Cathy Kunkel, Energy Analyst, IEEFA
Sean O'Leary, Senior Policy Analyst, WV Center on Budget and Policy
Ted Boettner, Executive Director, WV Center on Budget and Policy
February 2019

WEST VIRGINIA CENTER ON BUDGET & POLICY
Institute for Energy Economics and Financial Analysis
IEEFA.org

Falling Short

Shale Development in West Virginia Fails to Deliver on Economic Promises

Executive Summary

Natural gas production in West Virginia has increased by nearly a factor of six over the past decade. When shale drilling first took off in West Virginia, the industry was projected to deliver not only production increases, but also significant economic development gains for the state.

This report reviews the actual economic and financial performance of the shale industry in West Virginia over the past decade. Key findings include:

- The economic development gains of the shale industry have underperformed initial projections. This partly reflects the exaggerated early claims made by the industry and industry-funded studies. It also reflects the failure of these initial studies to anticipate the significant and sustained collapse in natural gas prices resulting from the large increase in production.

- Initial studies projected a sustained growth in natural gas severance tax revenues. In reality, severance tax revenues grew through Fiscal Year 2015 and then fell off. Fiscal Year 2018 natural gas severance tax revenues were only 15% higher than FY 2008 revenues, adjusted for inflation.

- Job gains in the natural gas industry have also been lower than projected a decade ago. The natural gas industry added 2,600 net new jobs from 2008 to 2017, as compared to gains of up to 5,700 new jobs by 2015 projected by early studies. The only reason that there has been any growth in employment at all from 2008 to 2017 is the increase in employment due to natural gas pipeline construction, which are largely temporary jobs; jobs in drilling and related support activities have actually declined. About 40% of pipeline construction jobs are held by out-of-state workers.

- Natural gas production is concentrated. Six of the state's 55 counties produced 80% of West Virginia's natural gas in 2017. Shale development has had a mixed impact on economic development at the county level in the top-producing counties. While there have been some gains in household income and educational attainment, overall these counties continue to decline in population and poverty levels remain comparable to a decade ago. Key

economic development indicators in these counties appear to follow a boom-and-bust pattern, tracking the price of natural gas.

- Early studies also failed to anticipate the negative economic and fiscal impacts of shale drilling on the state, including the economic collapse of coal mining, driven in large part by the glut of inexpensive shale gas. Initial studies also ignored the long-term liabilities that the expansion of drilling is creating for the state, in the form of hundreds of millions of dollars of orphaned well remediation costs.

- Today the natural gas industry is again promising significant economic development benefits from what it sees as the next big opportunity: Appalachian petrochemical development. We find that such claims are likely to be overstated, given the significant challenges stemming from domestic and international competition, as well as the financial weakness of the shale drilling industry itself.

West Virginia has a long history of economic boom-and-bust tied to coal extraction. Despite its vast natural resource wealth, the state has consistently ranked among the poorest in the nation. This report looks at whether the state can avoid repeating its past mistakes with the coal industry and use its natural gas resources to contribute to lasting in-state wealth.

Given the uncertain future outlook for the natural gas industry in West Virginia, we recommend that the state's economic development strategy take advantage of the near-term potential for continued production growth, but not count on the natural gas industry's rosy long-term economic development forecasts proving any more reliable than its projections a decade ago. Specifically, we recommend that the state raise the current natural gas severance tax rate to compensate for the current low-price environment (which has resulted in lower than anticipated severance tax collections) and use this money to finance the state's Future Fund to provide resources for diversified economic development less dependent on resource extraction and the vagaries of energy markets.

This paper starts with a review of the natural gas industry's performance in West Virginia, followed by a comparison of the actual state-level economic development impacts to what was promised a decade ago. We then explore in more detail the economic impact that shale drilling has had in the six top-producing counties. We conclude by reviewing the outlook for the industry in West Virginia and make recommendations for the state to minimize a potential "resource curse" by investing in the state's Future Fund.

Table of Contents

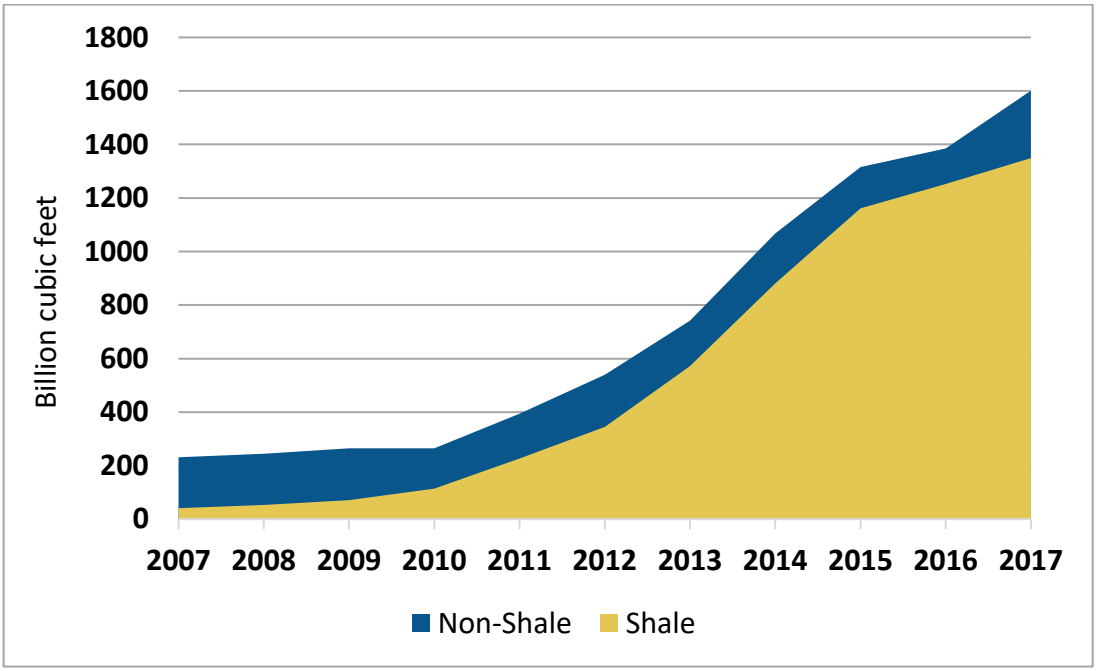
A Decade of Shale Industry Development

Rapid Production Growth, Falling Prices and Concentration of a Few Top Producers

The total amount of natural gas produced in West Virginia increased by nearly a factor of six from 2009 to 2017, as shown in Figure 1. Increasingly, this natural gas was produced from shale drilling, predominantly in the Marcellus share formation (but also in the Utica). Shale drilling grew from 18% of the state's total natural gas withdrawals in 2007 to 84% in 2017.

Conventional natural gas production has fallen over the period, as low natural gas prices resulting from the glut of Marcellus shale production have forced many conventional drilling operations out of business.

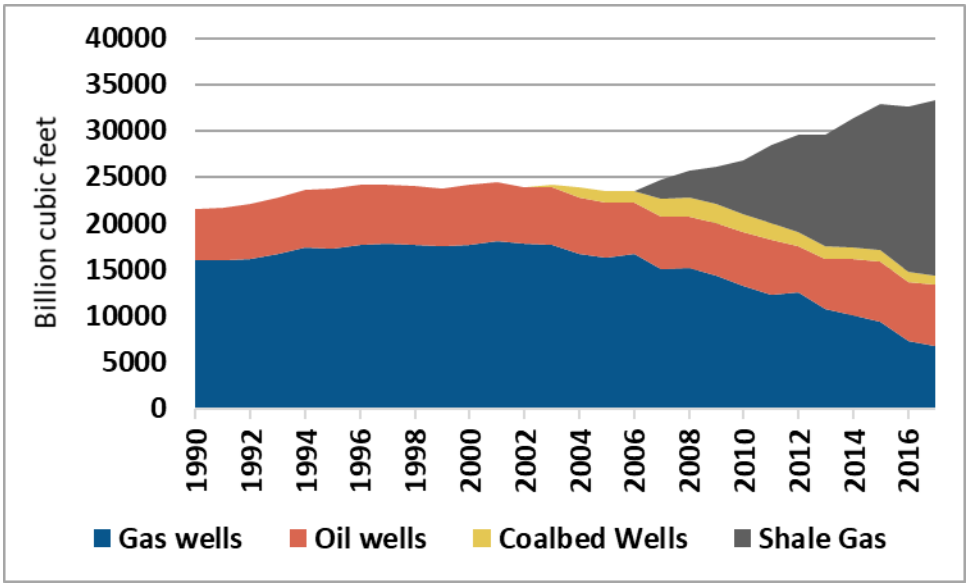
Figure 1: Gross Withdrawals of Natural Gas from Shale Resources in West Virginia Have Increased Dramatically in the Last Decade



Source: Energy Information Administration, "West Virginia Natural Gas Gross Withdrawals," Dec 31, 2018. And Energy Information Administration, "West Virginia Natural Gas Gross Withdrawals from Shale Gas," Dec 31, 2018.

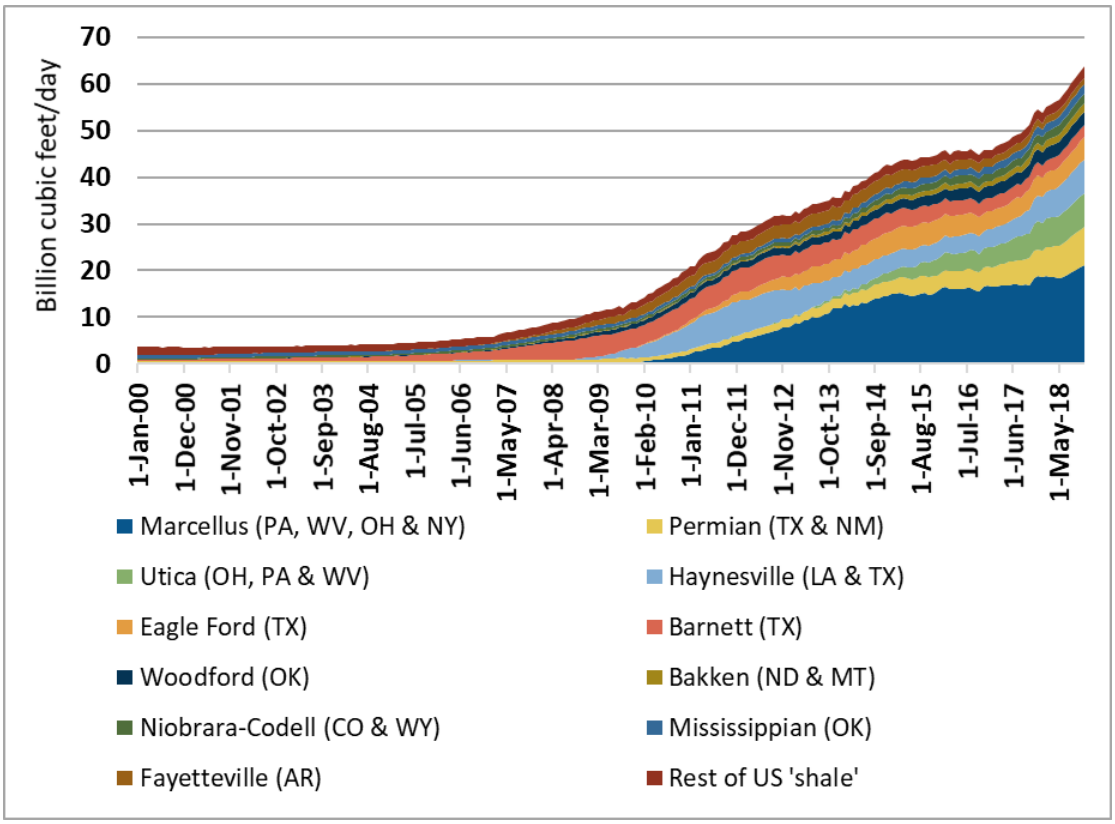
This explosion in natural gas production mirrors the national trend. The following two graphs show U.S. total natural gas production and U.S. natural gas production from shale, illustrating the dramatic take-off of shale gas production, particularly in the Marcellus Shale, since around 2009-2010.

Figure 2: United States Gross Withdrawals of Natural Gas and Natural Gas Liquids Show Rapid Growth from Shale in the Last Decade



Source: Energy Information Administration, "Natural Gas Gross Withdrawals and Production," Dec 31, 2018.

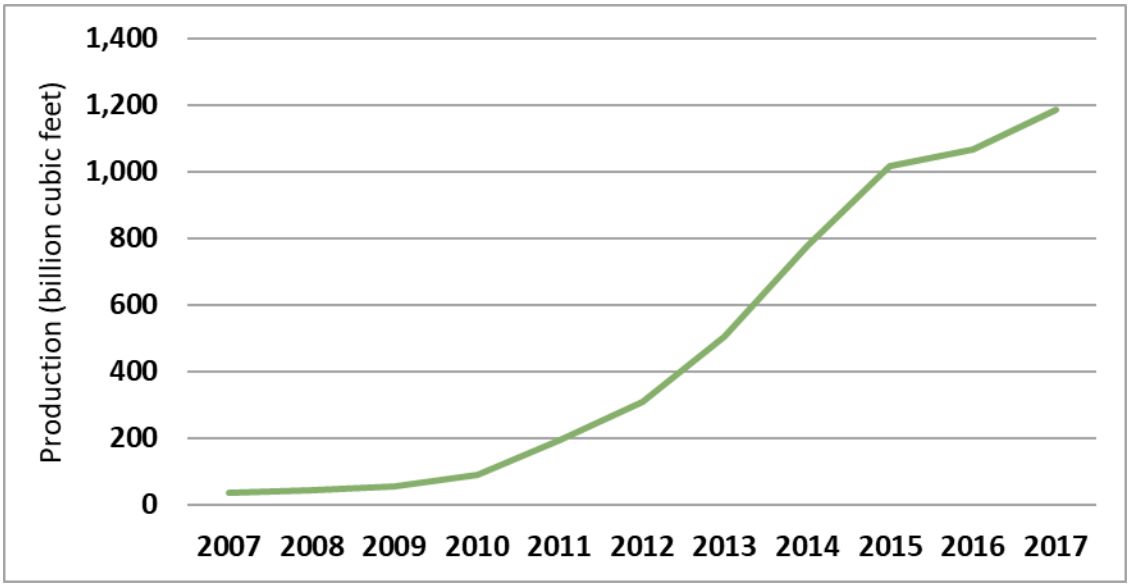
Figure 3: Marcellus Shale Has Dominated U.S. Dry Shale Gas Production



Source: Energy Information Administration, Natural Gas Weekly Update, January 17, 2019.

Natural gas production in West Virginia is heavily concentrated in a few northern counties. In 2017, the top six counties (Doddridge, Wetzel, Tyler, Ritchie, Marshall and Harrison) together accounted for 1,187 bcf of natural gas production, or 80% of the state's total production.[1] Only two of these counties— Ritchie and Harrison— were significant natural gas producers prior to the shale boom. These six counties collectively produced 28 times more gas in 2016 than they did in 2007, as shown in Figure 4.

Figure 4: Natural Gas Production Has Sharply Increased in the Top Six Counties

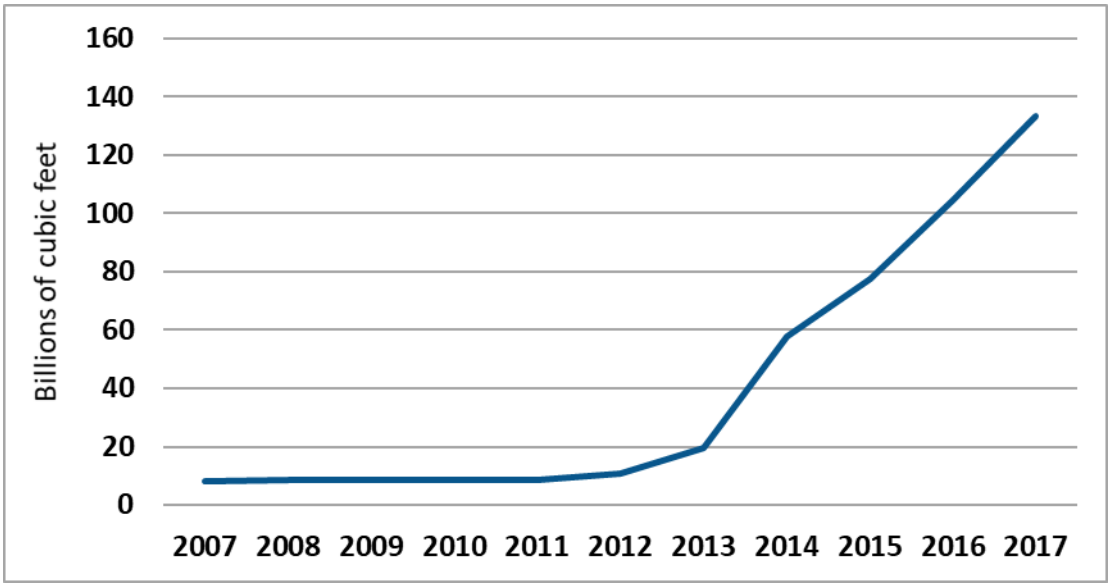


Source: WV Geological and Economic Survey database.

