



THE ECONOMIC IMPACT OF COAL IN WEST VIRGINIA

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The Economic Impact of Coal in West Virginia

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Executive Summary

In this report we consider the role of coal in the West Virginia economy. We begin with a detailed examination of recent trends in coal production, employment, employee compensation, and destination for West Virginia over the past several years. We devote a large portion of the report to coal exports. This is driven by the likelihood that domestic demand for coal will be flat at best in the coming years and any potential growth in coal production will likely come through export markets.

The core of this report is an estimate of the economic impact of coal on the West Virginia economy. Statistics indicate that coal mining directly employs over 13 thousand workers in West Virginia who earn a total compensation of around \$1.1 billion annually. Further, our estimates indicate that coal mines spend a total of around \$6.5 billion in the state's economy directly. However, the total economic impact of the industry does not end there. As coal mines operate, they purchase various inputs from local suppliers, thereby increasing demand for upstream businesses. Further, as coal mine employees spend their earnings in the local economy, additional economic activity is created. The primary usage of coal – electric power generation – also injects billions of dollars into the state's economy and employs around 2,800 high-wage workers. Highlights of our economic impact analysis are as follows:

- **Coal mining and coal-fired electric power generated approximately \$12.9 billion in total economic activity in the state of West Virginia in 2017. For context, total economic output for the state, as measured by gross domestic product (GDP), was around \$77 billion in 2017.**
- **Coal mining and coal-fired electric power generation supported around 39 thousand jobs in West Virginia in 2017.**
- **Coal mining and coal-fired electric power generation provided around \$2.5 billion in employee compensation in West Virginia in 2017.**
- **Coal mining and coal-fired electric power generation supported nearly \$652 million in select state and local tax revenue for West Virginia and its local governments.**



1 Introduction

In this report we consider the role of coal in the West Virginia economy. In Section 2, we begin with a detailed examination of recent trends in coal production, employment, employee compensation, and destination for West Virginia over the past several years. In Section 3, we devote a large portion of the report to coal exports. This is driven by the likelihood that domestic demand for coal will be flat at best in coming years and any potential growth in coal production will likely come through export markets.

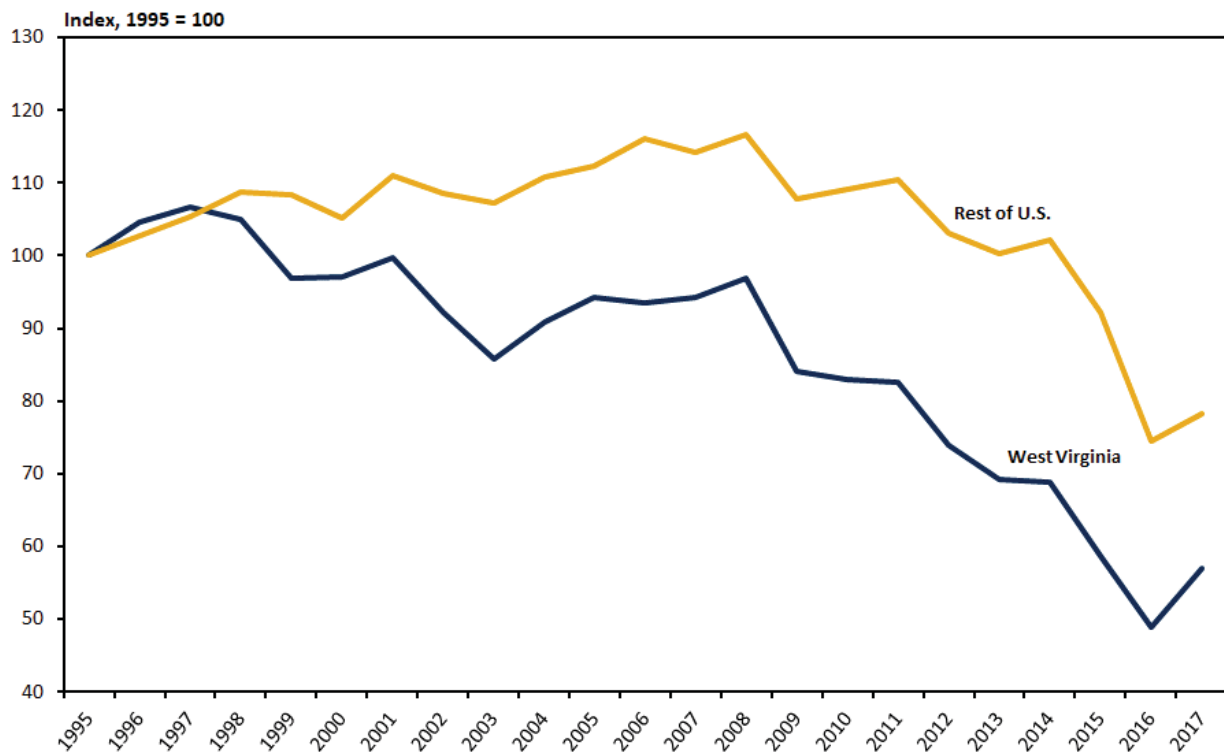
The core of this report is an estimate of the economic impact of coal on the West Virginia economy, which we present in Section 4. Statistics indicate that coal mining directly employs over 13 thousand workers in West Virginia who earn a total compensation of around \$1.1 billion annually. Further, our estimates indicate that coal mines spend a total of around \$6.5 billion in the state's economy directly. However, the total economic impact of the industry does not end there. As coal mines operate, they purchase various inputs from local suppliers, thereby increasing demand for upstream businesses. Further, as coal mine employees spend their earnings in the local economy, further economic activity is created. And the primary usage of coal – coal-fired electric power generation – injects billions of dollars into the state's economy as well and employ around 2,800 high-wage workers. Overall, we estimate the total economic impact of coal mining and coal-fired electric power generation on the state's economy. Our research indicates that coal mining generated around \$12.9 billion in economic activity in West Virginia in 2017.



2 Coal and the West Virginia Economy: Recent Trends

STATE AND U.S. COAL PRODUCTION: The coal industry in both West Virginia and the U.S. have experienced substantial declines over much of the past decade. The downturn was felt more strongly in West Virginia than the rest of the U.S. Total coal production in West Virginia peaked in 2008 at nearly 158 million short tons then declined to around 80 million short tons in 2016, a nearly 50 percent decline. In the rest of the U.S., production fell from one billion short tons to just over 0.6 billion short tons, a decline of about 36 percent. Contrary to these general trends, coal production increased in 2017 by more than 16 percent in West Virginia, much higher than the five percent increase in the rest of the U.S. (see Figure 1). West Virginia coal production is expected to remain generally stable over the next five years or so.

