The Economic Impacts of Coal Utilization and Displacement in the Continental United States, 2015

by

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Report Prepared for
The Center for Energy and Economic Development, Inc.
333 John Carlyle St., Suite 530
Alexandria, VA 22314

July 2006

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Executive Summary

Our analysis shows that, in 2015, U.S. coal production, transportation and consumption for electric power generation will contribute more than $1 trillion (2005 $) of gross output directly and indirectly to the economy of the lower-48 United States. Based on an average of two energy price scenarios summarized below, we calculate that $362 billion of household income and 6.8 million U.S. jobs will be attributable to the production, transportation and use of domestic coal to meet the nation's electric generation needs.

The United States relies heavily on coal to produce electric power. Domestic coal production has expanded from 560 million tons in 1950 to 1.13 billion tons in 2005, while coal consumption for electric generation has increased from 92 million tons to 1.04 billion tons in this period. Historically, coal has provided the lowest cost source of fossil energy in the U.S. Electricity is one of the most prominent commodities traded in the United States, second only to food in annual sales volume.

We based our analysis on state-specific "IMPLAN" input-output tables -- a widely utilized source of data on the composition of state economic activity -- to estimate the basic direct and indirect "multiplier" effects of coal utilization for electric generation. These multiplier effects include the economic impacts of coal mining and of government spending of taxes paid by coal mining for electricity generation, by companies that transport coal, and by coal-fueled electricity generation companies. We calculated results at the state level and compiled regional summaries by dividing the nation into five geographic regions (see Figure S1, below).

The study first presents estimates of the positive economic output, household income, and jobs attributable to projected levels of coal production and utilization in 2015. We used a 2015 base case because electric generation and other projections for this year were readily available from U.S. DOE and U.S. EPA. These estimates measure the "existence" value of coal as the key fuel input into U.S. electricity generation. The analysis includes estimates of the impact of higher electricity rates on individual state economies if utilities were required to utilize fuel sources and generating technologies more costly than coal-based electricity.

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Two Basic Scenarios

Our first scenario includes backward linkage, or demand-side multiplier, effects for coal-fueled electricity generation. Tax payments from coal production, utilization, and transportation subsequently result in government expenditures, which also generate multiplier effects. The analysis also includes the impacts of the favorable price differential attributable to coal-based electricity. This calculation measures the economic activity attributable to relatively cheaper coal in contrast to more expensive alternatives at upper-range ("high") prices for alternative generation sources.

Our second scenario is the same as the first in terms of backward linkages, but we calculated the price differential effects on the basis of lower-range estimates of the prices of alternative fuels and technologies.

The study relied on U.S. DOE Energy Information Administration (DOE/EIA) and other projections of electric generation and delivered coal prices to estimate the impact on energy prices of replacing 100% of projected coal-fueled electricity generation. We estimated the impact of higher energy prices on state economies using a price elasticity estimate of 0.10, meaning that a 10% change in energy costs would induce a 1.0% change in state economic output.

Regional results of the basic "Coal Existence" scenarios are summarized in Table S1 below. Assigning equal weight to each of the two energy price scenarios, we estimate that U.S. coal-fueled electric generation in 2015 will contribute:

- **$1.05 trillion (2005 $) in gross economic output;**
- **$362 billion in annual household incomes, and**
- **6.8 million jobs.**

We also estimated the prospective net economic impacts of the "displacement" of coal-fueled electricity generation at assumed levels of 66% and 33% from a projected 2015 base. These levels of displacement are consistent with some of the potential impacts of major environmental policy initiatives in climate change or other areas. In these cases, we again calculated backward linkage and price differential effects to determine potential negative impacts on each state's economy. Additionally, we calculated potential positive economic benefits due to the operation of replacement electricity generation of various types. In all states, the net effect of displacing coal-based electricity was negative for the "high-price" scenarios, and in nearly all states, the net effect was negative for the "low-price" scenarios.

Regional results of the "Displacement/Replacement" scenarios are presented in Tables S2 and S3. Assigning equal weight to the high- and low-price scenarios, we estimate the average impacts of displacing 66% of coal-fueled generation in 2015 at:

- **$371 billion (2005 $) reduction in gross economic output;**

- **$142 billion reduction of annual household incomes; and**

- **2.7 million job losses.**

Assigning equal weight to the high- and low-price scenarios, we estimate the average impacts of displacing 33% of coal-based generation in 2015 at:

- **$166 billion (2005 $) reduction in gross economic output;**

- **$64 billion reduction of annual household incomes; and**

- **1.2 million job losses.**

These findings are discussed in more detail in the state and regional analyses of the main report. Appendix C contains detailed state and regional results for each of the three displacement cases, including alternative impact estimates for the low and high energy price scenarios.

Figure S1
U.S. Regions Analyzed

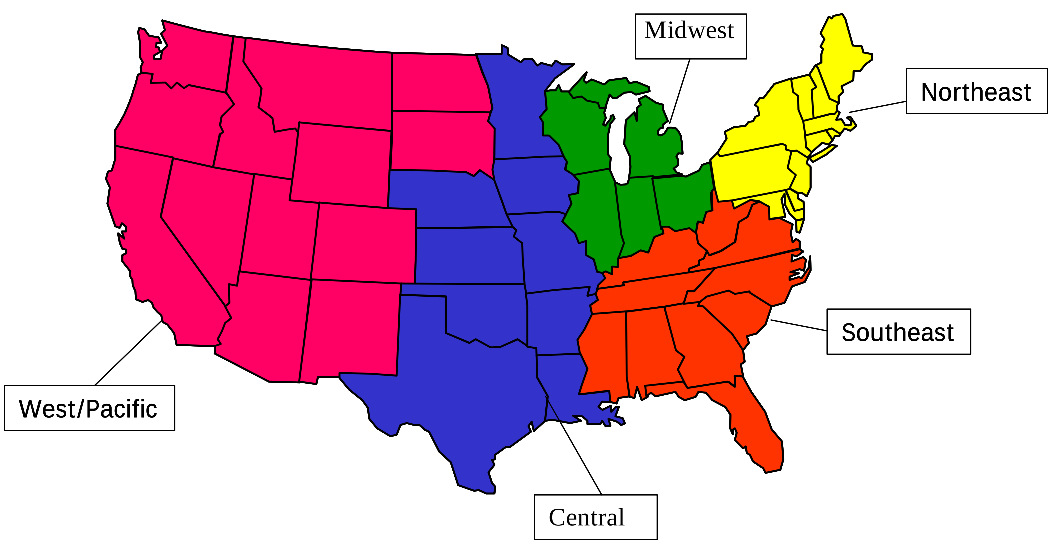

Table S1
Regional Summary of the "Existence" Value of U.S. Coal Utilization in Electric Generation, 2015
(in billions of 2005 dollars and millions of jobs)

Region	*High-Price Alternatives*	*Low-Price Alternatives*	*Average*
Southeast			
Output	$309	$166	$238
Earnings	$106	$55	$80
Jobs	2.2	1.1	1.6
Northeast			
Output	$145	$65	$105
Earnings	$56	$24	$40
Jobs	0.9	0.4	0.6
Midwest			
Output	$409	$199	$304
Earnings	$137	$65	$101
Jobs	2.4	1.2	1.8
Central			
Output	$305	$149	$227
Earnings	$106	$50	$78
Jobs	2.1	1.0	1.5
West			
Output	$213	$135	$174
Earnings	$78	$48	$63
Jobs	1.5	0.9	1.2
48 States			
Output	$1,381	$714	$1047
Earnings	$482	$242	$362
Jobs	9.0	4.6	6.8