Alongside the growth in natural gas production, West Virginia has also seen a sharp increase in natural gas liquids (NGLs) production. Natural gas liquids are heavier hydrocarbons (ethane, propane, butane and heavier compounds) that are produced alongside natural gas; "wet gas" contains a significant fraction of NGLs that can be separated and sold if economic conditions are favorable. The core Marcellus acreage in West Virginia is wet gas.[2]

[1] P. Dinterman, "2017 Marcellus Shale and Utica-Point Pleasant Production Summary," West Virginia Department of Commerce Geological & Economic Survey, August 24, 2018.
[2] In August 2017, the CEO of Southwestern Energy, which produces natural gas from both the wet gas-rich Marcellus acreage of southwestern PA and western WV and from the dry gas-rich Marcellus acreage of northeastern PA explained that those two areas "compete back and forth and the liquid side of that business, the realizations from NGLs … is really the lever that moves that [investment] decision back and forth." (Southwestern Energy, 2nd Quarter 2017 earnings call, August 4, 2017).

Figure 5: West Virginia Natural Gas Liquids Production Has Surged Since 2012

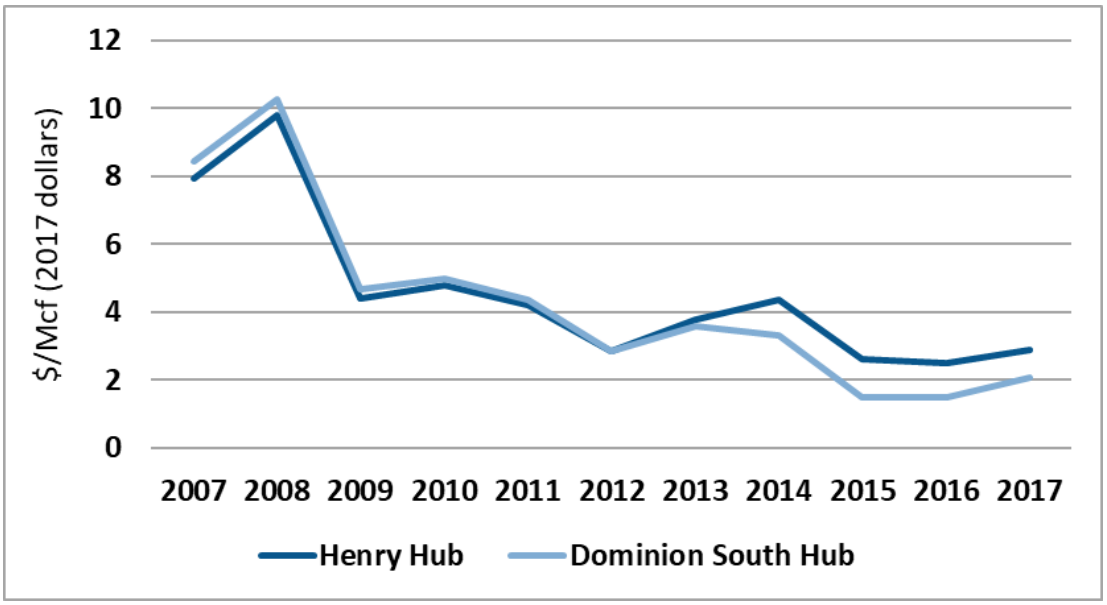


Source: Energy Information Administration, "West Virginia Natural Gas Plant Liquids Production," Dec 31, 2018.

Not surprisingly, this dramatic increase in production resulted in a crash in domestic natural gas prices.[3] Even the rush by the electric power sector to take advantage of cheap gas did not significantly drive up natural gas prices. The following figure shows natural gas prices at the Henry Hub (the national benchmark for U.S. gas prices) and at the Dominion South Hub, located in southeastern Pennsylvania, in constant (2017) dollars. Starting around 2014, prices at the Dominion South Hub decoupled from the Henry Hub because of the glut of natural gas produced from the Marcellus.

[3] Similarly, the increase of NGL production has also driven a decline in prices for ethane, propane, butane and natural gasoline.

Figure 6: Natural Gas Prices at the Dominion South Hub Decoupled from Henry Hub Prices Starting Around 2013



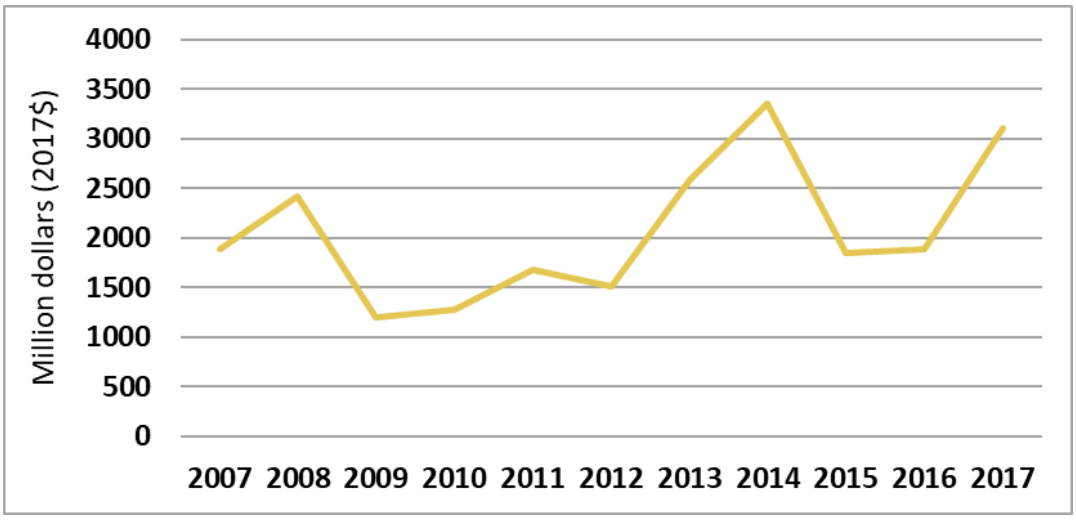
Source: S&P Global Market Intelligence day-ahead prices.

As a result of this crash in natural gas prices, the total value of natural gas produced in West Virginia has not mirrored the exponential growth in production. The following graphs show an estimate of the total value of natural gas, adjusted for inflation, produced in West Virginia and in the top producing counties (assuming that all gas is sold at Dominion South Hub prices). In the past decade, from 2008 to 2017, West Virginia produced $21 billion in natural gas, almost all of which was exported from the state.[4] Doddridge County, the state's top-producing county, alone produced $3.6 billion of natural gas from 2007 to 2017, virtually all of which was exported from the county.

From 2008 to 2017, West Virginia produced $21 billion in natural gas, almost all of which was exported from the state.

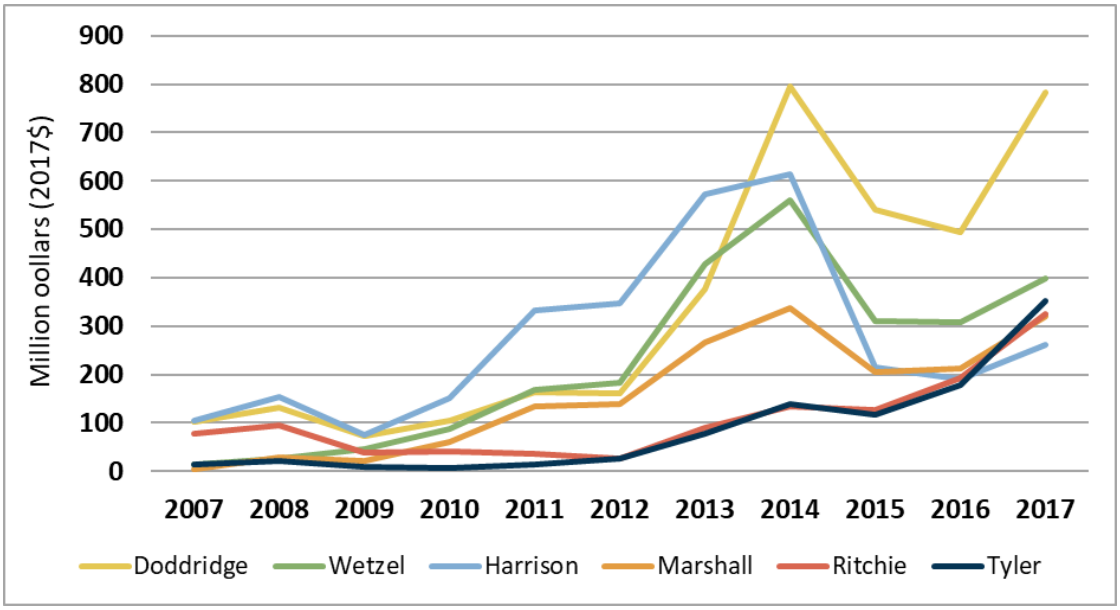
[4] In-state natural gas consumption data from: Energy Information Administration, Natural Gas Consumption by End Use, Dec 31, 2018; Dominion Energy West Virginia, 2017 Purchased Gas Application, WV PSC Case No. 17-1053-G-30C; Mountaineer Gas Company, 2017 Tariff Rule 30C Application, WV PSC Case No. 17-1065-G-30C.

Figure 7: The Value of West Virginia Dry Gas Production, Estimated Based on Dominion South Hub Natural Gas Prices, Has Been Highly Volatile



Source: Production numbers from EIA, "West Virginia Dry Gas Production," Dec 31, 2018; Dominion South Hub prices from S&P Global Market Intelligence day-ahead prices.

Figure 8: The Value of Natural Gas Produced by the Top Six Counties Has Mirrored Overall Volatility



Source: Production data from WV Geological and Economic Survey, Dominion South Hub pricing data from S&P Global Market Intelligence.

In addition, we estimate that West Virginia has produced nearly $1.5 billion in natural gas liquids over the past decade.[5]

Over the past decade, natural gas production has become concentrated in the hands of fewer and fewer producers, as part of a national trend of consolidation in the sector driven by weak financial performance. In late 2014, global oil and natural gas liquids prices collapsed. Starting in 2015, that collapse, coupled with already low natural gas prices, drove 167 North American oil and gas producers to file for bankruptcy.[6] Table 1 shows a snapshot of natural gas production by the top ten largest companies in the state in 2004, 2012 and 2017. The top ten companies' share of production has grown from 68% to 85% over that time period. In 2017, just the top three producers— all headquartered out-of-state— accounted for 66% of the state's natural gas production. Table 1 also indicates the rapid changes in the sector, as many of the early natural gas producers have gone bankrupt, been absorbed into larger companies, or sold their Marcellus acreage to concentrate on other U.S. shale plays.

In 2017, just the top three producers— all headquartered out-of-state— accounted for 66% of the state's natural gas production.

[5] Estimated based on severance tax revenues, assuming that "other" severance tax revenues are derived primarily from natural gas liquids. (Source: WV State Tax Department, "Severance Tax History and Data: FY 2008 through FY 2018.").
[6] Haynes and Boone, LLP, "Oil Patch Bankruptcy Monitor," January 7, 2019.

Table 1: Production Has Been Increasingly Concentrated Among Top Producers

2004		2012		2017	
Company	**Production (bcf)**	**Company**	**Production (bcf)**	**Company**	**Production (bcf)**
Companies in bold were/are headquartered in West Virginia.					
Equitable Production Company	33.4	Antero	105.7	Antero	543.6
Columbia Natural Resources LLC	25.6	Chesapeake	73.6	EQT	292.9
Cabot Oil & Gas	22.1	EQT	42.2	Southwestern Production	149.9
Dominion Exploration & Production	18.3	XTO	13	**HG Energy**	82.9
Eastern American Energy	10.1	Stone Energy	8.9	**Northeast Natural Energy**	39.5
Penn Virginia Oil & Gas	6.3	Grandier Energy Partners	8.1	**Jay-Bee Oil & Gas**	38.8
North Coast Energy Eastern	5.8	**PDC Mountaineer**	6.9	Arsenal Resources	33.8
CDX Gas LLC	5.1	CNX Gas / Consol Gas	6.5	Ascent Resources	31.5
Key Oil Company	3.7	Trans Energy	5.9	CNX Gas	28.2
Exploration Partners LLC	3.4	Triad Energy	5.8	XTO Energy	21.4
Total WV gas production	*197.2*		*345*		*1486*
% from top 10	*68%*		*80%*		*85%*

Source: G. Hammond, "Consensus Oil & Gas Forecast for West Virginia 2006," West Virginia University, November 2006; J. Pierson Moore, "2012 Marcellus Shale Production Summary," West Virginia Department of Commerce Geological & Economic Survey, July 29, 2013; P. Dinterman, "2017 Marcellus Shale and Utica-Point Pleasant Production Summary," West Virginia Department of Commerce Geological & Economic Survey, August 24,2018

The Promised State-Level Economic Impact of Shale Development in West Virginia Has Largely Failed to Materialize

The rapid growth in Marcellus shale production described in the previous section has contributed less to the state's economy than industry boosters projected a decade ago. In this section, we review some of the claims and projections made in the early days of Marcellus shale drilling in West Virginia and compare those projections to what actually occurred.

The following table summarizes the predictions of three studies from West Virginia University (WVU), the National Energy Technology Laboratory (NETL), and IHS Global Insight (IHS).[7] The NETL study in particular emphasized throughout that its analysis represented a "conservative" estimate of the economic benefits of shale development to the state.[8]

Table 2: Early Studies Predicted Significant Growth in Production, Tax Revenue and Jobs

	2009		2012	2015			2020	
	WVU	NETL	IHS	WVU	NETL	IHS	NETL	IHS
Shale production (bcf)					Approx 2,900		Approx 5,000	
Severance taxes (nominal $)		$68	$52		$141	$142	$235	$239
Direct jobs [(a)]	3,600	3,169	3,615	3,130-9,300		7,310		10,172

(a) Note that the 2009 and 2012 numbers are lower than the employment numbers presented in previous sections because our analysis looked at employment across the entire natural gas sector in West Virginia, whereas these studies attempted to isolate the job impact specifically from shale drilling.

Production Numbers Have Been Lower Than Forecast

The NETL study, the only one which provided a forecast of production, was wildly optimistic in its forecast. Despite the rapid growth in shale production over the past decade, actual 2015 production was less than half projected by the NETL study.

Severance Tax Revenues Increased Rapidly but Levelled Off, Underperforming Expectations

The following chart shows West Virginia severance tax collections from coal, natural gas and "other" minerals (predominantly natural gas liquids). Over the past decade, the severance tax has contributed between 8 and 14% of state revenues.[9] While natural gas severance tax revenues steadily increased from FY 2010 through FY 2014, tax revenues subsequently declined and have never regained their 2014 peak.

[7] A. Higginbotham, A. Pellilo, T. Gurley-Calvez and T. Witt, "The Economic Impact of the Natural Gas Industry and the Marcellus Shale Development in West Virginia in 2009", West Virginia University Bureau of Business and Economic Research, December 2010; A. Zammerilli, "Projecting the Economic Impact of Marcellus Shale Gas Development in West Virginia: A Preliminary Analysis Using Publicly Available Data," National Energy Technology Laboratory, March 2010; and "America's New Energy Future: The unconventional oil and gas revolution and the U.S. economy, Volume 2: State Economic Contributions," IHS Global Insight, December 2012.
[8] See NETL study at p. 29-30.
[9] Charleston Gazette-Mail, State Budget Browser, March 2017.

In FY 2018, natural gas severance tax revenues were only 15% higher than FY 2008 natural gas severance tax revenues (in constant 2018 dollars).

Figure 9: West Virginia Severance Tax Collections Fell Sharply After FY2015, Reflecting a Fall in Coal and Natural Gas Severance Tax Revenues

Source: WV State Tax Department, "Severance Tax History and Data: FY 2008 through FY 2018."

