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ECONOMIC ANALYSIS OF PROPOSED STREAM PROTECTION RULE

FINAL REPORT

RAMBOLL ENVIRON

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ACRONYMS AND ABBREVIATIONS

AOC	Approximate Original Contour
BLM	Bureau of Land Management
BLS	Bureau of Labor Statistics
CHIA	Cumulative Hydrologic Impact Assessment
CWA	Clean Water Act
DOE	Department of Energy
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
GDP	gross domestic product
IMPLAN®	IMpact analysis for PLANning
MMBtu	Million Metric British Thermal Units
MSHA	U.S. Department of Labor, Mine Safety and Health Administration
NEPA	National Environmental Policy Act
NMA	National Mining Association
O&M	Operations and Maintenance
OSM	Office of Surface Mining Reclamation and Enforcement
PWC	PricewaterhouseCoopers
QCR	Quarterly Coal Report
Ramboll Environ	Ramboll Environ US Corporation
SEC	Securities and Exchange Commission
SMCRA	Surface Mining Control and Reclamation Act of 1977
SPR	proposed Stream Protection Rule
The proposed rule	proposed Stream Protection Rule
U.S	United States

EXECUTIVE SUMMARY

The purpose of this draft report is to present the results of Ramboll Environ US Corporation's (hereinafter, "Ramboll Environ") analysis of the anticipated economic impacts associated with the proposed Stream Protection Rule (hereinafter, "SPR" or "proposed rule") that was published in draft form by the Office of Surface Mining, Reclamation, and Enforcement (hereinafter, "OSM") in July, 2015. This report was prepared at the request of the National Mining Association (hereinafter, "NMA"). The analysis contains the following key findings:

- Total number of jobs at risk of loss, including mining and linked sector employment, is between 112,757 and 280,809 (30 percent to 75 percent of current employment levels).
- Direct mining jobs at risk of loss are predicted to range from 40,038 to 77,520, with both surface and underground mining adversely affected.
- The overall decrease in recovery of demonstrated coal reserves is between 27 percent and 64 percent; both surface and underground mines will be significantly impacted.
- The annual value of coal lost to production restriction is between $14 billion and $29 billion.
- Total annual federal and state tax revenue potentially foregone because of lost production is estimated at $3.1 billion to $6.4 billion.

In order to estimate the economic impacts of the proposed SPR, Ramboll Environ evaluated the language of the July 2015 proposed rule and assessed the impact of implementation against current industry statistics and trends. Compliance with the proposed rule was evaluated for 36 current surface and underground mining operations in all regions of the country to determine the impact on access to demonstrated coal reserves. For several of these operations, the proposed rule implies closing operations due to restrictions in access, increased costs, and uncertainty regarding the interpretation of imprecise regulatory language. High and low ranges were calculated to account for various reasonable interpretations of key aspects of the proposed SPR. Respondents were challenged to interpret the rule as best they could, but not to assume a 'worst case scenario.'

The results presented in this report are based on data from the participating member sample of firms, and the sample of mines that were analyzed by the firms. The survey included data from 36 individual coal mines, from firms representing over 66 percent of the national coal production in the United States (U.S.).

The percent decrease in access to recoverable reserves was determined for both surface and underground mining, and for each of the three regions in the country. The largest decrease in recoverable reserves is expected in the Appalachian region, where 47 percent to 81 percent of the recoverable reserves will be lost if the proposed rule is implemented. Overall in the U.S., the decrease in recoverable reserves is anticipated to be between 27 percent and 64 percent (see **Table ES-1**).

The impact of sterilized coal reserves on annual production will occur over several years, as the proposed rule is implemented and operators adjust to meet operational considerations and contractual obligations. Once the decrease in access to demonstrated reserves is fully realized, the lost value of produced coal is estimated at between $14 billion and $29 billion annually (see **Table ES-2**).

Table ES-1: Anticipated Percent Decrease in Recoverable Reserves with Proposed SPR in Place			
Region	**Anticipated Percent Decrease in Recoverable Reserves with Proposed SPR**		
	Underground	**Surface**	**Total**
Appalachia	51% - 88%	38% - 67%	47% - 81%
Interior	33% - 94%	10% - 39%	23% - 68%
Western	60%	13% - 53%	18% - 54%
Total U.S.	**47% - 85%**	**16% - 53%**	**27% - 64%**

Table ES-2: Annual Coal Production Value at Risk with Proposed SPR in place (in Millions of 2014 Dollars)			
Region	**Anticipated Decrease in Value under Proposed SPR**		
	Underground	**Surface**	**Total**
Appalachia	$7,181 - $12,447	$2,175 - $3,887	$9,356 - $16,334
Interior	$1,645 - $4,599	$276 - $1,065	$1,921 - $5,664
Western	$1,213	$1,379 - $5,507	$2,592 - $6,720
U.S. Total	**$10,039 - $18,258**	**$3,830 - $10,459**	**$13,870 - $28,717**

The decline in annual coal production will have a direct impact on employment. At the national level, the implementation of the proposed SPR is predicted to eliminate between 112,757 and 280,809direct and indirect jobs, (see **Table ES-3** and **Figure ES-1**, which show the anticipated job loss by coal producing region and type). Nationally, direct mining job losses are predicted to be in the range of 40,038 and 77,520. This comes on the heels of an industry-wide contraction that resulted in a loss of approximately 30,000 jobs between 2010, and 2013. An earlier draft of this report (ENVIRON, 2012) showed a base of 135,533 direct employees in the industry in 2010, and an anticipated contraction of 30 to 42 percent of those jobs associated with a draft version of this same rule. In contrast, the current analysis suggests a contraction of between 39 and 75 percent of all direct employment. Consequently, further loss of jobs aggravates the impact to communities that are heavily dependent on coal production for employment and have already experienced significant losses.

Changes in the coal mining sector also indirectly impact sectors of the economy that provide products and services to the coal industry, or the “backward linkages” of coal production. Further, the change in employment means fewer workers will be earning an income, leading to additional impacts in industries that support household consumption. This estimate of the SPR impact on jobs does not include the “forward linkages” of coal production such as electricity generation, and therefore can be considered a conservative estimate of the impact to national employment.

In summary, the magnitude of effect from each of the proposed elements of the rule varied widely across each mine type and region. The differences in impact are largely based on unique site-specific characteristics of each mine, such as geology, topography, soils, climate, hydrology, and vegetation. Still, the most difficult points for underground mining operations are related to the proposed definition of material damage to the hydrologic balance. For surface miners, impacts stemmed from fish and wildlife considerations, concern about the potential inclusion of ephemeral streams into much of the prescriptive regulatory language, and increased compliance costs.

Table ES-3: Anticipated Decrease in Employment by Region with Proposed SPR in Place

Type of Mine	Existing Direct Employment	Direct Jobs at Risk	Existing Total Direct and Indirect Jobs	Direct and Indirect Jobs at Risk
Appalachia	64,215	30,115 - 52,566	232,611	79,142 - 190,415
Interior	20,305	4,931 - 14,638	73,551	18,674 - 53,023
Western	18,792	4,993 - 10,317	68,073	14,941 - 37,371
Underground	63,763	30,592 - 55,048	230,974	86,351 - 199,404
Surface	39,549	9,446 - 22,473	143,262	26,406 - 81,405
U.S. Total	**103,312**	**40,038 - 77,520**	**374,236**	**112,757 - 280,809**

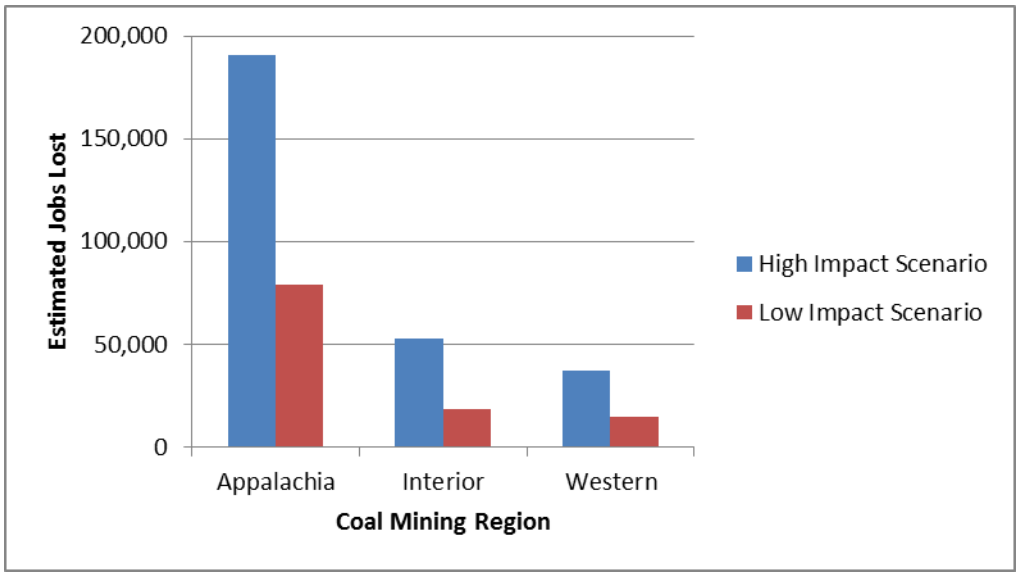


Figure ES-1: Total Jobs at Risk from Proposed SPR

1. INTRODUCTION AND BACKGROUND

The purpose of this report is to present the results of Ramboll Environ US Corporation's (hereinafter, "Ramboll Environ") analysis of the anticipated economic impacts associated with the proposed Stream Protection Rule (hereinafter, "SPR" or "the proposed rule") promulgated by the Office of Surface Mining, Reclamation and Enforcement (hereinafter, "OSM"). This economic analysis is based on estimates of how coal production and the coal industry as a whole might change under the proposed rule, considering the following key elements:

- Additional permitting, reporting and monitoring requirements;
- Restrictions on mining through, near, and beneath streams;
- A new definition of Material Damage to the Hydrologic Balance;
- Additional requirements for mining and reclamation regarding excess spoil fill placement, protection of fish and wildlife resources, stream restoration and reforestation; and
- Long-term financial assurance and bonding requirements.

The goals of the study are to identify the economic impacts to the coal mining industry in terms of: a) reductions in recoverable reserves; b) changes in production and output; c) impacts to the regional economy; d) employment in the coal and related industries; e) impacts on state, local, and tribal governments; f) additional permitting costs; and g) impacts to electricity consumers. Details of the derivation of these estimates by Ramboll Environ is also provided in the chapters that follow. This report was prepared at the request of the National Mining Association (hereinafter, "NMA").

1.1 Context and History

The OSM published a Proposed Rule and Supplementary Information in the Federal Register (80 Federal Register (FR) 44436) on July 27, 2015. This proposed rule, the Stream Protection Rule, or SPR, would replace the 2008 Stream Buffer Zone ("SBZ") Rule (73 FR 75815). Key among supplementary materials released for public comment in July are the Draft Environmental Impact Statement (EIS) and Draft Regulatory Impact Assessment (RIA). The proposed changes include provisions for coal mining companies to gather more specific baseline data on a proposed mine site's hydrology, geology, and aquatic biology; establishing a definition of the term "material damage to the hydrologic balance" of watersheds outside the permit area; and developing additional requirements for mine operators to achieve approximate original contour (AOC) or seek a variance from AOC - the requirement that mined areas be reclaimed to their approximate original contour. Since July, public comments provided by industry representatives have been strongly against the proposed SPR primarily arguing the rule change would significantly undermine the coal mining industry resulting in lost jobs and increased costs to meet the proposed permitting, compliance and financial assurance requirements.

1.2 Objectives of this Study

The key objectives of this study include:

- review the major provisions of OSM's SPR;
- design a complete concept of compliance with the proposed rule;
- establish the current and future regulatory environment in the absence of the proposed rule;
- conduct economic analysis of the impact of the proposed rule on employment, compliance cost, value of reserves, regional and local governments, and electricity consumers; and

- compile and explain analytic assumptions.

1.3 Structure of the Report

In order to clearly and accurately present the findings of the study, the report has the following structure. Chapter 1 introduces a brief history of the proposed rule in addition to outlining the goals and objectives of this study. Chapter 2 provides an overview of the methodology and economic approach employed to meet the objectives and analyze the economic impacts. The 3rd chapter presents the results of the economic analysis and provides details of the potential impacts of the proposed rule on coal reserves; on production and output; to the regional economy; on employment; to state, local, and tribal governments; additional permitting costs; and on consumers of electricity. The final chapter provides a conclusion and discussion of the analysis.

The report also has two appendices. Appendix A delves into an overview of the coal mining industry in the U.S., and outlines the trends and key issues impacting this sector. A case study related to loss of access to reserves are presented in Appendix B.

2. OVERVIEW OF METHODOLOGY

This chapter provides an overview of the methodology used to estimate the potential impacts of the proposed rule. First, the overall economic approach is presented. Next, the proposed changes to the SPR are outlined. Then, a discussion on entities potentially affected by the proposed rule is provided. This is followed by two sections on primary data collection and analysis and sources of secondary data. The final two sections outline the key assumptions underlying the analysis and the timeline for the analysis.

2.1 Economic Approach

This analysis examines the state of the regulatory environment with and without the proposed SPR. The "without Proposed SPR" scenario represents the baseline for the analysis, considering the existing regulation under the Surface Mining Control and Reclamation Act of 1977 (“SMCRA”). The "with Proposed SPR" scenario attempts to describe the incremental effects associated specifically with and unique to the proposed SPR. The focus of the analysis, however, is determining the increment of effects that can be uniquely attributed to the proposed rule, to the fullest extent practicable.

The first step in the economic analysis is to identify the baseline level of coal production without the proposed SPR. The baseline for this analysis is the existing state of regulation that provides protection to the streams under the SMCRA and the Clean Water Act (CWA), as well as under other Federal, state, and local laws and guidelines, without the proposed SPR.

Incremental effects of the rule will include the direct compliance costs associated with additional effort for the renewal of permits forecast for renewal (including time delays) and new permits that would not otherwise have been required under the existing regulations. Additionally, incremental effects may accrue as a result of actions initiated in response to the proposed rule. These may include decreased availability of recoverable reserves (including those which are rendered economically infeasible due to the increased cost of mining associated with the new regulations), loss of employment in the coal industry and other related industries (such as transportation), and loss of income for state, local, and tribal governments, among others. The nature of these costs is described in greater detail in Chapter 3.

2.2 Proposed Changes to OSM Stream Protection Rule

The proposed Stream Protection Rule (SPR) compiled by OSM and applicable to surface and underground mining (“Proposed SPR”) was published in the Federal Register in July 2015. The changes and revisions to the SPR are listed in 30 Code of Federal Regulations (CFR) 30 CFR Parts 700 - 827. The following discussion references several of the specific changes proposed to address the seven major elements the Proposed SPR covers. Briefly, the seven elements are identified by OSM as:

1. A definition of “material damage to the hydrologic balance”
2. Guidance on how to collect premining environmental data
3. How to conduct ongoing monitoring of groundwater and surface water
4. Restrictions related to impacts on intermittent and perennial streams
5. Ensure use of recent science in protection of surface and groundwater resources
6. Ensure that land is restored to its original ecological function post mining

7. Update and codify requirements to protect threatened and endangered species and critical habitat

Specific components of the proposed SPR drafted with the intention of achieving these seven elements are noted below.

2.2.1 Definition of Material Damage to the Hydrologic Balance

A national definition of “material damage to the hydrologic balance” is proposed under the rule. As defined in Part 701.5 Definitions - material damage to the hydrologic balance is "any adverse impact from surface coal mining and reclamation operations or from underground mining activities, including any adverse impacts from subsidence that may occur as a result of underground mining activities, on the quality or quantity of surface water or groundwater, or on the biological condition of a perennial or intermittent stream, that would… Preclude any designated use under sections 101(a) or 303(c) of the Clean Water Act or any existing or reasonably foreseeable use of surface water or groundwater… or … Impact threatened or endangered species, or have an adverse effect on designated critical habitat, outside the permit area in violation of the Endangered Species Act of 1973, 16 U.S.C. 1531 et seq."

Additional language proposed to define preventing material damage is provided in Part 780.23 or Part 784.23. For any surface water or groundwater parameters, these sections require the permittee to review monitored parameters at a specified sampling frequency (see Section 780.23 (a)(1)(i-ii))to determine if values or trends in values have reached the corrective action level specified in the cumulative hydrologic impact assessment prepared under Part 780.21 or Part 784.21 for any surface water or groundwater parameters.

2.2.2 Baseline Data Collection and Analysis

Under the proposed rule in Parts 780.19 and 780.21 for surface mining activities and 784.19 and 784.21 for underground mining activities, the requirements for permit applications regarding baseline data on hydrology, geology, and aquatic biology are more extensive and specific. These added baseline monitoring requirements would include parameters (i.e., chemical, physical, biological), frequency of sampling, location, and duration of sampling to assess the cumulative hydrologic impacts (CHIA) from mining.

Specifically in Part 780.19, proposed changes would establish additional sampling requirements from each location at equally spaced monthly intervals for a minimum of 12 consecutive months in order to document the seasonal variation in water quality. Sampling of perennial, intermittent and ephemeral streams within the permit area and adjacent areas would be required under the proposed rule. In addition, the collection of continuous flow measurement would be required where feasible. The rule also proposes to expand upon the chemicals and other parameters for analysis by including at minimum bicarbonate, sulfate and chloride (for major anions), calcium, magnesium, sodium and potassium (for major cations), hot acidity, pH, selenium, specific conductance, total alkalinity, total dissolved solids, total iron, total manganese, total suspended solids and other parameters of local importance. In addition, this section would mandate baseline sediment load (mentioned above) and identification of stressors associated with Total Maximum Daily Loads for those stream segments.

The rule would also impose the collection of data pertaining to temperature, precipitation amounts, and stormwater discharge data in order to develop appropriate models for surface water runoff, quantity and management. The documentation of riparian and stream biological conditions as well as forest and other native plant communities located upland would be required under the proposed rule. Other requirements include documentation of stream form and function such as the location of the channel head on terminal reaches, fish, wildlife, soil, and geologic characteristics. At a minimum, an appropriate array of aquatic organisms must be measured, including identification of benthic macroinvertebrates to the genus level for each perennial or intermittent stream within the permit, for

perennial and intermittent streams that receive discharge from mining operation in adjacent areas and a representative sample of ephemeral streams in the permit area or that would receive discharge from the mining operation in adjacent areas.

2.2.3 Monitoring during Mining and Reclamation

A discussion of additional monitoring during mining and reclamation is provided in Parts 780.23, 780.28, 784.23, 816.34, 817.34 and 816.57. Within these parts new proposed rule would establish monitoring requirements designed to identify conditions that could lead to material damage to the hydrologic balance. The sampling protocols improve on existing methods in order to develop a systematic data collection process that minimizes potential gaps. The requirements include increased water quality monitoring that must continue through mining and reclamation until the final bond is released. Monitoring data for streams must be submitted to the regulatory authority every three months for review. Biological monitoring would be required and submitted on an annual basis (or more frequently) to the regulatory authority for review. Biological monitoring, as well, would continue until the final bond release. The applicant must examine the hydraulic structures following every significant precipitation event, as specified by the regulatory authority. Within 48 hours of the precipitation event, a report must be prepared and certified by a registered professional engineer before being submitted to the regulatory authority. The report must address the performance of the hydraulic structures, identify and describe any material damage that occurred to the hydrologic balance outside the permit area, and identify and describe the remedial measures taken in response to that damage. The regulatory authority may request that applicants revise permits to include additional monitoring whenever information available to the regulatory authority indicates that additional monitoring is necessary to protect the hydrologic balance, detect hydrologic changes, or meet other requirements of the regulatory program. The regulatory authority may not release any portion of the bond if an evaluation of monitoring data indicates that adverse trends exist that could result in material damage to the hydrologic balance outside the permit area.

2.2.4 Mining Activities In or Near Streams

As discussed in Parts 816.57 and 817.57, surface and underground mining activities would be prohibited in or through perennial and intermittent streams or on the surface of lands within 100 feet of those streams. Furthermore, mining activities must not have an adverse impact on the pre-mining ecological function of stream segments following the completion of mining and reclamation. Specifically, mining activities must not impact the baseline flow of any stream segments.

The proposed rule also addresses requirements to obtain approval to construct an excess spoil fill or coal mine waste in or near an intermittent or perennial stream. The applicant must demonstrate that there is no practicable alternative that would avoid placement of excess spoil or waste rock in a perennial or intermittent stream and that the location and configuration of the proposed placement represents the alternative with the least adverse impact on fish, wildlife, and related environmental values after evaluating all reasonable possibilities. The waste disposal must be designed to minimize quantity of waste and must not contribute to a violation of water quality standards or result in formation of acid mine discharge. If these requirements are properly demonstrated, then a surface runoff management plan must be developed and the applicant must propose in the reclamation plan to establish or reestablish a 100-foot forested buffer on either side of streams. Riparian buffer establishment using native species, particularly ones with riparian characteristics, that is consistent with post-mining land use is mandated for all stream types, including ephemeral streams.

2.2.5 Surface Configurations and Fills

As discussed in 780.12, 784.28 and 816.102, more weight would be placed on minimizing the amount of excess spoil disposed of in valley fills and additional requirements regulating the placement of excess spoil would be imposed when restoring pre-mining topography. The proposed rule would achieve this by requiring permit applications to demonstrate that the operation has been designed to minimize the amount of excess spoil or waste rock to be placed in a perennial or intermittent stream to the fullest extent possible and that the maximum amount of overburden would be returned to the mined-out area. The proposed rule would prohibit uncontrolled placement of excess spoil in order to reduce unnecessary additional disturbance and sediment load. Surface configurations and fills must be conducted using current engineering practices. Landforming methods would be required and must be consistent with the pre-mining topography and the approved post-mining land use.