Figure 1: Annual Coal Production, West Virginia vs Other U.S. States

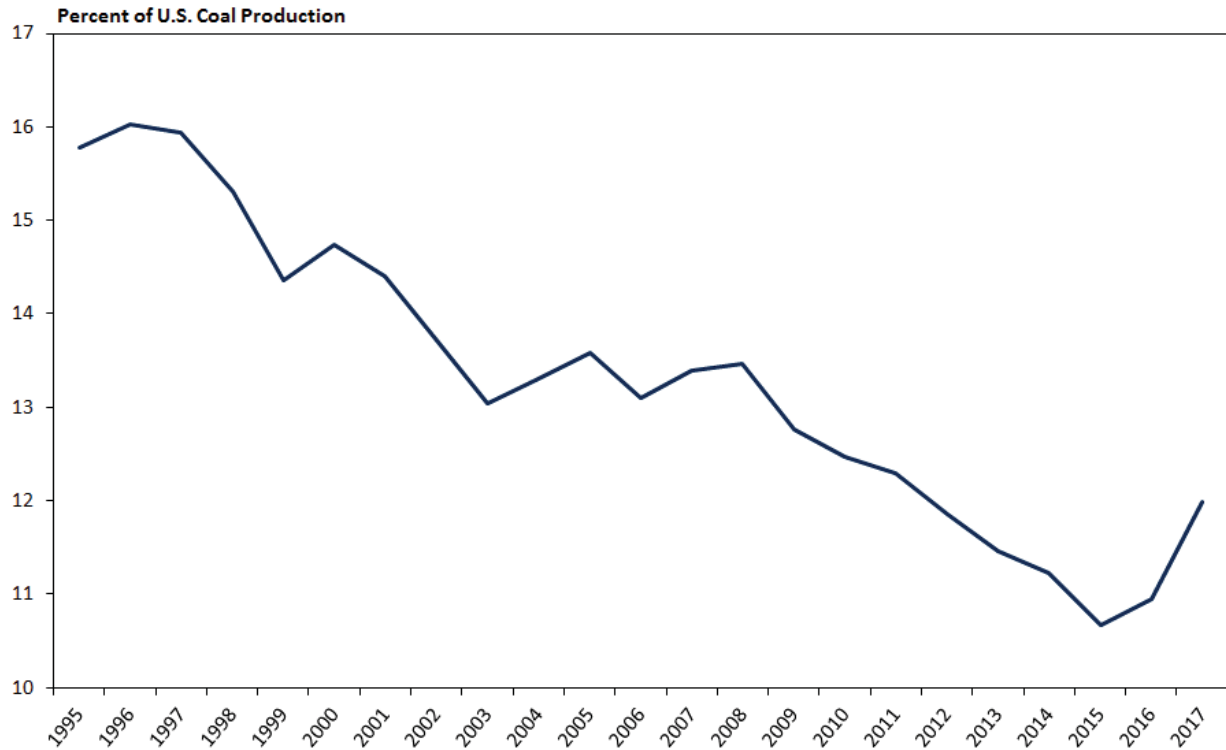


Source: Energy Information Administration



Having experienced steeper declines in production, West Virginia’s share of U.S. coal production has declined as well. West Virginia accounted for 15.8 percent of U.S. coal production in 1995. The share fell to 13.5 percent in 2008 and to 12.0 percent in 2017 (see Figure 2). Despite the decline, however, West Virginia remains the second-largest coal producer in the U.S., behind only Wyoming (whose share of U.S. coal production in 2017 was around 40 percent).

Figure 2: West Virginia Share of U.S. Annual Coal Production

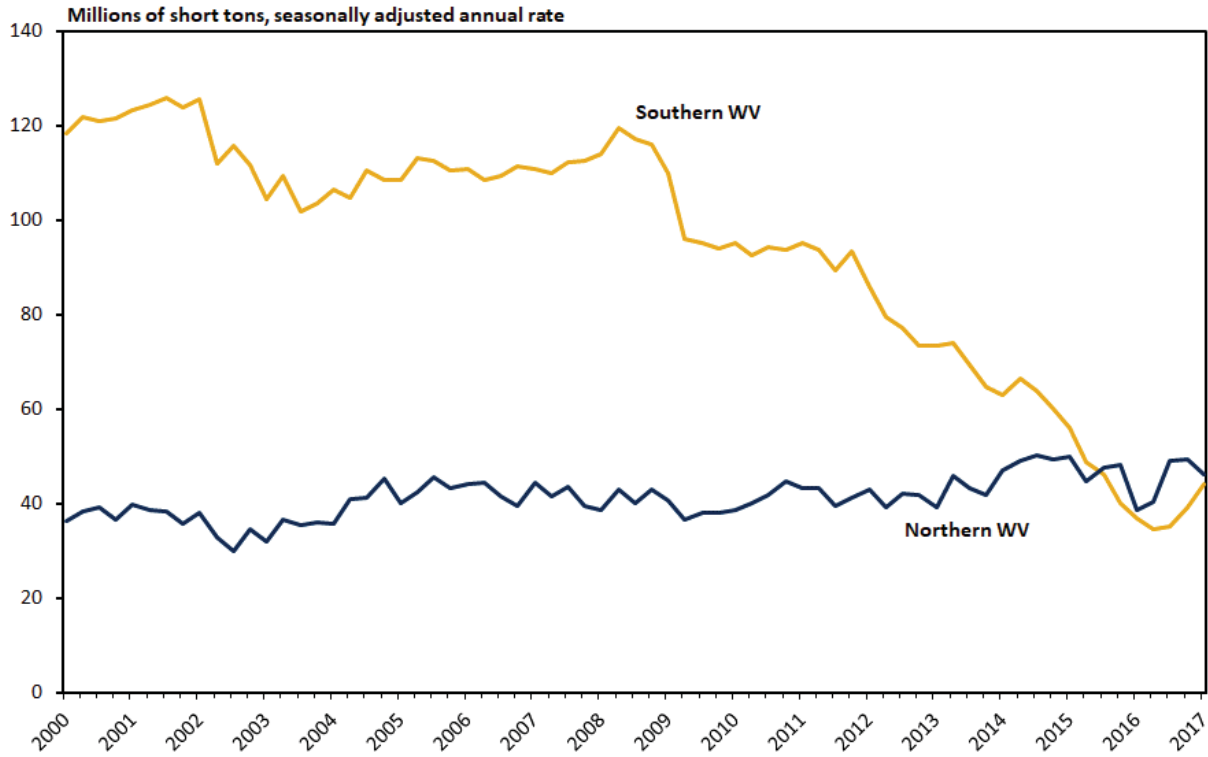


Source: Energy Information Administration
Note: Share was calculated based on production quantity.



REGIONAL COAL PRODUCTION: Most of the decline in coal production in West Virginia occurred in the state’s southern coal fields – part of the Central Appalachian Coal Basin. Between 2008 and 2017, Southern West Virginia coal production dropped from nearly 117 million short tons to less than 46 million short tons, a decline of about 60 percent. In contrast, during the same period the Northern West Virginia coal production (part of the Northern Appalachian Coal Basin) rose by a smaller margin. Consequently, Southern West Virginia’s share of total state coal production dropped from more than 74 percent in 2008 to about 50 percent in 2017 (see Figure 3).

