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A dramatic, high-contrast photograph of a metallurgical coal worker in a furnace. The worker, wearing a hard hat and safety glasses, is silhouetted against a bright, incandescent orange and yellow glow from the furnace. Sparks are visible in the air. The worker is holding a long metal rod or probe. The background is dark, making the intense light of the furnace stand out.

THE BROAD ECONOMIC IMPACT OF WEST VIRGINIA METALLURGICAL COAL IN THE UNITED STATES

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The Broad Economic Impact of West Virginia Metallurgical Coal in the United States

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Executive Summary

Metallurgical coal, or met coal, is a grade of coal that is used to produce coke, which is an essential ingredient for making steel. West Virginia is the leading producer of met coal in the United States. In 2019, West Virginia supplied nearly 63 percent of all the met coal distributed to US coke plants. Moreover, the value of coal exports from West Virginia to China and India, most of which is likely met coal because these two countries are major steel producers in the world, has increased to about \$1.2 billion in 2021, more than two times the average annual exports in the previous five years.

In this report, we examine the economic impact of the production of West Virginia met coal and the economic impact of the production of steel by the US steel mills that are supplied by West Virginia's met coal mines. Estimate is based on the West Virginia met coal production and the US steel production in 2019, respectively.

Highlights of our economic impact analysis are as follows:

West Virginia Met Coal Production

- The production of West Virginia met coal generated approximately \$9.6 billion in total economic activity in the United States in 2019.
- West Virginia met coal production supported about 30.5 thousand jobs in the nation in 2019.
- West Virginia met coal production provided about \$2.5 billion in labor income in the US in 2019.
- West Virginia met coal production generated nearly \$554 million in tax revenue for US state and local governments in 2019.

US Steel Production Using West Virginia Met Coal

- Met coal is an essential input for steel production. It is converted to coke, which is then used as both a fuel for blast furnace operation and as a chemical and physical reductant in the production of raw iron. In addition to producing coke, a specific blend of met coal referred to pulverized coal injection (PCI) coal is used in a blast furnace to heat the charge of raw iron ore, coke, and fluxing stone. Met coal and coke are also used in a variety of other ferro-alloy industries as a fuel for smelter and foundry operations and a carbon additive to finished alloys and metals.
- US steel production that uses West Virginia met coal generated approximately \$186.0 billion in total economic activity in the United States in 2019. This impact is in addition to the impact associated with the purchase of West Virginia met coal, which is already accounted for in the met coal production impact above.
- US steel production that relies on West Virginia met coal supported about 547 thousand jobs in the nation in 2019.
- US steel production that relies on West Virginia met coal provided nearly \$40 billion in labor income in the US in 2019.
- US steel production that relies on West Virginia met coal supported nearly \$5.4 billion tax revenue for US state and local governments in 2019.

1 Introduction

Metallurgical coal, or simply met coal, is a grade of coal that is used to produce good-quality coke, which is an essential fuel and reactant for making steel. West Virginia is among the major producers of met coal in the United States. In 2019, West Virginia supplied nearly 63 percent of all the met coal distributed to US coke plants. Moreover, the value of coal exports from West Virginia to China and India, most of which is likely met coal because these two countries are major steel producers in the world, has increased to about \$1.2 billion in 2021, more than two times the average annual exports in the previous five years.

In this report, we examine the economic impact of the production of West Virginia met coal and the economic impact of the production of steel by the US steel mills that are supplied by West Virginia's met coal mines. Met coal is an essential input for steel production. It is converted to coke, which is then used as both a fuel for blast furnace operation and as a chemical and physical reductant in the production of raw iron. In sum, met coal is a critical enabler of the steel manufacturing industry's economic impact on the US economy.

