Consensus Coal Production Forecast for West Virginia: 2021

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Introduction

The West Virginia Consensus Coal Production Forecast is a combined production forecast comprised of four component forecasts. A consensus approach to forecasting seeks the wisdom of the crowd in producing an expectation for output from the coal industry. The Consensus Forecast is used to provide the best expectation of tax revenues to be collected for mandatory reclamation activities conducted through the Special Reclamation Fund and the Special Reclamation Water Trust Fund.

This report describes recent historical coal production trends for the State of West Virginia including the individual industries that comprise the major segments of demand for coal produced in West Virginia. Each of the component forecasts used to form the Consensus Forecast is described, with information about assumptions and resulting projected levels of production for West Virginia. The process used to produce the Consensus is also described, including the weightings applied to each of the component forecasts. The West Virginia Consensus Coal Production Forecast is calculated for the years 2021 through 2045.

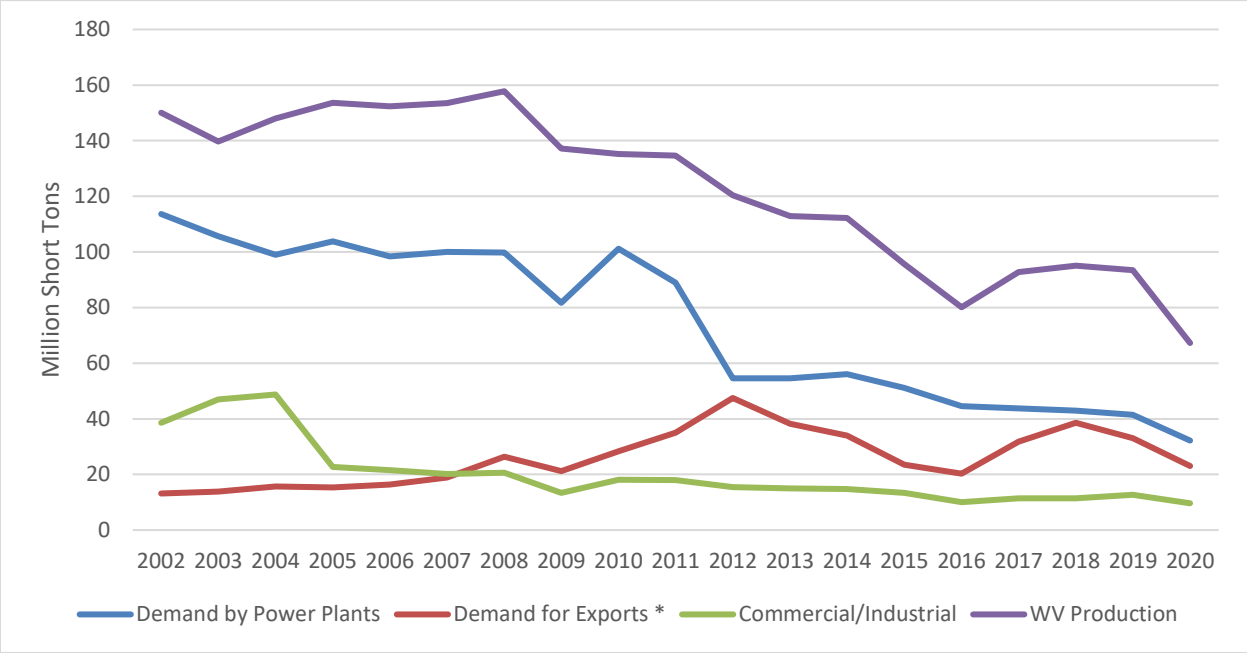
Overview of West Virginia Coal Production

West Virginia coal production for 2020 was 67.3 million tons (EIA 2021),[1] a decrease from the 93.3 million tons produced in 2019. This decrease reflects various trends and events within the coal industry's primary markets: power generation, exports, and industrial demand, all compounded by the effects of the COVID-19 pandemic. Demand for West Virginia coal decreased by about 28 percent from 2019 levels, led by a decrease in demand for exports.

Future demand for West Virginia coal depends on several variables. These include the pace of economic recovery from the pandemic, the capacity of gas-fired electrical generators in the region and the price paid for gas by those generators, the lifespan and generation levels of the coal-fired power plants that will continue to burn coal from the State, the extent of new renewable generation, exchange rates and the rate of economic growth of countries that import West Virginia coal, and the nature of compliance with environmental regulations. Recent demand trends with preliminary and estimated data for 2020 are shown in Figure 1.

[1] 67.3 million tons is the Energy Information Administration's revised 2020 production value based on the final 2020 value published by MSHA (clean coal production reported on MSHA Form 7000-2). The West Virginia Office of Miner's Health, Safety and Training (WVOMHST) reports 2020 production of 73 million tons, but this may not be exclusively clean coal, which is the final production volume.

Figure 1. Historical West Virginia Coal Production and Components of Demand



Source: EIA. Asterisked (*) 2020 volumes estimated by MU CBER. Other 2020 figures are preliminary by EIA.