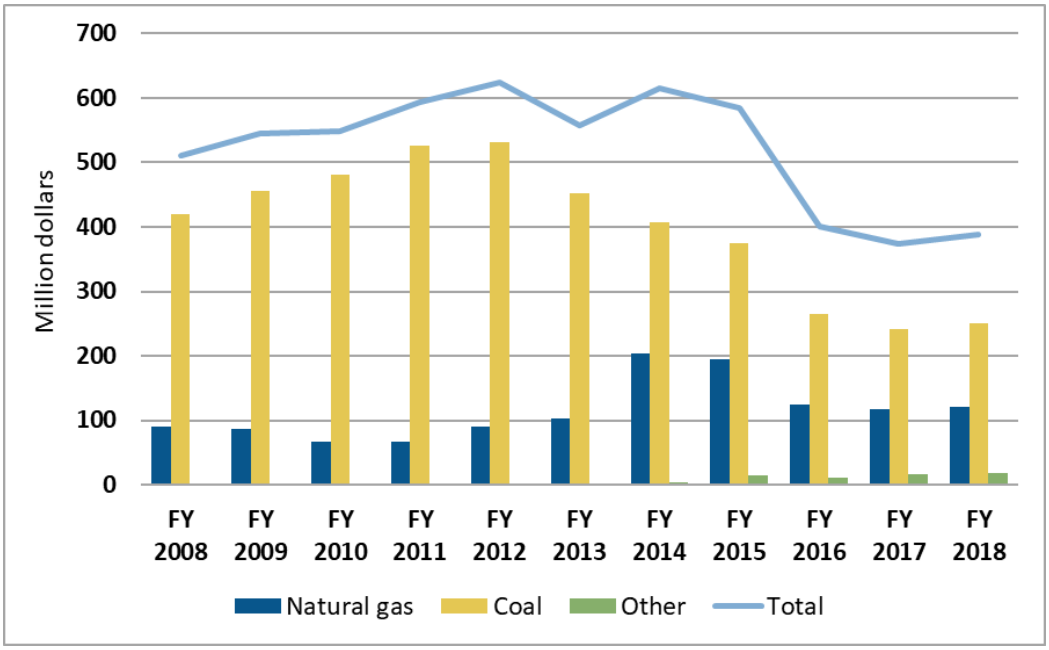
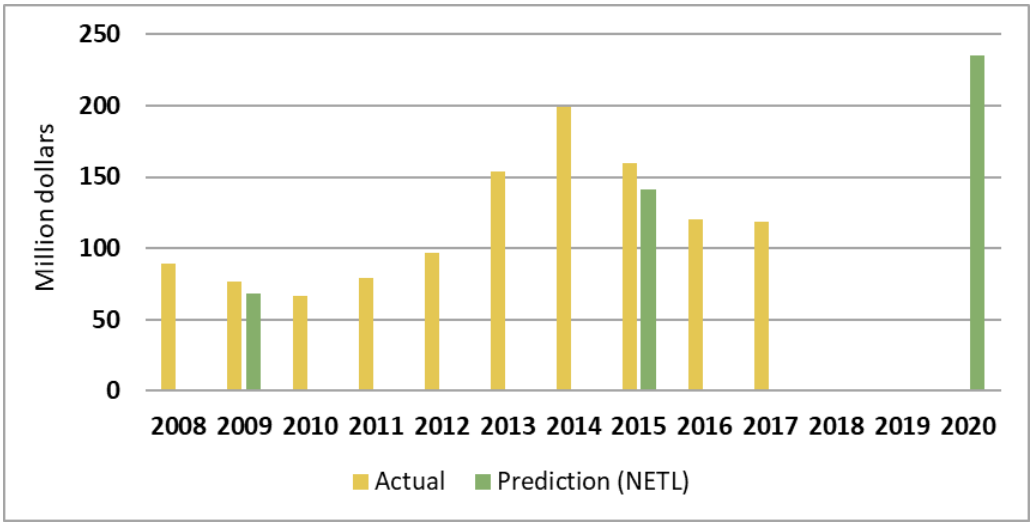


Figure 10 compares actual natural gas severance tax collections (translated from fiscal year to calendar year) to the projection of the NETL study.

Figure 10: Predicted Growth in Natural Gas Severance Tax Revenue from 2015-2020 Is Not Materializing



Source: WV State Tax Department, "Severance Tax History and Data: FY 2008 through FY 2018"; and NETL, 2010.

The initial studies by NETL and IHS fared better at predicting 2015 severance tax revenues, which were $159 million that year. But the continued growth in severance tax revenues projected by the studies has failed to materialize, as shown in Figure 10 above. Part of the reason for the fall in the severance tax was the elimination of the 4.7 cents/mcf flat tax on natural gas production in FY 2016; this portion of the severance tax had generated $58 million in FY 2015.[10] Severance tax revenues have also been impaired by the persistently low price of natural gas, which had apparently not been contemplated by either study.[11]

Early Studies Did Not Consider Financial Liabilities to the State

While initial studies forecasting the benefits of shale gas development highlighted the predictions of greater tax revenues, they failed to consider the possibility that shale development would leave the state with greater unfunded liabilities.

However, Marcellus shale drilling is adding to the state's already large abandoned well liability. West Virginia state code defines a well as "abandoned" if it is out of production for more than twelve months and has not been proven to have a bona fide future use.[12] We refer to such abandoned wells as "orphaned" if there is no known operator for the well, meaning that the liability for plugging the well reverts to the state. Currently the West Virginia Department of Environmental Protection's

[10] WV State Tax Department, "Severance Taxes: Tax Data, Fiscal Years 2015-2018."
[11] Specifically, the NETL study forecast the value of natural gas extracted would approach $22 billion by 2015, implying a wellhead price of approximately $7-$8 per mcf. (See Exhibit 23 on p. 40).
[12] West Virginia Code §22-6-19

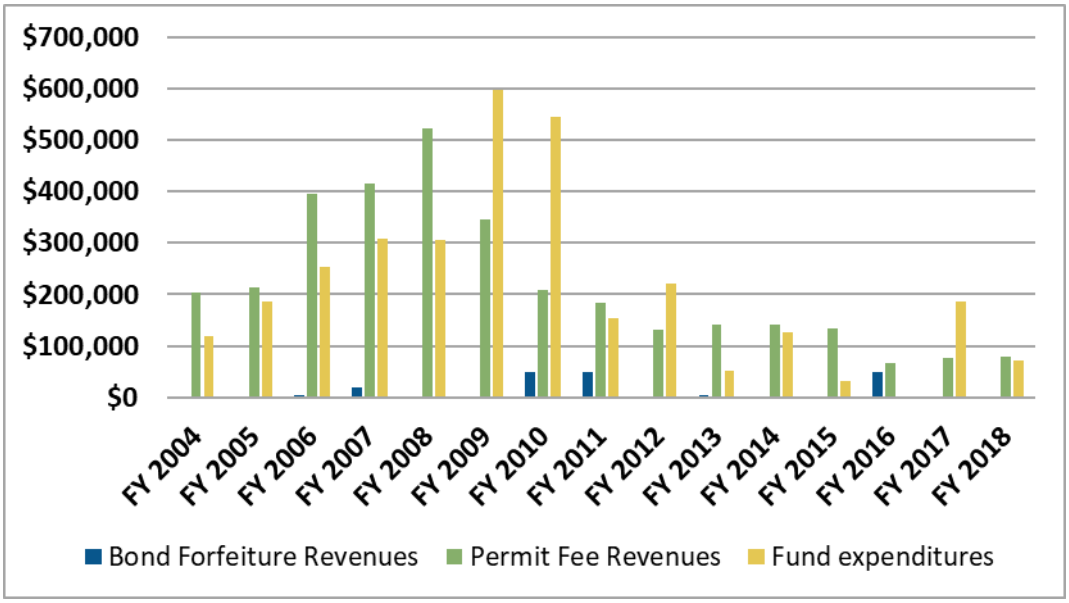
well database lists 4,560 orphaned wells.[13] In its entire history, the DEP has plugged only 349 orphaned wells.[14] According to recent annual reports, DEP plugged six wells in fiscal year 2017 and three in fiscal year 2018.[15]

According to the DEP, the average cost of plugging a well is $25,000.[16] However orphaned wells are often more difficult to plug because of their age and condition, and the DEP's average cost is between $45,000 and $65,000 per well.[17] An industry estimate puts the cost of well plugging at $45,000 per well.[18] At that cost, the state has an outstanding liability of $205 million in unplugged wells. As of June 2018, the DEP's "Oil and Gas Reclamation Trust Fund" (the fund specifically dedicated to reclaiming and plugging abandoned wells[19]) has a balance of $374,986, or 0.2% of the outstanding liability.[20]

The DEP funds its well plugging work through bond forfeitures and permit fees.[21] The revenue collected through permit fees has declined in recent years. The overall expenditures out of the fund have also declined. Expenditures averaged $331,000 per year for FY 2004 through FY 2010 and only $105,000 per year for FY 2011 through 2018. In short, the boom in Marcellus shale drilling has not benefited the abandoned well reclamation fund.

[13] Search of West Virginia Department of Environmental Protection Office of Oil & Gas well database on 7/22/18 for "abandoned well" "operator unknown"
[14] Ibid., search for "plugged well", "unknown – DEP paid plugging contract"
[15] WV Department of Environmental Protection, Annual Reports for Fiscal Year 2016-17 and Fiscal Year 2017-18.
[16] West Virginia Legislative Auditor, "Agency Review: Office of Oil and Gas, Department of Environmental Protection," PE 12-10-523, September 2012, p. 8
[17] Personal communication, David McMahon, WV Surface Owners' Rights Organization, January 29, 2019.
[18] Diversified Gas & Oil, Admission Document: Acquisition, Placing and Readmission to Trading, June 29, 2018 at p. 151.
[19] West Virginia Code §Code 22-6-29(b)
[20] WV Department of Environmental Protection, Annual Report for Fiscal Year 2017-18.
[21] West Virginia Code §22-6-29(b)

Figure 11: Revenues and Expenditures from the WV Department of Environmental Protection's Oil and Gas Reclamation Trust Fund Have Fallen in the Past Decade



Source: Data for FY 2011 through FY 2018 from WV Department of Environmental Protection annual reports. Prior years' data tabulated by WV Surface Owners Rights' Organization from DEP reports.

The vast majority (80%) of the orphaned wells were permitted more than 50 years ago. It is impossible to estimate how many of the 4,700 Marcellus shale wells permitted between January 2010 and January 2019 will ultimately become the financial responsibility of the state to plug.[22]

At the same time, many Marcellus drilling companies, including EQT[23], are selling their declining conventional wells to a company called Diversified Gas & Oil. Diversified currently has 17,000 wells in West Virginia (including some non-producing wells), or about 15% of the total wells drilled in the state. Yet a recent consent decree with the West Virginia Department of Environmental Protection requires Diversified to plug only 300 wells from 2020 to 2034.[24] With Diversified estimating that its producing wells will reach the end of their economic lives in

[22] West Virginia Department of Environmental Protection Office of Oil & Gas well database search for target formation "Marcellus Shale" on 1/20/19.
[23] EQT sold 12,000 wells to Diversified in 2018, of which 4,386 are in West Virginia. (Diversified Gas & Oil, Admission Document: Acquisition, Placing and Readmission to Trading, June 29, 2018 at p. 150)
[24] The decree requires at least 50 non-producing wells per year to be placed into production or plugged, at least 20 of which must be plugged. (WV Department of Environmental Protection, Consent Order issued under WV Code Chapter 22, Article 6, November 19, 2018).

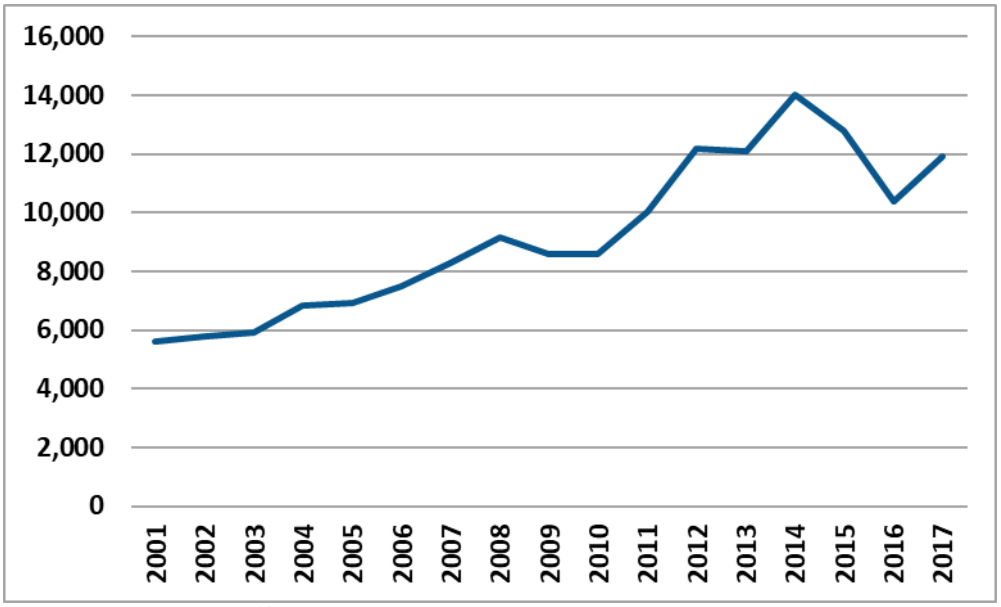
2047[25], it is likely that thousands of these wells will be abandoned and ultimately become liabilities of the state.

In short, due to shale companies both developing new Marcellus wells and shedding existing conventional well liabilities, West Virginia will likely face hundreds of millions, perhaps billions, of dollars in unplugged well liabilities in the coming decades, on top of the existing unfunded orphaned well liability. This liability was not captured in early projections of economic benefits to the state.

Employment Growth Has Underperformed Expectations

Between 2001 and 2008, before shale drilling took off in West Virginia, employment in the industry increased from 5,623 to 9,172. The growth in natural gas jobs appeared to be only temporarily slowed by the 2007 recession. After growing steadily pre-recession, jobs growth stopped from 2007 to 2010, as the state and nation weathered the depths of the recession. Job growth accelerated starting in 2010, booming along with production, reaching 14,013 jobs in 2014. Employment fell from 2014 to 2016 and grew slightly in 2017.

Figure 12: Total Natural Gas Industry Employment in WV



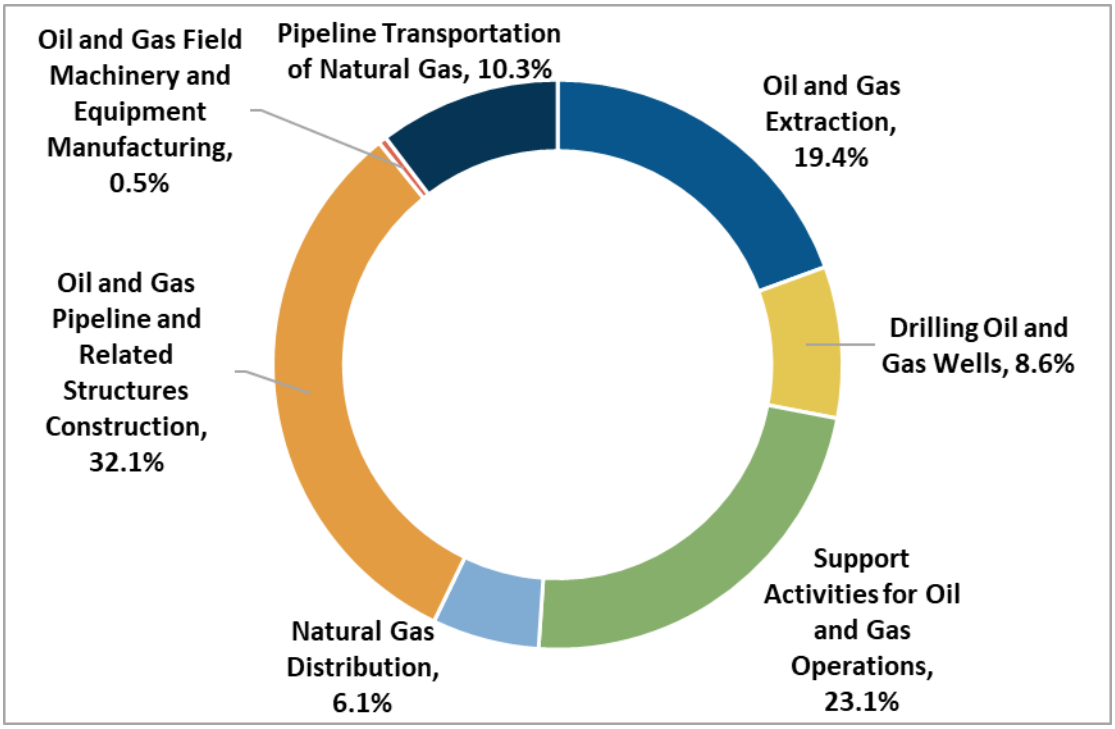
Source: Workforce WV.[26]

[25] Diversified Gas & Oil, Admission Document: Acquisition, Placing and Readmission to Trading, June 29, 2018 at p. 76.

[26] Includes jobs in the following North American Industry Classification System (NAICS codes): 211 (Oil and gas extraction), 213111 (Drilling oil and gas wells), 213112 (Support activities for oil and gas operations), 221210 (Natural gas distribution), 237120 (Oil and gas pipeline and related structures construction), 333132 (Oil and gas field machinery and equipment manufacturing) and 486210 (Pipeline transportation of natural gas). These NAICS categories capture all aspects of the natural gas extraction, processing and transportation system.

In 2017, nearly one in three natural gas jobs were in pipeline construction, with nearly a quarter in support activities. Less than 10 percent of jobs were in the actual drilling of gas wells, while there were only a handful of jobs in manufacturing oil and gas machinery and equipment (Figure 13). It is also worth noting that in 2015 (the only year for which data is available), 25% of jobs in natural gas drilling, pipeline construction and related support activities were held by out-of-state workers.[27] Pipeline construction is the sector with the largest concentration of out-of-state workers (40.6% in 2015) and it is the only natural gas-related sector that has boasted significant employment gains since 2015; therefore, the percentage of out-of-state workers in the natural gas industry today could well be more than 25%.

