Consensus Coal Production Forecast for West Virginia: 2013

FINAL REPORT

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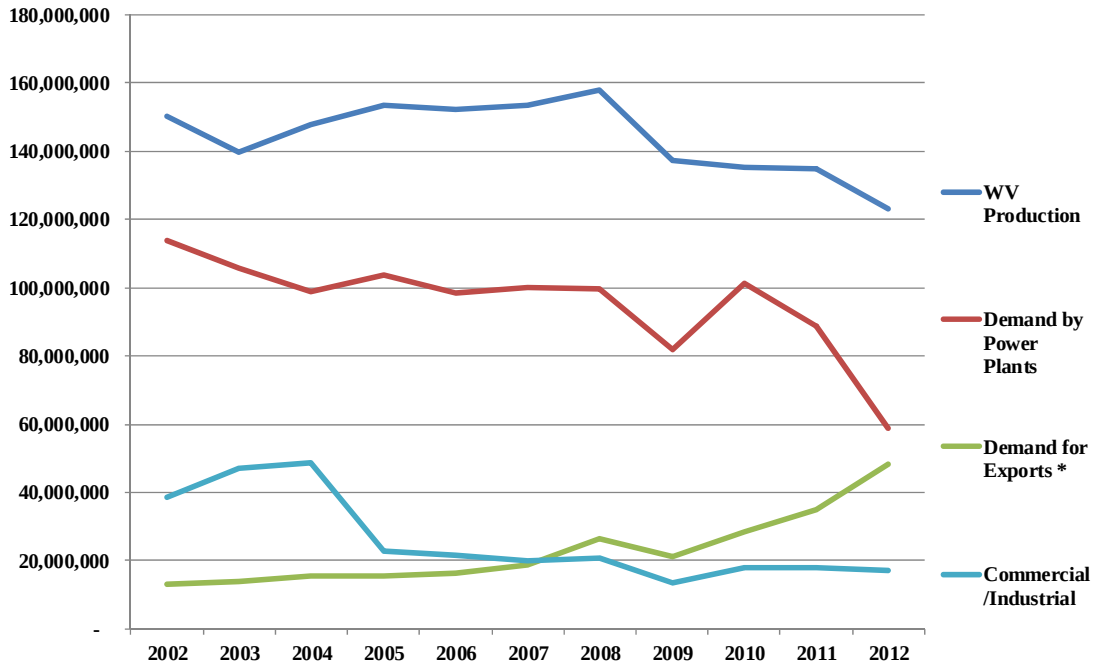
Consensus Coal Production Forecast for West Virginia: 2013

Overview

This report describes the results of the 2013 Consensus Coal Forecast conducted by the Marshall University Center for Business & Economic Research for the Special Reclamation Fund Advisory Council. The report begins with a brief summary of recent trends in West Virginia (WV) Coal Production and then describes each of the four component forecasts used to develop the Consensus Forecast.

West Virginia coal production for 2012 was around 123 million tons (Mine Safety & Health Administration 2013).[1] This represents a decline of about nine percent from the 135 million tons produced in 2011 and is 23 percent below 2008 production of 158 million tons, the height of production during the 2002 to 2012 time period. The most significant contributor to the recent decline has been very low natural gas prices, with the electricity sector demonstrating considerably lower demand and widespread substitution of natural gas for coal. Increasing coal prices in Appalachia and WV also reduced competitiveness with Western and Midwestern coals. Figure 1 shows the recent trends with preliminary sector-level data for 2012.

Figure 1: Historical West Virginia Coal Production and Components of Demand (tons)



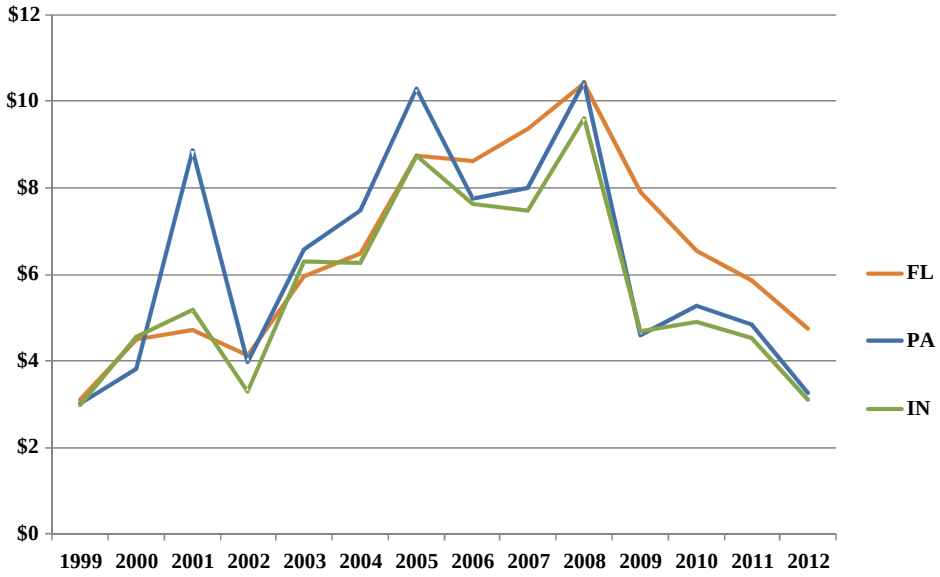
Source: (EIA 2013, MSHA 2013). * 2012 volumes estimated by MU CBER.