The Electricity Sector

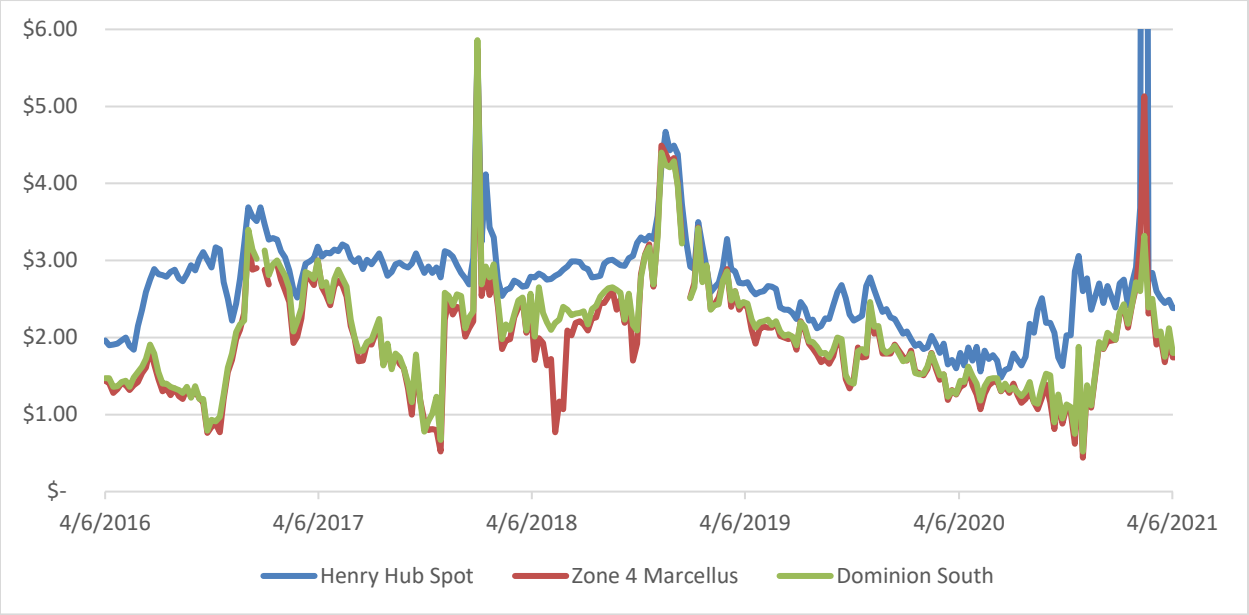
Preliminary coal distribution data for 2020, published by the U.S. Energy Information Administration (EIA), indicate that demand for West Virginia-produced coal by the electricity sector fell sharply in 2020, to about 32.2 million tons, compared to 41.4 million tons in 2019 (EIA 2021). This was a decline of 22.4 percent between 2019 and 2020, while total coal distribution to the electric power industry also fell by about 22.4 percent during the same time (EIA 2021).

Natural Gas Prices

In previous years, a large contributor to reduced coal demand was the price of natural gas. From 2019 to 2020, the average U.S. price of gas delivered to the electric power sector decreased sharply, averaging $2.99/mcf in 2019 (nominal dollars) and $2.48/mcf in 2020 (EIA 2020). Coal has been somewhat less competitive than in 2018, when delivered gas prices averaged $3.68/mcf.

For several years, abundant gas production from the Marcellus play, combined with relatively low takeaway capacity, has resulted in especially low gas prices in a primary region in which West Virginia coal competes. That differential has diminished but still persists at times, as shown in the following chart of weekly prices at the two primary Marcellus area price hubs vs. the Henry Hub (Figure 2).

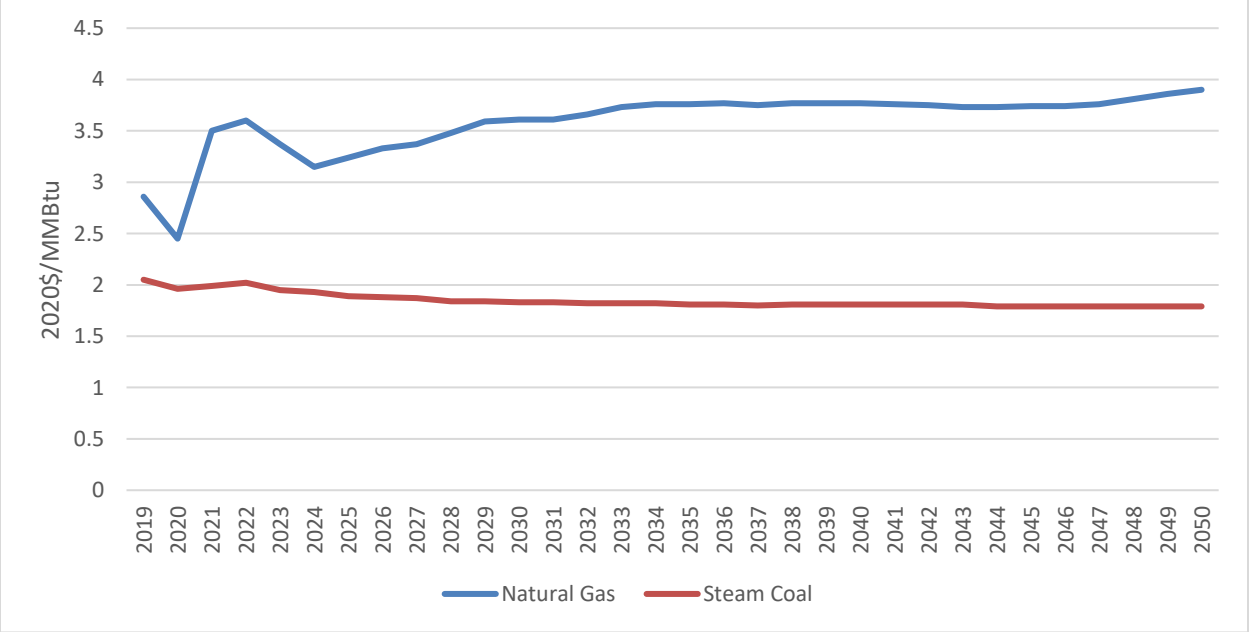
Figure 2. Select Marcellus Area Vs. Henry Hub Gas Prices ($/MMBTU)



Source: EIA, Natural Gas Weekly.

In its Annual Energy Outlook (AEO) 2021 Reference Case analysis, the EIA continues to project real natural gas prices delivered to the power generation sector to increase while coal prices decline at a gradual rate through 2050 (Figure 3) (EIA 2021).

Figure 3. EIA Forecasted Natural Gas & Coal Prices to Electricity Sector



Source: EIA, AEO 2021.