Table S2
Regional Summary of the Net Economic Costs of 66% Displacement of Coal-fueled Electric Generation in the U.S., 2015
(in billions of 2005 dollars and millions of jobs)

Region	*High-Price Alternatives*	*Low-Price Alternatives*	*Average*
Southeast			
Output	$116	$20	$68
Earnings	$44	$10	$27
Jobs	0.9	0.2	0.6
Northeast			
Output	$66	$13	$39
Earnings	$27	$6	$16
Jobs	0.4	0.1	0.3
Midwest			
Output	$189	$51	$120
Earnings	$67	$19	$43
Jobs	1.1	0.3	0.7
Central			
Output	$136	$33	$85
Earnings	$51	$14	$32
Jobs	1.0	0.3	0.6
West			
Output	$86	$33	$59
Earnings	$34	$14	$24
Jobs	0.7	0.3	0.5
48 States			
Output	$594	$148	$371
Earnings	$223	$62	$142
Jobs	4.2	1.2	2.8

Table S3
Regional Summary of the Net Economic Costs of 33% Displacement of Coal-fueled Electric Generation in the U.S., 2015
(in billions of 2005 dollars and millions of jobs)

Region	*High-Price Alternatives*	*Low-Price Alternatives*	*Average*
Southeast			
Output	$55	$5	$30
Earnings	$21	$3	$12
Jobs	0.4	0.07	0.3
Northeast			
Output	$31	$4	$18
Earnings	$13	$2	$7
Jobs	0.2	0.03	0.1
Midwest			
Output	$89	$19	$54
Earnings	$31	$7	$19
Jobs	0.5	0.1	0.3
Central			
Output	$66	$13	$39
Earnings	$24	$5	$15
Jobs	0.5	0.1	0.3
West			
Output	$39	$11	$25
Earnings	$16	$5	$10
Jobs	0.3	0.1	0.2
48 States			
Output	$279	$52	$166
Earnings	$105	$23	$64
Jobs	2.0	0.4	1.2

The Economic Impacts of Coal Utilization and Displacement in the Continental United States, 2015

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I. Introduction

This study projects the extent of the likely impacts of coal utilization for electricity generation on the economies of the forty-eight contiguous states in the year 2015. The projection period covers both current coal-related economic benefits and those that may result from the construction of new coal-fueled electric generating capacity.

We first estimate the overall economic benefits associated with the availability of coal as a relatively low-cost fuel resource. This "existence" value reflects the increased economic output, earnings, and employment associated with projected coal utilization for electric generation in 2015. We also estimate the net economic impacts of displacing 33% and 66% of projected coal generation by alternative energy resources, taking into account the positive economic effects associated with alternative investments in oil/gas, nuclear, and renewable energy supplies.

We performed our analysis with the aid of an interindustry, or input-output, model. Specifically, we analyzed how coal-based electric generation affects production (output), household income, and employment in other sectors of each state and the continental U.S. as a whole under three alternative displacement scenarios. Our results indicate that the combination "multiplier" and "price-differential" effects are sizeable, amounting to $1.05 trillion ($2005) in total 48-state economic output for the "existence" of coal as a relatively inexpensive fuel for electricity generation. The results illustrate that government policies and private industry decisions affecting coal-based electric generation potentially can affect every major aspect of the American economy.

The methodology underlying the study is summarized in Section II below, as well as in Appendix A, which also presents major assumptions and some basic computations underlying the analysis. The results for the five regions analyzed are summarized in Section III, with tables of basic data presented in Appendix B and simulation results presented in Appendix C.

We simulated cases where coal-based electricity generation is displaced at levels of 66% and 33% by alternative energy supplies, including natural gas, nuclear, and a 10% mix of renewables, reflecting potential Renewable Portfolio Standards (RPS) that could be in place by 2015. The results indicate that for the nation, and for nearly every state individually, this displacement -- even factoring in positive offsetting multiplier impacts of replacement fuels and technologies -- would have a net negative economic impact. We project that national gross output would decline by $371 billion for the 66% case, and by $166 billion for the 33% case.

II. Methodology

A. Measuring Economic Interdependence

With a broad base and high level of technological advancement, the U.S. economy exhibits a great deal of interdependence. Each business enterprise relies on many others for inputs into its production process and provides inputs to them in return. This means that the coal and coal-based electric utility industries' contributions to the nation's economy extend beyond their own production to include demand arising from a succession of "upstream" inputs from their suppliers and "downstream" deliveries to their customers. The economic value of these many rounds of derived demands and commodity allocations is some multiple of the value of direct production itself. Hence, the coal and coal-based electric utility industries generate "multiplier" effects throughout the U.S. economy.

The first round of demand impacts is obvious--the direct inputs to electricity generation, including coal and primary factors (labor and capital). Subsequent rounds, or indirect demands for goods and services used by the providers of these inputs, however, thread their way through the economy in subtle ways, eventually stimulating every other sector in some way. Likewise, they generate income that is transformed into consumer spending on still more products. All of this economic activity also generates local, state, and federal tax revenues, which, when spent by all three levels of government, creates still more multiplier effects.[1]

B. Measuring Locational Attractiveness

We omitted forward linkages, or supply-side multipliers, from our analysis in this study in contrast to the one performed by Rose and Yang (2002). The premise of the supply-side multiplier is that economic activity is stimulated by "locational attractiveness" characteristics for a state or region, such as the availability of relativity inexpensive coal-fueled electricity. This effect has been documented for electricity and other key inputs (see Blair and Premus, 1987). However, the supply-side multiplier has received significant criticism (cf. Oosterhaven, 1988; Rose and Allison, 1989). The main criticism is that this form of multiplier represents a further extension of a discredited economic theory called Say's Law, which states that supply creates its own demand.[2] Therefore, we omitted supply-side impacts from this study.

Another way to capture the locational attractiveness of a good or service is not to claim the entirety of output of its direct and indirect users, but only an amount relating to the price advantage of the input over its competitors. In this case, we calculate a "price differential" between coal and alternative fuels in electricity production, and then calculate how much economic activity is attributable to this cost saving. For this purpose, we use an economy-wide elasticity of output with respect to energy prices. This measures the percentage change in economic activity with respect to a 1.0 percent change in price. We analyzed a variety of sources of information to arrive at a value of 0.10, meaning that the availability of coal-fueled electricity at a price 10 percent lower than that of its nearest competitor is responsible for increasing total state or regional economic activity by 1.0 percent (see, e.g., Anderson 1982; Hewson and Stamberg, 1996).[3]

III. Economic Impacts of Coal on State and Regional Economies, 2015

To assess the importance of coal to state and regional economies in 2015, we first estimated the level of coal-based electricity generation in each state in 2015 based on projections by DOE/EIA (2006) and EPA (2005). We also assumed that the technological structure of the economy, embodied in individual state input-output tables, would remain unchanged over the projection period to 2015.

We evaluated coal-related impacts according to various assumptions embodied in our scenarios (see Appendix B for further explanation of assumptions).

Scenario Set 1: <u>"Coal Existence" Scenarios</u>

This set of scenarios calculates the positive regional economic output, household income, and jobs attributable to the projected levels of coal-fueled electricity in 2015. These scenarios estimate the "existence" value of coal as the key fuel input into electricity generation in the U.S. The economic impacts of coal that we calculated include two components: 1) the backward linkage, or demand-side multiplier, effects for coal-fueled electricity generation, and 2) the effects of the favorable price differential attributable to the relatively cheaper cost of coal-based electricity.