2.2.6 AOC Exceptions

As discussed in Parts, 785.16, 816.102, the rule would severely limit the ability of the regulatory authority to issue a variance from the approximate original contour requirements for non-mountaintop removal, steep-slope, and surface coal mining operations. In order to obtain a variance for steep-slope mining, the applicant would need to demonstrate that the variance would not result in the construction of a fill in a perennial or intermittent stream. In addition, the applicant must demonstrate that the proposed variance would result in a lesser adverse impact on stream characteristics compared to what would occur if the area were to be restored to its approximate original contour.

In order to obtain a variance for mountaintop removal mining, the applicant must demonstrate that the proposed operation would not increase the amount or concentration of total suspended solids and other parameters of concern. Furthermore, the applicant must demonstrate that the proposed operation would not result in adverse effect to watershed condition, flows or flood hazard. Moreover, the total volume of flow must not vary in a way that would adversely affect any existing or approved use of surface or groundwater under the CWA. Revegetation and Topsoil Management

Parts 780.12 and 780.16 would establish new requirements for revegetation, reforestation and topsoil restoration and management. The new requirements include revegetation of all reclaimed lands to be consistent with the post-mining land use and the plant communities. Revegetation must be at least equal in extent of cover of the natural vegetation of the area. All vegetation and other organic materials that are to be removed must be stored and redistributed for restoration purposes. In cases where the applicant elects to use a top soil substitute, the regulatory authority must approve the use of the substitute selected and the applicant must demonstrate its appropriateness.

Applicants must reforest areas based on regulatory authority specifications. As proposed in Parts 816.116 and 817.116, the revegetation standard for success as approved by the permit authority, the permit must include information on the plant community and vegetation, soil type and productivity, land use, approved post-mining land use, species diversity, distribution of species, ground cover, agricultural production, and stocking for areas re-vegetate and seed with woody plants.

2.2.7 Performance Bonds and Release

The proposed rule establishes bonding and bond release measures that are designed to assure financial responsibility is attached directly to the mine operator and mitigate any risk that such responsibility could by default be attached at some future point to the regulatory authority or tax payers. Performance bonds are limited to surety bonds, collateral bonds and, in limited circumstances, alternative bonding systems. Self-bonding, a formerly acceptable bonding mechanism, is specifically eliminated from the approved bonding mechanisms, but listed as an alternative bonding

system. An obligation that is not eligible for an alternative bonding system is treatment of long-term post-mining discharges. In order to obtain release of any existing restoration bond, the permittee must post a separate bond or financial assurance to cover the restoration of ecological functions and the permittee must post a financial assurance, a collateral bond, or a combination of the two for the guarantee long-term treatment of post-mining discharges. The calculations used to determine the amount of the bond must specifically identify the amount of the bond needed to guarantee restoration of stream's ecological function. Finally, the proposed rule would prohibit the regulatory authority from releasing any bond for restoration of stream form and function or long-term treatment of post-mining discharges if it is determined that adverse trends exist that may result in material damage to the hydrologic balance outside the permit area.

2.2.8 Financial Assurance for Long-Term Discharges of Concern

The proposed rule would establish a financial guarantee mechanism in the form of a financial assurance to be used instead of a conventional bond in the case of long-term discharges. In addition to prohibiting the use of alternative bonding systems and self-bonding as financial assurance instruments, the proposed rule would establish that only trust funds and annuities are eligible as financial assurance which can be used in a manner that guarantees that sufficient monies would be available when needed to pay for treatment of discharges in perpetuity. The permittee would be held accountable for financial assurance in perpetuity unless the permittee properly demonstrates, and regulatory authority finds, that treatment would be needed for a lesser time, either because the discharge would attenuate or its quality would improve. Finally, the trust funds or annuities must meet administrative requirements.

2.2.9 Fish and Wildlife Protection and Enhancement

Part 780.16 establishes new measures for the protection and enhancement of fish and wildlife. In general, applicants must include a fish and wildlife protection and enhancement plan. The applicant must comply with species-specific protective measures that are required by the regulatory authority and are consistent with the U.S. Fish and Wildlife Services and must be described in the permit. Enhancement measures must be located within the same watershed as the proposed operation unless opportunities for enhancement are not available within that watershed, in which case, enhancement measures must occur on the closest adjacent watershed.

2.2.10 Permit Coordination

The proposed rule mandates coordination efforts with other existing laws such as the CWA and the National Environmental Policy Act (NEPA). Coordination required through EPA CWA permits have resulted in significant delays in permitting as documented by the EPA inspector general's report titled: "Congressionally Requested Information on the Status and Length of Review for Appalachian Surface Mining Permit Applications."[1]

2.3 Challenges to Mining from Proposed SPR

The Proposed SPR presents many challenges to coal mining as currently written. In general, the lack of clarity and vagueness of language introduces additional uncertainty and risk to business decision making, thus hindering well-functioning markets. Examples of some of the most challenging

[1] U.S. Environmental Protection Agency. November 21, 2011. "Congressionally Requested Information on the Status and Length of Review for Appalachian Surface Mining Permit Applications." Report No. 12-P-0083.

components of the regulation were identified by a committee of environmental representatives from various coal producing companies, and are listed below.

2.3.1 Stream Conversion

Proposed 30 CFR 780.24(b)(2)(ii) prohibits mining in or through a perennial, intermittent, or ephemeral stream if it would result in conversion of the stream segment from intermittent to ephemeral, from perennial to intermittent, or from perennial to ephemeral, even if the conversion is temporary and there is no limit on size. Due to the practical requirement that streams will undergo at least some temporary conversion during mining, this standard cannot be met and would effectively prohibit most if not all mining operations in the United States.

2.3.2 Peak Runoff

Proposed 30 CFR 780.29(a)(1) requires “An explanation of how you will handle surface water runoff in a manner that will prevent peak discharges from the proposed permit area, both during and after mining and reclamation, from exceeding the pre-mining peak discharge from the same area for the same size precipitation event.” As written this provision would not allow for the deviation in the peak rate of runoff at any time during the either the mining or reclamation phases. This is physically impossible because variables affecting the peak rate of runoff are constantly changing during a mining project and the peak rate cannot be kept static, or the same as the pre-mining peak rate of runoff at all times during mining and reclamation. As interpreted, this rule would result in a violation that could not be cured at every SMCRA site and effectively result in cessation of most or all mining operations.

2.3.3 Long Term Treatment Standard

At proposed 30 CFR 773.15(n)(2) the rule states “Applicant must demonstrate that there is no credible evidence that the design of the proposed operation will not work as intended to prevent the formation of discharges with levels of parameter of concern that would require long-term treatment after mining has been completed.” The burden of proof that the operator discredit any evidence that the design could possibly result in the formation of the discharge levels described is both a practical and legal impossibility that could never be met for any mining operation, regardless of how remote the “credible evidence” of a discharge may be. For this reason, any analysis of this provision applying the only logical reading of the language would result in near 100 percent sterilization of coal reserves and cessation of all operations.

2.3.4 Definition of Material Damage to the Hydrologic Balance and Overlap with Clean Water Act

Where this proposed definition states that material damage includes any adverse impact from surface or underground mining and reclamation operations that would preclude any designated use under sections 101(a) and 303(c) of the Clean Water Act, this assumes that operators will have to complete the permitting requirements under these sections of the CWA twice, from the ground up each time. In other words, the SPR doesn’t not guarantee that OSM will defer to CWA authorities on this determination, and may require a separate, parallel analysis of its own showing that the operation will not impair a designated stream use.

2.3.5 Role of U.S. Fish and Wildlife

Proposed 30 CFR 779.20 and 783.20 for surface and underground mining respectively provides the U.S. Fish and Wildlife Service with absolute, unfettered veto authority over every SMCRA permit. These sections require the submission of a protection and enhancement plan for both listed and proposed threatened and endangered species for which the operation poses the possibility of an adverse impact to the FWS. The FWS must sign off on this plan before a SMCRA permit can be granted. Because this requirement is made pursuant to SMCRA, and not the ESA, the FWS cannot be

sued for their decision to reject a plan. A suit for rejection of a plan would lie against the regulatory authority/OSM only. As a result, the required approval of the protection and enhancement plans has the potential to cause both significant permit delay and obstruction of mining operation approval without requiring FWS accountability.

2.3.6 Restrictions on Self Bonds

The proposed rule prohibits the use of self-bonds to cover reclamation costs associated with mining through a stream. Taking into account the 100 foot width of riparian corridor that must be established on both sides of streams post mining, operator reclamation costs for restoring form and function of streams would be high. Capacity of operators to provide surety bonds where self bonds are no longer acceptable is potentially limiting to mining operations.

2.3.7 Baseline Information Requirements

Section 780.19: What baseline information on hydrology, geology, and aquatic biology must I provide? Proposed paragraph (k) specifies that a permit will be void from the date of issuance and have no legal effect if the permit issuance was based on substantially inaccurate baseline information. The phrase ‘‘substantially inaccurate,’’ could mean situations such as missing chemical analyses of geologic strata.” (FR 44500) The purpose of such data is to properly prepare the PHC and CHIA. So, if an unexpected discharge of a pollutant occurs, it is the result of either bad information or bad analysis. PHCs and CHIAs are difficult, but now they must anticipate all possible “parameters of concern,” a nearly impossible task. For example, selenium was not looked for several years ago because it was not identified as a “parameter of concern.” It was not factored into the PHC or CHIA because no geologic data was collected: it is “missing "data. Under the current program, operators are working with EPA to avoid or treat for selenium. Under the proposed SPR, the permit would be revoked.

2.4 Potentially Affected Entities

It is anticipated that the proposed rule, if implemented, would affect a wide array of public and private entities. The most direct effect of the proposed regulations is expected to be on coal companies and their employees. For the coal companies, this effect would manifest in lost income due to decreased or lost accessibility to reserves, changes in mining methods and technology, higher permitting costs, and delays in permitting process, among others. Because of the possibility of decreased production and lost income for coal companies, these companies are anticipated to cut jobs.

The direct effects on the coal industry are also anticipated to ripple through and impact other related industries. The most important among these is the transportation sector, including rail and barge, which are heavily utilized in coal transportation. These industries are anticipated to suffer decrease or loss of business. The power generation sector, which consumes almost 94 percent of all coal produced in the U.S., is anticipated to be faced with higher priced coal, thus increasing the cost of power generation. Some of these effects would eventually be passed onto electricity customers in the form of more expensive power. Similar impacts can be expected for all sectors of the economy, including energy intensive manufacturing sector which likely will also suffer loss of business and jobs as they become less competitive globally. Venders who supply the coal industry with parts, services, and consulting services will also experience indirect impacts.

Public entities, such as state, local, and tribal governments, are expected to lose income from taxes on the coal industry if the proposed rule is implemented. For some tribal governments, these monies make up a large portion of their incomes. In addition to impacts on taxes, some state and tribal governments may lose income from mining leases if the coal companies give up those leases as a consequence of the proposed rule.

The state permitting agencies would also be faced with the cost of hiring additional staff, or increasing the hours for existing staff in order to carry out the additional permitting requirements and monitoring needs under the proposed rule.

2.5 Area of Analysis

The Energy Information Administration (EIA) classifies the coal-producing areas in the U.S. into three major geographic regions; Appalachia, Interior, and Western. These regions are further divided into sub-regions. Given the unique characteristics of coal and the coal mining industry in each region, the key results are presented separately for each of the three major coal-producing regions. However most of the analysis was carried out at the state level, and aggregated up to the sub-region and region levels in part to protect confidentiality of sample results. Table 2-1 shows the areas included in each region and sub-region, while Figure 2-1 presents these areas on a map.

Table 2-1: Coal-Producing Areas in the U.S.		
Coal Producing Region	**Sub-Region**	**States Included**
Appalachia	Northern Appalachia	1. Maryland; 2. Ohio; 3. Pennsylvania; 4. Northern West Virginia.
	Central Appalachia	1. Virginia; 2. Eastern Kentucky; 3. Part of Tennessee; 4. Southern West Virginia.
	Southern Appalachia	1. Alabama; 2. Part of Tennessee.
Interior	Illinois Basin	1. Illinois; 2. Indiana; 3. Western Kentucky.
	Other Coal Producing States in the Region	1. Arkansas; 5. Missouri; 2. Kansas; 6. Oklahoma; 3. Louisiana; 7. Texas. 4. Mississippi;
Western	Powder River Basin	1. Northeastern Wyoming; 2. Southeastern Montana.
	Western Bituminous	1. Southern Wyoming; 2. Part of Colorado; 3. Part of Utah.
	Other Coal Producing States in the Region	1. Alaska;5. New Mexico; 2. Arizona; 6. North Dakota; 3. Part of Colorado; 7. Part of Utah. 4. Part of Montana; 8. Part of Wyoming

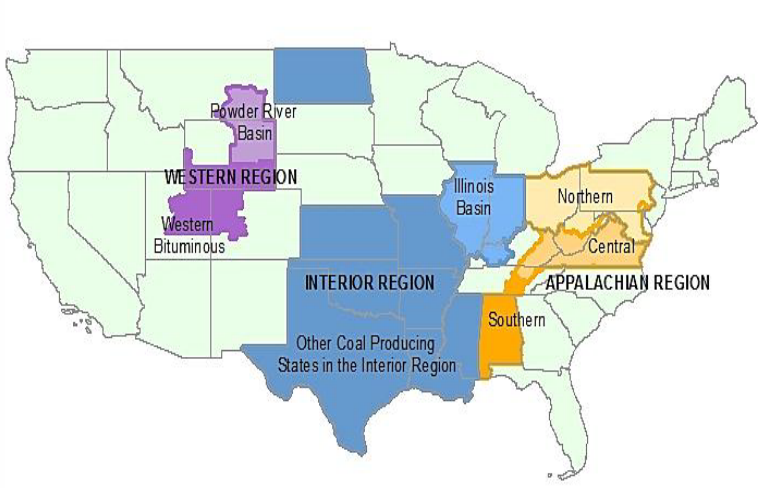


Figure 2-1: Major Coal-Producing Regions in the U.S.

2.6 Primary Data Collection

In order to estimate the economic impact to the many types of coal producing firms that would be affected by the regulation, Ramboll Environ first conducted a review of current coal production and recent trends in the industry. Key information from that process is presented in Appendix A to this report. The proposed rule and supporting information was also reviewed. Based on the understanding of the rule and its potential impact on the industry, a list of informal questions was developed and used to conduct interviews with coal companies that would be impacted by the rule. In addition, and as a result of the interviews, firms estimated a range of potential impacts on a representative sample of mines, reporting this information to Ramboll Environ. Impacts reported on a mine-by-mine basis were used to develop estimates of the percent decrease in access to recoverable reserves in each of six categories identified by Ramboll Environ based on the coal production regions and type of mining. The data were also used to develop an estimate of increased costs by type of mining (underground or surface).

The figure below shows the framework for data collected for each of the 36 mines (see Figure 2-2). Because the SPR as proposed is not final and does is subject to much interpretation, many of the respondents struggled to complete the analysis. In some cases, respondents concluded that they would have to shut down operations in order to comply with the rule. If so, Ramboll Environ encouraged respondents to assume that the most challenging component of the regulation were to be eliminated, and complete the analysis under assumed 'most favorable' conditions. For example, with underground mines, respondents were encouraged to think about how they might mine if temporary damage to the hydrologic balance were to be considered acceptable. For surface miners, the most common assumption used to develop a third alternative mine plan was to assume that ephemeral streams were not to be included in any kind of more stringent regulations as Perennial and Intermittent streams are now.

	Present Plan	Plan with SPR
Recoverable Reserves (short tons)		
Annual Production (Tons/year)		
Expected End Date		
Annual Cost of Operation per Year		
Employment		
Permitting Costs		
Expected Permit Approval Time		
Notes		

Figure 2-2: Mine – Level Data Collection Format

The results presented in this report are based on data from the participating sample of firms, and the sample of mines that were analyzed by the firms. The survey included data from 36 individual coal mines, from firms representing over 66 percent of the national coal production in the U.S.

This report includes a range of impacts depending on how the regulations are implemented. The responses gathered through the data collection process were in the form of notes by the interviewer, as well as spreadsheets provided by the companies with whichever information they could provide -

potentially lost reserves, increased costs of compliance, increased permitting costs, and employment changes among others. The following steps were involved in analyzing these data:

1. Data on a mine-by-mine basis were compiled into a master spreadsheet for synthesis and analysis.
2. In case there was any missing information or clarification needed, the company representatives were contacted again to minimize gaps in the analysis. In addition, some information for publicly traded companies was also derived or clarified from the Security and Exchange Commission's (SEC) Form 10-K filings.
3. The region and state for each mine was identified, along with the mining method and type of mining associated with the mine.
4. Data were analyzed on a mine-by-mine basis in order to achieve maximum accuracy. The key variable analyzed was the anticipated loss of coal reserves. Companies provided the accessible reserves under the present situation (baseline), as well as the reduction in these reserves under one or more interpretations of the proposed rule.
5. The results were aggregated by state and by type of mining. Each observation (mine) was weighted by the share of state production in the sample represented by the observation, and then and by the share of regional production represented by each state to produce results by region and type of mining.
6. The resulting percentage decrease in coal reserves was derived for each of the three coal producing regions and the U.S., and for underground and surface mining in each geographic unit.
7. The decrease in reserves was applied to the actual production data in each region and type of mining in order to derive the anticipated loss in annual production due to the proposed rule.
8. Based on the average prices for each region and the U.S., and for the two types of mining, the lost value of coal production was estimated for the three regions, the U.S., and for underground and surface mining in each.
9. Reserve losses were used to estimate declines in production and projected job losses.

2.7 Other Sources of Data

The main sources of information for this report are actual communications with, and data provided by personnel from the coal companies. In addition to using primary data collected directly from coal companies, the analysis relied on data from reliable secondary sources. These data were used for understanding the current status of the coal industry, developing the baseline scenario for the analysis of potential impacts, and confirming or adding to the information collected through the primary data collection process. Following is a list of the major sources of secondary data:

- Department of Energy/Energy Information Administration (DOE/EIA)
- National Mining Association (NMA)
- Bureau of Labor Statistics (BLS)
- Mining Safety and Health Association (MSHA)
- Security and Exchange Commission – Form 10-K Filings by publicly traded coal companies (SEC)

2.8 Assumptions

The analytic framework for the study is based on the following main assumptions:

1. Production within the U.S. in the absence of the proposed rule will continue as per the current trends, and following forecasts from DOE/EIA.
2. The regulatory environment will continue as it presently operates, which involves state-run mine permitting interpreted by local authorities.
3. Impacts evaluated are to include only those impacts that are attributable to the proposed SPR. For example, if a firm currently faces declining production or profitability, this is anticipated to continue both with, and without the rule in place.
4. Production numbers from the most recent publicly available U.S. data[2] are assumed to be representative of current production. These data are aggregated across mines found in the state and region; although prices, markets served, and coal quality vary significantly from mine to mine.
5. In order to estimate impacts on the entire country, it is assumed that the sample of mines analyzed is representative of other mines within the state and region, and within the country.
6. Estimates of reductions in reserves from the firms were developed using company-specific decision making processes which include estimates of risk and uncertainty associated with expected returns and include a measure of uncertainty surrounding the interpretation of the regulation.
7. This study does not involve estimates of the potential benefits of the proposed regulation, and neither does it address the question of whether or not the proposed regulation represents a least cost approach to achieving the desired outcome of the rule.

2.9 Timeline for the Analysis

The analysis estimates effects based on activities that are “reasonably foreseeable,” including, but not limited to, activities that are currently authorized, permitted, or funded, or for which proposed plans are currently available. This analysis considers economic effects from 2018 (anticipated year of the implementation of the proposed SPR).

[2] Energy Information Administration. 2014. Quarterly Coal Report (QCR) October-December 2013. May.

3. POTENTIAL ECONOMIC IMPACTS OF THE PROPOSED RULE

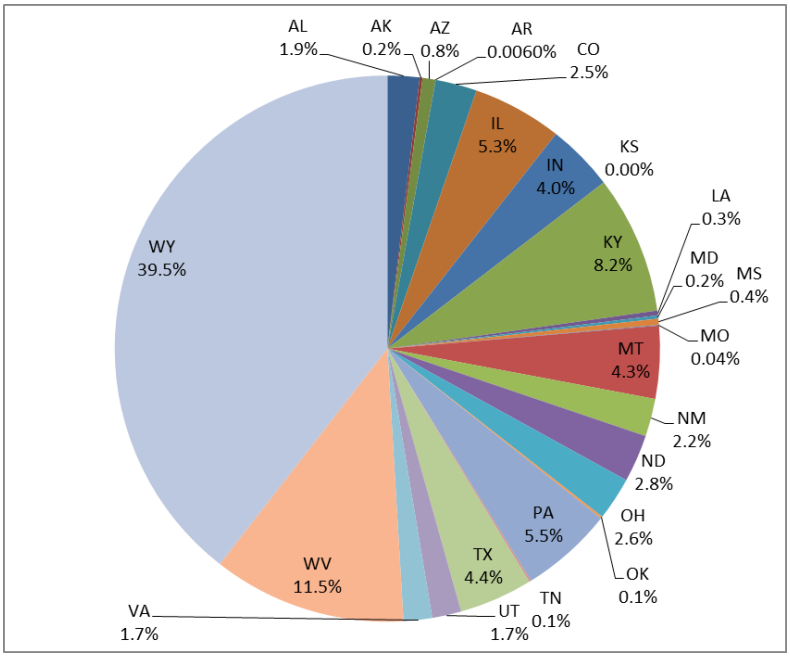
This chapter presents the anticipated economic impacts of the proposed rule. The first section outlines the context regarding production and value of coal in the country. The next section explains why and how certain key provisions in the proposed rule cause cost increases and/or loss of reserves based on information received from the coal companies. Then, the potential impacts on coal reserves are presented. This is followed by potential impacts on the value of production. Fifth, a discussion on impacts on the regional economy is presented followed by sections on potential impacts on employment; potential impacts to governments; potential impacts on consumers of electricity; and delays in the permitting process. Estimates of overall cost increases is presented, and the chapter concludes with a summary and discussion of all the impacts is presented.

