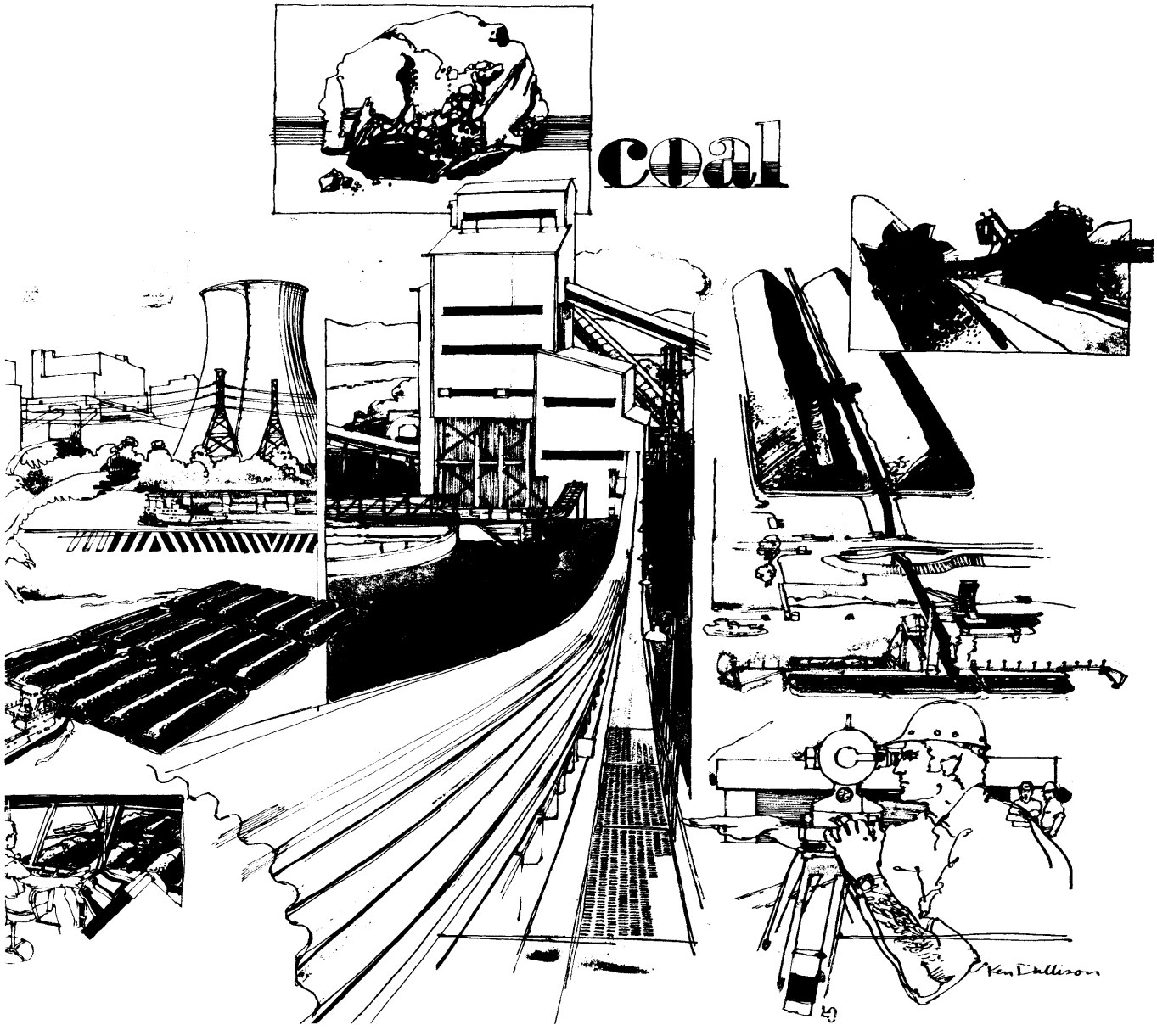
The Fiscal Impact of the Kentucky Coal Industry



Research Report No. 172

LEGISLATIVE RESEARCH COMMISSION
Frankfort, Kentucky

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The Fiscal Impact of the Kentucky Coal Industry

Prepared by
Richard G. Sims

Research Report No. 172

Legislative Research Commission
Frankfort, Kentucky
September, 1980

This Report was prepared by the Legislative Research Commission and paid for from state funds.

FOREWORD

The importance of coal in the economy of Kentucky has long been recognized. Its impact on income and employment within the Commonwealth has been the subject of much discussion and analysis over the years. The economic impact which coal has on the state government itself has received much less attention, however. A more thorough knowledge of this fiscal impact is needed to allow policymakers to make more informed decisions on the coal-related issues which are bound to arise in the future.

Toward this end, the 1978 General Assembly passed House Concurrent Resolution 83, directing the Legislative Research Commission to study the fiscal impacts which the coal industry has on the government of the Commonwealth of Kentucky. Richard G. Sims was the principal author, with assistance from Mary Lynn Collins and Linda Kubala. Jeanie Privett was the principal typist and Dr. Charles Bush the editor.

VIC HELLARD, JR.
Director

The Capitol
Frankfort, Kentucky
September 1980

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SUMMARY

Using standard economic analysis, this report looks at the major coal-related variables which have a fiscal impact on the Kentucky state government to evaluate each specific impact and to determine the net fiscal impact of the coal industry. A summary of these impacts for fiscal 1976 is presented below:

Summary of Fiscal Impacts

Revenues	
Sales and Use Tax	$ 32.0 million
Personal Income Tax	31.7
Corporate Income Tax	15.9
Coal Severance Tax	91.1
Motor Fuels Tax	19.1
TOTAL	$189.8 million
Costs	
Direct Education	$ .4 million
Elementary and Secondary Education	31.6
Higher Education	10.8
Vocational Education	2.3
Rehabilitation	.2
Coal Haul Road Damage	51.4
Non-Coal Haul Transportation Cost	25.4
Natural Resources & Environmental Protection	4.0
Mines and Minerals	.7
Center for Energy Research	2.1
TOTAL	$128.9 million

The total of the direct and indirect revenues identified with the coal industry exceeds the total of the direct and indirect costs attributable to it by $60.9 million. This amount then represents the net fiscal benefit from the coal industry to the Kentucky state government.

The major revenue source attributable to coal is the coal severance tax, which comprises approximately half of all the coal-related revenues. This is the only tax unique to coal and is directly related to coal sales. The second largest revenue source is the sales and use tax. Since the sale of coal is not subject to this tax directly, it comes entirely from the general economic stimulation which coal production inspires. The third largest revenue, personal income tax, is a

mixture of directly and indirectly related sources. It includes people employed in the industry, and people whose income is attributable in some degree to the existence of the coal industry.

The corporate income tax includes the contribution of both coal corporations and other corporations whose incomes can be identified to some extent with the coal industry. Motor fuels consumed in the actual mining process are exempted from taxation. The revenues associated with motor fuels are those which stem from the general economic activity attributable to coal.

The fiscal costs analyzed in this report also include both direct and indirect ones. By far the largest direct cost is for road damage, which accounts for over one-third of the entire costs of coal and is the only truly significant direct cost. The other costs which might be termed direct are related to mining education and three state agencies' cost of regulating and promoting coal. These other direct costs together amount to only slightly over one-tenth of the cost of coal haul road damage.

The majority of the remaining fiscal costs are the indirect costs of education of the coal-related population. Since education is generally the largest single category of state government expenditures, it is reasonable that the coal-related expenditures in this category were also quite large, approaching even the coal haul road damage value.

The final cost factor is for those transportation costs exclusive of coal hauling. This category includes all of the state-supported transportation costs necessary to support the coal industry, after deducting the direct costs of coal haul damage. The total cost for this item was one-half as large as the values determined for coal haul damage.

The $60.9 million by which the sum of all coal-related revenues exceeds the sum of the coal-related expenses may be viewed as the net contribution of the industry toward the general fiscal well-being of the state. In other words, it is the amount of revenue from the coal industry for general government purposes after all fiscal costs of the industry have been deducted. This net contribution is approximately two and one-half percent of the total state budget for the year under consideration.

This report has concentrated on coal-related fiscal impacts as they exist under the current legislative framework. A thorough evaluation of coal policy alternatives which would modify the existing or create new fiscal impacts would be quite useful in plotting future legislative action. This report, which addresses the question, "Where are we now?" is a necessary first step to confronting the obvious next question, "Where do we go from here?" A detailed analysis of policy options would clearly be an extensive undertaking and is beyond the scope of the present report; however, a few comments along these lines might be offered.

One observation which relates both to the current report and to future analysis deals with the concept of the *net* fiscal impact. The cost side of the evaluation performed here deals exclusively with actual costs and makes no judgment as to the adequacy of the expenditures involved from a societal perspective. The coal-producing areas of the state, particularly eastern Kentucky, have always suffered from a low level of public services. Schools and roads, especially, have lagged behind those of the rest of the state and the nation in service levels. It might well be that the citizens of Kentucky would prefer bringing these public services up to a more desirable standard. Since these and other public sector services have been shown by this report to be coal-related in part, this increased cost could quickly wipe out the net benefit calculated herein.

On the other hand, some of the coal-related revenues are expected to show increases in the future under the current legislative framework, even after adjusting for inflation. Because of the continuing energy crisis and the national effort to shift more reliance to coal, such revenues as severance tax receipts should continue to show a real increase for a number of years. To the extent that there is a net revenue-benefit gain for state government from coal development, this net amount could be used in part or in total to upgrade the public services provided to the coal-impacted areas and to develop an expanded economic base to decrease the degree of reliance on the often volatile coal industry.

Finally, any analysis of Kentucky coal policy options will have to address the fact that coal is an exhaustable natural resource. This problem of exhaustability has long been recognized but is seldom given the thorough policy evaluation it deserves. The rate of extraction of an exhaustable resource has severe economic and fiscal implications. Without an extensive analysis of these implications, policy decisions with disastrous long-run consequences might be made.

CHAPTER 1

INTRODUCTION

With the possible exception of the horse industry, coal production is the industry most closely associated with Kentucky. Coal is a way of life for a great number of Kentuckians and has significant impacts on the social, political, environmental, and economic aspects of life in and around the coal-producing areas and, to a lesser degree, throughout the entire state. These impacts in turn generate impacts on the state government of Kentucky. While each of these impacts is important, perhaps the most observable, and certainly the quantifiable, are the economic aspects stemming from coal activity. Coal is the sixth largest occupational group in the state, accounting for 3.8 percent of the non-agricultural workforce, and contributing 7.8 percent of the state's total personal income.[1]

This direct coal activity generates other employment and income in those businesses which support and service the coal industry and in those businesses not directly related to coal but whose business volume is influenced by activity in the coal industry.

The state government, in turn, derives benefits from coal-produced economic activity in both direct and indirect ways. Taxes on coal itself and on businesses and individuals engaged in coal production represent direct benefits to the state. Taxes and other government revenues not directly attributable to coal but which arise because of coal-related economic activity form indirect state benefits.

There are also certain costs associated with coal production, some of which are direct and some indirect in nature. Direct costs are those which may be linked directly to the activity of producing coal. Indirect costs, then, are those costs which are necessary to support the coal industry and its related activities but which are not directly associated with the production of coal.

Purposes

The purpose of this study is to estimate the fiscal impact of the coal industry on the state government. This impact includes both the benefits and the costs attributable to the industry.

The benefits which this study was designed to estimate are (1) taxes paid by the coal industry and people employed directly by it, and (2) that portion of taxes and other receipts paid by non-coal businesses and individuals but traceable to the coal industry. The costs encompassed are (1) highway repair and maintenance expense resulting from coal-hauling; (2) transportation expenses associated with other coal-related activities; (3) educational expense for coal industry personnel; (4) educational expense for pupils who are dependents of those employed in coal-related activities; and, (5) coal-related expenditures of state support and regulatory agencies.

This report represents an attempt to identify all of the major sources of revenue and expenditures of the Commonwealth resulting from the presence of the coal industry. The in-

direct and induced impacts as well as the direct impacts are considered. This report should prove useful to state government policymakers who must make decisions regarding the imposition of taxes, the allocation of expenditures, and the overseeing of the many laws and regulations affecting the coal industry.

The methodological approach utilized is incremental analysis. Incremental analysis involves estimating the impact of an activity on costs and revenues, stressing the impact on total costs and total revenue. This is quite similar to the marginal analysis concept used frequently in analytical economics, except that marginal analysis deals with unit-by-unit changes (considering the effects of increasing coal production by one ton, for example), whereas incremental analysis deals with the impact of an entire activity.[2] In this analysis the state govenment is the entity of concern and the coal industry is the activity to be evaluated. The goal of this incremental analysis is to determine the net impact of the entire activity of coal production, including all of the indirect and induced impacts.

In order to estimate the magnitude of the indirect and induced costs and revenue, another economic concept, that of the multiplier, is utilized. The multiplier measures that total economic effect resulting from some initial activity. Multipliers can be developed for employment, income, or overall economic activity resulting from an initial activity. To this multiplier, or "ripple effect," other economic indications, such as income tax per dollar of income, can be applied, which can lead to an estimate of total fiscal effect on the state government.

Fiscal year 1976 was selected as the benchmark for this analysis. The "boom" period in coal, with its sharply rising and unstable prices, had passed, profits for the industry were falling back in line with those of other industries, and the year was relatively free of major strikes.

One objective of the study is to annualize the fiscal effects involved. This means determining the effects which "should have" resulted from the target year's coal activity, based on certain standards or norms. These results might differ in theory and in observation from the amounts recorded as receipts and expenditures for budgetary purposes during any given year. A straight budgetary depiction of the coal industry's impacts would greatly understate the costs of keeping coal haul roads from deteriorating. In this instance, annualizing would attempt to account for the actual costs, and not just the current expenditure, of road damage resulting from coal haulage during the target year. In other words, the annualized costs of coal haul road damage would be the current maintenance and repair outlay plus the depletion in the capital stock of highways attributed to use during the target year.

For many items accounted for, current budget figures are taken as representative of true annualized cost, particularily for state agencies providing intangible services, as opposed to maintaining a capital stock.

Finally, it should be noted that this report addresses only those impacts which will ultimately be realized by the state government under prevailing legislative and institutional conditions. Many costs created by the production of coal, such as deterioration of the land and loss of aesthetic quality, do not enter the market system as it now exists. Such costs are not considered in this report.

CHAPTER 2

EDUCATION-RELATED EXPENDITURES

This chapter considers those costs, both direct and indirect, relating to education. The direct costs are those which are directly connected to the coal-producing activity: miner training, mine safety, and reclamation programs, for example. These costs vary directly with coal employment and production and are relatively easy to quantify.

Indirect educational costs are those not directly tied to coal mining but which may ultimately be traced back to that industry. In general, they are the state's share of the public sector costs of education of the dependents of coal-related employees. The specific programs identified in this section are elementary and secondary, vocational, rehabilitation, and higher education. These indirect costs, while not varying in direct proportion to coal employment or production, are necessary to support and maintain that industry.

Direct Costs

The modern coal industry requires more training of its employees than the industry required in the past. Not only are the machinery and techniques more sophisticated, but federal legislation now mandates training requirements for miners. The Federal Coal Mine Health and Safety Act of 1969, Public Law 91-173, requires initial training for the inexperienced miners and additional annual training for experienced miners.

A few coal companies provide their own training for certification, but most of the training is done either by state agencies or colleges and universities within the state. Funding for these programs comes from the Mine Safety and Health Administration (MSHA), formerly called the Mine Education and Safety Administration (MESA). In fiscal year 1976, MESA awarded the Kentucky Department of Mines and Minerals $389,625.71 to provide training for mining certification. The Department paid $204,586.69 out to colleges and universities and retained the rest for training and administrative costs.[3] This award covered all costs of training by the state in that year. The Department still receives annual support for mining certification programs and reports that 90 percent of its costs are covered by federal funds.[4]

In addition to training for miners' certification, the Kentucky Department of Mines and Minerals has supported since 1976, through an award from the Mine Safety and Health Administration, an Emergency Medical Technician Training Program at several state universities. In 1976, $30,000 was received from the federal agency, which covered all costs involved.[5]

In fiscal year 1976, the Kentucky Bureau for Vocational Education had programs in mining careers, repair, and maintenance. This occupational program was relatively new in 1976—only two secondary schools and five post-secondary ones offered these programs, with a total of 275 students. Of the $114,155.10 expended for this program, the Appalachian Regional Commission contributed 10.26 percent. The Comprehensive Employment and Training Administration (CETA) contributed 45.89 percent, and the state contributed 43.84 percent.[6]

In 1977, the Bureau for Vocational Education's mining program expanded to include training for certification of miners. Table 2 shows the sources for money budgeted for mining programs in fiscal year 1979.

The Institute for Mines and Minerals Research (IMMR) supports a number of coal-related education projects in the state. IMMR is a part of the University of Kentucky and the prime contractor for the Center for Energy Research. Although IMMR does receive some outside funding, all monies that have gone to IMMR coal-related education projects have been from state funds, according to Don Blume, Senior Research Scientist of IMMR.

IMMR contributes to most of the mining technology programs located in the states' colleges and universities. IMMR also supports various short-term coal projects each year. In fiscal year 1976, for example, IMMR conducted three seminars concerning coal and supported a number of mining engineering students through a scholarship program.

The remainder of the coal-related education programs are in Kentucky's colleges and universities. There are currently seven two-year mining technology programs and one four-year coal mining administration program. For the present study, each university and college operating such a program was contacted for information concerning funding and enrollment. The mining options within engineering programs were not investigated because officials stated that the engineering program in the university system would exist regardless of the presence or absence of coal within the state.

Morehead State University offers an Associate Degree in Applied Science in Mining Technology. In 1976, enrollment was 39 students; 1979 enrollment was 92 students. In addition to support from MSHA, state support for this program in fiscal year 1976 was $32,925.