Figure 3: West Virginia Regional Coal Production

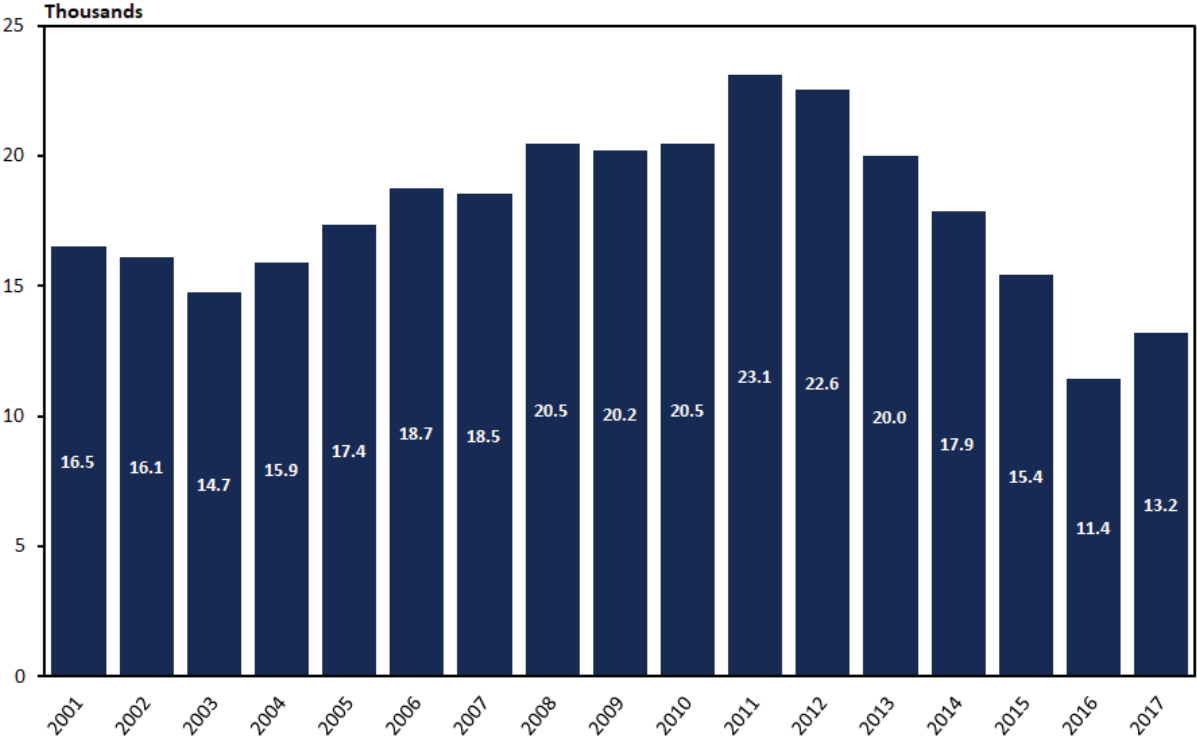


Source: US Energy Information Administration; WVU Bureau of Business & Economic Research



COAL MINING EMPLOYMENT: Here we turn to the role of the West Virginia coal mining industry in providing jobs and income to the state’s residents. Figure 4 shows that coal mining directly provided 13.2 thousand jobs in the state in 2017.¹ This reflects a decline of around 3.3 thousand, or 20 percent, from 2001.

Figure 4: Coal Mining Employment in West Virginia



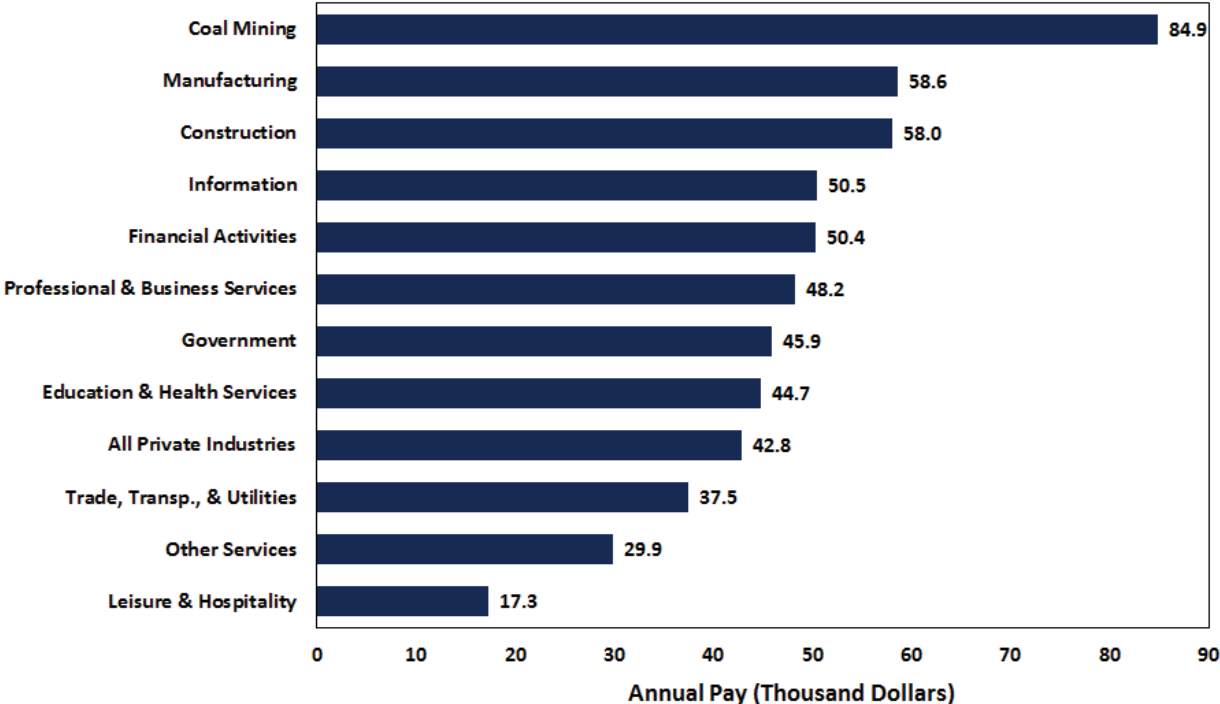
Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics

¹ This specifically represents jobs in the coal mining sector, classified as NAICS code 2121.



COAL MINING WAGES: The coal industry’s contribution to the West Virginia economy is more pronounced in terms of providing income to its workers. In 2017, the coal industry paid its workers an average of \$85 thousand annually. This pay nearly doubles the average annual pay in all private industries in the state (Figure 5). While coal mining accounts for nearly 2.5 percent of all jobs in private industries in West Virginia in 2017, earnings from coal mining account for 4.8 percent of all earnings from private industries (see Figure 6).