3.1 Context – Production and Value of Coal

Critical to understanding the dynamics of the coal industry in the U.S. is to recognize the relationship, or lack thereof, between the production and value of coal. Figures 3-1 and 3-2 present the proportion of coal produced by state and the percentage of the value of coal attributable to each coal producing state, respectively. Almost 44 percent of coal in the U.S. is produced in northeastern Wyoming and southeastern Montana in the Powder River Basin (part of the Western region). However, in terms of value, the two states' share is only about 17 percent. The nine states within the Western region combined make up 51 percent of U.S. production, but account for only about 24 percent of value. On the other hand, 32 percent of U.S. coal produced in the Appalachian region, including, among others, the states of West Virginia, Pennsylvania, and Kentucky, make up 60 percent of the value of this resource. The Interior region's 17 percent share of production accounts for about 16 percent of coal value in the U.S.

As is discussed in more detail in Appendix A, the reason behind this discrepancy is the difference in the price of coal. Several factors affect the price of this resource, the key ones being quality and rank (based on characteristics such as sulfur content and heat value), end use, mining method, size of mine, transportation costs, and accessibility to reserves see (Table 3-1). While on the one hand, reserves in the Appalachian region are becoming increasingly harder and more expensive to access due to mining over the years, those in the Western region are abundant, easier to mine and, thus, have lower production costs. Further, permitting costs are relatively higher in the Appalachia. Western coal also has lower sulfur content, which makes it more attractive and cost-effective for power plants that are faced with regulations limiting sulfur-dioxide emissions. Coal in the Powder River Basin within the Western region generally has lower heat value, and power plants often blend it with coal with higher heat value in order to use it. These factors make the price of Western coal lower in the market. Therefore, given that value is a factor of both price and quantity produced, while the Appalachian region produces relatively less coal than the Western region, the higher price of that coal gives the former a much larger share of value overall.

Figure 3-1: Coal Production by State, 2013

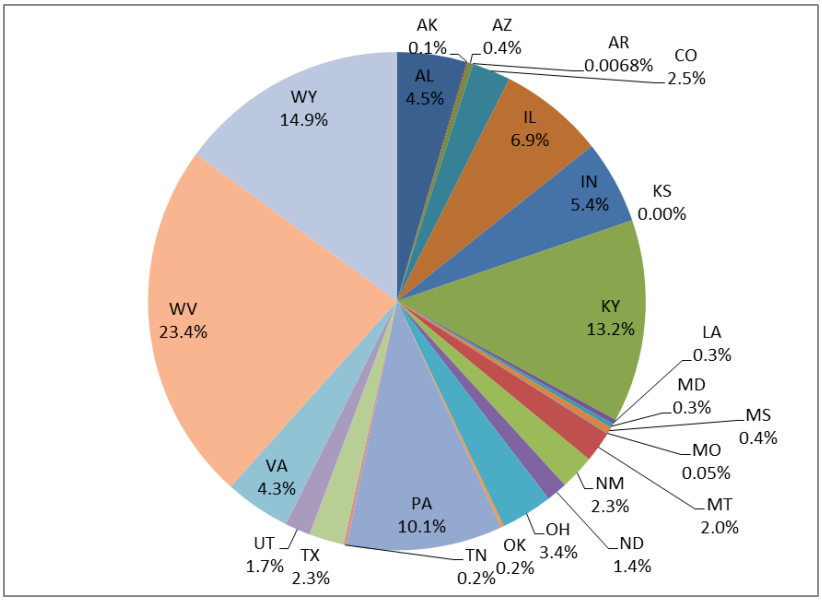


Sources:

U.S. DOE/EIA. Annual Coal Report 2013. Released April 23, 2015.

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

Figure 3-2: Distribution of Value of Coal by Production State, 2013



Sources:

U.S. DOE/EIA. Annual Coal Report 2013. Released April 23, 2015.

U.S. Department of Labor, MSHA. Form 7000-2. Quarterly Mine Employment and Coal Production Report.

U.S. EIA. Form EIA-7A. Coal Production and Preparation Report.

Table 3-1: Characteristics of Coal and their Effects on Relative Prices by Region						
Coal Producing Region	**Sub-Region**	**States Included**	**Rank of Coal Primarily Produced**	**Heat Value**	**Sulfur Content**	**Relative Prices**
Appalachia	Northern Appalachia	Maryland; Ohio; Pennsylvania; Northern West Virginia	Anthracite; Bituminous	High 10,300 Btu – 13,500 Btu	High 0.8% – 4.0%	Higher than other regions
	Central Appalachia	Eastern Kentucky; Tennessee (part); Virginia; Southern West Virginia	Bituminous	High 11,400 Btu – 13,200 Btu	Low 0.2% – 2.0%	Higher than other regions
	Southern Appalachia	Alabama; Tennessee (part)	Bituminous	High 11,300 Btu – 12,300 Btu	High 0.7% – 3.0%	Higher than other regions
Interior	Illinois Basin	Illinois; Indiana; Western Kentucky	Bituminous	Higher 10,100 Btu – 12,600 Btu	High 1.0% – 4.3%	Lower than Appalachia; Higher than Western
	Other Coal Producing States in the Region	Arkansas; Kansas; Louisiana; Mississippi; Missouri; North Dakota; Oklahoma; Texas	Sub-bituminous; Lignite			Lower than Appalachia; Higher than Western
Western	Powder River Basin	Northeastern Wyoming; Southeastern Montana	Sub-bituminous	Low 8,000 Btu – 9,500 Btu	Low 0.2% – 0.9%	Generally lower than other regions
	Western Bituminous Region	Southern Wyoming; Colorado; Utah	Bituminous	Higher 10,000 Btu – 12,200 Btu	Low 0.4% – 0.8%	Generally lower than other regions

3.2 Potential Impacts on Coal Reserves

The key to understanding the larger impacts of the proposed rule is looking into how, and to what extent, the regulations might affect the costs of operations, and access to recoverable reserves. The primary data collection process involved asking the coal companies specific questions regarding this particular impact, given its significance for the analysis.

Aggregation to the sectors shown here – each sector being a combination of one of three geographic regions, and either surface or underground mining for a total of six sectors – was completed by assuming that the sample mines were representative of the sector and state where the mine is located. The potential losses at all mines within a particular state were averaged based on the magnitude of reserves represented in each mine. Then, the losses for all states within a sector were used to develop an average sector loss by taking a weighted average of the state losses based on the share of regional production seen in each state.

Tables 3-2(a) and 3-2(b) present the lower and upper ranges of the percentage decrease in recoverable reserves anticipated as a result of the implementation of the proposed SPR.

Table 3-2(a):Anticipated Percent Decrease in Recoverable Reserves with Proposed Stream Protection Rule - LOW RANGE

Region	Anticipated Percent Decrease in Recoverable Reserves with Proposed Stream Protection Rule		
	Underground	Surface	Total
Appalachia	51%	38%	47%
Interior	33%	10%	23%
Western	60%	13%	18%
Total U.S.	**47%**	**16%**	**27%**

Table 3-2(b):Anticipated Percent Decrease in Recoverable Reserves with Proposed Stream Protection Rule - HIGH RANGE

Region	Anticipated Percent Decrease in Recoverable Reserves with Proposed Stream Protection Rule		
	Underground	Surface	Total
Appalachia	88%	67%	81%
Interior	94%	39%	68%
Western	60%	53%	54%
Total U.S.	**85%**	**53%**	**64%**

The declines in recoverable reserves are anticipated for varying reasons; complete loss of reserves including loss of access to reserves, increased cost of production due to avoiding stream contours and possible damage to ground water (rendering fewer recoverable reserves economically available to mine), and in some cases, mine closures resulting from high costs due to variable operating costs. Overall in the U.S., the decrease is anticipated to range between 27 percent and 64 percent in total coal production, with different sectors affected in different ways.

The significance of the loss of recoverable reserves is expected to result in different responses depending on the coal sector, the specific site characteristics of a mine, ability to change mining equipment types and continued mining productivity, firm-level business strategies, ability to pass additional costs onto the customers, and overall markets and prices. Some mines will continue producing but at reduced levels of output and employment; other mines will continue producing at current levels, but will simply exhaust reserves at an earlier time; others may have reduced annual production while maintaining current levels of labor and increasing costs. Some mines with contractual obligations will continue to mine but will incur higher costs per ton mined. Still others may be forced to shut down.

In terms of the loss in access to coal, the sectoral losses estimated above translate into an overall loss of coal production totaling 263 million tons nationwide under the low range, and about 630 million tons in the high range case. Tables 3-3(a) and 3-3(b) show how this varies from area to area. The Appalachian region shows the greatest volume of potential losses, with between 126 and 220 million metric tons of lost production. It should be noted that losses are based on estimates of known and defined reserves and might be expected to increase as more reserves or claims are made.

Table 3-3(a): Anticipated Change in Production of Coal with Proposed Stream Protection Rule (in Million Short Tons) - LOW RANGE

Region	Anticipated Decrease in Production under Proposed Rule		
	Underground	Surface	Total
Appalachia	95.0	30.8	125.8
Interior	33.1	8.5	41.6
Western	32.6	63.2	95.8
U.S. Total	**160.7**	**102.4**	**263.1**

Table 3-3(b): Anticipated Change in Production of with Proposed Stream Protection Rule (in Million Short Tons) - HIGH RANGE			
Region	**Anticipated Decrease in Production under Proposed Rule**		
	Underground	**Surface**	**Total**
Appalachia	164.7	55.0	219.7
Interior	92.5	32.8	125.2
Western	32.6	252.2	284.8
U.S. Total	**289.7**	**340.0**	**629.7**

The implications of reduced recoverable reserves and subsequent production losses resulting from the proposed SPR will impact the total employment and output. The degree to which contractions in production occur in the near future will have an immediate impact on employment and output, while other impacts will occur through time. For the high impact range, 18 of the 36 mines analyzed are expected to shut down representing 50 percent of all mines, and 82 percent of underground mines. This represents 90 percent of underground production and 75 percent of surface mine production.

Assumptions for the shutdowns stem primarily from the definition of material damage to the hydrologic balance as it is discussed in the SPR and supporting documentation for underground mining. Especially longwall mining is expected to shut down. Several of the longwall miners considered shifting technologies, but the financial analysis of this shift proved economically infeasible at this time. For surface mines, the main cause of the shutdowns is the inclusion of ephemeral streams in the regulations. As written, ephemeral streams are included in some but not all elements of the rule. However, the federal register notice requested comments on whether or not ephemeral streams should be included in other elements of the regulation, suggesting the possibility of greater inclusion of ephemeral streams in determining material damage to hydrologic balance, monitoring, and reclamation activities. In all cases, there are many elements of the Proposed SPR that blend together to create a shutdown scenario including uncertainty, business risks, fundamentally additional costs, and loss of access to reserves in order to avoid streams.

For the low impact range, firms were asked to relax assumptions about the inclusion of ephemeral streams, to assume that temporary impacts to the hydrologic balance would be allowed, and to assume that agency interpretation of the regulatory language was the most favorable that they could reasonably expect from agencies. Under this interpretation, there are still anticipated to be seven shut downs, with these predominantly in the underground mining sector. The impact to production based on reduced production and ceased production is expected to represent 51 percent of underground production and 5 percent of surface mining for a total loss in production of 21 percent.

3.3 Direct Economic Effect

The losses in recoverable reserves are further used to estimate losses in the value of coal output in each of the six sectors analyzed. In 2013, the total sale of coal produced was reported at $36.7 billion.[3] For the purpose of this analysis, average price data for each sector were developed based on

[3] U.S. Department of Energy/Energy Information Administration. 2013. Annual Coal Report. Released April 23, 2015

data from the EIA and through primary data collected from coal companies. Coal prices vary widely according to the quality of coal, and the average prices in general represent a weighted average across all quality types in each sector. For example, coal mined in Western surface mines is typically of lower quality, selling at $17.50 per ton. The price of coal from Appalachia, while varying significantly within the region, averages around $73.90 per ton due to the significantly higher quality. The average prices for each sector are shown in Table 3-4 in 2014 dollars.

Table 3-4: Average Price of Coal by Region and Type of Mining (in 2014 Dollars)

Region	Average Price		
	Underground	Surface	Total
Appalachia	$75.6	$70.6	$73.9
Interior	$49.7	$32.5	$42.3
Western	$37.2	$21.8	$17.5

Sources:
U.S. Department of Energy/Energy Information Administration. Form EIA-7A. Coal Production and Preparation Report.
Primary data collected from coal companies.

Using the average prices, the total value of coal production by sector is estimated based on 2013 production levels reported by the EIA. The total estimated current value of annual production is tallied at $40.1 billion using this method. Although the contraction in production is likely to occur across time in a varying degree, once the full impact of the contraction is reached the anticipated decrease in coal mining output is estimated to be between $14 billion under the low impact range and $29 billion annually under the high. The largest decrease in output is projected to occur in Appalachia which represents the largest direct contributor in economic output. In the low impact range, Appalachia is anticipated to decrease output by $9.4 billion and in the high impact range the decrease is estimated at $16.3 billion annually. Results are shown in Tables 3-5(a) and 3-5(b).

Because the prices are higher in sectors that are more affected by the regulation, the total potential effect of the proposed regulation on the value of coal production represents a higher percent of total coal value than total production. While the national impact of the rule shown in Tables 3-2(a) and 3-2(b) shows a contraction in recoverable reserves totaling 27 percent in the low range and 64 percent in the high range, the parallel contraction in annual production value represents a 34.6 percent loss under the low range and 71.7 percent in lost value with the high range (see Table 3-6). These data show that underground mining is anticipated to lose more than surface mining at the national level, with between 47.4 percent and 86.2 percent in potential lost value forecast. This compares with estimated losses of 20.3 percent to 55.4 percent in the surface mining sector.

Table 3-5(a): Coal Value at Risk under Proposed Stream Protection Rule (in Millions of 2014 Dollars) - LOW RANGE			
	Current Value	**Secure Value under Proposed Rule**	**Value at Risk under Proposed Rule**
Appalachia Underground	$14,217	$7,036	$7,181
Appalachia Surface	$5,762	$3,587	$2,175
Appalachia Total	$19,979	$10,623	$9,356
Interior Underground	$4,916	$3,271	$1,645
Interior Surface	$2,736	$2,461	$276
Interior Total	$7,652	$5,731	$1,921
Western Underground	$2,038	$825	$1,213
Western Surface	$10,382	$9,003	$1,379
Western Total	$12,420	$9,828	$2,592
U.S. Underground	$21,171	$11,132	$10,039
U.S. Surface	$18,880	$15,050	$3,830
U.S. Total	**$40,052**	**$26,182**	**$13,870**

Table 3-5(b):Coal Value at Risk under Proposed Stream Protection Rule (in Millions of 2014 Dollars) - HIGH RANGE			
	Current Value	**Secure Value under Proposed Rule**	**Value at Risk under Proposed Rule**
Appalachia Underground	$14,217	$1,770	$12,447
Appalachia Surface	$5,762	$1,875	$3,887
Appalachia Total	$19,979	$3,645	$16,334
Interior Underground	$4,916	$317	$4,599
Interior Surface	$2,736	$1,671	$1,065
Interior Total	$7,652	$1,988	$5,664
Western Underground	$2,038	$825	$1,213
Western Surface	$10,382	$4,875	$5,507
Western Total	$12,420	$5,701	$6,720
U.S. Underground	$21,171	$2,913	$18,258
U.S. Surface	$18,880	$8,421	$10,459
U.S. Total	$40,052	$11,334	$28,717

***Totals may not sum due to use of average price

Table 3-6: Percent of Coal Value at Risk under Proposed Stream Protection Rule		
	Percent Value at Risk – LOW RANGE	**Percent Value at Risk - HIGH RANGE**
Appalachia Total	46.8%	81.8%
Interior Total	25.1%	74.0%
Western Total	20.9%	54.1%
U.S. Underground	47.4%	86.2%
U.S. Surface	20.3%	55.4%
U.S. Total	**34.6%**	**71.7%**

3.4 Impacts to the Regional Economy

Changes in the coal mining sector will also indirectly impact industries that provide inputs to coal mining. In addition, the change in output and employment means fewer workers will be earning an income, leading to additional impacts occurring in industries that support household consumption. Together, these impacts are known as the direct, indirect, and induced impacts to a regional economy.

The estimated total change in output was derived using multipliers from the National Mining Association (NMA) 2014 study of regional economic impacts to the coal mining industry using 2012 data (see Section A.2.4 in Appendix A of this study for a description of the research). The NMA study reported estimates of multipliers for the contribution to gross domestic product (GDP), or the value-added metric. These multipliers capture the same ripple effect of indirect and induced contributions to GDP associated with coal mining activity, and therefore will be applied to the impact assessment in this report to provide an estimate of the total impact of the proposed rule. NMA estimated a national multiplier of 2.51.[4] This multiplier means that for every $1 contributed (or subtracted) to GDP from coal mining production directly, the total impact is $2.51. The contribution to GDP multipliers for each region was derived from the NMA study by estimating the weighted average for each region using the reported multipliers for each state. Multipliers vary at the regional level due to the different economic linkages.

The coal industry has backward linkages from coal mining to Exploration and Mining Support Services, Construction Services, Coal mining itself, Finance, Petroleum and Coal Product Manufacturing, Rail Transport, Non-Residential Property Operators and Real Estate Services, Wholesale Trade, Transport Support services and storage and Professional, and Scientific and Technical Services.

Similarly the coal economy has forward linkages to Electricity Generation, Iron and Steel Manufacturing, Non Ferrous Metal Ore Mining, Iron Ore Mining, Coal mining itself, Cement, Lime and Ready-Mixed Concrete Manufacturing, Non Metallic Mineral Mining, Pulp, Paper and Paperboard Manufacturing, Basic Non-Ferrous Metal Manufacturing, Grain Mill and Cereal Product Manufacturing, Oil and gas extraction, and Rental and Hiring Services. While the coal industry is affected and effects other industries through forward and backward linkages the multipliers used here and derived from IMPLAN only use backward linkage multipliers. In this sense the results are conservative.

The results indicate that if the full 27 percent reduction in coal production were to fully occur in the immediate future and result in the estimated $13.9 billion reduction in coal production, the total loss in contribution to GDP could be $27.7 billion (see Table 3-7(a)). If the full 64 percent reduction in production were to fully occur in the immediate future, the associated loss of $28.7 billion in coal production could result in $58.7 billion reduction in the total contribution to GDP (Table 3-7(b)).

[4] National Mining Association. 2014. *The Economic Contributions of U.S. Mining (2012)*. September.

Table 3-7(a): Total Impact on Output - LOW IMPACT RANGE (Billions of 2014 Dollars)				
Type of Mine	**Effective Multiplier**	**Direct Impact on Output**	**Indirect and Induced Impact**	**Total Impact on Output**
Underground	2.03	$10.04	$10.32	$20.36
Surface	1.92	$3.83	$3.52	$7.35
U.S. Total	**2.00**	**$13.87**	**$13.83**	**$27.70**

Table 3-7(b):Total Impact on Output - HIGH IMPACT RANGE (Billions of 2014 Dollars)				
Type of Mine	**Effective Multiplier**	**Direct Impact on Output**	**Indirect and Induced Impact**	**Total Impact on Output**
Underground	2.11	$18.26	$20.31	$38.57
Surface	1.93	$10.46	$9.68	$20.14
U.S. Total	**2.04**	**$28.72**	**$30.00**	**$58.71**

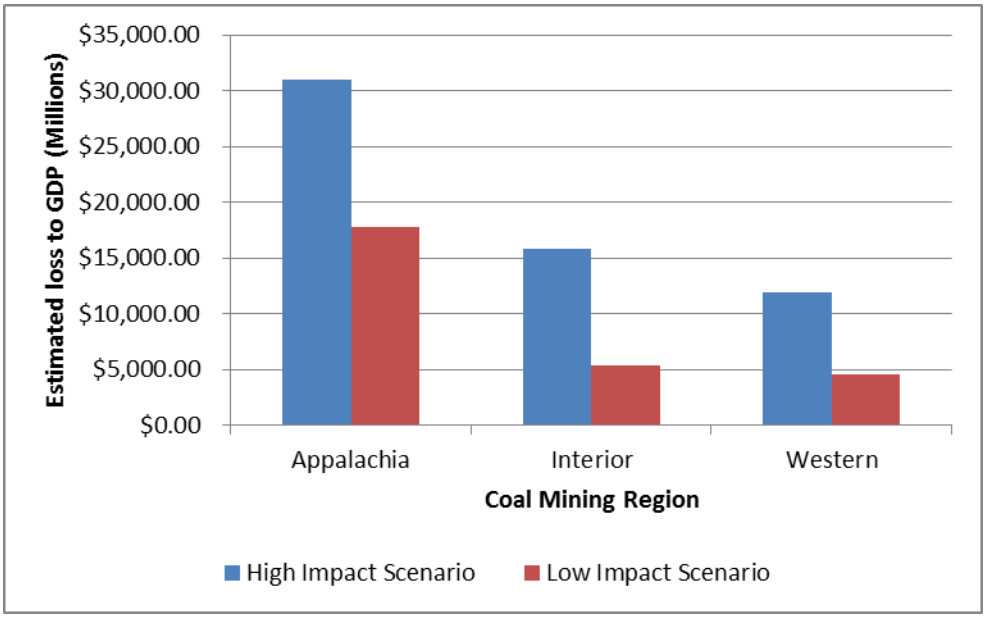


Figure 3-3: Total Loss to Output including Direct, Indirect, and Induced Effects

3.5 Employment

In 2013, employment in the coal industry was reported at 103,312 with 80,396 operator employees and 22,916 contractors.[5] At the national level, the direct employment impact due to the estimated full decrease in access to reserves is predicted to range from 40,038 jobs for the low impact range (27 percent reduction in production) to 77,520jobs for the high impact range (64 percent reduction in production). Since the average annual income for coal mining in 2013 was reported at $82,058, job losses in this sector represent significant lost wages.