Lees Junior College operates a two-year program in Mining and Reclamation Technology, leading to an Associate of Arts degree. In 1976, the first year for the program, enrollment was 18 students; the fall enrollment for 1979 was 31 students. All state funds for this program came through the Institute for Mines and Minerals Research.

Madisonville, Hazard, and Southeast Community Colleges each provide a two-year Mining Technology Program, leading to an Associate Degree in Applied Science. The combined enrollment for the programs in 1976 was 227 students. In addition to general fund support, IMMR contributes a sizable amount to the community college mining programs.

Pikeville College's mining technology program, begun in 1971, is the oldest in the state. It is funded by MSHA and local industry. Its 1976 enrollment was 140. Although IMMR provides no support for this mining technology program, it has supported special classes. In FY 1976 two evening classes in Mine Water Quality Analysis and Mine Electricity were funded by IMMR. For the past three years Pikeville College has had an Industry Technical Assistance Center, providing assistance to local coal industry in the area. This center is supported largely by funds from the Appalachian Regional Commission, but IMMR also provides some support.

In the fall of 1979, Union College began a program in coal technology, leading to an Associate Degree of Applied Science. There is no outside funding, federal or state, for this program.

A four-year program in Coal Mining Administration, designed to train personnel for high level management positions in the mining industry, was established in 1977 at Eastern Kentucky's College of Business. Island Creek Coal is the only source outside of state government that contributes to the program.

Table 3 sums up all costs to the state in fiscal year 1976 of providing coal education.

TABLE 1

EXPENDITURES BY THE BUREAU FOR VOCATIONAL EDUCATION FOR MINING PROGRAMS, FY 1976

Source of Funds	Amount
Appalachian Regional Commission	$ 11,718.62
Comprehensive Employment and Training Administration	52,386.38
State	50,050.10
TOTAL	$114,155.10

SOURCE: Kentucky Department of Education, Bureau for Vocational Education, Division of Finance.

TABLE 2

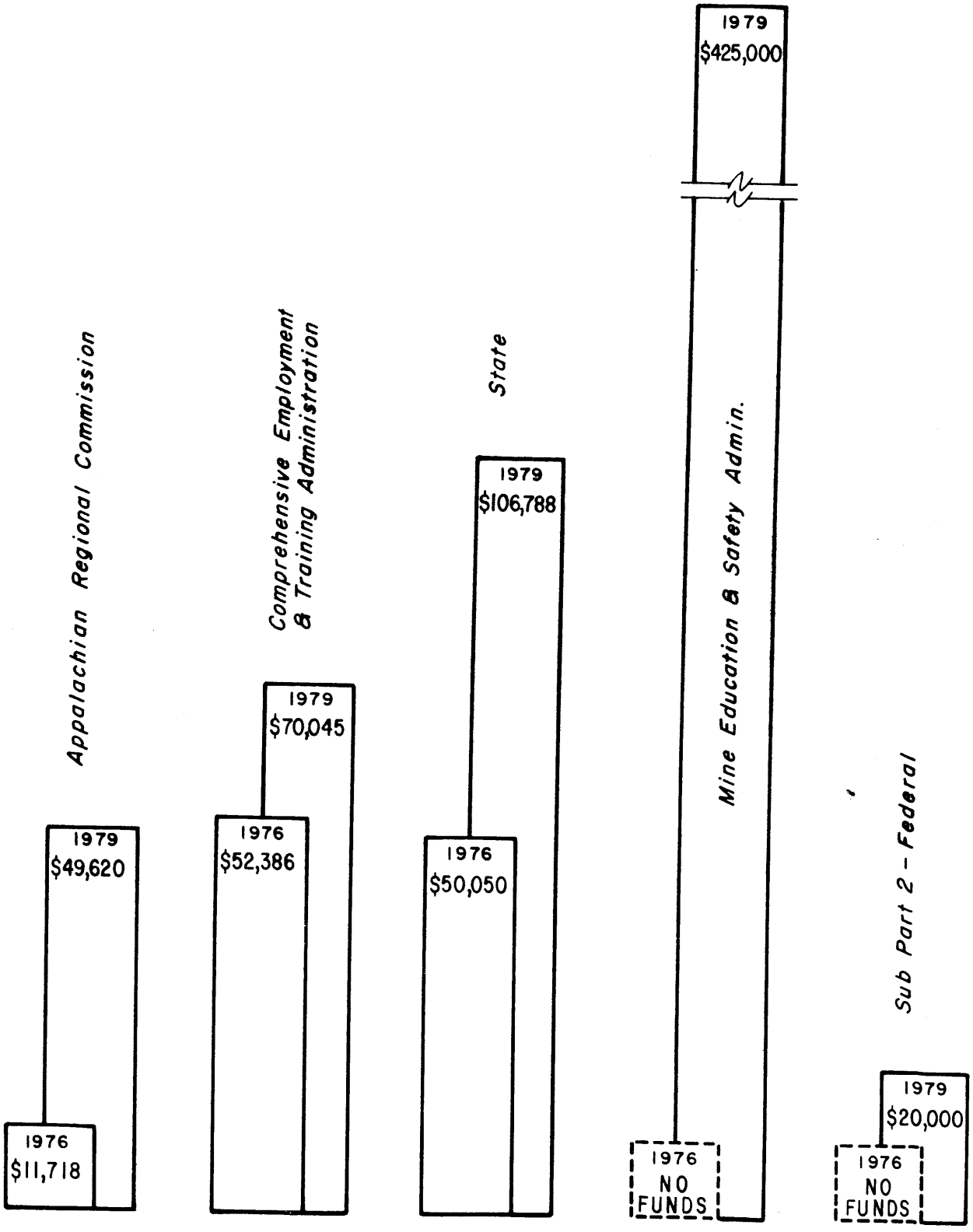
EXPENDITURES BY THE BUREAU FOR VOCATIONAL EDUCATION FOR MINING PROGRAMS, FY 1979

Source of Funds	Amount
Appalachian Regional Commission	$ 49,620.00
Comprehensive Employment and Training Administration	70,045.00
Sub Part 2—Federal	20,000.00
Mine Education and Safety Administration	425,000.00
State	106,788.00
TOTAL	$671,453.00

SOURCE: Kentucky Department of Education, Bureau for Vocational Education, Division of Finance.

FIGURE 1

COMPARISON OF TABLES 1 & 2



Indirect Costs

An increase in the mining industry creates an increase in population, which, in turn, increases education costs. For this study, the indirect costs of education were examined in the areas of elementary and secondary education, vocational education, vocational rehabilitation, and higher education. To determine the state's costs related to the coal industry, it is necessary first to determine the total employment related to that industry and then the number of students associated with those employees. Assuming the ratio of students to population for the coal region is the same as that of the rest of the state, the formula for determining education cost attributable to the coal industry is:

$$\frac{\text{Total Enrollment}}{\text{Total Employment}} \text{ X Coal Employment X } \frac{\text{Total Education Cost}}{\text{Total Enrollment}} =$$

Enrollment per Employee X Coal Employment X Cost per Pupil

Here, coal employment means that part of all employment which is attributed, directly, indirectly, or through inducement, to the coal industry. It would, therefore, include miners and coal truck drivers but also that additional employment in the economy which would not have occurred in the absence of the coal industry. To determine this total coal-related employment, an employment multiplier developed by Mohammed Nasser Sherafat in his dissertation, *The Impact of the Coal Industry on Output, Income, and Employment in Eastern Kentucky: An Input-Output Analysis*, was used.[8] Sherafat's analysis produced separate multipliers for underground mining and for surface mining, with surface mining having a somewhat higher employment multiplier effect. In 1976, both the east Kentucky and west Kentucky coal fields had an approximately .55 to .45 ratio of underground to surface mining.[9] Applying these weights to Sherafat's multipliers of 1.6 for underground and 2.16 for surface production gives a weighted average employment multiplier for the coal industry as a whole of 1.86. Since the data for this analysis was developed in east Kentucky, this result was compared to other study findings to determine the validity of applying it statewide. A 1972 study of the Kentucky coal industry by Spindletop Research used 1.9 as the average employment base multiplier of the coal-producing counties.[10] A 1973 doctoral dissertation by Richard R. Carroll developed employment multipliers by Area Development District.[11] Averaging the employment multipliers for the five ADD's that produce the bulk of Kentucky's coal yields a value of 2.01. These results appeared sufficiently close to the results obtained from Sherafat's analysis to justify the latter's acceptance.

Applying the employment multiplier thus obtained to the total workforce engaged in coal mining produced the following result:

48,224[12] (number of miners) X 1.86 = 89,697

This result means that, in addition to the 48,224 miners, there were 41,473 people working because of the coal industry.

In each area of education examined, total costs of education were computed in the following way, unless otherwise stated:

(1) The capital value of buildings, land, and equipment within the education area was determined for FY 76. Capital value, instead of annual capital outlay was used, since in periods of large increase in school enrollment, capital construction costs rise more rapidly than other expenditures. From this capital value an annualized capital cost was determined.

(2) Capital outlay money was deducted from the 1976 current expenditures in the education area involved to prevent double accounting for capital costs.

(3) In order to obtain state costs of education only, all 1976 federal receipts were subtracted from the 1976 current expenditure figure.

(4) The adjusted current expenditures were then added to the annualized capital costs in order to obtain the total annual costs of education.

TABLE 3

STATE COSTS OF MINING EDUCATION ACTIVITIES IN FY 76

Activity	Source of Funding	$ Amount Expended
Scholarships for UK Mining Engineering Students	IMMR	$ 96,856
3 Mining Seminars	IMMR	6,369
Mine Water Quality Analysis Course at Pikeville College	IMMR	19,611
Mining Electricity Course at Pikeville College	IMMR	22,141
Mining Courses in Vocational Education	Bureau for Vocational Education	50,050
Morehead State University's Mining Technology Program	General Fund	32,925
Madisonville, Hazard and Southeast Community Colleges' Mining Technology Program	IMMR General Fund	104,525 13,200
Lees Junior College's Mining and Reclamation Technology	IMMR	27,419
TOTAL		$373,096

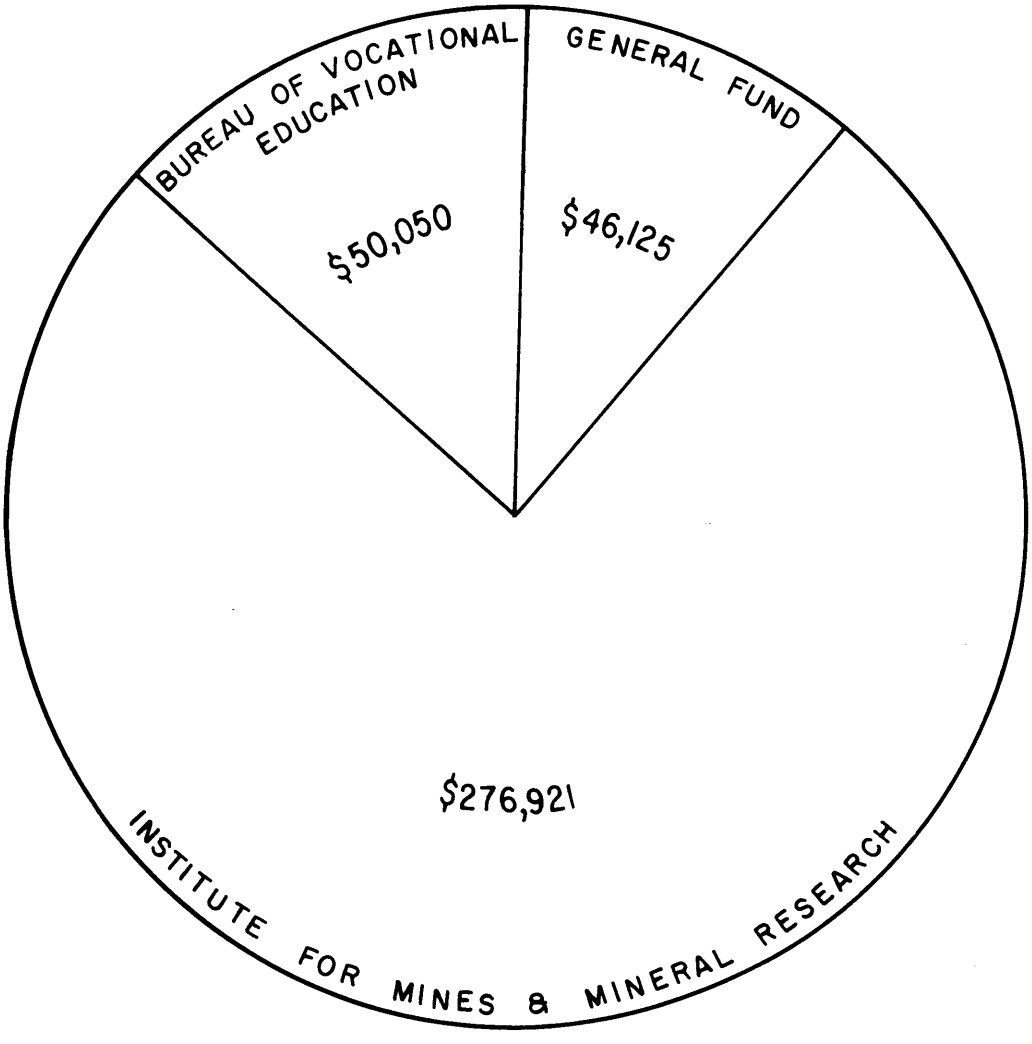
SOURCES: Institute for Mines and Mineral Research, *Semi-Annual Report: A Kentucky Energy Resource Utilization Program*, January 1—June 30, 1976.

Kentucky Department of Education, Bureau for Vocational Education, Division of Finance.

Information supplied by the individual universities and colleges.

FIGURE 2

STATE SOURCES OF FUNDING MINING EDUCATION ACTIVITIES FY 76



Elementary and Secondary Education in Public Schools

Since public schools are owned by the 181 school districts, and not by the Commonwealth, it was not necessary to examine capital costs. *The 1978-80 Kentucky Executive Budget* reported total state expenditures for elementary and secondary education, including the Minimum Foundation program, to be $390,069, 153 in FY 1976. For elementary and secondary education in public schools, therefore, the state costs attributable to coal were:

$$\frac{703,104 \text{ (Total Enrollment)}}{1,108,900 \text{ (Non-Agricultural Employment)}} \times 89,697 \text{ (Coal Employment)}$$

$$\times \frac{\$390,069,153 \text{ (Cost of Education)}}{703,184 \text{ (Total Enrollment)}} = \$31,551,817$$

Vocational Education

The Bureau of Vocational Education has, for each year, inventory values of state-owned facilities used by the Bureau. These inventory figures include the buildings and any large pieces of equipment. The inventory value for the Bureau's facilities in FY 76 was $26,492,275.[13] An additional 10 percent was attached to this figure for land value, making the FY 76 capital value of state-owned vocational education facilities $29,141,503. Assuming a continued replacement of buildings and the facilities being in mid-life, capital value was divided by 15. (Lifetime of buildings is estimated by the Department of Education to be 30 years.) The annualized capital costs were computed to be $1,942,767.

Total expenditure for vocational education FY 76 was $42,307,752.68.[14] Of this amount, $2,858,659.98 went for capital outlay; vocational federal receipts for the year amounted to $12,943,766.[15] Deleting federal receipts and capital outlay costs from expenditures gives an adjusted current expenditure of $26,505,326.70. Therefore, $28,448,095 was the total cost of providing vocational education. To determine how much of this cost could be attributed to coal, the basic formula was used:

$$\frac{241,458 \text{ (Total Enrollment)}}{1,108,900 \text{ (Non-Agricultural Employment)}} \times 89,697 \text{ (Coal Employment)}$$

$$\times \frac{\$28,448,094 \text{ (Cost of Education)}}{241,458 \text{ (Total Enrollment)}} = \$2,300,728$$

The dollar amount attributable to the coal industry for vocational education was computed to be $2,300,728.

Vocational Rehabilitation

Costs involving vocational rehabilitation were arrived at by employing the same method used in determining costs in vocational education. Inventory value of facilities owned by the Bureau for Vocational Rehabilitation in FY 76, adjusted for land value, was

$4,880,452.50.[16] The annualized capital cost, then, was $325,363.50. Current expenditures, not including capital outlay, and adjusted for any federal dollars coming in, were $2,718,737.[17] The state's costs in providing vocational rehabilitation services in FY 1976, then, were $3,044,101. The portion of this cost attributable to the coal industry was:

$$\frac{34,485 \text{ (Total Enrollment)}}{1,108,900 \text{ (Non-Agricultural Employment)}^{18}} \times 89,697 \text{ (Coal Employment)}$$

$$\times \frac{\$3,044,101 \text{ (Cost of Education)}}{34,485 \text{ (Total Enrollment)}} = \$246,667$$

Higher Education

The costs of educating Kentucky students in state-supported colleges and universities were then examined. It was not possible to calculate capital construction costs but capital outlay costs were included in cost figures. Because of the large number of part-time students in colleges and universities, student population figures were converted to full-time equivalent ones. Data on full-time equivalent enrollment at the state-supported universities and colleges was available by total enrollment only and was not broken down by resident and non-resident students for the 1975 school year. Therefore, the 1975 resident full-time equivalent enrollment was estimated by applying the 1979 percentage of resident students to the 1975 full-time. For higher education, the state's costs attributable to coal were:

$$\frac{703,104 \text{ (Total Enrollment)}}{1,108,900 \text{ (Non-Agricultural Employment)}} \times 89,697 \text{ (Coal Employment)}$$

$$\times \frac{\$133,884,517 \text{ (Cost of Education)}}{703,104 \text{ (Total Enrollment)}} = \$10,830,016$$

Fiscal Year 1976 Coal-Related Education Costs

The direct cost of providing coal-related education is quite small, $373,096. Funds from the federal government keep the costs to the state low. Indirect educational costs attributable to the coal industry in the area of vocational education and vocational rehabilitation are relatively low for the same reason, totaling only $2,547,383. However, if federal funding in these areas were cut significantly, Kentucky would be forced either to allocate sizable increases or cut back the programs. The indirect costs of public school education attributable to the coal industry are large enough to warrant consideration in any policymaking process concerning coal and the coal industry in Kentucky. Such elementary and secondary costs totaled $31,551,817, while those for higher education were $10,830,000. Total education-related expenses attributable to the coal industry for fiscal year 1976 are thus found to be $45,302,296.