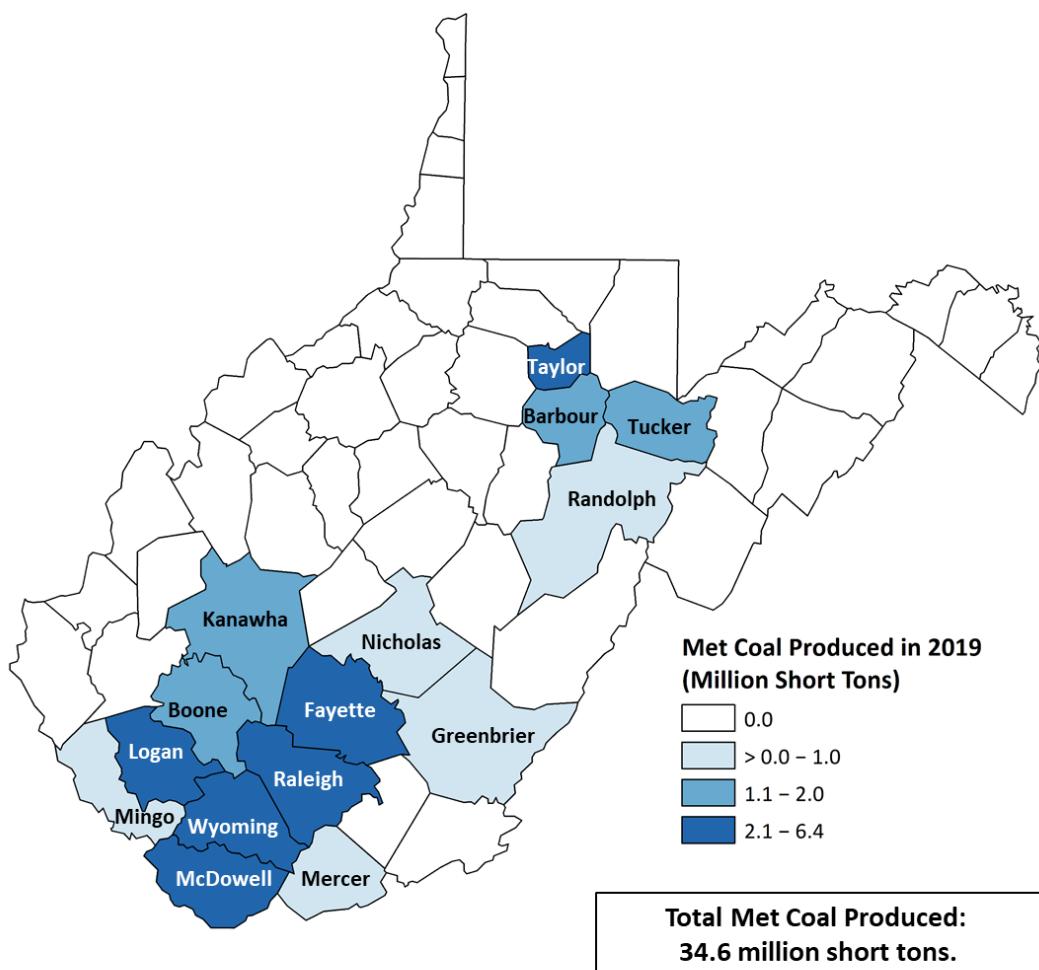
Section 2 of the report looks at the current trends in the met coal production and employment in West Virginia, followed by Section 3 that reports the economic impact of the West Virginia met coal production. Section 4 examines the economic impact the steel production that uses the West Virginia met coal. Finally, Section 5 summarizes the overall impact of West Virginia met coal production and the steel production in the United States. We present the economic impact in terms of output, employment, labor income, and tax impacts.

2 Met Coal Production and Employment in 2019

Our economic impact analysis is based on the met coal production in 2019. In this section we examine the met coal production and met coal employment in 2019 in West Virginia. The West Virginia Coal Association provided information on the names of coal mines in the state that produced met coal in 2019, as opposed to thermal coal, or coal that is used for electric power generation. We match these names with the US Mine Safety and Health Administration (MSHA) mine level data and calculate the amount of coal produced and the number of workers employed by these mines.

Figure 1 shows West Virginia met coal production by county in which these mines were located. We identified 15 counties in West Virginia that produced met coal in 2019. As shown, the majority of West Virginia met coal was produced by mines in southern West Virginia. Logan and Raleigh counties produced the largest amount of coal of more than 6.0 million short tons each in 2019. Fayette, McDowell, and Wyoming counties in southern West Virginia, as well as Taylor County in northern West Virginia, produced more than 2.0 million short tons each in 2019. The total amount of met coal produced in the state in 2019 was 34.6 million short tons.