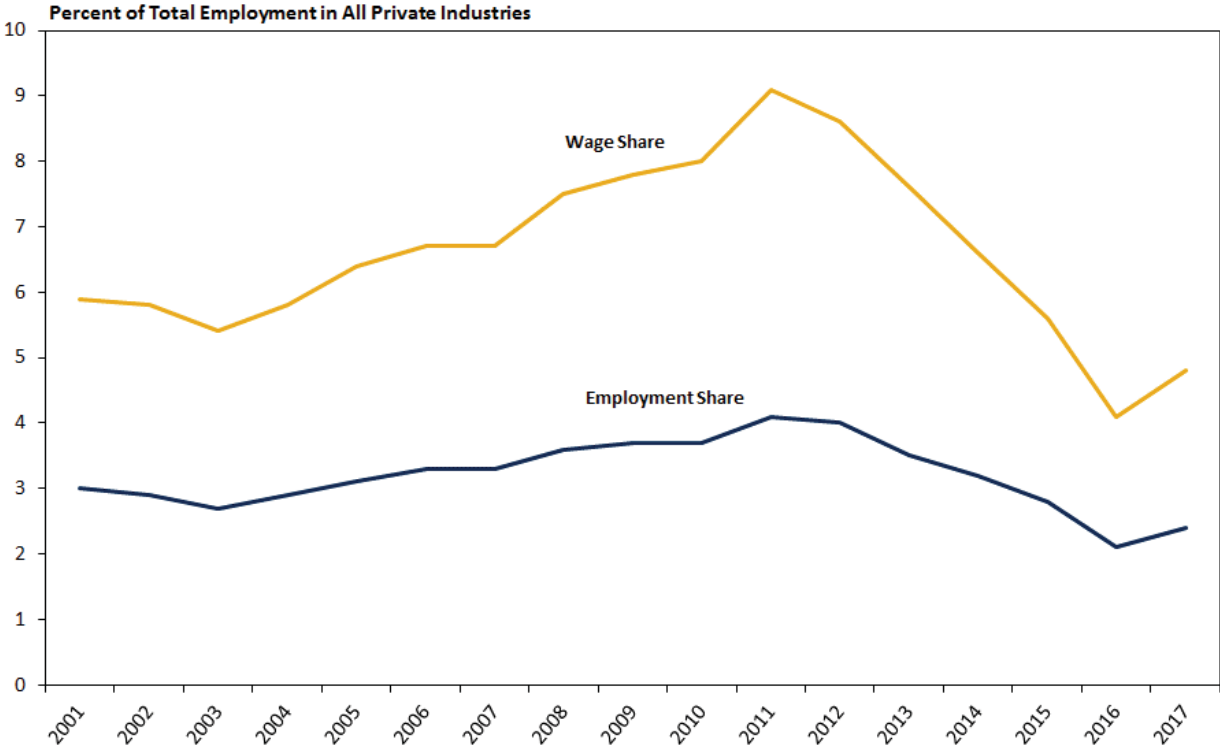
Figure 5: Annual Wage by Industry, West Virginia, 2017



Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics



Figure 6: Coal Mining Share in Employment and Wages, West Virginia

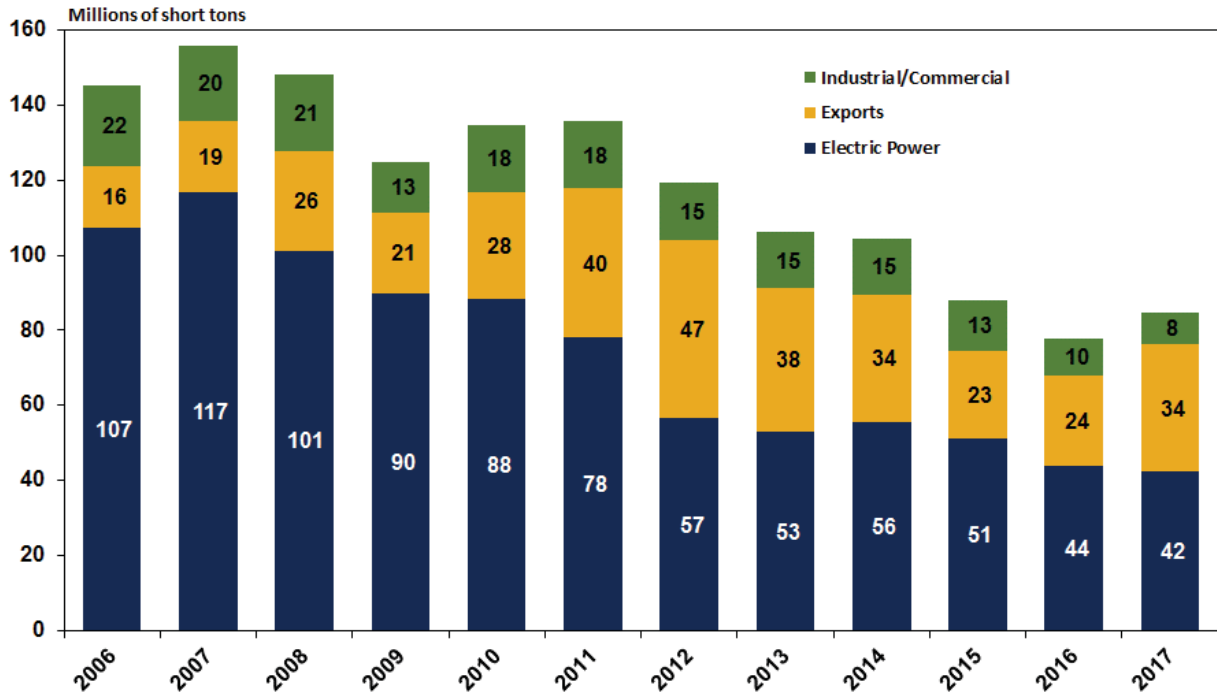


Source: Quarterly Census of Employment and Wages (QCEW), Bureau of Labor Statistics



COAL DISTRIBUTION AND DEMAND: Now we turn to how West Virginia coal is distributed among its users. The majority of the West Virginia coal is used for electric power generation, although the amount used has declined substantially, from over 100 million short tons as recently as 2008 to 42 million short tons in 2017, a nearly 60 percent drop. Coal exports have experienced significant volatility over the past decade or so, and are discussed in greater detail below in Section 3 (see Figure 7).