We first use the 2002 IMPLAN input-output tables to estimate the direct and indirect (multiplier) economic output, household income, and jobs created by coal-fueled electricity generation in each state. In this study, we measure only the minimum backward linkage effects for the "multiplier" effects. This method excludes all forward linkages (all the production that uses coal-fueled electricity directly or indirectly) and focuses only on the factor inputs of coal-based electricity generation, such as fuel and electric generating equipment.

Tax payments from coal mining, coal transportation services, and coal-fueled electricity generation result in government expenditures, which also generate multiplier effects of the conventional demand-driven type. We calculated total personal income and employment impacts of government expenditures by multiplying these total sectoral output changes by their corresponding income and employment coefficients, rather than by direct application of multipliers.

We then evaluated the impacts of a favorable price differential attributable to coal-based electricity. Essentially, we are measuring the economic activity attributable to relatively cheaper coal in contrast to what would take place if a state were dependent on more expensive alternatives, which we assume would be a combination of oil/gas, renewable, and nuclear electricity. Here we perform two calculations: 1) an upper-range ("high") price scenario, and 2) a lower-range ("low") price scenario. These two scenarios have the same backward linkages effects, but different price differential effects based on their different energy price assumptions. We estimated the impact of higher electricity prices on state economies using a price elasticity estimate of 0.10, meaning that a 10% differential in electricity prices causes a 1.0% change in regional economic activity.

Finally, we assigned equal weight to each of the two price scenarios to obtain the average "existence" impacts of coal-fueled electricity generation in 2015. The results of this set of scenarios for each state and region in the year 2015 are presented in the summary tables in Appendix C. An example of the detailed derivation of the price differential effect is presented in Appendix Table B2.

Table 1 summarizes our regional findings for the "existence" value of coal in 2015 for the low and high energy price scenarios, as well as an average of the two price scenarios.

Table 1
Regional Summary of the "Existence" Value of U.S. Coal Utilization in Electric Generation, 2015
(in billions of 2005 dollars and millions of jobs)

Region	*High-Price Alternatives*	*Low-Price Alternatives*	*Average*
Southeast			
Output	$309	$166	$238
Earnings	$106	$55	$80
Jobs	2.2	1.1	1.6
Northeast			
Output	$145	$65	$105
Earnings	$56	$24	$40
Jobs	0.9	0.4	0.6
Midwest			
Output	$409	$199	$304
Earnings	$137	$65	$101
Jobs	2.4	1.2	1.8
Central			
Output	$305	$149	$227
Earnings	$106	$50	$78
Jobs	2.1	1.0	1.5
West			
Output	$213	$135	$174
Earnings	$78	$48	$63
Jobs	1.5	0.9	1.2
48 States			
Output	$1,381	$714	$1047
Earnings	$482	$242	$362
Jobs	9.0	4.6	6.8

Scenario Set 2: <u>66% "Coal Displacement/Replacement" Scenarios</u>

In this set of scenarios, we calculate the net economic impacts of "displacement" of coal-based electricity generation at a level of 66% from the projected 2015 level, and "replacement" by alternative fuel sources and generating technologies. We calculated both the backward linkage and price differential effects as in the "Coal Existence" scenarios. However, in contrast to the first set of scenarios, which only calculate the backward linkage multiplier effects of coal-fueled generation, we include the positive economic impacts due to the operation of replacement electricity generation of various types, i.e., gas/oil-fueled electricity, nuclear electricity, and an electricity generation mix from renewables.

For the 66% coal displacement/replacement level, we perform one scenario that calculates the price differential effects based on upper-range price assumptions. The second scenario has the same backward linkage multiplier effects on both the displacement and replacement sides, but price differential effects based on lower-range price assumptions.

We again assign equal weight to each of these two scenarios. The detailed state and regional results of this set of scenarios for the year 2015 are presented in Appendix C. Table 2 summarizes regional results for the 66% displacement cases.

Table 2
Regional Summary of the Net Economic Costs of 66% Displacement of Coal-fueled Electric Generation in the U.S., 2015
(in billions of 2005 dollars and millions of jobs)

Region	*High-Price Alternatives*	*Low-Price Alternatives*	*Average*
Southeast			
Output	$116	$20	$68
Earnings	$44	$10	$27
Jobs	0.9	0.2	0.6
Northeast			
Output	$66	$13	$39
Earnings	$27	$6	$16
Jobs	0.4	0.1	0.3
Midwest			
Output	$189	$51	$120
Earnings	$67	$19	$43
Jobs	1.1	0.3	0.7
Central			
Output	$136	$33	$85
Earnings	$51	$14	$32
Jobs	1.0	0.3	0.6
West			
Output	$86	$33	$59
Earnings	$34	$14	$24
Jobs	0.7	0.3	0.5
48 States			
Output	$594	$148	$371
Earnings	$223	$62	$142
Jobs	4.2	1.2	2.8

Scenario Set 3: <u>33% "Coal Displacement/Replacement" Scenarios</u>

In this set of scenarios, we calculate the impacts of "displacement" of coal-based electricity generation by 33% from the projected 2015 level, and its "replacement" by alternative generating technologies. The methodologies of calculating the backward linkage multiplier effects and the price differential effects (again, one scenario for the high-price case and one scenario for the lower-price case) are similar to the 66% "Coal Displacement/Replacement" scenarios.

The state and regional results of this set of scenarios are presented in Appendix C. Summary results for the five U.S. regions are shown in Table 3.

Table 3
Regional Summary of the Net Economic Costs of 33% Displacement of Coal-fueled Electric Generation in the U.S., 2015
(in billions of 2005 dollars and millions of jobs)

Region	*High-Price Alternatives*	*Low-Price Alternatives*	*Average*
Southeast			
Output	$55	$5	$30
Earnings	$21	$3	$12
Jobs	0.4	0.07	0.3
Northeast			
Output	$31	$4	$18
Earnings	$13	$2	$7
Jobs	0.2	0.03	0.1
Midwest			
Output	$89	$19	$54
Earnings	$31	$7	$19
Jobs	0.5	0.1	0.3
Central			
Output	$66	$13	$39
Earnings	$24	$5	$15
Jobs	0.5	0.1	0.3
West			
Output	$39	$11	$25
Earnings	$16	$5	$10
Jobs	0.3	0.1	0.2
48 States			
Output	$279	$52	$166
Earnings	$105	$23	$64
Jobs	2.0	0.4	1.2

IV. Conclusion

Coal-based electricity generation provides a significant stimulus to the U.S. economy by increasing output, income, and employment in all sectors through direct and indirect (multiplier) effects. It also increases the purchasing power of the consumer, and enhances the competitiveness of U.S. exports, by avoiding increased reliance on higher-priced fuels and electricity-generating technologies. Even when we take into account the positive economic effects of capital investments and operation of alternative energy generation sources, the replacement of coal-based electricity by relatively more expensive fuels or generating technologies would have a net negative economic impact on every region and on nearly every state. In general, these results reflect the large economic benefits associated with coal's favorable price differential effect relative to alternative fuels.

Note on Study Scope and Limitations

Our analysis is not intended to measure the impacts of any specific policy that could result in decreased coal production or utilization. The impacts of specific policy proposals on coal production and related electric generation should be determined on a case-by-case basis. However, the findings of our coal displacement scenarios provide preliminary insights into the potential magnitude of state, regional and national economic impacts of policy initiatives that could result in significant decreases in coal production and utilization.