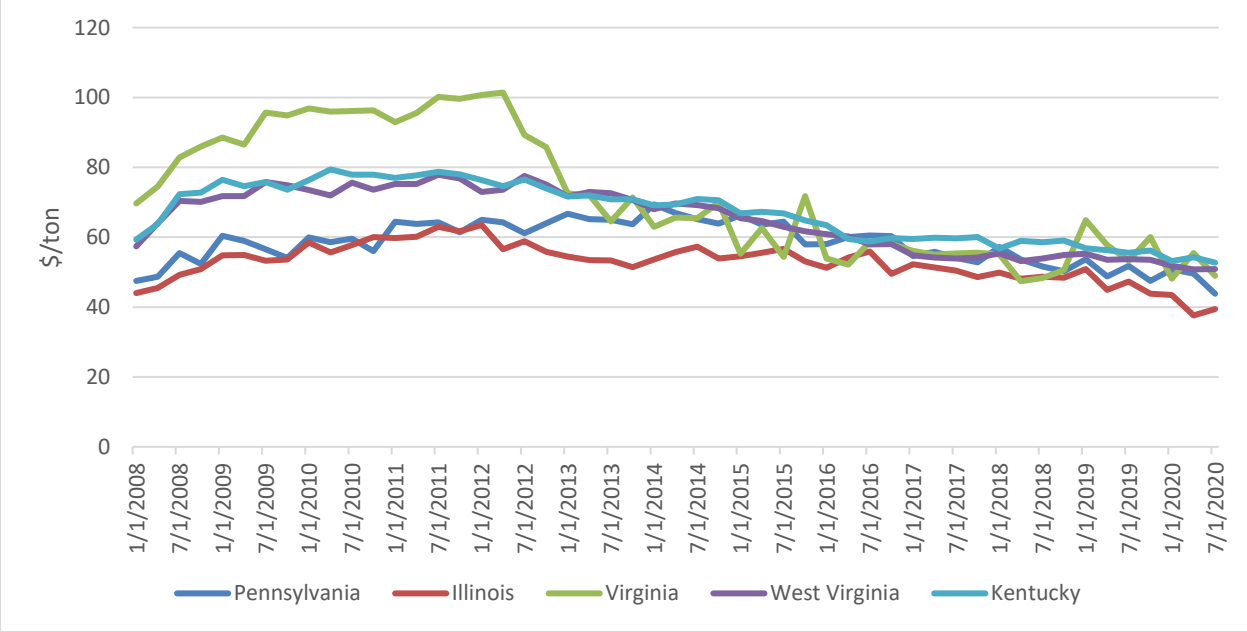
Coal-Fired Power Plant Retirements

In 2019 and 2020, several coal-fired power plants retired that were consumers of West Virginia coal. One of these plants, the 69 MW Morgantown Energy Facility, was located in West Virginia. Other significant closures included two other independent power producers, the 655 MW Somerset plant in New York, and the 588 MW Dickerson plant in Maryland. In 2019, Virginia Electric & Power closed smaller coal units at three plants that used West Virginia coal - Chesterfield, Mecklenburg, and Yorktown (EIA 2020).

Prices of Coal Delivered to the Electricity Industry

The price of West Virginia-produced coal delivered to power plants has been falling since around 2012. Average prices for regional coal producing states are much closer than in previous decades. Prior to 2013 West Virginia, Virginia and Kentucky producers commanded a premium over coal produced from Pennsylvania and Illinois. Prior to 2019 that premium had largely disappeared, although the gap between Illinois coal grew in 2019 and 2020 (Figure 4).

Figure 4. Coal Prices to the Electricity Industry by Mine State



Source: EIA, Quarterly Coal Report.

Environmental Regulation

On March 15, 2021, EPA finalized the Revised Cross-State Air Pollution Rule Update for the 2008 ozone National Ambient Air Quality Standards (NAAQS). Starting in the 2021 ozone season, the rule will require additional emissions reductions of nitrogen oxides (NOX) from power plants in 12 states (Environmental Protection Agency 2021).

The Waters of the United States (WOTUS) law was revised in 2020. The new version of the law is considered to be less stringent than the 2015 version and to provide some clarity for the mining industry (National Mining Association 2020). The rule rejected the "significant nexus" test for navigability from 2015, but may have extended regulation for wetlands, man-made ditches, and ephemeral streams. Per the law man-made ditches are now considered "tributaries" if they pass through wetlands and water flows through them. Ephemeral streams are now only federally regulated if an ephemeral break is part of an otherwise regulated intermittent or perennial tributary, or if they are seasonally inundated by more than a direct response to precipitation, e.g., indirectly by groundwater table elevation or snowpack melts (The National Law Review 2020).

The Industrial Sector

As shown In Figure 1, demand for West Virginia coal by the industrial sector (coke plants and self-generating manufacturers, including coal-fired combined heat and power plants) decreased substantially from 2018 to 2020, with demand down about 15 percent from 2018. This decrease occurred primarily at coke plants, which represented annual demand of almost 8.8 million tons in 2020. From 2018 to 2019, U.S. steel production increased by one percent, to 87.8 million metric tons (mmt), up from 86.8 mmt in 2018, but fell to 72.7 mmt in 2020 (International Trade Administration 2021).

In 2020, the U.S. imported 20 million metric tons of steel, a 21% decrease from 25.4 mmt in 2019. The U.S. steel trade deficit amounted to 13.9 mmt, a 25% decrease from 18.7 mmt in 2019. Imports from Russia (-60%) showed the largest volume decline in 2020, followed by Japan (-35%), Taiwan (-31%), South Korea (-22%) and Mexico (-11%). 2020 imports from Turkey increased by 72% (ITA 2021).