Figure 7: Distribution of West Virginia Coal by Consumer

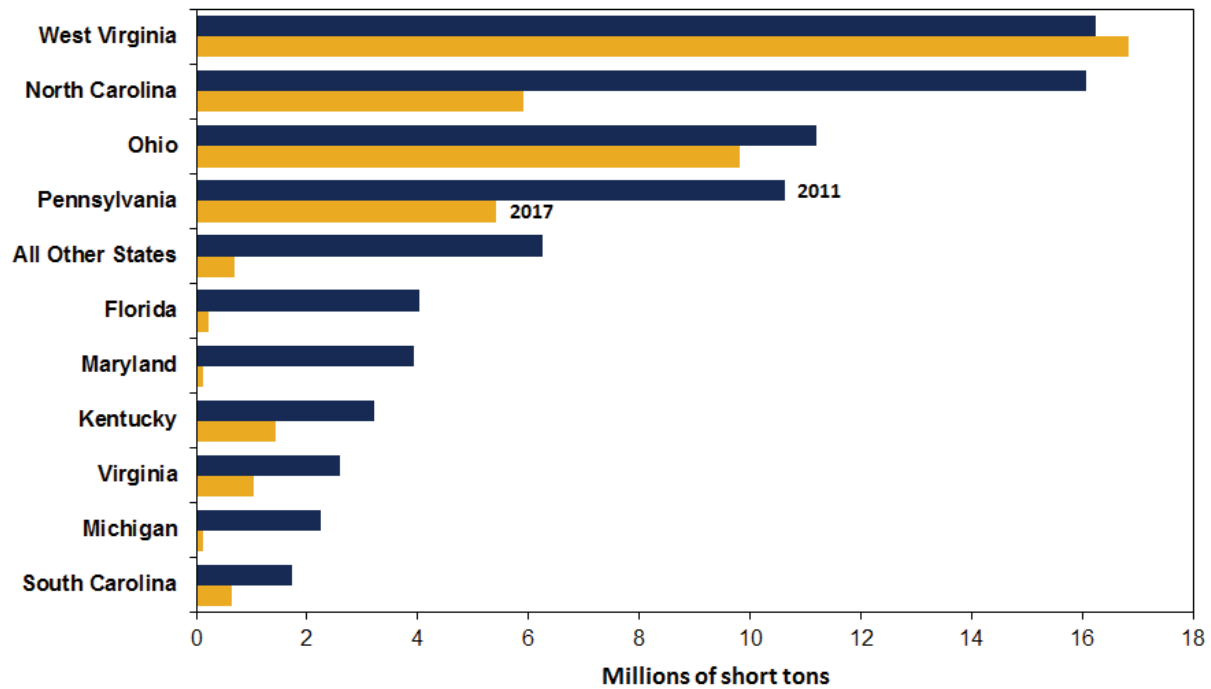


Source: Energy Information Administration



Figure 8 shows the breakdown of electric power-plants the West Virginia’s coal was shipped to. In 2011 more than 16 million short tons of coal went to power-plants within the state of West Virginia. About the same amount was shipped to North Carolina’s power-plants that same year. In 2017 the amount shipped within the state increased to nearly 17 million short tons, but that shipped to North Carolina dropped to less than 6 million short tons, a more than 63 percent drop. The amount shipped to the other states also dropped substantially during the same period.

Figure 8: West Virginia Coal Shipments to Power Plants by Destination State, 2011 vs 2017

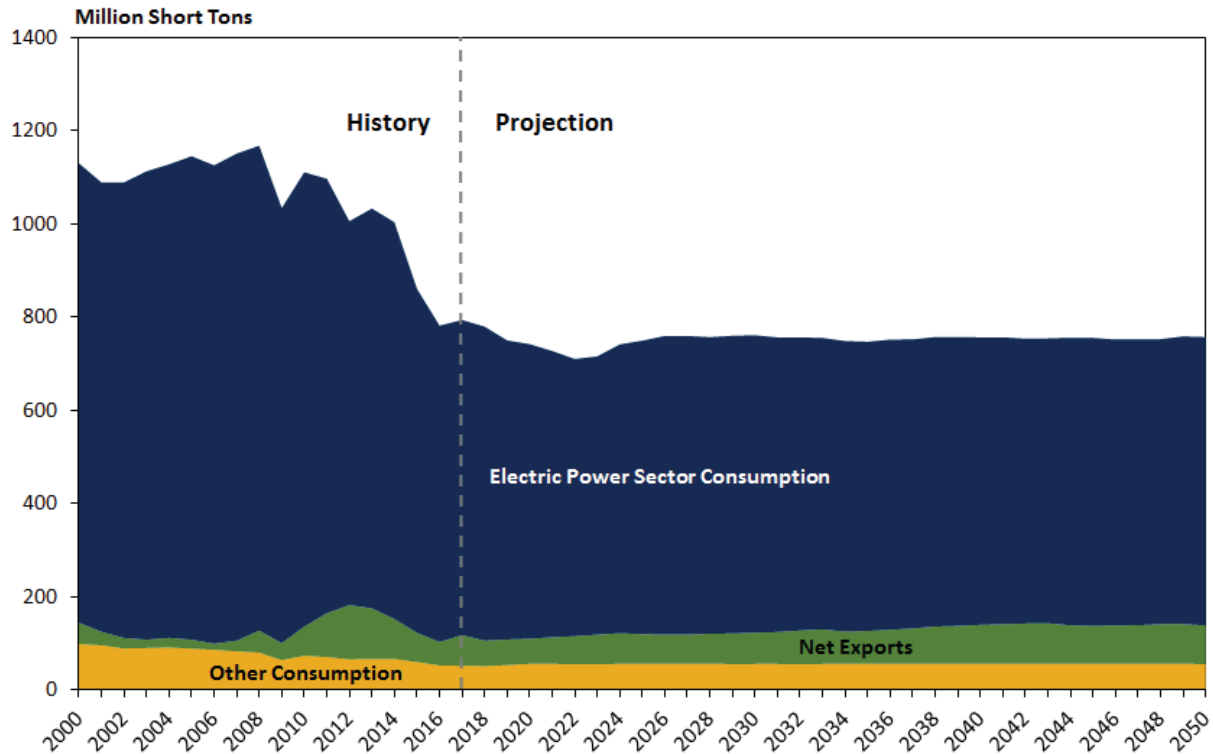


Source: US Energy Information Administration



COAL PRODUCTION FORECAST: After looking at recent trends in coal consumption we now examine coal consumption projections for the long run. The U.S. Energy Information Administration (EIA) predicts that domestic demand for U.S. coal is expected to remain relatively flat through 2050 (Figure 9). Coal exports are expected to grow over the next few decades and are explored in more detail in the next section.

Figure 9: U.S. Coal Demand Forecast



Source: Annual Energy Outlook 2018, U.S. Energy Information Administration



3 West Virginia Coal Exports

WEST VIRGINIA AND U.S. COAL EXPORTS: West Virginia coal exports experienced significant volatility over much of the past decade. Total value of the state’s coal exports declined from nearly \$7.5 billion in 2012 to \$1.3 billion in 2016, before rising again to \$3.2 billion in 2017. Figure 10 shows that West Virginia coal exports have consistently made up a large share of U.S. coal exports, and both figures fluctuate in a similar pattern over time. In Figure 11 we report West Virginia coal exports as a share of total U.S. coal exports measured both by market value and by tonnage.