In addition to the employment directly related to the coal mining sector, employment multipliers have again been developed to demonstrate the total economic impact showing the linked industries that could also be affected. The NMA study estimated a national employment multiplier of 3.62 for the coal mining industry.[6] This implies that for every worker directly employed in the coal mining industry, 2.62 additional jobs are created in the national economy, with the total impact representing 3.62 jobs. Just as with the value added multipliers, the multiplier impacts vary across regions due to the different degree of inter-connection within regional economies.

The employment multipliers were developed based on IMPLAN modeling results and a review of similar studies. The total direct employment in the MSHA data captures both mining employees and contract workers. The results indicated that if the full 27 percent reduction in coal production were to occur in the immediate future and result in 40,038 jobs lost, then the total national impact could be 112,757 jobs (Table 3-8(a)). If the full 64 percent decrease were to occur, the associated 77,520 direct jobs lost would expand to 280,809 jobs in the national economy (Table 3-8(b)). Figure 3-4 illustrates the total impact expected to occur in the different coal mining regions.

Table 3-8(a): Anticipated Decrease in Employment by Region with Proposed SPR in Place – LOW IMPACT RANGE

Region / Type of Mine	Existing Direct Employment	Direct Jobs at Risk	Existing Total Direct and Indirect Jobs	Direct and Indirect Jobs at Risk
Appalachia	64,215	30,115	232,611	79,142
Interior	20,305	4,931	73,551	18,674
Western	18,792	4,993	68,073	14,941
Underground	63,763	30,592	230,974	86,351
Surface	39,549	9,446	143,262	26,406
U.S. Total	**103,312**	**40,038**	**374,236**	**112,757**

[5] U.S. Department of Labor, Mine Safety and Health Administration. MSHA Accident, Illness, and Injury and Employment Self Extracting Files (Part 50 Data) Table 7. 2000-2015. Updated June 2015. Accessible at http://www.msha.gov/OpenGovernmentData/OGIMSHA.asp

[6] National Mining Association. 2014. *The Economic Contributions of U.S. Mining (2012)*, September.

Table 3-8(b): Anticipated Decrease in Employment by Region with Proposed SPR in Place – HIGH IMPACT RANGE				
Region / Type of Mine	**Direct Employment**	**Direct Jobs at Risk**	**Total Direct and Indirect Jobs**	**Direct and Indirect Jobs at Risk**
Appalachia	64,215	52,566	232,611	190,415
Interior	20,305	14,638	73,551	53,023
Western	18,792	10,317	68,073	37,371
Underground	63,763	55,048	230,974	199,404
Surface	39,549	22,473	143,262	81,405
U.S. Total	**103,312**	**77,520**	**374,236**	**280,809**

In the low impact range, the decrease in reserves is estimated to be 27 percent, which is expected to lead to a 30 percent reduction in employment. For the high impact range, the 64 percent reduction in recoverable reserves is anticipated to reduce direct employment by 75 percent, with job loss potential reaching as high as 82 percent in the Appalachia region. This is because the sectors of coal production anticipated to be most affected are those that are more labor-intensive, or have higher employment requirements per ton of coal produced.

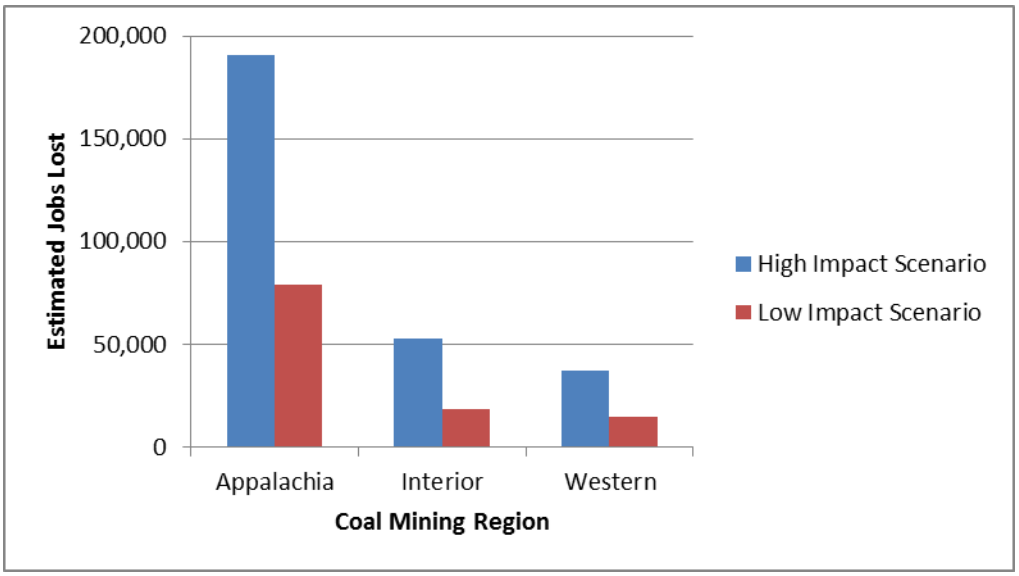


Figure 3-4: Total Jobs at Risk from Proposed SPR

3.6 Potential Impacts on State, Local, and Tribal Governments

The NMA study reported a national total impact to taxes from coal of $18,637 million.[7] The estimated decrease in coal production will result in a direct loss to state and federal income due to a decrease in taxable coal mining revenue. In addition, the decrease in economic activity will generate indirect and

[7] National Mining Association. 2014. *The Economic Contributions of U.S. Mining (2012)*, September.

induced impacts that will further affect the flow of tax payments to government. For the purpose of this analysis, the estimated impact to taxes was derived using the reported total impact to taxes by state and the total contribution to GDP by state reported in the NMA study. This information provided an estimated tax rate for each coal mining region. The derived tax rate was applied to the anticipated loss in coal production resulting in an estimated total loss in tax revenue. Potential impacts to taxes are reported below in Tables 3-9(a) and 3-9(b). The results indicate if the full 27 percent reduction in coal mining production were to occur, the estimated loss in total tax revenue is $3.13 billion annually. If the full 64 percent reduction in coal mining production were to occur, then the estimated loss total tax revenue could be $6.44 billion. The largest loss in tax revenue for the high impact range is expected to occur in Appalachia. The impact can potentially be as high as $3.76 billion, which is 58 percent of the anticipated total loss in tax revenue. Figure 3-5 illustrates the expected impact to taxes for the three different coal mining regions.

Table 3-9(a):	**Tax Low Impact Range – 27 percent Reduction in Production**		
Region	**State**	**Federal**	**Total**
Appalachia	$0.93 billion	$1.22 billion	$2.15 billion
Interior	$0.16 billion	$0.25 billion	$0.41 billion
Western	$0.26 billion	$0.31 billion	$0.57 billion
U.S. Total	**$1.35 billion**	**$1.78 billion**	**$3.13 billion**

Table 3-9(b):	**Tax High Impact Range – 64 percent Reduction in Production**		
Region	**State**	**Federal**	**Total**
Appalachia	$1.62 billion	$2.14 billion	$3.76 billion
Interior	$0.47 billion	$0.72 billion	$1.20 billion
Western	$0.67 billion	$0.81 billion	$1.48 billion
U.S. Total	**$2.77 billion**	**$3.67 billion**	**$6.44 billion**

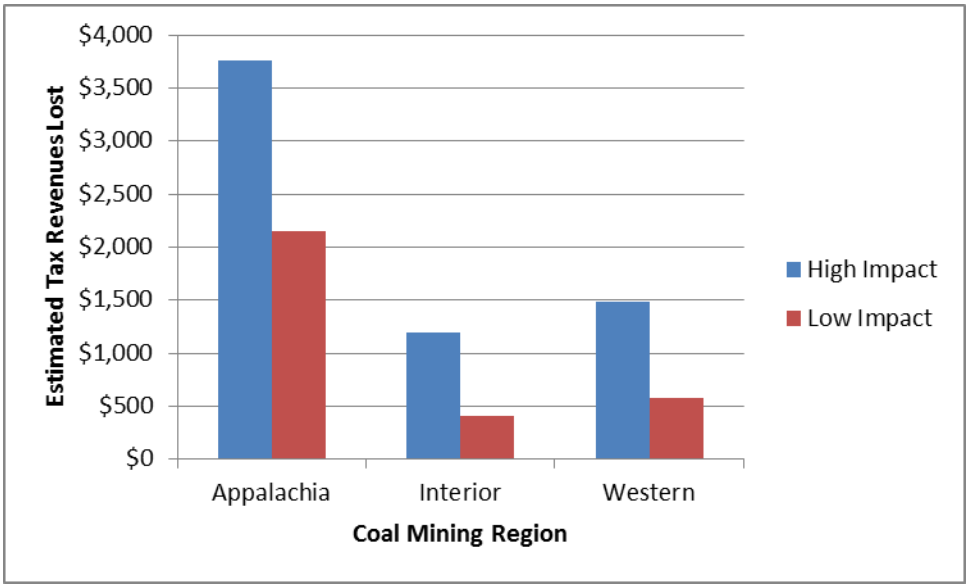


Figure 3-5: Estimated Total Impact to Federal, State, and Local Governments

Even if the impacts on tax revenue were to be partially offset by an uptick in other energy sectors,, the expansion in the substitute sectors would lag behind a contraction in the coal sector, thus creating the potential for aggravation of current budgetary challenges facing governments at all levels as well as unemployment nationwide.

3.6.1 Royalties, Lease Payment, and Rents

Lease payments, rents, and royalties paid to the federal government and tribal governments (as well as to private landholders) will decline with any contraction of the industry. Lease rights may be defaulted, and the recipients of these income streams will lose the income streams. This can be particularly difficult for the tribal governments who depend on the income to support services for populations that do not have as strong a tax base as is seen on non-tribal lands.

Royalties collected for coal mined on federal and tribal land will also decrease due to the proposed SPR. According to the Bureau of Land Management, royalties currently levied on coal mined on federal and tribal land are eight percent for underground mining and 12.5 percent for surface mining. From EIA data on coal production on federal and Indian lands, the impact on royalties due to the Rule can be estimated at $236 million to $629 million, and is highlighted in Table 3-10. This represents a drop in royalties collected from 25 to 59 percent, which is a dramatic decrease.

3.6.2 Pension Funding

Coal companies also make substantial payments to employee pension funds. In 2014, contributions to the United Mine Workers Association (UMWA) pensions and benefits funds totaled over $170 million. Coal company contributions to pensions go to the 1974 Pension Plan and Trust which “provides pensions to eligible mine workers who retire, to those who become totally disabled as a result of a mine accident, and to the eligible surviving spouses of mine workers.” The plan has recently been financially stressed based on standard annual evaluations of funded percentage under federal pension law. Under the proposed SPR, mining companies will not be able to uphold their contributions under the National Bituminous Coal Wage Agreement. This employer funding is the primary contribution to

benefit funding under the Plan. The Pension Benefit Guaranty Corporation guarantees coverage should the 1974 Pension Plan and Trust become insolvent. Should the proposed SPR be put into place, the national government will be financing pensions for eligible mine workers, not through general tax revenues, but through "insurance premiums set by Congress and paid by sponsors of defined benefit plans, investment income, assets from pension plans trusteed by PBGC, and recoveries from the companies formerly responsible for the plans".

Table 3-10: Royalty Loss Impact Range

Region	Royalty Loss (Low)	Royalty Loss (High)
Appalachia	$ -	$ -
Interior	$1.0 million	$3.5 million
Western	$235.0 million	$625.5 million
U.S. Total	**$236 million**	**$629 million**

Note that no coal in the Appalachian region is produced on federal or tribal land.

3.7 Potential Impacts on Consumers of Electricity

As outlined previously, one of the drivers of electricity prices is the cost and type of fuel used. Although the price of natural gas tends to be the fuel with the greatest impact on electricity prices, the scarcity of any fuel can cause the price of electricity to rise. If the availability of coal begins to decline, with load demand the same, first the immediate demand for coal would remain the same, as substitution to another fuel at any particular plant is not a viable option, and this would increase the price of coal as fuel. Because the vast majority of coal is sold on contract to utilities, price increases might be slow to move into the electricity sector. However, many contract coal sales have clauses allowing the coal producer to pass on costs that stem from regulatory changes. Whether or not coal producers will be able to enforce these clauses remains a source of uncertainty in the minds of many producers, and so the degree to which cost increases will translate into contract coal sales (and utility price increases) remains to be seen.

If long-term supply of coal for fuel remained at the reduced level, it would most likely force the substitution of another fuel (most likely natural gas) through the construction of a new plant, retiring the coal-fired plant or plants. This would then most likely drive the price of the substituted fuel (natural gas) higher, thereby increasing the cost to produce electricity. As most electric service providers pass the cost along to the customers, this would increase the cost of electricity at the end-user level for all sectors of the economy including the energy-intensive manufacturing sector which likely will also suffer loss of business and jobs as they become less competitive globally.

3.8 Delays in Permitting Process

Participating coal producing firms were asked about the potential for permitting delays, additional permitting costs, and the costs associated with additional delays. Currently, some states allow continuation of mining while permitting data is still in process. In an effort to accommodate the concerns about permits being delayed, Ramboll Environ evaluated the cost of delaying returns through time for one to two years in the middle of the mining plan. The analysis compared the net present value of a mine following the "without SPR" or primary mine plan with the net present value assuming a 2 year delay. Results suggest that the cost of the delays are on average a difference of

approximately 1.5 percent of total revenue per year of delay. This rough estimate does not account for any labor or operational expenditures that might need to be paid while a firm waits for a permit to be approved. Given the variability of other linked costs, the research team decided to incorporate just the 1.5 percent per year estimate when considering an overall cost increase. Several firms anticipate permit delays especially in the initial period as state agencies adjust do the changes and staff up to accommodate the new information.

Such delays present quite a different story for smaller firms. If a firm cannot expect to have a permit approved in a reasonable time frame due to an increased monitoring period, then operations may not progress from one reserve to the next. This could result in costly down time and a loss of short term fixed expenditures, as well as foregone revenues and ultimately a loss of jobs.

3.9 Cost Increases

The information provided by respondents to Ramboll Environ often included good estimates of cost increases based on avoiding streams, collecting data, and conducting the necessary restoration activities. Sometimes it was this analysis – a consideration of the technology and overall strategy needed to meet the requirements of the rule – that caused a firm to conclude that they would have to shut down. In some of these such cases, the data on the cost increase was provided. In other cases, firms concluded that they would have to shut – down, but they did not provide details of the cost increases. Still others provided cost increase data for the "best case" scenario, under the assumption that the most challenging component of the rule as written would be removed or modified before the final rule is promulgated. For example, especially in the surface mining sector, several respondents provided cost increases assuming that they would be able to obtain a permit allowing them to mine through perennial and intermittent streams. Finally, some firms provided this information simply by making an interpretation of the rule, and estimating cost increases in conjunction with the expectation of continued production with higher costs.

Because the data for these estimates were developed under a variety of different assumptions, the results below may be considered as a low-end estimate of cost increases that firms will face. Firms that are shutting down but did not provide estimates for cost increases may be assumed to face very high costs that cannot be met by market demand. The results for the anticipated increases in cost associated with implementing the SPR are shown in Table 3-11. For the entire country, the average cost increase was about 31 percent. For surface mining the result is lower – at 14%, and for underground mining it is higher (62 Percent). It should be noted that this is a per-ton percentage increase, and for example, with large surface mines that produce a large volume of coal, the cost increase is spread over a larger volume of coal.

Table 3-11 Expected Cost Increases with SPR	
Mine Type	**Percent Cost Increase from SPR**
Underground	62%
Surface	14%
U.S. Total	**31%**

3.10 Summary and Discussion of Potential Economic Impacts

This chapter provides the estimated economic impacts of the proposed stream protection rule from OSM. Impacts quantified include:

- Total number of jobs at risk of loss, including mining and linked sector employment is between 112,757 and 280,809 (30 to 75 percent of current employment levels).
- Direct mining jobs at risk of loss are predicted to be between 40,038 and 77,520.
- The overall decrease in recovery of demonstrated coal reserves is between 27 percent and 64 percent; both surface and underground mines will be significantly impacted.
- The annual value of coal lost to production restrictions is between $14 billion and $29 billion.
- Total annual federal and state tax revenue potentially foregone because of lost production is estimated at $3.1 billion to $6.4 billion.
- Total loss of royalties due to mining on Federal and Indian lands is estimated between $236 million and $629 million.

These results were based on the analysis of 36 different mining operations from mining corporations representing more than 66 percent of coal production in the United States. Based upon review of the data associated with mining operations across each of the major coal mining regions of the United States, it is abundantly clear that the proposed SPR cannot be accepted as a “one-size fits all” rule. The magnitude of effect from each of the proposed elements of the rule varied widely across each mine type and region. It is important to note that the data provided by respondents was compiled by actual mine staff, including experienced professional engineers, geologists, wildlife biologists, soil scientists, and vegetation specialists with years of experience in the coal mining industry, all of whom had intimate working knowledge and experience with the current regulatory environment.

The differences in impact are largely based on unique site-specific characteristics of each mine, such as the geology, topography, soils, climate, hydrology, and vegetation. Still, some trends in responses can be summarized by mine type. Underground mining operations (especially longwall operations) indicated that the stranding of recoverable reserves came mostly from two generalized conditions of the rule:

1) Stream Conversion, as described above in Section 2.3.1, this report, and

2) the proposed definition of Material Damage to the Hydrologic Balance.

Both of these result in extremely significant increased cost and business uncertainty. For example, here is a quote from one respondent that is similar to many other respondents who found a number of challenges in trying to interpret the rule as proposed,

> *being an underground mining operation…, there is not one square inch of the current or potential future lease and permit areas that are not part of an ephemeral, intermittent or perennial stream or the angle of draw. Considering the proposed rule "does not differentiate between…long-term…and short term impacts," in terms of material damage to the hydrologic balance, (as stated within the Preamble), and as this could be broadly and differently interpreted by the agencies regarding perceived potential impacts to flow, adjacent riparian areas, wildlife habitat, public water resources, there would be very little likelihood of being able to design an economically-recoverable mine plan. This is critical because all future potential coal reserves are under streams covered by this rule. And this economic infeasibility comes before consideration of obtaining the leases, permitting and conducting exploration, and constructing wells and stations to obtain the extensive new baseline monitoring data (that is impossible to obtain year-round due to heavy snow cover).*

Similarly for surface mining operations, respondents noted that many of the proposed rules are extremely vague and difficult to interpret and they had to "guess" what OSM intends by the rule. There were a number of conditions associated with the proposed rule that were cited as being responsible for either increased costs or shut downs, or both. These are:

> 1) Mining is prohibited through intermittent and perennial streams or material damage includes mining of ephemeral streams;
>
> 2) Material damage to the hydrologic balance being inclusive to "any" impact, and not allowing for temporary conversion, or partial repairment; and,
>
> 3) Increased costs of compliance (establishing baseline, lack of permit shield, fish and wildlife veto, increased reclamation cost).

All of these result in extreme increased cost and business uncertainty.

Finally, it is important to note that respondents were not asked to envision a "worst case scenario." Instead, the data represent the best effort of industry experts to optimize production under the new set of constraints presented by the proposed SPR.

4. CONCLUSIONS AND DISCUSSION

This study involved interviews with coal producers representing over 66 percent of U.S. annual production. Small, medium, and large producers were interviewed regarding the potential impacts to their businesses as a result of a proposed SPR currently under consideration by the OSM. The results of the interviews demonstrate that impacts would be different for different operators depending on the state and region of the country, quality of coal produced, the number of streams in the area, the type of mining, local hydrology, proximity to customer base, operating margins, and many other factors. Detailed estimates of how mining plans would be altered at 36 different mines were developed. Assuming those analyses are representative of other mines in the same region and for the same type of mine, the result would be a nationwide loss in access to recoverable reserves of between 27 percent and 64 percent, with the lower estimate (27 percent) only possible with substantial favorable changes in the proposed SPR.

An impact on employment is anticipated to occur as a result of implementation of the proposed SPR due to a likely contraction of the coal industry; the degree of impacts can be estimated from the survey information and is expected to be immediate or in the short term, though details of the timing of the impact remain uncertain. If the low impact range (27 percent contraction in production) were to occur immediately, the associated employment would be a 30 percent loss of employment due to the labor intensity of the mines that would be affected. Under the high impact range (64 percent contraction in production), the employment decline would be 75 percent, or 77,520direct jobs at risk. A more likely range is that the magnitude of the initial impact on the industry will be somewhat smaller than the estimated 27 percent to 64 percent decline, with the additional impact occurring over time. Further, the combined increases in cost and decreases in mineable reserves will result in upward pressure on energy prices, thus indirectly influencing a much wider share of the overall economy.