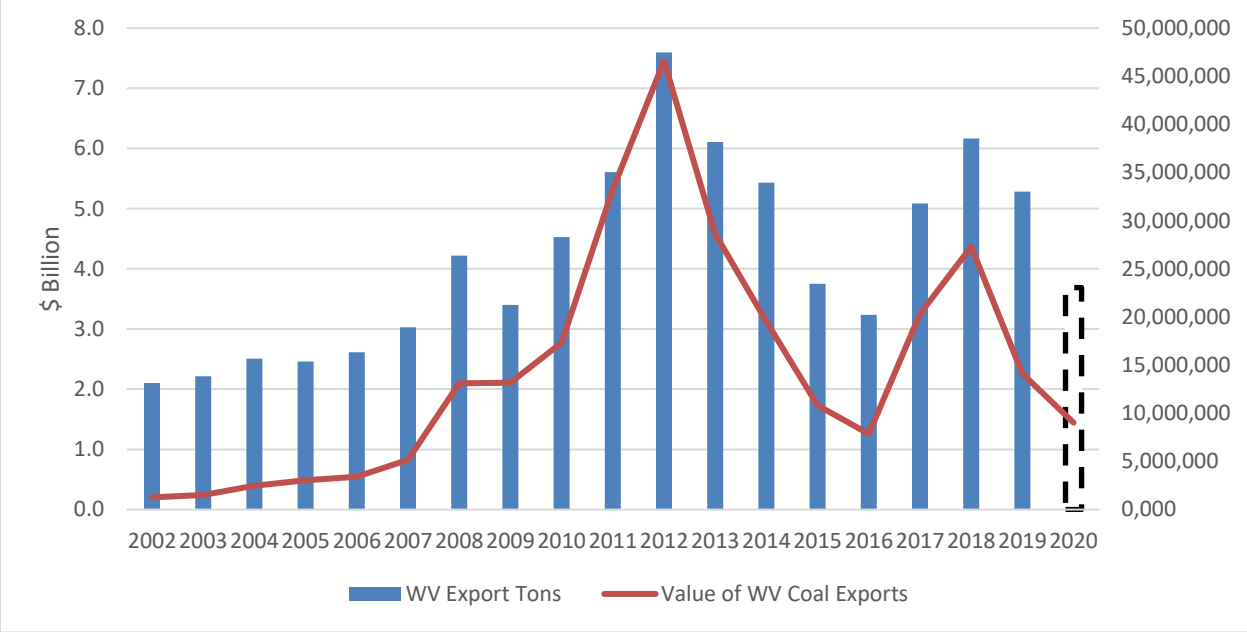
Exports

The nation's coal exports fell in 2019 and 2020, totaling 93.7 million short tons in 2019 and 69.1 million tons in 2020, down from about 116 million short tons in 2018.[2]

The value of coal exports from West Virginia dropped to $1.4 billion in 2020, down from $2.3 billion in 2019. The State maintained exports to many countries in North America, Europe, South America, Africa, and Asia. The top five importing countries by value were India, Ukraine, Brazil, the Netherlands, and Morocco (ITA 2021). Figure 5 shows the value of West Virginia-based coal exports and associated tonnage from 2002 to 2020.

[2] 2020 data for coal export tonnage by U.S. state of origin has not yet been released. CBER estimates West Virginia's exports based on historical shares of total exports and the value of coal exports from the state.

Figure 5. Value and Tonnage of West Virginia Coal Exports, 2002-2020



Source: EIA, ITA; 2020 export tonnage estimated by CBER.

Component Forecasts

Energy Information Administration (EIA)

Publication: Annual Energy Outlook 2021

Date: January 2021

Forecast Horizon: 2021-2050

Region(s): Northern Appalachia, Central Appalachia

The EIA provides a forecast of coal production by region in its 2021 Annual Energy Outlook, projecting through 2050. This projection is generated using the National Energy Modeling System (NEMS). NEMS uses a market-based approach that balances energy supply and demand while considering regulations and industry standards. NEMS is a modular system, with modules that represent each of the fuel supply markets, conversion sectors, and end-use consumption sectors of the energy system (EIA 2021).

Only the EIA Reference Case figures are used for the Consensus forecast, which represents EIA's 'best assessment of how U.S. and world energy markets will operate through 2050." This projection assumes improvement in known energy production, delivery, and consumption technology trends (Energy Information Administration 2021).

The EIA's forecasts for Appalachia are used to create an EIA forecast for West Virginia coal production. The method used is described in Appendix B.

Key Assumptions:

Macroeconomic Issues: Real GDP growth averages 2.1% per year from 2020 to 2050.

Coal Prices: EIA projects the average mine mouth price for all coals to be about $31/ton in 2021 (2020$) and to rise to $35 by 2050.

Natural Gas Prices: Henry Hub[3] spot prices are expected to be about $3.10 in 2021 and rise thereafter at an annual rate of 2.0 percent, resulting in an average expected price of $3.69/MMBtu in 2050.

Electricity: U.S. use of coal for production of electricity is expected to decline by 1.1% annually through 2050. Coal-fired generating capacity is expected to decrease at a rate of 2.5 percent

[3] The Henry Hub in Louisiana is the delivery point for the natural gas futures contract on the New York Mercantile Exchange.

per year through 2050. By comparison, combined cycle (natural gas) capacity is projected to increase by 1.6% per year and renewable capacity is projected to increase by 3.2 percent per year.

Industrial/Commercial: Industrial self-generators (CHP plants, power plants with a non-regulatory status, and small on-site generating systems) are expected to see a very slight increase in coal consumption of 0.2 percent per year through 2050. Metallurgical coal use in coke plants is projected to decrease by 0.4 percent per year. The commercial sector is expected to maintain flat coal consumption of one million tons per year.

Exports: U.S. coal exports are projected to rise steadily to 99 million tons in 2024 and to be at least 95 million tons throughout the remaining forecast period.

Environmental: The AEO2021 includes the effects of current legislation, environmental regulations, and international protocols including recent government actions for which implementing regulations were available as of the end of September 2020. This includes the Mercury and Air Toxics Standards (MATS) and the Cross-State Air Pollution Rule (CSAPR). AEO2021 reflects a number of state-level policies that affect its projections of the electricity generation mix. These include the Illinois Future Energy Jobs Act, the New York Clean Energy Standard, and the Maryland Clean Energy Jobs Act. In 2020, only Virginia enacted new legislation for renewable portfolio standards (RPS) programs. At the federal level, the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) jointly issued The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021-2026 Passenger Cars and Light Trucks in April 2020 as an amendment to and replacement of the 2012 Corporate Average Fuel Economy (CAFE) standards for light-duty vehicles. The updated standard sets fuel economy and carbon dioxide standards, which increase 1.5% in stringency each year from model years 2021 through 2026 (EIA 2021).