TABLE 4

KENTUCKY'S COST OF EDUCATING RESIDENT STUDENTS IN STATE-SUPPORTED INSTITUTIONS FOR THE 1975-1976 ACADEMIC YEAR

Name of Institution	1975 Full-Time Equivalent Enrollment of Resident Students[1]	Kentucky's Cost for a Full-Time Student for the 1975-1976 Academic Year[2]	Kentucky's Total Cost for Full-Time Equivalent Resident Students for the 1975-1976 Academic Year
Eastern Kentucky Univ.	9,284.3	$1,729	$ 16,052,554
Kentucky State Univ.	1,025.6	3,055	3,133,208
Morehead State Univ.	4,694.6	2,230	10,468,958
Murray State Univ.	5,523.6	2,124	11,732,126
Northern Kentucky Univ.	3,804.2	1,712	6,512,790
University of Kentucky	16,038.8	2,399	38,477,081
University of Kentucky Community College System	10,409.1	863	8,983,096
University of Louisville	10,567.3	2,188	23,121,252
Western Kentucky Univ.	9,273.6	1,661	15,403,449
TOTAL			$133,884,517*

* May not total due to rounding.

[1] These estimates are based on fall 1975 equivalent enrollment statistics supplied by the Council on Higher Education.

[2] These costs, supplied by the Council on Higher Education, are costs to the state not met by tuition or other souces of revenue. Excluded from these costs are: debt service, teachers' retirement, cooperative extension service and hospital support at the University of Louisville and the University of Kentucky.

CHAPTER 3

CONSTRUCTION AND MAINTENANCE OF COAL HAUL ROADS

Trucks carried 86 million tons of coal from Kentucky mines in 1976, according to the Department of Mines and Minerals.[19] The amount of coal hauled and the size of the trucks used to haul coal on public roads have increased dramatically in recent years. Heavy truck traffic has damaged, and in some cases destroyed, existing roadways in coal-producing areas.

Yet public funds have been used to maintain those roads. Even the most conservative figures place costs at several million dollars a year. An estimate of this cost is an important element in an assessment of the fiscal impact of the coal industry in Kentucky. However, this cost cannot simply be taken from a budget document. Estimates of the dollar value of costs caused by coal trucks can vary widely, depending on the assumptions and data selected. The following characteristics of road costs must be taken into account if a reasonably accurate estimate is to be obtained:

- The use of public roads is not limited to one class of vehicle. Costs associated with roads must be allocated in some way among the public as a whole, which benefits from increased accessibility, and among vehicles of different types. The total cost of maintaining coal roads cannot be assessed against the coal industry;
- The deterioration of roads, or the need, due to heavy traffic, for better roads, imposes a demand for public funds. This cost can be deferred by the responsible agency. In this case the burden is shifted to local residents and road users in such forms as longer travel times, lower property values, and vehicle damage. In fact, highway funds have not been sufficient to maintain the quality of coal haul roads in the past, particularly in eastern Kentucky. Therefore, actual expenditures for maintenance and construction of coal haul roads in any year understate the actual costs imposed by truck use;
- The demand for better roads, imposed by heavy truck use, could be met in several ways: by increased maintenance of existing roads, by construction and maintenance of heavy-duty gravel roads, by construction of hard-surface roads capable of withstanding heavy use. The costs of alternatives differ, and the choice of alternatives can bias the resulting estimate.

In this chapter an attempt is made to analyze available data on coal haul road construction and maintenance costs and to estimate 1976 costs attributable to the coal industry. The term "incremental cost" is used for this estimate, since costs assigned to the industry are those which accrue beyond the cost of providing decent roads for general traffic. The use of this term, however, does not imply as sophisticated an analysis as the incremental cost studies used in highway systems research.

The deterioration of roads used by coal trucks, especially in Appalachia, has become an important political issue, and the focus of numerous studies. During the past few years the Kentucky Department of Transportation,[20] Research Triangle Institute,[21] and the Federal Highway Administration[22] have prepared detailed analyses, estimating the miles of road damage or projected damage by coal trucks, and the cost of constructing roads which can handle

the traffic. The reader is cautioned that the focus of these studies is not on assigning costs for past damage, but on the cost of building an adequate system of coal haul roads for the future. Despite this difference in focus, however, 1976 figures developed by the Kentucky Department of Transportation are used extensively to develop the incremental cost estimates of this chapter.

Other studies have focused on indirect costs of coal trucking. Continuous dust, noise and vibration, for instance, may cause a higher incidence of disease among those living along deteriorated coal haul roads. Coal trucks traveling at high speeds along narrow roads are a safety hazard, as is the broken, rutted pavement of damaged roads. Deterioration of roadways has increased the isolation of many rural families and disrupted community services. Such social costs as these, which are absorbed by the population of the coal producing region, are almost impossible to quantify, and are not specifically treated in this study. Other research has focused on taxing policies,[23] design criteria to minimize damage by heavy trucks,[24] and policy considerations for resolving conflicts over the use of roads in coal areas.[25]

Truck Transportation of Coal—Scope of the Problem

As shown in Table 5, both the production of coal and the number of active mines increased dramatically in the ten years from 1967-1977.[26] Figures for 1978 show some decrease, due to the protracted coal strike and rail transportation bottlenecks. Of the 3,667 mines operating in 1977, 3,410 were in eastern Kentucky, and 3,510 reported that the coal was shipped from the mine by truck.

The use of trucks to haul coal has increased dramatically since the Second World War. In 1956, the Department of Mines and Minerals reported that 39 percent of east Kentucky coal and 8 percent of west Kentucky coal was hauled by truck. By 1976, trucks carried 80 percent of the coal produced in eastern Kentucky. Most of the remainder was loaded onto rail cars directly at the mine. One reason the portion of east Kentucky coal moving by truck is so large is that in that part of the state hundreds of small mines truck their coal to the nearest railroad.

TABLE 5

COAL PRODUCTION AND NUMBER OF MINES, KENTUCKY

Year	Production (Millions of Tons)	Number of Mines
1967	100	1,871
1969	108	1,650
1971	119	2,094
1973	128	1,498
1975	144	3,599
1977	148	3,311
1978	137	3,667

SOURCE: Kentucky Department of Mines and Minerals, *Annual Report*, 1978.

FIGURE 3

KENTUCKY COAL PRODUCTION & NUMBER OF MINES

(See Table 5)

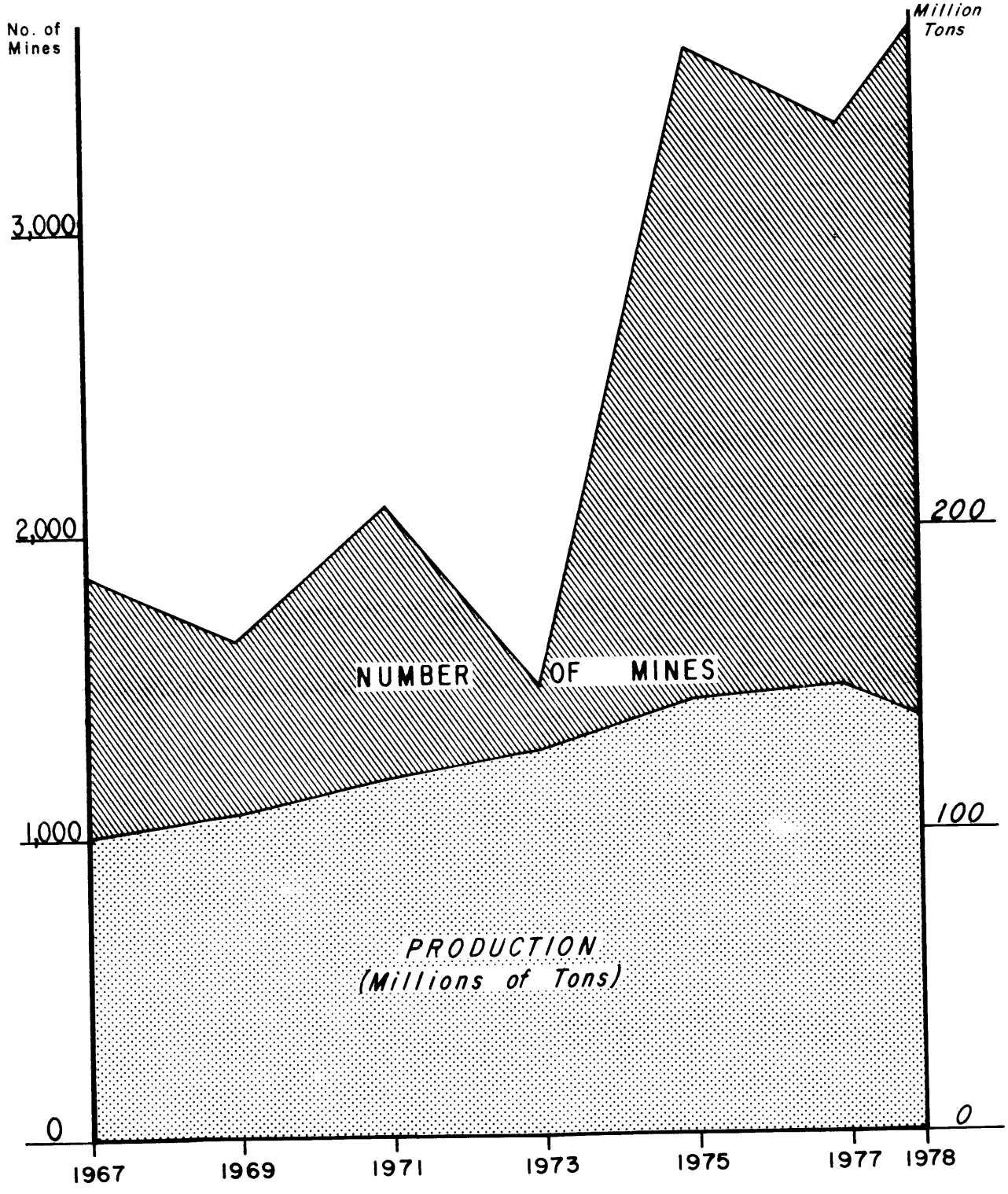


TABLE 6

COAL TRUCKED FROM KENTUCKY MINES

Year	TONNAGE BY TRUCK, PERCENT OF COAL PRODUCED		
	East	West	State Total
1970	67.2	24.8	54.5
1974	73.9	22.7	
1976	79.8	27.3	60.0
1977	81.5	31.6	64.1
1978	83.1	37.0	69.7

SOURCE: Kentucky Department of Mines and Minerals, *Annual Report*, various years.

These figures may underestimate the amount of coal trucked, at least short distances, for reloading onto rail cars. The 1977 Research Triangle Institute[27] study of coal haul roads adjusts the figures reported to the Kentucky Department of Mines and Minerals. They found that many smaller mines not located directly on rail spurs reported shipping coal by rail even though they had to truck the coal to a tipple for loading. Revised estimates for 1974, used by that study, show 87.5 percent of coal trucked, compared with 73.9 percent reported by Mines and Minerals. Table 7 shows figures developed by the Research Triangle Institute.

It generally is assumed that most of the coal moves only a short distance by truck, and that trucks are used mainly by small mines unable to justify a rail spur directly to the mine. But the Department of Mines and Minerals' figures for 1977 indicate that only 4.5 percent of all mines shipped directly by rail, yet these mines accounted for 36 percent of the coal produced in the state. On an operating basis, trucking is by far the most expensive mode for transporting coal (see Tables 8 and 9), even for short distances. It is the least energy-efficient mode. However, only a few mines lie directly on a navigable waterway. Transport by rail or pipelines requires a large private investment for construction. (The small production and temporary nature of many of the smaller mines, particularly in eastern Kentucky, do not justify this initial expense.) The roads, constructed and maintained with public funds, represent much cheaper transportation for most of these small mines.

Coal trucks have not only become more numerous in recent years, they also have become larger. In a 1972 study,[28] Dr. Curt Harvey noted the rapid increase in eastern Kentucky of trucks registered to carry loads far in excess of most posted road weight limits. The percentage of trucks registered in eastern Kentucky with gross weights in excess of 73,000 pounds increased from 0.6 in 1978 to 24.5 in 1971. Despite lower weight limits on most roads, these heavy trucks have since become standard. The 1977 Research Triangle Institute study used an average load of 25 tons of coal per truck in making its calculations, thus assuming an average gross weight of approximately 80,000 pounds. The Kentucky Department of Transportation reports that loaded coal trucks routinely exceed even the maximum limits for AAA roads of 80,000 pounds and sometimes weigh more than 100,000 pounds. Only the major arteries used for coal haul are designed for 80,000 pound weight limits. Many of the feeder roads are posted to carry a maximum of 30,000 pounds. It should be pointed out that trucks capable of hauling 80,000 pound loads weigh approximately 30,000 pounds empty. Also, due to the coal haul routes used, it is

very rare for a trucker who is within the 80,000 pound legal limit and the 18,000 pound axle limit to be within legal limits at all times.

These larger trucks can transport coal at a somewhat lower cost per ton mile than smaller trucks, but at the cost of much more rapid destruction of the roadways. This latter cost is paid only indirectly, if at all, by either the trucker, the coal operator, or the purchaser of the coal.

The damage caused to pavements by heavy trucks is not solely a function of gross weight, however. The Kentucky Department of Transportation has done considerable analysis of the damage caused by trucks of different designs.[29] Table 10 shows the damage caused to a sound pavement by different types of trucks. The "damage factor" measures these trucks against a standard defined as the effect of one pass of an 18,000 pound single axle with 4 tires. According to this table a single unit truck, a type used extensively in the eastern coal fields, causes in a single pass more than 11 times the damage caused by a 5-axle semi-trailer carrying the same gross weight.

TABLE 7

COAL MOVEMENT BY MODE IN EASTERN KENTUCKY, 1974

Truck Only	5.4%	
Truck to Rail	80.5%	
Truck to Water	1.1%	
Truck Total	87.5%	
Rail	13.0%	
Total	100.0%	85 Millic Tons

SOURCE: Rese:ch Triangle Institute and Appalachian Regional Commission, "An Assessment of the Effects of Coal Movement on the Highways in the Appalachian Region." Final Report, 1977, pp. 7-16.

FIGURE 4

COAL MOVEMENT BY MODE
EASTERN KENTUCKY, 1974

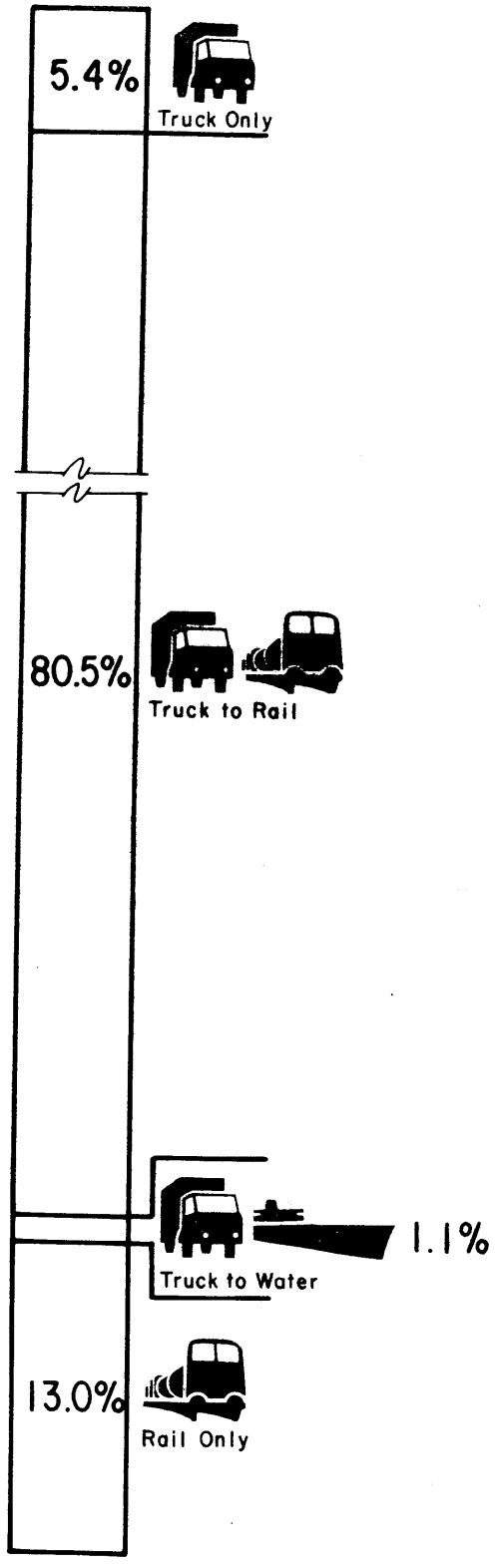


TABLE 8

COSTS (Cents Per Ton-Mile) FOR MAJOR TRANSPORTATION MODES
1974

Mode	Distance Transported		
	50 Mi.	100 Mi.	400 Mi.
Train: Single Car	4.7	2.6	1.5
Train: Unit	—	1.0	0.5
Barge Tow	0.9	0.7	0.5
Diesel Truck	6.5	—	4.2
Slurry Pipeline	—	—	0.4

SOURCE: Spindletop Research, Inc., *Kentucky's Coal Transportation*, 1975, p. 59.

