Economic impacts on West Virginia from projected future coal production and implications for policymakers

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Abstract

Multiple economic and geologic factors are driving fundamental changes in the nation’s energy system, weakening coal’s dominance as a fuel for electricity generation, with significant implications for places like West Virginia that are heavily dependent on coal for economic activity. Some of these factors include low natural gas prices, rising labor costs and declining productivity, economic competition with other coal mining regions, environmental regulations to reduce pollution and safeguard public health, state energy efficiency and renewable electricity standards, falling costs of renewable energy resources like wind and solar, and the likely prospect of future limits on greenhouse gas emissions. This analysis uses an input–output model to examine the effects on West Virginia’s economy from these multiple factors by exploring a range of scenarios for coal production through 2020. In addition to changes in the coal industry, hypothetical investments in additional sectors of the economy are considered as a way to gauge potential alternative economic opportunities. This paper offers recommendations to policymakers for alternative economic development strategies needed to create new jobs and diversify the state’s economy, and highlights the importance of transition assistance at the federal level.

Keywords: economic impacts, coal, West Virginia, economic diversification

Online supplementary data available from stacks.iop.org/ERL/9/024006/mmedia

1. Introduction

Economists have long studied the impacts of natural resource extraction on a country’s economic growth and development. Booms in extractive industries have not always been associated with broad economic growth, a phenomenon called ‘Dutch disease’ (Corden and Neary 1982) or more broadly, the ‘resource curse’ (Sachs and Warner 1995, Gylfason 2004). Some governments have successfully avoided this fate, for example by investing oil revenues in pension funds, as Norway\textsuperscript{3} and Bolivia\textsuperscript{4} have done. Subnational governments have enacted similar policies, including Alaska’s permanent fund and Wyoming’s permanent mineral trust fund. As the United States and the world begin to curb greenhouse gas (GHG) emissions in response to the impacts of climate change, fossil fuels (coal in particular) are becoming less competitive when compared to other sources that result in little or no GHG emissions, like renewable energy. This analysis considers the possible economic impacts on the state of West Virginia, a longtime leading producer of coal, resulting from potentially declining future coal production and offers insights into the po-

\textsuperscript{3} www.nbim.no/en/About-us/Government-Pension-Fund-Global/.
\textsuperscript{4} http://academy.ssc.undp.org/GSSDAcademy/SIE/SIEV1CH2/SIE V1CH2P1.aspx.
Figure 1. Three companies controlled more than 60% of coal produced in West Virginia in 2010, and all three were headquartered out-of-state. Less than 10% of coal produced in West Virginia (shown in blue) was controlled by in-state owners (the lighter shade represents entities with some in-state ownership). Gray portions represent out-of-state entities. The black sliver at the far right indicates the 1.7% of total production by owners with unknown location. See the supplemental materials (available at stacks.iop.org/ERL/9/024006/media) for a list of the top 20 producers and detailed description.

3. Recent coal industry trends

Labor productivity, defined as the amount of coal mined per miner-hour worked, began to decline in all regions nationwide around 2000. The decline was most pronounced in Central Appalachia, falling by 45% between 2000 and 2010 (Energy Information Administration 2001, 2012a). At the same time, there have been reductions in reserve estimates of US coal fields and increased production costs, which also adversely affect the economics of coal mining (National Research Council 2007, Luppens et al 2008). For Central Appalachia in particular, the rapid decline in labor productivity indicates that the easiest to mine seams have been mined out (McIlmoil and Hansen 2010). However, an overall increase in coal production over the same period of time has outstripped the decline in labor productivity, resulting in an increase in coal mining employment. In 2010, about 86,000 coal miners were employed in the United States, and about 25% of them worked in West Virginia (Energy Information Administration 2012a). The US Energy Information Administration (EIA) projects that this decline in labor productivity will continue in the foreseeable future (albeit more slowly than in the 2000s), leading to continued increases in the price of coal (Energy Information Administration 2013a).

Over the past few years, major changes have fundamentally shifted the economics of the electric power industry in the United States. Natural gas prices fell to historic lows due from the local jobs created by the coal industry, the primary mechanism by which the state can benefit from this natural resource is through tax policy. In 2008, West Virginia’s effective tax rate was 6.5% of the value of the coal removed from the ground (Boettner and O’Leary 2012). That figure includes various taxes and fees, but the primary one is the state severance tax, which remains at 5.0%, with exceptions for thin coal seams (O’Leary 2011).