[1] 123.2 million tons is the final 2012 value published by the MSHA, the source of EIA's publications, and is clean coal production reported on MSHA Form 7000-2. As EIA will conduct its own internal evaluation of the data prior to publishing its 2012 Annual Coal Report what it reports as final tonnage for 2012 may not match this amount.

The Electricity Sector

Demand for coal by the electricity sector has declined and is expected to decline further as closure of many power plants in the Eastern U.S. has been announced for the 2014 to 2018 time period to comply with Environmental Protection Agency (EPA) air quality regulations. At least 75 plants that were customers of West Virginia coal between 2002 and 2011 have already retired or have announced full retirement by 2018. Several plants due to retire have already reduced consumption of WV coal, thus causing the effects of retirement to occur sooner. The ability to observe individual plant coal consumption changes while gas prices were at recent historical lows allowed valuable insight into the relative sensitivity of coal demand by plants at varying locations and with varying characteristics, both for total and WV coal. Figure 2 shows average delivered natural gas prices to the electricity industry for select states that are also major customers of West Virginia coal.

Figure 2: Natural Gas Prices to Electric Power Consumers, 1999 to 2012 (Select States)



Source: EIA, 2013.

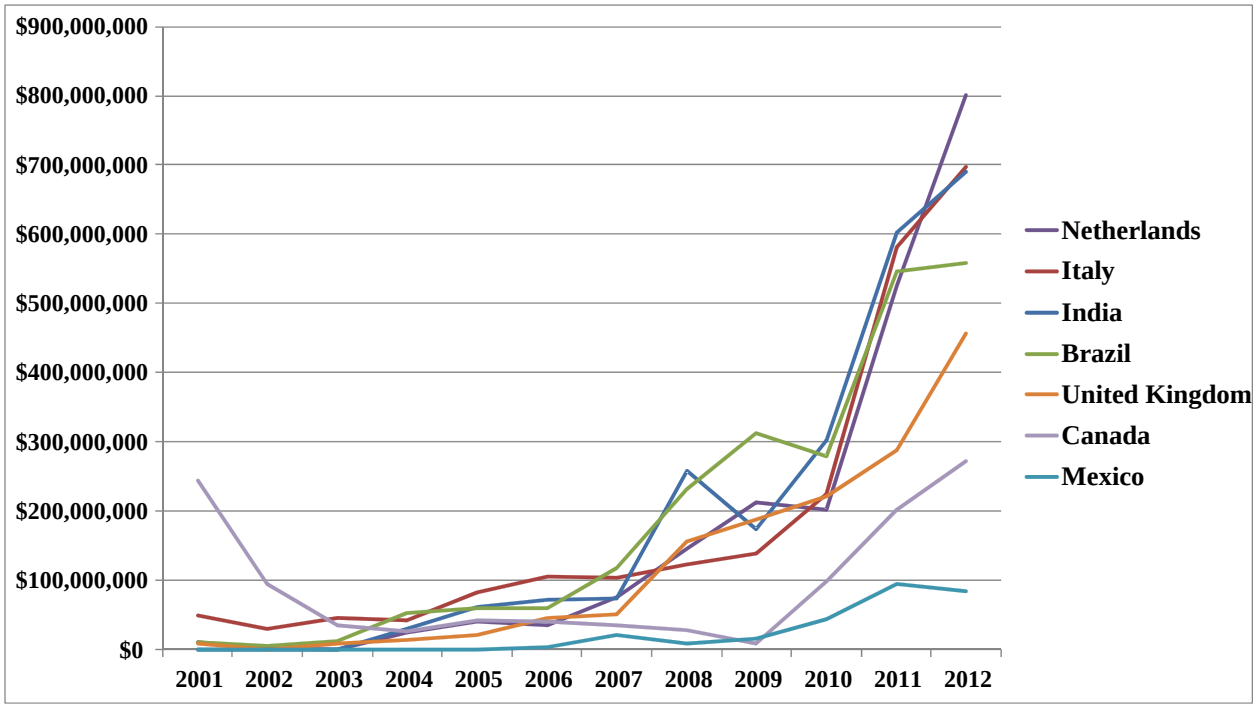
The Industrial Sector

As shown in Figure 1, demand for coal by the industrial sector, i.e. coke plants and self-generating manufacturers, was less responsive than demand at power plants to the low natural gas prices observed in 2012. For the steel industry in particular, fuel substitution represents more of a long-term opportunity rather than a short-term opportunity as opposed to the electricity industry where substitution is for some suppliers a very short-term decision. Demand for WV coal by industrial self-generators also declined but not as dramatically as within the electricity industry.

