of between $27.3 million and $35.6 million in direct economic benefit to the state's economy each year. Electricity prices would be expected to fall by about 0.02 percent. And

[13] Author calculations based on EIA. "Electric Power Annual." US Energy Information Administration, 2013. http://www.eia.gov/electricity/annual/

employment in the coal mining industry is expected to rise between 57 and 75 jobs as a direct result of the gains in production.

Table 3: Summary of Direct Impact

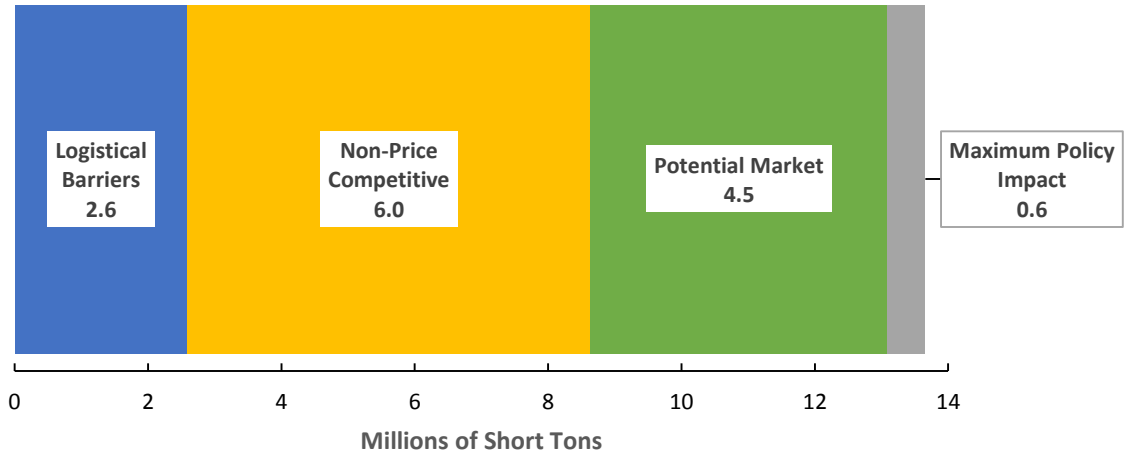
	New Equilibrium		Direct Impact		
	Price per ton*	**Increase in coal quantity (thousand tons)**	**Increase in coal output value (millions)**	**Electricity price decrease**	**Coal Mining Employment Increase**
$3 Severance Tax Reduction	$62.94 to $63.08	433 to 564	$27.3 to $35.6	0.02%	57 to 75
5% B&O Tax Credit	$62.94 to $63.08	433 to 565	$27.2 to $35.6	0.02%	57 to 75

*Original equilibrium price was set to equal the 2012 average market price of $62.50 per ton.

The B&O tax credit provides a somewhat larger impact on coal sales than the severance tax reduction, a difference of approximately 700 tons. The output increase is approximately the same, coming in at $35.6 million in both cases. In either case, the policy's maximum effect on coal production will capture approximately 565 thousand tons, which is 11 percent of the potential coal imports. This direct impact is reflected in Figure 19. According to our market

model, if the state wanted to capture the remaining 4.5 million tons in the potential market, the government would have to offer a subsidy of at least 50 percent of the price of a ton of coal.

Figure 19: Estimated Policy Effect on Coal Market Share



Source: Author Calculations based on data from the US Energy Information Administration

6.5 Overall Economic Impact Results

Having estimated direct impact of each policy change, we use the REMI model to estimate the overall economic impact of each policy. As outlined above, the $3 per ton tax credit and the 5 percent B&O tax credit provide virtually identical direct impact results. Because of this, we report only one set of results with high and low points reflecting our different assumptions regarding the demand elasticity.