This study has not addressed the several important "externalities" associated with coal used in electricity generation. On the down-side are various types of environmental pollution and the emissions of greenhouse gases. On the up-side are the creation of saleable by-products of combustion, and coal's major contribution to lowering our dependence on foreign oil. Public health benefits also may result from increased employment and higher levels of personal income associated with lower energy costs (see, e.g., Brenner, 2005). All of these external impacts are, however, beyond the scope of this study.

Endnotes

*The authors are, respectively, Professor of Energy, Environmental and Regional Economics, and Graduate Assistant in the Department of Geography at the Pennsylvania State University. The authors wish to acknowledge the funding of the Center for Energy and Economic Development (CEED). We are most grateful to Eugene Trisko for providing the data and feedback on various earlier drafts. The methodology employed in this report is an extension of that developed in an analysis by Adam Rose and Ram Ranjan in the "The Economic Impacts of Coal Production and Utilization in the Southern Appalachian Mountain Region" (June 2001), and by Adam Rose and Bo Yang in the "The Economic Impact of Coal Utilization in the Continental U.S. (January 2002) also prepared with the support of the Center for Energy and Economic Development. Dr. William Schaffer of Georgia Tech served as a consultant to and reviewer of the 2002 study. The methodology employed in the current study reflects in principle Dr. Schaffer's constructive comments on this previous work, including the suggested elimination of more speculative "forward-linkage" calculations.

[1] Note that this and subsequent multipliers used in this study are Type II multipliers, which include the stimulus from household income and spending (see Appendix A for further discussion of multipliers). Tax multiplier effects are calculated separately.

[2] Thus, supply-side multipliers do not have the solid footing of demand-side multipliers. In the latter, production definitely requires material inputs; hence the analogy of pulling an object with a rope will guarantee that the object will come forth. The supply-side analysis suggests that just the attractiveness of an input will cause it to be used; the analogy here is that pushing on a rope doesn't necessarily move the object.

[3] A 0.14 estimate first appeared in an unpublished National Economic Research Associates report by K. P. Anderson in 1982. More recent studies for the state of Georgia and the United Kingdom yield similar results. Also, the output elasticity is directly related to the ordinary price elasticity of demand for electricity, which more studies indicate to be in the range of 0.05 to 0.25. Under normal conditions, the output elasticity and price elasticity of demand are equivalent. We chose to use the more conservative value of 0.10 in this study to place our results on as solid a footing as possible

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Appendix A

Input-Output Analysis

An input-output (I-O) table is a valuable tool that provides insights into economic interdependence. The table is composed of a set of accounts representing purchases and sales between all of the sectors of an economy. Official versions of this table at the national level, prepared by the U.S. Department of Commerce, are based on an extensive collection of data from nearly all of the business establishments in the United States.

I-O accounts can serve as the foundation for more formal models, the most basic of which assumes a linear relationship between inputs and the outputs they are used to produce. This structural model enables analysts to trace linkages between sectors and to estimate the economy-wide effects of changes in activity in any one sector.

Input-output analysis was pioneered in the 1930s by Professor Wassily Leontief. Since that time, Leontief and hundreds of other researchers have extended I-O theory, constructed tables for countries and regions around the world, and used these tables to perform a broad range of economic impact analysis. I-O analysis is considered to be such an important achievement that Leontief was awarded the Nobel Prize in economics in 1973. (For further insight into input-output analysis, see Leontief, 1986; Miller and Blair, 1985; and Rose and Miernyk, 1989.)

In addition to the national I-O table, based on a census of business establishments, tables have been constructed for many regions of the U.S., based on adjustments of national data and/or a regional sample of firms. One of the preeminent sets of regional input-output tables are those of the Impact Analysis for Planning System, or IMPLAN, developed and maintained by the U.S. Forest Service in conjunction with several other government agencies. IMPLAN consists of national and regional economic databases and methodologies to construct, update, and modify I-O tables, and to apply them in impact studies (MIG, 2005). In this study, we used the latest IMPLAN I-O Tables for the forty-eight contiguous states, which are updated to 2002 (MIG, 2005).

Due to the enormous amount of data collection and reconciliation that goes into constructing the official U.S. Table, a considerable lag typically exists between the year in which data are gathered and the date of availability of the table. It is therefore standard practice to use an I-O table that is somewhat dated and this is, of course, inevitable when making future projections as in this report. We have satisfied ourselves that we are utilizing the best available model, and that any errors in estimating coal-related impacts are likely to be small. For example, although the Florida economy has grown and changed since 1998, and will continue to do so, the structural relationships (ratios of input to outputs), upon which the model is based, have been found to be relatively stable over short time periods (around 10 years).

The standard IMPLAN multipliers are now Type II multipliers. In general, a multiplier is a ratio of total impacts divided by direct impacts. Versions of multipliers differ according to the calculation of total impacts. Type I multipliers only include indirect impacts (interindustry demands) and are rarely used because they omit a major component of economic interdependence. Type II multipliers include indirect effects and induced effects (those stemming from income payments and their expenditure). Type III multipliers also include both indirect and induced effects, but are based on marginal propensities to consume (spend) out of additional income, instead of average propensities to consume. Since marginal propensities are slightly lower than average propensities, Type III multipliers are a bit more conservative than standard Type II multipliers. We used Type II multipliers in our analysis because IMPLAN recently ceased the calculation of Type III multipliers.

Appendix B

Key Assumptions

We have embodied several key assumptions in our analysis. These assumptions are needed due to limitations of data, and for computational manageability. We have taken special care, however, to ensure that the assumptions are as realistic as possible.

A. General Assumptions

1. Economic growth is proportional across all sectors and is the same in 2015 as in 2002.
2. Intraregional trade patterns are constant over time.
3. Interregional trade patterns are constant over time.
4. Technology (except for electricity generation) is constant over time.
5. Relative prices (except for fuels and electricity) are constant over time.
6. Coal heat rate is 10,250 btu/kwh and natural gas heat rate is 7,200 btu/kwh in 2015.

B. Energy-Specific Assumptions

1. We based costs of fuels and prices of electricity generation on estimates from U.S. EIA or EPA as presented in Table B1.

a. We assumed a 10-percent minimum renewable target in each state. In states, where this target was exceeded (primarily due to the presence of extensive hydroelectricity), we based our projections on actual values.

b. We used our best judgment in determining low and high price ranges for different fuels and technologies. Specifically, for nuclear and renewable electricity generation, high price estimates were 25% above the average in Table B1, and low price estimates were 25% below Table B1 estimates for all 3 cases.

For delivered natural gas prices:

33% displacement scenario -- $5/mcf for low and $9/mcf for high

66% displacement scenario -- $6/mcf and $10/mcf

100% “existence” case -- $8/mcf and $12/mcf

2. Projected electricity generation in each state is based on estimates from U.S. DOE/EIA and EPA. Specifically, we used EIA's 2015 regional electricity generation projections as control totals, and used EPA's projections of state to regional proportions for 2015 to calculate the projected electricity generation for each state.

C. Other Assumptions

1. The 100% Displacement ("Coal Existence") case does not include the impacts of replacement fuels or technologies.

2. The 66% and 33% Displacement cases do include the impacts of replacement fuels and technologies.

We made an adjustment in these simulations in the price differential effect of exporting coal-fueled electricity. The price differential effect is applied in each state to the amount of coal-fueled electricity generated and used in that state. We were not able to compute the effect of this relatively lower-priced generation on the economies of the states that import it (to do so, we would ideally need to know the origin and destination of all coal-fueled electricity exports).