Exports

West Virginia's coal exports more than tripled during the study period. Exports have been considerably uncorrelated with prices, with the large growth between 2010 and 2012 being major points of observation. West Virginia has a historical average market share of about one-third of total US volume. This share is likely to have risen in 2012[2], based on growth in export value of 40 percent, although it is uncertain whether the current volumes can be sustained. The State has consistent exports to more than 30 countries throughout the world, and the Energy Information Administration (EIA) expects these countries to increase overall coal consumption by 60 percent by 2035 from 2011 levels. European countries are expected to reduce consumption while countries in the Middle East, South America, Africa and Asia are expected to increase consumption. Total US coal exports are projected to grow by 25% from 2012 to 2035, based on 2012 exports of 126 million tons. Figure 3 shows WV coal export trends for the top five importing countries in 2012 by value (Netherlands, Italy, India, Brazil, United Kingdom), plus Canada and Mexico.

Figure 3: West Virginia Coal Exports by Value, Top 5 Countries + Canada & Mexico



Source: (International Trade Administration 2013)

[2] 2012 data for coal export tonnage by U.S. State of origin has not yet been released.

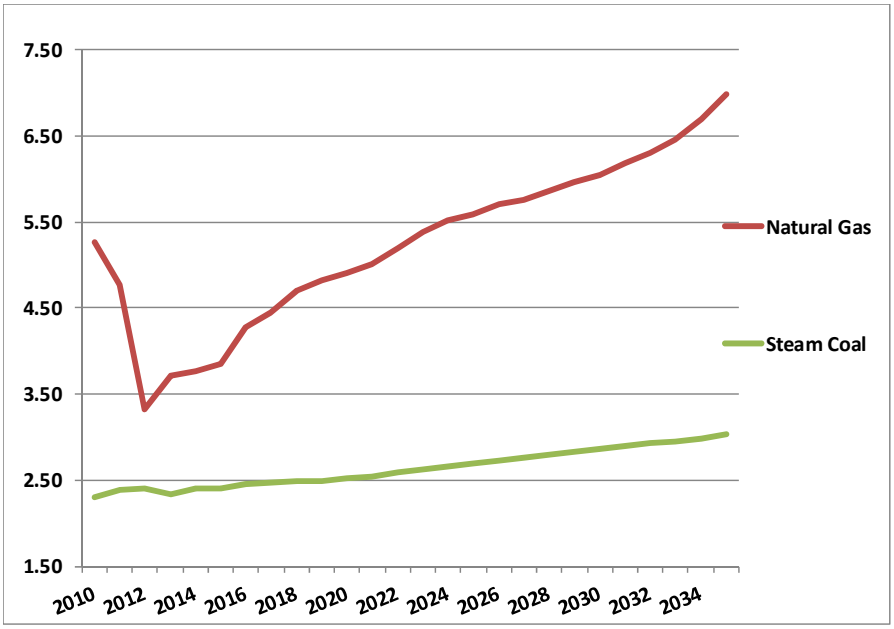
Looking Forward

Future demand for West Virginia Coal depends on several variables with uncertain outcomes including the prices of competing fuels, the longevity of the fleet of coal-fired power plants that have historically burned coal from the State and economic activity of importing countries.

The capacity of power plants available to use West Virginia coal is shrinking as many older plants retire, some ahead of schedule in order to comply with federal air-quality regulations. The recent announcement of the intent to close the Hatfield's Ferry plant, a large generator of 1970s vintage, demonstrates this uncertainty.