TABLE 9

ENERGY COST COMPARISON BY MAJOR MODE, 1974

Mode of Transportation	Ton Miles Per Gallon of Fuel
Waterways	306
Slurry Pipelines	285
Rail	183
Diesel Truck	54

SOURCE: Spindletop Research, Inc., *Kentucky's Coal Transportation, 1975*, p. 60.

TABLE 10

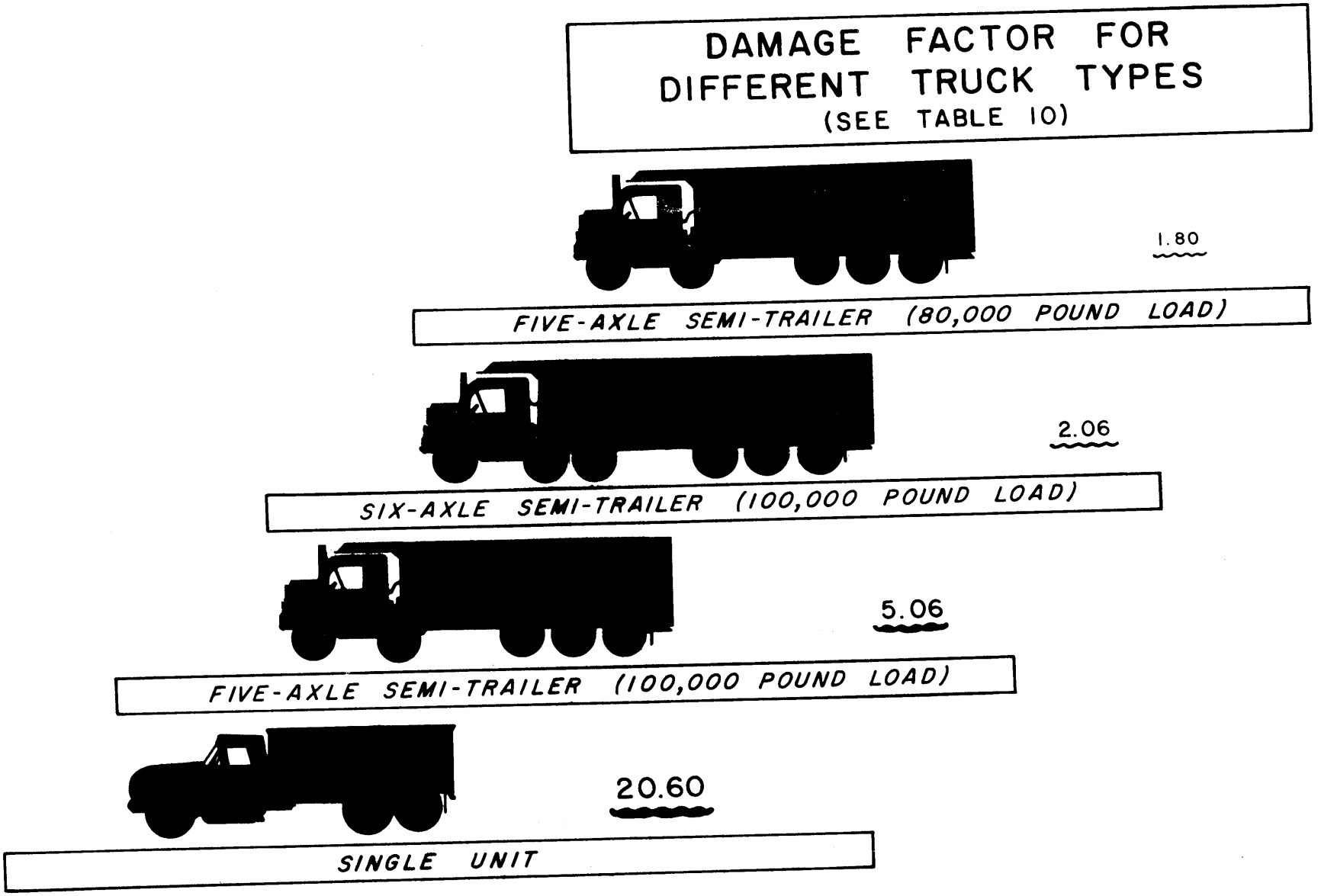
DAMAGE FACTORS FOR DIFFERENT TRUCK STYLES

Truck Style	Axle-Group	Load Pounds	Damage Factor
Single Unit	Front	16,000	1.40
	Tandem	64,000	19.20
	VEHICLE TOTAL	80,000	20.60
Five-Axle Semi-Trailer	Front	12,000	0.56
	Tandem	34,000	0.62
	Tandem	34,000	0.62
	VEHICLE TOTAL	80,000	1.80
Five-Axle Semi-Trailer	Front	14,000	0.92
	Tandem	43,000	2.07
	Tandem	43,000	2.07
	VEHICLE TOTAL	100,000	5.06
Six-Axle Semi-Trailer	Front	12,000	0.56
	Tandem	36,000	0.82
	Tri-Axle (Trailer)	52,000	0.68
	VEHICLE TOTAL	100,000	2.06

Damage Factor = 1.0 = one pass of 18,000-pound single axle with four tires.

SOURCE: Kentucky Department of Transportation, Division of Research.

FIGURE 5


DAMAGE FACTOR FOR
DIFFERENT TRUCK TYPES
(SEE TABLE 10)
1.80
FIVE-AXLE SEMI-TRAILER (80,000 POUND LOAD)
2.06
SIX-AXLE SEMI-TRAILER (100,000 POUND LOAD)
5.06
FIVE-AXLE SEMI-TRAILER (100,000 POUND LOAD)
20.60
SINGLE UNIT

Miles of Roads Affected and Cost of Repairs

The Kentucky Department of Transportation completed a major study of coal transportation and its impact on the state's highways in 1974, and updated the figures in 1976.[30] The 1976 figures are probably the most accurate available for the present study; coal roads were identified with the help of personnel actually responsible for designing, constructing and maintaining roads in Kentucky. Later studies at the national level, including the Federal Highway Administration Study[31] currently underway, use Kentucky figures developed by the Kentucky Department of Transportation.

Research Triangle Institute's study of coal movement in Appalachia developed data on affected roads for 1974 and projected needs to 1980.[32] This study used an allocation procedure to identify segments of coal haul roads, and used standard costs for the whole region to estimate needed maintenance and construction in individual states. Estimates developed for east Kentucky by Research Triangle Institute probably are less accurate than those of the Kentucky Department of Transportation. They appear to be well done, however, and are used here for comparison where appropriate.

Research Triangle estimated that in 1974, 3,953 miles of road in east Kentucky were used for coal hauling; 2,997 miles were estimated to carry at least 10 coal trucks a day, a level which would accelerate the deterioration of local and secondary roads. Nearly 500 miles of road in eastern Kentucky were estimated to carry over 100 laden coal trucks a day, a figure selected rather arbitrarily, on the assumption that this level of use would damage even primary roads designed for heavy use. The effect of this traffic level on a typical primary road is shown in greater detail in Table 11, using data developed by the Kentucky Department of Transportation.

According to the table, the pavement of a "typical primary road" designed to withstand 20 years of normal use would last only 0.8 years if used by 100 single-unit coal trucks a day carrying the maximum legal weight, or 9.3 years if the trucks all conformed to the least damaging design.

The Research Triangle study analyzed a sample group of coal roads for structural condition and state of repair, and used the resulting data to estimate the proportion of coal haul roads in each region which probably needed to be rebuilt. It estimated that 2,041 miles of coal haul roads in east Kentucky were inadequate in 1974 and required reconstruction.

By comparison, the Kentucky Department of Transportation identified 3,448 miles of road in eastern Kentucky being used for coal haul in 1974. It did not attempt to estimate the number of trucks using various roads, nor did it attempt to differentiate between roads which were severely damaged and those which were not. Despite the very different methods of arriving at estimates, the estimates from these two studies are reasonably close to one another.

TABLE 11

ESTIMATED LIFE OF A "TYPICAL" PRIMARY ROAD PAVEMENT SUBJECTED TO 100 COAL TRUCKS A DAY

Truck Style (80,000 LBS)	Volume	Damage Factor	Total Damage Per Day	Years at 300 Days Per Year
Single-Unit	100	20.6	2060	0.8
Single-Unit	75	20.6	1545	
Five-Axle Semi-Trailer	25	1.8	45	
Total	100	22.4	1590	1.1
Single-Unit	50	20.6	1030	
Five-Axle Semi-Trailer	50	1.8	90	
Total	100	22.4	1120	1.5
Single-Axle	25	20.6	515	
Five-Axle Semi-Trailer	75	1.8	135	
Total	100	22.4	650	2.6
Five-Axle Semi-Trailer	100	1.8	180	9.3
Total	100	1.8	180	9.3

ASSUMPTIONS: Typical design for primary road is 6 inches of asphalt on 12 inches of crushed stone base = 500,000 passes of 18,000-pound single axle with four tires. This is equivalent to 93 semi-trailer trucks hauling commercial commodities other than coal or crushed stone, etc., for 300 days per year over a twenty-year period. Such trucks would carry food, hardware, tires, etc., as typical loads. Style of truck is also very important, as shown in Table 10.

SOURCE: Kentucky Department of Transportation, *Kentucky Coal and Its Transportation Impact*, 1976.

Total miles of coal haul roads, as estimated by the Department of Transportation, are shown in Table 12.

TABLE 12

MILES OF COAL HAUL ROADS

Year	Eastern Kentucky	Kentucky Total
1974	3,448	4,383
1976	3,881	4,889
1977	5,112	6,814

SOURCE: Kentucky Department of Transportation, *Kentucky Coal and Its Transportation Impacts*, 1976; and *Kentucky's Coal Transportation Highway System*, 1977.

Research Triangle Institute used cost estimates for maintenance and construction of roads which were broadly applicable to the whole Appalachian region in 1977. The following per mile figures for routine maintenance of roads assume first that the roads are properly constructed to carry heavy weights, and that legal weight limits are not exceeded:

Primary Roads	$5,000-$6,000 per mile per year
Secondary Roads	$3,000-$3,500 per mile per year

In 1974, the Kentucky Department of Transportation estimated that it would cost $12 million per year to maintain the coal haul roads, exclusive of small local roads, if they were first reconstructed to proper standards. This comes to only $3,180 per mile. The Department recommended reconstructing local roads to a traffic bound macadam (gravel) surface, which could be maintained at a minimum expenditure with graders. The estimated cost for maintenance for these roads was only $1,639 per mile in 1974.

Comparable estimates of maintenance costs were not made in 1976. However, the Department recommended a program to upgrade existing roads to various standards, and proposed a continuing maintenance program for these roads estimated to cost $38 million per year. This comes to $5,927 per mile, averaged over local, secondary and primary roads.

Similarly, standard construction cost figures were used by Research Triangle, and are shown here for comparison with Department of Transportation figures for Kentucky's coal roads (Table 13 and Table 14).

The Kentucky Department of Transportation estimates are generally higher than those used by Research Triangle, even though they are for earlier years. Construction costs in eastern Kentucky undoubtedly are higher than in many other parts of Appalachia where the terrain is not so rough. The costs in Table 13 include widening and realigning many of the primary and secondary roads so that they can carry anticipated traffic comfortably and safely.

TABLE 13

AVERAGE CONSTRUCTION COSTS, 1977, RESEARCH TRIANGLE

Primary Roads	$750,000 — $850,000 per mile
Secondary Roads	$450,000 — $550,000 per mile
Local Roads	$105,000 — $165,000 per mile
Bridges (assumed to occur every 16 miles along roads)	$500,000 apiece

SOURCE: Research Triangle Institute, pp. 10-13.

TABLE 14

AVERAGE CONSTRUCTION COSTS, COAL HAUL ROADS
KENTUCKY DEPARTMENT OF TRANSPORTATION
(Cost to reconstruct roads to full design standards for heavy coal haul)

	COST PER MILE		
	1974	1976	East Kentucky 1976
State Primary	$590,100	$712,700	$937,800
State Secondary	703,480	847,700	999,300
Rural Secondary	548,400	655,400	676,800
Local (TBM Surface)	135,200	143,500	151,300

SOURCE: Kentucky Department of Transportation, *Kentucky Coal and Its Transportation Impact*, 1976, p. 16.

Total Cost to Repair Coal Haul Roads

The above discussion should make it clear that the two studies assign very different costs to the job of restoring east Kentucky roads to handle coal traffic. Research Triangle estimates a cost of approximately $1 billion (1977 dollars) to reconstruct about 2,000 miles of road. The Department of Transportation estimated in 1976 that 3,200 miles of state-maintained roads in eastern Kentucky needed reconstruction, at a cost of $2.7 billion. At the same time, the Department estimated that these roads could be structurally improved—providing a heavier pavement but neither widening nor otherwise redesigning—at a cost of "only" $570 million. The estimates developed by the Department of Transportation are shown in detail in Table 15.

The Department of Transportation's 1976 estimates to repair all Kentucky coal haul roads, not just those in eastern Kentucky, are $3 billion for reconstruction to full design standards, and $640 million to make structural improvements for heavy coal haul.

A third set of cost figures, for the year 1975, was presented in the report of the Coal Transportation Task Force of the U.S. Department of Transportation. According to these figures Kentucky had "backlog" needs of $2.3 billion to restore roads already damaged by coal hauling, and would need an additional $1.1 billion to meet reconstruction needs caused by traffic growth through 1985.[33]

TABLE 15

MILES AND COSTS OF KENTUCKY COAL HAUL ROADS* BY STATE HIGHWAY SYSTEMS AND REGIONS ($1000)

	1 Miles of Coal Haul	2 Cost of Restoration	3 Total Annual Maint. after Restoration	4 Cost of Imp. for Heavy Coal Haul	5 Cost of App. Des. Std. for Heavy Coal Haul	6 Cost of App. Des. Std. w/o Heavy Coal Haul
Eastern Kentucky Region						
Interstate	35	$ 0	$ 280	$ 0	$ 0	$ 0
Other State Primary System	876	41,873	7,794	118,961	821,513	804,168
State Secondary System	1,362	52,573	12,314	265,999	1,361,047	1,157,155
Rural Secondary System	845	33,631	9,000	171,450	571,896	391,488
Unclassified Roads	88	3,159	947	15,620	15,620	1,892
Local Roads & Streets	675	—	1,350	—	—	—
Total Eastern Ky. Region	3,881	131,236	31,685	572,030	2,770,076	2,354,703
Western Kentucky Region						
Interstate	0	—	—	—	—	—
Other State Primary System	282	424	1,909	7,529	45,797	41,341
State Secondary System	352	2,268	1,849	34,672	114,083	77,722
Rural Secondary System	76	991	436	12,507	32,809	18,605
Unclassified Roads	3	14	12	224	626	301
Local Roads & Streets	44	—	140	—	—	—
Total Western Ky. Region	757	3,697	4,346	54,932	193,315	137,969
Remaining Coal Haul Region						
Interstate	72	0	360	0	0	0
Other State Primary System	104	457	558	7,894	32,136	28,912
State Secondary System	79	2,904	395	7,513	44,864	39,059
Rural Secondary System	6	154	30	751	2,833	1,667
Unclassified Roads	0	—	—	—	—	—
Local Roads & Streets	0	—	—	—	—	—
Total Remaining Coal Haul	261	3,515	1,343	16,158	79,833	69,637
Total All Coal Haul Regions						
Interstate	107	0	640	0	0	0
Other State Primary System	1,262	42,754	10,261	134,384	899,446	874,421
State Secondary System	1,793	57,745	14,558	308,184	1,519,994	1,273,935
Rural Secondary System	927	34,776	9,466	184,708	607,538	411,760
Unclassified Roads	91	3,173	959	15,844	16,246	2,193
Local Roads & Streets	719	—	1,490	—	—	—
Total All Coal Haul Roads	4,899	138,448	37,374	643,120	3,043,224	2,562,309

* Effective January, 1976

SOURCE: Kentucky Department of Transportation, *Kentucky Coal and Its Transportation Impact*, 1976.

Estimates prepared by Kentucky for a study currently underway by the Federal Highway Administration totaled $4.4 billion to upgrade coal haul roads. These figures reflect higher construction costs, altered guidelines, and an increase in miles of road used for coal haul.

These studies all indicate that a tremendous investment is needed to repair roads already damaged by heavy coal traffic and to reconstruct them to carry heavier weights. The 4,900 miles of coal haul roads identified by the Department of Transportation in 1976 comprised only about 7 percent of all Kentucky roads, yet the Department estimates a minimum reconstruction cost of $640 million, plus $100 million to improve the local roads (See Table 15).

Total road fund receipts for 1975-76 were only $319.2 million, and total Departmental funds in that year, including federal funds and funds for programs other than highways, were $472 million.[34]

Estimates of Incremental Costs for Coal Trucking

The concept of incremental costs was discussed at the beginning of this study. It is a measure of costs for road construction and maintenance beyond those which would occur if coal trucks did not use the roads. Or, expressed another way, it measures the costs required specifically for the benefit of coal trucks, costs which provide no additional benefit to the mix of general traffic expected on the roads. The Department did not keep separate figures for coal roads, but estimated in 1974 that about $3 million had been expended for maintenance of these roads per year between 1972 and 1974. These figures do not represent costs, but the realization that an effort to maintain the roads properly without major prior reconstruction is almost futile. Most incurred costs were postponed by allowing the roads to deteriorate further each year, or were "transferred" to the local population in the form of excessive dust, longer travel times, increased vehicle wear, and the isolation due to poor roads.

Because coal trucks use the roads, many of them must be rebuilt to higher and therefore more costly standards. The incremental cost is not simply one of added maintenance, but includes the premature obsolescence of existing roads and the need for a better highway system than otherwise would be required. It must be assumed that some portion of this need for construction accrued through the use and deterioration of coal roads during 1976, and should be included in an incremental cost figure for that year.

The need for better roads still has not been satisfied, and these incurred costs continue to be postponed. Costs have been estimated for a variety of possible solutions, but funding has not been found, and a single plan has not been selected.