4.1 Understanding the Industry Response

As described above in section 2.4 (Primary Data Collection), the response to the proposed rule was based on confidential discussions with firms regarding the contents of the proposed SPR; the changes from the previous rule; and how this might affect each firm. Responses varied widely from mine to mine, and participants solicited detailed data from individual mine operators. Some respondents prepared internal analyses of the anticipated impacts of these proposed rule on their own mines prior to the decision to conduct this study, indicating that such numbers are what operators are actually using in their own long-term mine planning.

Under the high impact range, the number of mines anticipating shut down is 18, or 50 percent of the 36 mines in the sample. For the remaining mines, there was an anticipated loss of access to reserves resulting from the proposed rule, and firm strategies for responding to this fall loosely into three responses to this impact:

- Continue producing at the same level, and close mine earlier than would have happened otherwise, thus decreasing employment over time;
- Produce less on an annual basis (in effect raising costs/ton) which will decrease employment immediately and over time; or
- Increase production at other mines in order to meet annual output targets (in effect raising costs/ton) which may decrease employment over time.

The decision regarding which of these alternatives to select will also vary from firm to firm and from mine to mine. For this reason, the timing of anticipated contractions/cost increases/shut downs is not clear. However the impacts have been assessed for recoverable reserves and have been measured at

active mines. Consequently, it is likely that the adjustments will begin immediately upon acceptance of the proposed regulations, and can be expected to occur throughout the life of the existing mines.

Differential impacts are anticipated across different geographies and types of mining. Responses between small and large firms are also expected to differ. In general, increased costs of permitting, and financial assurances and security bonds are up-front costs that are more easily assumed by larger firms that can spread the cost across a large volume of existing output. Smaller firms operate on smaller profit margins and will have greater difficulty responding to the upfront costs. Further, small firms are more susceptible to the risk of being shut down even temporarily because it will dramatically influence their income. Therefore, uncertainties described above are more pronounced in terms of feasibility decision-making. Additional explanations of the specific determinations that lead to estimates of lost access to reserves are provided in Appendix B - Loss of Reserve Access Examples.

4.2 Associated Impacts

The potential associated impacts estimated in this report suggest that significant effects in industries linked to the coal industry are possible with the acceptance of the proposed regulation. The pace and magnitude of the associated impacts will also depend entirely on the pace and magnitude of the impacts within the industry. These associated impacts measured include economic contractions in:

- Industries with backward linkages (indirect impacts) to the industry, and industries that benefit from incomes provided through coal production (indirect impacts);
- Industries linked through transportation and other businesses that support coal production;
- Industries with forward linkages, such as steel production and electricity generation;
- Tax impacts on federal, state, and local governments;
- Foregone lease payments, rents, and royalties to private landowners, the federal governments, and tribal governments.

As these associated impacts occur, the affected industries will contract, causing declines in output and employment in the associated economic sectors. Additional risks should be considered as any contraction in one sector implies contraction in others, and each affected sector is linked to many other sectors, just as the coal industry is linked to many others. Further, there is the possibility that simultaneous risks can compound upon each other and result in more system slowdowns. While some compensating increase in employment and output may be anticipated in the environmental science and consulting sector, and presumably in state agencies responsible for enforcing the new regulation, such increases are not anticipated to significantly compensate for job losses in the coal industry and related sectors.

4.3 Uncertainty

Many economic analyses assume the economy is at or near full employment conditions. Therefore job losses associated with a rule's impacts are assumed to be quickly subsumed within the economy. Potential job losses from the rule are not likely to be readily absorbed in the short term and for some regions of country these jobs losses may be permanent.

4.4 Conclusion

The results of this study suggest that the SPR as proposed would result in loss of between 27 percent and 64 percent of the recoverable reserves at active mines. Associated employment impacts are expected to be between 112,757 and 280,809 lost jobs, including impacts to industries linked to the coal industry. Industries supplying inputs to the coal industry will experience an associated loss of revenue. Additional impacts can be expected in the steel and electricity industries as coal supplies

are constrained and more costly reserves are accessed, both activities putting upward pressure on prices. Municipal, tribal, state, and federal governments will experience decreased tax, royalty, and fee revenues.

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APPENDIX A. OVERVIEW OF COAL MINING INDUSTRY IN THE UNITED STATES

Coal is an important energy source in the U.S., and has been used for that purpose for hundreds of years. In addition to providing energy for domestic heating and cooking, it has historically played a critical role in transportation, energy for industrial applications, and generation of electricity. The use of coal has grown over time due to the abundance of coal reserves in the U.S. and the availability of this resource at relatively low prices. At present, almost 93 percent of coal produced in the U.S. is used for power production. This appendix provides an overview of the coal mining industry in the U.S., and looks at the trends, future outlook, and key factors impacting coal. The data presented here also provides a baseline for analyzing the potential effects of the proposed rule on the coal mining industry.

A.1 Trends in Coal Mining, Future Outlook, and Key Factors Impacting Coal

Critical to understanding the dynamics of the coal industry in the U.S. is to recognize the relationship, or lack thereof, between the production and value of coal. Figures A-1 and A-2 present the proportion of coal produced by state and the percentage of the value of coal attributable to each coal producing state, respectively. Almost 44 percent of coal in the U.S. is produced in northeastern Wyoming and southeastern Montana in the Powder River Basin (part of the Western region). However, in terms of value, the two states' share is only about 17 percent. The seven states within the Western region combined make up 51 percent of U.S. production, but account for only about 24 percent of value. On the other hand, 32 percent of U.S. coal produced in the Appalachian region, including, among others, the states of West Virginia, Pennsylvania, and Eastern Kentucky, make up 60 percent of the value of this resource. The Interior region's 17 percent share of production accounts for about 16 percent of coal value in the U.S.

As is discussed in more detail later in this chapter, the reason behind this discrepancy is the difference in the price of coal. Several factors affect the price of this resource, the key ones being quality and rank (based on characteristics such as sulfur content and heat value), end use, mining method, size of mine, transportation costs, and accessibility to reserves. While reserves in the Appalachian region are becoming increasingly harder and more expensive to access due to historical mining activities, those in the Western region are abundant, easier to mine and, thus, have lower production costs. These, in turn, render coal produced in the Appalachian region more expensive. Further, permitting costs are relatively higher in the Appalachia. Western coal also has lower sulfur content, which makes it more attractive and cost-effective for power plants that are faced with regulations limiting sulfur-dioxide emissions. Coal in the Powder River Basin within the Western region generally has lower heat value, and power plants have to blend it with coal with higher heat value in order to use it. These factors make the price of Western coal lower in the market. Therefore, given that value is a factor of both price and quantity produced, while the Appalachian region produces relatively less coal than the Western region, the higher price of that coal gives the former a much larger share of overall value.

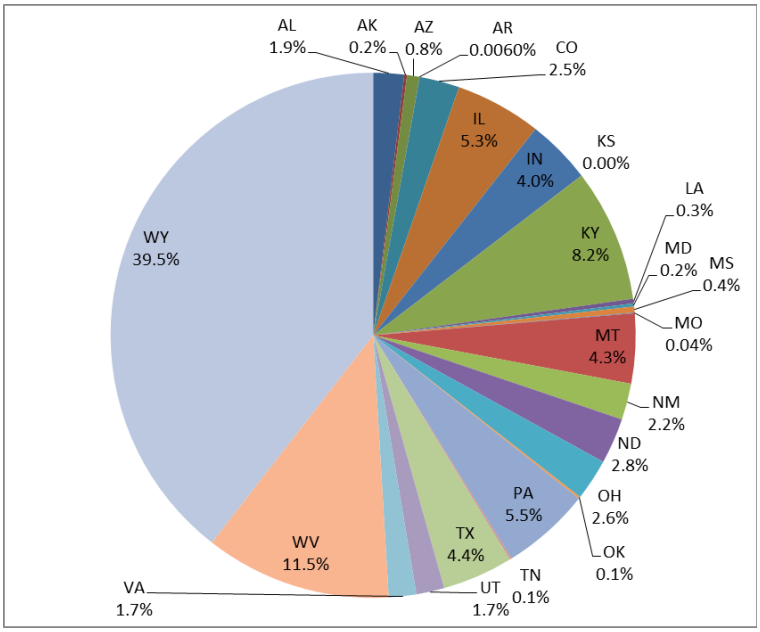


Figure A-1: Coal Production by State, 2013

Sources: U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

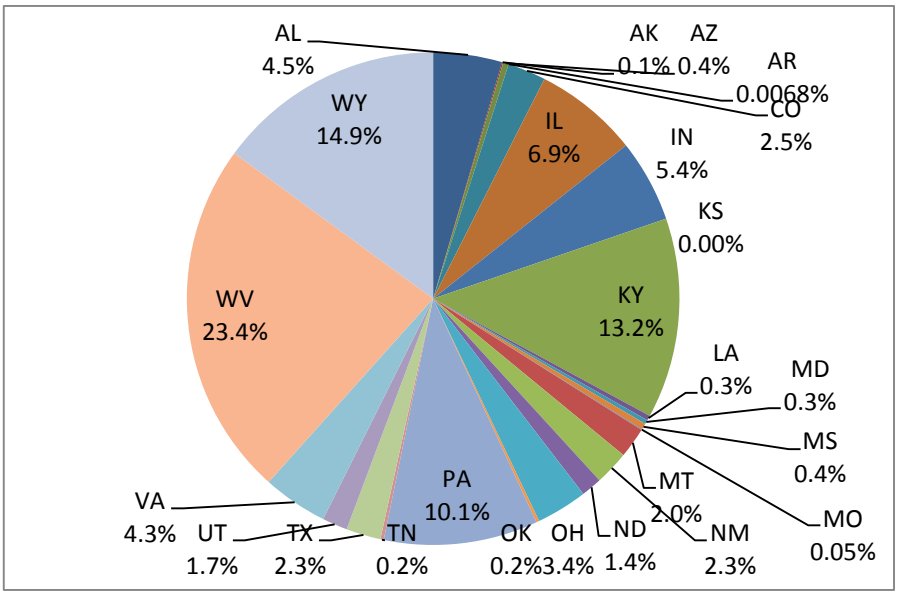


Figure A-2: Distribution of Value of Coal by Production State, 2013

Sources: U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

U.S. EIA. Form EIA-7A. Coal Production and Preparation Report.

A.1.1 Trends in Coal Production

Coal production in the U.S. has been steadily increasing, in general, for many decades. From approximately 560 million short tons in 1950, it has grown to almost one billion short tons in 2013. The main reasons behind this rapid increase include, among others, abundant domestic coal reserves, increasing mine productivity due to better technology and larger mines, high demand, the 1973 Oil Embargo, and the 1978 Power Plant and Industrial Fuel Use Act (which mandated conversion of most existing oil-burning power plants to coal or natural gas). As presented in Figure A-3, the production of coal has fluctuated over the past few years.

One of the most noteworthy trends in coal production in the U.S. over the past three decades is the increasing shift of production from the eastern states to the west. This is primarily occurring due to the presence of extensive beds of low sulfur coal with low mining costs in the states of Wyoming, Montana, and North Dakota. Strict regulations on sulfur emissions over the past decades have rendered purchasing this cheap coal from the west more feasible for power plants than to install costly equipment for meeting sulfur dioxide limits. Further, cheap transportation of the resource through unit trains and the development of huge surface mines in the west have further enhanced the cost-effectiveness of Western coal.

Between 1970 and 2010, coal production in the Western region increased over 16-fold, and is dominated by surface mining. In 1970, Western production was 31.8 million short tons. It rose to 187.8 million short tons by 1980, to 296.6 million short tons by 1990, to 454.9 million short tons by 2000, to 522.3 million short tons by 2010, and 530.2 million short tons in 2013.

Unlike the growth in the Western region, production in the Appalachian region has decreased over the past 40 years. In 1970, Appalachian production was 529.6 million short tons. Production was 608.2 million short tons in 1980, 409.7 million short tons in 1990, 528.9 million short tons by 2000, 444.4 million short tons by 2010, and 269.7 million short tons in 2013.

Coal production in the Interior region also has changed little over the course of the last 40 years. Interior production was 158.3 million short tons in 1970, 202.9 million short tons in 1980, 167.2 million short tons in 1990, 136.2 million short tons in 2000, 146.3 million short tons in 2010, and 183.0 million short tons in 2013.

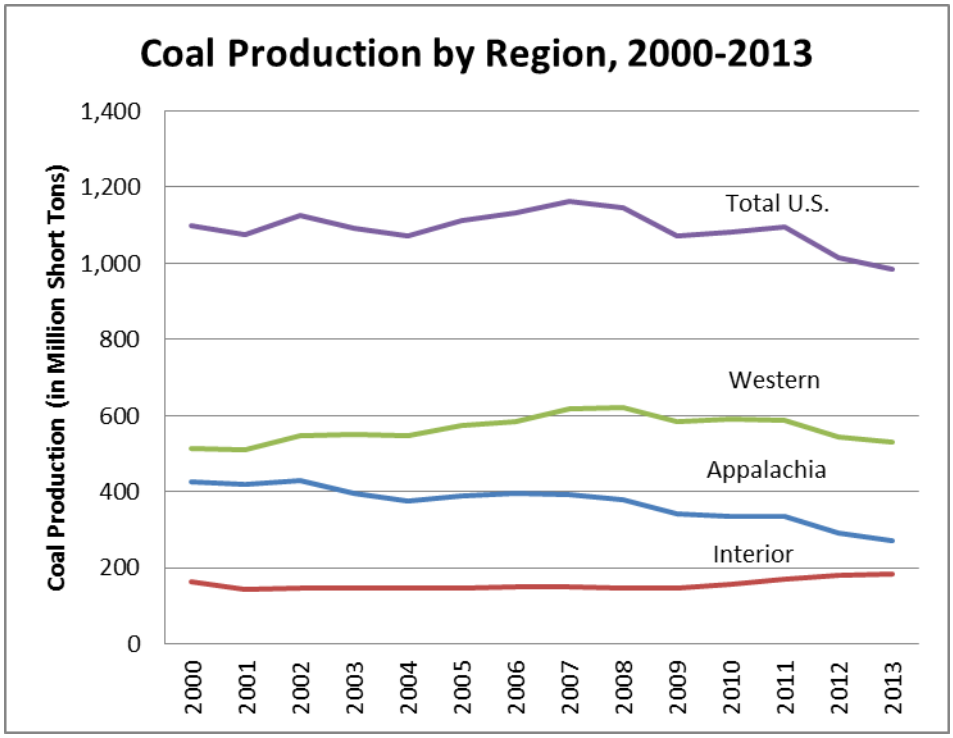


Figure A-3: Coal Production by Region, 2000-2013

Sources:

U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. DOE/EIA. Annual Coal Report. Various Issues.

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

It is projected that the Western coal production will remain fairly constant in the coming decades, making up 50 percent of all production by 2040 (compared to 55 percent in 2010), while the proportion of production from the Appalachia region would decrease to 20 percent in 2040 (from 31 percent in 2010). In contrast, the Interior region will see growth to 30 percent in 2040 (from 14 percent in 2010) (see Figure A-4).

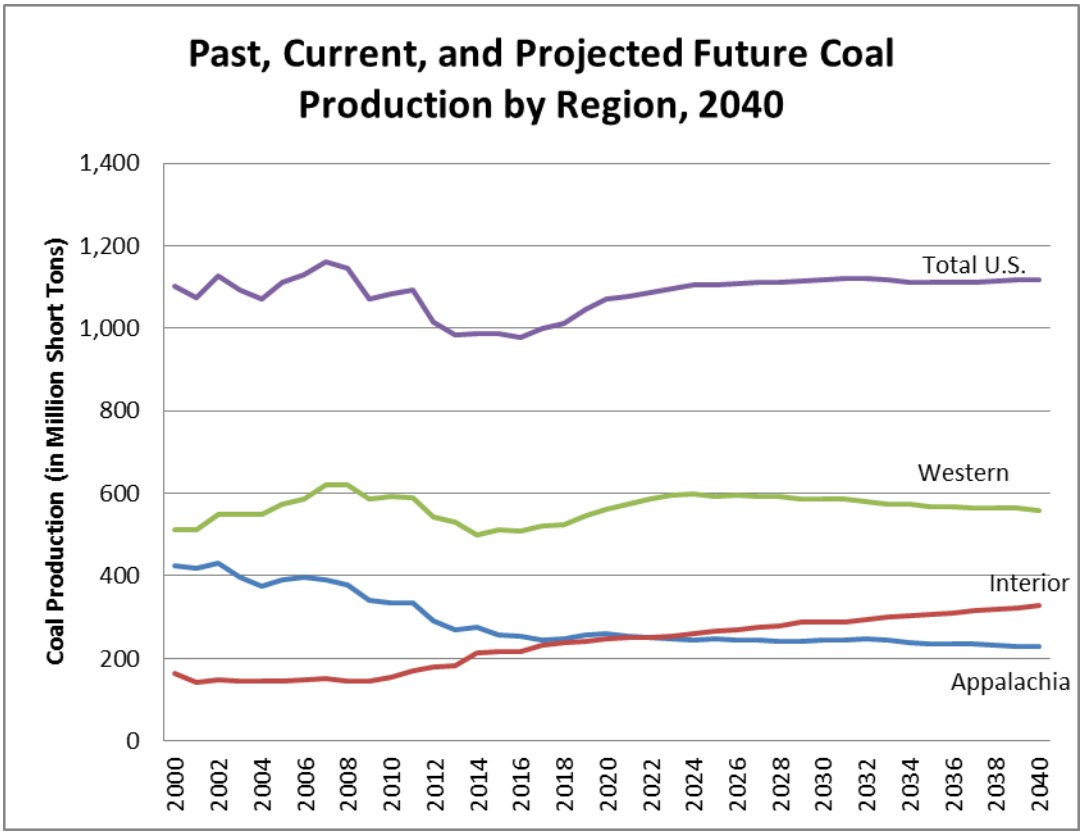


Figure A-4: Past, Current, and Projected Future Coal Production by Region, 2000-2040

Sources:

U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. DOE/EIA. Annual Coal Report. Various Issues.

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

U.S. Energy Information Administration. AEO2013. National Energy Modeling System.

Another important trend in coal mining over the past few decades is the increasing shift from underground to surface mining. As presented in Figure A-5, underground mining still dominated surface mining in 1970. The two types of mining shared 50 percent of production each in 1973. However, between 1970 and 2010, the share of production from underground mines declined by almost a third, from 56 percent to 31 percent.

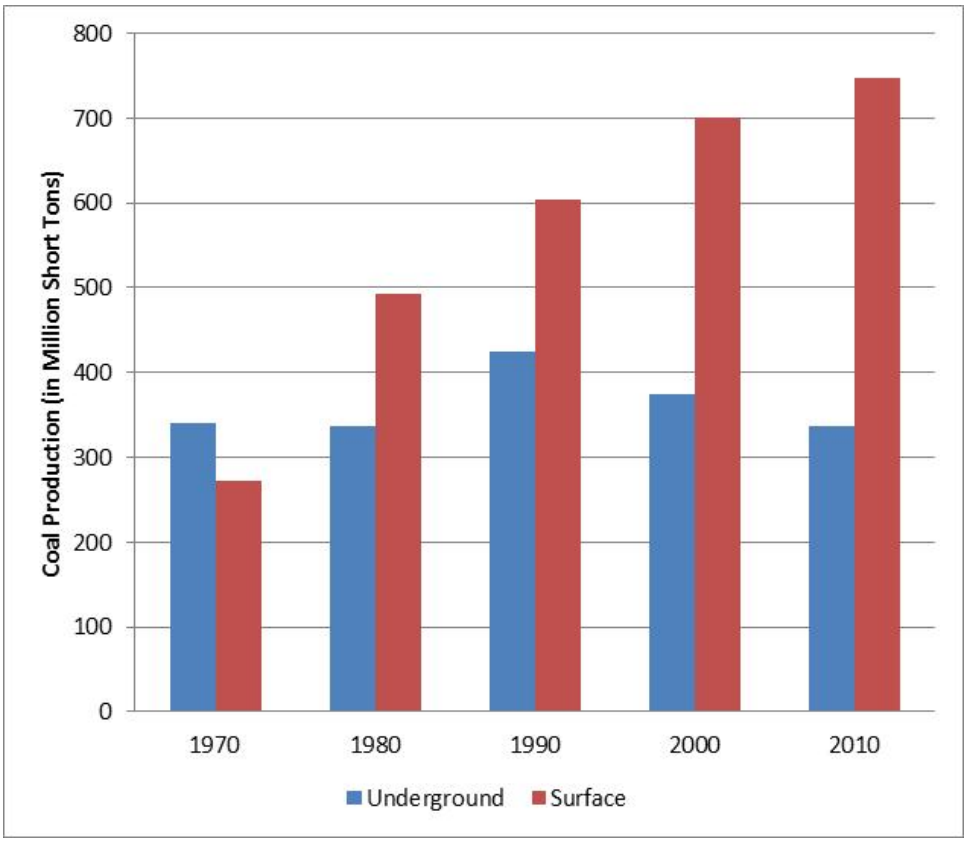


Figure A-5: Change in Distribution of Coal Production by Mining Method over Time, 1970-2010

Sources:

U.S. Department of Energy/Energy Information Administration. Report Number DOE/EIA-0584 (2009). Released October 1, 2010 and updated February 3, 2011.

U.S. Department of Energy/Energy Information Administration. Report Number DOE/EIA-0584. Annual Coal Report. 2001-2009 - various issues.

U.S. Energy Information Administration. Quarterly Coal Report. October-December 2010. DOE/EIA-0121(2010/Q4) (Washington, DC, March 2010).