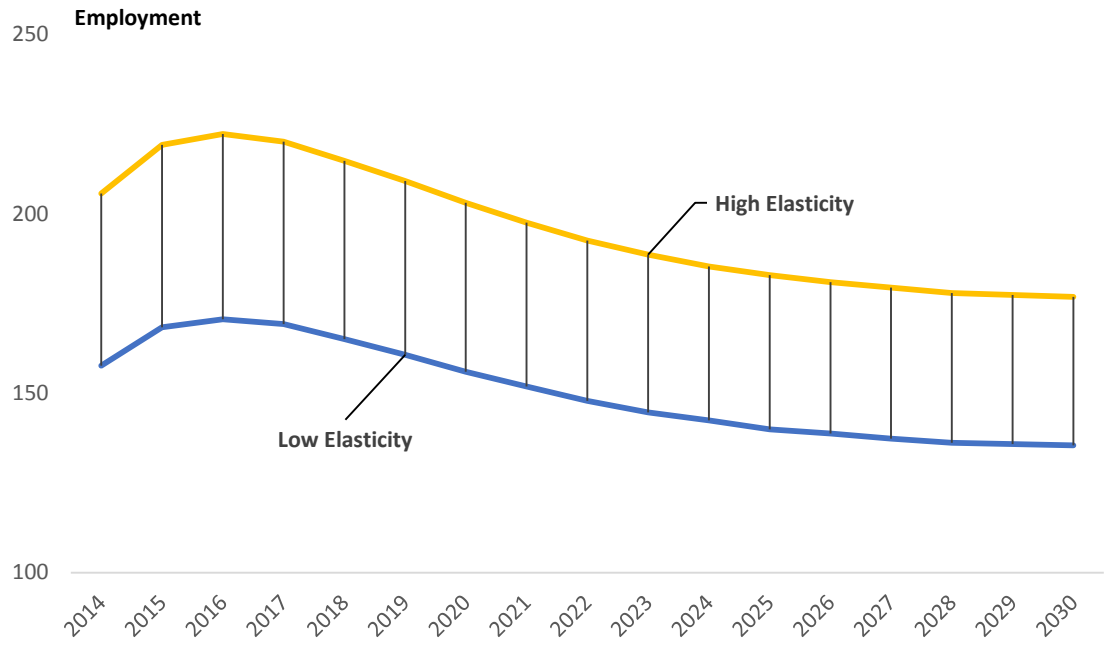
Within the REMI model we make one final assumption that affects the impact of these policies on employment. REMI generally assumes prices of goods and services, as well as wages, tend to increase over time. This, combined with possible changes in the relative price of resources (e.g. wages relative to capital or wages in coal mining industry relative to those in the other industries), can cause worker productivity to increase. Increased worker productivity has the effect of causing any policy's employment impact to decline over time as fewer workers are required to produce the same gains in output. However, as mentioned above, coal mining productivity in West Virginia has been declining for the last 15 years. To compensate for this falloff in productivity, we have held employment in the coal-mining industry constant, while still allowing the model to adjust employment in other industries for worker productivity. This has the effect of lessening the decline in employment over time.

6.5.1 Employment Impact

Figure 20 illustrates the employment impact from the two policies. As expected, the higher elasticity scenario generates the largest employment impact, resulting in a gain of 206 jobs in the first year. The lower elasticity produces an estimate of 158 jobs in the first year. The employment impact increases in the following two years, rising to between 171 and 222 jobs in 2016. These increases represent the accumulation of employment impact generated by the current year's policy and the residual employment impact generated by the previous years'

policy. In other words, it takes more than one year for the impact of a policy to completely work its way through the economy.