Figure 13: One in three Natural Gas Jobs Were in Pipeline Construction in 2017

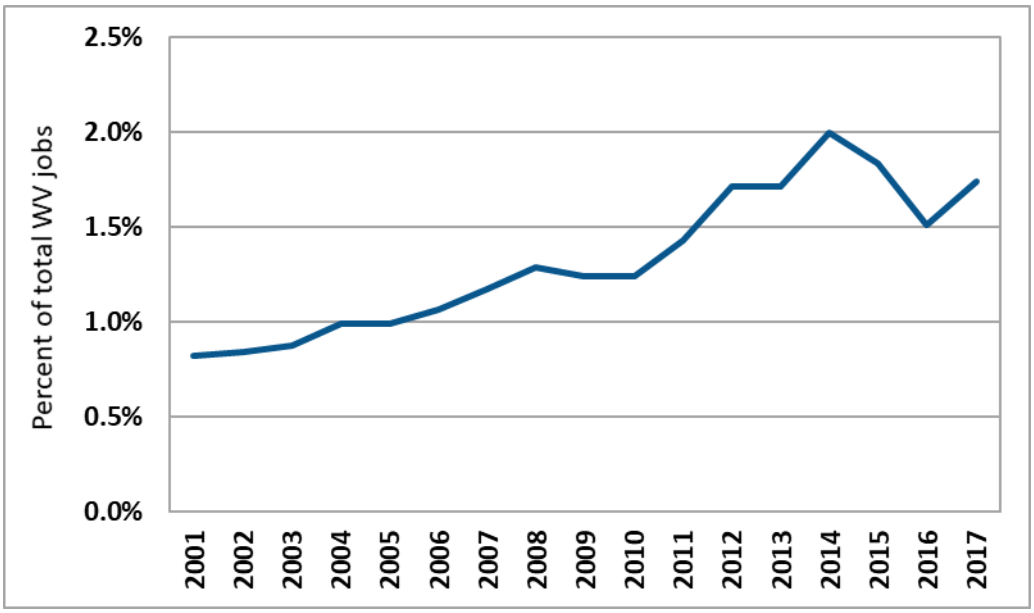


Source: WVCBP analysis of Workforce WV data.

Even at its peak, employment in the natural gas industry was a relatively small share of total employment in the state, never topping more than 2 percent of total jobs in the state.

[27] Workforce WV, West Virginia Oil and Gas Study: Residency Status.

Figure 14: Natural Gas Industry Comprises Less Than 2% of WV Jobs



Source: WVCBP analysis of Workforce WV data.

In terms of employment, the WVU study projected a range of up to 5,700 new shale jobs by 2015, and the IHS study projected approximately 3,700 new jobs between 2012 and 2015. These studies implied that these jobs would be additional jobs, on top of already existing natural gas jobs in the state. However, what actually occurred was a 25% increase in natural gas industry employment from 2008 to 2017, or 2,600 net new jobs. This is smaller than the increase in Marcellus shale jobs predicted by initial studies. Part of the reason for this discrepancy is that the growth in shale production has cannibalized the pre-existing conventional natural gas industry, reducing production and employment from conventional drilling.[28] Indeed, the only reason that there has been any growth in employment at all from 2008 to 2017 is the increase in employment due to natural gas pipeline construction, which are largely temporary jobs; jobs in drilling and related support activities have actually declined.

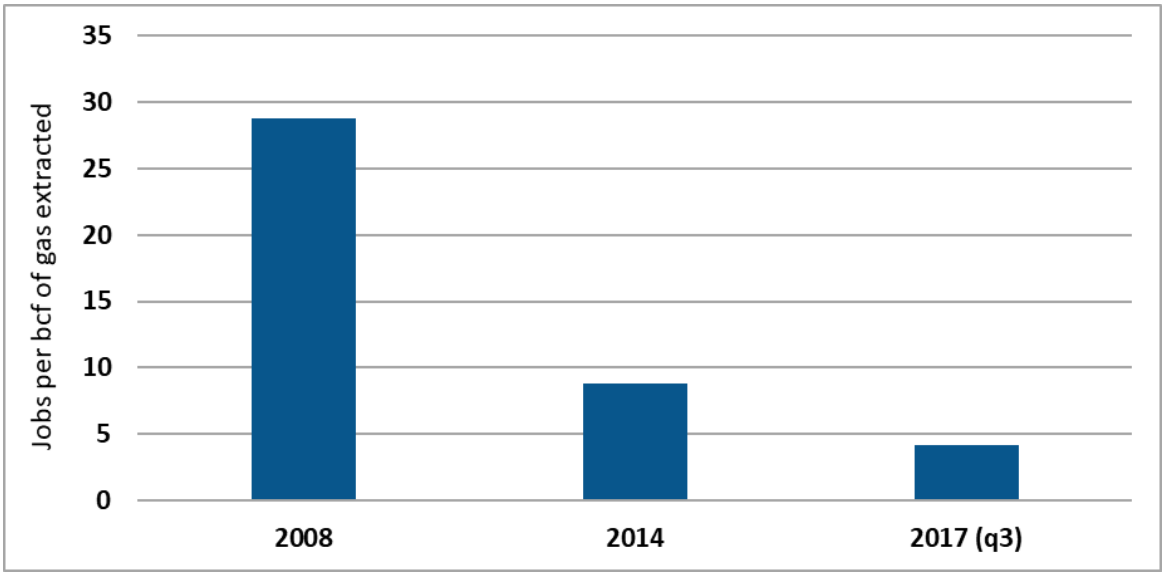
Jobs in drilling and related support activities have actually declined.

The poor performance of shale drilling as a driver of new employment opportunities is connected to the low-price environment created by the expansion of shale

[28] Natural gas production from conventional wells in West Virginia declined 40% from 2008 to 2016. (C. Burd, "Current state of the natural gas industry from the West Virginia producer's perspective," presentation at Governor's Energy Summit, October 18, 2017).

drilling, a consequence that was not anticipated in initial studies. Low prices have forced the industry to become more technologically innovative, in order to lower the cost structure of the industry. This means that the number of jobs in shale drilling per unit of natural gas extracted has declined dramatically. The number of exploration and production jobs per billion feet of natural gas extracted in West Virginia plummeted from 29 jobs per bcf in 2008 to 9 jobs per bcf in 2014 to 4 jobs per bcf in 2017.[29]

Figure 15: West Virginia Natural Gas Exploration and Production Has Become Significantly Less Labor-Intensive



Source: Employment data from Workforce WV, dry gas production data from Energy Information Administration.

Impact of Shale on WV Coal Industry Not Considered

Early industry reports also failed to consider shale development's negative impact on the coal industry. Nationally, the glut of natural gas and the low price environment drove wholesale power market prices to sustained low levels that made it difficult for coal-fired electricity generation to compete. Since 2010, the share of U.S. electricity generation produced by coal has fallen from 45% in 2010 to 30% in 2017[30], which translates into 330 million tons of coal per year no longer burned for power generation.[31] The driving factor in this transformation of the

[29] Jobs in NAICS sectors 211 ("oil and gas extraction"), 213111 ("drilling oil and gas wells") and 213112 ("support activities for oil and gas operations") were divided by West Virginia total dry gas production.
[30] Energy Information Administration, Electricity Data Browser, last accessed January 2019.
[31] Energy Information Administration, Coal Data Browser, last accessed January 2019.

power sector, far more than environmental regulations, has been low wholesale electricity market prices, driven by natural gas.[32]

In West Virginia, the production of steam coal for power generation has fallen 32% since 2010, with extremely negative consequences for West Virginia's top coal-producing counties.[33] Because of the declining market for coal, coal severance tax collections have fallen even more sharply, generating half as much revenue in 2017 as in 2010, as shown in Figure 9 above. In Boone County, formerly the state's largest coal-producing county, employment fell 58 percent from 2011-2015.[34] It would be incorrect to blame all of West Virginia's coal decline on natural gas. Competition with cheaper coal from other U.S. basins has also reduced the market for West Virginia coal. But the pressure from cheap shale gas has certainly contributed substantially to the collapse of the West Virginia coal industry.

In short, the economic impact of the shale industry in West Virginia— in terms of employment and tax revenues— has underperformed expectations, while early studies also failed to consider negative impacts of shale development on the state's economy and finances.

The Economic Development from Shale Drilling Has Largely Followed a Boom-and-Bust Pattern in the Largest Shale-Producing Counties

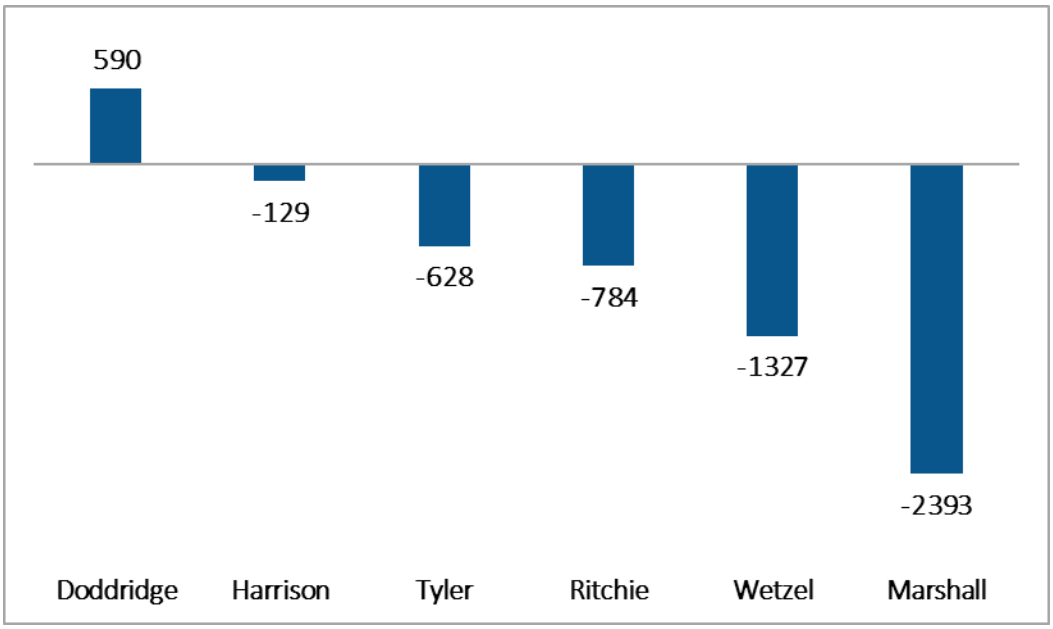
The economic development impact of shale development in the top six natural gas-producing counties has been mixed, with some indicators showing improvement and others weakening. Yet the overall impact has been relatively small in terms of its contribution to lifting these counties out of poverty. In addition, many of these economic indicators show a boom-and-bust pattern, as opposed to sustained economic development

Population

Shale development has generally not had a positive impact on population growth in the counties where it is occurring. Only one of West Virginia's top producing gas counties, Doddridge, has gained population over the past decade, despite the massive influx in natural gas drilling activity, as shown in Figure 16.

[32] The financial problems for coal-fired power plants have been compounded by flat demand for electricity, meaning that new generation is displacing older plants. (See, for example, P. Maloney, "New gas build, coal retirements could make PJM next market with distressed power prices," Utility Dive, April 7, 2017.)
[33] Energy Information Administration, Quarter Coal Reports for Oct-Dec 2010 and Oct-Dec 2017.
[34] D. Mistich, "Central Appalachia, Southern West Virginia 'ground zero' for recent coal mine layoffs," WV Public Broadcasting, June 17, 2015.

Figure 16: Change in Population of the Top Six Shale-Producing Counties, 2007-2017



Source: Bureau of Economic Analysis.

Median Household Income

Median household income measures the income of the typical household— or the household in the middle of the income distribution— and serves as a good indicator for how the middle class is faring. Shale development is correlated with improvements in county-level median household income.

The top gas producing counties have all experienced strong median household income growth during the natural gas boom. All but Marshall County have exceeded the state average median household income growth since 2010, with Doddridge and Harrison nearly doubling the state's growth rate (Table 3).

Table 3: Median Household Income Before and After the Natural Gas Boom (Nominal Dollars)

	2010	2017	Percent Change
United States	*$51,914*	*$57,652*	*11.1%*
West Virginia	$38,241	$43,238	13.1%
Doddridge County	$34,444	$44,370	28.8%
Harrison County	$40,441	$51,711	27.9%
Marshall County	$37,206	$41,471	11.5%
Ritchie County	$35,170	$40,636	15.5%
Tyler County	$36,122	$43,951	21.7%
Wetzel County	$36,390	$41,882	15.1%

Source: U.S. Census Bureau Small Area Income and Poverty Estimates.

Educational Attainment

Another positive for the gas producing counties is that educational attainment, while in general lower than the state average, has been increasing during the natural gas boom. All but Ritchie County have seen an increase in the share of the population 25 and older with at least a bachelor's degree, while Wetzel County experienced a decrease (Table 4). Increasing the levels of education in the workforce is one of the key factors in improving the state's economy.[35]

Table 4: Share of Population 25 and Older with at Least a Bachelor's Degree

	2009	2017	Change
United States	*27.5%*	*30.9%*	*+3.4%*
West Virginia	17.1%	19.9%	+2.8%
Doddridge County	8.3%	14.9%	+6.6%
Harrison County	18.4%	22.6%	+4.2%
Marshall County	12.2%	17.1%	+4.9%
Ritchie County	9.0%	9.3%	+0.3%
Tyler County	10.2%	13.5%	+3.3%
Wetzel County	13.4%	11.8%	-1.6%

Source: 2009 and 2017 5-year American Community Survey.

Poverty

However, despite gains in median household income and educational attainment, the boom in natural gas production and related activity does not appear to have had a significant impact on poverty rates in the top natural gas producing counties or the state as a whole. Since natural gas production began increasing sharply in 2010, the state's poverty rate has remained essentially unchanged at 18.5%, even as poverty rates declined nationwide. Among the 6 top gas producing counties, 4 saw minor reductions in their poverty rates, while two saw increases of more than 2 percentage points.

Table 5: Poverty Rates Before and After the Natural Gas Boom

	2010	2017	Change
United States	*15.3%*	*13.4%*	*-1.9%*
West Virginia	18.2%	18.5%	+0.3%
Doddridge County	20.6%	20.1%	-0.5%
Harrison County	17.3%	16.8%	-0.5%
Marshall County	17.0%	19.1%	+2.1%
Ritchie County	19.9%	18.5%	-1.4%
Tyler County	16.2%	16.0%	-0.2%
Wetzel County	18.3%	20.6%	+2.3%

Source: U.S. Census Bureau Small Area Income and Poverty Estimates.

[35] See State of Working West Virginia, WVCBP, 2015 and 2016.

Similarly, another economic indicator, the Appalachian Regional Commission's (ARC) County Economic Status, shows a lack of economic progress for the state's top gas producing counties. The ARC County Economic Status is an index based on county averages for three economic indicators, three-year average unemployment rate, per capita market income and poverty rate, compared with national averages. Counties are designated as distressed, at-risk, transitional, competitive or attainment, based on their ranking in the index. None of West Virginia's top natural gas producing counties have seen an improvement in the ARC County Economic Status during the natural gas boom. (Table 6).

Table 6: Appalachian Regional Commission County Economic Status

	FY 2010	FY 2019
Doddridge County	At-Risk	At-Risk
Harrison County	Transitional	Transitional
Marshall County	Transitional	Transitional
Ritchie County	At-Risk	At-Risk
Tyler County	At-Risk	At-Risk
Wetzel County	At-Risk	At-Risk

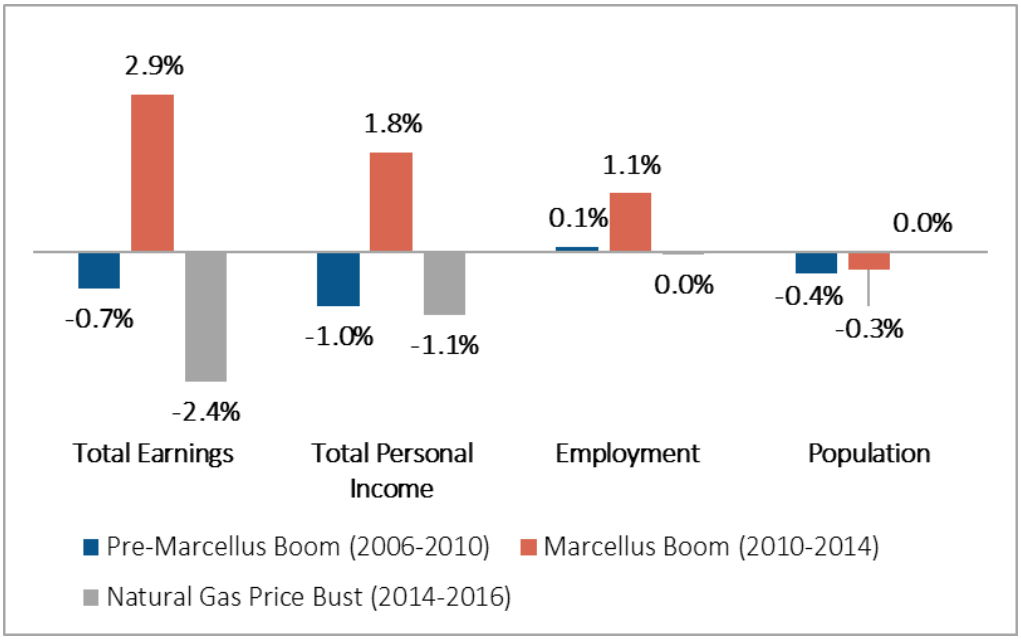
Source: Appalachian Regional Commission.