Coal is ranked into four main categories based on heat value supplied by the carbon content; lignite, sub-bituminous, bituminous, and anthracite (in ascending order of heat value). The heat value, commonly measured in Btus, determines the amount of energy it contains per unit of weight and also its end use. Lignite has the lowest heat value, while anthracite has the highest. Both sub-bituminous and bituminous coal is used for power generation, while bituminous coal is also used for making coke for the steel industry. In terms of coal rank, approximately 49 percent of all coal produced in the U.S. in 2013 was Sub-bituminous Coal, closely followed by Bituminous Coal at 42 percent (see Figure A-6). Most of the remaining ten percent was Lignite, while Anthracite made up less than one percent of coal production.

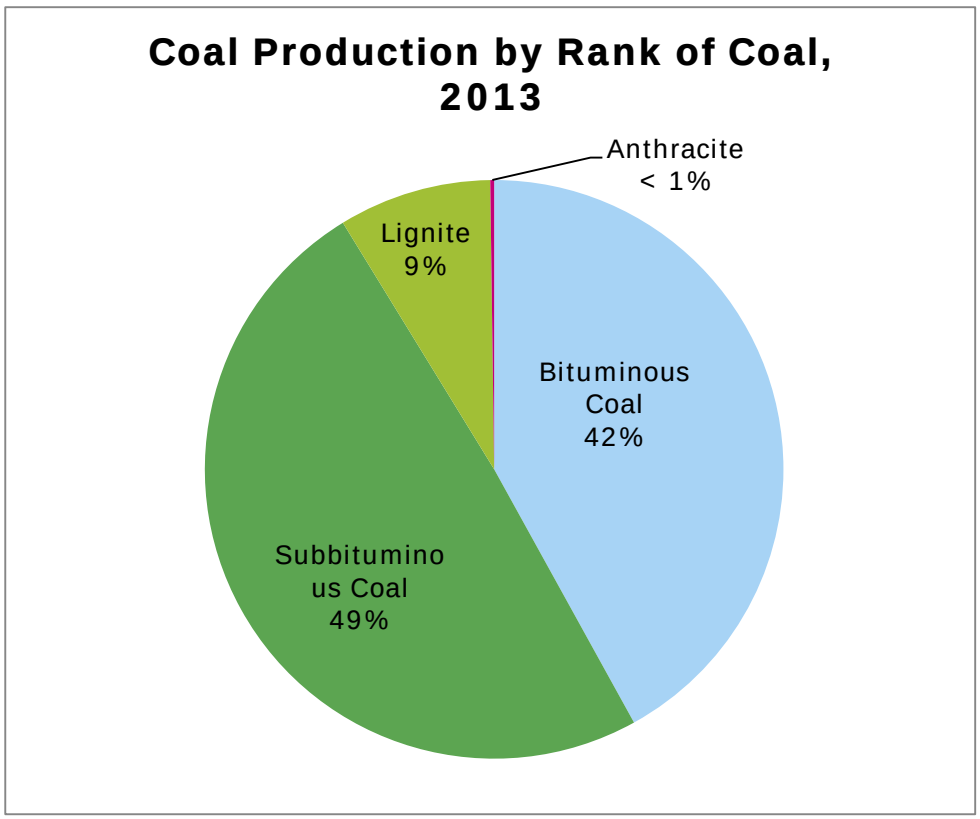


Figure A-6: Coal Production by Rank of Coal, 2013

Sources:

U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

A.1.2 Coal Producing Companies

In 2013, there were 29 major coal producing companies in the U.S., producing more than 5 million short tons each.[8] The combined share of production of the top five coal producers is over 55 percent. The top ten producers account for over 76 percent of production, while the top 15 for more than 85 percent.[9]

A.1.3 Coal Reserves

Coal reserves are categorized in the Energy Information Administration (EIA) data as demonstrated reserve base, estimated recoverable reserves, and recoverable reserves at producing mines. The demonstrated reserve base is defined as “a collective term for the sum of coal in both measured and indicated resource categories of reliability, representing 100 percent of the in-place coal in those

[8] U.S. Department of Energy/Energy Information Administration. 2015. Report Number DOE/EIA-0584 (2015). Released April 23, 2015

[9] U.S. Department of Energy/Energy Information Administration. 2015. Report Number DOE/EIA-0584 (2015). Released April 23, 2015

categories as of a certain date." The U.S. coal demonstrated reserve base is 479,914 million short tons as of January 2014 (see Figure A-7). Of these, about 41 percent are in the Western Region.

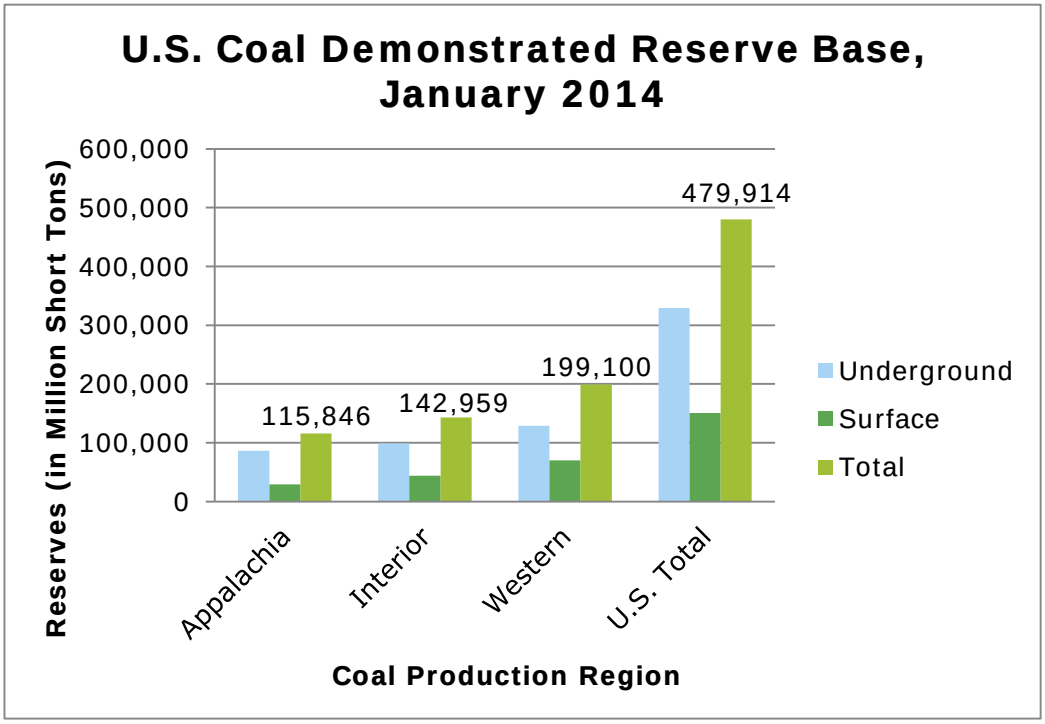


Figure A-7: U.S. Coal Demonstrated Reserve Base, January 2014

Sources:

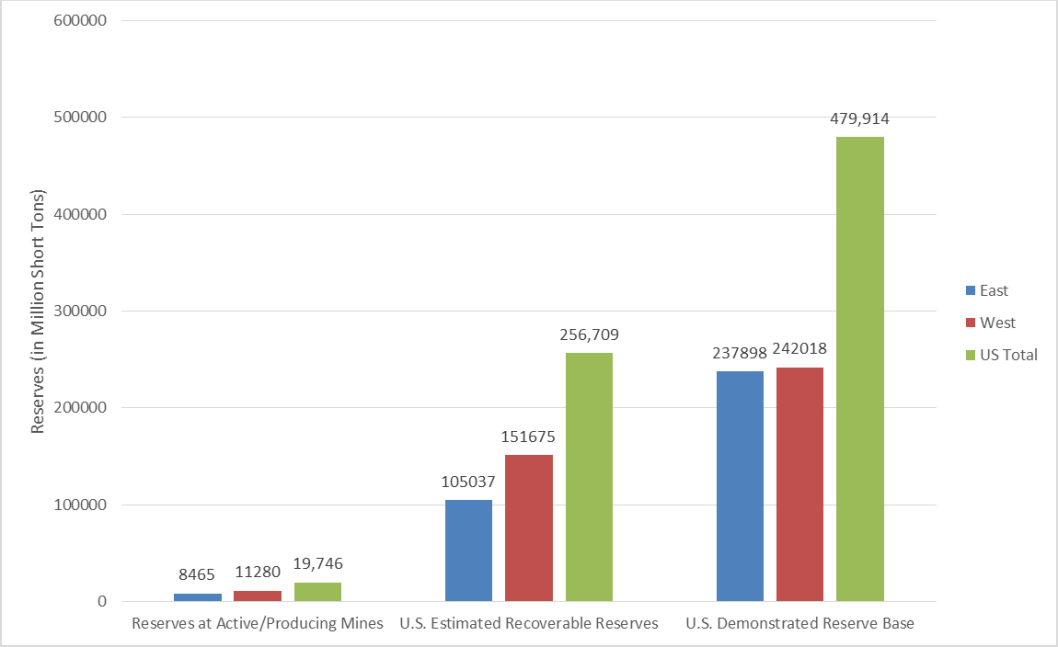
U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

The estimated recoverable reserves, based on a demonstrated reserve base adjusted for assumed accessibility factors and recovery factors, are derived by the EIA "without specific economic feasibility criteria by factoring (downward) from a demonstrated reserve base for one or more study areas or regions." The estimated recoverable reserves in the U.S. are 256,709 million short tons, approximately 59 percent of which are in the west (see Figure A-8).

Finally, EIA defines recoverable reserves at producing mines as "The amount of coal that can be recovered (mined) from the coal deposits at active producing mines as of the end of the year." These are derived by EIA by aggregating "(upward) from reserve estimates reported by currently active, economically viable mines on Form EIA-7A." The recoverable reserves at producing mines are estimated at about 19,746 million short tons. Of these, almost 57 percent are located in the west.

Figure A-8: U.S. Coal Reserves by Type, 2013



Sources:

U.S. Department of Energy/Energy Information Administration. Annual Coal Report 2013. Released April 23, 2015

U.S. Energy Information Administration. Coal Reserves Database.

The U.S. government is the largest holder of reserves. With approximately 87 billion tons of estimated recoverable coal reserves, it owns one-third of the nation's coal resources.[10] This is followed by Great Northern Properties Limited Partnership, which reported 20 billion tons of reserve holdings.

A.1.4 Demand and Consumption

The major consumers of coal in the U.S. are electric power plants, the steel industry, and other industry. Demand is led by power plants, which consumed almost 93 percent of all coal produced in the U.S. in 2013, a substantial increase from about 19 percent (91.9 million short tons) in 1950 (see Figure A-9). Residential and commercial users, who made up over 23 percent of coal consumption in 1950, now account for only 0.3 percent. The steel industry consumed 2 percent and other industrial use made up about 5 percent of coal consumption in 2013. As presented in Figure A-10, production in the U.S. is outpacing consumption overall.

[10] National Mining Association. 2010 Coal Producer Survey. May 2011.

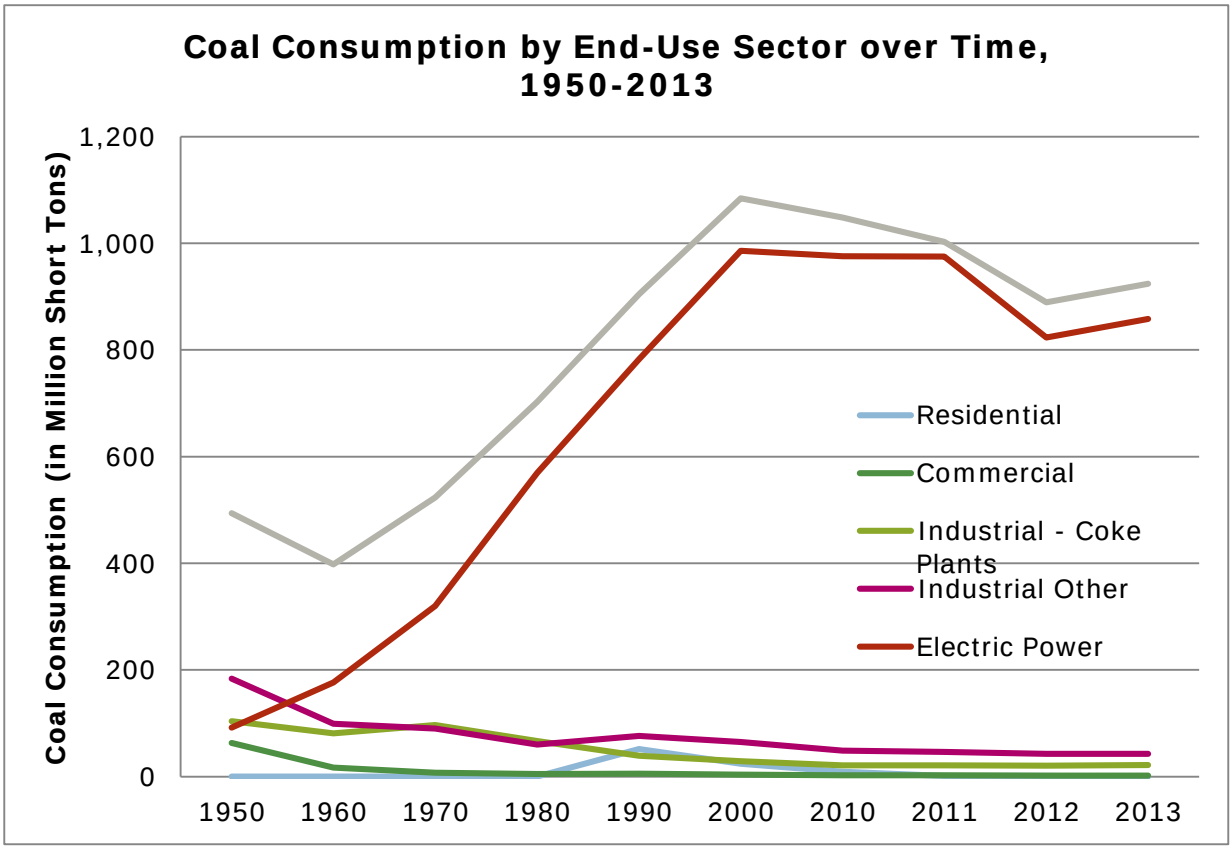


Figure A-9: Coal Consumption by End-Use Sector over Time, 1950-2013

Sources:

U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

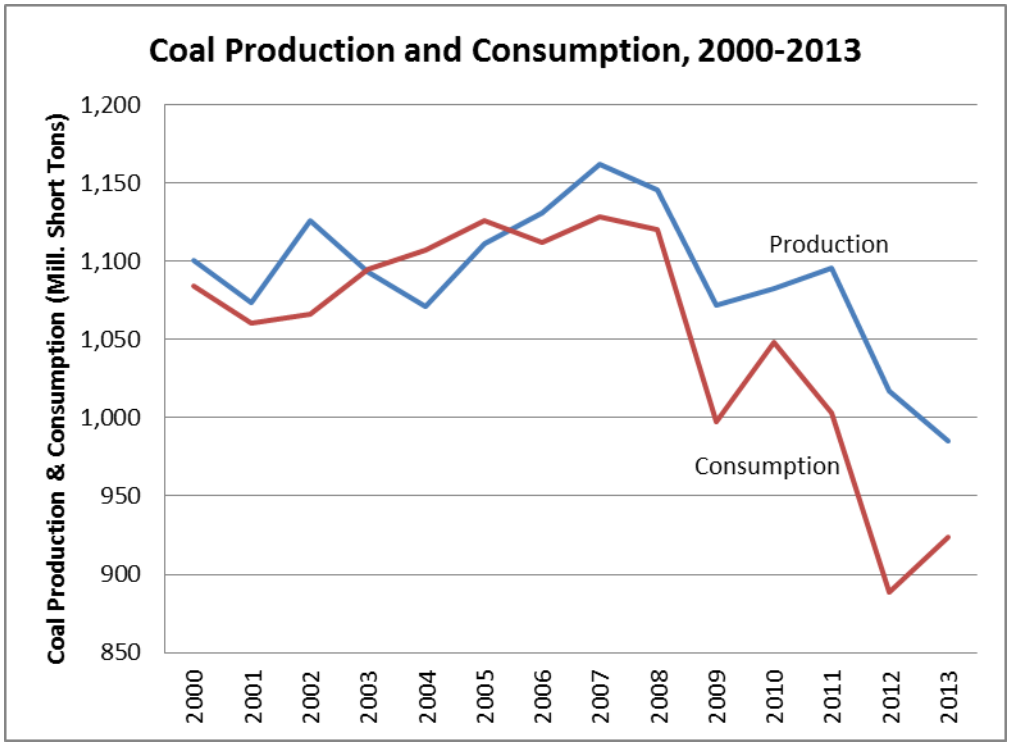


Figure A-10: Coal Production and Consumption, 2000-2013

Sources:

U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

A.1.5 Employment and Wages in the Coal Industry

In 2013, the coal mining industry employed 103,312 people in the U.S., including contractors. In Figure A-11, we see the Appalachian region employs 49,955 workers, making up over 62 percent of total employment in the industry.[11] This is followed by the Interior region with almost 20 percent of employment and the Western region with the remaining 18 percent. Factors such as type of mining, mining methods, technology, and regional production levels are some of the key factors that affect employment. About 62 percent of mining employment is in underground mining (see Figure A-12). This is primarily because of the lower productivity per worker in underground mining methods.

[11] The distribution of employment by coal-producing region is estimated through applying the proportions of workers in each region provided by the Energy Information Administration (Report Number DOE/EIA-0584 (2015). Released April 23, 2015 to the employment numbers for 2013 available from the U.S. Department of Labor, Mine Safety and Health Administration (MSHA Accident, Illness, and Injury and Employment Self Extracting Files (Part 50 Data)).

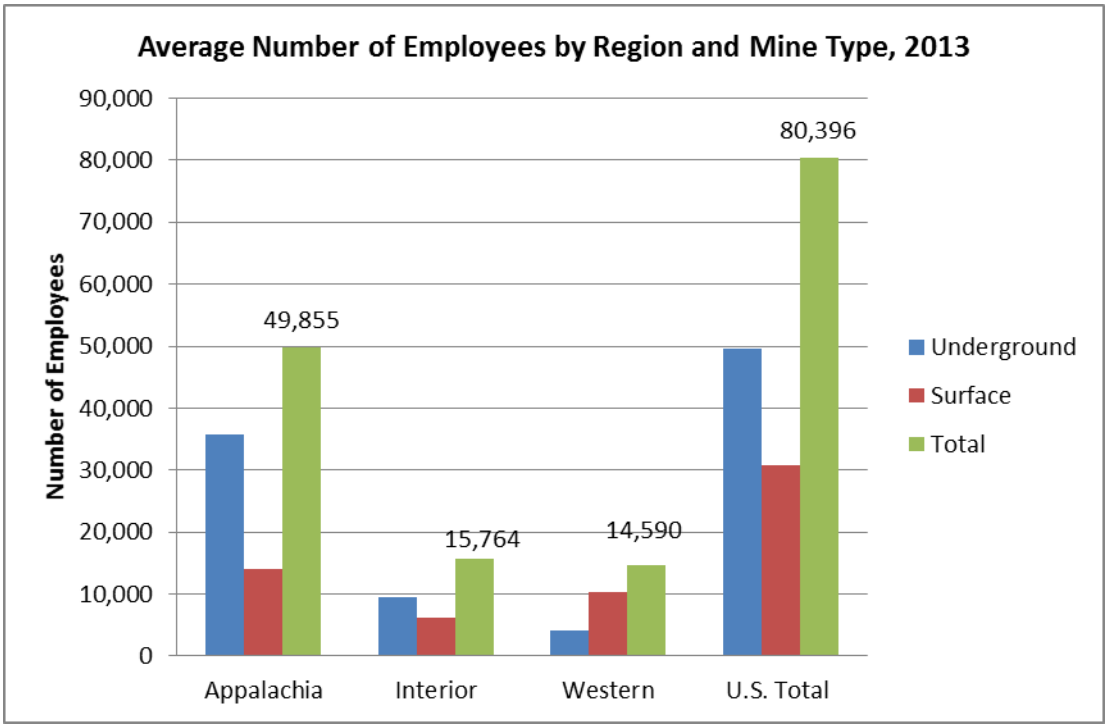


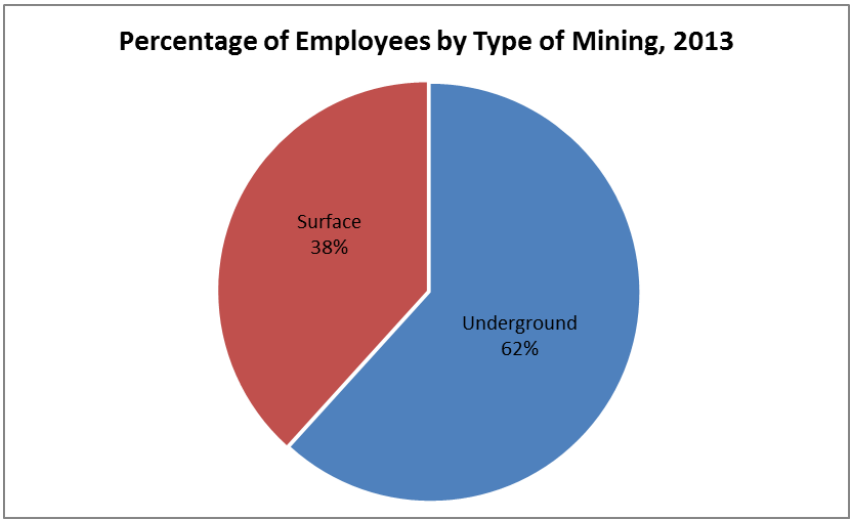
Figure A-11: Average Number of Employees by Region and Mine Type, 2013

Sources:

U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

Figure A-12: Percentage of Employees by Type of Mining, 2013



Sources:

U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

U.S. Department of Labor, MSHA Form 7000-2, "Quarterly Mine Employment and Coal Production Report."