Figure 20: Coal Incentive Policy Impact: Employment



Source: REMI Results

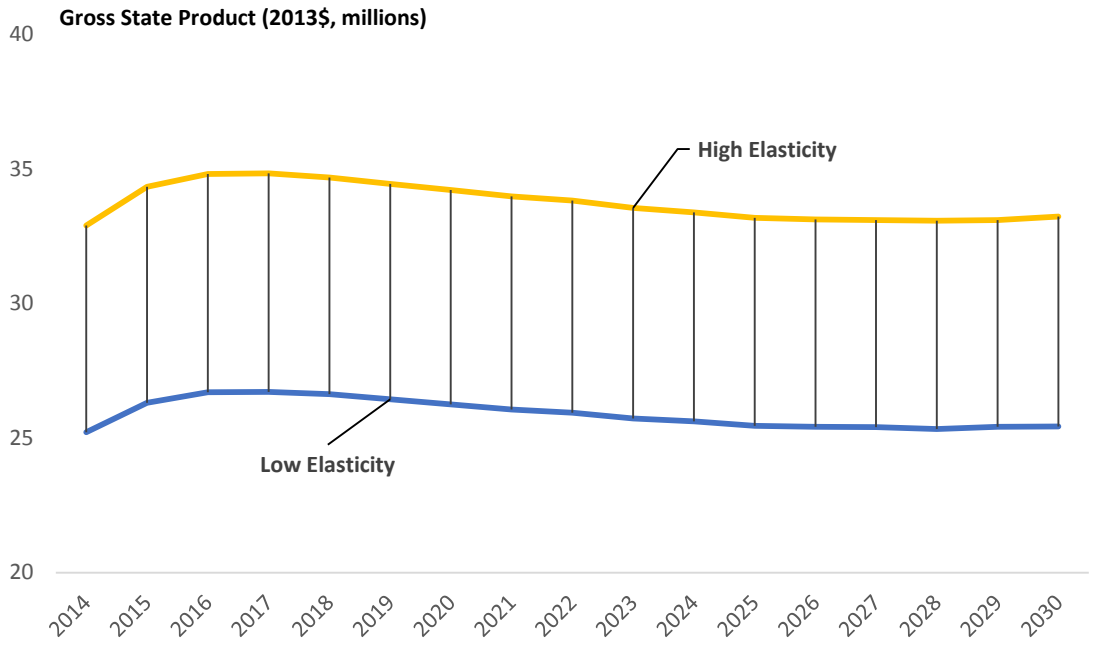
After 2016, the employment gains begin to taper off, with employment in 2030 between 135 and 177 jobs above baseline. This decline represents the impact on the economy of the continued economic growth driven by the increase in the state coal production and associated gains in worker productivity in non-mining industries.

6.5.2 Economic Growth Impact

In Figure 21 we illustrate the policies' impacts on West Virginia's gross state product (GSP). The coal incentives are expected to contribute between $25.2 million and $32.9 million to the state's GSP in the first year, depending on the elasticity assumptions. This represents a small change in comparison with the state's total GSP in 2013 of approximately $74 billion. The contribution rises through 2016, reaching between $26.7 million and $34.8 million, and then

stabilizes for most of the rest of the forecast. By 2030, the policy will contribute between $25.4 million and $33.2 million to the state's economy.

Figure 21: Coal Incentive Policy Impact: Gross State Product



Source: REMI Results

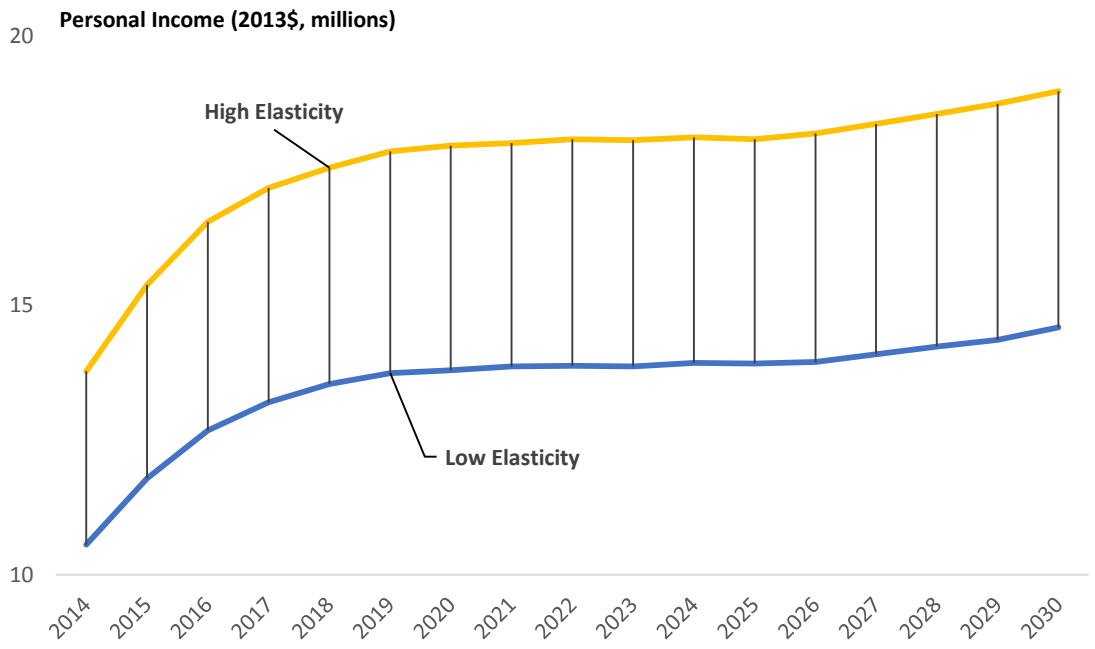
The GSP forecast is somewhat different than the employment trend, as it is expected to remain stable through the end of the forecast. This largely reflects the gains from lower utility rates, which provide a benefit to the entire economy. Also, more than half of the GSP gain is driven by increases in real wages and personal income, indicating that wages rise faster than employment decreases during the forecast horizon.