Figure 10: Coal Exports, West Virginia vs Other U.S. States

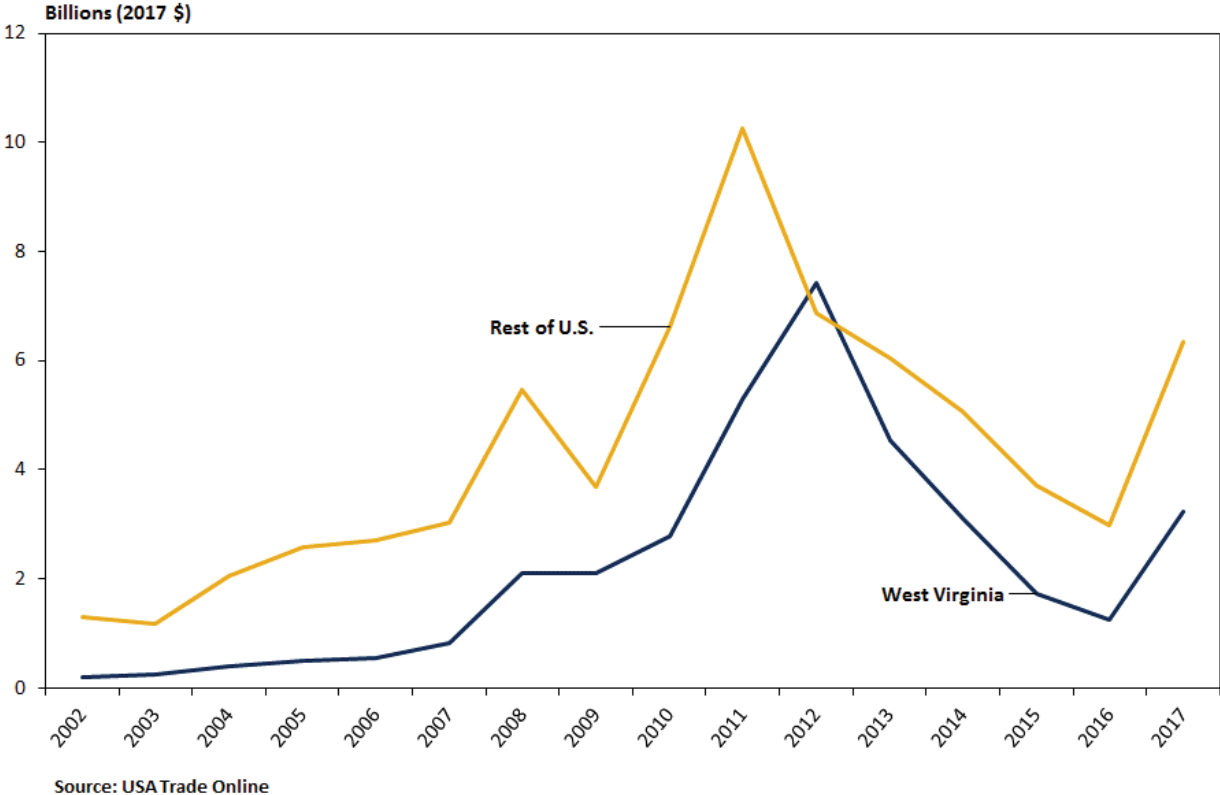
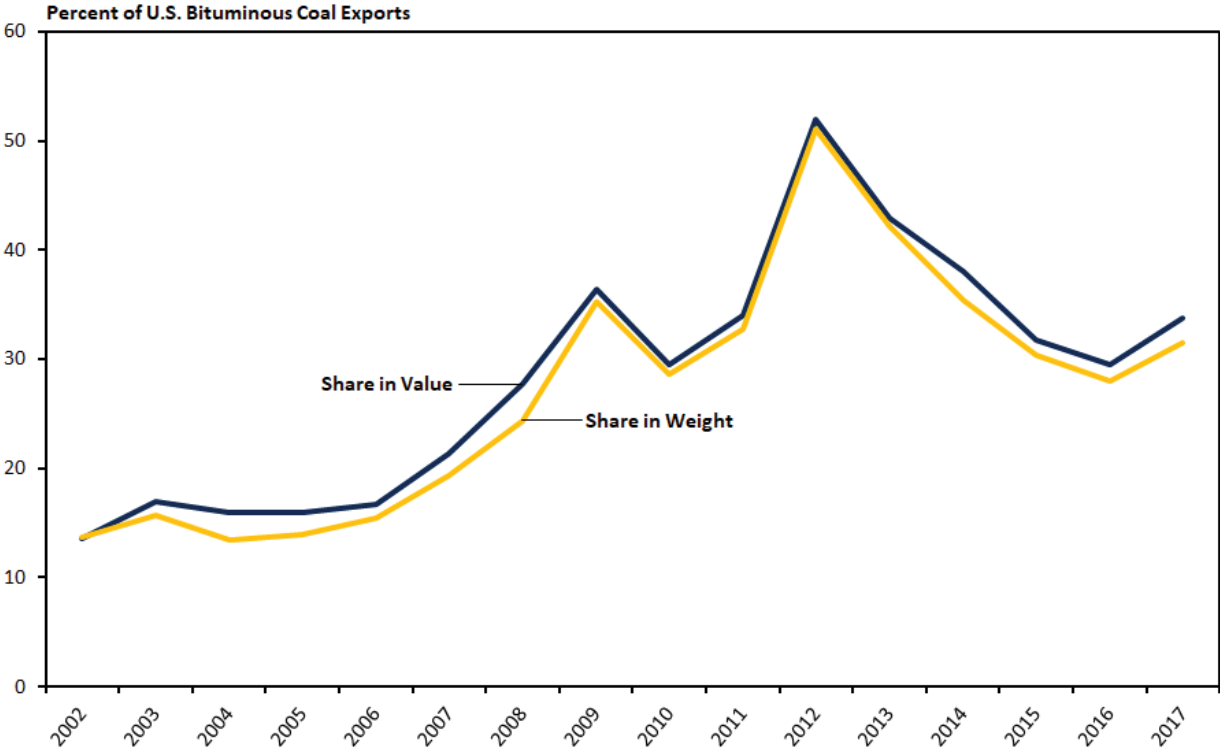