Coal mining is one of the higher paid industries in the U.S. The average wage for coal mining in 2013 was $82,058 which is 40 percent higher than that for all industries combined (see Table A-1). This difference is highest in Kansas (over 62 percent), followed by Montana (58 percent) and New Mexico (57 percent).

Table A-1: Annual Coal Mining Wages vs. All Industries, 2013

State	Avg. Wages for Coal Mining	Avg. Wages for All Industries	% Difference b/w Coal Mining and All Industries Wages
Alabama	$89,262	$41,399	53.6%
Alaska	$85,000	$50,624	40.4%
Colorado	$84,036	$51,124	39.2%
Illinois	$85,399	$52,625	38.4%
Indiana	$82,827	$41,792	49.5%
Kansas	$113,602	$42,294	62.8%
Kentucky	$72,779	$40,584	44.2%
Maryland	$62,139	$51,928	16.4%
Montana	$87,748	$36,499	58.4%
New Mexico	$92,551	$39,660	57.1%
North Dakota	$93,905	$48,740	48.1%
Ohio	$75,613	$44,059	41.7%
Pennsylvania	$80,021	$48,785	39.0%
Tennessee	$64,207	$44,273	31.0%
Texas	$81,588	$52,146	36.1%
Utah	$75,430	$41,702	44.7%
Virginia	$76,664	$51,665	32.6%
West Virginia	$84,959	$39,519	53.5%
Wyoming	$82,654	$44,699	45.9%
United States	$82,058	$49,700	39.4%

Notes:

Data for all industries are for private industry only and also exclude oil and gas extraction.

Wages for Alaska and New Mexico are estimated and based on preliminary data.

Source:

U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages.

A.1.6 Prices

Coal prices in the U.S. have remained relatively stable during the past 40 years. The two noteworthy instances of increasing coal prices were the 1973 oil embargo and the 2003-2004 growing coal demand in China, both external factors (see Figure A-13). The decline in coal prices between 1975 and 2000 largely reflect the improved labor productivity due to shift of coal mining to areas with higher productivity, such as the Western region. Improved technology and better management have also played roles in improving the cost-effectiveness of mining and, consequently, lowering the price.

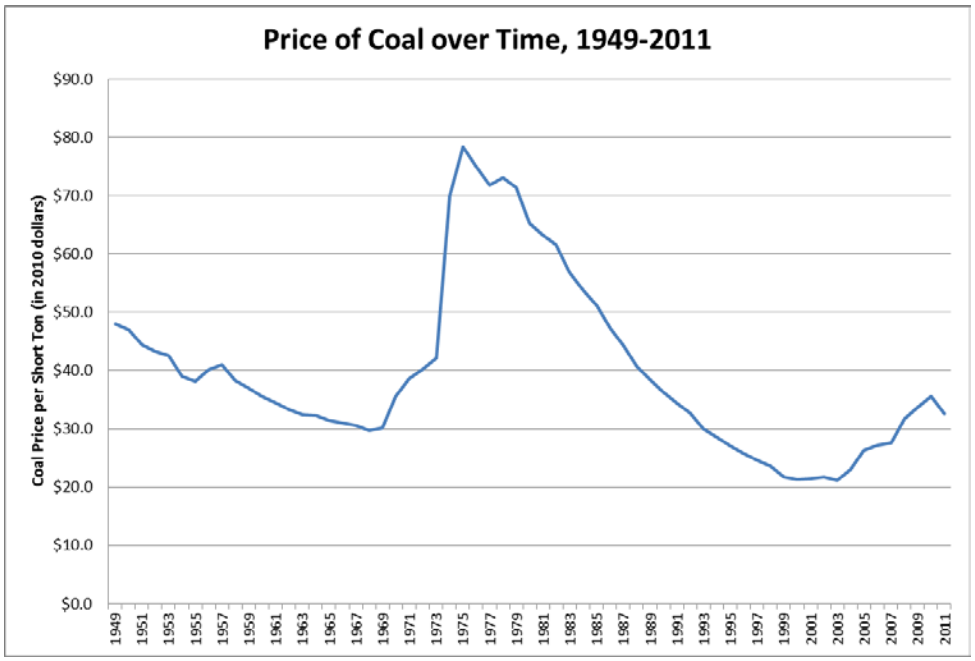


Figure A-13: Price of Coal over Time, 1949-2011

Source: U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

Several factors affect the price of coal, the key ones being quality and rank (based on characteristics such as sulfur content and heat value), end use, mining method, size of mine, transportation costs, and accessibility to reserves (see Table A-2). While on the one hand, reserves in the Appalachian region are becoming increasingly harder and more expensive to access due to mining over the years, those in the Western region are abundant, easier to mine and, thus, have lower production costs. These, in turn, render coal produced in the Appalachian region more expensive. Western coal also has lower sulfur content, which makes it more attractive and cost-effective for power plants that are faced with regulations limiting sulfur-dioxide emissions. Coal in the Powder River Basin within the Western region generally has lower heat value, and power plants have to blend it with coal with higher heat value in order to use it. These factors make the price of Western coal lower in the market.

In 2013, the average sales price per short ton of coal in the U.S. was $37.24 (in 2013 dollars). Coal produced through underground mining was priced at $60.98 per short ton (in 2013 dollars) on average, while that produced from surface mines fetched $24.50 per short ton (in 2010 dollars).[12] In terms of end use, coal sold to power plants was priced, on average, at $45.03 per short ton (in 2010

[12] U.S. DOE/EIA. Annual Coal Report. Released April 23, 2015

dollars), while that for other industrial plants at $69.16 per short ton (in 2010 dollars). Metallurgical coal used for the production of steel fetched the highest average price at 156.99 per short ton (in 2010 dollars), followed by commercial and institutional uses at $90.51 per short ton (in 2010 dollars).[13]

Table A-2: Characteristics of Coal and their Effects on Relative Prices by Region

Coal Producing Region	Sub-Region	States Included	Rank of Coal Primarily Produced	Heat Value	Sulfur Content	Relative Prices
Appalachia	Northern Appalachia	Maryland; Ohio; Pennsylvania; Northern West Virginia	Anthracite; Bituminous	High 10,300 Btu – 13,500 Btu	High 0.8% – 4.0%	Higher than other regions
	Central Appalachia	Eastern Kentucky; Tennessee (part); Virginia; Southern West Virginia	Bituminous	High 11,400 Btu – 13,200 Btu	Low 0.2% – 2.0%	Higher than other regions
	Southern Appalachia	Alabama; Tennessee (part)	Bituminous	High 11,300 Btu – 12,300 Btu	High 0.7% – 3.0%	Higher than other regions
Interior	Illinois Basin	Illinois; Indiana; Western Kentucky	Bituminous	Higher 10,100 Btu – 12,600 Btu	High 1.0% – 4.3%	Lower than Appalachia; Higher than Western
	Other Coal Producing States in the Region	Arkansas; Kansas; Louisiana; Mississippi; Missouri; North Dakota; Oklahoma; Texas	Sub-bituminous; Lignite			Lower than Appalachia; Higher than Western
Western	Powder River Basin	Northeastern Wyoming; Southeastern Montana	Sub-bituminous	Low 8,000 Btu – 9,500 Btu	Low 0.2% – 0.9%	Generally lower than other regions
	Western Bituminous Region	Southern Wyoming; Colorado; Utah	Bituminous	Higher 10,000 Btu – 12,200 Btu	Low 0.4% – 0.8%	Generally lower than other regions

[13] U.S. Department of Energy/Energy Information Administration. Annual Coal Report 2013. Released April 23, 2015.

A.2 Economic Contribution of Coal Mining

In addition to the improved output and employment generated by coal production, the sector also contributes to the national economy through:

Indirect linkages to input suppliers that in turn improve output and employment in those sectors;

1. Improved household spending income generation that in turn stimulates retail industries;
2. State and local tax revenue and royalties;
3. Links to transportation and other support sectors; and
4. Forward linkages to utilities and industries that use coal such as steel production.

This section provides a discussion of the ways that such linkages have been measured, and reports estimates of the overall economic impact of the coal sector where possible.

A.2.1 Direct, Indirect, and Induced Impacts

Economic contribution of coal mining production is captured through the direct impact coal mining creates through the hiring of labor and expenditures on equipment and the subsequent indirect and induced impacts stemming from the circulation of money through the economy. For many counties in the United States, coal mining represents a base sector. This means the employment and expenditures generated from coal mining stimulate economic activity in sectors that support the industry. These different impacts are categorized into direct impacts, indirect impacts, and induced impacts. Together, they sum up to the total economic impact from coal mining.

5. Direct impacts capture the employment and spending resulting from coal mining activities that is injected into the local economy. This impact is created from the firms that operate coal mines.
6. Indirect impacts measure the response of local supplies to the demand for equipment and materials from inter-industry transactions. The indirect impacts trace the ripple effect through the local economy. As coal firms demand materials and equipment for mining, the industries that support coal increase their demand from upstream supplies as well.
7. Induced impacts measure the response of local industries to the expenditures resulting from household spending. Income generated and attributable to coal mining and the industries along the supply chain is spent throughout the local economy on household consumption.

Economic impact studies employ input-output modeling which provides estimated multipliers that can be used to determine the total impact resulting from a new project, policy or economic activity. Input-output modeling traces the inter-connected industries through a local economy and produces multipliers which measure, for example, the resulting total impact in a region given a $1 direct contribution from a coal firm. Multipliers are a function of the structure of the local economy and to what degree coal mining is interconnected with industries inside the region. Therefore, the more diverse a local economy is, the greater the region will be able to retain and circulate the funds generated from coal mining.

A survey of six recent coal mining studies provide a baseline for understanding the total economic impacts and multiplier effect resulting from direct spending and hiring from coal firms. The various studies examined the impact for coal mining in different regions of the country including regions such as Appalachia, Illinois Basin, and New Mexico. Table A-3 summarizes the economic impacts found in these studies. The study by Thompson (2001) that examines the Appalachia region estimated the smallest multiplier although the volume of output was the largest. The total multiplier is 1.49, meaning that one dollar of direct output generates $0.49 in the related area. In other words, the direct output represents 67% of the total impact. This study, however, only included counties that were located in Appalachia and did not include impacts occurring at the state level. In general, the larger the study area, the larger the expected multiplier because a larger portion of the economic 'ripple effect' is included. This may be seen in the multiplier estimates for Pennsylvania and West Virginia which show much larger multipliers – 2.3 and 2.65 respectively - than the multiplier estimated for Appalachian counties. The estimated multipliers for the Illinois Basin and New Mexico

are slightly larger than the estimated multiplier for the total Appalachia region indicating a relatively more economically diverse area. The Alaska study (McDowell Group 2013) included the direct output impacts but did not provide any indirect or induced (or related multiplier). The focus for the Alaska study was with employment and labor wages.

Table A-3: Output Impact by Study and Region (2014 Dollars)

Study	Study Region	Direct	Indirect & Induced	Total	Multiplier
Thompson et al (2001)	Appalachia	$18.35 billion	$9.03 billion	$27.38 billion	**1.49**
Sparrow (2009)	Illinois Basin	$1,610.9 million	$1,014.8 million	$2,625.7 million	**1.63**
Peach (2009)	New Mexico	$772.1 million	$419.3 million	$1,191.3 million	**1.54**
Penn Economy League (2010)	Pennsylvania	$3.41 billion	$4.44 billion	$7.85 billion	**2.30**
Bureau of Business and Econ (2010)	West Virginia	$8.22 billion	$13.57 billion	$21.82 billion	**2.65**
McDowell Group (2013)	Alaska	$50.7 million	-	-	**-**

A.2.2 Value Added Approach

Value added is a slightly different way to measure the contribution of one industry to an economic system. 'Value added' is the portion of the estimated economic output that enters GDP directly. It is equal to output less the cost of inputs used in the production of coal. This measures the amount of new value that is added which is entirely generated by the production process. The estimated multipliers here also reflect the total value added in the economy given $1 of value added through production. Only two of the six studies reviewed reported estimates for value added from coal production. Both studies covered state- level impacts, and by comparing the direct output estimates (see Table A-3) with the value added portion (see Table A-4) it becomes clear that the value added portion is approximately 55% of the total direct impact. The total multiplier, based on the value added portion of production was estimated to be 1.59 and 1.46 for New Mexico and West Virginia respectively. Although the result for West Virginia had a slightly smaller multiplier, the state generated a much larger volume of production leading to nearly 10 times the estimated value added when compared to New Mexico.

Table A-4: Value Added Impact by Study and Region (2014 Dollars)

Study	Study Region	Direct	Indirect & Induced	Total	Multiplier
Thompson et al (2001)	Appalachia	-	-	-	**-**
Sparrow (2009)	Illinois Basin	-	-	-	**-**
Peach (2009)	New Mexico	$424.2 million	$215.7 million	$674.3 million	**1.59**
Penn Economy League (2010)	Pennsylvania	-	-	-	**-**
Bureau of Business and Econ (2010)	West Virginia	$4.48 billion	$2.06 billion	$6.54 billion	**1.46**
McDowell Group (2013)	Alaska	-	-	-	**-**

A.2.3 Employment Impact Review

Employment impacts are the numbers of jobs that are within, and are attributable to the coal mining industry. Although the estimates in the studies focus on coal production in general within a region, employment and labor requirements vary between underground and surface coal production due to different production methods. For example, underground coal mining requires more labor than surface coal mining (Thompson 2001). Another significant factor is coal seam thickness. Coal seams out west in the Powder River basin are very thick, and therefore allow for a much higher productivity rate. A quick demonstration of this is seen in the following chart showing the number of workers used to produce 1 million tons of coal in different areas of the country (see Figure A-14). In Appalachia, more than 180 workers are needed, while in Western region, the same figure is just over 20.

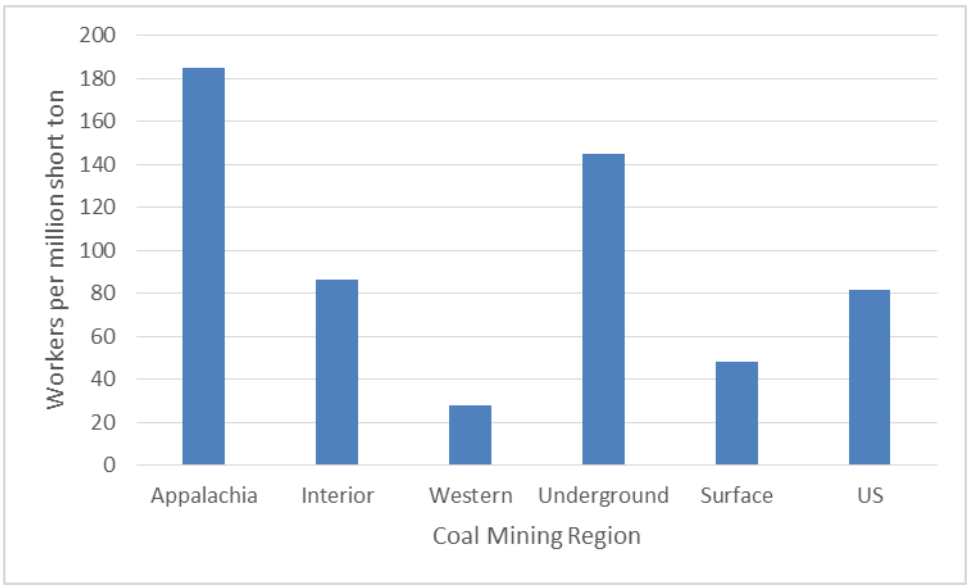


Figure A-14: Jobs per Million Tons of Coal by Region
Source: Estimates based on data from U.S. Department of Energy/Energy Information Administration. Annual Coal Report. Released April 23, 2015.

Returning to the employment multiplier, the results from different studies naturally vary, with the estimates ranging from 2.24 to 4.77 (see Table A-5). The difference in the estimates has to do with the composition of the regional economy, and the way direct, indirect, and induced results are measured. The study from Pennsylvania shows a much higher impact from employment, with a multiplier of 4.77. This could be the result of a highly diversified economy. Furthermore, the large multiplier can be attributed to only including employees directly in coal and not counting direct support or contractors. These jobs are then captured in indirect and induced effects resulting in a much larger multiplier. Pennsylvania and West Virginia (which are located in the Appalachia region) contributed over 40,000 total jobs. New Mexico although having the second largest multiplier contributed the smallest portion of jobs total. The Alaska study provides an additional multiplier for "forward linkages", which includes coal-fired power plant employment. When these are included in the impact analysis, the total multiplier is 4.84. The multipliers presented in Table A-5 represent only the backward linkages for consistency.

Table A-5: Employment Impact by Study and Region					
Study	**Study Region**	**Direct**	**Indirect & Induced**	**Total**	**Multiplier**
Thompson et al (2001)	Appalachia	60,000 jobs	73,000 jobs	143,000 jobs	**2.38**
Sparrow (2009)	Illinois Basin	-	-	-	**-**
Peach (2009)	New Mexico	1,390 jobs	1,903 jobs	3,293 jobs	**2.37**
Penn Economy League (2010)	Pennsylvania	8,724 jobs	32,853 jobs	41,577 jobs	**4.77**
Bureau of Business and Econ (2010)	West Virginia	20,500 jobs	25,600 jobs	46,000 jobs	**2.24**
McDowell Group (2013)	Alaska	143 jobs	327 jobs	470 jobs	**2.5**

A.2.4 Current National Economic Impact

National estimates of impacts are provided by a 2014 study by the National Mining Association (NMA), which addressed several types of mining impacts for the entire U.S., including the specifics of coal mining. The study approached impacts using IMPLAN® (IMpact analysis for PLANning), an economic input-output impact modeling system. The IMPLAN system allows researchers to estimate impacts based on data from the local economy. The estimated multipliers in the NMA study allow for impacts to cross state boundaries and therefore capture the full economic impact occurring inside the United States. The estimated multipliers from the PWC report are used later in this analysis of the impacts associated with the Stream Protection Rule.

The NMA study reported results using the value added, or contribution to GDP approach. Table A-6 summarizes the estimated contribution to GDP by region and also presents the total of the three regions analyzed in this study as well as the total impact to the national economy. The Appalachia region contributes an estimated $35.6 billion annually to GDP which is over 40% of the total contribution to the national GDP. The Interior region has the largest estimated multipliers. The multiplier estimates suggest that for every dollar in direct contribution to GDP, the total contribution to GDP is estimated to be $2.79. This multiplier is capturing impacts across all states from the Interior region, and all of the impact will not necessarily occur within the Interior region. The Western region has the least total economic impact out of the three coal mining regions. This can be attributable to a relatively lower direct impact, but also a smaller multiplier than the national average and the average of the three coal mining regions signifying a relatively less diverse regional economy. The estimated multiplier for all three coal mining regions is 2.05 which is just under the estimated multiplier for the full country. This means there are substantial impacts occurring in other parts of the country that are not being captured inside the coal mining regions.

Table A-6: Contribution to GDP by Region (in 2012 Dollars)				
Region	**Direct**	**Indirect & Induced**	**Total**	**Multiplier**
Appalachia	$18,665 million	$16,701 million	$35,635 million	**1.89**
Interior	$6,677 million	$11,944million	$18,624 million	**2.79**
Western	$7,502 million	$5,853 million	$13,359 million	**1.78**
Total of Regions	$32,844 million	$34,498 million	$67,348 million	**2.05**
US Total	$33,122 million	$50,034million	$83,156million	**2.51**
Data Source: National Mining Association (NMA). 2014. The Economic Contributions of U.S. Mining (2012), September.				

A.2.5 Current Employment Impacts

Employment measures the number of jobs that exist and are attributable to the coal mining industry. Table A-7 reports the estimated multipliers and employment for each region developed in the report by the NMA. The national multiplier suggests a total of 3.62 jobs in the national economy for every 1 job directly in the coal mining industry. Again, there is variation in the degree of impact across regions and associated mining methods. Appalachia captures the largest direct impact to employment making up nearly 61% of the total employment contributed between the three coal mining regions. In addition, the Appalachia region also captures the majority of the total employment even though it has the lowest multiplier. The largest multiplier was seen for the Interior coal mining region. This could be related to a more diverse regional economy. The multiplier estimates for every direct coal mining job, an additional 2.29 jobs are created through indirect and induced effects. This means that although the Interior region only captures 22% of the direct employment between the three regions, it generates nearly 29% of the total employment impact. Western region contributes the least total employment impact amongst the three regions making up only 17% of the total employment. However, the Western region does carry a slightly larger multiplier than the average of the three regions signifying a relatively more diverse economy than average. Similar to contribution to GDP, the estimated multiplier for the three coal mining regions is 2.95 which is less than the estimated multiplier for the nation. This means, there are impacts occurring to employment that are not captured within the three coal mining regions and imply additional impacts to employment.

In this study by the NMA, the 'direct' job category includes jobs in the related industries of transportation and other contractors and support industries (see Section A.2.6). For this reason, the number of direct jobs reported in the nation – 195,490 – is larger than the number of employees within the coal sector according to MSHA data reported in Section A.1.5. The number of jobs directly generated by the mining industry in that estimate was 103,312 in 2010.

Table A-7: Contribution to Employment by Region				
Region	**Direct**	**Indirect & Induced**	**Total**	**Multiplier**
Appalachia	118,065	192,210	310,275	**2.63**
Interior	43,545	121,380	164,925	**3.79**
Western	32,160	64,080	96,240	**2.99**
Total of Regions	193,770	377,670	571,440	**2.95**
US Total	195,490	512,650	708,140	**3.62**
Data Source: National Mining Association (NMA). 2014. The Economic Contributions of U.S. Mining (2012), September.				