6.5.3 Personal Income Impact

Figure 22 shows the impact on the state's personal income. The coal incentives are expected to increase the state's total personal income by between $10.6 million and $13.8 million in the first year of implementation. Unlike the employment forecast, the policy's impact on personal income continues to rise through 2030, reaching a maximum in 2030 of $14.6 million in the low

elasticity scenario, and $19.0 million in the high elasticity scenario. The increase in the personal income impact represents continued gains to workers' wages, despite the diminishing employment impact toward the end of the forecast.

Figure 22: Coal Incentive Policy Impact: Personal Income

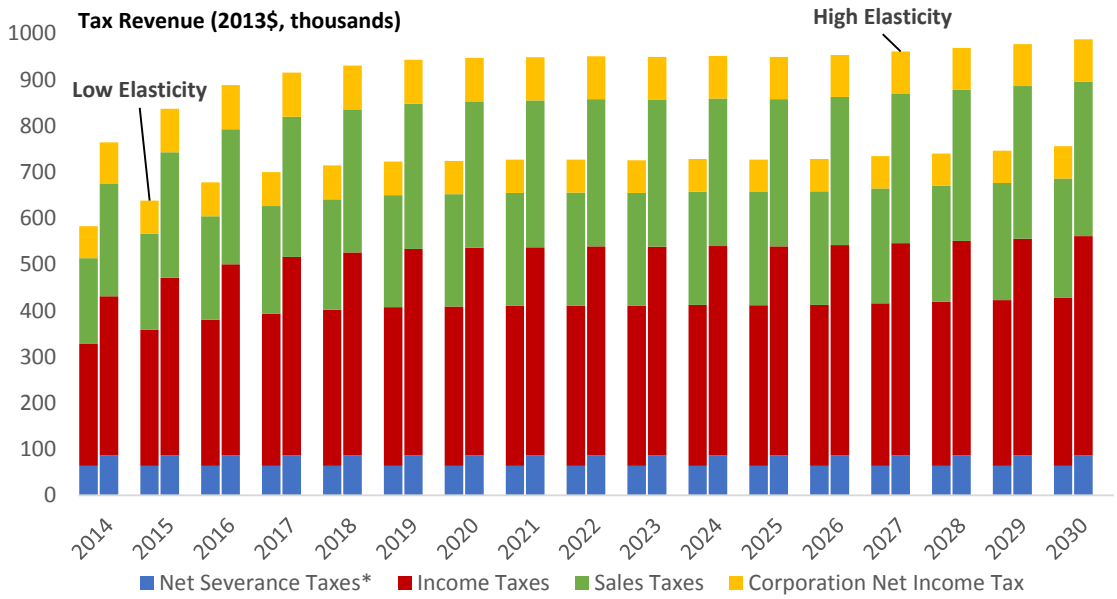


Source: REMI Results

6.5.4 Tax Impact

Along with increases in employment, GSP, and personal income, the state can expect to collect more tax revenue as a result of additional economic activity generated by the coal incentive policies. Figure 23 shows the expected revenues over the forecast period from four selected taxes: severance taxes, personal income taxes, sales taxes, and corporation net income taxes. The revenue from severance taxes represents the net severance tax revenue that will be collected if the severance tax reduction policy is put in place, as this policy does not completely eliminate the severance tax. The B&O tax reduction would provide a net severance tax of zero, as the gain in severance tax revenues would be offset by a reduction in B&O tax revenues from utilities.