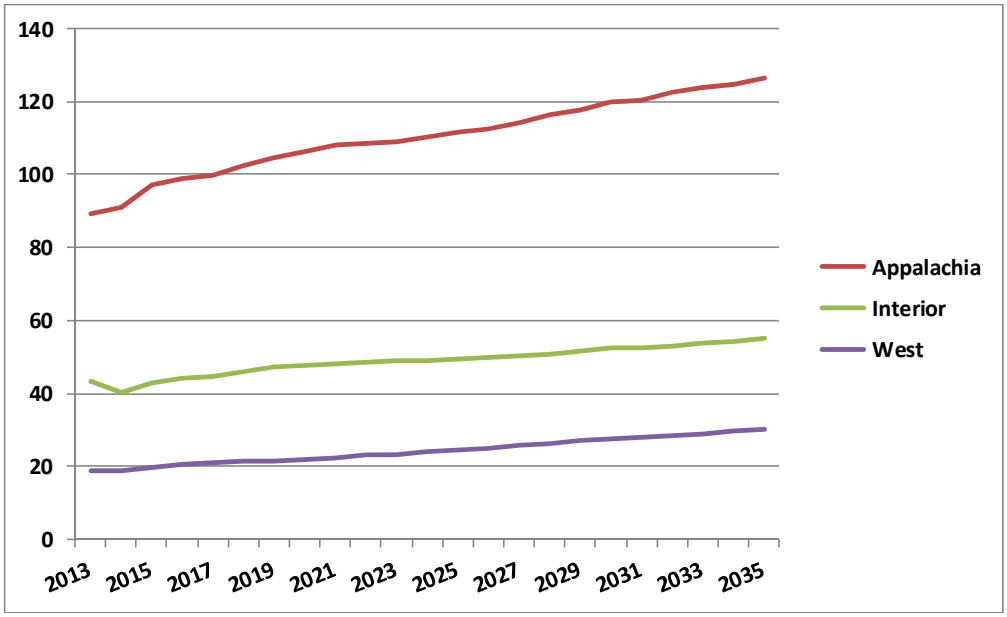
A very important factor affecting utilization of coal-fired power plants is the price of natural gas, which is in turn influenced by a number of other factors. Supply of natural gas has been very high, putting downward pressure on prices. Future developments such as increased exports of liquefied natural gas could put upward pressure on natural gas prices, although analyses differ on this outcome. Some analysis projects very little increase in prices due to increased exports (Deloitte 2011) while others expect more moderate increases (NERA Economic Consulting 2013) depending on supply. In its AEO 2013 Base Case analysis of commodities delivered to the electricity sector, the EIA projects natural gas prices to increase at a faster rate than coal prices.

Figure 4: EIA Forecasted Natural Prices & Coal to Electricity Sector (2011 $/MMBtu)



The relative price of West Virginia coal and Western and Illinois-basin coal is another factor. WV producers have been losing market share in the power generation sector to coal produced in Illinois and further west as plant operators substitute lower-btu, lower cost coal for WV coal. Installation of scrubbers on many power plants also allows greater usage of high-sulfur coal such as that found in Illinois. The EIA projects Appalachian coal prices to increase at a higher rate than Interior coal prices (includes Illinois) but at a slower rate than Western coal.

Figure 5: EIA Forecasted Minemouth Coal Prices, by Region (2011 $/ton)



Component Forecasts

Energy Information Administration (EIA)

Publication: Annual Energy Outlook 2013

Date: April 2013

Forecast Horizon: 2012-2040

Region(s): Northern Appalachia, Central Appalachia

The EIA provides a forecast of coal production by region in its Annual Energy Outlook, projecting 20 to 30 years into the future. 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.

As the EIA's forecasts are by coal-producing region only, some adjustments are made to adapt these figures to forecast West Virginia coal production. The Northern Appalachia region includes Pennsylvania, Maryland, Ohio, and Northern West Virginia while Central Appalachia includes Virginia, Eastern Kentucky, Northern Tennessee, and Southern West Virginia. To forecast West Virginia coal production through 2040, the annual growth rate for Northern Appalachia is applied to historical production figures for Northern West Virginia and the annual growth rate for Central Appalachia is applied to Southern West Virginia figures. Only the EIA Reference Case figures are used.

Key Assumptions/Results:

Macroeconomic Issues: The long-term macroeconomic projection from IHS Global Insight, Inc. is used in the EIA forecast. Real GDP growth averages 2.5% per year over the period from 2011 to 2040.

Coal Prices: Minemouth prices are expected to increase from $41.16 per ton to $61.28 per ton nationally by 2040, reflecting the assumption that coal mining productivity will continue to decline, but at slower rates than during the 2000s. EIA expects Appalachian coal prices to also increase due to a shift toward more higher-value coking coal exports.

Natural Gas Prices: Henry Hub [3] spot prices for natural gas are expected to increase by an average 2.4% per year to $7.83 per million Btu in 2040.

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

Electricity: Growth in overall electricity use has slowed but is still expected to increase by 28% from 2011 to 2040. Coal capacity additions in electricity generation are expected to be very low accounting for only 3% of total capacity additions through 2040.