2. Ownership of West Virginia coal

Much of West Virginia’s land and resources (and indeed, throughout Appalachia) are actually controlled by out-of-state owners. A seminal report dating back 30 years surveyed 80 counties in the Appalachian region and found that about 75% of surface lands and about 80% of mineral rights were controlled by out-of-county or out-of-state owners (Appalachian Land Ownership Task Force 1981). A recent report studied current surface ownership patterns in West Virginia and found that, of the top ten private landowners in the state, not a single one was headquartered in West Virginia (Spence et al 2013). In six counties, the top ten landowners own 50% or more of private lands.

Although the new study excludes the important question of mineral rights, absentee ownership of the state’s natural resources persists. In 2010 West Virginia produced about 139 million short tons of coal from 244 active and producing mines that were ultimately owned by 91 different entities. The vast majority of coal production came from mines that were ultimately controlled by out-of-state interests, as shown in figure 1. The blue sections of the bar chart represent the fraction of coal produced (less than 10% of the total) owned by West Virginia proprietors or companies; the gray shaded sections, on the other hand, indicate the 89% of production controlled by out-of-state interests.

This structural reality implies that corporate profits from the coal industry generally leave the state. Therefore, aside from the local jobs created by the coal industry, the primary mechanism by which the state can benefit from this natural resource is through tax policy. In 2008, West Virginia’s effective tax rate was 6.5% of the value of the coal removed from the ground (Boettner and O’Leary 2012). That figure includes various taxes and fees, but the primary one is the state severance tax, which remains at 5.0%, with exceptions for thin coal seams (O’Leary 2011).

EIA notes that employment figures include ‘all employees engaged in production, preparation, processing, development, maintenance, repair shop, or yard work at mining operations, including office workers.’
to widespread development of unconventional resources using horizontal drilling techniques and hydraulic fracturing. US electricity generation from wind and solar nearly quadrupled from 2007–2012, due to falling costs and supportive federal and state policies (Solar Energy Industries Association 2013, Wiser and Bolinger 2012). The PJM Interconnection Regional Transmission Organization (which includes West Virginia) recently held its capacity auction for 2016–2017, in which 10,000 MW of coal generation did not clear, in part due to importing low cost wind generation from the Midwest (PJM 2013). Environmental regulations focusing on reducing air pollution, protecting water, and lessening hazards from coal ash disposal have presented additional costs to coal-fired power plants, especially older, dirtier units (McIlmoil et al 2013). As concerns about the impacts of climate change grow, carbon intensive fuels such as coal will face additional costs to comply with future policies to cut greenhouse gas emissions. Taken together, these factors are putting many coal-fired power plants at an economic disadvantage (Fleischman et al 2013, Cleetus et al 2012, Freese et al 2011).

Low natural gas prices, combined with a mild winter in 2012, led to an increase in electricity generation from natural gas and a decrease in generation from coal (SNL Energy 2012). In fact, in April 2012, coal’s share of the electricity mix dropped below 40% for the first time since the 1970s; that month, coal and gas accounted for nearly the same level of generation (Energy Information Administration 2012c). Coal production fell sharply from 2011 to 2012: western production dropped 45% and Appalachian production fell 43% (Energy Information Administration 2013c). As a result, some coal mining operations in Appalachia have been idled (Ward 2012).

EIA coal data and county-level economic data, together with EIA projections for future coal production, are used in an input–output model to gauge changes in West Virginia’s economy resulting from expected changes in coal production.

4. Methodology and assumptions

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4.1. IMPLAN

This analysis uses the software package IMPLAN, a commercially available and commonly used input–output (I-O) modeling program (Lindall and Olson 1996) to analyze how changes in the coal industry impact West Virginia’s economy. County-level 2010 IMPLAN data for all of West Virginia form the baseline state economy in 2010 and establish linkages among sectors. For our analysis, we split the state into northern and southern counties based on the type of coal mined (Northern or Central Appalachian). IMPLAN data are expressed in dollars, and the coal mining sector’s industry output (or sales) is equivalent to the production value of the coal (i.e., price x production). Data collected by EIA on state coal production and regional coal prices are used to calculate the value of coal produced by northern and southern West Virginia in 2010. We updated the 2010 IMPLAN study area data for the coal mining sector with the EIA-derived production value. Projections for future coal production and prices come from various scenarios in EIA’s Annual Energy Outlook (AEO) 2013 (Energy Information Administration 2013a). The projected production value of coal in 2020 represents the primary indicator used to conduct the economic analysis. For a given EIA scenario, the difference in coal production value between 2010 and 2020 is the input to the IMPLAN model. Details on the IMPLAN methodology can be found in the supplemental materials (available at stack.s.iop.org/ERL/9/024006/mmedia).