Figure 23: Coal Incentive Policy Impact: Tax Revenue



Source: Author calculations based on REMI Results.
* Note: Severance Taxes not present under B&O Tax Policy.

In the first year of implementation, total tax revenue ranges from $583 thousand in the low elasticity scenario to $764 thousand in the high elasticity scenario. The lower total includes $63.7 thousand in severance tax revenue, $69.4 thousand in net income tax revenue, $186.2 thousand in sales tax revenue, and $264.1 thousand in personal income taxes. The high elasticity scenario yields $86.8 thousand in severance tax revenue, $90.5 thousand in net income tax revenue, $242.9 thousand in sales tax revenue, and $344.6 thousand in personal income tax revenue.

Total tax revenues rise throughout the forecast period, reaching between $756.1 thousand and $987.6 thousand in 2030. Between $63.7 thousand and $86.8 thousand is expected to come from additional severance taxes, and between $63.7 thousand and $86.8 thousand from corporation net income taxes. Sales tax revenues are expected to be between $257.3 thousand and $334.7 thousand, with personal income rising at between $365.0 thousand and $474.8 thousand.

7 Conclusions

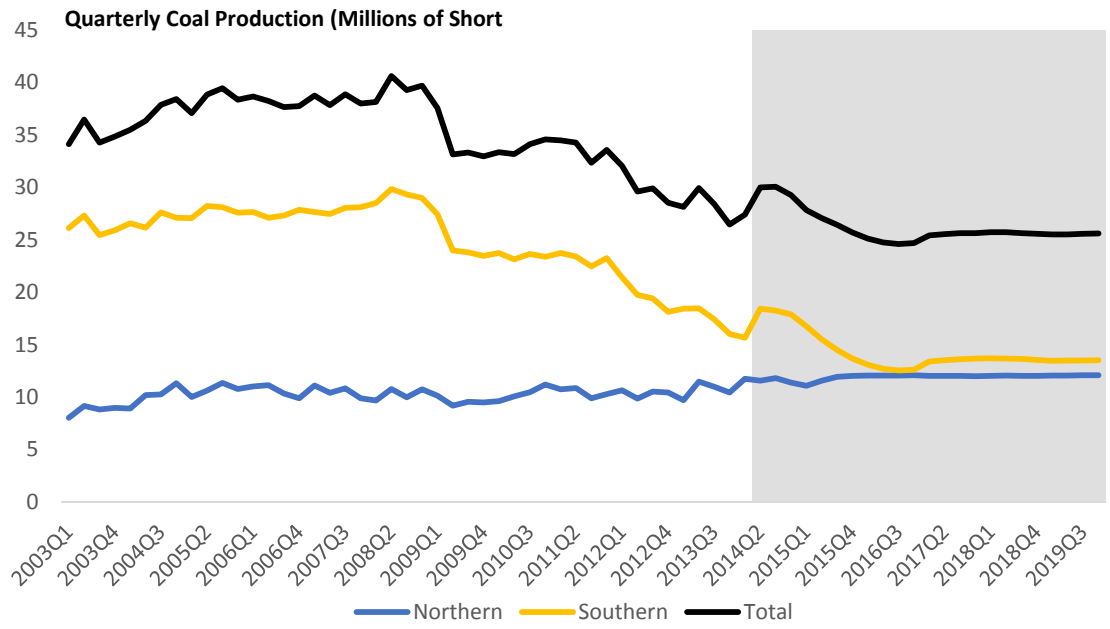
In this report we have examined the potential economic impact of state tax policies that provide incentives for electric utilities to switch to coal produced in West Virginia from coal produced outside the state. The two policies we examine would potentially increase demand for in-state coal by more than half a million tons per year. This gain to coal production would provide a small boost to the state's economy, adding approximately $33 million to the state's gross state product and supporting more than 200 jobs in mining and other industries.