County Economic Indicators Follow a Boom and Bust Pattern

Using several economic indicators - total earnings, total personal income, employment, and population - a clear boom and bust pattern can be found in the top six gas producing counties. And the pattern closely follows the price of natural gas, which, as mentioned in the previous section, fell sharply when production first began booming, falling from Henry Hub prices of $4.59/MMBTU in 2010 to $2.78 in 2012. Prices recovered between 2012 and 2014, fuelling the biggest acceleration in West Virginia's production, but as prices fell again in 2014, the pace of production in West Virginia began to slow. After bottoming out in 2016, prices began to recover in 2017. These changes in prices and production have resulted in three distinct phases of the industry's economic impact in the top producing counties.

Figure 17 shows the difference in the average annual growth rates of West Virginia and the top six gas producing counties for each economic indicator. Bars above the line mean that the gas counties had higher growth rates than the state on that measure. Bars below the line mean that the gas counties had lower growth rates than the state.

Figure 17: Difference in Average Annual Growth Rates Between Top Natural Gas Producing Counties and West Virginia



Source: WVCBP analysis of Bureau of Economic Analysis data.

In the years leading up to the natural gas boom, West Virginia's natural gas producing counties experienced relatively slower growth than the state as a whole, trailing in earnings, income, and population growth, while experiencing slightly higher employment growth. During the initial boom in natural gas production, starting in 2010, the gas counties saw much faster rates of growth in earnings, income, and employment, while in fact losing population. But when natural gas prices began to fall in 2014, the economic boom busted, and the counties began to experience slower earnings and income growth, with no better employment and population growth than the state average.

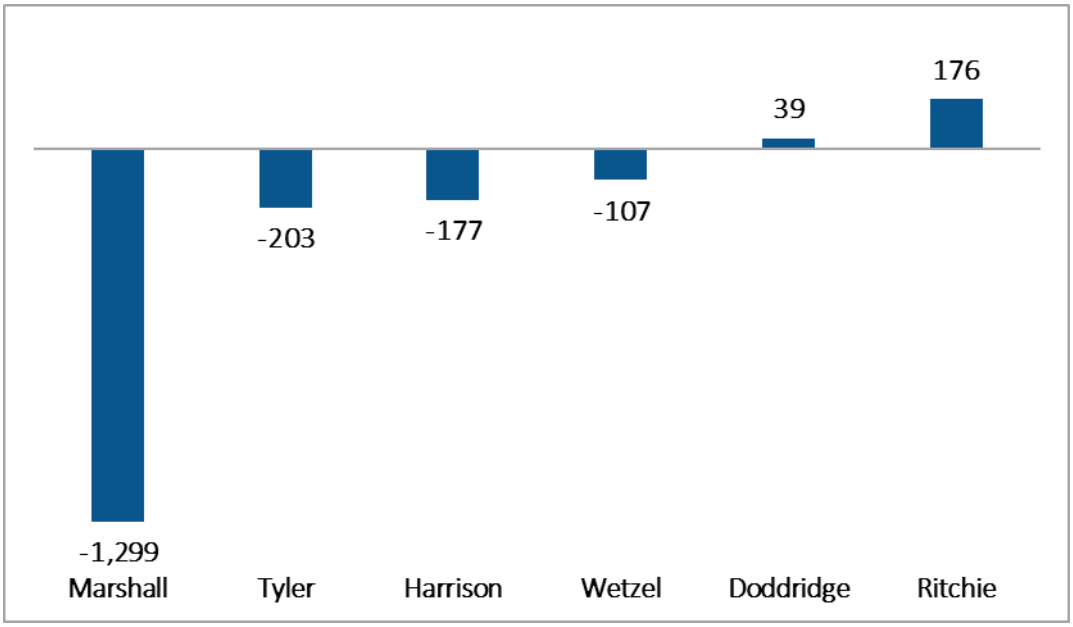
The accelerated boom and bust cycle means that for several of the state's top natural gas producing counties, many of their economic gains have been wiped out by falling natural gas prices, even as they continue to produce natural gas. For example, adjusted for inflation, Wetzel County produced more than $2 billion in natural gas from 2010 to 2016, including $308 million in 2016. But Wetzel county experienced no net job increase from 2011 to 2016 and has lost 338 jobs (-5.3%) since its peak in 2012. The same can be said for Marshall County, which from 2010 to 2016 produced more than $1.3 billion in natural gas, including $211 million in 2016. In 2016 Marshall County had fewer jobs (13,006) than it did in 2009 (13,736)

Wetzel County experienced no net job increase from 2011 to 2016.

and has lost more than 1,500 jobs (-10.4%) since its peak in 2013.

During the crash of natural gas prices starting in 2014, West Virginia's top natural gas producing counties lost 1,571 jobs despite producing $5.7 billion worth of natural gas from 2014 to 2016[36] (Figure 18).

Figure 18: Change in Nonfarm Employment 2014-2016

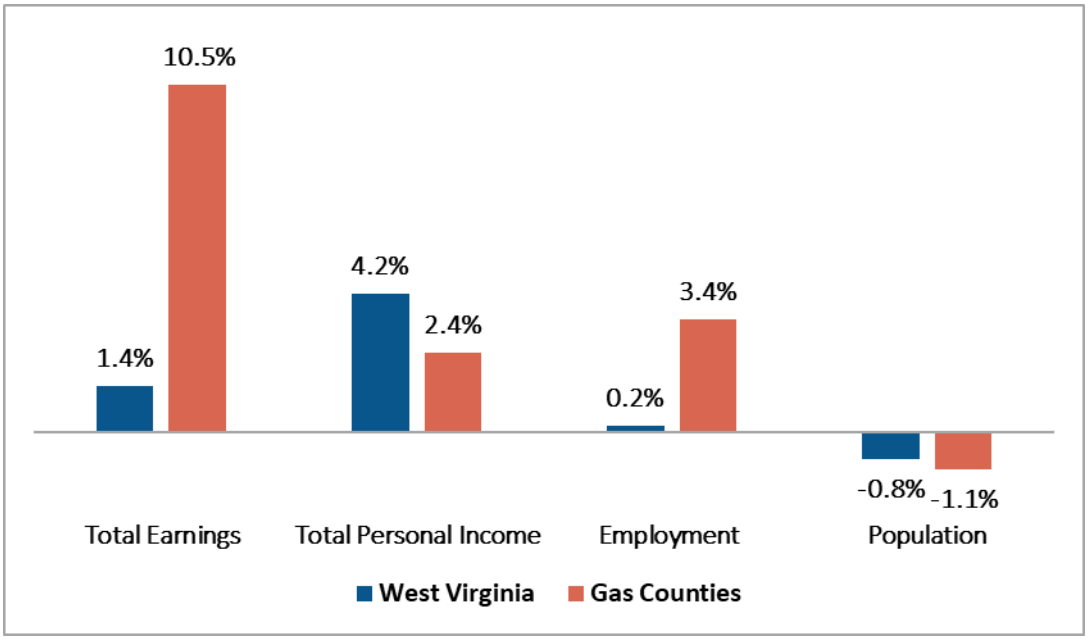


Source: Workforce WV.

In 2017, as natural gas prices stopped their free fall, the state's top gas producing counties began to recover their lost gains. In 2017, the top gas producing counties saw gains exceeding the state average in earnings, personal income, and employment, although they continued to lose population (Figure 19).

[36] Natural gas value based on pricing at Dominion South Hub.

Figure 19: Annual Growth Rates of Key Economic Indicators, 2016-2017



Source: WVCBP analysis of Bureau of Economic Analysis data.

In short, while the natural gas producing counties have seen some economic benefits from the shale boom, these benefits have been small relative to the billions of dollars of shale gas extracted from these counties. The boom-and-bust nature of the economic gains, combined with the persistent declining population of these counties, indicates that shale development is not yet translating into long-term economic gains for these counties.

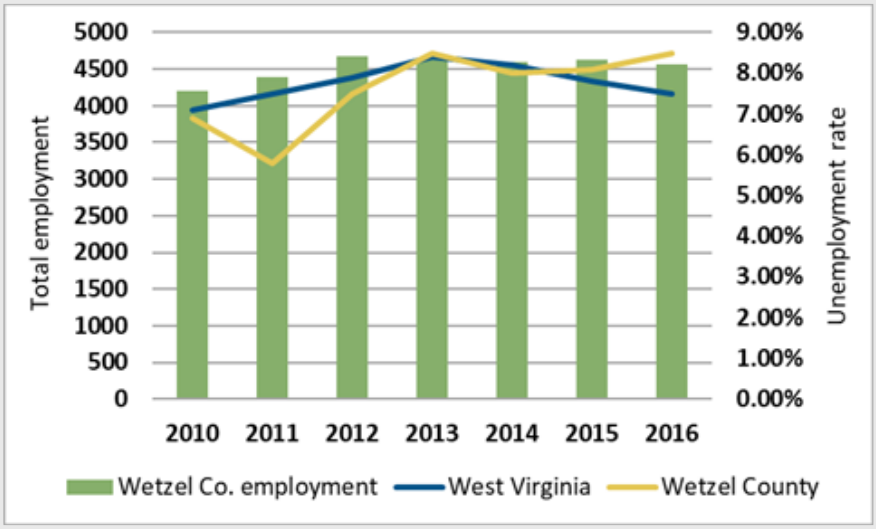
Wetzel County Case Study

Wetzel County has consistently been one of West Virginia's largest shale gas producing counties.[i] In 2017, this rural county in northern West Virginia accounted for 12.8% of all gas produced in the state. Yet Wetzel County's economy has performed worse than the rest of the state in key macroeconomic indicators during the last decade of the shale boom.

From 2010 to 2016, Wetzel County lost 3.5% of its population, a nine times greater rate of population loss than the state as a whole. Enrollment in K-12 schools has fallen by 11%, a rate six times great than the state as a whole. Median household income has increased by 7.7%, less than the overall increase across West Virginia of 11.1%. In 2010, Wetzel County had approximately the same percentage of households below the federal poverty line as the state as a whole (17.4 compared to 17.5%). By 2016, West Virginia's poverty rate was essentially flat at 17.7%, while Wetzel County's poverty level had grown to 21.1%.[ii]

However, Wetzel County has outperformed the state as a whole in terms of total employment. Employment has increased 8%, compared to a 1% decrease across the state from 2009 to 2017; however, the county experienced all of this job growth from 2009 to 2012 and jobs have remained approximately constant since 2012. About half of the new jobs in Wetzel County have been in the mining and natural resources sector (a classification that includes natural gas drilling). Nevertheless, the unemployment rate in Wetzel County has actually increased, from 6.9% in 2010 to 8.5% in 2016.[iii]

Figure 20: Employment in Wetzel County and Comparison of Unemployment Rate to State as a Whole



Source: Workforce WV.

Interviews with Wetzel County officials[iv] provide some indication as to why this increase in employment has not translated into a decrease in unemployment or poverty or into increases in population or school enrollment. According to these

officials, the labor force for the gas industry still resides primarily in hotels, motels, and campsites.[v] In other words, natural gas industry workers are from out of the county and are generally not putting down roots and starting families in Wetzel County.

Interviews with county officials also revealed significant quality of life concerns that the natural gas industry has caused for county residents, primarily related to heavy truck traffic.[vi] Although a voluntary safety agreement has been established by the County Commission, the Wetzel County School Board and industry representatives— an agreement which includes standard practices for escort cars, road curfews to allow safe passage of school buses, and limits on truck size and weight— there is no penalty for drillers who do not comply with the commitments. Existing federal guidelines for best practices of escort cars are not well-tailored for rural West Virginia conditions, which include narrow roads, blind turns, steep grades, convoy lanes, difficulty in communicating the number of vehicles in a convoy, multiple companies and contractors, degraded infrastructure, yard and road staging, and poor notification of road closures. Residents also had a number of complaints of unsafe driving by pipeline construction vehicles. Because these companies are only in the area for a short time, residents feel they have even less of an incentive to protect community members and listen to their concerns.

One positive development for the county from natural gas production has been the increase in the county's education budget resulting from natural gas property tax collections.[vii] This has allowed the county to hire new teachers and nurses, invest in new electronic equipment for classrooms, give teachers' salaries above the state base formula, and avoid consolidating the county's four high schools.

However, on balance, the example of Wetzel County shows that the actual impact of shale gas development has not had the local economic development impact anticipated by early boosters of the shale industry. Instead, employment has primarily gone to workers brought in from outside the county, who have not chosen to remain in the county for the long-term. The second-largest natural gas producing county in the state has fared worse than the state as a whole; poverty has increased and population and school enrollment have fallen faster than the state average.

[i.] From 2012 to 2017, Wetzel has been either the 2nd or 3rd largest dry gas producing county each year. (See WV Geological & Economic Survey Marcellus Shale and Utica-Point Pleasant summary reports.)
[ii.] U.S. Census Bureau, American Community Survey 5-Year Estimates.
[iii.] Workforce WV.
[iv.] Interviews conducted by Rachel Rubin (WV Center on Budget and Policy) in summer 2018 with: Wetzel County Commission (Larry Lemon, Bob Gorby, Lisa Heasley), Wetzel County School Board (Superintendent Ed Toman, Personnel Director Shane Highley and Treasurer Jeffrey Lancaster), Ray Renaud of the Wetzel County Oil and Gas Task Force, and local business owner Steve Conlon.
[v.] See also: L. Matthews, "Hotel to Open April 7," Wetzel Chronicle, January 21, 2015; L. Matthews, "Commission shows support for local workers," Wetzel Chronicle, April 29, 2015; J. Snoderly, "Campsites for oil and gas workers benefit economy, but not without issues," The Exponent Telegram, October 28, 2018.
[vi.] See also: C. Lawrence, "Wetzel County group hopes changes will be adopted for safe roads," WV Metro News, April 21, 2018.
[vii.] See also: "Wetzel Gas Tax Brings in $1.67M", Wetzel Chronicle, May 13, 2015.

Shale Industry in West Virginia Faces Uncertain Outlook

The future outlook for the shale industry in West Virginia is uncertain, in large part due to the shaky financial position of the industry itself.

Despite the rapid growth of oil and gas production, the paradox of shale is that it has never made money.[37] From a financial perspective, the last decade of the shale boom has been a bust.

The underlying challenge to the industry's financial health is that shale drilling is much more capital intensive than conventional natural gas drilling. Shale gas wells deplete quickly: in the Marcellus shale, for example, production from a shale well often declines by 60-80% in the first year.[38] As a result, shale-focused companies must spend heavily on new wells simply to maintain production— and must spend even more to keep output climbing.

From a financial perspective, the last decade of the shale boom has been a bust.

Shale-focused companies have never been able to finance these massive drilling outlays solely from the sale of gas and oil. Instead, they have repeatedly sought new infusions of cash from debt and equity markets to finance their drilling budgets and keep their companies afloat. While one would expect a new industry to require significant start-up capital, as the industry matures, investors expect that the industry should become financially self-sustaining, generating enough cash to cover new investments. The oil industry, for example, has always generated enough cash from operations to fund its capital expenditures. And the U.S. coal industry for most of its history funded itself out of cash from operations, until its recent period of financial distress. By 2012-2013 many coal companies were turning more to equity and debt markets to finance capital expenditures.

An analysis of financial records from 32 independent, publicly traded oil and gas companies revealed that shale-focused companies spent $196 billion more on capital expenditures from 2010 through mid-2018 than they realized by selling hydrocarbons. Even with an uptick in prices through much of 2018, which the

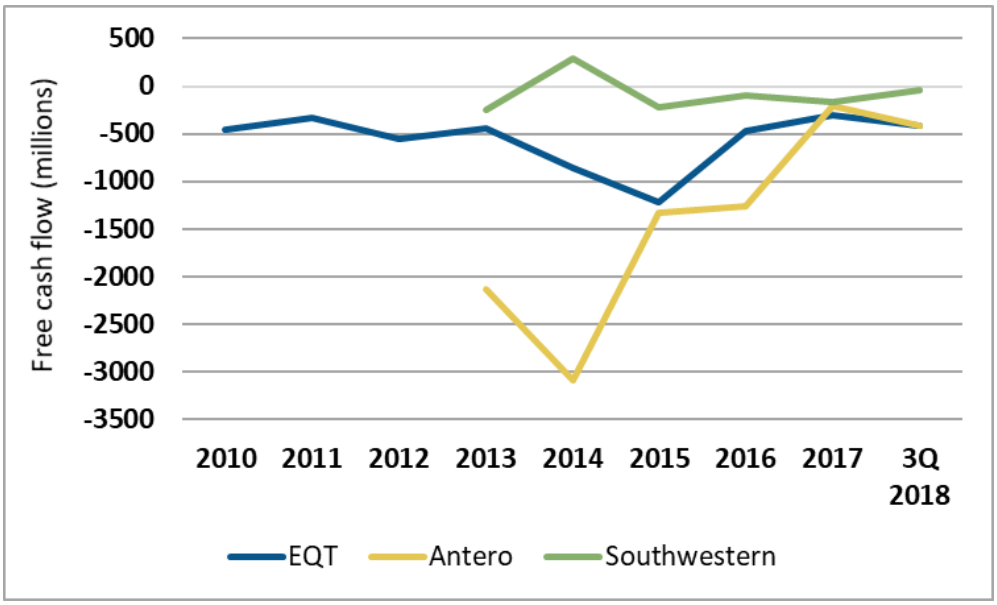
[37] B. Olson and L. Cook, "Wall Street tells drillers to stop counting barrels, start making profits," Wall Street Journal, December 13, 2017; R. Elliott and B. Olson, "Frackers burn cash to sustain U.S. oil boom," Wall Street Journal, August 12, 2018; C. Matthews and B. Olson, "Oil is above $70, but frackers still struggle to make money," Wall Street Journal, May 17, 2018; N. Salvaterra, "Rising costs are cutting into shale company profits – Energy Journal," Wall Street Journal, August 13, 2018.