For the 66% and 33% coal "Replacement" cases, the situation differs. If coal were replaced by higher-priced generation, the alternative replacement electricity could not compete in regional markets (if each state unilaterally replaced coal-fueled generation with alternatives). We assumed this would cut coal-fueled electricity generation exports to zero from each state. We then adjusted the coal displacement and coal replacement columns for each state accordingly. However, it is not appropriate to also include the price differential effect on importing states, since these states are no longer importing coal-fueled electricity (because those quantities have been replaced by higher-price alternative generation that is not competitive), nor is it appropriate to add the price differential effect of coal exports to the exporting states (since it would not impact their economies even if the exports were maintained).

Appendix Table B1. Prices of Electricity by Various Technologies and Fuels in Pennsylvania, Example Projected to 2015 (in 2003 cents per kwh)

Technology		COM TRB[1]	Nuclear[2]	Wind Turbines	Solar Thermal	Solar PV	Hydro	Geothermal	Biomass	Average Mix Price
Energy Source	Coal	Gas	Uranium	Wind	Sunlight	Sunlight	Water	Brine/Steam	Landfill or Wood	
Existing Capacity in 2015[3]										
Generation	2.24									
Transmission	0.41									
Distribution	2.36									
Total	5.01									
New Capacity in 2015[4]										
Generation and Transmission		8.34[5]	6.19	6.03		22.43	4.88[6]		5.72	5.33
Distribution		2.36	2.36	2.40	n.a.[7]	2.40	2.40	n.a.[7]	2.40	2.36
Total		10.70	8.55	8.43		24.83	7.28		8.12	7.69

Sources:

EIA. 2005a. *EIA Annual Energy Outlook 2005*. Tables 60-72. Electricity Power Projections for Electricity Market Module Regions.

EIA. 2005b. *EIA Annual Energy Outlook 2005*. Unpublished Diagnostic File "LevCost" From National Energy Modeling System (NEMS) Reference Case Run aeo2005.d102004a.

EPA. 2005. Average *Costs of Generation for Existing Coal Units in 2015 Under CAIR/CAMR/CAVR*.

(NCOE) North Carolina Office of Energy. 2005. *North Carolina Energy Impact Model*. Raleigh, NC.

[1] COM TRB: Combustion turbine, including both conventional and advanced combustion turbine (pollution control equipment unspecified).
[2] Listed as "Advanced Nuclear" for year 2015 from EIA (2005b).
[3] The projected generating cost is from EPA (2005) for the MACW Region. The total projected electricity price is computed by adding the EPA generating cost and the projected transmission and distribution costs from EIA (2005a) for the Mid-Atlantic Region.
[4] All entries are projections from EIA (2005a and 2005b) for the Mid-Atlantic Region in Year 2015 unless otherwise noted. The total projected electricity prices are computed by adding the electricity levelized costs (including generation and transmission costs) from EIA (2005b) and the distribution costs from EIA (2005a).
[5] Average cost of "conventional combustion turbine" and "advanced combustion turbine" technologies.
[6] Data from NCOE (2005) for Year 2000 U.S. dollars adjusted to 2003 U.S. dollars.
[7] There is no solar thermal generation or geothermal electricity generation in EIA 2015 projections for the Mid-Atlantic Region.

Appendix Table B2. Example Calculation of Price Differential Effect (Pennsylvania)

Row				
	Basic fuel price			
1	Price of coal ($/million BTU)		1.73	1
2	Price of gas ($/thousand cubic feet)		12.00	2
3	Price of gas ($/million BTU)		11.70	3
	Fuel cost differential			
4	Total amount of coal consumed in electric power sector (million BTU)	[Calculated by the authors][a]	1,046,733,435.57	4
5	Total amount of electricity coal displaced by gas (million BTU)	[Calculated by the authors][b]	279,410,551.74	5
6	Total cost of coal displaced by gas (million $)	[Row 5 X Row 1]	482.65	6
7	Total physical amount when gas is used (million BTU)	[Row 5 X 0.70 (Conversion Factor)]	195,587,386.22	7
8	Total cost of gas (million $)	[Row 7 X Row 3]	2,287.57	8
9	Cost differential of coal and gas (million $)	[Row 8 - Row 6]	1,804.92	9
	Electricity price differential			
10	Displaced coal-fired electricity (excluding the part displaced by gas) (million kwh)	[From "APPENDIX A" Table 1]	74,137.85	10
11	Price of coal-fired electricity (2005cents/kwh)	[From "APPENDIX A" Table 4]	5.35	11
12	Total value of displaced coal-fired elec (excluding part displaced by gas) (million $)	[Row 10 X Row 11]	3,969.02	12
13	Displacement generation by renewables (million kwh)	[From "APPENDIX A" Table 1]	13,589.94	13
14	Weighted average price of renewable electricity (2005cents/kwh)	[25% higher than the price from "APPENDIX A" Table 4]	10.52	14
15	Total value of displacement renewable electricity (million $)	[Row 13 X Row 14]	1,429.40	15
16	Displacement generation by nuclear (million kwh)	[From "APPENDIX A" Table 1]	60,547.91	16
17	Price of nuclear electricity (2005cents/kwh)	[25% higher than the price from "APPENDIX A" Table 4]	11.44	17
18	Total value of displacement nuclear electricity (million $)	[Row 16 X Row 17]	6,924.77	18
19	Total value of the displacement renewable and nuclear electricity (million $)	[Row 15 + Row 18]	8,354.17	19
20	Total value differential of electricity with displacement (million $)	[Row 19 - Row 12 + Row 9]	6,190.07	20
21	Total electricity generation (million kwh)	[From "APPENDIX A" Table 1]	205,050.91	21
22	Average mix price of electricity after displacement (2005cents/kwh)	[From "APPENDIX A" Table 4]	7.59	22
23	Total value of electricity generation (million $)	[Row 21 X Row 22]	15,561.27	23
24	Price differential averaged over all electricity in the state (%)	[(Row 20 / Row 21) X 100]	39.78	24
	Impact Differential			
25	Elasticity of regional economic activity	[From Text]	-0.10	25
26	Impact differential factor (%)	[Row 24 X Row 25]	-3.98	26
	Impact Results			
	Output			
27	Total base gross output (million $)	[Calculated by the Authors]	1,184,626.90	27
28	Gross output change induced by price differential (million $)	[Row 26 X Row 27]	-47,122.95	28
	Income			
29	Total base income generated (million $)	[Calculated by the Authors]	423,310.39	29
30	Income change (million $)	[Row 26 X Row 29]	-16,838.75	30
	Employment			
31	Total employment	[Calculated by the Authors]	7,946,201.85	31
32	Employment change (person years)	[Row 26 X Row 31]	-316,089.82	32

Notes: a. This is calculated by multiplying the EIA regional projection of electricity coal consumption in 2015 by the EPA projected ratio of state coal-fired
b. This is calculated by multiplying the number in Row 4 by the percentage of gas-fired electricity in total displacement electricity.