How the tax policy is structured would be an important consideration for policy makers should this policy go into effect. The two policies we examine in this report would be applied to different sides of the coal market, with one applied to the severance tax on coal producers, and the other applied to taxes on utilities. However, a flat $3 per ton coal severance tax subsidy could be problematic if coal prices fall below $60 per ton. At current price levels, $3 is roughly equal to the state's severance tax rate of 5 percent. If prices fall below $60 per ton, the state would be giving a subsidy greater than the taxes it would be taking in on that tonnage.

The policies examined in this report have been designed to limit potential tax base reductions by applying the subsidies only to coal demand above and beyond that in a base year. As such, they could potentially provide a small economic boost with little impact on the state treasury. However, the choice of the base year will be an important policy consideration for state lawmakers. As Figure 24 shows, coal production is expected to fall over the next two years and then flatten out. If the base year were set too early, utilities would be unlikely to meet the criteria for the subsidy, as their demand would fall because of falling demand for coal overall, even if they switched to a greater share of in-state coal. In contrast, if the market were to rebound more

than expected, the state could end up subsidizing coal sales that would have happened without the subsidy.

Figure 24: Baseline Coal Production Forecast



Source: BBER Macroeconomic Forecast Model

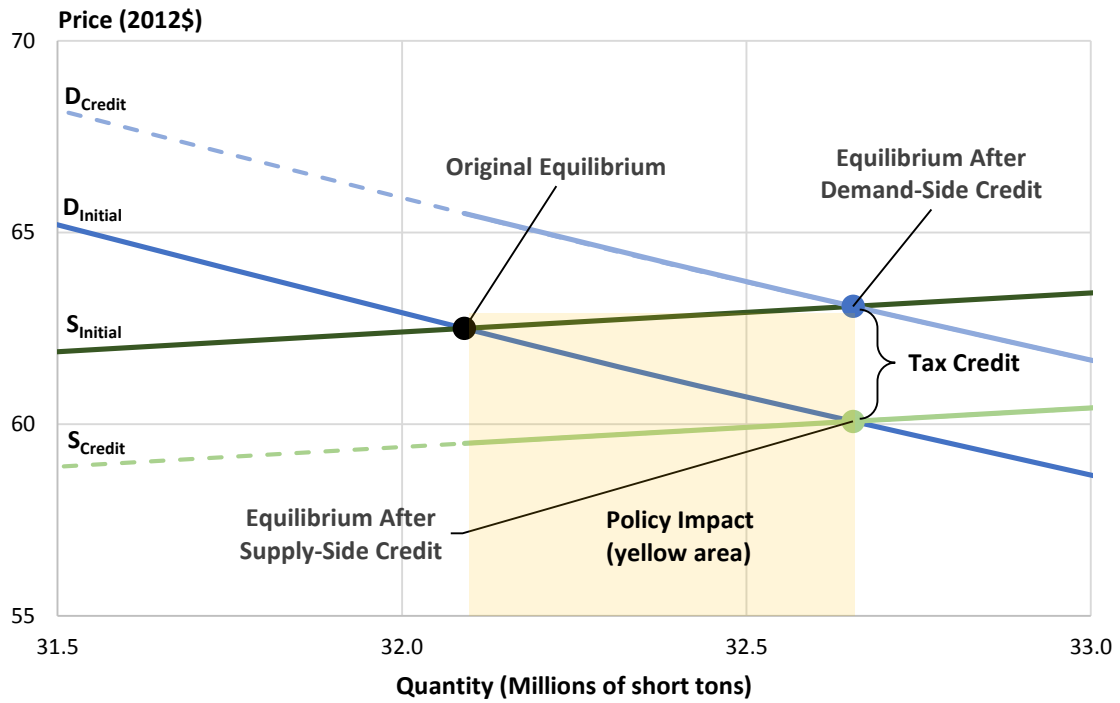
Appendix A: Coal Supply and Demand Model

The policy effects on coal production detailed in this report are based on a supply and demand model of the market for coal. We use a partial equilibrium method to determine the expected new equilibrium states following the policy intervention. This appendix details this approach.