Figure 1: West Virginia Met Coal Producing Counties, 2019



Source: US MSHA and West Virginia Coal Association

Figure 2 shows total met coal employment in these met coal producing counties and how it compared to the overall coal mining employment. Logan and Raleigh counties, two met coal producing counties that produced more than 6.0 million short tons of met coal in 2019, had also the biggest met coal employment of 1,250 and 1,330, respectively. While met coal employment in the two counties was the majority, it accounted for nearly 56 percent of all coal mining employment in Logan County and more than 77 percent in Raleigh County. Several counties produced only met coal in 2019 and their met coal employment accounted for 100 percent of all coal mining employment. They include Barbour, Greenbrier, McDowell, and Wyoming counties. On average, the met coal producing counties accounted for 62.7 percent of all coal mining employment in their counties.

Figure 2: Met Coal Employment Relative to Coal Mining Employment, Met Coal Producing Counties, 2019

County	Coal Mining Employment		
	Met	Thermal	Percent Met
Barbour	434	0	100.0
Boone	229	629	26.7
Fayette	386	221	63.6
Greenbrier	256	0	100.0
Kanawha	333	863	27.9
Logan	1,250	1,027	54.9
McDowell	1,137	0	100.0
Mercer	29	12	70.9
Mingo	67	671	9.1
Nicholas	126	86	59.5
Raleigh	1,330	395	77.1
Randolph	164	21	88.6
Taylor	427	42	91.0
Tucker	112	112	50.0
Wyoming	578	0	100.0
All Met Coal Producing Counties	6,857	4,078	62.7

Source: US MSHA and West Virginia Coal Association

3 Economic Impact of West Virginia Met Coal Production in the United States

In this section we examine the economic impact of West Virginia met coal production on the US economy. This impact includes the economic impact that goes to the West Virginia economy and the associated economic that spills to the rest of the states. Our estimate is based on the 2019 met coal production as it closely represents the production experienced during normal demand before the effects of the 2020 COVID-19 pandemic. Additionally, met production data for 2021 are not yet available.

ECONOMIC IMPACT ANALYSIS BACKGROUND: To estimate the economic impact of West Virginia met coal production and associated steel industries, we apply a detailed model of the US economy that outlines how trade-flows among industries interact with key economic indicators such as employment, income, output, and tax revenue.¹

As an example, expenditures that take place to mine coal and compensate coal mine workers are referred to as the direct economic impact of coal production. The total economic impact of this coal production, however, 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, suppliers that provide services such as site preparation, tunneling, coal stripping, truck transportation, etc., will increase their production in correspondence with an increase in coal production. 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 US economy, generating additional output, income, and employment. This activity associated with employees spending their income in the nation 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 on the US economy.

ECONOMIC IMPACT OF WEST VIRGINIA MET COAL PRODUCTION: We estimate the direct impact of the met coal production based on the revenue received from the sale of met coal produced in West Virginia in 2019. More specifically, we estimate the revenue by multiplying the amount of the met coal produced that year by the average coal’s mine-mouth price for the same year.

We estimate met coal’s mine-mouth price using two sets of information: information on the average price of all coal produced in the northern and southern West Virginia from the US Energy Information Administration (EIA) and information on the amount of met coal produced in northern and southern West Virginia from MSHA. Our estimate yields a met coal’s mine-mouth price of about \$122 per short

¹ This study was conducted using the IMPLAN modeling software, an industry-standard input-output model of the economy. More information about IMPLAN can be found at <http://www.implan.com>.

ton. Based on this information, we estimate that the met coal produced in West Virginia generated revenue of about \$4.2 billion.²

For the purposes of estimating the direct economic impact, we assume that the total expenditures are the same as the total revenue received from the sale of the coal, which is \$4.2 billion. This figure represents the direct output impact of West Virginia met coal production. For comparison, this represents about 65 percent of the direct output impact of all West Virginia coal we estimated in our [previous study](#).³

We estimate that this \$4.2 billion direct output is expected to generate \$5.4 billion in secondary output impacts, resulting in a total economic impact of \$9.6 billion in output in the US economy, or a multiplier of 2.3 (Figure 3). For comparison, this multiplier is significantly bigger than the multiplier we estimated in our previous study, which is 1.5. This is because our [previous study](#) considered only the impact of coal on West Virginia economy, while this study considers the impact on the US economy as a whole.