A.2.6 Transportation and Supporting Service Employment

The three transportation modes primarily used for domestic coal shipments in the U.S. include rail, truck and river. Most of the coal delivered to U.S. consumers is transported by railroads, which accounted for 68 percent of total domestic coal shipments in 2013 (see Table A-8). Rail transportation is used primarily for transportation due to the long distances coal needs to travel. Trucks are used for short distances and make up 11 percent of the transported coal consumed. Finally, river transportation made up 13 percent of coal transported on inland waterways. In addition, tramways, conveyors, and slurry pipelines (where the coal is mixed with water, pumped, and then separated at the destination) are used over smaller distances and represents only 8 percent of transportation. Finally, transportation across the Great Lakes and tidewater piers represent the least used for of transportation and account roughly around 1% each.

The average rate for transporting the three primary modes range from roughly $21 to $5 per ton. Specifically, the estimated rate for transporting coal by rail is $20.93. This results in an average transportation cost of coal by rail of $12,194,676 each fiscal quarter. The estimated rate for transportation by barge is $5.68 per ton which is $614,065 per fiscal quarter. Finally, the estimated rate for transporting coal by truck is $6.36 per ton which results in $625,334 per fiscal quarter.

Table A-8: Mode of Transportation and Millions of Short Tons per Shipment per Fiscal Quarter (2013)		
Mode of Transported	**% of Total Transportation**	**Average Tons per Shipment per Fiscal Quarter**
Rail Road	68%	582,641
River	13%	108,110
Truck	11%	98,323
Tramway, Conveyor, and Slurry Pipeline	8%	68,824
Great Lakes	1%	337
Tidewater Piers, Ocean Vessel	1%	90
Data Source: U.S. Energy Information Administration. Annual Coal Distribution Report. http://www.eia.gov/coal/distribution/annual/		

Furthermore, transportation generates its own economic contributions and impacts. PWC found that transportation comprises over 61,000 direct employees annually. In addition, the Bureau of Business and Economic Research in West Virginia found rail transportation for coal contribute directly to 2,700 jobs leading to 6,200 jobs total in the local economy. Water transportation directly contributed 600 jobs generating a total of 1,700 jobs. The total output impact resulting from transporting coal by rail in West Virginia was estimated at $2,609.6 million with value added capturing 31% of total output. Finally, water transportation of coal generated $768.8 million in total output impacts in West Virginia with value added capturing 20% of the total output.

A.2.7 Taxes to Federal, State, and Local Governments

Economic activity provides an opportunity for federal, state, and tribal governments to collect funds for publically provided benefits such as health care and national parks. Coal mining has been a source of income for governments for many years, and governments may now depend on these funds. The NMA study reported direct taxes paid by the coal mining industry that total over $18.6 billion, but did not report indirect and induced funds for tax impacts resulting from coal mining. For the purpose of this analysis, multipliers were derived using the total contribution to GDP by state and the total taxes paid by state resulting from coal mining provided in the NMA study. Multipliers vary between region due to economic linkages and the indirect and induced activity that generates taxable funds. Results for federal tax impacts are reported in Table A-9 and results for state tax impacts are reported in Table A-10.

The results indicate that although Appalachia has the second smallest federal tax multiplier, the region represents the estimated largest contributor to federal taxes out of the three regions providing nearly half of the total taxes combined ($5,105 million). This is followed by the Interior region which contributed a slight larger portion of total federal taxes than the Western region. The Interior region has the largest multiplier which is expected given that the region also has the largest multiplier for value added and employment. The total estimated federal taxes attributable to coal mining that is paid between the three coal mining regions is more than $8 billion dollars annually.

Similar with federal taxes, Appalachia has a smaller multiplier although it contributes more than half of the total estimated state taxes. This is followed by the Western region which contributed slightly more state taxes than the Interior region. The Interior region has the largest multiplier which is expected given that the region also has the largest multiplier for value added and employment. The total estimated state taxes attributable to coal mining that is paid between the three coal mining regions is nearly $6.5 billion dollars annually. The total state and federal taxes paid between the three coal mining regions sums up to $15 billion annually. The NMA estimated a national contribution to state and federal taxes of $18 billion annually. This indicates that additional tax impacts will occur outside of the three coal mining regions.

Table A-9: Federal Taxes by Region (in 2012 Dollars)				
Region	**Direct**	**Indirect & Induced**	**Total**	**Multiplier**
Appalachia	$2,706 million	$2,399 million	$5,105 million	**1.89**
Interior	$584 million	$1,306 million	$1,887 million	**3.23**
Western	$901 million	$713 million	$1,614 million	**1.79**
Total of Regions	$4,191 million	$4,418 million	$8,606 million	**2.05**
US Total	$4,226 million	$6,555 million	$10,781 million	**2.55**
Data Source: National Mining Association (NMA). 2014. The Economic Contributions of U.S. Mining (2012), September				

Table A-10: State Taxes by Region (in 2012 Dollars)				
Region	**Direct**	**Indirect & Induced**	**Total**	**Multiplier**
Appalachia	$2,173 million	$1,704 million	$3,877 million	**1.78**
Interior	$394 million	$857 million	$1,251 million	**3.18**
Western	$793 million	$537 million	$1,330 million	**1.68**
Total of Regions	$3,360 million	$3,098 million	$6,458 million	**1.92**
US Total	$3,382 million	$4,474 million	$7,856 million	**2.32**
Data Source: National Mining Association (NMA). 2014. The Economic Contributions of U.S. Mining (2012), September.				

A.2.8 Royalties and Lease Payments to Federal and Tribal Governments

Coal mining operations that occur on Federal Government land or on Native American land must be leased. Furthermore, these lands receive royalties that are a proportion of total coal sales. A lease can be acquired after an evaluation and planning process has been reviewed in order to determine if the land is suitable for coal mining development. The Bureau of Land Management (BLM) is responsible for leasing lands where the coal mineral is owned by the Federal Government. The BLM collects revenues on coal leasing from (1) a bonus that is paid at the time the BLM issues the lease through a competitive leasing process, (2) royalties paid on the value of the coal after it has been mined and, (3) an annual rental payment of $3.00 per acre. The size of the bonus is determined through a competitive bidding process. Once land that is suitable for coal development is identified by the BLM, the BLM begins a leasing process and formulates an estimated "fair market value" of the coal which is kept confidential. Sealed bids are accepted and the winning bid will be the highest bid that meets or exceeds the coal's presale estimated fair market value. The bid value is known as the bonus. The royalty paid for federal coal is established by law to be 12.5% of the gross value of surface coal produced and 8% of the gross value of underground coal produced. Finally, the $3 per acre is required annually.

The payments to Native American lands follow the same process as Federal Government lands. All coal produced on Native American lands are subject to royalties determined by the BLM. This

means, the rate of 12.5% of the gross value of surface coal produced and 8% of the gross value of underground coal produced apply. Furthermore, a bonus and rent is paid to Native American lands. There are 308 leases on Federal lands, with 475,171 associated coal producing acres . Looking at Federal lands alone, the total rent collected at $3 per acre was $1,296,355. Table A-11 details the royalty revenue collected for Federal and Native American lands. The tons produced on Federal lands were about 20 times the tons produced on Native American lands. In addition, the royalty collected on Federal lands was roughly 10 times the royalty collected on Native American coal producing lands. This can be related to a higher price for coal collected on Native American lands and also whether the coal was surface coal which collects a larger rate. The total royalty paid by coal firms is $770 million. Finally, Table A-12 presents the total payments made to Federal lands and Native American lands. The total includes the bonus and rental rates which adds an approximately $471 million to the total payments from coal firms on top of royalties.

Table A-11: Production and Royalties (Fiscal Year 2014)

Land Owner	Tons Produced	Sales Volume	Royalty Revenue
Native American	18,852,002	$606,400,806	$69,916,904
Federal Government	404,919,443	$6,756,994,102	$699,641,723
Total	**423,771,445**	**$7,363,394,908**	**$769,558,627**

Data Source: Office of Natural Resources Revenues.
http://www.onrr.gov/ONRRWebStats/Home.aspx

Table A-12: Total Payments (Fiscal 2014)

Land Owner	Native American	Federal Government	Total Payments
Total Funds	$89,118,405	$1,151,710,084	$1,240,828,489

Data Source: Office of Natural Resources Revenues. http://www.onrr.gov/ONRRWebStats/Home.aspx

A.2.9 Forward Linkages: Coal and Electricity Consumers

Coal production and costs are factors that influence the price of coal, which in turn has the potential to influence the buyers of coal – many of which are electric utilities. Hence just as there are backward economic linkages from coal production to the suppliers of inputs to the industry, coal customers are among the forward linkages to coal production, and these sectors too are potentially affected by changes in the supply structure. This section covers the background and explanation for understanding the relationship between coal production and electricity prices.

U.S. average end-user electricity prices were relatively stable in the 1990's, ranging between a low of 6.51 cents per kilowatt-hour (cents/kWh) in 1990 and a high of 6.93 cents/kWh in 1993, followed by a rapid increase between 2001 (7.29 cents/kWh) and 2008 (9.74 cents/kWh), as shown in Figure A-15. Since 2008, prices have slowly risen, with an average price of 10.96 cents/kWh in July 2015.

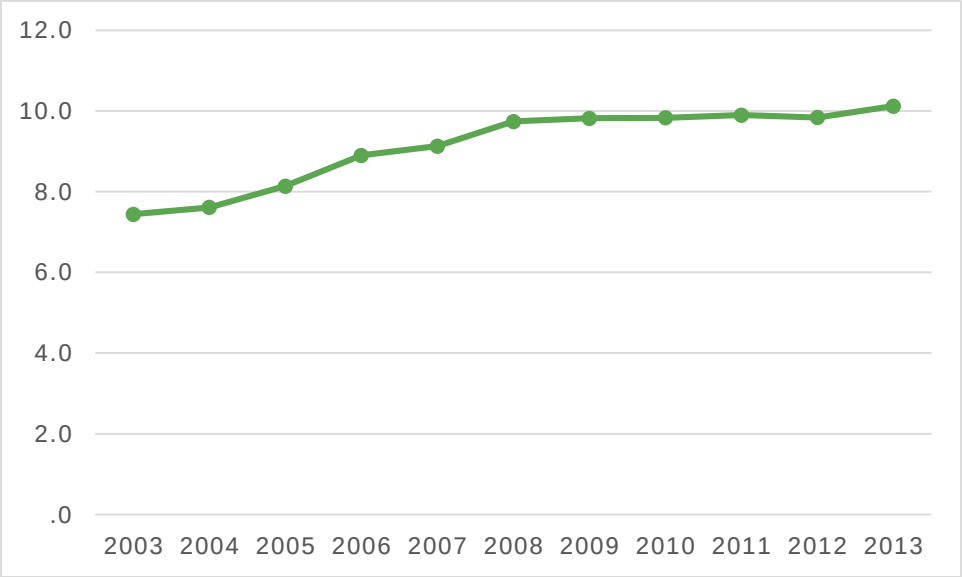


Figure A-15: Total US Electric Historical Price in cents/KWH
Source: Energy Information Administration (EIA), Average Retail Price of Electricity to Ultimate Customers by End-Use Sectors 2003 through 2013. Table 2.4. Released August 26, 2015.

A.2.9.1 Regional Differences in Electricity Prices

The EIA divides the U.S. into nine regions: New England, Middle Atlantic, E.N. Central, W.N. Central, S. Atlantic, E.S. Central, W.S. Central, Mountain, and Pacific. Prices between these regions can vary widely. In 2015, New England had the highest average total electricity price of 15.49 cents/kWh. The W.S. Central region had the lowest average price of 8.62 cents/kWh. The W.S. Central region includes Arkansas, Louisiana, Oklahoma, and Texas. Table A-13 shows the July 2015 prices for each region.

Table A-13: Average Regional Electricity Price for All Sectors (cents/kWh)

Region	July 2015
New England	15.49
Middle Atlantic	13.62
E.N. Central	10.28
W.N. Central	10.42
S. Atlantic	10.54
E.S. Central	9.42
W.S. Central	8.62
Mountain	10.27
Pacific	14.46
U.S. Average	10.96

Source: Energy Information Administration (EIA), Table 5.6.A. Average Price of Electricity to Ultimate Consumers by End-Use Sector. Available at http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a Updated September 24, 2015. Note: Alaska and Hawaii excluded.

A.2.9.2 Drivers of Electricity Prices

Electricity prices are driven by several factors. These include generation (type and quantity produced), fuel (type and cost), emissions (costs and quantity), load (quantity demanded by sector), and transmission and distribution (cost to deliver power). The price of natural gas is one of the strongest drivers of electricity prices and has historically been the most volatile.

A.2.9.3 Deregulation of Electricity

Deregulation of the electricity market is defined as the act or process of removing rules or regulations, and is a decision made by individual states. There are currently 24 electricity deregulated states in the United States. These states are concentrated in the New England, South Atlantic, and Mountain regions, with Pacific, Middle Atlantic, W.S. Central, and E.N. Central also represented. Deregulation generally occurs at the generation level, as compared to transmission or distribution level. Very simply stated, deregulated states have open market competition for the generation portion of electricity service, while transmission and distribution of the electricity remains regulated and local utilities remain distributors of electricity to consumers.

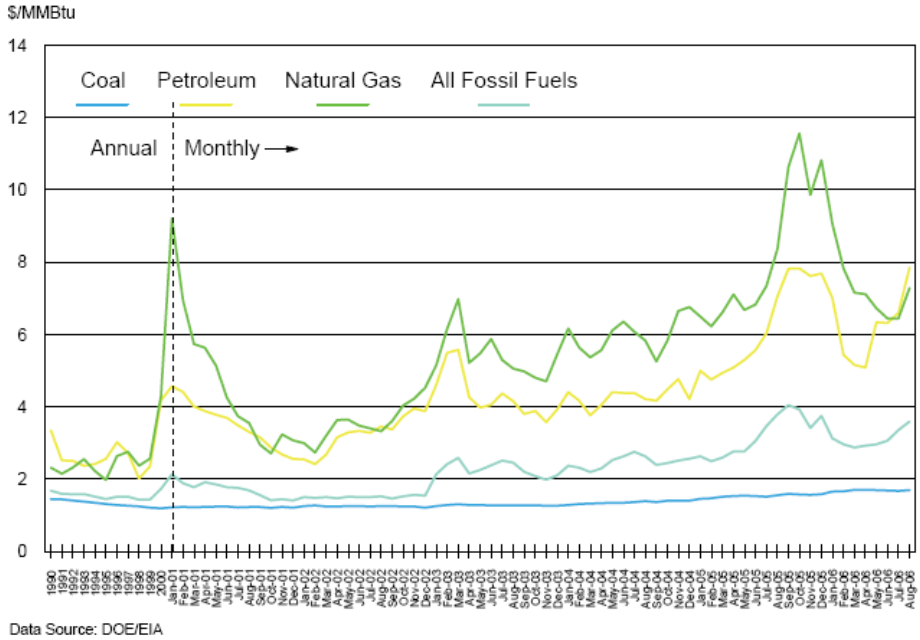
A.2.9.4 The Role of Coal in Electricity Production

In the first half of 2015, coal produced 34 percent of all electricity in the U.S. Approximately 93 percent of all U.S. coal consumption is used for electricity production. The share of coal-fueled electricity is expected to decline by the year 2035, but with the increase in electricity demand, the actual coal expected to be used for fuel will increase.

A.2.9.5 Impact of Coal on the Electricity Market

According to the EIA, the fuel cost of generating one kWh of electricity from coal is much lower than that of natural gas, despite the greater efficiency of some natural gas generating plants compared to coal plants. Further, the historical stability of coal prices through time provides greater certainty than the volatility of natural gas prices. Much of that is due to long-term coal supply contracts in the electricity industry. Coal fuel prices have historically been fairly stable and have much less impact on electricity prices than natural gas. The recent historical increases in electricity costs can be primarily attributed to increased fuel and purchased power costs. They account for virtually the entire rise in operating expenses for electric utilities. In 2005 these costs comprised approximately 71 percent of utility Operations and Maintenance (O&M) costs. Figure 1A below is Figure 1 from “The Impact of Fuel Costs on Electric Power Prices” by Kenneth Rose. It clearly shows how coal fuel prices (in $/MMBtu) have been increasing at a much slower rate than natural gas through 2006, and the overall cost of fossil fuel used in electric generation generally follows the price changes in natural gas and petroleum. EIA’s projected delivered coal fuel costs indicate expected continued increases in the near-term, with longer-term price impacts to the electricity sector more uncertain.

Figure A-16: Cost of Fossil Fuels for Electric Generation



Source: Rose, Kenneth, 2007, The Impact of Fuel Costs on Electric Power Prices, June, available at: http://www.kenrose.us/sitebuildercontent/sitebuilderfiles/impactoffuelcostsonelectricpowerprices_final.pdf, accessed February 9, 2012.

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B. MEMBER EXAMPLE OF IMPACT OF PROPOSED SPR RULE ON LONGWALL MINING

The following series of maps was developed by a member of the National Mining Association. The maps display a portion of an actual longwall mine, and show how the mine plan is altered to avoid perennial and intermittent streams (first) and then altered again to show how the mining company would have to alter the mine plan to avoid perennial, intermittent, and ephemeral streams. In the first map, the intermittent, perennial, and ephemeral streams are identified with different colors see Figure B-1. The purple lines represent perennial streams, the green intermittent, and the light blue represent ephemeral streams. The next map shows how much of the area is no longer mineable due to the streams. The purple area shows the longwall panel area that would not be able to be mined under the rule. In a more severe interpretation of the proposed rule, Figure 3 shows in gold the additional area that would become stranded if ephemeral streams were to be included under the restrictions of the SPR as is under consideration by the OSMRE. In this case only the yellow portions of the coal deposit would still be able to be mined following the original mine plan.

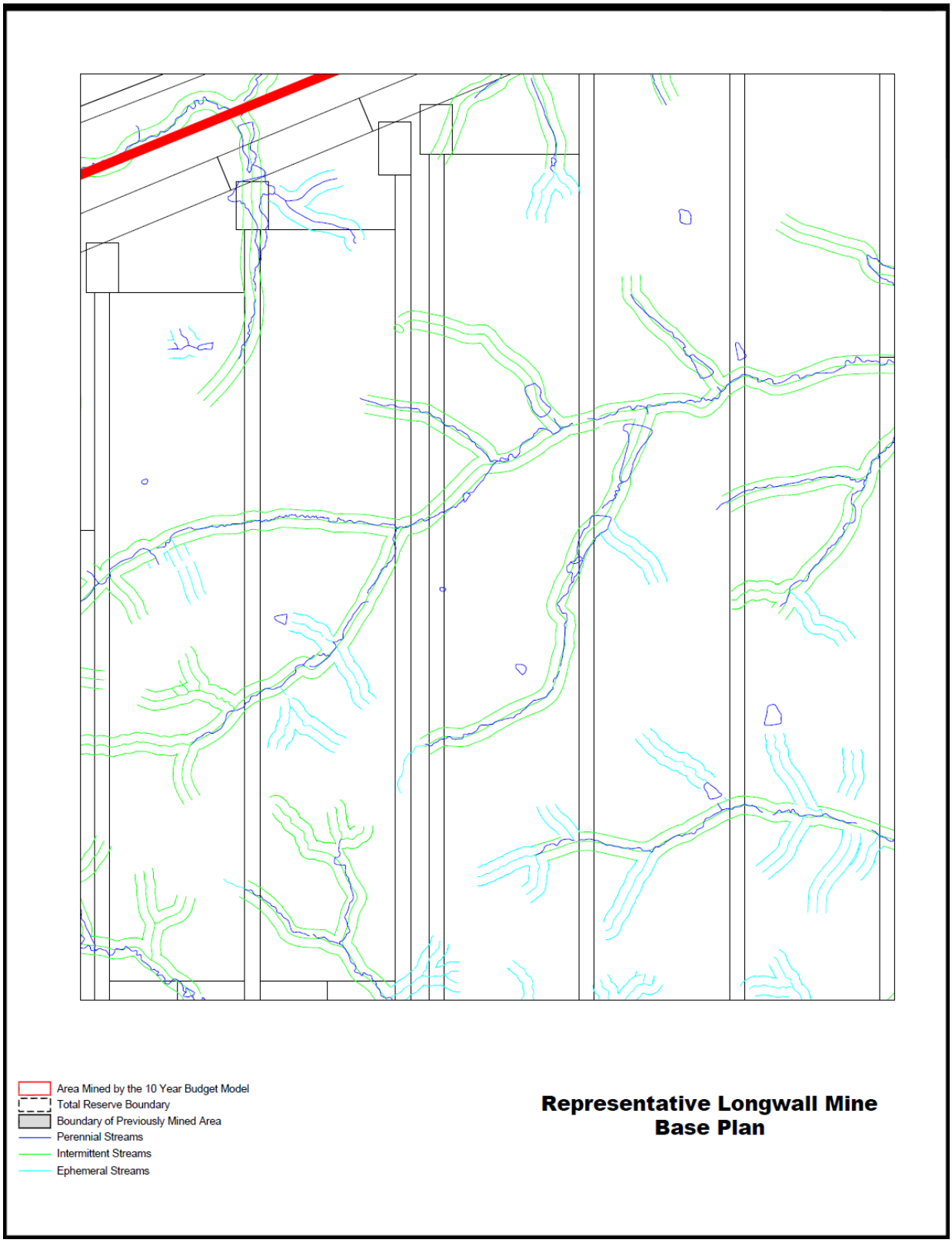

Figure B-1 Mine Plan Going Forward in Absence of SPR

Figure B-2 Mine Plan with SPR including Intermittent and Perennial Streams

Figure B-3 Mine Plan with Proposed SPR including Intermittent, Perennial, and Ephemeral Streams