[38] "Natural gas production decline curve and royalty estimation," Penn State Extension, October 30, 2014.

industry touted as the beginning of a turnaround[39], these companies collectively spent $4.9 billion more on capital expenditures through the first three quarters of 2018 than they gained from selling their products. All told, 23 of the 33 companies spent more on drilling than they realized from oil and gas sales through the first three quarters of the year.[40]

Appalachian drillers are no exception to this trend. Figure 21 shows the free cash flow of major Appalachian drilling companies EQT, Antero, and Southwestern Energy. Aside from a brief moment of positive cash flow for Southwestern in 2014, these drillers have failed to become financially sustainable, and have relied on new infusions of money from investors to fuel their operations for the entire period of their operations in West Virginia.

Figure 21: Free Cash Flow (Cash from Operations Less Capital Expenditures) for the Top Three Appalachian Natural Gas Producers



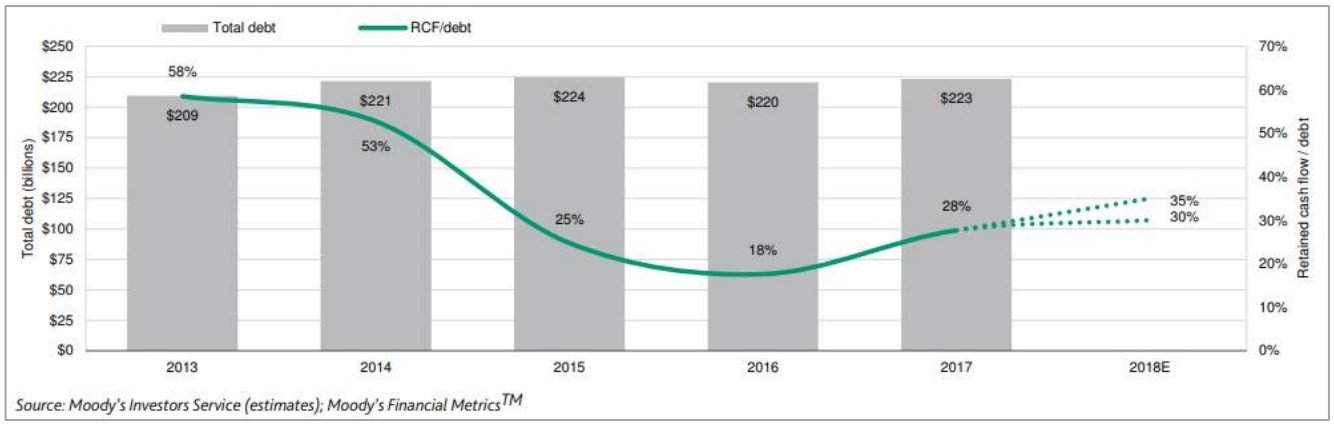
Source: Form 10-Ks and 10-Qs filed with Securities and Exchange Commission. Data for Antero and Southwestern starts in 2013 because Antero completed its initial public offering and Southwestern acquired significant Marcellus acreage in that year.

In addition to negative cash flows, the shale industry is showing other signals of financial stress. For example, in the U.S. oil and gas exploration and production industry as a whole, net debt increased 250% from 2005 to 2014, while EBITDA (earnings before interest, taxes, depreciation and amortization) increased only

[39] B. Olson, "Frackers could make more money than ever in 2018, if they don't blow it," Wall Street Journal, January 22, 2018.
[40] K. Hipple, T. Sanzillo, and C. Williams-Derry, "More Red Flags on Fracking," Institute for Energy Economics and Financial Analysis, December 2018; C. Williams-Derry, K. Hipple and T. Sanzillo, "Energy Market Update: Red flags on fracking," Institute for Energy Economics and Financial Analysis, October 2018.

68%.[41] Since 2014, the relationship between debt and earnings has only gotten worse. Currently the oil and gas E&P sector has much lower levels of cash flow relative to debt than it did before oil prices collapsed in 2014.

Figure 22: Total Debt and Retained Cash Flow to Debt Ratio for 35 North American Exploration and Production Companies



Source: Moody's Investor Service, Sector-in-depth: Exploration & Production, North America, June 11, 2018.

Part of the problem for shale drillers has been the low natural gas price environment described in the previous sections. Producers are caught in a trap of production and prices. They must continually drill in order to offset well declines and attract new investors. Yet they are unable to sell their gas at a favorable price because the market is oversupplied with natural gas. Remarkably, the U.S. natural gas market was oversupplied even before the shale boom took off. In its 2009 annual outlook on the independent oil and gas exploration and production sector, Moody's wrote, "An unprecedented surplus of natural gas has haunted North America's independent exploration and production (E&P) sector in 2009, and shows little sign of retreating in 2010… For the near term, we see little relief in the ongoing oversupply conditions… Until we see more evidence of a healthier supply/demand balance for natural gas, our outlook for the E&P Industry remains negative." At the time of that report, U.S. natural gas production was 20%

Remarkably, the U.S. natural gas market was oversupplied even before the shale boom took off.

[41] A. Azar, "Reserve base lending and the outlook for shale oil and gas finance," Columbia Center on Global Energy Policy, May 2017, p. 9.

lower than 2017 production and Henry Hub prices stood at $4.4/MMBTU— far higher than today's prices.

The underlying oversupply problem identified by Moody's back in 2009 has persisted, despite the industry's best efforts to stimulate demand. Those efforts include an unforeseen conversion of the electric power sector to natural gas; a build-out of natural gas pipeline infrastructure to bring natural gas to new markets for power generation (including a significant increase in natural gas exports to Mexico), and a rush to build liquefied natural gas export terminals. So far, these efforts have not resulted in any significant improvement in pricing.

The rapid growth of shale gas production under these conditions has been enabled by Wall Street lenders, who have tolerated the industry's persistent failure to become financially self-sustaining.[42]

The shale gas revolution has been fuelled by the cheap credit made available after 2008 when the Federal Reserve decided to maintain U.S. interest rates at near-zero levels. In 2017, the CEO of Anadarko Petroleum described Wall Street investors as "the problem" for enabling financially unsustainable growth and punishing companies that tried to live within their cash flow.[43]

Over the last few years, industry leaders have periodically claimed that the sector is on the verge of becoming financially sustainable, even as Wall Street investors have threatened to impose financial discipline on the industry.[44] To date, financial performance does not indicate that these goals are being achieved, as the oil and gas sector continues to spend more on drilling than it realizes from selling oil and gas.

The financial reality of the industry is in sharp contrast to its rhetoric as "one of the fastest-growing and successful industries in the state."[45] Ironically, if raising the severance tax had the impact that the industry feared— raising natural gas prices and curtailing production— it would actually improve the financial health and long-term viability of the industry.

---

[42] See, for example, B. McLean, "How America's 'most reckless billionaire' created the fracking boom," The Guardian, August 30, 2018.
[43] B. Olson and A. Sider, "Wall Street cash pumps up oil production even as prices sag," Wall Street Journal, July 7, 2017.
[44] B. Holland, "JPMorgan clamping down oil, gas clients, expects more bankruptcies, S&P Global Market Intelligence, February 24, 2016; B. Olson, "Frackers could make more money than ever in 2018, if they don't blow it," Wall Street Journal, January 22, 2018; B. Olson and L. Cook, "Wall Street tells drillers to stop counting barrels, start making profits," Wall Street Journal, December 13, 2017; S. Layag, "Growing demand, higher prices put NGLs at forefront of US drillers' strategy," S&P Global Market Intelligence, Thursday, August 30, 2018; B. Holland, "Investors warm to Appalachian gas drillers that limit spending, buy back shares," S&P Global Market Intelligence, May 14, 2018; S. Layag, "Appalachian gas drillers banking on NGL price improvements for cash flow goals," S&P Global Market Intelligence, May 31, 2018; C. Matthews and B. Olson, "Frustrated investors want frackers to consolidate," Wall Street Journal, October 19, 2018; E. Crooks, "Capital raising by US oil companies falls sharply," Financial Times, January 23, 2019.
[45] A. Blankenship, "Higher natural gas severance is a tax on WV's future," The State Journal, September 24, 2018.

Despite persistent industry-wide underperformance, shale gas production in West Virginia is projected to continue growing. As indicated above, higher interest rates and/or a decision by investors to make good on their periodic threats to discipline shale drillers could result in this growth being lower than typically forecast.

The Energy Information Administration projects U.S. gas production to increase 59% by 2050, an increase of 45 billion cubic feet per day, with most of the growth coming from Appalachia.[46] However other industry analysts are less optimistic. Rystad Energy forecasts Appalachian production peaking and starting to decline after 2026.[47] Speaking at an industry conference in 2017, a senior vice president of Range Resources stated, "Historically, every play gets overbuilt. Pipelines always get bigger because companies at any given point in time predict certain growth, but things change. Whether it's commodity price, whether it's [the discovery of] new basins, whether it's a whole bunch of other things, it changes. Activity levels are going to be lower than probably most people expect."[48]

The natural gas industry is focusing on petrochemicals as the next big economic development opportunity for West Virginia. Petrochemicals dominated the natural gas discussion at the 2017 West Virginia Governor's Energy Summit.[49] The industry's goal is to develop a petrochemical hub in northern West Virginia and southwestern Pennsylvania to take advantage of the region's cheap natural gas liquids and process them locally, rather than sending them to petrochemical facilities in Texas and Louisiana.

A 2017 industry report by the American Chemistry Council estimated the economic development benefits for a chemical and storage hub "on a scale comparable to that in the Gulf Coast."[50] It estimated that this would generate more than 100,000 jobs and $1.2 billion a year in state and local tax revenue by 2025 in the four-state region of West Virginia, Kentucky, Ohio and Pennsylvania.

For the past several years, there have been efforts to locate ethane crackers in Appalachia to take advantage of the surge in natural gas liquids production. Thus far, only one is under development in Pennsylvania; a second proposed cracker in Ohio is moving forward with permitting and feasibility studies, but a final

[46] EIA also projects a 240% increase in natural gas production from the eastern U.S. (Energy Information Administration, Annual Energy Outlook 2018, Table 61). See also: Energy Information Administration, "U.S. natural gas production and consumption increase in nearly all AEO2018 cases," April 16, 2018.
[47] Rystad Energy AS (Sept. 2018) via Oil Change International.
[48] J. Magill, "'Sweet spot exhaustion' predicted for Appalachian gas production," S&P Global Market Intelligence, October 23, 2017.
[49] See: http://energywv.org/energy-summit/2017-energy-summit-presentations/
[50] Specifically, the study assumed $35.8 billion of capital investment into 5 ethane crackers (total capacity of 6.25 million tons of ethylene per year), two propane dehydrogenation plants (total capacity of 1 million tons per year), downstream polyethylene and other petrochemical derivatives, and 75-100 million barrels of underground storage capacity. ("The potential economic benefits of an Appalachian petrochemical industry," American Chemistry Council, May 2017).

investment decision has been delayed multiple times.[51] A proposal for an ethane cracker near Parkersburg, WV has not moved forward since it was first proposed five years ago.[52]

Although the industry is as excited now about the economic development potential of petrochemicals as it was about shale drilling itself a decade ago, there are reasons to be less optimistic.

The push for petrochemicals in West Virginia is part of a national and global boom in petrochemical development, driven both by low natural gas liquids prices and by oil majors looking to diversify their investments. According to the American Chemistry Council, $202.4 billion in petrochemical projects have been announced in the United States since 2010, with 53% of that investment under construction or completed.[53]

However, the prospects for developing an Appalachian petrochemical hub are far from certain. Risks to the development include:

1. Competition from Other U.S. Petrochemical Developments

One of the fastest-growing shale gas plays in the United States, alongside the Marcellus, is the Permian basin in western Texas. In the last two years, production from the Permian has increased nearly 60%[54] and now accounts for about 11% of U.S. natural gas production, second only to Appalachia.[55] The development of the Permian is driven not by natural gas, but by shale oil production.[56] But Permian shale oil wells also produce significant volumes of natural gas— allowing producers to sell natural gas very cheaply as a byproduct of oil production.[57] While there are currently transportation constraints for moving oil and gas out of the Permian, such constraints are expected to be alleviated by new pipeline construction entering into service in the second half of 2019.[58] This should give natural gas from the Permian the advantage of easier access to the pre-existing petrochemical hub in the Gulf Coast. Gulf Coast petrochemical development has already been expanding, with 80% of recent U.S. petrochemical investment going to Gulf Coast facilities.[59]

---

[51] A. Duquiatan, "Shell begins construction on PA ethane cracker complex," S&P Global Market Intelligence, November 9, 2017.
[52] A. Brown, "Brazilian company out of WV ethane cracker plans, but project not dead," Charleston Gazette-Mail, June 10, 2016.
[53] American Chemistry Council, "U.S. Chemical investment linked to shale gas: $202 billion and counting," September 2018.
[54] Energy Information Administration, Drilling productivity reports for Sept 2016 and Sept 2018.
[55] Energy Information Administration, "Appalachia, Permian, Haynesville drive U.S. natural gas production growth," August 28, 2018.
[56] Energy Information Administration, "Permian region natural gas prices fall as production continues to grow," July 18, 2018.
[57] Federal Reserve Bank of Dallas, "Dallas Fed Energy Survey," March 28, 2018.
[58] "Moody's: Permian basin pipeline constraints to limit 2019 production," Oil & Gas Journal, October 10, 2018.
[59] "U.S. prepared for more than a second wave of chemical investment-ACC", Petrochemical Update, June 16, 2017.

Some analysts predict that growth from the Permian will dampen growth in the Marcellus and Utica over the next several years.[60]

2. Competition from Global Petrochemical Developments

The United States is not the only country that is rushing to get into petrochemical development. Other major oil-producing nations, state-owned oil companies and multi-national oil producers have recognized the value of petrochemical production as a hedge against oil prices. When oil prices are low, petrochemical investments are more profitable. When oil prices are higher, oil exploration and development has historically been more attractive to investors. Oil majors such as Exxon and Shell are investing significantly in petrochemical development.[61] Similarly major oil-producing states such as Saudi Arabia, Iran and Qatar have all announced plans to rapidly expand petrochemical development in the next decade.[62]

This is relevant because most of the petrochemical production growth planned for the U.S. is destined for export, according to industry leaders. In 2017, Exxon stated that, "most of ExxonMobil's planned new chemical capacity investment in the Gulf region [$20 billion over 10 years] is targeted toward export markets in Asia and elsewhere."[63] The CEO of LyondellBasell, one of the largest petrochemical producers in the U.S., stated that "These expansions in the US are geared towards exports to Asia. What drives demand for plastics is the growing middle class in China and India."[64] And the American Chemistry Council report on a prospective Appalachian chemical hub stated that much of the production would be destined for export.

Industry analysts have noted the potential for petrochemical capacity expansion to outpace demand over the next decade. Argus assumes annual average demand growth of 3.6% per year through 2021 and notes that capacity expansion is likely to grow faster, at 4.1% per year through that same period. McKinsey expects global demand growth to be even slower, at 1.6% to 3.1% per year through 2025. McKinsey also expects increasing competition from new entrants, including state-

---

[60] "Driving Appalachia's problem is free gas coming from shale oil wells in the Permian Basin in the Southwest, Bernstein said. The gas is "free" in the sense that the gas has to be moved to keep oil flowing, and the amount of revenue that this associated gas generates is of little or no concern to Permian producers. Bernstein is predicting the Permian will add 7 Bcf/d of new gas to the national market and push Henry Hub prices as low as $2.25/Mcf within three years. 'This 7 Bcf/d increase to 2025 more or less came directly out of the SW Marcellus/Utica, the next basin on the cost curve,' Bernstein said. 'Instead of our prior view of the Marcellus/Utica growing to 36 Bcf/d and filling the upcoming pipes by 2021, we now expect much more moderate growth in which the Marcellus/Utica gradually rises but maxes out at around 30 Bcf/d in 2025.'" (B. Holland, "Pipeline capacity commitments will drag on Marcellus producers, Bernstein says," S&P Global Market Intelligence, April 4, 2018.)

[61] Exxon 2017 10-K, and Shell 2017 Strategic Report (p. 11)

[62] F. De Beaupuy, C. Connan, "Aramco, Total plan $5 billion Saudi Arabia petrochemical complex," Bloomberg, April 10, 2018; KPMG, "A new era for Iranian petrochemicals," August 2017; "Qatar Petroleum to build world-scale petrochemicals complex, including Middle East's largest ethane cracker," May 15, 2018.

[63] ExxonMobil, "News Release: ExxonMobil plans investments of $20 billion to expand manufacturing in U.S. gulf region," March 6, 2017.