According to data from the West Virginia Coal Association, the West Virginia met coal production directly generated nearly 6.9 thousand coal mining jobs in 2019. We estimate that it is expected to generate 23.6 thousand additional jobs in the US economy, resulting in a total employment impact of 30.5 thousand jobs. The large multiplier of about 4.5 represents the fact that coal miners earn relatively high incomes.

Further, West Virginia met coal production generates around \$2.5 billion in labor income in the nation. Finally, West Virginia met coal production is estimated to generate nearly \$554 million revenue for the US state and local governments.

Figure 3: Economic Impact of West Virginia Met Coal Production in the United States

Type of Impact	Direct	Indirect and Induced	Total
Output (\$, billions)	4.2	5.4	9.6
Employment (thousand jobs)	6.9	23.6	30.5
Labor Income (\$, billions)	0.9	1.6	2.5
Tax Revenue (\$, millions)	--	--	553.9

Notes: Output, Income, and Taxes are measured in 2019 dollars. Tax impact includes US state and local sales, personal income, property, corporation net income, and severance taxes.

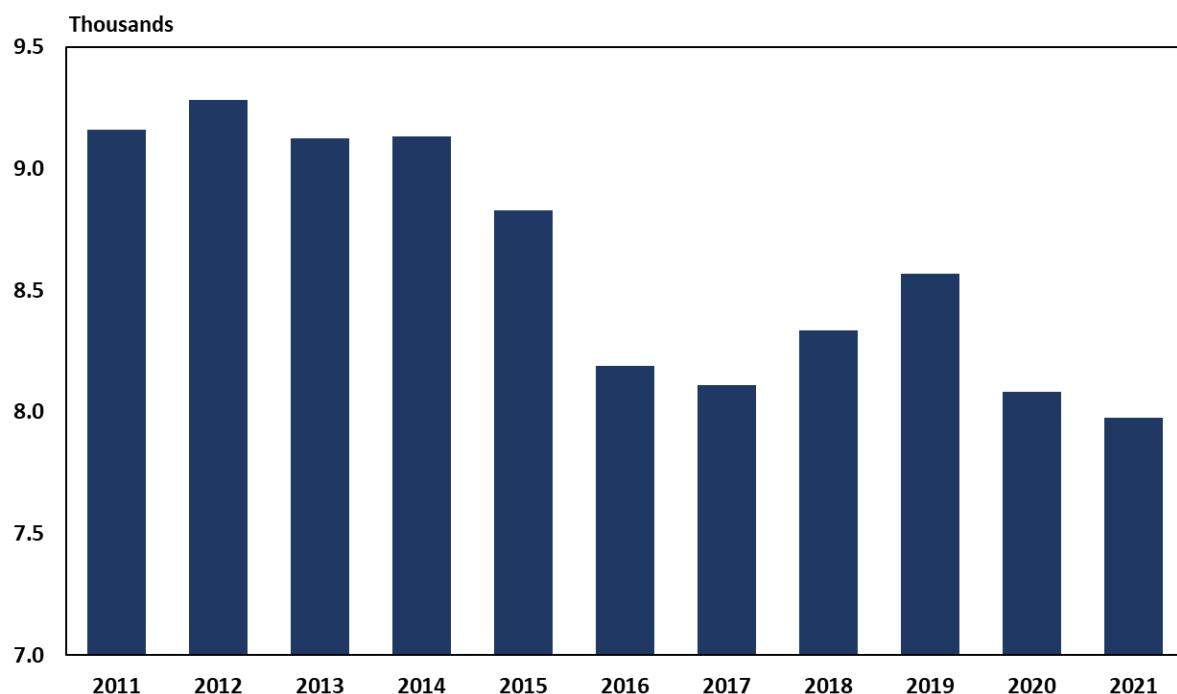
² This figure is derived by multiplying 34.6 million short ton of coal by met coal's 2019 annual average mine-mouth price of \$122 per short ton.

³ Our previous study can be accessed here: [The Economic Impact of Coal and Coal-fired Power Generation in West Virginia](#).