Energy Ventures Analysis (EVA)

Publication: EVA Long-Term Forecast

Date: June 2021

Forecast Horizon: 2021-2050

Region(s): All states

EVA utilizes the AURORAxmp 24/7 dispatch model (which EVA licenses) to calculate electricity generation by fuel type. The forecast reflects the least cost dispatch solution consistent with the operating parameters of individual units and regulatory requirements. Existing generation, planned generation which is deemed to be likely to be constructed, and announced retirements are reflected. In addition, the model adds and retires capacity in an economic manner and as required by law.

Key Assumptions:

Macroeconomic Issues: GDP growth is expected to average 2.8% per year over the forecast period, with strong GDP growth in the next three years and then gradually declining growth to under 2% in the latter part of the forecast period.

Coal Prices: Coal prices vary by region, coal quality, and market. Current prices are relatively high due to the strength in the global market and expected economic growth as a result of the recovery from the coronavirus pandemic. After recovery, prices are expected to soften slightly and then start to grow slightly in real terms throughout the forecast period. Pricing is based upon production costs including return on investment. Future pricing also reflects the higher cost of capital related to the reduced access to capital as a result of environmental, social and governance (ESG) concerns.

Natural Gas Prices: Henry Hub gas prices are expected to soften from current levels which are above $3.00 per MMBtu ($2020) in 2021 and range from $2.50 to $3.00 ($2020) through 2040. Thereafter, prices are expected to increase through 2050 resulting in a price of $3.56 per MMBtu (2020$) in 2050.

Electricity: Growth in electricity demand is expected to average 1.0% per year. This rate of growth is higher than in prior years due to the expected impact of electric vehicles on demand. Utility demand for coal is expected to decline from 515 million tons in 2021 to less than 100 million tons by 2050. The decline is heavier in the early years as a number of plants are retired in response to CCR and ELG rule. The forecast production reflects which power plants are

assumed to be in operation in each year and their expected coal supply. Therefore, the forecast would change with any changes to the retirement schedules.

Industrial/Commercial: Demand from other sectors is also expected to decline. The decline reflects industrial plant conversions from coal to natural gas and reduced metallurgical coal in steelmaking as the industry continues to shift from blast furnace to electric arc furnace production. The non-metallurgical industrial demand affects most coal supply regions. As this demand is tied to specific plants, demand depends upon their continued operation. As industrial plants are retired, the mix of coals is affected. All of the domestic metallurgical coal is expected to originate in Appalachia. Commercial demand is relatively small.

Exports: The level of exports is affected by global demand for coal and global supply. U.S. export levels are a function of the competitiveness of U.S. coals in the global market which in turn is affected by the relative strength of the U.S. dollar particularly with respect to the Australian dollar as global coal trade is U.S. dollar denominated and Australia is the largest exporter of bituminous coals. The U.S. exports both steam and metallurgical coals. U.S. metallurgical coal exports exclusively originate in Appalachia. U.S. steam coals originate throughout the U.S. with the origin a function of coal quality, transportation logistics, and cost. Steam and met coal export forecasts are exogenously determined through an analysis of global supply and demand. The resulting price forecast, however, affects domestic pricing and therefore utility coal demand.

Steam coal exports are largely expected from four regions in the future: Northern Appalachia, the Illinois Basin, the Powder River Basin, and the Rockies. Other regions, such as Central Appalachia, are believed to be not economic long-term and therefore unlikely to participate except in unusual circumstance. The exports reflecting the expected shift in the market away from the Atlantic to the Pacific. Both the Powder River Basin and Rockies coal are typically exported through the west coast, primarily terminals in western Canada. Northern Appalachia coals will move through the U.S. East Coast while Illinois Basin coals will move through the U.S. East Coast and the U.S. Gulf. While the U.S. continues to be a swing global supplier, contraction in the global coal industries has created a potentially larger role.

Met coal exports are largely expected from Appalachia. Metallurgical coal production is expected from the Northern, Central, and Southern areas where the highest quality metallurgical coal is produced. While global metallurgical coal demand is expected to decline over time, some continued blast furnace production is expected globally through 2050.

Environmental: Coal Combustion Residuals (CCR) and Effluent Limitation Guidelines (ELGs) go into effect according to their regulatory schedule. Plants which are not expected to comply are retired. Federal carbon limitations are not assumed. Compliance is assumed with announced

state/regional plans. Pennsylvania is assumed to join the Regional Greenhouse Gas Initiative (RGGI) effective January 2022. The caps in AB32 (California) are assumed to be extended through 2050. Florida is assumed to put into place a Renewable Performance Standard (RPS) for solar development. The various tax credits (i.e., production tax credits, investment tax credits, and Section 45Q [carbon capture] credits) are generally assumed to continue as they are.

Market Uncertainty: There are substantial changes underway in the global energy market as global concerns over carbon emissions are resulting in significant changes in the U.S. and other countries. The changes include efforts to reduce carbon emissions through the expansion of low carbon generation including increased use of renewables including offshore wind, batteries, small modular nuclear reactions, and green hydrogen. With respect to fossil fuels, there are global efforts to expand the use of carbon capture technology. Other technologies of interest include direct air capture. In addition, the transportation sector is moving toward greater use of electrical vehicles which in turn would increase electricity demand growth. The future forecasts of coal production are qualified by these uncertainties.