A series of estimates are developed in the following pages, each assuming a different strategy for maintaining the roads, and using 1976 cost estimates developed by the Department of Transportation and shown in Table 15.

In the following estimates it is assumed that newly-constructed roads, with proper maintenance, have a depreciable life of 20 years. This 20-year figure was not based on actual physical depreciation, though this did influence the selection, but on economic depreciation. Economic depreciation is concerned with depreciating the opportunity cost of capital over a period of years, regardless of whether the depreciated object is useless or still valuable after its "assigned" life is over. In addition, in the research conducted in the area of this study, the 20-year depreciation figure is utilized and is generally accepted as a reliable estimate.

On the basis of this 20-year depreciatory life assigned to newly-constructed roads, 1/20 of the construction cost is designated as the cost of the road for a year. Cost in this case is, as stated, capital cost, and does not include any maintenance expenses. Also, weight restrictions are presumed to be observed. Obviously, constant violation of road weight limits will create accelerated physical depreciation.

ESTIMATE #1

It generally is accepted that any solution to the road problem requires extensive reconstruction of roads used to haul coal, and that it is futile to try to patch and repair local farm-to-market roads that are being used by 80,000 pound coal trucks. Nevertheless, it is theoretically possible to increase maintenance efforts to such a degree that existing roads will not experience a net deterioration during any year.

In this case roads would be reconstructed to original conditions on a scheduled basis, with no extra costs or changes in the schedule to adjust for heavier use. Incremental costs would be incurred solely in the form of increased maintenance efforts.

Table 15 shows basic cost estimates for this case. Column 2 shows a total cost to restore roads to their original condition, making no allowance for heavier use, to be $138 million. Total annual maintenance cost for the restored system (column 3) is estimated at $37 million. Elsewhere in the report it is estimated that 75 percent of this maintenance cost, or about $28 million, could be attributed directly to coal hauling on the roads.

Following this logic, the estimate of incremental cost, under case 1, is 75 percent X $37,374,000, or *$28,030,500.*

This probably is the least realistic of the estimates. It makes no allowance for accelerated physical deterioration of the roads, which would be likely to occur regardless of the maintenance level chosen, unless roads were structurally improved. The approach of maintaining roads with reconstruction is discussed in the 1974 report (p. 59), with the following conclusion: "However, not only is this impossible to do in a fiscal sense, it is also impossible to do in a physical sense, as there is no existing roadway structure capable of being so maintained throughout much of the system."

ESTIMATE #2

The second case assumes that general traffic requirements in the coal regions have not increased so much that roads would have to be redesigned at the present time if there were no coal haul. Therefore, costs for general road usage for each year would be 1/20 of total capital outlay for the road and include "normal wear" annual maintenance costs for the road.

It further assumes that, in order to maintain roads for heavy coal trucks as well as general traffic, it is necessary to improve all coal haul roads structurally. Primary and secondary roads must be upgraded to carry 80,000 pound loads. Local roads are to be provided with a traffic-bound macadam surface (TBM), which provides a reasonable surface for passenger cars, and can be maintained at minimal expense by periodic grading. None of the roads would be widened or realigned to accommodate heavier traffic.

Incremental costs for this case would be the difference in construction costs for the existing and improved systems, plus additional maintenance attributable to coal trucks.

$643,120,000	—	Cost of improving roads for heavy coal haul (column 4, Table 11)
- 138,448,000	—	Cost of reconstructing roads to their original condition (column 2, Table 11)
= $504,672,000	—	Additional construction cost attributable to coal industry requirements

$$\frac{\$504,672,000}{20 \text{ Years}} = \$25,233,600 \text{ per year}$$

additional construction cost imposed in one year because of coal truck use of the roads

The Kentucky Department of Transportation has estimated that maintenance on the improved roads will be $13,500,000 per year, of which 15 percent, or $2,025,000, is attributed directly to coal hauling, and also that additional reconstruction costs for local roads and streets will total $5,159,050 annually.

The estimate of incremental costs for one year under case 2, then, is as follows:

$24,233,600	—	additional construction costs incurred annually
+ 2,025,000	—	additional annual maintenance
+ 5,159,050	—	additional annual reconstruction costs for coal roads
= $32,417,650	—	annual incremental cost attributable to coal hauling

ESTIMATE #3

The third case assumes that design improvements on the coal haul roads are needed both for the benefit of general traffic and of coal trucks, and that added strength is required on most of the roads to accommodate the trucks. In this case, then, it is assumed that all state-maintained roads used for coal haul are to be improved to meet design standards recommended on the basis of expected traffic patterns. Many of the narrow, winding roads would be widened and provided with adequate shoulders, and realigned to eliminate dangerous curves and grades.

The Department has estimated the cost of rebuilding the roads to approved design standards in columns 6 and 7 of Table 15. Even if there were no coal trucks, this massive construction project would cost an estimated $2.6 billion in 1976 dollars. The presence of coal traffic requires even higher structural standards for most of the roads, for an estimated construction cost of over $3 billion.

If it is assumed that the basic road improvements benefit all traffic, the incremental construction cost for the coal industry is the difference between the two estimates, or $480,915,000, and the annual incremental construction cost is 1/20 of this, or $24,045,750.

Since no alternative figures are available, it is assumed that additional maintenance costs attributed to coal traffic are the same as in Estimate #2, and also that local roads are upgraded with TBM as in Estimate #2.

Total incremental cost for this case, then, is:

	$24,045,750	— additional construction costs incurred annually
+	2,025,000	— additional annual maintenance
+	5,159,050	— additional annual reconstruction costs for coal roads
=	$31,229,800	— annual incremental cost attributable to coal hauling

ESTIMATE #4

The assumptions in Estimate #3 may be realistic in assigning a majority of benefits of better roads to general highway users. Certainly few would argue against better roads. However, in a situation where funds are always limited, roads generally are reconstructed, not when it would be nice to have them improved, but when increased traffic causes tie-ups, or after a series of accidents occurs in a dangerous curve.

By 1976 many of the coal haul roads had reached the point where widening and realignment were badly needed for the safety of users, yet in many cases the danger and inadequacy of the roads is related to usage by coal trucks, not general traffic. Coal trucks are much wider than passenger cars and heavier than other trucks which travel the roads. Thus, the need for widening and realignment, in many cases, can reasonably be attributed to their use for coal.

Therefore, Estimate #4 assumes that widening and realignment of roads is necessary, not because general traffic has increased so much, but because of coal trucks. If there were no coal, roads would be adequate if rebuilt to their original design on a scheduled basis. Usage by the coal industry, however, requires that the roads be brought up to approved design standards for heavy coal haul at a cost of over $3 billion. Under these assumptions, the incremental construction costs would be the difference between columns 5 and 2 of Table 15, $2,904,776,000. Using twenty-year capital depreciation, the annual figure is $145,238,800.

Additional maintenance costs and costs to upgrade local roads are assumed to be the same as in Estimates 2 and 3. Annual incremental costs for this case, therefore, are:

	$145,238,800	— additional construction costs incurred annually
+	2,025,000	— additional annual maintenance
+	5,159,050	— additional annual reconstruction costs for coal roads
=	$153,422,850	— annual incremental cost attributable to coal hauling

Total severance tax receipts in Fiscal Year 1975-76 come to only $91 million, and to $112 million in Fiscal Year 1976-77.

This estimate undoubtedly is high; the others are probably low. Some roads would need to be upgraded even if they carried no coal at all, and many of the roads can be made adequate and safe without all of the desirable design changes.

Conclusions

Four separate estimates of incremental cost have been made, ranging from $28 million to $153 million. A realistic estimate, which includes actual needs for new construction caused by the coal industry, but does not exaggerate these needs, undoubtedly lies within that

range. Incremental cost is a theoretical number and is dependent on the assumptions used, assumptions which are believed to be as realistic as possible under current data conditions.

Estimate 3 and Estimate 4 are the two extremes. Estimate 3 assumes that road service and road use are primarily for general traffic, while Estimate 4 assumes road service and road use are primarily of a coal haul nature. Therefore, it was determined, for the present study, to weigh these estimates less than Estimate 1 and Estimate 2; this was accomplished by averaging Estimate 3 and Estimate 4 separately and then averaging Estimates 1, 2, 3 and 4. The four cost estimates and the average figure of approximately $51.4 million per year are summarized in Table 16. Unfortunately, there is no magic formula that will resolve the conflicts associated with this estimate. In any case, the figure of $51.4 million represents what appears to be a conservative estimate of the yearly incremental cost for coal haul.

This assumption is valid for the roads designed to carry heavier loads if it also can be assumed that weight limits will be enforced, and that trucks with gross weights in excess of 80,000 pounds will not use these roads. This has not been the case in the past, and there are examples of roads, particularly in eastern Kentucky, which were constructed to full structural standards for heavy coal haul and which nonetheless show serious deterioration within two or three years. If trucks are allowed to continue to exceed even the maximum weight limits allowed by federal law, then these incremental cost estimates are low (Table 16). Studies of road wear indicate that pavement designed with specific limitations that are continuously exceeded requires substantial renovation after very short periods of time. For example, a pavement designed to handle truck traffic at the rate of one hundred 80,000 pound 5-axle semi-trailer trucks a day over a 20-year period will require substantial renovation after 2.4 years if used daily by one hundred such trucks weighing 120,000 pounds each. If these trucks are of the 3-axle variety weighing 80,000 pounds, substantial renovation will be required after 1.7 years.[35] In this case, substantial renovation is defined as regarding medians and roadways, restructuring guardrails where necessary, examining and repairing of bridge super-structures and installing new concrete surfaces.

TABLE 16

ESTIMATES OF ANNUAL INCREMENTAL COST FOR COAL HAUL*
1976

	Annual Incremental Cost	
1. Roads are maintained in their present condition	$ 28,030,500	
2. State-maintained roads are strengthened, local roads TBM	33,418,000	
3. State-maintained roads are redesigned and rebuilt for general traffic, but with additional strength for coal haul; local roads TBM	32,229,800	
4. State-maintained roads have to be redesigned and rebuilt *because of* coal haul, local roads TBM	153,422,850	
Average of Estimates 3 and 4		*$92,826,325*
Average of Estimates 1, 2, 3, and 4		*$51,424,941*

* It should be noted that the capital used for road construction is depreciated on a 20-year basis and that the road with routine maintenance will physically exist in a satisfactory state for this 20-year period.

SOURCE: LRC Staff

CHAPTER 4

OTHER COAL-RELATED EXPENDITURES

Among the remaining coal-related expenses of which the state must bear the major cost are other transportation costs attributable directly or indirectly to the coal industry. The total Department of Transportation expenditure for fiscal year 1976 was $488,699,798.[36] This amount was $16,747,429, or 3.5 percent, above the current funds provided that year. The primary reason for the deficit was that highway expenditures exceeded their budgeted amount by $42,534,025.

Of the $471,952,369 available that year, $123,446,130, or approximately 26 percent, was provided by the federal government. Since the concern of this report is to describe the state government's "own" receipts and expenditures, the federal contribution should properly be subtracted from the total expenditures. In addition, local governments contributed $556,660 to local airport development, which should be subtracted as well. Thus a total of $364,797,008 could be termed the state's own expenditures for the Department of Transportation in fiscal year 1976.

The procedure for estimating the general transportation costs attributable to coal-related and induced activity is to allocate the state's own transportation outlay according to the proportion of total activity accounted for by coal. Since the direct coal haul costs were addressed in Chapter 3, those costs should be deducted from the state's total to avoid double counting. By converting this remainder to a per capita basis, transportation costs can be apportioned to those individuals who are identified as being associated with the coal industry.

Using this approach transportation costs are assumed to be synonymous with transportation expense. For general traffic this assumption would seem to be reasonable, since construction and maintenance for general traffic is based on use and deterioration projections, which are usually quite accurate. For coal haul usage, as described in Chapter 3, however, it is quite likely that *cost*, which is the value of the physical deterioration of the transportation system, exceeds *expense*, which is the amount actually spent on the system over some given time period.

This disparity occurs when actual use significantly exceeds projections for that period. To the extent that coal haul costs were greater than actual expenses for that purpose during 1976, subtracting the cost-based estimate from the expense-based total will leave a remainder less than if both had been on an expense basis. This procedure will thus yield a conservative estimate of non-coal haul tranportation costs, beyond the annual expense outlay for transportation. This estimate is the basis of the computations of the paragraph which follows. Finally, we might acknowledge that, other than for direct coal hauling, coal-related Kentuckians derive benefits, measured as costs, from the state transportation expenditures in the same proportion as other Kentuckians.

Using the $51,400,000 estimate obtained in Chapter 3 for direct coal haul expenses would leave $313.5 million in total non-coal haul state government expense, or $91.50 per Kentuckian, based on the Bureau of Census 1976 Kentucky population figure of 3,428,000.[37]

The 1976 non-agricultural work force was 1,109,000, an average of one worker for each 3.1 citizens. In Chapter 2 it was determined that there were 89,696 total coal-related workers in the state. Applying the average ratio of citizens to workers would indicate that there are 278,058 citizens in Kentucky whose family incomes may be termed coal-related. Multiplying this figure by the average per capita transportation expenditure of $91.50 yields a total non-coal haul related cost of $25.4 million.

The Department for Natural Resources and Environmental Protection, which has authority over strip mining and reclamation, would naturally be expected to have a significant share of its total expenditures tied directly to coal. Indeed, the state, through the General Fund, spent $3,704,286[38] for surface-mined land reclamation, which is completely attributable to coal. In addition, the Division of Water Quality, which is charged with safeguarding the state's water resources from pollution, attributes part of its expenditures to the presence of the coal industry, since much of its work involves small dams and globpiles that come about as coal industry by-products. The data does not reflect a specific cost within this program attributable to coal but estimates are that the figure would be in the neighborhood of $300,000.[39]

The Mine Inspection Division of the Department of Mines and Minerals issues annual licenses and permits to open and operate coal and clay mines. Since there were only 28 licensed clay mines operating in 1976, compared to 3,000 coal mines, it would seem reasonable to attribute the entire budget for that program, $689,900, to the coal industry. Also the Mine Safety and Health Training and Education Instruction program is clearly coal-related, but was accounted for in the education section of this report.

The Department of Energy, which came into being in August of 1975, is primarily concerned with insuring adequate supplies, equitable distribution and efficient utilization of energy in the Commonwealth, and is not significantly affected by the coal industry. However, the Kentucky Center for Energy Research, which has since merged with the Department for Energy, has as its primary mission the promotion and development of Kentucky's fossil fuels, primarily coal. The entire General Fund support of the Center, $2,089,000, is directly tied to the state's coal industry.

In summary, the coal-related state government expenditures identified in this section are:

Transportation	$25.4 million
Natural Resources	4.0
Mines and Minerals	.7
Energy	2.1
TOTAL	$32.2 million

CHAPTER 5

COAL-RELATED REVENUES

For purposes of this report the benefits from coal to the state government are determined as those state revenues whose ultimate source is the coal industry. Just as both direct and indirect costs were identified and estimated, so direct and indirect revenues are determined.

Sales and Use Tax

In general, retail sales in Kentucky are subject to the five percent sales and use tax set forth in Chapter 139 of the Kentucky Revised Statutes. Though Section 139.480 specifically exempts coal for the manufacture of electricity from this tax, the production of such coal still contributes to the state sales and use tax receipts through its influence on the general level of economic activity.

As the general economy is stimulated, part of the resulting activity will mean the consumption of goods and services subject to the sales tax. By determining the relationship of sales and use tax receipts to total economic activity, thus determining that part of the economic activity attributable to the coal industry, an estimate can be made regarding the total amount of sales and use stemming directly and indirectly from the coal industry.

In their 1977 study, *The Implication of a Doubling of Kentucky Coal Production*,[41] Professors Hultman and Davis, using Department of Revenue data and the Kentucky input/output model, calculated the ratio to sales tax receipts to economic activity to be 1.06 percent. In other words, for each $100 worth of output in Kentucky's economy, $1.06 went to the state treasury through the sales tax.

To calculate the total coal-related economic activity, the effect of coal support activities and of coal-induced economic activity, as well as that of the industry itself, must be considered. The economic output multiplier addresses just this need. This multiplier measures the total amount of output created in the economy by each one dollar change in the final demand for the product of a certain sector. In his analysis of the impact of the coal industry on the economy of east Kentucky, Sherafat calculated output multipliers for both underground and strip-mined coal.[41] No comparable analysis has been performed on the west Kentucky coal fields, but an earlier study, which developed economic base multipliers for each of Kentucky's Area Development Districts (ADDs), found the ADDs encompassing the western coal fields to have higher multipliers than those in the east, indicating that those by Sherafat, applied statewide, would probably be conservative.[42] With that caveat, Sherafat's output multipliers for underground and surface-mined coal are applied, based on the weighted taxable value of the output of the eastern ($20.70) and western ($12.27) coal fields for 1976.[43] Adjusting for the difference in value of the eastern and western product, underground produced coal is found to have a total value of $1,028,507,899 and surface-mined coal $1,248,453,049, representing 45.2 percent and 54.8 percent, respectively, of the state's total value of production, $2,276,960,950. These results are presented in Table 17.

TABLE 17

VALUE OF KENTUCKY COAL BY REGION AND TYPE OF MINING

	Eastern	Western	Total
Underground	$ 736,803,194	$291,704,705	$1,028,507,899 (45.2%)
Surface	886,111,330	362,341,719	1,248,453,049 (59.8%)
TOTAL	$1,622,914,524 (71.3%)	$654,046,424 (28.7%)	

SOURCE: Data compiled from Kentucky Department of Revenue, Annual Report 1976-77.