4.2. Future coal scenarios

EIA projects a slight overall increase in US coal production through 2035, with important regional differences. The increase in production is driven primarily by Western and Interior coal. Within Appalachia, Central Appalachian production is in the midst of a steep decline, while Northern Appalachian production grows slightly (Energy Information Administration 2012b). The AEO 2013 Reference Case is based on all current federal, state, and local laws and policies in effect as of September 2012, as well as recent market trends, and is used as the baseline scenario for this analysis (Energy Information Administration 2013a). A number of other possible scenarios for future coal production, drawn from AEO 2013 side cases, are also considered in the analysis: two focusing on the production costs of coal (low coal cost and high coal cost); two focused on the availability of natural gas (low gas resource, which implies higher natural gas prices, and high gas resource, which implies lower natural gas prices); three that look at options for pricing greenhouse gas (GHG) emissions6 (no GHG Concern, GHG10, GHG25); one that combines a carbon price with low natural gas prices (GHG10/low gas price); and one that considers a range of extended energy policies (extended policies). A list of the scenarios considered in this analysis is shown in table 1.

Of particular importance for coal production, the Reference Case includes the Mercury and Air Toxics Standard (MATS) and the Clean Air Interstate Rule (CAIR) (Energy Information Administration 2013b). MATS, finalized in December 2011, is assumed to be fully implemented by 2016, and sets limits on mercury, heavy metals, and acid gases from generators greater than 25 MW. CAIR is a cap and trade program that regulates SO2 and NOX emissions from fossil generators in 27 states and DC. Other proposed or pending regulations affecting coal, including the stream buffer rule and coal waste regulations, are not considered by the AEO 2013 but could have significant implications for coal production, especially for Central Appalachia (McIlmoil et al 2013). Because the AEO side cases do not explicitly consider the impacts of different environmental regulations, and because it is difficult to compare AEO reference cases from previous years, this analysis does not quantify the relative impacts of environmental regulations on West Virginia’s economy.

5. Results

Scenarios represent a range of possible futures for coal production through 2020. Figure 2 illustrates projected coal production for the reference case and four selected scenarios, showing the relative changes in production value across the scenarios.
Figure 2. All scenarios considered for West Virginia coal production through 2020. Northern West Virginia production (blue, solid curves) is slightly increasing over this period; southern West Virginia (red, dashed curves) is in the midst of a steep decline in production. Reference cases for both are shown in bold. Details on all scenarios can be found in the supplemental materials (available at stacks.iop.org/ERL/9/024006/mmedia).

Table 1. Description of scenarios used in the analysis (Energy Information Administration 2013b).

| Scenario                  | Assumptions                                                                                                                                 |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Reference                 | The ‘business as usual’ case. Includes all federal, state, and local laws in effect as of September 2012. Assumes real GDP grows at an average annual rate of 2.5% from 2011 to 2040. |
| Low coal cost             | Productivity growth rates for coal mining in all regions are ∼2.5% per year higher than the Ref case. Coal mining wages, mine equipment, and coal transport rates are all lower than the Ref case, down to ∼25% below the Ref case in 2040. |
| High coal cost            | Productivity growth rates for coal mining in all regions are ∼2.5% per year lower than the Ref case. Coal mining wages, mine equipment, and coal transport rates are all higher than the Ref case, up to 25% to 32% above the Ref case in 2040. |
| Low gas resource          | Estimated Ultimate Recovery (EUR) per shale gas, tight gas, and tight oil well is 50% lower than in the Ref case.                                |
| High gas resource         | EUR per well is 100% higher than in the Ref case.                                                                                            |
| No GHG concern            | No GHG policy is enacted, and market investment decisions are not altered in anticipation of such a policy. This removes the 3% cost multiplier for coal plants assumed in the Ref case. |
| GHGS10                    | Applies an economy-wide price for CO2 emissions, starting at $10/ton in 2014 and rising by 5% per year through 2040.                           |
| GHGS10 and low natural gas prices | Combines the GHGS10 and high gas resource side cases.                                                                                      |
| GHGS25                    | Applies an economy-wide price for CO2 emissions, starting at $25/ton in 2014 and rising by 5% per year through 2040.                           |
| Extended policies         | Extends all existing energy policies and legislation with sunset provisions, as well as an extension and increase in capacity cap of the Investment Tax Credit. Also assumes additional rounds of efficiency standards, building codes, and fuel economy standards. |

Both northern and southern West Virginia. In general, northern counties can expect a slight increase in coal production over the next decade, except in extremely unfavorable conditions (like the high GHG price scenario shown in figure 2). Southern counties, meanwhile, face a dramatic drop in coal production; even in the reference case, production from southern counties falls from 93 million short tons in 2010 to 50 million short tons in 2020, a decline of 43%. Details on all scenarios, along with trends in coal production, production value, and mining employment, can be found in the supplemental materials (available at stacks.iop.org/ERL/9/024006/mmedia).