Marshall University Center for Business and Economic Research (CBER)

Publication: CBER West Virginia Coal Production Forecast 2021

Date: May 2021

Forecast Horizon: 2021-2050

Region(s): West Virginia

The CBER forecast of West Virginia total coal production is an econometric model based on quarterly coal production from 1984 through 2020. The forecast uses an averaging approach based on two separate long-term forecasts (through 2050). Both models incorporate a mid/short-term forecast (through 2033) based largely on the market for thermal coal produced in the State. One short-term model treats the economic recession in 2009 and subsequent sharp downturns in historical coal production as structural breaks in the market while the other uses the differential between natural gas and coal prices delivered to the power generation sector to explain changes in production. To create the initial short-term forecasts, quarterly changes in total coal production were modeled with a vector autoregression (VAR) approach based on historical demand for West Virginia-sourced coal in regional power generation. For years beyond 2033, the forecast utilizes an autoregressive approach, which estimates future changes in total coal production based on historical patterns.

Because this is a technical model based solely on historical data, CBER does not make any specific assumptions about future micro or macroeconomic variables. The model is heavily influenced by recent downward trends in demand for coal and projects a continued and fairly rapid decline in production over the next few years.

West Virginia University Bureau for Business and Economic Research (BBER)

Publication: WVU BBER Coal Production Forecast 2021

Date: June 2021

Forecast Horizon: 2021-2050

Region: Northern West Virginia and Southern West Virginia

The WVU Bureau of Business and Economic Research Coal Production Forecast is an econometric model based upon changes in factors that affect the demand and price for coal sourced from mines in Northern and Southern West Virginia between 1985 and 2020. Historical data on coal prices, production and other energy-related data are obtained from a variety of Energy Information Administration reports. Forecasts for US-level explanatory variables were taken from the IHS March 2021 Long-Term Forecast and the 2021 Annual Energy Outlook from the Energy Information Administration (West Virginia University 2021).

Consensus Forecast

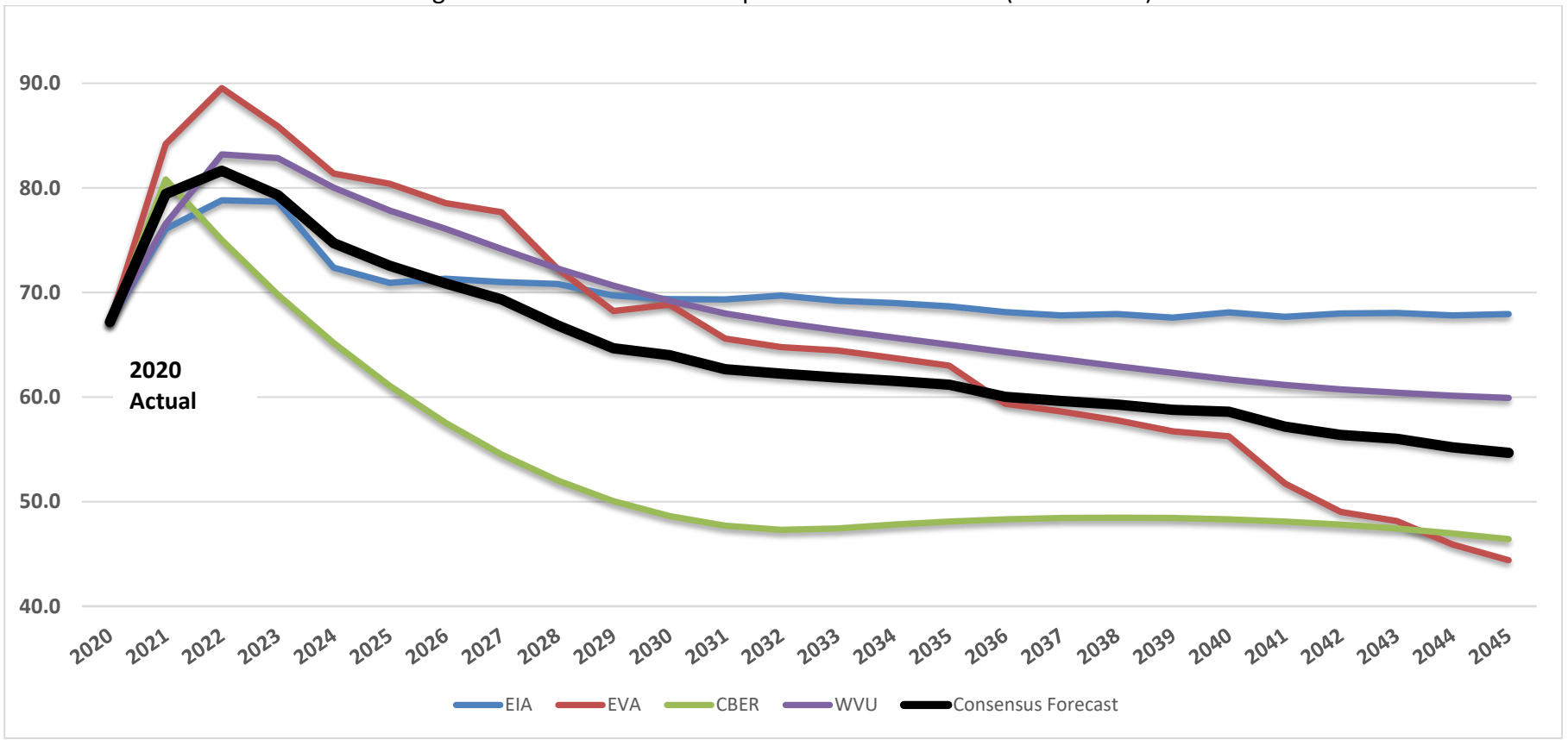
The four long-term forecasts produced by EIA, EVA, CBER and BBER are combined to create the 2021 Consensus Forecast for West Virginia Coal Production. For simplicity, a simple average was used to calculate the consensus forecast[4] (Figure 6 and Table 2). Coal production in West Virginia is projected to initially rebound from 67.3 million tons in 2020 to 81.6 million tons in 2022, followed by a steady decline to about 55 million tons in 2045.