Applying the Sherafat output multiplier values of 1.16 for underground coal and 1.46 for surface coal to the values derived here produces the following results:

TABLE 18

OUTPUT MULTIPLIER EFFECT BY TYPE OF MINING

TYPE	VALUE	MULTIPLIER	EFFECT
Underground	$1,028,507,899	1.16	$1,193,069,163
Surface	$1,248,960,948	1.46	$1,823,482,984
		TOTAL	$3,016,522,147

Thus, the production and sale of $2,276,960,948 worth of coal generated a total effect of $3,016,552,147 in 1976. Multiplying this value times the sales and use tax ratio derived by Hultman and Davis indicates that this total output should generate $31,975,452 to the state through the sales and use tax.

Personal Income Tax

In 1976, coal mining represented 3.8 percent of Kentucky's non-agricultural employment[44] but accounted for 7.0 percent of the state's non-agricultural personal income,[46] a fact explained by the relatively high income enjoyed by coal miners in the state. The total income of coal miners that year was $977,695,000.[46]

Kentucky's personal income taxes are nominally a flat 6 percent of all income over $8,000. Because of deduction, credits and exemptions, however, the effective rate will actually be something less than the 6 percent nominal rate. Dividing the 1976 personal income tax receipts by the total personal income for that year gives the effective personal income tax rate. From this calculation, $292,925,172 ÷ $14,051,067,000 = .02085,[48] it is found that for every

dollar of personal income earned in 1976 the state collected 2.085 cents in personal tax, or an effective rate of 2.085 percent.

Since the concern here is to determine the impact of all activity sparked by the coal industry and not just the direct impacts, it is necessary again to turn to the multiplier effect. The specific interest is with taxes stemming from personal income, thus the appropriate multiplier to use would be the income multiplier. Sherafat developed income multipliers for the east Kentucky underground and surface-mining industries, which include the "spending effects." These multipliers represent "the ratio of direct, indirect and induced income changes resulting from a one dollar increase in final demand."[48] The income multiplier values turned out to be 1.33 for underground mined coal and 1.83 for surface coal.

The Department of Mines and Minerals Annual Report for 1977 shows 55.3 percent of Kentucky's coal miners working underground and 44.7 working on the surface.[49] Though differences exist in the pay rate of miners, depending on the size of the employing company, presence or absence of a union, the price of coal, and many other variables, it does not seem unreasonable to allocate coal wages on an underground/surface basis.

The following table presents the total direct coal income for 1976 allocated by type of mining:[50]

TABLE 19

DIRECT COAL INCOME BY TYPE OF MINING, 1976

TYPE	INCOME SHARE	PERCENT
Underground	$540,665,335	55.3
Surface	$437,029,665	44.7
	$977,695,000	100.0

Applying the respective multipliers to each of the income shares and summing gives the following result for total coal-related income:

TABLE 20

INCOME MULTIPLIER EFFECT BY TYPE OF MINING, 1976

TYPE	INCOME SHARE	MULTIPLIER	EFFECT
Underground	$540,665,335	1.33	$ 719,084,896
Surface	$437,029,665	1.83	$1,518,849,183

With an effective tax rate of 2.085 percent, coal produced $31,668,005 of state income tax through its direct, indirect and induced impacts. This tax, which results from the total impact of coal, represents 11.8 percent of total 1976 tax receipts. This same multiplier in 1975 would have generated $23,178,929 and represented 22.5 percent of that year's total receipts. As seen from Table 21, however, this is still less than the proportion paid directly by mining firms in 1974.

TABLE 21

PERCENTAGE OF TAX

	1972	1973	1974	1975
Manufacturing	45.8%	42.7%	31.4%	31.6%
Trade	23.7	25.6	24.4	26.7
Mining	2.8	6.9	23.7	19.0
Utilities	14.2	12.6	9.3	11.5
All Others	13.5	12.2	11.2	11.2
	100.0%	100.0%	100.0%	100.0%

SOURCE: Kentucky Department of Revenue, *Annual Report 1977-1978*, page 81.

The jump from 1972 to 1974 represents a 1,428 percent increase in taxes paid, stemming from a 1,738 percent increase in reported net income, which, in turn, was the result of a 13.2 percent increase in output and a 251 percent increase in price.[51]

Corporate Income Tax

The corporate income tax rate in Kentucky is 5.8 percent on all taxable net income over $25,000. Actual tax payments in 1976 turned out to be 5.5 percent of reported net taxable income. The Department of Revenue figures indicate that coal companies paid $12,042,928 in corporate taxes in 1976.[52] This figure represents revenue only from companies directly engaged in the activity of mining coal and not those whose income otherwise arises, in part or in total, from coal production.

By taking the same approach used to calculate the sales and use tax receipts, an estimate can be made of the total impact which coal production has on corporate tax receipts. To make an estimate to the impact which all coal-related activities have on corporate income tax receipts, an approach similar to that used to make that determination for the sales and use tax is used.

Since more information is available on the corporate tax than on the sales tax, namely, the amount of tax actually reported as coming directly from coal, it would be appropriate to incorporate this new information into the total tax model. Thus, the reported tax becomes the value to which the output multipliers are applied.

As Table 18 shows, the overall output multiplier value is 1.32. Applying this multiplier to the known value of actual direct coal tax receipts produces: Direct Tax—$12,042,928 X Multiplier—1.32 = Total Tax—$15,896,665.

Motor Fuels Tax

In 1976, Kentucky taxed motor fuel at a rate of nine cents per gallon. Fuel used for off-road coal mining equipment is specifically exempted from taxation (KRS 138.210). Except for exempted fuels no record is kept regarding the use to which purchased motor fuels are put,

nor for that matter can specific geopolitical sales boundaries be drawn, since taxes are reported by fuel distributors whose service areas are not determined by governmental boundaries. The amount of fuels tax receipts attributable to the coal industry will therefore have to be allocated statistically.

Studies of fuel consumption indicate that fuel use is highly correlated to income.[53] For the ten years immediately prior to the 1976 base year of this study, the Pearson coefficient of correlation between income and fuel use was .964, indicating a very strong relationship. Allocating the motor fuel tax in proportion to its contribution to total personal income of the industry should therefore provide a reasonable estimate of motor fuels consumption and thus tax receipts attributable to coal.

As cited in the personal income tax section of this chapter, the direct income contribution of coal was 7.0 percent and the weighted multiplier for total income generated from coal-related activities was 1.55. Applying this total income multiplier to the direct income results in the attributing of 10.85 percent of the total personal income in Kentucky to the coal industry. This proportion of the 1976 motor fuels tax total of $175,799,014[54] would be $19,074,193.

Coal Severance Tax

Kentucky's first coal severance tax legislation, House Bill 337, was signed on March 15, 1972, and went into effect April 1 of that year. The proceeds of this tax were expected to replace a major portion of the sales tax lost as a result of exempting "grocery store" food in that same bill. The rate of tax on coal was four percent of the taxable value of the coal, or 50 cents per ton, whichever might be greater.

In fiscal year 1972-73, the severance tax brought in $37,226,134.[55] A large part of the coal sold that year went for less than the $7.50 price threshold beyond which the four percent rate applied. The Department of Revenue estimated that 85 percent of the severance tax was exported to other states through their purchases of Kentucky coal and that the tax did not have an adverse effect on the Kentucky coal industry.[56]

Senate Bill 281, passed in the 1974 session, created a Coal Producing County Development Fund to be used for public improvement projects in the coal counties. The Fund was financed from one-half the difference between the Department of Revenue estimates of the tax receipts, $41,000,000 in 1973-74 and $44,000,000 in 1974-75, and the actual receipts in each of those years. Actual receipts were $53,495,409 in 1973-74, yielding $6,247,705 for the Fund the following year, and $98,739,678 in 1974-75, generating $27,369,824 for 1975-76.

The Coal Producing County Development Fund expired after the 1975-76 fiscal year and was replaced by the Coal Severance Economic Aid Fund, created by House Bill 674 of the 1978 General Assembly. This bill appropriated $5,000,000 a year from the General Fund for 1976-77 and 1977-78.

Effective July 1, 1976, KRS Chapter 143 was amended to increase the rate of taxation to 4½ percent of value, or fifty cents per ton, whichever was higher. Under the four percent rate, the 131,705,378 tons produced $91,078,438 in tax revenue, at an average price of $17.37 per ton. The 4½ percent rate generated $111,775,181 on 136,687,562 tons in 1976-77, when the price averaged $18.17 per ton. The 1975-76 production values, $2,287,722,416, would

have generated $102,947,509 at the new tax rate. It should be noted that even when the higher rate of tax is factored in, the severance tax receipts have increased approximately fifty percent from 1975-76 to 1978-79.

FOOTNOTES

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Information supplied by Steve Marcum, Kentucky Department of Education, Director of Division of Buildings and Grounds.

Marks, D., et al., *The Economic Impact of Truck Traffic on Tennessee Highways*. Transportation Center, University of Tennessee, Knoxville, 1975.

Research Triangle Institute and Appalachian Regional Commission. *An Assessment of the Effects of Coal Movement on the Highways in the Appalachia Region*, 1977.

Sherafat, Mohammed Nasser. "Doubling of Kentucky Coal Production," 1978.

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Song, Murphy Inbum. "Can the Carter Gasoline Conservation Policy Work in the Commonwealth of Kentucky?" Unpublished paper presented to the Kentucky Economic Association, October, 1975.

Information supplied by Marshall Swain, Kentucky Department of Education, Head Assistant Superintendent for Bureau of Rehabilitation Services.

U. S. Department of Commerce, Bureau of Census. *1970 Census of Population, Characteristics of the Population, Kentucky; Population Estimates, Series P-26*, No. 76-17, July 1977.

U. S. Department of Commerce, Bureau of Economic Analysis (various dates).

U. S. Department of Energy. *Energy Data Report*. Office of Energy Data and Interpretation, Washington, D.C., Feb., 1979.

RECOMMENDED FOR FURTHER READING

1. Kentucky's Coal Transportation — June, 1975

Development Cabinet, D.O.T., I.M.M.R., Spindletop Research.
Kentucky coal production, shipping and marketing data.
Suggests "coal information system" in the state to service industrial needs and produce market forecasts.
Some good tables. 96 pp.

2. Appalachia magazine
Vol. II, #2 — October-November, 1977

Appalachian Regional Commission. Special issue on the Appalachian Conference on Balanced Growth and Economic Development. One of the five task forces was "Energy and Its Socioeconomic Impacts." See p. 28 for speech by Monroe Newman, Pennsylvania State economist:

a) U.S. dependence on oil and gas must decline because we can't rely on imports.
b) Between now and 2000 we'll shift heavily to coal and nuclear energy, after that there'll be a lot more options. "Coal is likely to play a pivotal role in U.S. energy supply again and then find its relative role diminishing again."
c) Coal extraction, transportation and utilization despoil our human and natural resources.
d) Shift to coal will be gradual, won't mobilize national response.
e) Without planning, burdens of the shift to coal will be borne by a few. Between now and 1985 communities in Appalachia will have to spend over $1/2 billion on infrastructure because of energy growth, excluding transportation. Later, when the importance of coal declines, the blows could be softened by broadening the economic base of coal-dependent areas. See recommendations, p. 34.

3. Fossil Fuel Taxation — December, 1974

Montana Legislative Council. In Montana, highly variable net proceeds on which taxes are levied make it difficult for county officials in coal areas to predict their budgets from year to year, and tax revenues always lag behind coal development impacts (see p. 18). Proposal: replace net proceeds tax with gross proceeds tax. Interesting section on what are criteria for a wise tax.

4. Mineral Taxation — November, 1975

Colorado Legislative Council. Similar to Montana study. Good discussion of severance taxation (p. 95), and includes comparison of uses of taxes in various states.

The Coal Industry: Where To?
New Industrial Horizons Series, Number 3, Gail Greenburg

This publication deals with the development of the coal industry, its origins, history, methods and types of mining, parties involved. It also looks at coal utilization, including combustion, synthetic fuel processes, environmental effects and the markets for coal. It concludes that government policies must be reevaluated and amended if the U.S. is to reach its goal of increasing production to 1.2 billion tons by 1985. It specifically sites the following policies as obstacles to increased coal production:

(1) Clean Air Act of 1970
(2) Federal Mine Safety Act of 1969
(3) Federal Leasings Regulations
(4) Transportation Facilities
(5) Technical Manpower
(6) Mine Labor
(7) Equipment Availability

A Study of the West Virginia Coal Industry and Ways to Help It
Presented to the Joint Committee on Government and Finance by the Subcommittee on Coal Mining, January, 1975

Financing coal expansion is far more difficult than commonly believed. The owner of coal has a hard time obtaining money from financial institutions at reasonable rates. Coal owners need financial help from the party purchasing the coal. Report gives illustrations of such deals between companies.

The West Virginia Tax Department estimated that W. VA. coal sales and production produces Business and Occupation tax revenues of $44.5 million for 73-74 and projected $60 million for 74-75.

The report gave figures for the costs of opening and running several typical deep mines, a list of associations, unions and state agencies connected with coal.

"Keystone News Bulletin" December, 1974 predicted that by 1983 West Virginia will have over 33 million tons per year of new production from 47 mines. Kentucky will have over 14 million new tons and Virginia some 1,200,000 new tons of coal.

Kentucky Coal and Its Transportation Impacts, Kentucky Department of Transportation, 1974

Study assesses Kentucky's coal industry from the perspective of highway transportation needs, examines the condition of the state highway system in the coal producing regions and evaluates Kentucky's responsibilities and financial capabilities to provide an adequate highway system to satisfy transportation needs of the coal industry.

This study graphically illustrates:

(1) Coal district per capita income as a % of state per capita income.
(2) Mining employment by coal district.
(3) Coal reserves.
(4) Kentucky coal production (1890-1973).
(5) County coal production.
(6) Projected Kentucky production to 1984.
(7) Coal transportation by mode.
(8) Distribution coal loads.
(9) Percentage of state and federal aid systems.
(10) Miles and costs on Kentucky coal haul roads by state highway systems and regions and by federal-aid systems.
(11) Kentucky highway program income.
(12) Kentucky highway program expenditures.
(13) Transportation needs for Kentucky by mode.

Highway Transportation of Coal: The Kentucky Experience, Department of Transportation

A general discussion of coal transportation problems and plans in Kentucky.

Socially Optional Tax Policy Requirements for the Coal Industry. H. S. Burness, Economics Department, University of Kentucky, June, 1975.

This paper is concerned with optional and efficient use of coal reserves. It illustrates the production decision rule in the case when reserves are limited, contrasts it with the usual rule and determines the effects of various taxes and subsidies on the behavior of individual coal firms and the industry.

The Western Kentucky Coal Industry. by Curtis E. Harvey.

Institute for Mining and Minerals Research. Presents results obtained from examining the economic structure of the Western Kentucky coal industry.

Relevant information:

(1) Average number of men working daily in coal mines 1967-70. U.S. Department of Interior, Bureau of Mines, Minerals Yearbook.
(2) Total primary and secondary employment in the Interior Coal Basin in 1970.
(3) Total projected demand for bituminous coal to 2000.
(4) Life of strippable coal reserves for selected counties in Western Kentucky.
(5) Average size and productivity of labor for mines in Indiana, Illinois, and Western Kentucky by county, 1970.
(6) The relative costs of production, p. 57.
(7) Percentage share of output from different size categories of underground mines, surface mines.

Kentucky's Coal Manpower: An Updated Assessment of Needs and Availability for Increased Coal Production Through 1985; Kentucky Development Cabinet, 1974.

Kentucky's Coal Production Constraints. Kentucky Center for Energy Research.

Report reviews and summarizes the findings of recent, detailed studies identifying coal manpower, transportation, and market constraints on Kentucky coal production.

Relevant graphical information:

(1) Coal production by county.
(2) Predicted Kentucky coal production.
(3) Coal production manpower productivity.
(4) Required yearly additions to Kentucky coal manpower.
(5) Employment in Kentucky coal mines.
(6) Labor supply for coal producing counties.
(7) Estimated capital investment and yearly operating costs for four sizes of underground coal mines in Kentucky.
(8) Estimated capital investment and yearly operating costs for four surface coal mines.

The Cost of Coal Surface Mining and Reclamation in Appalachia
E. A. Nephew & R. L. Spore, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

The report presents an empirical formula for predicting reclamation and coal production costs for terrain angle, stripping ratio, and levels of reclamation quality.

North Dakota Farm Research - July-August, 1974, Vol. 31, No. 6

(1) "The Economic Impact of Coal Based Energy Development in Western North Dakota", p. 12.

Study describes probable changes in gross business volume, employment, population, and income associated with various levels of prespective coal development.

An input-output model of SW North Dakota is used to analyze the economic, social and environmental impacts of three alternative coal development policies. The results indicate the sum of direct and indirect or induced effects of each development alternative.

Options:

(1) Development to meet regional demand.
(2) Development to meet regional and national demand.
(3) Development to contribute to national energy self-sufficiency.

Graphs showing:

(1) Coal production and related energy activity associated with the three alternatives.
(2) Gross business volume, employment and population with the three alternatives.

Summary: Estimates indicate that coal development is likely to cause major economic changes in areas with extensive and readily recoverable coal reserves. Higher levels of development will place considerable pressure on public service delivery systems and may impose substantial social costs on present residents.

(2) "Land Use and Coal Development in North Dakota", Robert E. Stewart, Earl E. Stewart, M. L. Mazaheri, p. 17.

Article emphasizes need for residents and state and local government representatives to address development issues lists:

(1) Basic information requirements.
(2) Major determinates affecting future development (section on taxation advocates creating trust fund for severance tax receipts of non-renewable resource).
(3) Organizational structure for planning.

(3) "Factors Relating to Provide Future Health Care for Increased Population In Support of Coal Energy Development", by Earl E. Stewart.

Brings up the question of implementing local government policies to influence future population distribution with intensive coal energy development. (No hard data).

"On the Taxation of Non-Replenishable Natural Resources", H. S. Burness, University of Kentucky.