[64] E. Crooks, "Chemical industry split about the case for more US plants," Financial Times, May 2, 2017.

owned enterprises, to drive down the profitability of the petrochemical sector. They conclude, referring to trends in increased competition, slowing global demand and declining innovation in specialty chemicals, "If just a few of these shifts gain substantial momentum, the chemical industry will face a decade very different from, and much tougher than, the last one."[65] A Saudi Arabian consulting firm similarly noted "more intensive global competition" as one of the headwinds facing Saudi Arabia's petrochemical expansion plans.[66]

In short, investors in Appalachian petrochemical development run the risk of ramping up production for export into an already saturated global market.

3. Higher Natural Gas Liquids Prices

As described in the previous section, the growth in Marcellus shale production has been fueled by cheap capital. It is impossible to predict how long prices will remain at the current financially unsustainable level, but it is unlikely that investors will be willing to put up with several more decades (the lifespan of a major infrastructure investment) of losing money on shale. A cutback in production at some point is necessary to right the supply/demand imbalance in the market and drive up prices to financially sustainable levels. This would make the economics of Appalachian petrochemical production less favorable.

Can West Virginia Avoid a Resource Curse in Shale Development?

West Virginia's economy over the last hundred years has been characterized by boom and bust patterns of resource extraction tied to the coal industry. The state's persistent poverty in the face of its vast coal wealth has been extensively discussed.[67] In the past decade, the natural gas industry has underperformed expectations regarding economic development and county-level economic indicators appear to follow a boom-and-bust pattern. Will West Virginia's history of a "resource curse" associated with coal[68] repeat itself with natural gas, and can this be avoided?

The term "resource curse" was coined by Richard M. Auty, a British economist, in 1993 to describe the paradox of how underdeveloped countries with rich mineral resources often grow slower than countries without these resources.[69] Moreover, Auty argued that unless resource-rich countries can diversify their economies, they

[65] F. Budde, O. Ezekoye, T. Hundertmark, M. Prieto, T.J. Simons, "Chemicals 2025: Will the industry be dancing to a very different tune?", McKinsey & Company, March 2017.
[66] Jadwa Investment, "Petrochemicals and the Vision 2030," February 2017.
[67] See, for example, "2016 State of Working West Virginia: Why is West Virginia so poor?", WV Center on Budget and Policy and American Friends Service Committee, December 2016.
[68] Ibid.
[69] Auty, Richard M. 1993. Sustaining Development in Mineral Economies: The Resource Curse Thesis. London: Routledge.

will continue to suffer from the boom-bust cycles of market volatility. The resource curse is also known as the "paradox of plenty."

According to the National Resource Governance Institute, the resource curse refers "to the failure of many resource-rich countries to benefit fully from their natural resource wealth, and for governments in these countries to respond effectively to public welfare needs."[70] The thesis holds that countries with non-renewable resource wealth are more prone to social conflict, poor governance (e.g. authoritarianism), economic instability, and lasting environmental damage. Other scholars have defined the resource curse as simply "a situation where the abundance of natural resources actually leads to slower economic growth."[71]

Studies examining the resource curse thesis have done so by looking at particular countries (international level), U.S. states (subnational level) and at small jurisdictions (counties). One of the most famous, and most comprehensive, was conducted by Jeffery Sachs and Andrew Warner in 1995 that looked at 95 countries over a 20-year period. Sachs and Warner found that countries with a high ratio of resource exports (as a share of Gross Domestic Product) experienced slower economic growth even after controlling for a number of factors, such as per capita income and trade.[72] Sachs and Warner extended this research in 2001 and found similar results.[73] Some skeptics of the resource curse have insisted that the economic outcome of resource dependent countries is determined by how good the institutions in place are during the commodity boom.[74] While there is a lack of consensus on the resource curse hypothesis and its inevitability, with obvious counterexamples such as Norway, the weight of the literature finds that natural resource-based economies tend to grow slower over the long term.[75]

Over the last two decades, there have been a number of studies that have attempted to look at the effect of natural resource-based economies on state economic growth in the United States. One of the first studies was in 2004 by Papyrakis and Gerlaugh, who found that natural resource abundance had a significant negative impact on

---

[70] National Resource Governance Institute, "The Resource Curse: The Political and Economic Challenge of Natural Resource Wealth," NRGI Reader, March 2015.
[71] Farren, Michael, Amanda Weinstein, and Mark D. Partridge, "Making Shale Development Work for Ohio." Swank Program in Rural-Urban Policy Summary Report, June 2012.
[72] Sachs, Jeffrey, and Andrew Warner, 1995, "Natural Resource Abundance and Economic Growth," in G. Meier and J. Rauch, eds., Leading Issues in Economic Development, New York: Oxford University Press. NBER WP 5398.
[73] Jeffery D. Sachs and Andrew M. Warner, "Natural Resources and Economic Development: The Curse of Natural Resources," European Economic Review 45 (2001) 827-838.
[74] For a good discussion of the academic literature on skeptics of the resource curse thesis, see Jeffery A. Frankel, "The Natural Resource Curse: A Survey of Diagnoses and Some Prescriptions," Harvard Kennedy School and NBER. June 2012. Uploaded from Also see, Gavin Wright and Jesse Czelusta, "The Myth of the Resource Curse," Challenge Magazine, Vol 47. No. 2. March/April 2004.
[75] For literature review surveys on the resource curse thesis, see: Frankel, Jeffrey "The Natural Resource Curse: A Survey" Discussion Paper 2010--21, Cambridge, Mass.: Harvard Environmental Economics Program, September, 2010; Fredrick van der Ploeg, "Natural Resources: Curse of Blessing?" Journal of Economic Literature, July 2010, Vol.49 (2), p.366-420; Ramez, B et al," The Evolution of the Natural Resource Curse Thesis: A Critical Literature Survey," Department of Economics and Finance, University of Canterbury, Working Paper, April 7, 2016; and Paul Stevens, "The Resource Curse Revisited," Chatham House, August 2016.

growth, including decreases in investments, schooling, openness, and R&D expenditures, while increasing corruption.[76] Donald Freeman found similar results in a 2009 study that looked at individual states, also concluding that there is "strong evidence that resource-based economies are more volatile economies, and volatile economies may be less desirable to investors."[77]

Studies that have examined resource dependency and economic performance at the county level in the United States have also found the presence of a resource curse. A 2011 study by Alex James and David Aadland found "clear evidence that resource-dependent counties exhibit more anaemic economic growth, even after controlling for state-specific effects, socio-demographic differences, initial income, and spatial correlation."[78] A 2014 study that focused on the energy booms and busts of Western counties found that localities benefit from the boom, but, over the long-run, suffered a larger decline in per capita incomes than if the boom never occurred.[79]

A 2015 study by Strafford Douglas and Anne Walker that examined coal resource dependence and long run income growth of more than 400 Appalachian counties between 1970 and 2010 found resource dependence was associated with lower per capita income growth and that it disincentives educational attainment.[80] A 2005 study that looked at the coal boom and bust in Kentucky, Ohio, Pennsylvania and West Virginia also found the existence of a resource curse, finding that the resource bust was stronger than the preceding boom and that it had a negative effect on schooling.[81] In slight contrast, a 2015 study with a focus on Appalachia does not find "strong evidence of a resources curse", except that resource extraction is negatively linked with small business formation and population growth."[82] While there is some disagreement, most of the state and county level empirical evidence generally finds a negative relationship— especially in the long-run— between economic performance and heavy reliance on natural resource extraction.

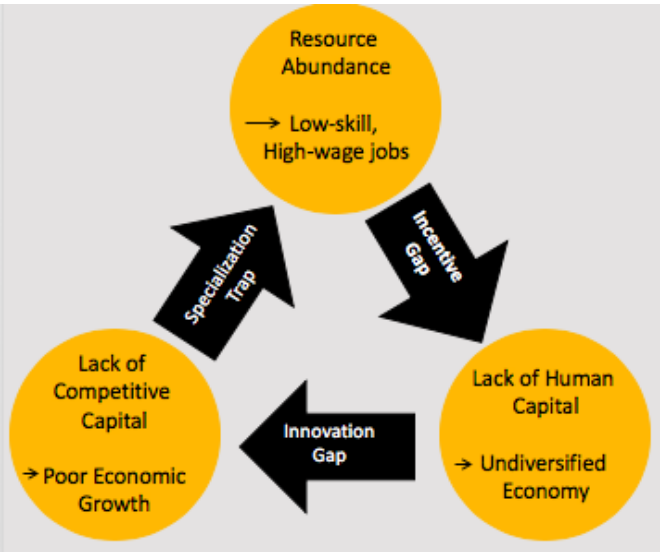
In a recent study entitled "Making Shale Development Work for Ohio," economists Michael Farren, Amanda Weinstein, and Mark Partridge suggest that the "root cause" of the resource curse is a "vicious cycle" where high-wage and low-skilled jobs create a disincentive to invest in innovation, higher education, advanced job skills, and other industries that results in less diversification of the economy (Figure

---

[76] Papyrakis, Elissaios, and Reyer Gerlagh. 2004. "Resource abundance and economic growth in the United States." *European Economic Review* 51 (4) (05): 1011-39.
[77] Donald Freeman, 2009. "The 'Resource Curse' and regional US development," Applied Economics Letters, Taylor & Francis Journals, vol. 16(5), pages 527-530.
[78] Alex James and David Aadland, "The curse of natural resources: An empirical investigation of U.S. counties," Resource and Energy Economics, Vol 33, Issue 2, May 2011, pp.440-453.
[79] Grant D. Jacobsen and Dominic P. Parker, "The Economic Aftermath of the Resource Booms: Evidence from the Boomtowns in the American West," The Economic Journal, June 2014. Pp.1092-1128
[80] Strafford Douglas and Anne Walker, "Coal Mining and the Resource Curse in the Eastern United States," Journal of Region Science, November 1, 2016. Vol.57, Issue 4, pp.568-590.
[81] Black, Dan, Terra McKinnish, and Seth Sanders. 2005b. "The Economic Impact of the Coal Boom and Bust." *Economic Journal* 115 (503): 449-76.
[82] Michael Betz, Linda Lobao, and Mark D. Partridge, "Coal Mining, Economic Development, and the Natural Resource Curse," Energy Economics, April 2015.

23).[83] A less diverse economy can mean less economic stability, which, in turn, can mean a harder landing from the booms and bust of natural resource-based economies. Economic diversity can not only promote stability in weathering economic cycles, but it can also promote adaptability.

Figure 23: The "Vicious Cycle" of the Resource Curse



Source: Farren, Weinstein, and Parkridge (2012).

Avoiding the "Resource Curse" in Shale Development

Since the natural resource curse is a long-run observation that examines the booms and busts of resource-based economies, most studies have focused on the short-term impact of unconventional shale oil and gas development on local economies. These studies have generally found positive effects on wages/earnings, jobs and economic development.[84] However, the positive effects could be overestimated if the state includes a large portion of workers who do not reside in-state or in the country where the observations exist. A heavy reliance on out-of-state workers can reduce the development of the local workforce. In rural communities that are more reliant on extraction with less economic diversity, the volatility of natural gas prices can lead to more acute energy busts that over the long-run can lead to weaker economic performance.[85] There have also been a number of studies that have looked at community impacts of shale development, including its adverse impact to health, safety, the environment, land use and infrastructure.[86]

The ability of states and counties to turn the resource curse into a blessing depends heavily on limiting rent-seeking behavior and corruption, promoting good

[83] Ibid.
[84] Alan J. Krupnick and Isabel Echarte, "Economic Impacts of Unconventional Oil and Gas Development," Resources for the Future, June 2017.
[85] Ibid.
[86] Alan J. Krupnick et al, "WHIMBY (What's Happening in My Backyard?): A Community Risk-Benefit Matrix of Unconventional Oil and Gas Development," Resources of the Future, June 2017.

governance and fiscal policy (e.g. adequate taxation), developing a more diversified economy that reduces the "crowding out" of other industries, mitigating the economic downturns or busts with wealth management (e.g. permanent trust funds), investing in infrastructure and education, reducing environmental externalities, and slowing the pace and scale of mineral production.

A Softer Landing from Shale Development

Funding the WV Future Fund

The following recommendations are focused solely on ways to use fiscal policy to help provide the resources necessary to help create a more sustainable future and economy from shale development. This means raising the severance tax on natural gas, oil, and natural gas liquids so the state can invest in local communities to build a more educated and skilled workforce, better infrastructure, and improve the quality of life. This recommendation becomes even more imperative given the uncertainty around the future for shale development in the state and how long the boom in production will last. If the industry's plans for petrochemical development do not materialize as promised, as appears likely, the state would benefit from having its own resources to invest in other economic development opportunities.

While some opponents of raising the severance tax argue it could hurt the state's economy, most of the empirical evidence suggests that this is not the case.[87] Overall, most of the academic and policy analysis literature finds that drilling is inelastic to changes in severance tax rates.[88] There are several reasons why the severance tax has little impact on production and employment in the mining sector, while having a big impact on boosting revenues that can fund budget priorities:

- **Exportability**: Most of the natural gas produced (89%) in West Virginia is exported out-of-state and most of the major shale gas extraction companies are located out of state, along with their corporate shareholders. The exportability factor helps explain why many of the states with the highest effective business tax rates (e.g. Wyoming) also have favorable "business tax climates". The two states with tax incidence models (Texas and Minnesota) find that severance taxes are mostly exported. For example, Texas finds that 65.7 percent of natural gas production taxes are exported, while 65.4 percent of its oil production taxes are exported.[89]

- **Deductibility**: The severance tax, like many other state business taxes, is deductible from the federal corporate income tax, which is currently 21 percent. This means that for $1 paid in state severance taxes, a firm's federal corporate income tax liability falls by $0.21. This partially offsets any increase in the severance tax by reducing a firm's federal corporate income tax liability.

---

[87] Sean O'Leary, "Investing in the Future: Making the Severance Tax Stronger for West Virginia," WV Center on Budget and Policy, December 2011.
[88] Jason P. Brown et al., "Effects of State Taxation on Investment: Evidence from the Oil Industry," Federal Reserve Bank of Kansas City, September 2018.
[89] "Tax Exemptions and Tax Incidence," Texas Comptroller, November 2018.

Therefore, if there are disincentive effects from raising the severance tax, they are partly abated by deductibility.

- **Taxes Are Small Compared to Other Factors**: State and local taxes only make up a small share of the cost of doing business and are not, in general, the primary factor when it comes to business investment decisions, especially regarding mineral extraction. If tax rates were all that mattered, oil and natural gas companies would all be moving to Ohio, which has a very small severance tax. Natural gas resource extraction and investment decisions depend heavily on proven reserves, quality of the resource, commodity prices and the differential between wet and dry gas pricing, infrastructure (e.g. pipelines), available workforce, and regulations, among other factors. Fluctuations in commodity prices are far greater than the variations in effective tax rates. For example, the Henry Hub natural gas prices fell by 70 percent from 2008 to 2016; and are up 25 percent from 2016 to 2018. This makes the differences in effective tax rates look comparatively small.[90]

Most studies that examine the impact of severance taxes on employment, production, or investment fail to look at the impact of the revenue the tax creates and how it is used (e.g. funding education, colleges, etc). A recent study by Penn State University found that for every $100 million in severance taxes imposed on oil and natural gas companies in Pennsylvania, the state would see a net gain of 1,100 jobs and a slight boost to Gross State Product (GSP) if the funds went to general revenue fund expenditures such as public education.[91] One reason is that oil and natural gas extraction is very capital intensive, while budget items such as public education are very labor-intensive, which nets more in-state economic activity.

Severance Tax Revenues Should Be Used to Strengthen the Future Fund

In 2014, the legislature created the West Virginia Future Fund as an inviolate trust fund to help build a permanent source of wealth for the state from severance taxes.[92] Under state law, the WV Future Fund is to receive three percent of General Revenue Fund severance tax collections on coal, oil, natural gas, limestone and sandstone (not including natural gas liquids (NGLs), coal bed methane, timber, or any other minerals), if certain fiscal conditions are met. From FY 2020 onward, investment income from the fund (but no portion of the principal) can be used to fund economic development and diversification, infrastructure improvements, and tax relief.[93] The amount of money that can be appropriated from the fund is based

[90] See Gilbert E. Metcalf, "The Impact of Removing Tax Preferences for U.S. Oil and Gas Production," Council on Foreign Relations, August 2016.
[91] Rose M. Baker and David L. Passmore, "Benchmarks for Assessing the Potential Impact of a Natural Gas Severance Tax on the Pennsylvania Economy," Penn State Institute for Research in Training & Development, September 2010.
[92] West Virginia State Code (§11-13A-5b.)
[93] State code (§11-13A-5b.) defines the three buckets that can be funded: (1) "Economic development and diversification" means fostering economic growth and development in the state, including commercial, industrial, community, cultural or historical improvements; or preservation or other

on a formula that uses the "average net investment return for the immediately preceding five fiscal years" in order to provide a more consistent amount of distribution over time.

The WV Future Fund was modelled after several trust funds in other states that have non-renewable depleting natural resources (coal, oil, natural gas, and other minerals). The purpose of these trust funds is to provide assets to a state that can help fund budget priorities long after the natural resources are gone.