Appendix C

State and Regional Summary Tables

SUMMARY TABLES FOR SOUTHEAST REGION

Southeast Table 1A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Alabama	-$20,844	-$11,832	-$16,338
Florida	-$34,134	-$19,080	-$26,607
Georgia	-$51,674	-$26,160	-$38,917
Kentucky	-$60,222	-$38,444	-$49,333
Mississippi	-$7,118	-$3,950	-$5,534
North Carolina	-$44,661	-$17,028	-$30,845
South Carolina	-$8,625	-$5,763	-$7,194
Tennessee	-$40,188	-$15,182	-$27,685
Virginia	-$17,527	-$11,166	-$14,346
West Virginia	-$24,140	-$17,687	-$20,913
Total	-$309,134	-$166,292	-$237,713

Southeast Table 1B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Alabama	-$6,740	-$3,642	-$5,191
Florida	-$12,786	-$6,813	-$9,800
Georgia	-$18,184	-$8,941	-$13,563
Kentucky	-$19,877	-$12,472	-$16,174
Mississippi	-$2,449	-$1,300	-$1,875
North Carolina	-$14,648	-$5,330	-$9,989
South Carolina	-$2,759	-$1,777	-$2,268
Tennessee	-$13,406	-$4,916	-$9,161
Virginia	-$6,996	-$4,295	-$5,646
West Virginia	-$7,897	-$5,615	-$6,756
Total	-$105,742	-$55,102	-$80,422

Southeast Table 1C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

(jobs)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Alabama	-133,263	-69,100	-101,182
Florida	-289,553	-147,923	-218,738
Georgia	-326,643	-158,495	-242,569
Kentucky	-418,442	-262,106	-340,274
Mississippi	-60,110	-31,290	-45,700
North Carolina	-323,124	-111,687	-217,406
South Carolina	-60,351	-37,886	-49,119
Tennessee	-252,608	-92,739	-172,673
Virginia	-111,876	-68,710	-90,293
West Virginia	-190,125	-130,984	-160,554
Total	-2,166,094	-1,110,920	-1,638,507

Southeast Table 2A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Alabama	-$6,629	-$668	-$3,649	-$3,063	-$64	-$1,564
Florida	-$10,511	-$228	-$5,370	-$5,447	$204	-$2,622
Georgia	-$21,133	-$4,245	-$12,689	-$9,822	-$1,306	-$5,564
Kentucky	-$17,693	-$3,191	-$10,442	-$7,596	-$155	-$3,876
Mississippi	-$2,376	-$252	-$1,314	-$1,189	-$80	-$635
North Carolina	-$20,213	-$2,033	-$11,123	-$9,749	-$744	-$5,246
South Carolina	-$2,463	-$224	-$1,343	-$1,349	-$71	-$710
Tennessee	-$21,628	-$5,124	-$13,376	-$10,802	-$2,550	-$6,676
Virginia	-$8,107	-$2,789	-$5,448	-$4,389	-$1,225	-$2,807
West Virginia	-$5,112	-$788	-$2,950	-$1,187	$1,071	-$58
Total	-$115,863	-$19,542	-$67,702	-$54,593	-$4,921	-$29,757

Southeast Table 2B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Alabama	-$2,491	-$442	-$1,467	-$1,155	-$124	-$640
Florida	-$4,683	-$603	-$2,643	-$2,369	-$127	-$1,248
Georgia	-$8,038	-$1,920	-$4,979	-$3,738	-$653	-$2,196
Kentucky	-$6,637	-$1,705	-$4,171	-$2,874	-$344	-$1,609
Mississippi	-$945	-$175	-$560	-$463	-$61	-$262
North Carolina	-$7,037	-$906	-$3,972	-$3,389	-$353	-$1,871
South Carolina	-$938	-$170	-$554	-$509	-$70	-$289
Tennessee	-$7,501	-$1,898	-$4,700	-$3,747	-$945	-$2,346
Virginia	-$3,688	-$1,430	-$2,559	-$1,986	-$643	-$1,315
West Virginia	-$1,949	-$420	-$1,185	-$547	$251	-$148
Total	-$43,906	-$9,670	-$26,788	-$20,778	-$3,069	-$11,923

Southeast Table 2C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

(jobs)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Alabama	-54,666	-12,230	-33,448	-25,402	-4,054	-14,728
Florida	-117,734	-20,997	-69,365	-59,213	-6,049	-32,631
Georgia	-149,000	-37,700	-93,350	-69,315	-13,192	-41,254
Kentucky	-142,623	-38,514	-90,568	-61,874	-8,457	-35,165
Mississippi	-24,568	-5,253	-14,911	-11,960	-1,870	-6,915
North Carolina	-162,747	-23,643	-93,195	-78,418	-9,520	-43,969
South Carolina	-22,290	-4,714	-13,502	-12,042	-2,003	-7,022
Tennessee	-140,742	-35,229	-87,985	-70,293	-17,537	-43,915
Virginia	-58,850	-22,768	-40,809	-31,704	-10,235	-20,969
West Virginia	-52,375	-12,749	-32,562	-15,858	4,828	-5,515
Total	-925,596	-213,797	-569,696	-436,079	-68,088	-252,084

SUMMARY TABLES FOR NORTHEAST REGION

Northeast Table 1A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Connecticut	-$4,337	-$1,291	-$2,814
Delaware	-$5,890	-$3,358	-$4,624
Maryland	-$27,103	-$10,767	-$18,935
Massachusetts	-$11,128	-$6,244	-$8,686
Maine	-$503	-$316	-$409
New Hampshire	-$1,641	-$952	-$1,297
New Jersey	-$14,964	-$5,185	-$10,074
New York	-$22,321	-$10,243	-$16,282
Pennsylvania	-$57,580	-$26,337	-$41,959
Total	-$145,467	-$64,692	-$105,080

Northeast Table 1B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Connecticut	-$1,718	-$462	-$1,090
Delaware	-$1,968	-$1,112	-$1,540
Maryland	-$12,174	-$4,579	-$8,376
Massachusetts	-$4,403	-$2,387	-$3,395
Maine	-$175	-$107	-$141
New Hampshire	-$575	-$313	-$444
New Jersey	-$5,787	-$1,935	-$3,861
New York	-$8,955	-$3,911	-$6,433
Pennsylvania	-$19,909	-$8,744	-$14,327
Total	-$55,664	-$23,551	-$39,607

Northeast Table 1C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

(jobs)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Connecticut	-23,935	-6,408	-15,171
Delaware	-35,807	-20,010	-27,909
Maryland	-192,852	-71,418	-132,135
Massachusetts	-61,119	-33,359	-47,239
Maine	-4,221	-2,506	-3,363
New Hampshire	-10,941	-5,719	-8,330
New Jersey	-79,520	-26,566	-53,043
New York	-112,861	-50,345	-81,603
Pennsylvania	-368,645	-159,069	-263,857
Total	-889,901	-375,400	-632,650

Northeast Table 2A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Connecticut	-$2,076	-$15	-$1,045	-$1,014	$92	-$461
Delaware	-$2,567	-$840	-$1,703	-$1,168	-$222	-$695
Maryland	-$13,677	-$2,889	-$8,283	-$6,541	-$1,139	-$3,840
Massachusetts	-$4,198	-$950	-$2,574	-$1,805	-$145	-$975
Maine	-$176	-$52	-$114	-$72	-$10	-$41
New Hampshire	-$490	-$35	-$263	-$202	$26	-$88
New Jersey	-$7,860	-$1,294	-$4,577	-$3,759	-$391	-$2,075
New York	-$9,723	-$1,751	-$5,737	-$4,421	-$435	-$2,428
Pennsylvania	-$25,488	-$4,807	-$15,148	-$12,253	-$1,824	-$7,039
Total	-$66,254	-$12,632	-$39,443	-$31,235	-$4,047	-$17,641