Armed with the difference in coal production value for each scenario, IMPLAN is used to gauge the range of potential economic impacts on the state in 2020. Total changes in employment and in total economic activity are tabulated from the IMPLAN run of each scenario. These impacts statewide are plotted in figure 3. Importantly, the results are presented as the difference between the impact in a given scenario and that of the reference case in 2020. For example, in 2020, in the low coal cost case, there are about 6000 fewer jobs economy-wide than in the reference case (figure 3(a)) and just over $1.5 billion less in total economic output than in the reference case.
Figure 3. Comparison of IMPLAN model results for each scenario, indicating (a) the change in employment and (b) the change in total economic activity from 2010 to 2020. These results are expressed as the difference between the change projected in each scenario and the change expected in the reference case in 2020. That is, these charts show the projected changes with respect to what EIA expects for business as usual in 2020.

Figure 3(b)). For reference, West Virginia’s gross state product (GSP) was approximately $62.7 billion in 2010. The magnitude of the changes projected in each scenario can be found in the supplemental materials (available at stacks.iop.org/ERL/9/024006/mmedia).

Six of the nine scenarios indicate reduced economic activity statewide relative to the reference case (figure 3). Only three scenarios project increased economic activity in the state; in the high coal cost case, additional labor, goods, and services are needed to maintain production levels, resulting in increased economic activity. When natural gas prices are high (low gas resource), coal production increases, boosting the state’s economy. No GHG concern results in very slight increases in the state’s economic activity.

However, the total statewide impacts hide important differences between the northern and southern counties (figure 4). The cost of coal production has a significant impact on total jobs and economic activity in southern counties, compared to the reference case. Northern counties face more dramatic decreases—relative to the reference case—in jobs and economic activity for cases that consider a price on GHG emissions. That is not to say that southern counties fare better; on the contrary, as noted in figure 2, southern West Virginia is already in the midst of a steep decline in coal production.

To gain insight into the price competition between coal and natural gas, the low and high gas resource cases are useful. Recall that the low gas resource case implies higher prices for natural gas, and conversely for the high gas resource case (table 1). As expected, low prices for natural gas, which result in more displacement of coal with natural gas to generate electricity, have a severely negative impact on the state’s economy as a whole. The trend holds for northern and southern counties separately (figure 4).

Scenarios that assume a future cost for the emission of GHGs have a strongly negative effect on the state’s economy, unless the state shifts away from its economic dependence on coal and invests in alternatives. The $25/ton price beginning in 2014 has the most negative impacts on the statewide economy of any scenario. The $10/ton GHG price combined with the high gas resource case produces nearly the same level of negative impacts. Given the growing concern over the impacts of climate change, the implementation of policies to price carbon emissions seems to be inevitable. These results emphasize the need to diversify West Virginia’s economy to help mitigate the potential negative economic impacts of future
6. The potential for diversification

6.1. Policy solutions

The economic impacts from projected changes in coal production through 2020 demonstrate the critical need to invest in alternative forms of economic development in West Virginia. Some state leaders are actively working on policies to help the state diversify its economy. Senate President Jeff Kessler introduced a bill in the 2013 legislative session that would have established the West Virginia Future Fund using a portion of severance taxes from natural gas drilling (Kessler 2013). He recently led a delegation to North Dakota to study what that state is doing to take advantage of the recent boom in natural gas drilling (Gutman 2013). The revenue stream generated from the fund would depend on its structure. Assuming it allowed annual withdrawals of 5%, one analysis suggests it could generate additional annual revenue of approximately $40 million in 2020 (Boettner et al 2012). Although the Future Fund as proposed would be funded from a portion of severance taxes from natural gas drilling, the idea of a slight (1%) increase in the coal severance tax has also been suggested (Boettner et al 2012, O’Leary 2011). Recent polling shows extremely strong support by West Virginians for the Future Fund concept, and even for the idea of raising taxes on the coal industry by 1%, if the revenues were used to support infrastructure and economic development (Richardson 2013, Lake Research Partners 2013, Ward 2013).