Industrial/Commercial: The largest growth is expected to be in the industrial sector increasing energy use by 5.1 quadrillion Btu from 2011-2040. The commercial sector is expected to increase energy use 0.2% per year over the time period equaling 1.6 quadrillion Btu.

Exports: National coal exports are expected to increase by 48.6% by 2040. Forecasts for individual coal-producing regions are not published.

Environmental: Current legislation and environmental regulations for which implementing regulations were available as of September 30, 2012 are considered in the forecast. The reference case assumes regulations are primarily unchanged during the forecast horizon with the provision that policies with a sunset date will not exist past the stated date. Regulations considered include the Clean Air Interstate Rule (CAIR), the U.S. EPA's National Emissions Standards for Hazardous Air Pollutants (NESHAP), and the Mercury and Air Toxics Standards (MATS). The Cross-State Air Pollution Rule (CSAPR) has been vacated.

Table 1: EIA Annual Energy Outlook 2013 Adapted to WV Production

Historical			Forecast	
2011	2012	2013	2014	2015
134.7	123.2	116.9	119.4	115.4
		Forecast		
2016	2017	2018	2019	2020
116.1	117.2	109.2	104.1	104.6
		Forecast		
2021	2022	2023	2024	2025
103.4	106.0	108.8	108.2	107.9
		Forecast		
2026	2027	2028	2029	2030
108.6	108.4	107.3	107.4	107.7
		Forecast		
2031	2032	2033	2034	2035
107.8	105.8	104.4	104.9	104.7

Energy Ventures Analysis (EVA)

Publication: Long-Term Forecast
Date: May 2013

Forecast Horizon: 2013-2040

Region(s): Northern Appalachia, Central Appalachia, West Virginia

EVA utilizes the Aurora XP Dispatch Model that calculates electricity generation by fuel type by developing the least cost generation situation that will meet power demand. All existing and planned generation capacity is included and the model can add or retire capacity as needed (Energy Ventures Analysis 2013).

Key Assumptions/Results:

Macroeconomic Issues: GDP growth is expected to average 2.3% per year through 2040.

Coal Prices: Coal prices for both Northern and Central Appalachia are expected to increase. Northern Appalachia will reach of price of almost $70 per ton ($2013) and Central Appalachia will see a price over $90 per ton by 2040, averaged for both metallurgical and steam coals.

Natural Gas Prices: A competitive gas supply is a key assumption of the model. Gas prices are expected to steadily increase through 2040 resulting in a price over $7 per MMBtu.

Electricity: Growth in electricity demand is expected to average 1.3% per year through 2040. Demand for Appalachian coal by the electricity sector will fall by 50% between 2012 and 2040.

Industrial/Commercial: Non-coke industrial demand for Appalachian coal will fall by about 40% by 2040. Demand for metallurgical coal from Northern and Central (primarily) Appalachia will rise by about 20% by 2040.

Exports: Steam coal exports from Northern and Central (primarily) Appalachia will peak in 2013 and decline by about 45% by 2040. Met coal exports from Northern and Central (primarily) Appalachia will peak in 2012 and decline by about 40% by 2040. An export terminal will be constructed in the Pacific Northwest to deliver coal from the Powder River Basin (PRB) and the Rockies to Asia. Compared to 2011 volume, total Appalachian coal exports decline by 35% by 2040.

Environmental: CAIR is assumed to continue with impacted emitters exceeding compliance. CSAPR has been overturned and will not be replaced. MATS will continue through April 2015 plus a one year extension. Section 316(b) of the Clean Water Act, which covers cooling water intake structures, requires compliance by 2018 and the Coal Combustion Residuals (CCR) requires compliance by 2020. National Ambient Air Quality Standards (NAAQS) revisions will become affective after 2018. Greenhouse Gas New Source Performance Standard is assumed to

see significant revisions to the draft proposal, and CO2 policies are not considered at the national level.

Table 2: EVA Long-Term Forecast 2013, Million Tons

Historical		Forecast		
2011	2012	2013	2014	2015
134.7	123.2	117.1	115.3	110.2
Forecast				
2016	2017	2018	2019	2020
102.8	105.0	104.4	103.3	101.0
Forecast				
2021	2022	2023	2024	2025
101.7	102.8	101.6	102.1	100.3
Forecast				
2026	2027	2028	2029	2030
99.5	99.2	98.9	98.4	97.1
Forecast				
2031	2032	2033	2034	2035
95.3	93.8	91.1	87.9	82.8

Marshall University Center for Business and Economic Research (CBER)

Publication: MU CBER West Virginia Coal Production Forecast 2013

Date: June 2013

Forecast Horizon: 2012-2035

Region(s): West Virginia

The MU CBER West Virginia Coal Production Forecast is partly a simulation-style approach to short- and long-term coal production forecasting and partly an adoption of EIA's growth projections. This method utilizes electricity generation capacity as a primary factor influencing demand for coal by the electricity industry combined with observations of individual power plants to simulate future demand for West Virginia coal. The influence of many elements including environmental regulations, natural gas prices, and coal prices on future capacity are considered. The commercial, industrial, and export markets are evaluated separately, with inputs based largely on EIA demand assumptions and historical demand.