Figure 25 is a supply and demand diagram depicting the market shifts that would be expected to result from the tax policies outlined in this report. The dark blue line is the demand curve, which shows the relationship between the price of coal (on the y axis) and the amount of coal consumers would be willing to purchase at that price (x axis). The dark green line is the supply curve, which shows the relationship between the price of coal and the amount of coal mine owners would be willing to supply at that price. Where the lines cross (the black dot) is the initial equilibrium price and quantity. The initial equilibrium in the model has been set to equal to the

values for 2012, when West Virginia utilities consumed 32 million tons of coal at an average price of $62.50.

Figure 25: Partial Equilibrium Supply and Demand Model



We can use the supply and demand curve equations to can solve for the new market equilibria in response to the tax credits detailed in this report. In the figure, the dark green line, labeled $S_{Initial}$, and the dark blue line, labeled $D_{Initial}$, represent the original supply and demand, respectively. The light green line ($S_{Subsidy}$) and light blue line ($D_{Subsidy}$) represent how the market would change after applying one of the tax credits for either suppliers or buyers of coal. The dotted portions of the demand and supply curves indicate that the policies do not apply to these portions of the market.

The light green line indicates the effect of a severance tax reduction. This form of tax credit would lower costs for producers and allow them to supply more coal at the same price. This

would shift the supply curve downward by an amount equal to the tax, depicting the lower cost of mine owners and the lower price they would be willing to accept to sell their coal. This has the effect of lowering the price of coal to consumers, such as utilities and industry, which increases the amount of coal they would purchase in the market.

The light blue line is the new demand curve that would result from a tax credit applied to utilities. In this case, the tax subsidy lowers the price that consumers of coal would pay, thus causing them to demand more. Because of the increased demand, the market price rises for coal suppliers and causes them to supply more coal. However, because of the subsidy the effective price for consumers would still be lower than it would be before the tax incentive was put in place.

Through the forces of supply and demand, a new equilibrium price and quantity are reached. The green and blue dots represent the new equilibrium price and quantity arising as a result of these policies. The yellow shaded area is the total impact of the new policy, which equals the additional quantity sold multiplied by the new price. It is important to note that we make an assumption that change in the price of West Virginia coal only applies to the state's coal and utility companies. The equilibrium in the national market, on the other hand, is assumed not to change because of this policy.

The supply and demand curves used in this model are defined by constant elasticity equations. Elasticity is an economic concept that measures how a percent change in one variable – usually the price – is related to a percent change in another – in this case quantity. In other words, it represents the responsiveness of the quantity demanded or supplied to a change in the price. A constant elasticity curve assures that the same percentage change in price at any point along the curve results in the same percent change in quantity.

The market model requires two measures of elasticity: elasticity of supply and elasticity of demand. The elasticity of supply for our model was derived from the long-run estimate of

elasticity in a study of the Australian coal market.[14] Based on the results in this study, it is assumed to be 1.9, meaning that a 10 percent increase in the price of West Virginia coal leads to a 19 percent increase in the quantity of coal supplied. This elasticity indicates that coal suppliers are highly responsive to changes in the price of coal.

The elasticity of demand was more difficult to determine, as there were no published measures of elasticity of substitution between coal produced in West Virginia and coal produced outside the state. Instead we derived the elasticity of demand used in the model using regression methods. We gathered power plant data from the US Energy Information Administration for the years 2008 to 2013,[15] and then estimated several econometric models to determine how responsive the share of coal demand served by West Virginia mines was to a change in the price of in-state coal. The elasticities we found in our analysis ranged in a fairly narrow band from -0.32 to -0.44, meaning that a 10 percent decline in the price of West Virginia coal leads to an increase in the quantity of coal demanded of between 3.2 and 4.4 percent.

[14] http://data.daff.gov.au/brs/data/warehouse/pe_abarebrs99000210/tp91.1_black_coal.pdf

[15] http://www.eia.gov/electricity/data/eia923/

About the Bureau of Business and Economic Research

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.

The BBER has research expertise in the areas of public policy, health economics, energy economics, economic development, economic impact analysis, economic forecasting, tourism and leisure economics, and education policy, among others. The BBER has a full-time staff of three PhD economists, and two master's-level economists. This staff is augmented by graduate student research assistants. The BBER also collaborates with affiliated faculty from within the College of Business and Economics as well as from other parts of WVU.

To learn more about our research, please visit our website at http://www.be.wvu.edu/bber.