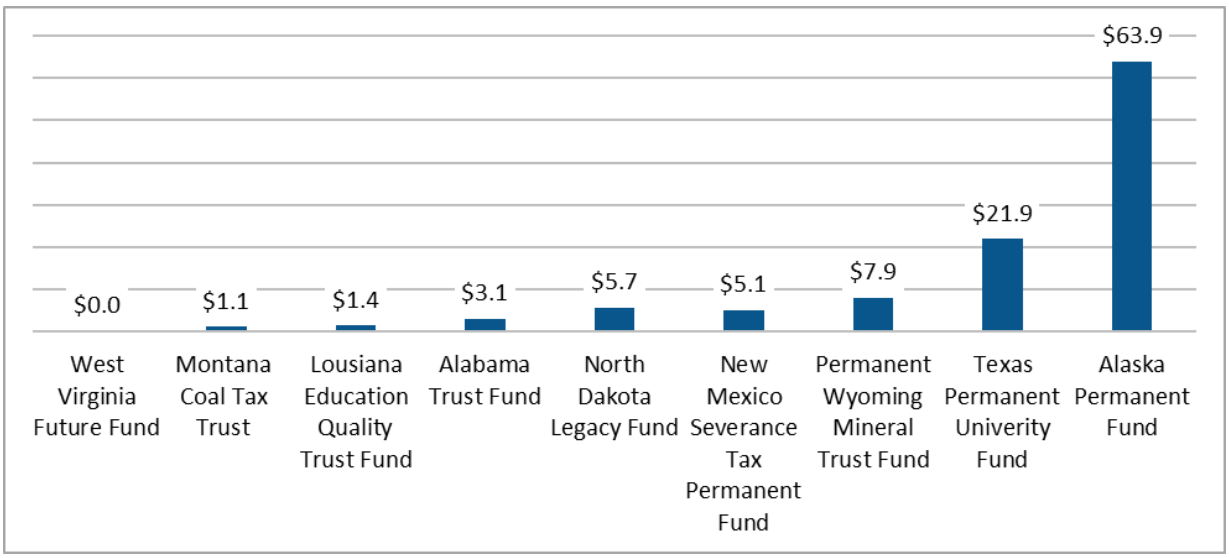
Most natural resource trusts funds are "permanent" because the principal of the fund is constitutionally protected or inviolate. Most permanent natural resource funds are invested similarly to pension funds (stocks, bonds, real estate, etc.) and the investment earnings are used each year to financially bolster a state's economy through strategic investments, such as education, infrastructure, dividends, or lower taxes for state residents. States create the funds for several reasons, including to help even out the booms and busts associated with volatile energy markets, to ensure that future generations benefit from a finite resource, to improve credit worthiness (e.g. boost credit ratings), to give the state greater political leverage and autonomy, to build public trust and lower taxes for state residents, and to diversify and expand local economies by using the revenues to invest in human and physical capital and mitigate externalities.

As Figure 24 highlights, nine states currently have permanent natural resource funds funded by severance taxes or royalty payments, including Alaska, Texas, Wyoming, North Dakota, Alabama, Louisiana, Montana, and West Virginia. The funds differ in size and scope but share similar attributes such as how they are invested and disbursed.[94] For example, Alaska uses the investment earnings from its fund to provide dividend checks to each state resident, while Wyoming uses its earnings to fund general revenue programs and services like public education. At the same time, both Alaska and Wyoming have constitutionally protected funds that are invested similarly to pension funds and both disburse funds based on a five-year formula.

proper purposes.(2) "Infrastructure improvements" means fostering infrastructure improvements including, but not limited to, post-mining land use, water or wastewater facilities or a part thereof, storm water systems, steam, gas, telephone and telecommunications, broadband development, electric lines and installations, roads, bridges, railroad spurs, drainage and flood control facilities, industrial park development or buildings that promote job creation and retention. (3) "Tax relief" means reducing the tax responsibility of citizens and businesses located in the State of West Virginia, including but not limited to increasing the Homestead Exemption and reducing or eliminating the ad valorem property tax on inventory and equipment held for commercial or industrial use.

[94] For more information about permanent natural resource trust funds see, Boettner et al. "Creating an Economic Diversification Trust Fund," WV Center on Budget and Policy, January 2012.

Figure 24: Values of States' Permanent Natural Resource Funds as of 2018, in Billions



Source: WVCBP survey of each state's most recent investment and financial statements.

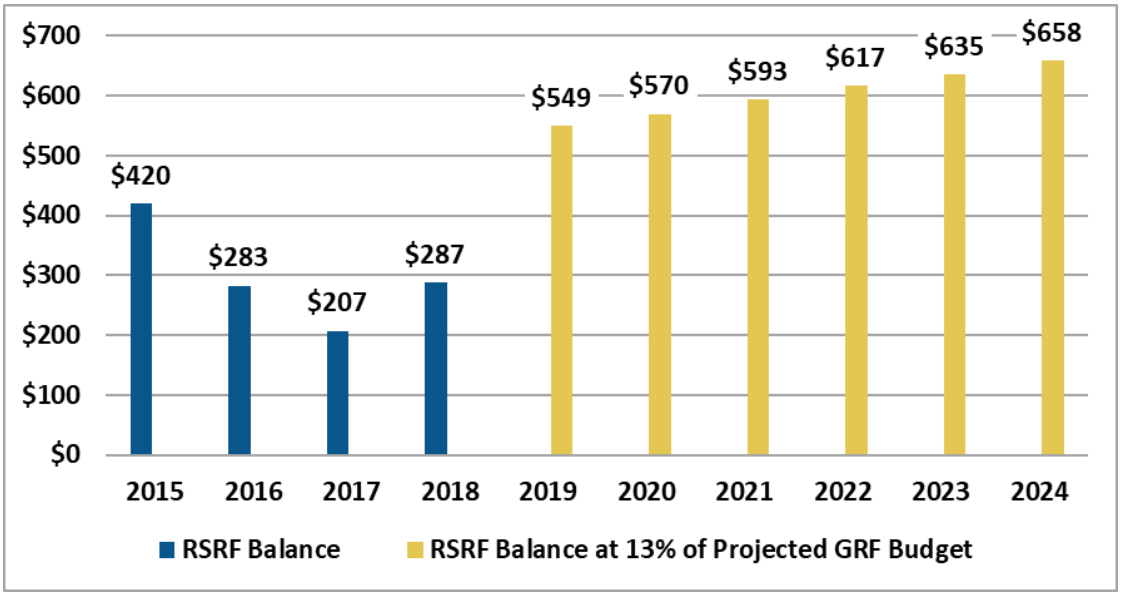
As shown in Figure 24, the WV Future Fund has not received any deposits as of 2018 because of several restrictions or triggers that are in place. In order for deposits to be made into the fund, the balance of the Revenue Shortfall Reserve Fund (Part A) has to be at least 13 percent of the General Revenue Fund budget for the previous year within sixty days of the end of the prior fiscal year (end of August). The chart below shows the balance of the Revenue Shortfall Reserve Fund in August from 2015 to 2018 as a share of the previous year's General Revenue Fund budget and what the balance would have to be from 2019 to 2024 in order to meet the 13% threshold based on projected General Revenue Fund expenditures. In order for 3 percent of severance taxes to be deposited in the WV Future Fund in August of 2019, the Revenue Shortfall Reserve Fund would have to grow $262 million to an estimated $549 million. This is unlikely to occur for several reasons.

The WV Future Fund has not received any deposits as of 2018.

First, state law requires that 50 percent of GRF surplus revenues at the end of each fiscal year be deposited in the Revenue Shortfall Reserve Fund. Therefore, it would take a FY 2019 General Revenue Fund surplus of at least $524 million to reach a balance of 13 percent by August 2019. As of November 2018, the state is currently running a GRF surplus of $141 million. If the surplus continued at its current pace (around $338 million for FY 2019), it would only result in a deposit of about $169

million into the Revenue Shortfall Reserve Fund. It is highly unlikely the current surpluses will grow to $524 million or to similar levels in outer years. Lastly, the state legislature has never deposited any more funds into the Revenue Shortfall Reserve Fund than is required by law.

Figure 25: Revenue Shortfall Reserve Fund Balance (In Millions)



Source: WV State Budget Office.

Deposits into the WV Future Fund are also predicated upon meeting other conditions. If the Governor relies on transfers from the Revenue Shortfall Reserve Fund to fund the General Revenue Fund appropriations, or if there are any mid-year spending reductions, hiring freezes, or mid-year decreases in appropriations, then no deposits into the WV Future Fund can occur.

On top of these barriers, the maximum amount of revenue hypothetically dedicated to the WV Future Fund is too small of an amount to build a trust fund of any size that can help diversify the economy or build sustainable wealth for the state. For example, if the state had deposited three percent of General Revenue Fund severance tax collection over the last four fiscal years (FY 2015-2018) the total deposits over this period would have been just $37.7 million.[95] For comparison, Montana dedicates 50 percent of coal severance taxes to the Coal Severance Tax Trust Fund. In FY 2017, Montana deposited $30.2 million.[96] Meanwhile, New Mexico dedicates 12.5 percent of all severance tax revenues to its fund, North Dakota 30 percent of oil tax revenues, and Wyoming applies a 1.5 or 1 percent severance tax on coal, oil, and natural gas.

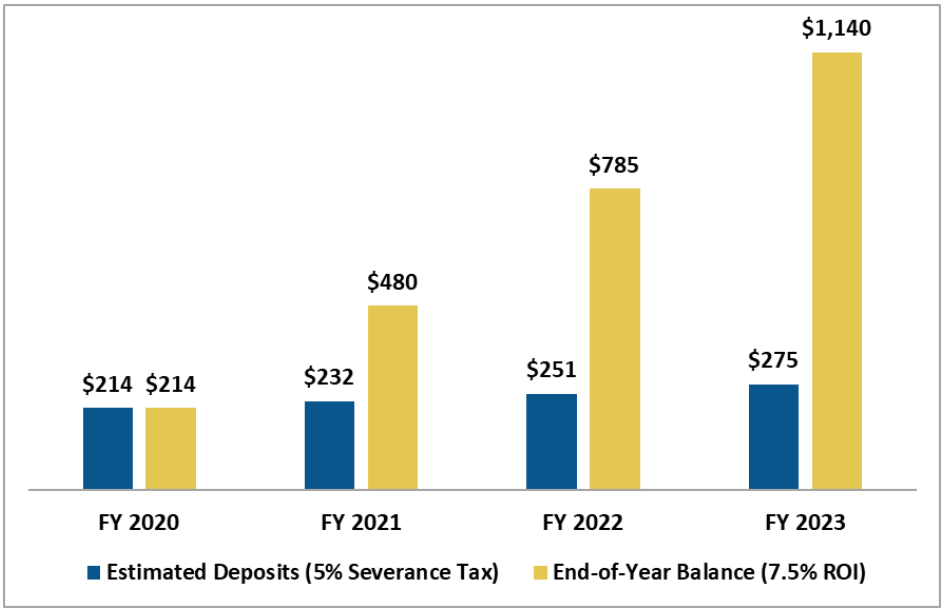
[95] See West Virginia State Tax Department, uploaded from: https://tax.wv.gov/Documents/Reports/SeveranceTaxes.TaxData.FiscalYears.2015-2018.pdf
[96] See Revenue Estimate Recommendations, Fiscal Years 2017, 2018, and 2019, Montana Legislative Fiscal Division.

Instead of dedicating three percent of some severance tax revenues to the WV Future Fund, the state should increase the severance tax rate from 5 to 10 percent on all minerals, or at least natural gas, natural gas liquids, and oil that are mostly coming from shale development. Moreover, state policymakers should include the assets in Revenue Shortfall Reserve Fund Part B, which has a balance of $430.4 million as of November 30, 2018, to be included in meeting the fiscal condition that the state has at least 13 percent of General Revenue Fund expenditures in its rainy-day funds. This will allow deposits to be made into the WV Future Fund as these two rainy day funds combined have $715 million in assets, or more than 16 percent of FY 2019 General Revenue Fund expenditures.

The state should increase the severance tax rate from 5 to 10 percent on all minerals, or at least natural gas, natural gas liquids, and oil that are mostly coming from shale development.

Based on projections from the WV Department of Revenue, an additional 5 percent severance tax on natural gas, oil, and natural gas liquids would allow an estimated $214 million to be deposited in the WV Future Fund in FY 2020 (Figure 26). By FY 2023, the fund would have an estimated $1.1 billion based on projected deposits and an investment return rate of 7.5% (similar to the state's pension funds), if no funds are expended during this time.

Figure 26: Estimated WV Future Fund Deposits and End-Of-Year Balance with Additional 5 Percent Severance Tax on Natural Gas, Oil, and Natural Gas Liquids (In Millions)



Source: WVCBP analysis "Regular Mineral Gross Receipt Forecast, November 2017" from the WV Department of Revenue. Note: For FY 2021 to FY 2023 the End-of-Year balances reflect a 7.5 percent investment return on the principal of the fund and no withdrawals.

The investment earnings from the WV Future Fund may be expended on "education and workforce development" and three broadly defined categories, according to state code:

1. "Economic development and diversification" means fostering economic growth and development in the state, including commercial, industrial, community, cultural or historical improvements; or preservation or other proper purposes.

2. "Infrastructure improvements" means fostering infrastructure improvements including, but not limited to, post-mining land use, water or wastewater facilities or a part thereof, storm water systems, steam, gas, telephone and telecommunications, broadband development, electric lines and installations, roads, bridges, railroad spurs, drainage and flood control facilities, industrial park development or buildings that promote job creation and retention.

3. "Tax relief" means reducing the tax responsibility of citizens and businesses located in the State of West Virginia, including but not limited to increasing the Homestead Exemption and reducing or eliminating the ad valorem property tax on inventory and equipment held for commercial or industrial use.

While many of the above areas for investment are laudable, state policymakers should also invest in strategies to diversify and decarbonize the state's energy sector by investing in energy efficiency and renewable energy, such as solar power. Such strategies could include investments in the state's underfunded low-income weatherization program; energy efficiency incentives; incentives and financing for solar power investments; investment in electric vehicle infrastructure; and more.[97]

It would be prudent not to expend any investment earnings from the WV Future Fund until at least five years after the first deposit is made into the fund. Based on the above projections, by FY 2024, the state could expect an estimated $274 million in investment earnings over the first five years, or a five-year average of about $55 million, that could be used on the above budget priorities based on using "no more than the average net investment return for the immediately preceding five fiscal years."

The state could expect an estimated $274 million in investment earnings over the first five years.

On top of raising the amount of revenue dedicated to the WV Future Fund, state policymakers will need to take further action to ensure the fund's success. This includes proposing a constitutional amendment to ensure that lawmakers cannot raid the corpus of the fund or use it for purposes outside of what is stipulated by

[97] For an example of a comprehensive set of state government programs, see: https://www.nyserda.ny.gov/All-Programs

law, and that they build in more transparency and accountability into how the fund is used, managed and invested.

Conclusion

The last decade of rapid natural gas production growth in West Virginia has underperformed compared to expectations for economic development. Early indications are that economic development at the county level is following a classic boom-and-bust pattern, leading to concerns that West Virginia may be experiencing a "resource curse." In order to convert the shale industry's rapid production growth into a more sustained source of wealth for the state, and in the face of the industry's volatility and uncertain financial future, we recommend an increase in the severance tax to be invested in the Future Fund for the long-term economic development of the state.

About IEEFA

The Institute for Energy Economics and Financial Analysis conducts research and analyses on financial and economic issues related to energy and the environment. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

About the WV Center on Budget and Policy

The West Virginia Center on Budget and Policy is a policy research organization that is nonpartisan, nonprofit, and statewide. The Center's research and analysis is designed to support informed public dialogue and policy in West Virginia. The Center consults and collaborates with other organizations to ensure that its analyses are relevant and timely and strives to be a knowledgeable and respected source of credible information on public budget and fiscal issues for policymakers, advocates, media, and the public.

About the Authors

Cathy Kunkel

Cathy Kunkel, IEEFA Energy Analyst, is the author of numerous studies on coal plants, natural gas pipelines and regulated utilities. Her research focuses on energy markets and utilities in the eastern United States and Puerto Rico. She has testified before numerous government agencies and was a senior research associate at Lawrence Berkeley National Laboratory. She has undergraduate and master's degrees in physics.

Sean O'Leary

Sean O'Leary is a Senior Policy Analyst with the West Virginia Center on Budget and Policy. Since joining the Center in 2010, Sean has authored numerous reports on working family issues, economic development, and state and federal budget and tax policy, including annual reports on the state budget and the State of Working West Virginia. In 2011, Sean co-authored "The Importance of Federal Earmarks to State Coffers" that appeared in the Journal of Public Budgeting, Accounting & Financial Management. Sean holds a B.A. in political science and economics and a Master of Public Administration from West Virginia University.

Ted Boettner

As the co-founding Executive Director of the West Virginia Center on Budget and Policy, Ted brings a wealth of experience and understanding of state fiscal and economic issues. Ted is the author of numerous reports on state tax and budget issues, economic development, and family economic security, including the annual "State of Working West Virginia." Ted frequently presents policy proposals to the West Virginia Legislature and testifies before committees. He also regularly addresses statewide civic groups on

state tax, budget and economic policies and is frequently quoted in news stories from a variety of state and national publications. In 2011, The State Journal named Ted "one of the most influential businesses leaders" in West Virginia. He has also taught at West Virginia University Institute of Technology and West Virginia University. Ted holds a bachelor's in journalism from West Virginia University and a master's in political science from the University of New Hampshire.