4 Economic Impact of US Steel Production that Uses West Virginia Met Coal

RECENT TRENDS IN THE US STEEL PRODUCTION: After declining in the early 2010s to 81.0 thousand jobs in 2017, employment in the iron, steel, and ferroalloy manufacturing industry increased temporarily to 85.7 thousand jobs in 2019, before declining again to less than 80.0 thousand jobs in 2021 (Figure 4). This is the lowest employment level in the industry since 2011. As of 2021, the industry makes up about 0.07 percent of US total private employment or 0.09 percent of US total private salary and wages.⁴

Figure 4: Employment in the Iron, Steel, and Ferroalloy Manufacturing Industry, United States



Source: U.S. Bureau of Labor Statistics

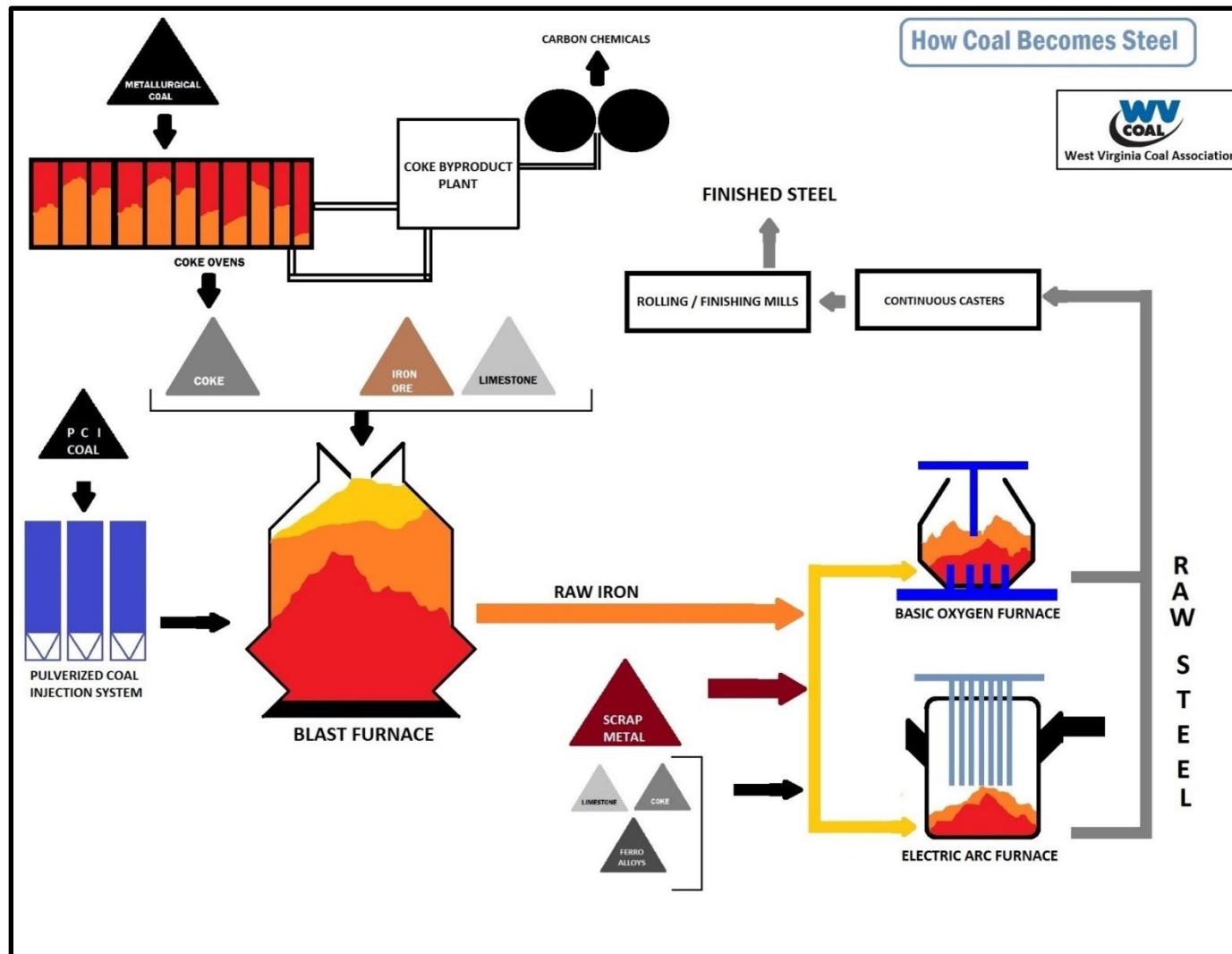
⁴ Source: Quarterly Census of Employment and Wages (QCEW), US Bureau of Labor Statistics

USE OF MET COAL IN THE STEEL PRODUCTION: In this section we briefly describe using met coal in the steel production process. The description helps interpret the economic impact of the US steel production that we estimate in this report.