Key Assumptions/Results:

Macroeconomic Issues: Not separately considered outside of EIA's assumptions.

Coal Prices: The EIA projects minemouth coal prices in the Interior region to increase by about 1.4% per year through 2035. Appalachian coal prices are projected to increase by about 1.5% per year and Northern Great Plains, which includes the PRB, coal prices to increase by 2.8% per year.

Natural Gas Prices: The EIA projects real natural gas prices for power generation to return to 2011 levels in 2019 or 2020 and to increase by an average of 3.0% per year to $6.98 ($2011) per million Btu in 2035.

Electricity: Although electricity demand is expected to grow, no new coal-fired power plants are projected to be built within West Virginia's supply region. Thus, demand for West Virginia coal from the electricity industry is limited to the current portfolio of power plants. Individual plant demand is projected based on observed sensitivity to gas prices, comparing the relative sensitivity of change in total coal utilization to change in WV coal utilization. Plants that have not announced retirement are assumed to close upon reaching typical retirement age.

Industrial/Commercial: Assumes EIA's regional growth rate projections for coal consumed by industrial self-generators, coke plants and commercial facilities applies to users of WV coal. WV supplies coal to industrial customers in roughly a 20-state area that overlaps several sub-regions, each with a different consumption forecast. EIA forecasts different rates of growth or decline for sub-regions within WV's supply area and for the different types of users.

Exports: WV exports will return to historical average market shares in 2014, after peaking in 2012. From 2014 through 2035, WV will slowly lose market share, but will maintain export volumes at 2011 levels or higher. In the short-term, WV's export volume will largely keep pace with that of the nation, but in the long-term increases in coal exports will come from other producing regions due to the location of growth markets and increasing demand for coal with lower energy value.

Environmental: Power plant closures simulate announced retirements made to comply with EPA regulations. Unscrubbed plants will no longer consume coal from WV after 2015.

Table 3: MU CBER West Virginia Coal Production Forecast 2013, Million Tons

Historical			Forecast	
2011	2012	2013	2014	2015
134.7	123.2	119.8	116.1	114.6
		Forecast		
2016	2017	2018	2019	2020
114.2	114.4	114.7	115.6	116.0
		Forecast		
2021	2022	2023	2024	2025
115.7	115.8	114.2	112.2	111.1
		Forecast		
2026	2027	2028	2029	2030
110.0	109.9	109.5	108.0	105.0
		Forecast		
2031	2032	2033	2034	2035
101.9	101.7	96.5	96.3	94.7

Consensus Forecast

The three long-term forecasts produced by EIA, EVA, and Marshall CBER are combined to create the Consensus Forecast for West Virginia Coal Production. A weighted average is used to combine the four projections as follows.

$$WV\ Coal\ Production_t = w_{EIA} * EIA\ Production_t + w_{EVA} * EVA\ Production_t + w_{CBER} * CBER\ Production_t$$

The weight (w_i) assigned to each forecast is based on the accuracy of past forecasts by that organization. All available forecasts from 2009 through 2012 were evaluated for accuracy in the first four years of the forecast's horizon. For example, EIA's 2009 Annual Energy Outlook was assessed by considering the accuracy of its 2008, 2009, 2010, and 2011 projections.

This methodology was employed for various reasons. Only years since 2009 were evaluated due to the tumultuous macroeconomic conditions that appeared in late 2007 and 2008. This recession was not well predicted by national GDP indicators; therefore, the forecasts created prior to 2009 have inaccuracies based primarily on unexpected macroeconomic situations and not due to a lack of understanding of West Virginia's coal economy. Predictions for the first four years of the time horizon were considered because accuracy is typically highest at the beginning of the forecast. Long-term accuracy was not considered in this weighting method due to the large potential for unpredictable macroeconomic conditions to affect annual error.

The error (e_i) of a forecast was determined using the following formula.

$$e_{i,t} = \frac{Forecast\ Production_{i,t} - Actual\ Production_t}{Actual\ Production_t}$$

The absolute value of the errors was averaged for each forecasting organization to remove the effects of under-estimation and over-estimation canceling each other. CBER has no reported errors because 2013 is its first forecasting year. Table 4 shows the results of this process.