Figure 11: West Virginia Coal Exports as a Share of U.S. Coal Exports

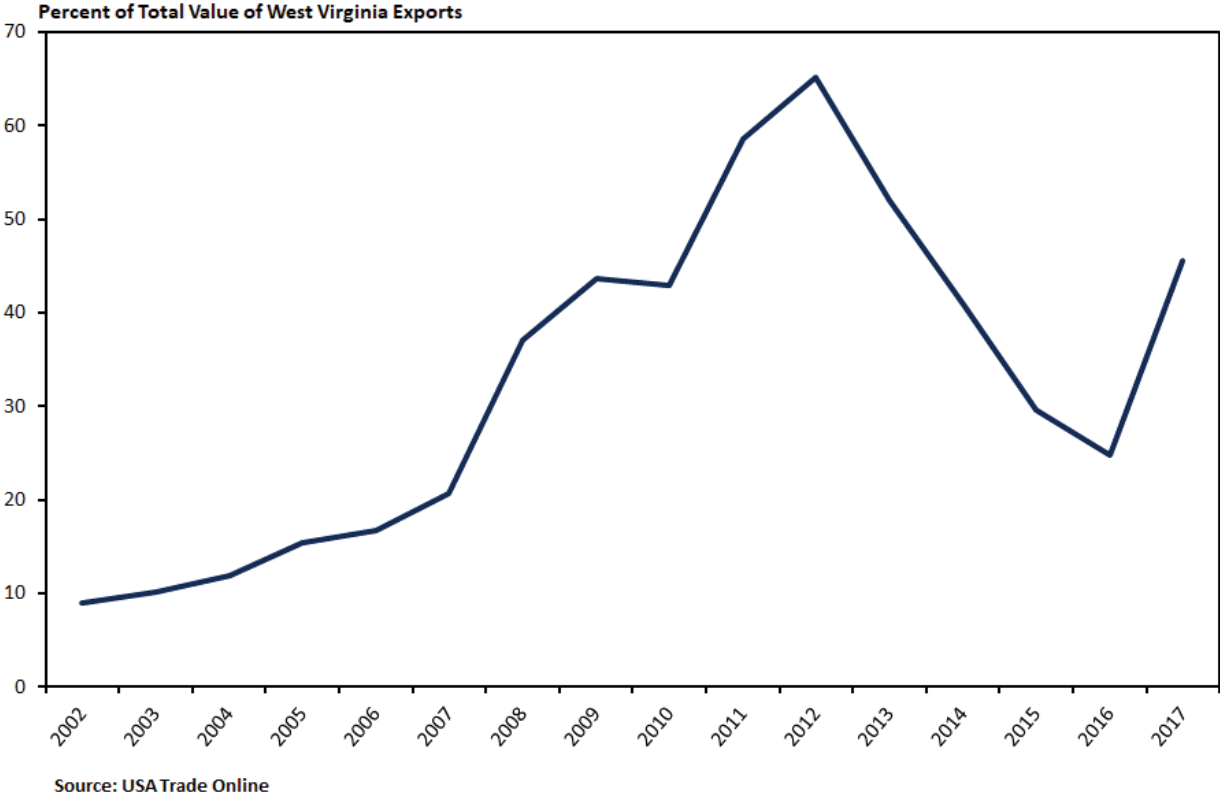


Source: USA Trade Online
Note: Share in weight is calculated based on the shipping weight of trade going through vessel ports, and share in value is based on total value of exported coal.



WEST VIRGINIA COAL EXPORTS AS A SHARE OF TOTAL WEST VIRGINIA EXPORTS: Comparing West Virginia coal exports and the state’s total exports yields a similar picture. Coal exports accounted for less than 10 percent of the state’s total exports in 2002, gradually rising over time and peaking at 65 percent in 2012, before dropping to less than 25 percent in 2016. The share rose again to more than 45 percent in 2017 (see Figure 12).

Figure 12: West Virginia Coal Exports as a Share of the State’s Total Exports



WEST VIRGINIA COAL EXPORT DESTINATIONS: The international demand for West Virginia’s coal come from various countries. The list of the primary importing countries can drastically change from year to year. Despite the fluctuations, however, the West Virginia coal exports to the top seven destination countries have remained strong since at least 2010 (see Figure 13). The largest exports in 2017 went to India at a total value of \$636 million, followed by Ukraine at nearly \$460 million, Brazil at \$276 million and the Netherlands at \$233 million.

Figure 13: West Virginia Coal Exports by Country of Destination, 2017

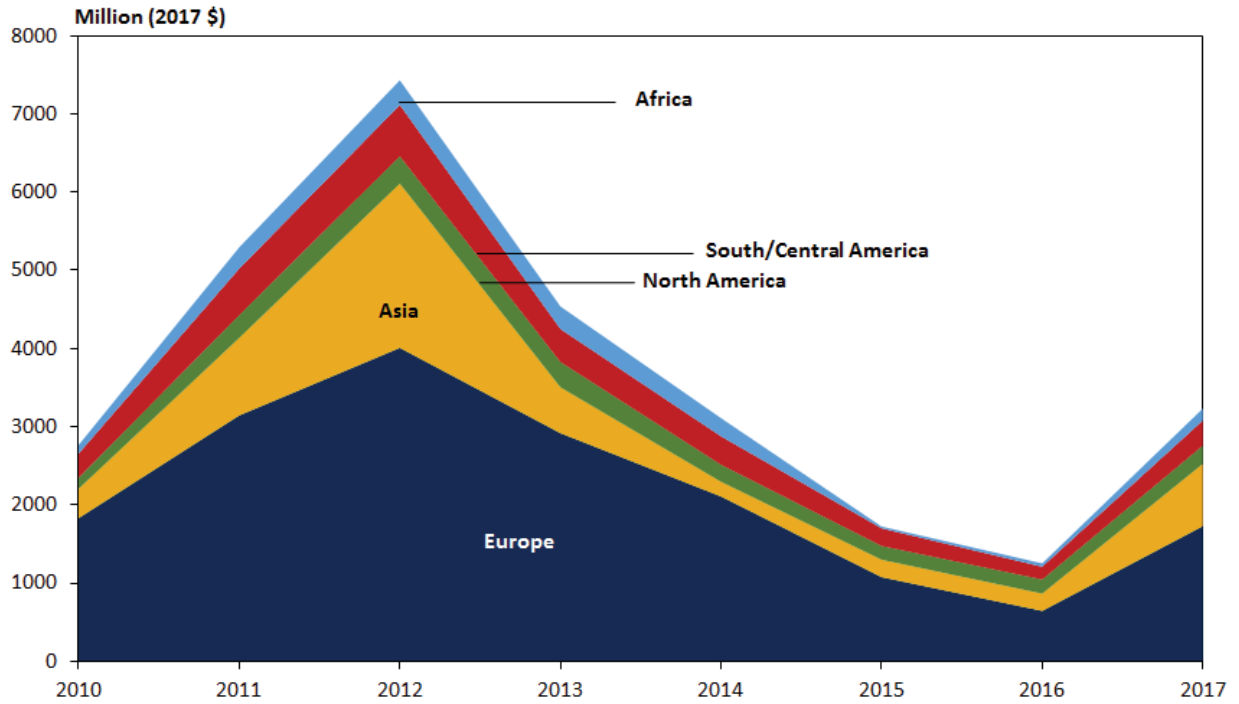
Country of Destination	Value of Exports (Millions, 2017\$)	Percent Share
1. India	636.4	19.6
2. Ukraine	458.9	14.2
3. Brazil	275.5	8.5
4. Netherlands	233.1	7.2
5. Italy	224.4	6.9
6. France	190.5	5.9
7. Canada	165.0	5.1
8. South Korea	150.1	4.6
9. Turkey	146.9	4.5
10. United Kingdom	123.9	3.8
11. Spain	106.4	3.3
12. Morocco	103.1	3.2
Rest of the World	69.4	13.1

Source: USA Trade Online



Looking at destinations in terms of world region shows that the largest exports of West Virginia coal have gone to Europe, followed by Asia and then South/Central America (see Figure 14).

Figure 14: West Virginia Coal Exports by Destination Region



Source: USA Trade Online



WEST VIRGINIA AND WORLD COAL EXPORTS: Figure 15 compares the state’s coal exports to world coal exports. Australia is the largest coal exporter in the world, shipping more than \$40 billion worth of coal to the world in 2017, and accounting for more than 36 percent of total world coal exports. Indonesia came in second place with nearly \$18 billion worth of coal exports. The U.S. comes at 4th, shipping nearly \$10 billion worth of coal in 2017. U.S. coal exports account for nearly 9 percent of total world’s coal exports, and accordingly, West Virginia’s coal exports accounts for nearly 3 percent (see Figure 15). If West Virginia were a country in itself, it would be the world’s ninth largest coal exporter.