Figure 5 illustrates the process of turning met coal into steel. Met coal is converted to coke in specially designed ovens. Coke is used as both a fuel for the blast furnace operation and as a chemical and physical reductant in the production of raw iron. Coke produced from met coal is also used in iron and steel refining processes, where iron is converted to steel in Basic Oxygen and Electric Arc furnaces.

In addition to producing coke, a specific blend of met coal referred to as pulverized coal injection (PCI) coal is used in a blast furnace to heat the charge of raw iron ore, coke, and fluxing stone. Today, given the high price of natural gas, the operating cost of using PCI coal to heat furnaces is cheaper than using natural gas or furnace flue gas. Finally, met coal and coke are also used in a variety of other ferro-alloy industries as a fuel for smelter and foundry operations and a carbon additive to finished alloys and metals.

Figure 5: The Process of Using Met Coal to Produce Steel



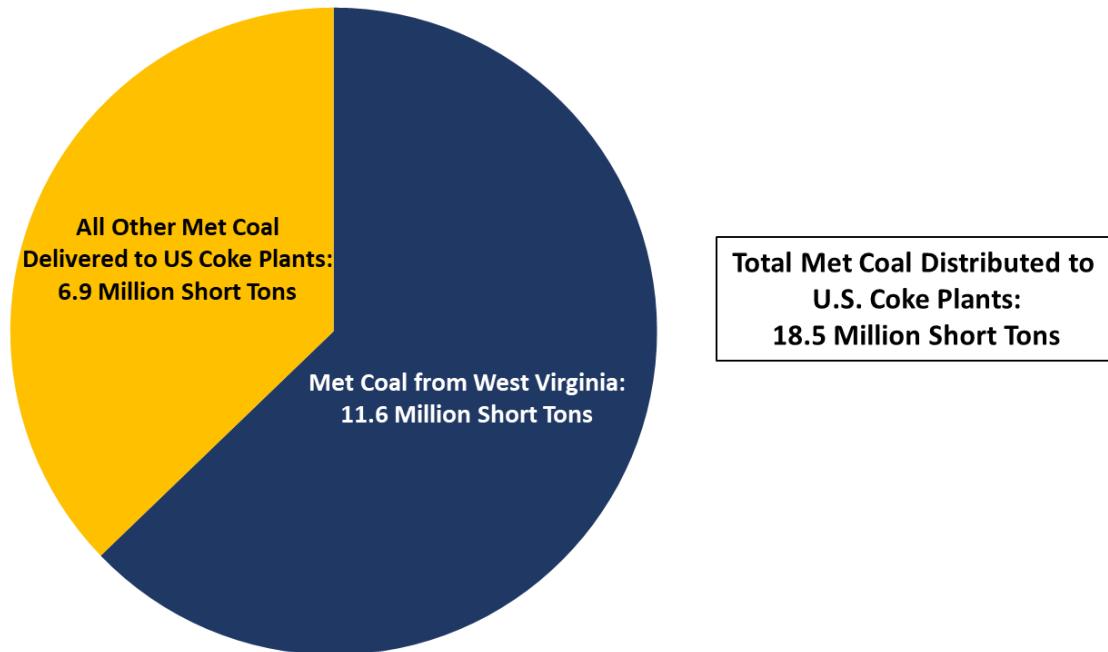
Source: West Virginia Coal Association

ECONOMIC IMPACT OF THE US STEEL PRODUCTION: In this section we report our estimate of the economic impact of the US steel production. Our analysis focuses on the steel production in the US that uses coke converted from the West Virginia met coal. We don't account for the impact of any byproduct that is also produced using the West Virginia met coal.