Study seeks to delineate the effects of various tax-subsidy policies on natural resource firms and the composite industry. The analysis considers first the competitive case. The effects of taxes on single firm production rates and depletion dates are examined, these results being appropriate when taxes are imposed on a regional basis, and then the analysis is generalized to the case where taxes and subsidies are industry wide. The analysis is extended to consider the case of monopoly as well.

"Effects of Energy Development on Agriculture and Rural Communities In the West", Ad Hoc Committee of the Great Plains Agriculture Council for the Western Governors.

The paper examines in a very general manner, potential effects of energy development on agriculture and rural communities in the Western states. The effects on agriculture are discussed with special reference to competition between the energy industry and agriculture for the use of land, water and labor. Effects on rural communities are discussed with reference to adjustments required by the private and public sectors if quality of life is to be maintained in areas undergoing rapid industrialization.

West Virginia Research League, Report to the Subcommittee on Taxation - Joint Committee on Government & Finance, West Virginia Legislature, July 1, 1975.

Report compares state tax burdens imposed upon the coal industry in West Virginia and selected competing coal-producing states.

The relative impact of differing state tax burdens imposed upon a coal mining enterprise is determined by constructing a hypothetical corporate structure situated within each state.

Relevant graphical information:

(1) Annual unemployment compensation taxes as percent of total and taxable wages and total general taxes - selected states.
(2) Comparison of franchise, license, and general property taxes payable by hypothetical coal mining corporation - selected states.
(3) Outline of the major state and local taxes annually imposed upon deep coal mining corporations by the 21 states analyzed in the report. (Taken from State Tax Guide, Commerce Clearing House, Inc.).

"Strip Mining in Appalachia", (a social, economic and political issue) Commission on Religion in Appalachia

This "dialogue-focusser" simply provides in outline form an analysis of the issues involved in strip-mining and the views held by the various "sides."

"Systems Analysis of Policy and Institutional Alternatives for the Central Appalachian Coal Producing Region", Alan Randall, Department for Agricultural Economics, University of Kentucky, and Sue Johnson, Center for Developmental Change, University of Kentucky.

A proposal to study policy and institutional alternatives which would affect the impact of the Central Appalachian coal industry on the social and economic well-being and quality of life in the coal producing region through a social systems model is presented.

SUMMARY OF RESEARCH PLAN

A. Preliminary Conceptualization of Central Appalachian Social System.

1. to conceptualize the social system of the central Appalachian coal producing region.

2. to generate a framework for systems analysis.

3. to identify data needs.

B. Data Collection.

1. Inventory and evaluate all information available from other completed and on-going research projects.

2. Collect and analyze information from primary and secondary data sources:

--demand and supply relationships for coal and competing energy resources as related to national economic conditions.

--technical and economic information on alternative technologies for coal production, coal utilization, marketing and distribution and environmental protection.

--impacts of coal mining industry on environmental quality in the producing region.

--intersectoral input-output relationships in the regional economy.

--impacts of coal mining industry on income and employment and the distribution of income and employment opportunities in the region.

--impacts of the coal industry on state and local government finances in the coal producing region.

--impacts of the coal industry on residents' perception of social and economic well-being and quality of life in the coal producing region.

--social, economic, and quality of life goals of residents in the coal producing area. Develop a trade-off evaluation framework.

--existing laws, institutions and policies at all governmental levels with respect to the coal industry, environmental protection, economic development and social welfare.

C. Development of Operational Social Systems Model

1. Refine and adapt methodology for social systems analysis.

2. Develop first generation social systems model (See Figure 1).

3. Develop progressively more sophisticated social systems models in an evolutionary process based on relevant theoretical considerations and using the results of sensitivity analyses and validation tests performed with earlier models.

4. Adapt information collected under Objective 2 to forms appropriate for social systems analysis.

5. Develop and validate an operational social systems model.

D. For Objective 4, Identification and Evaluation of Legal, Policy and Institutional Alternatives

1. Soliciting the help of experts in industry, government, regional and community organizations to identify legal, institutional and policy alternatives.

2. Preliminary evaluation of alternatives for legal, political, economic and social feasibility.

3. Using the operational social systems model, to analyze the impact of promising legal, institutional, and policy alternatives and evaluate the contributions of alternative policies to social and economic well-being and quality of life in the coal producing region. Identifying those clusters of policy alternatives that make the greatest positive contribution to the coal-producing region.

Outlook for Energy in the United States to 1985. John G. Winger, John D. Emerson, Gerald D. Sparling.

Total and Nonwhite Population and Labor Force Data in Kentucky by County, Kentucky Department of Economic Security.

A Study of Surface Coal Mining in West Virginia, Stanford Research Institute.

The following relevant information is given:

(1) The number of employees required for annual production relative to average productivity.

(2) Reclamation costs.

(3) Fiscal and economic aspects of the surface coal mining industry of West Virginia.

(4) Reporting coal production.

(5) Graph showing selected demographic indicators in West Virginia, Kentucky, and Ohio compared with U.S. averages.

(6) 1970 per capita revenues and expenditures in West Virginia, Kentucky, Pennsylvania, Ohio compared with U.S. averages.

(7) Relations of surface mining to unemployment and outmigration.

(8) Finance and profits in the surface mining industry projection of future production levels.

(9) West Virginia mining and reclamation laws.

(10) Personnel and expenditures for the Division of Reclamation.

(11) Operational aspects of increased control and regulation over surface mining (including financial impact of increased controls).

Transporting the Nation's Coal, U. S. Department of Transportation, January, 1978.

Study provides graphs on:

(1) Truck capacity and surface mined.

(2) Tonnage by state and region.

(3) Summary of state reported needs.

(4) Coal shipments by water.

Discusses coal transportation capabilities and needs along with recommendations.

Future Trends in the U. S. and Kentucky Coal Industry, by R. Stafford Johnson.

Possible demand and supply factors which may impact the Kentucky and U. S. coal industries over the long-run are delineated in this article.

Demand. Johnson discusses the following factors in determining future demand:

(1) The growth of substitute energy sources.

(2) The growth of the coal-using industries.

(3) The expansion of western coal in the United States.

Supply. Discusses considerations which will influence Kentucky coal production:

(1) Labor costs and productivity.

(2) Environmental costs.

(3) Capital formation.

(4) Transportation.

Illustrated graphically in the study is projected electric generation showing from 1975 to 1985 the proportion of total electrical power fueled by coal, oil, gas, nuclear or hydropower. Also charted are coal mining labor costs from 1968 to 1975.

From his analysis, Johnson enumerates six points of concern for the long-term outlook for Kentucky's coal:

(1) Oil vs. coal costs.

(2) Nuclear power.

(3) Electrical consumption.

(4) Western coal.

(5) Labor and environmental costs.

(6) Transportation systems.

"Kentucky Economy: Review and Outlook"
Council of Economic Advisors, Annual Report, 1978.

An Assessment of the Effects of Coal Movements on the Highways in the Appalachian Region. Research Triangle Institute, N.C.S.U. and ARC, November, 1977.

"Opportunity Costs Associated with Coal Production," Robert Spore, Economist, ORNL-NSF Environmental Program, Oak Ridge National Laboratory.

Analyzes whether the production of coal by surface mining necessarily represents an efficient use of scarce resources. Concludes that surface mining may constitute an inefficient use of scarce and valuable resources.

Appalachia, June-July, 1975, "Forecast: Doubled Coal Production in Appalachia" Shows Regional Energy Model (REM) developed by the ARC.

The Huntington Herald-Dispatch Newspaper, December, 1974. Tom Miller.
Shows study of ownership of West Virginia's land and coal. (Some 24 firms own 50% or more of the land in 27 West Virginia counties.)

A Study of Coal Prices. United States Government Printing Office, March, 1976.

Coal Data. National Coal Association. Annual. Prior to 1974 edition, title was Bituminous Coal Data.
Provides many valuable statistics on coal industry.

Coal Facts. National Coal Association Biennial, Prior to 1974-1975 edition, title was Bituminous Coal Facts.
Presents statistics on growth of industry, production, markets, transportation, manpower and safety, earnings, reserves and more.

Coal Traffic Annual. National Coal Association. Annual. Summarizes statistics on transportation since 1969.

Commodity Data Summaries, 1974. Information on domestic production and use, salient statistics on the United States, events, trends and issues, government trends, world production, resources and reserves.

Energy User's Report. Bureau of National Affairs, Inc.
Looseleaf binder series since 1974.
Provides statistics on basic coal industry and related topics.

Injury Experience in Coal Mining. F. T. Mayer and M. B. McNair
U. S. Bureau of Mines
A comprehensive summarization of all coal-mining related injuries - cause, frequency, and type.

Keystone Coal Industry Manual.
New York: McGraw-Hill. Annual

Presents data on production, number of mines, methods of mining, consumption. Top 15 producing companies, 50 biggest mines.

Keystone News Bulletin. Monthly.

Monthly update to Manual.

MESA Safety Reviews.
Coal mine injuries and worktime. Monthly.

Minerals Yearbook. U. S. Bureau of Mines.
Vol. I provides a general review of mineral industries, a statistical summary, and a chapter on technologic trends related to the domestic economy.
Vol II presents statistical summaries for specific states.

Statistical Abstract of the United States.
U. S. Department of Commerce.
Provides basic information -- production and consumption of fuels, imports and exports of fuels, etc.

Survey of Coal Availabilities by Sulfur Content. L. Hoffman.
Present and future coal availabilities by rank and sulfur content, coal reserves, production and mining growth potentials.

U. S. Energy Outlook. December, 1972. National Petroleum Council. Committee on Energy Outlook (Look for Update).

Provides summaries and conclusions concerning the future coal supply, reserve base, growth capacity, factors limiting supply.

Weekly Coal Reports. Mineral Industry Surveys. U. S. Bureau of Mines.

Estimations of weekly production by states and supplies by consumer class in U.S.

A Dictionary of Mining, Minerals and Related Terms. Paul W. Thrust, U. S. Bureau of Mines, 1968.

Bulletin. Kentucky Department of Mines and Minerals. Monthly.

Includes licensing activity report, summaries by class of mines, fatalities, production by county and type, tonnage, production and fatalities by year and decade.

Strip Mining: An Annotated Bibliography, 1973, R. F. Munn.

The Economics of the Private and Social Costs of Appalachian Coal Production, by J. R. Moore.

Statement on Benefit/Cost Evaluation on Strip Mining in Appalachia, F. K. Schmidt-Bluk.

Strip Mining in Kentucky. The Kentucky Department of Natural Resources.

Surface Mining and Reclamation in Kentucky. The Kentucky Division of Reclamation.

The Economic Implications of Strip Mining Legislation: The Small Firms G. R. Druse, Society of Mining Engineers.

Transactions of the Society of Mining Engineers of AIME (Contains a special section devoted to coal research papers)

Fuel. IPC Science and Technology Press Ltd.

Engineering Index - Journals dealing with coal literature.

Chemical Abstracts - Abstracts of coal literature.

Fuel Abstracts and Current Titles. The Institute of Fuel. Covers non-research oriented literature.

Government Reports Index.

Energy Perspectives - The Battelle Memorial Institute Energy Research Center - Articles on a different energy topic each month.

Office of Coal Research reports indexed regularly in Engineering Index.

Bibliography and Index of U. S. Geological Survey Publications Relating to Coal.

The Institute for Mining and Mineral's Research Library maintains:

(1) A "coal file" (card catalog).

(2) A list of publications of several government organizations, commercial publishers and research organizations.

(3) A file of various newsletters.

(4) A newspaper clipping file on coal and mining articles appearing in the Courier-Journal and The Lexington-Herald.

(5) Subscriptions to new services.

Appalachian Population and Income Show Significant Growth, Dr. Jerome Pickard.

Includes the following relevant charts:

(1) Total population and estimated components of population change Appalachian Region and United States.

(2) Local development district areas with largest net outmigration.

(3) Local development district areas with largest net immigration.

(4) Per capita money income, 1969-1974 Appalachian Region and United States with 1969-1974 trends adjusted for inflation.

(5) Distribution of Appalachian counties by 1974 money income level.

(6) A summary of Appalachian projects approved as of March, 1978.

Kentucky Coal Mining Industry.
Economic and employment data, underground and surface mining, Kentucky Coal Association.

Chemistry of Coal Utilization. by H. H. Lowry.

Coal Preparation. J. W. Leonard. Observations on surface mining of coal.

Energy Future: Report of the Energy Project at the Harvard Business School. Edited by Robert Stobaugh and Daniel Yergin. Random House, New York, N.Y., 1979.

A much acclaimed publication that evaluates America's energy options. Conventional sources, coal, nuclear, petroleum, and natural gas, are found to be wanting, with the author favoring the alternative energy sources, primarily solar and conservation.

Energy in America's Future: The Choice Before Us, Resources for the Future. Johns Hopkins University Press. Baltimore, Maryland, 1979.

This book attempts to determine whether a consensus can be established that will allow the U. S. to embark on a clear cut consistent national energy policy. It surveys the strenghts and constraints of the various energy sources and concludes that we must continue to rely on the conventional sources, primarily coal and nuclear (especially the breeder reactor), into the next century. Coal is known to be the most dangerous of all energy sources to human health and to the environment.

Coal-Bridge to the Future, by the World Coal Study, 1980.

This major policy book looks exclusively at coal and, as the title implies, from a world perspective. The participants, eighty of them, find a multitude of constraints preventing coal from taking its role as the primary transition fuel taking the world from exhaustible energy sources to the renewable sources that might be expected to assume their place sometime during the next century, but in each case the participants point to solutions to these constraints. This book is a call to action without which the future of coal will continue to be restricted and our reliance on uncertain energy sources will continue.

Energy in Transition 1985-2010 National Academy of Sciences. Washington, D.C. 1980.

The most comprehensive and sophisticated of the recent energy books. The authors are some of the most honored names in their respective fields. They anticipate coal supplying one third to one half of the nations' energy needs by the year 2000 but, due to the problems associated with coal use, demand, not supply, will continue to be the limiting factor in coal's future.

The Direct Use of Coal Office of Technology Assessment. Congress of the United States. Washington, D.C. 1979.

A detailed account of the various aspects of coal production and utilization, including the environmental and sociological implications. A well-documented, realistic analysis.

Economic and Fiscal Impacts of Coal Development: Northern Great Plains. John V. Krutilla and Anthony C. Fisher, Johns Hopkins University Press. Baltimore and London, 1978.

An indepth analysis of current and projected impacts of coal development on two counties in the heart of the western coal boom, Big Horn and Rosebird Counties, in Montana. Various growth senarios are used to project the economic and fiscal impacts stemming from coal development. The details of the impacts differ considerably from those found in Kentucky and the problems of growth addressed here are not the same as for Kentucky's more established coal areas but may be quite similar to those anticipated in Kentucky's synfuels counties.

Coal Data Book The President's Commission on Coal. Washington, D.C. 1980.

An exhaustive source of data on coal, including supply, demand, prices, labor force, technology and regulation. A useful reference book.

APPENDICES

APPENDICES

APPENDIX A-1

COAL RELATED STATUTES

BROAD CATEGORIES

I.	Coal Funds		
	A.	County Development Fund	42.300-310
	B.	Coal Severance Economic Aid Fund	42.330 thru .340 and 45.045
	C.	Energy Road Fund	177.960
	D.	Coal Impact Road Fund	177.960-.970
	E.	Coal Miners' Pneumoconiosis Fund	342.317
II.	Coal Tax		
	A.	Sales Tax on Electrical Power or Energy	96.820
	B.	Delinquent Taxpayer	131.181
	C.	Method of Taxing Unmined Coal	132.020 & .200
	D.	Taxing Coal Company Car	136.120
	C.	Gasoline	138.210
	D.	Gross receipts from sales to Ky. resident for home consumption	139.470
	E.	For the Manufacture of Electricity	139.480
	F.	Gross Income Derived from Disposal	141.010
	G.	Tax on Power of Attorney for Conveyance of Coal	142.010
	H.	Severance Tax	143.010 thru .100

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	A. Scope of Department, Duties and Qualifications of Employees	351.010 thru 351.191
	B. Mine Safety Analysis	351.241 thru .243
	C. Blasting Regulations (see also Regulations)	351.250 thru .990
IV.	Occupational Disease	
	A. Claims Procedure -- Employer Liability	342.316
	B. Security Against Liability to Workers	342.340
	C. Exemptions -- for Liability	342.650
	D. Application to Claims	342.800
V.	Processing	
	A. Coal Conversion Facility	103.200
	B. Machinery	139.170
	C. Manufacture of Electricity	139.480
	D. Coal Conversion	152.570
	E. Dry cleaning & Dyeing business	228.010-.230
	F. Extraction	350.010
	G. Stripmining	350.020
VI.	Research	
	A. Responsible Agency	152A.090
	B. Research Programs	152A.100
	C. Ky. Coal Research Board	351.250

VII. Regulation

A.	Public Scales	84.200
B.	Coal Factories	84.220
C.	Standards for Weights & Measures	86.130
D.	Sale of Coal Oil	234.210-.220
E.	Transporting Coal Products	281.627
F.	Strip Mining Regs.	Ch. 350
	1. Authority to adopt regs	350.029
	2. Permit required	350.060
	3. Reclamation Plan	350.090 thru .465
G.	Department of Mines & Minerals	Ch. 351
	1. Definitions, Duties & Qualifications of Commissioner	351.010 thru 351.070
	2. Exceptions to Mine Safety Standards	351.075
	3. Appointment of Mine Inspectors	351.090
	4. Certificate of Competency	351.102
	5. Board of Miner Training, Education and Certification	351.105
	6. Implementation of training program	351.107
	7. Qualifications of Mine Superintendents	351.108
	8. Coal Mine Electrician	351.109
	9. Mine Foreman & Assistant Mine Foreman	351.120
	10. First Aid Training	351.125

11.	Mine Inspector	351.140
12.	Coal Mine Owner	351.170
13.	Mine Weights or Scales	351.180
14.	Mine Rescue Divisions & Rescue Team	351.190 & 351.191
15.	Mine Safety Analysis	351.241
16.	Explosives	351.315
17.	Penalties	351.990
H.	Mining Regulations	Ch. 352
1.	Definitions	352.010
2.	Methods of Ventilation	352.020
3.	Underground Machinery	352.050
4.	Rock Dusting	352.060
5.	New or Additional Openings, Mine to Have 2 Openings	352.080 & 352.110
6.	Hoisting Devices	352.130
7.	Haulage Roads, Transportaton of Men, First Aid Equipment	352.150
8.	Electric Lamps; Electricity in Mines & Service Installations	352.170 and 352.220
9.	Explosives & Blasting Devices	352.241
10.	Duty of Mine Foreman -- Breakthroughs, measurement of air current	352.360
11.	Filing Map of Mine, Property Line	352.450 & 352.490
12.	Mining near Oil or Gas Wells	352.510
13.	Mine Scales, Weighman	352.520-.530
14.	Inclusion of clay mines	352.620

	I.	Oil, Gas, & Salt Water Wells	353.010 thru .720
	J.	Condemation of Underground Passageways	381.635 & .636
	K.	Recording of Conveyance	382.080
	L.	Lien for Rent	383.070
	M.	Leasing of Mineral Rights by Guardian & Committee	387.150 & 387.250
VIII.	Transportation		
	A.	Conditions of Roads, Construction of new Highway	175.640
	B.	Registration Fee for Motor Vehicles	186.050
	C.	Exemption of Motor Vehicles Use for Certain Purposes	281.605
	D.	Transportation of Coal Products	281.627
	E.	Transportation of Men (See Mining Regs-H7)	352.150

FEDERAL COAL REGULATIONS

MANDATORY CONVERSION TO COAL

Power Plant and Industrial Fuel Use Act of 1978, Public Law 95-620; enforced by the Department of Energy (DOE).