Table 4: Average Absolute Forecast Errors

	Average Error
EIA	4.26%
EVA	9.12%
CBER	N/A

The weight given to each organization in the consensus was calculated as follows.

$$w_i = \frac{\frac{1}{e_i}}{\sum_i \frac{1}{e_i}}$$

A low weight is assigned to the CBER forecast due to lack of previous forecast(s) to determine accuracy. A weight of 0.15 is assigned the entire time period (2013-2035). Results are shown in the following table.

Table 5: Consensus Weights

	2013-2035
EIA	0.58
EVA	0.27
CBER	0.15

Using the above weights, the Consensus Forecast is calculated. The results are shown in Table 6 and Figures 6 & 7. The Consensus Forecast for West Virginia Coal Production shows levels decreasing after 2012 and remaining stable through 2014 at 117 million tons. Production levels decrease moderately through 2016, show a slight increase in 2017, and decrease more rapidly through 2019. Production stabilizes around 105 million tons from 2019 through 2021. Levels increase moderately from 2022 to 2023. After 2023, West Virginia coal production is expected to decrease slowly through 2035 resulting in 97.3 million tons of coal produced.

Table 6: Consensus Forecast for West Virginia Coal Production 2013 (Million Tons)

Historical		Forecast		
2011	2012	2013	2014	2015
134.7	123.2	117.4	117.8	113.9
		Forecast		
2016	2017	2018	2019	2020
112.2	113.5	108.7	105.6	105.4
		Forecast		
2021	2022	2023	2024	2025
104.8	106.6	107.6	107.2	106.3
		Forecast		
2026	2027	2028	2029	2030
106.3	106.1	105.4	105.0	104.4
		Forecast		
2031	2032	2033	2034	2035
103.5	101.9	99.6	99.0	97.3