Summary

The four component models incorporate a range of possible levels of West Virginia coal production over the next 24 years, with varying forecasts that illustrate the impact of primary supply and demand variables and uncertainty over the continuation of recent trends. The consensus reduces uncertainty by combining the forecasts into one aggregate projection. Despite an expected short-term recovery in coal production, the consensus forecast projects that West Virginia will experience a steady decline in coal production through 2045.

[4] Due to the subjective nature of weight selection, a simple average approach (with same weight for all four forecasts) would generate a very similar forecast as the weighted average but does not require additional (often unrealistic) assumptions to estimate accuracy rate of historical forecasts.

Figure 6: Consensus and Component Forecasts 2021 (million tons)



Source: EIA, EVA, WVU BBER and authors' calculation.

Table 2: Consensus Forecast for West Virginia Coal Production 2021 (million tons)

Year	Historical	2021 Forecasting Group				2021 Consensus	2019 Consensus	2017 Consensus	2016 Consensus	2015 Consensus
		EIA	EVA	CBER	BBER*					
2015	95.5									107.2
2016	80.1								79.5	103.4
2017	92.8							86.8	76.9	101.7
2018	95.1							83.6	74.7	102.7
2019	92.4						91.1	84.1	76.7	104.8
2020	67.2						88.3	87.1	80.1	104.9
2021		76.1	84.2	80.8	76.6	79.4	84.4	86.1	78.6	104.4
2022		78.8	89.5	75.0	83.2	81.6	84.1	85.9	75.7	103.4
2023		78.7	85.9	69.8	82.9	79.3	83.3	84.7	73.1	102.8
2024		72.4	81.4	65.2	80.0	74.7	82.3	82.8	70.3	102.8
2025		70.9	80.4	61.1	77.8	72.6	81.2	81.5	69.1	102.4
2026		71.3	78.5	57.5	76.1	70.9	80.7	80.2	67.9	102.2
2027		71.0	77.7	54.5	74.2	69.3	80	79.3	66.2	101.7
2028		70.8	72.3	52.0	72.3	66.8	78.8	77.7	64.5	101.2
2029		69.7	68.2	50.1	70.7	64.7	78.7	76.8	63	100.9
2030		69.4	68.8	48.6	69.2	64.0	77.6	76.3	61.7	100.9
2031		69.3	65.6	47.7	68.0	62.7	76.8	76.1	62.1	100.5
2032		69.7	64.8	47.3	67.1	62.2	76.1	76	62.9	100.9
2033		69.2	64.5	47.4	66.4	61.9	75.3	76.6	63.3	99.8
2034		69.0	63.7	47.8	65.7	61.6	74	76.7	63.1	98.3
2035		68.7	63.0	48.1	65.0	61.2	73.5	76.6	62.5	97.3
2036		68.1	59.4	48.3	64.3	60.0	73.4	76.5	62.3	
2037		67.8	58.6	48.4	63.6	59.6	73.1	76.1	60.4	
2038		67.9	57.8	48.5	63.0	59.3	72.6	75.6	59.7	
2039		67.6	56.7	48.4	62.3	58.8	72	75.8	58.6	
2040		68.1	56.3	48.3	61.7	58.6	71.2	75.3	57.1	
2041		67.7	51.7	48.1	61.2	57.2	70.7			
2042		68.0	49.0	47.8	60.7	56.4	70.4			
2043		68.0	48.1	47.4	60.4	56.0	70.3			
2044		67.8	45.9	47.0	60.1	55.2	70.1			
2045		67.9	44.4	46.4	59.9	54.7	69.9			

Source: EIA, EVA, WVU BBER and authors' calculation. All forecasts were produced in 2021.

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Appendix A: EIA Forecasts for Regional Coal Production

EIA forecasts Appalachian coal production to decline gradually through 2037, with greater stability from 2037 to 2050. As shown below (Figure A1), Interior[5] production is projected to challenge Appalachian production throughout the time period. Northern Appalachian[6] production is expected to be 10 million tons above Central Appalachia through 2050.