Figure 15: World Coal Exports, West Virginia vs Other Countries, 2017

Country/State of Origin	Value of Exports (Billions, 2017\$)	Percent Share
1. Australia	40.6	36.6
2. Indonesia	17.9	16.1
3. Russia	13.5	12.2
4. United States	9.9	8.9
West Virginia	3.2	2.9
5. Colombia	6.8	6.1
6. South Africa	5.7	5.2
7. Canada	5.1	4.6
8. Netherlands	4.1	3.7
9. Mongolia	2.2	2.0
10. China	1.1	1.0
Rest of the World	3.9	3.6

Source: worldtopexports.com and USA Trade Online



4 Economic Impact of Coal in West Virginia

In this section we examine the economic impact of coal on the West Virginia economy in 2017. To estimate the economic impact, we apply a detailed model of the West Virginia economy that outlines how industry-specific trade-flows interact with key economic indicators such as employment, income, output, and tax revenue. Our analysis consists of two aspects of the coal economy: First, we consider the economic impact of coal mining. Second, we consider the impact of the primary use of coal in the state – coal fired electric power generation.

ECONOMIC IMPACT ANALYSIS BACKGROUND: Expenditures that take place directly to mine coal and compensate coal mine workers are referred to as the direct economic impact of coal mining.² However, the total economic impact of coal mining is not limited to the direct impact, but also includes the secondary economic impacts accrued as those initial direct expenditures are re-spent throughout the rest of the economy. For example, to support coal mining, contractors providing services such as site preparations, tunneling, coal stripping, truck transportation, etc., will increase their production in correspondence with an increase in coal mining. As these suppliers increase production, their subsequent suppliers will increase production, and so on. All of this additional economic activity that stems from coal mining is referred to as indirect impacts. In addition, the coal mine and these suppliers employ numerous workers, part of whose income will be spent in the West Virginia economy, generating additional output, income, and employment. This activity associated with employees spending their income in the state is referred to as induced impacts. These indirect and induced impacts together form what is known as the “multiplier effect.” The original stimulus to the economy from the operation’s total expenditures is re-spent multiple times through the rest of the economy. The combined direct impact and secondary impacts constitute the total economic impact of coal mining.

ECONOMIC IMPACT OF COAL MINING Since we do not have access to data on direct expenditures at coal mines in West Virginia, we estimate total spending based on the sales value of coal produced in West Virginia, and we assume zero profit for the year 2017. As such, based on the total value of coal sales, we estimate that coal mines in West Virginia spent around \$6.5 billion in total in 2017. As reported in Figure 16, this direct expenditure is estimated to generate \$2.7 billion in secondary output impacts, resulting in a total economic impact of \$9.2 billion in output in the West Virginia economy. For context, total economic output (GDP) in West Virginia was around \$77 billion in 2017.³

Further, the 13,200 coal mining jobs in West Virginia in 2017 are expected to generate 16,500 additional jobs in the state economy, resulting in a total employment impact of just under 30,000 jobs. The unusually large multiplier (2.25) is driven by the fact that coal miners earn unusually large incomes. Further, coal mining generates around \$1.8 billion in total employee compensation in the state. Finally, coal mining is estimated to generate more than \$523 million in select state and local tax revenue.

² Employment data are provided by the U.S. Bureau of Labor Statistics, Quarterly Censuses of Employment and Wages, NAICS code 2121, shown in Figure 4 above.

³ U.S. Bureau of Economic Analysis.



Figure 16: Economic Impact of Coal Mining in West Virginia

Type of Impact	Direct	Indirect and Induced	Total
Output (\$, billions)	6.5	2.7	9.2
Employment (thousand jobs)	13.2	16.5	29.7
Employee Compensation (\$, billions)	1.1	0.7	1.8
State and Local Tax Revenue (\$, millions)	--	--	523.2

Notes: Output, Employee Compensation, and Taxes are measured in 2017 dollars. Tax impact includes severance, sales, personal income, property, and corporation net income taxes.

ECONOMIC IMPACT OF COAL-FIRED POWER GENERATION: We also consider the economic impact of the primary use of coal in West Virginia – coal fired electric power generation. This is the primary downstream use of coal in general. It is important to note that for the coal-fired power plants, coal mining sector serves as the main supporting sector. For that reason, estimating the economic impact of these plants would normally include the multiplier impact that goes through all power plants’ supporting sectors, including coal mining. However, since the impact of coal mining is accounted for above, we are careful to exclude coal purchases in this section of the analysis to avoid double counting.

In a similar pattern to our approach above, we estimate the power-plants annual spending based on their sales revenue. We estimate that the coal-fired power plants in West Virginia spent about \$2.7 billion in total in 2017, excluding coal purchases. This direct expenditure is estimated to generate \$1.0 billion in secondary output impacts, resulting in a total economic impact of \$3.7 billion in output in the West Virginia economy.

Coal-fired power plants employed directly about 2,750 workers. They are expected to generate 6,500 additional jobs in the state economy, resulting in a total employment impact of more than 9,000 jobs. The unusually large multiplier (3.3) is driven primarily by two reasons: the impact spreads from a highly capital-intensive sector to more labor-intensive sectors and power-plant workers also earn large incomes. Further, coal-fired power plants generate around \$680 million in total employee compensation in the state. Finally, coal-fired power plants are estimated to generate more than \$128 million in select state and local tax revenue (see Figure 17).



Figure 17: Economic Impact of Coal-Fired Power Plants

Type of Impact	Direct	Indirect and Induced	Total
Output (\$, billions)	2.7	1.0	3.7
Employment (thousand jobs)	2.8	6.5	9.3
Employee Compensation (\$, millions)	391.2	289.5	680.7
State and Local Tax Revenue (\$, millions)	--	--	128.5

Notes: Output, Employee Compensation, and Taxes are measured in 2017 dollars. Tax impact includes sales, personal income, property, and corporation net income taxes.

Figure 18 shows the combined economic impact of the coal mining and the operation of coal-fired power plants. Coal overall generated a combined output impact of nearly \$13 billion during 2017, a total employment impact of 39,000 jobs, and a total employee compensation impact of \$2.5 billion. The sector also generates more than \$650 million in state and local tax revenue.

Figure 18: Overall Economic Impact of Coal (Mining and Power Generation) in West Virginia

Type of Impact	Direct	Indirect and Induced	Total
Output (\$, billions)	9.2	3.8	12.9
Employment (thousand jobs)	16.0	23.0	39.0
Employee Compensation (\$, billions)	1.5	1.0	2.5
State and Local Tax Revenue (\$, millions)	--	--	651.6

Notes: Output, Employee Compensation, and Taxes are measured in 2017 dollars. Tax impact includes severance, sales, personal income, property, and corporation net income taxes.



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