6.2. Alternative economic sectors

Since the structure of the ultimate policy enacted (if any) is not known, this exercise considers a hypothetical investment of $1 million dollars in 2020 in a variety of different sectors of the state’s economy. This allows a comparison of the job creation potential of different sectors on a per-million-dollars invested basis. Similar to the coal scenario analysis, the investment is
Figure 5. Total number of jobs created in a number of different sectors, per $1 million in increased sales.

represented in IMPPLAN as an increase of $1 million in industry output for a given sector. Industrial sectors were chosen to reflect potential growth areas in the coming decade. Candidate sectors were derived from the state’s existing economy in 2010 and include only those that had a minimum of 100 existing jobs in both northern and southern counties. That is an important criterion, because the idea was not to model the creation of new industries within the state, but rather to gauge the potential for job growth from retooling or expanding current industries. Potential sectors were drawn in part from a list of industrial sectors that could include green jobs (Bureau of Labor Statistics 2013b), but also included other existing and primary economic sectors in West Virginia. A broad range of sectors were included in the analysis, including renewable energy, natural gas, energy efficiency, agriculture, recycling, and reclamation of abandoned mine lands; details on the sectors and potential jobs created can be found in the supplemental materials (available at stacks.iop.org/ERL/9/024006/mmedia).

Potential sectors that could support the wind industry supply chain (Sterzinger and Svrcek 2004) and that had existing jobs in West Virginia include production of turbine controls, iron, metal structures, and turbine blades and motors. Similarly, for the solar industry supply chain (Sterzinger and Svrcek 2005), West Virginia companies could potentially support the production of solar films and packaging, encapsulants, and solar panel frames. The sector with the greatest job multiplier in the state was agriculture and forestry, which could include activities such as organic farming and post mining land reclamation (figure 4). Logging was a distant second, and notably could include the production of wood chips for biomass power plants or co-firing in coal plants. Energy efficiency efforts could fall under a number of construction related sectors, including retrofitting existing residential buildings and commercial buildings, construction of manufacturing facilities, and construction of new homes and commercial buildings. Coal mining is shown for comparison, and it falls near the middle of the list; ten sectors have higher job creation potential than that of mining.

7. Conclusions and recommendations

This analysis underscores the fact that West Virginia’s economy is vulnerable to changes in coal production, as is well documented for economies based heavily on resource extraction and subject to boom-bust cycles (O’Leary and Boettner 2011, Sachs and Warner 1995). Coal mining employment declined steadily over the last half of the 20th century, mostly the result of increased mechanization (see the supplemental materials available at stacks.iop.org/ERL/9/024006/mmedia). Furthermore, the geologic and economic forces at work in West Virginia (especially in southern counties) are not likely to be offset by policy decisions of any particular legislative body or executive agency. Yet there is still much the state can do to address the uncertainty in the coal mining industry and the potential impacts on the state’s economy. This analysis suggests that investing in other sectors of the economy can provide a cushion against future shocks resulting from changes in the coal industry. Recommendations to state leaders and policy makers are:
• West Virginia should focus efforts on diversifying its economy, particularly in southern counties and communities where the coal industry drives the local economy. The state budget could include specific support for economic diversification to support new and existing small scale efforts in West Virginia communities.

• Instead of fighting EPA’s statutory obligations to reduce pollution from power plants, West Virginia leaders could focus instead on securing federal assistance to help workers hardest hit by the transition away from coal, and on ensuring that federal money is used effectively to help communities diversify their local economies.

• Given that West Virginians strongly support economic diversification (Richardson 2013, Lake Research Partners 2013, Ward 2013), funded by taxes on extractive industries like coal and natural gas, state leaders could establish the Future Fund to ensure that revenue is made available annually and immediately to support economic diversification and workforce development in communities.

• West Virginia’s challenges extend well beyond the changes happening in the coal industry, and touch on a number of other issues, including low workforce participation, an aging population, lack of broadband access, infrastructure needs, poor health outcomes, drug addiction, and education; policy makers must take a holistic view of overcoming these challenges.

As the last few years have shown, big changes are happening in the energy sector in the nation as a whole. With leadership and vision, West Virginia can reinvent itself as more than just an energy state and ensure a bright future for future generations.