Figure A1. EIA Forecasted Coal Production by Region

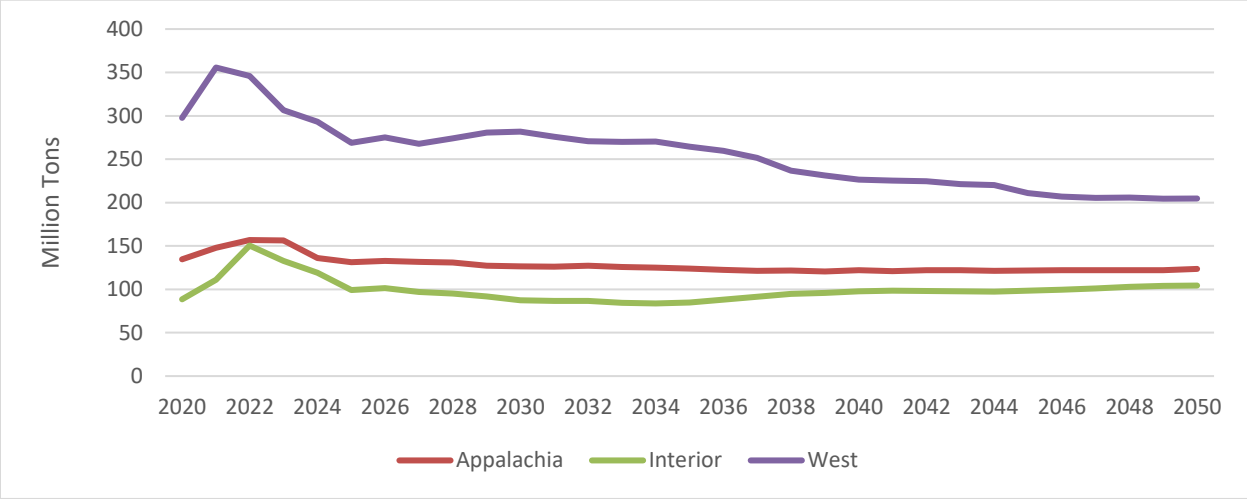
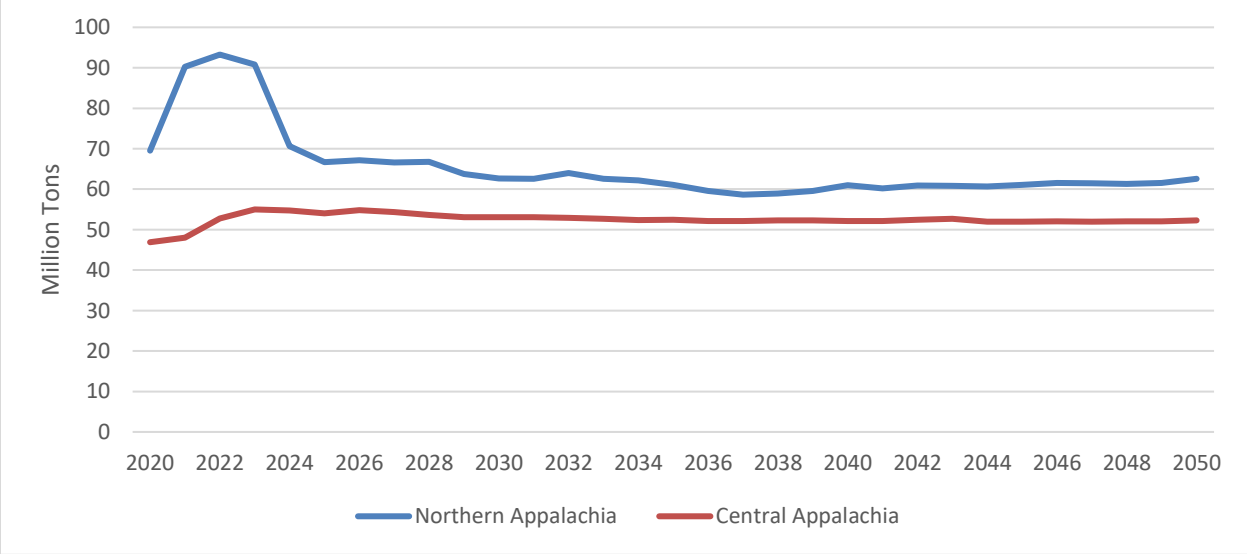


Figure A2. EIA Forecasted Coal Production for Northern and Central Appalachia



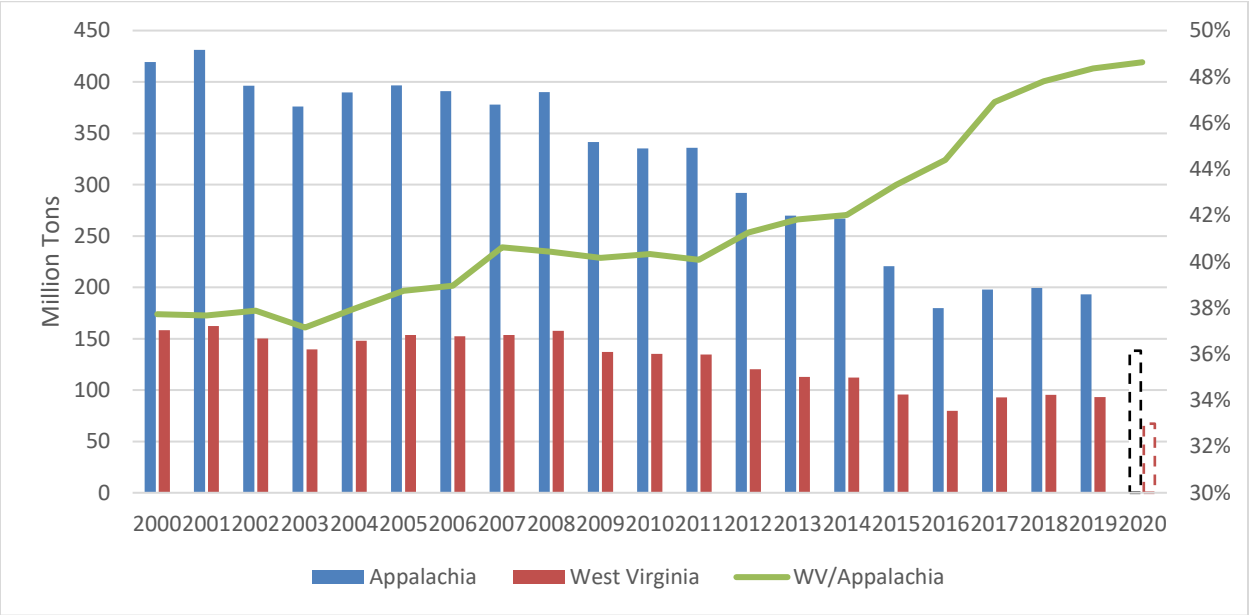
Source for Figure A1 and Figure A2: EIA AEO 2021.

[5] Arkansas, Illinois, Indiana, Iowa, Kansas, W. Kentucky, Louisiana, Mississippi, Missouri, Oklahoma, and Texas.
[6] Northern Appalachia includes Pennsylvania, Maryland, Ohio, and N. West Virginia. Central Appalachia includes Virginia, E. Kentucky, N. Tennessee, and S. West Virginia.

Appendix B. EIA Forecast for West Virginia

The EIA forecast for WV coal production is derived from EIA's forecast for the Appalachia region, as the agency does not publish forecasts for individual states. The WV forecast was calculated using year-adjusted WV/Appalachia coal production.

Figure A3. EIA Appalachian Forecasts Applied to West Virginia Coal Production



Source: EIA AEO 2021 and CBER calculations for West Virginia production.

Appendix C. WVU BBER Forecast of Northern vs. Southern WV Production

Figure A4. WVU BBER Forecast of Northern vs. Southern WV Production