As described in the Economic Impact Analysis Background section above, the total impact of an economic activity includes the activity's direct impact, its indirect impacts, and their associated induced impacts. The activity's indirect impacts stem from all industries that subsequently support that activity. This implies that when we estimate the economic impact of the US steel production, we've already considered the impact of the West Virginia met coal and its converted coke that are used in the steel production in the US. Accordingly, when we report the economic impact of the US steel production below, we take out the impact associated with the West Virginia met coal used in the production because it is already included in the economic impact of West Virginia met coal production reported above.

To estimate the direct output impact of the steel production we first get the estimate of the total output produced by the US iron, steel, and ferroalloy manufacturing in 2019 from IMPLAN, which is \$110.8 billion. The next step is to figure out how much of this output is attributed to the use of the West Virginia met coal. We estimate this by multiplying this total output by the share of West Virginia met coal out of all the US met coal used to produce steel. Figure 6 shows a total of 18.5 million short tons of met coal were distributed to coke plants in the US in 2019, of which 11.6 million short tons or nearly 63 percent came from West Virginia. Using this share, we calculate that out of the \$110.8 billion output produced by the US iron, steel, and ferroalloy manufacturing, \$69.6 billion can be attributed to the use of West Virginia met coal. This latter figure represents our estimate of the direct output impact of the US steel production that uses West Virginia met coal.

Figure 6: Met Coal Distributed to US Coke Plants by State of Origin, 2019



Source: Coal Distribution Report and Coal Report, U.S. Energy Information Administration

It is important to note that since the economic impact of West Virginia met coal production has already been counted above, its impact included in the overall impact of steel production is excluded from the indirect and induced impacts to avoid double counting. After excluding the impact of the West Virginia met coal production, we estimate that the \$69.6 billion direct output of steel industry supported by West Virginia's met coal is expected to generate \$116.4 billion in secondary output impacts, resulting in a total economic impact of \$186.0 billion in output in the United States economy (Figure 7).

We estimate the US steel production supplied by West Virginia coal directly generated 55.6 thousand jobs in 2019 in the iron, steel, and ferro alloy manufacturing industry, and is expected to generate more than 491 thousand additional jobs in the US economy, resulting in a total employment impact of 547 thousand jobs. This employment impact multiplier (9.8) is larger than that for the met coal production impact. This is driven by the fact that in addition to paying high wages, the iron, steel, and ferro alloy manufacturing is very capital intensive.

Further, the US steel production generates \$39.4 billion in labor income in the nation. Finally, the US steel production is estimated to generate \$5.4 billion of tax revenue for US state and local governments.

Figure 7: Economic Impact of Steel Production that Uses West Virginia Met Coal

Type of Impact	Direct	Indirect and Induced	Total
Output (\$, billions)	69.6	116.4	186.0
Employment (thousand jobs)	55.6	491.4	547.0
Labor Income (\$, billions)	6.3	33.1	39.4
Tax Revenue (\$, billions)	--	--	5.4

Notes: Output, Income, and Taxes are measured in 2019 dollars. Tax impact includes US state and local sales, personal income, property, corporation net income, and severance taxes.

5 Total Economic Impact of West Virginia Met Coal Production and US Steel Production in the United States

Finally, we recap the economic impact of both West Virginia met coal production and the US steel production. We estimate that West Virginia met coal production and associated US steel production generated a combined direct output impact of \$73.8 billion in 2019. We further estimate that this direct output impact generates \$121.8 billion in secondary impacts, resulting in a total economic impact of nearly \$195.6 billion of output in the United States economy.

We estimate that both West Virginia met coal production and associated US steel production employed around 62.5 thousand workers directly. We estimate these industries also support more than 515 thousand additional jobs in the US economy, resulting in a total employment impact of around 577.5 thousand jobs. Further, West Virginia met coal production and associated US steel production generate around \$41.9 billion in total labor income. Finally, these activities are estimated to generate around \$5.9 billion in tax revenue for US state and local governments (Figure 8).

Figure 8: Economic Impact of West Virginia Met Coal Production and Steel Production in the United States

Type of Impact	Direct	Indirect and Induced	Total
Output (\$, billions)	73.8	121.8	195.6
Employment (thousand jobs)	62.5	515.0	577.5
Labor Income (\$, billions)	7.2	34.7	41.9
Tax Revenue (\$, billions)	--	--	5.9

Notes: Output, Income, and Taxes are measured in 2019 dollars. Tax impact includes US state and local sales, personal income, property, corporation net income, and severance taxes.

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