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References

Appalachian Land Ownership Task Force 1981 Land Ownership Patterns and Their Impacts on Appalachian Communities: A Survey of 80 Counties (Washington, DC: Appalachian State University and Highlander Research and Education Center)
Boettner T 2013 private communication
Boettner T, Kriesky J, McIlmoil R and Paulhus E 2012 Creating An Economic Diversification Trust Fund: Turning Nonrenewable Natural Resources into Sustainable Wealth for West Virginia (Charleston, WV: West Virginia Center on Budget and Policy) Online: www.wvpolicy.org/downloads/WVEconomicDiversificationTrustFundRpt013012.pdf
Boettner T and O’Leary S 2012 Major Yax Responsibilities of Coal and Natural Gas Producers in Wyoming and West Virginia (Charleston, WV: West Virginia Center on Budget and Policy) Online: www.wvpolicy.org/downloads/TaxResponsibilities030212.pdf
Cleetus R, Clemmer S, Davis E, Dyette J, Downing J and Frenkel S 2012 Ripe for Retirement: The Case for Closing America’s Costliest Coal Plants (Cambridge, MA: Union of Concerned Scientists) Online: www.ucsusa.org/assets/documents/clean_energy/Ripe-for-Retirement-Full-Report.pdf
Corden W M and Neary J P 1982 Booming sector and de-industrialisation in a small open economy Econ. J. 92 825
Energy Information Administration 2001 Annual Coal Report 2001 (Washington, DC: US Department of Energy) Online: www.eia.gov/coal/annual/archive/05842001.pdf
Energy Information Administration 2012a Annual Coal Report 2011 (Washington, DC: US Department of Energy) Online: www.eia.gov/coal/annual/pdf/acr.pdf
Energy Information Administration 2012b Assumptions to the Annual Energy Outlook 2012: Coal Market Module (Washington, DC: US Department of Energy)
Energy Information Administration 2012c Monthly coal- and natural gas-fired generation equal for first time in April 2012 Today Energy Online: www.eia.gov/todayinenergy/detail.cfm?id=6990#
Energy Information Administration 2013a Annual Energy Outlook 2013 (Washington, DC: US Department of Energy) Online: www.eia.gov/forecasts/aeo/pdf/0383%282013%29.pdf
Energy Information Administration 2013b Assumptions to The AEO 2013 (Washington, DC: US Department of Energy) Online: http://nuclear.com/archive/2012/12/05/ML12339A605.pdf
Energy Information Administration 2013c Short-Term Energy Outlook—US Energy Information Administration (EIA) Online: www.eia.gov/forecasts/steo/report/coal.cfm
Fleischman L, Cleetus R, Dyette J, Clemmer S and Frenkel S 2013 Ripe for retirement: an economic analysis of the U.S. coal fleet Electr. J. 26 51
Freese B, Clemmer S, Martinez C and Nogee A 2011 A Risky Proposition: The Financial Hazards of New Investments in Coal Plants (Cambridge, MA: Union of Concerned Scientists)
Gutman D 2013 18 W.Va. legislators off to study North Dakota’s Legacy Fund Charleston Gazette Online: www.wvgazette.com/News/201307260138
Gylfason T 2004 Natural Resources and Economic Growth: From Dependence to Diversification (Berlin: Springer) Online: http://link.springer.com/content/pdf/10.1007-540-31183-1_10.pdf
Interagency Working Group on Social Cost of Carbon 2013 Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866 Online: www.whitehouse.gov/sites/default/files/omb/assets/inforeg/technical-update-social-cost-of-carbon-for-regulator-impact-analysis.pdf
Kessler J 2013 SB 167 Text Online: www.legis.state.vt.us/Bill_Status/bills_text.cfm?billid=SB167%20SUB1.html&yr=2013&sesstype=RS&is=167
Lake Research Partners 2013 Support for Expanding West Virginia’s Energy Economy and West Virginia Future Fund. Online: www.ucusa.org/assets/documents/global_warming/LakeResearch-Partners-Poll-Results-June-2013-Topline-Memo.pdf
Lindall S A and Olson D C 1996 The IMPLAN Input–Output System (Stillwater, MN: MIG, Inc.)
Luppens J A, Scott D C, Haacke J E, Osmonso L M, Rohrbacher T J and Ellis M S 2008 Assessment of Coal Geology, Resources, and Reserves in the Gillette Coalfield, Powder River Basin, Wyoming (Reston, VA: US Geological Survey) Online: http://pubs.usgs.gov/of/2008/1202/pdf/ofr2008-1202.pdf