Northeast Table 2B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Connecticut	-$874	-$24	-$449	-$425	$31	-$197
Delaware	-$883	-$299	-$591	-$402	-$82	-$242
Maryland	-$6,575	-$1,560	-$4,068	-$3,148	-$636	-$1,892
Massachusetts	-$1,813	-$473	-$1,143	-$785	-$99	-$442
Maine	-$66	-$21	-$44	-$27	-$5	-$16
New Hampshire	-$196	-$23	-$109	-$83	$4	-$40
New Jersey	-$3,139	-$552	-$1,845	-$1,499	-$172	-$835
New York	-$4,188	-$859	-$2,524	-$1,910	-$246	-$1,078
Pennsylvania	-$9,367	-$1,976	-$5,672	-$4,496	-$769	-$2,632
Total	-$27,101	-$5,787	-$16,444	-$12,774	-$1,974	-$7,374

Northeast Table 2C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

(jobs)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Connecticut	-12,246	-383	-6,314	-5,945	420	-2,762
Delaware	-16,601	-5,824	-11,213	-7,545	-1,639	-4,592
Maryland	-105,876	-25,687	-65,781	-50,701	-10,543	-30,622
Massachusetts	-24,849	-6,386	-15,617	-10,745	-1,306	-6,026
Maine	-1,723	-591	-1,157	-716	-150	-433
New Hampshire	-4,001	-555	-2,278	-1,719	4	-857
New Jersey	-43,222	-7,665	-25,444	-20,629	-2,393	-11,511
New York	-51,565	-10,305	-30,935	-23,501	-2,871	-13,186
Pennsylvania	-177,621	-38,894	-108,257	-85,246	-15,285	-50,265
Total	-437,704	-96,289	-266,996	-206,746	-33,762	-120,254

SUMMARY TABLES FOR MIDWEST REGION

Midwest Table 1A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Illinois	-$95,392	-$37,686	-$66,539
Indiana	-$82,113	-$50,407	-$66,260
Michigan	-$75,140	-$34,452	-$54,796
Ohio	-$112,434	-$55,018	-$83,726
Wisconsin	-$43,485	-$21,719	-$32,602
Total	-$408,564	-$199,282	-$303,923

Midwest Table 1B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Illinois	-$36,956	-$13,941	-$25,449
Indiana	-$24,932	-$15,182	-$20,057
Michigan	-$24,212	-$10,997	-$17,605
Ohio	-$36,538	-$17,603	-$27,071
Wisconsin	-$14,194	-$6,990	-$10,592
Total	-$136,833	-$64,713	-$100,773

Midwest Table 1C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

(jobs)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Illinois	-472,111	-184,972	-328,541
Indiana	-511,683	-308,906	-410,294
Michigan	-403,210	-182,568	-292,889
Ohio	-713,994	-341,917	-527,956
Wisconsin	-291,017	-142,659	-216,838
Total	-2,392,015	-1,161,021	-1,776,518

Midwest Table 2A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Illinois	-$49,946	-$12,025	-$30,986	-$23,853	-$5,137	-$14,495
Indiana	-$30,565	-$9,251	-$19,908	-$13,791	-$2,565	-$8,178
Michigan	-$38,409	-$11,547	-$24,978	-$18,357	-$4,913	-$11,635
Ohio	-$50,482	-$12,389	-$31,436	-$23,830	-$4,492	-$14,161
Wisconsin	-$19,998	-$5,595	-$12,797	-$9,293	-$2,037	-$5,665
Total	-$189,400	-$50,808	-$120,104	-$89,124	-$19,143	-$54,134

Midwest Table 2B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Illinois	-$20,369	-$5,246	-$12,808	-$9,717	-$2,252	-$5,984
Indiana	-$9,826	-$3,272	-$6,549	-$4,425	-$973	-$2,699
Michigan	-$12,630	-$3,904	-$8,267	-$6,037	-$1,670	-$3,853
Ohio	-$17,018	-$4,455	-$10,736	-$8,029	-$1,651	-$4,840
Wisconsin	-$6,773	-$2,006	-$4,389	-$3,149	-$747	-$1,948
Total	-$66,616	-$18,883	-$42,750	-$31,356	-$7,294	-$19,325

Midwest Table 2C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

(jobs)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Illinois	-250,522	-61,834	-156,178	-119,582	-26,449	-73,015
Indiana	-203,241	-66,933	-135,087	-91,806	-20,010	-55,908
Michigan	-210,979	-65,309	-138,144	-100,873	-27,971	-64,422
Ohio	-333,726	-86,869	-210,297	-157,760	-32,441	-95,100
Wisconsin	-140,143	-41,973	-91,058	-65,165	-15,707	-40,436
Total	-1,138,612	-322,918	-730,765	-535,186	-122,578	-328,882

SUMMARY TABLES FOR CENTRAL REGION

Central Table 1A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arkansas	-$5,787	-$4,541	-$5,164
Iowa	-$28,434	-$14,894	-$21,664
Kansas	-$36,552	-$16,146	-$26,349
Louisiana	-$14,349	-$8,154	-$11,251
Minnesota	-$48,120	-$17,154	-$32,637
Missouri	-$63,824	-$30,163	-$46,994
Nebraska	-$29,741	-$9,505	-$19,623
Oklahoma	-$19,943	-$13,780	-$16,861
Texas	-$58,320	-$34,517	-$46,418
Total	-$305,070	-$148,854	-$226,962

Central Table 1B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arkansas	-$1,782	-$1,375	-$1,579
Iowa	-$8,655	-$4,472	-$6,564
Kansas	-$11,990	-$5,134	-$8,562
Louisiana	-$5,655	-$3,067	-$4,361
Minnesota	-$16,881	-$5,887	-$11,384
Missouri	-$22,680	-$10,462	-$16,571
Nebraska	-$10,617	-$3,277	-$6,947
Oklahoma	-$6,995	-$4,704	-$5,849
Texas	-$20,766	-$11,950	-$16,358
Total	-$106,020	-$50,328	-$78,174

Central Table 1C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

(jobs)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arkansas	-40,347	-30,892	-35,619
Iowa	-208,837	-105,890	-157,363
Kansas	-273,630	-114,374	-194,002
Louisiana	-129,606	-68,828	-99,217
Minnesota	-298,349	-103,699	-201,024
Missouri	-433,836	-200,399	-317,118
Nebraska	-144,287	-45,783	-95,035
Oklahoma	-158,953	-105,794	-132,373
Texas	-369,816	-209,171	-289,494
Total	-2,057,661	-984,830	-1,521,246

Central Table 2A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arkansas	-$878	$265	-$307	-$566	$163	-$202
Iowa	-$12,028	-$3,073	-$7,551	-$5,564	-$1,058	-$3,311
Kansas	-$17,601	-$4,165	-$10,883	-$8,565	-$1,893	-$5,229
Louisiana	-$5,349	-$1,220	-$3,285	-$2,530	-$406	-$1,468
Minnesota	-$27,513	-$7,076	-$17,295	-$13,604	-$3,385	-$8,494
Missouri	-$30,131	-$7,883	-$19,007	-$14,331	-$3,161	-$8,746
Nebraska	-$17,324	-$4,054	-$10,689	-$8,342	-$1,834	-$5,088
Oklahoma	-$3,921	$157	-$1,882	-$1,497	$556	-$470
Texas	-$21,739	-$5,517	-$13,628	-$10,600	-$1,735	-$6,167
Total	-$136,484	-$32,567	-$84,525	-$65,598	-$12,753	-$39,176