Figure 6: WV Coal Production - Consensus Forecast

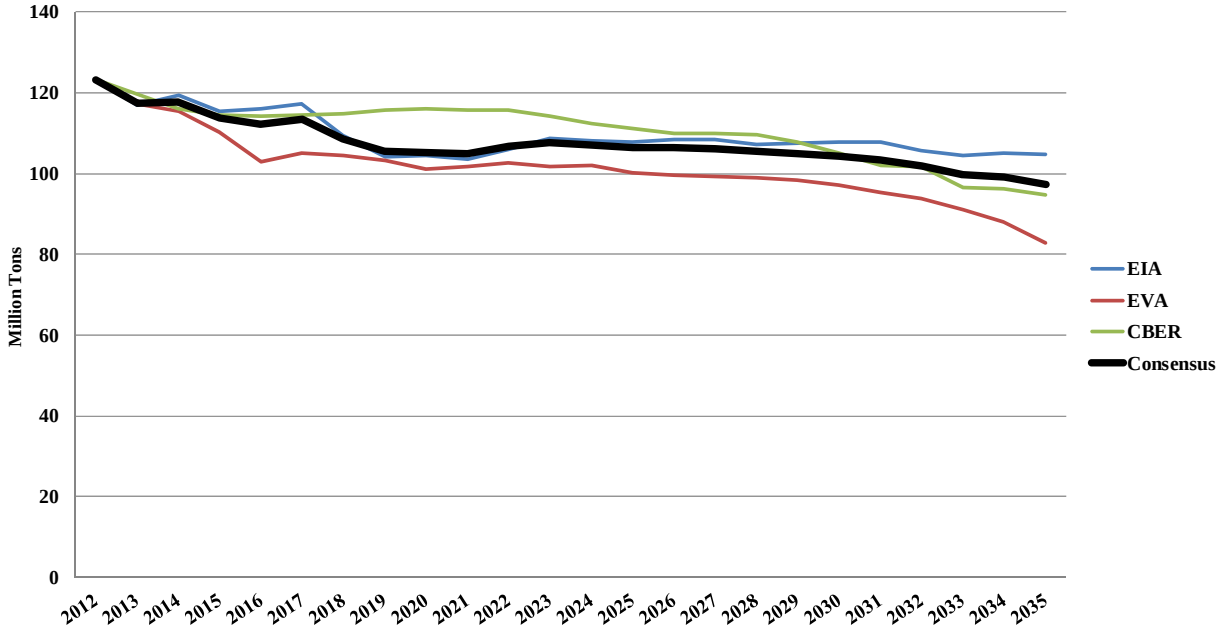


Figure 7: Consensus Forecast and Historical WV Coal Production, Million tons

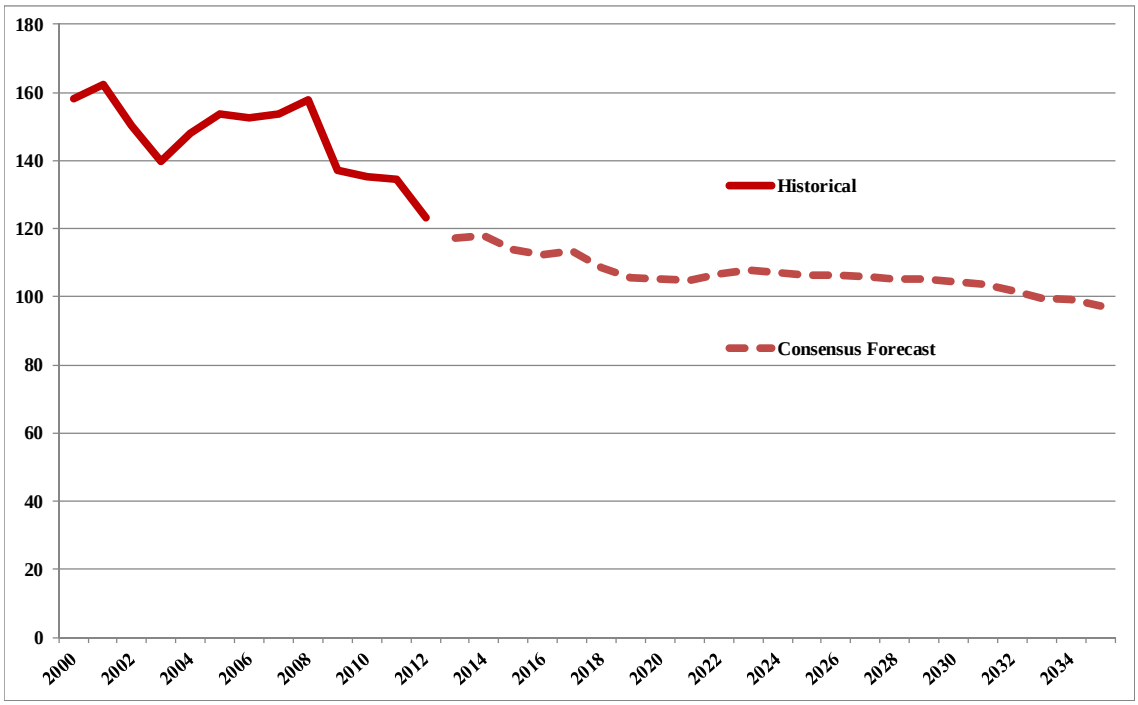


Table 7: Comparison of Consensus, Component Forecasts and 2012 Consensus

West Virginia Coal Production – Million Tons					
Year	**Forecasting Group**				
	EIA	**EVA**	**CBER**	**2013 Consensus**	**2012 Consensus**
2012	123.2	123.2	123.2	123.2	130.5
2013	116.9	117.1	119.8	117.4	123.1
2014	119.4	115.3	116.1	117.8	118.1
2015	115.4	110.2	114.6	113.9	113.1
2016	116.1	102.8	114.2	112.2	110.1
2017	117.2	105.0	114.4	113.5	105.8
2018	109.2	104.4	114.7	108.7	102.6
2019	104.1	103.3	115.6	105.6	100.4
2020	104.6	101.0	116.0	105.3	96.0
2021	103.4	101.7	115.7	104.8	96.3
2022	106.0	102.8	115.8	106.6	96.9
2023	108.8	101.6	114.2	107.6	95.1
2024	108.2	102.1	112.2	107.2	95.0
2025	107.9	100.3	111.1	106.3	94.9
2026	108.6	99.5	110.0	106.3	95.6
2027	108.4	99.2	109.9	106.1	98.1
2028	107.3	98.9	109.5	105.4	97.0
2029	107.4	98.4	108.0	105.0	97.3
2030	107.7	97.1	105.0	104.4	99.2
2031	107.8	95.3	101.9	103.5	
2032	105.8	93.8	101.7	101.9	
2033	104.4	91.1	96.5	99.6	
2034	104.9	87.9	96.3	99.0	
2035	104.7	82.8	94.7	97.3	

Summary

The 2013 West Virginia Consensus Coal Forecast figures are somewhat higher than the 2012 Consensus. A primary reason for this is the vacating of the CSAPR, which caused EIA to raise their 2013 projections for Appalachian coal production and to reduce projections for Western coal production throughout much of the forecast time period. The CSAPR had limitations on emissions trading that forced emissions reductions in all states, as well as lower emissions caps and more rapid phasing in of those caps (Energy Information Administration 2013). This factor outweighs the lower forecasted natural gas prices expected to be delivered to the electric power sector compared to the 2012 AEO. As the EIA is the dominant forecast utilized to construct the Consensus, its assumptions heavily influence forecast production levels.

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