Central Table 2B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arkansas	-$390	-$17	-$204	-$235	$3	-$116
Iowa	-$3,818	-$1,052	-$2,435	-$1,768	-$376	-$1,072
Kansas	-$6,086	-$1,572	-$3,829	-$2,960	-$719	-$1,839
Louisiana	-$2,434	-$709	-$1,572	-$1,144	-$256	-$700
Minnesota	-$9,883	-$2,628	-$6,255	-$4,887	-$1,260	-$3,073
Missouri	-$11,358	-$3,282	-$7,320	-$5,400	-$1,346	-$3,373
Nebraska	-$6,364	-$1,551	-$3,957	-$3,064	-$703	-$1,883
Oklahoma	-$1,811	-$296	-$1,053	-$731	$32	-$349
Texas	-$8,552	-$2,544	-$5,548	-$4,140	-$857	-$2,499
Total	-$50,696	-$13,649	-$32,173	-$24,329	-$5,481	-$14,905

Central Table 2C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

(jobs)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arkansas	-9,754	-1,091	-5,423	-5,799	-274	-3,037
Iowa	-96,719	-28,630	-62,675	-44,836	-10,578	-27,707
Kansas	-143,214	-38,353	-90,784	-69,689	-17,622	-43,656
Louisiana	-58,667	-18,153	-38,410	-27,501	-6,655	-17,078
Minnesota	-175,242	-46,772	-111,007	-86,659	-22,425	-54,542
Missouri	-214,264	-59,976	-137,120	-101,951	-24,484	-63,218
Nebraska	-84,531	-19,939	-52,235	-40,708	-9,032	-24,870
Oklahoma	-45,015	-9,844	-27,429	-18,438	-726	-9,582
Texas	-160,540	-51,058	-105,799	-77,460	-17,638	-47,549
Total	-987,945	-273,816	-630,881	-473,042	-109,434	-291,238

SUMMARY TABLES FOR WESTERN/PACIFIC REGION

Western Table 1A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arizona	-$15,373	-$10,242	-$12,807
California	-$74,935	-$41,882	-$58,408
Colorado	-$20,758	-$17,183	-$18,971
Montana	-$5,317	-$3,614	-$4,466
Nevada	-$9,382	-$6,103	-$7,743
New Mexico	-$17,166	-$11,714	-$14,440
North Dakota	-$9,881	-$7,028	-$8,454
Oregon	-$1,808	-$1,185	-$1,497
South Dakota	-$3,151	-$2,030	-$2,591
Utah	-$40,038	-$24,796	-$32,417
Washington	-$6,307	-$3,287	-$4,797
Wyoming	-$8,470	-$5,814	-$7,142
Total	-$212,585	-$134,879	-$173,732

Western Table 1B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

($2005 million)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arizona	-$5,314	-$3,428	-$4,371
California	-$28,259	-$15,540	-$21,900
Colorado	-$7,540	-$6,191	-$6,866
Montana	-$1,840	-$1,228	-$1,534
Nevada	-$3,682	-$2,359	-$3,021
New Mexico	-$6,637	-$4,391	-$5,514
North Dakota	-$3,160	-$2,215	-$2,687
Oregon	-$620	-$403	-$512
South Dakota	-$913	-$587	-$750
Utah	-$14,639	-$9,012	-$11,825
Washington	-$2,366	-$1,209	-$1,788
Wyoming	-$2,979	-$1,925	-$2,452
Total	-$77,950	-$48,488	-$63,219

Western Table 1C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the 100% Displacement (Existence) Case

(jobs)

State	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arizona	-105,323	-66,600	-85,962
California	-438,164	-239,492	-338,828
Colorado	-120,198	-98,649	-109,424
Montana	-53,467	-34,798	-44,133
Nevada	-78,607	-49,759	-69,215
New Mexico	-159,775	-103,413	-131,594
North Dakota	-82,479	-55,952	-64,183
Oregon	-14,319	-9,163	-11,741
South Dakota	-22,545	-14,400	-18,473
Utah	-304,341	-186,933	-245,637
Washington	-38,285	-19,477	-28,881
Wyoming	-67,423	-43,659	-55,541
Total	-1,484,929	-922,295	-1,203,612

Western Table 2A. Estimates of the Statewide Output Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arizona	-$3,409	-$5	-$1,707	-$1,501	$227	-$637
California	-$33,815	-$12,000	-$22,907	-$15,435	-$4,527	-$9,981
Colorado	-$8,553	-$4,319	-$6,436	-$5,743	-$2,253	-$3,998
Montana	-$1,831	-$707	-$1,269	-$681	-$119	-$400
Nevada	-$3,626	-$1,461	-$2,544	-$1,542	-$460	-$1,001
New Mexico	-$5,228	-$1,583	-$3,406	-$2,212	-$321	-$1,266
North Dakota	-$2,663	-$780	-$1,721	-$503	$439	-$32
Oregon	-$700	-$288	-$494	-$298	-$93	-$196
South Dakota	-$1,099	-$360	-$730	-$457	-$88	-$272
Utah	-$19,177	-$9,068	-$14,122	-$8,325	-$3,197	-$5,761
Washington	-$3,133	-$1,140	-$2,137	-$1,471	-$475	-$973
Wyoming	-$2,690	-$929	-$1,809	-$746	$146	-$300
Total	-$85,923	-$32,641	-$59,282	-$38,915	-$10,720	-$24,818

Western Table 2B. Estimates of the Statewide Personal Income Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

($2005 million)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arizona	-$1,511	-$260	-$885	-$671	-$36	-$353
California	-$13,517	-$5,122	-$9,319	-$6,192	-$1,994	-$4,093
Colorado	-$3,606	-$2,009	-$2,807	-$2,349	-$1,032	-$1,690
Montana	-$700	-$296	-$498	-$273	-$72	-$173
Nevada	-$1,567	-$694	-$1,130	-$674	-$238	-$456
New Mexico	-$2,388	-$887	-$1,637	-$1,027	-$248	-$637
North Dakota	-$893	-$269	-$581	-$177	$135	-$21
Oregon	-$256	-$113	-$184	-$110	-$38	-$74
South Dakota	-$312	-$97	-$205	-$129	-$22	-$75
Utah	-$7,185	-$3,452	-$5,319	-$3,127	-$1,233	-$2,180
Washington	-$1,234	-$470	-$852	-$581	-$199	-$390
Wyoming	-$1,218	-$520	-$869	-$438	-$84	-$261
Total	-$34,387	-$14,187	-$24,287	-$15,747	-$5,059	-$10,403

Western Table 2C. Estimates of the Statewide Employment Impact of Coal-Fueled Electricity Generation for the Displacement/Replacement Cases

(jobs)

State	66% Displacement/Replacement			33% Displacement/Replacement		
	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average	High Alternative-Price Scenario	Low Alternative-Price Scenario	Average
Arizona	-31,451	-5,759	-18,605	-13,988	-943	-7,465
California	-213,835	-82,712	-148,274	-98,065	-32,503	-65,284
Colorado	-58,565	-33,046	-45,806	-37,989	-16,949	-27,469
Montana	-22,739	-10,418	-16,578	-9,296	-3,135	-6,216
Nevada	-35,506	-9,232	-17,986	-15,373	2,123	-2,254
New Mexico	-62,516	-24,832	-43,674	-26,994	-7,439	-17,216
North Dakota	-26,740	-16,466	-25,986	-6,631	-5,853	-10,613
Oregon	-6,344	-2,941	-4,642	-2,747	-1,045	-1,896
South Dakota	-7,838	-2,462	-5,150	-3,247	-559	-1,903
Utah	-150,590	-72,715	-111,652	-65,580	-26,076	-45,828
Washington	-20,116	-7,703	-13,909	-9,464	-3,258	-6,361
Wyoming	-27,713	-11,959	-19,836	-10,098	-2,118	-6,108
Total	-663,954	-280,243	-472,099	-299,472	-97,754	-198,613