- This segment of the National Energy Act modifies and expands the coal conversion program which to-date has been administered by DOE under the Energy Supply and Environmental Coordination Act of 1974 (ESECA -- P.L. 93-319).

- This Act mandates utility and industrial conversion to coal by providing for:

  - Prohibition of New Oil- and Gas-Fired Facilities. The use of oil or natural gas as the primary fuel in new electric utility generation facilities or in new large industrial boilers with a heat input of 100 million Btu/hour or more (or aggregations of units with total capacity greater than 250 million Btu/hour) is prohibited, unless exemptions are granted by DOE. The burden of proving that exemptions are justified lies with the utility or industry companies. Grounds for exemption from conversion to coal include environmental regulations, site limitations, cost, and other factors. "New" facilities are defined as those for which construction commenced after April 20, 1977.

  - Restrictions on Existing Coal-Capable Facilities. Existing coal-capable utilities and large industrial boilers (100 million Btu/hour or greater) may be ordered, individually or in categories, to convert to coal or an alternative fuel; non-coal-capable units may be ordered to use coal-oil or other fuel mixtures. Coal capability is determined by DOE, and conversion orders are based on grounds of economic and technical feasibility.

  - Restrictions on Users of Natural Gas for Utility Fuel. The use of natural gas by existing utility power plants is limited to the proportion of total fuel used during the period 1974-1976, and no switches from oil to gas are allowed. With certain exceptions, the use of natural gas by utilities must cease by 1990.

  - Pollution Control Loan Program. An $800 million loan program is established to assist utilities that cannot raise the necessary funds for pollution control.

  - Energy Impact Assistance. A total of $180 million is allocated for energy impact assistance in regions particularly affected by expansion of coal and uranium production; several other provisions to reduce any negative impacts resulting from increased coal production are included.

  - Railroad Rehabilitation. $100 million is authorized for the rehabilitation of railroads for transportation of coal.

- Under ESECA, 32 existing electric power plants were targeted for conversion to coal, although only a few have been forced to convert. Relatively few orders have been issued to industrial facilities, and conversions have been delayed by requests for exemptions.

Clean Air Act Amendments of 1970 and 1977, Public Laws 91-604 and 95-95; enforced by the Environmental Protection Agency (EPA).

State Air Pollution Laws.

- The Clean Air Act's overall strategy for reducing air pollution includes the following elements:

  - National Ambient Air Quality Standards (NAAQS), promulgated by EPA, set ambient air quality limits for major pollutants including sulfur oxides (SO_x), nitrogen oxides (NO_x), and particulates. Individual states are permitted to establish more stringent standards.

  - State Implementation Plans (SIP) set sulfur and particulate standards for fossil fuel-burning utilities and large industrial boilers which began construction before August 17, 1971; these state limits may be more strict than those of NAAQS. SIPs are subject to EPA review, and their approval is contingent upon State specification of how the standards will be achieved (including emission limitations, compliance schedules, and enforcement provisions) within three years of Plan approval.

  - New Source Performance Standards (NSPS), issued by EPA, apply to coal- and other fuel-fired utilities and industrial boilers built or modified between August 17, 1971 and September 12, 1978. Sulfur limits are set at 1.2 lb SO_2/million Btu. For coal-fired units, compliance may be achieved by burning low-sulfur coal or by stack gas scrubbing.

  - Revised Utility New Source Performance Standards (NSPS II) regulations apply to new plants constructed after September 12, 1978. They require a "continuous reduction in emissions," which can be achieved with flue gas desulfurization, coal washing or new methods in combination. A minimum reduction in sulfur emissions (compared to the sulfur content of the raw coal) of 70% is required if net emissions are .6 lb SO_2/million or less. Unless emissions are this low, then a higher removal percentage is required - up to a maximum of 90% removal. For example 70% removal would be adequate on a coal with less than 2.0 lbs SO_2/million Btu while 90% is needed on a coal with 6.0 lbs SO_2/million Btu or more.

  - Prevention of Significant Deterioration (PSD) requirements affect new (constructed after September 12, 1978) fossil fuel-fired units built in "attainment" areas in which the air quality is higher than that required by the Standards. The granting of construction permits is contingent upon a demonstration that the additional sulfur oxide and particulate emissions do not exceed "maximum allowable concentrations," as specified by EPA on a case-by-case basis.

- Many states and localities have regulations which limit coal use or the allowable sulfur content of coal burned.

AIR POLLUTION CONTROL - COAL MINING AND PROCESSING

Clean Air Act Amendments of 1970 and 1977, Public Laws 91-604 and 95-95; enforced by EPA.

Surface Mining Control and Reclamation Act of 1977 (SMCRA), Public Law 95-87; enforced by OSM.

- The Environmental Protection Agency (EPA) regulates dust discharges from new coal-cleaning plants under the authority of its New Source Performance Standards for plants built or modified after October 24, 1974.

- The Office of Surface Mining (OSM) will require dust control measures such as paving, watering, or oiling haulroads at all mines, with a specific program to be developed as part of each mine permit.

RECLAMATION

Surface Mining Control and Reclamation Act of 1977 (SMCRA), Public Law 95-87; enforced by the Office of Surface Mining (OSM), Department of the Interior.

State Reclamation Laws.

- The Office of Surface Mining (OSM), established by SMCRA, will oversee enforcement of reclamation regulations by those states that submit programs conforming to the OSM regulations or will regulate directly in those states that do not. The contents of state plans are spelled out in detail in over 400 pages of OSM regulations.

- All surface mines and surface facilities of underground mines are regulated by SMCRA. Major requirements include:

  - Very detailed permit applications must be submitted by mine operators. These must include background environmental data, geology and water information, and detailed mining and reclamation plans.

  - All mined areas must be backfilled, graded to the approximate original contour, covered with topsoil (when present), and revegetated.

  - Sediment and acid in mine runoff are strictly controlled during mining, and pre-mining water quality levels must be attained before the operator's responsibility ends.

  - Construction of haulroads, spoil disposal areas, dams, and other mine facilities must meet detailed design and performance standards.

  - States must have procedures for the designation of lands unsuitable for mining, and certain areas such as alluvial valley floors in the West and "prime farmlands" are either specially protected or precluded from mining.

Federal Water Pollution Control Act Amendments of 1972 and 1977 (FWPCA), Public Laws 92-500 and 95-217; enforced by EPA.

Surface Mining Control and Reclamation Act of 1977 (SMCRA), Public Law 95-87; enforced by OSM.

State Water Laws.

- FWPCA establishes standards for water discharges from coal mines and preparation plants (washeries). Acid (pH), iron, sediment (total suspended solids – TSS), and manganese are the principal pollutants regulated. The numerical standards (effluent limitations) are:

Effluent Characteristics	(milligrams per liter) Maximum allowable	Average of daily values for 30 consecutive discharge days
Iron, total*	7.0	3.5
Manganese, total**	4.0	2.0
Total suspended solids†	70.0	35.0
pH	Within range of 6.0 to 9.0	

* For new mines, a maximum allowable level of 6.0 and 30-day average of 3.0.
** No manganese standards for alkaline mine drainage.
† Determined on a case-by-case basis in the states of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming.

- Permits for mines and plants are issued by the Environmental Protection Agency or by those states which have been granted the authority to do so.

- Under SMCRA, the Federal Office of Surface Mining (OSM) and approved state agencies will issue permits incorporating the EPA standards. In addition, the OSM regulations mandate a variety of specific pollution control measures, including burial of acid-forming materials, mulching and other erosion-control measures to reduce sediment, and sediment settling ponds.

- Most coal mining states regulate pollution discharges from mines. Effluent standards are generally comparable to EPA requirements for iron and pH, but are much less strict for suspended solids.

COAL MINE SAFETY

Coal Mine Health and Safety Act of 1969 (CMHSA), Public Law 91-173; enforced by Mine Safety and Health Administration (MSHA), Department of Labor.

Federal Mine Health and Safety Amendments Act of 1977, Public Law 95-164; enforced by MSHA.

- The CMHSA is intended to improve mine safety by requiring approval of mining plans and by establishing very detailed operational and design standards for underground and surface mines and preparation plants. Miner health is to be protected by respirable dust standards (limiting respirable dust levels to 2.0 milligrams/cubic meter, which operators can meet with ventilation and dust suppression measures) and by noise standards (developed by the Occupational Safety and Health Administration -- OSHA) which limit noise and exposure time levels.

- Principal areas covered by the safety standards (which fill 559 pages of the Code of Federal Regulations) are:

  - Ventilation. A minimum of 3000 cubic feet/minute of air must reach each working face, and methane concentrations must be below 1.0 percent in working areas. Ventilation must be kept within 10 feet of the working face.

  - Roof Control. Entry width is limited to 20 feet (except where special support is provided); minimum size and spacing of supports are specified.

  - Rock Dusting. Coating with powdered rock must be maintained within 40 feet of the faces.

  - Electrical. Only specially designed permissible (i.e., explosion-proof and tested by MSHA) electrical equipment may be used; "ground checks" to warn of short circuits must be provided.

  - Clean-up. All working areas must be free of loose coal and coal dust.

- MSHA inspectors may shut down a portion of or an entire mine if sufficient danger exists. During the period 1973 through 1978, a total of 502,000 notices of violations were served to underground coal mining operations, and 129,000 notices were served to surface mine operations.

FEDERAL COAL LEASING

Mineral Leasing Act of 1920.

Federal Coal Leasing Amendments Act of 1976 (FCLAA), Public Law 94-377; enforced by the Bureau of Land Management (BLM), Department of the Interior.

Federal Lands Policy and Management Act of 1976 (FLPMA), Public Law 94-579; enforced by BLM.

Surface Mining Control and Reclamation Act of 1977 (SMCRA), Public Law 95-87; enforced by OSM.

- Most Federal coal reserves lie in the western states. Leasing of Federal coal lands is expected to resume soon, ending a moratorium which was imposed in 1971 (in order to reassess Federal leasing policy) after a BLM study revealed that, while the amount of Federal coal under lease was rapidly increasing, production was declining.

- Leasing is now regulated under FCLAA which requires:

  - all leasing must be by competitive bidding,
  - minimum royalties of 12½ percent must be paid on surfaced mined coal or a lesser amount (currently 8%) at the discretion of the Secretary of the Interior,
  - leases must be developed "diligently" within 10 years.

- Land use planning to identify areas unsuitable for mining and to resolve conflicts between mining and other land uses must be completed before leases are offered.

OTHER REGULATIONS

- Railroad rates for coal are regulated by the Interstate Commerce Commission under Title 49, Subtitle 4, U.S. Code (P.L. 95-473, formerly the Interstate Commerce Act).

- Disposal of solid wastes at mines, preparation plants, and coal-burning facilities is governed by the Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act of 1976 (RCRA -- P.L. 94-580).

- Water pollution from coal-fired plants is regulated by EPA under the Clean Water Act of 1977 (P.L. 95-217).

- Federal coal leasing is affected by laws protecting endangered species and by the general requirements of the National Environmental Policy Act of 1969 (NEPA -- P.L. 91-190).

- Many states have special taxes on coal production, generally called "severance taxes," which are an indirect form of regulation.

- Coal-fired powerplants are subject to a myriad of other Federal, State, and local regulations affecting utility planning, plant siting and construction, safety, and other aspects of plant operation.

APPENDIX B

APPENDIX B-1

EASTERN KENTUCKY COAL MINES, PRODUCTION, AND EMPLOYEES, UNDERGROUND AND SURFACE, BY COUNTY, 1976

County	Underground			Surface			Total		
	Mines	Tonnage	Employees	Mines	Tonnage	Employees	Mines	Tonnage	Employees
Bell	25	1,260,047	502	55	3,263,950	1,007	80	4,523,997	1,509
Boyd	--	--	--	8	267,345	75	8	267,345	75
Breathitt	7	20,635	21	74	6,352,073	1,139	81	6,372,708	1,160
Carter	1	472	2	43	333,430	318	44	333,902	320
Clay	30	221,243	225	56	569,828	370	86	791,071	595
Elliott	--	--	--	18	373,234	183	18	373,234	183
Floyd	119	2,214,695	1,026	64	2,346,878	638	183	4,561,573	1,664
Greenup	--	--	--	17	102,050	110	17	102,050	110
Harlan	160	8,564,246	3,226	81	1,938,478	724	241	10,502,724	3,950
Jackson	3	202,078	99	27	605,040	154	30	807,118	253
Johnson	7	90,091	95	90	2,719,413	1,156	97	2,809,504	1,251
Knott	115	2,785,781	1,659	62	1,535,067	462	177	4,320,848	2,121
Knox	22	118,192	154	52	993,331	470	74	1,111,523	624
Laurel	6	32,010	98	73	1,173,261	698	79	1,205,271	796
Lawrence	--	--	--	35	1,166,374	471	35	1,166,374	471
Lee	--	--	--	14	276,812	152	14	276,812	152
Leslie	124	1,885,304	747	90	2,524,854	696	214	4,410,158	1,443
Letcher	150	2,866,504	2,143	48	1,259,104	332	198	4,125,608	2,475
McCreary	5	362,419	260	8	244,850	84	13	607,269	344
Magoffin	9	71,707	68	48	2,171,237	902	57	2,242,944	970
Martin	29	2,796,512	1,099	66	5,363,461	2,026	95	8,159,973	3,125
Menifee	--	--	--	2	2,550	6	2	2,550	6
Morgan	--	--	--	41	604,393	376	41	604,393	376
Owsley	1	30,000	8	21	264,595	176	22	294,595	184
Perry	70	2,366,256	1,319	150	5,106,995	1,933	220	7,473,251	3,252
Pike	407	14,219,923	6,807	138	4,782,078	1,141	545	19,002,001	7,948
Pulaski	6	139,610	77	8	321,679	118	14	461,289	195
Rockcastle	1	500	2	9	54,327	57	10	54,827	59
Wayne	--	--	--	4	168,551	53	4	168,551	53
Whitley	6	108,534	65	93	1,389,424	991	99	1,497,958	1,056
Wolfe	--	--	--	11	345,496	61	11	345,496	61
Totals:	1,303	40,356,759	19,702	1,506	48,620,156	17,079	2,809	88,976,915	36,781

Source: Kentucky Dept. of Mines and Minerals, Annual Report, 1976.

APPENDIX B-2

EASTERN KENTUCKY COAL PRODUCTION AND EMPLOYMENT
RANKED BY COUNTY PRODUCTION, 1976

County	Production		Employees	
	Tonnage	% of KY (E) Total	Number	% of KY (E) Total
Pike	19,002,001	21.36	7,948	21.60
Harlan	10,502,724	11.80	3,950	10.74
Martin	8,159,973	9.17	3,125	8.50
Perry	7,473,251	8.40	3,252	8.84
Breathitt	6,372,708	7.16	1,160	3.15
Floyd	4,561,573	5.13	1,664	4.52
Bell	4,523,997	5.08	1,509	4.10
Leslie	4,410,158	4.96	1,443	3.92
Knott	4,320,848	4.86	2,121	5.77
Letcher	4,125,608	4.64	2,475	6.73
Johnson	2,809,504	3.16	1,251	3.40
Magoffin	2,242,944	2.52	970	2.64
Whitley	1,497,958	1.68	1,056	2.87
Laurel	1,205,271	1.35	796	2.16
Lawrence	1,166,374	1.31	471	1.28
Knox	1,111,523	1.25	624	1.70
Jackson	807,118	0.91	253	0.69
Clay	791,071	0.89	595	1.62
McCreary	607,269	0.68	344	0.94
Morgan	604,393	0.68	376	1.02
Pulaski	461,289	0.52	195	0.53
Elliott	373,234	0.42	183	0.50
Wolfe	345,496	0.39	61	0.17
Carter	333,902	0.38	320	0.87
Owsley	294,595	0.33	184	0.50
Lee	276,812	0.31	152	0.41
Boyd	267,343	0.30	75	0.20
Wayne	168,551	0.19	53	0.14
Greenup	102,050	0.11	110	0.30
Rockcastle	54,827	0.06	59	0.16
Menifee	2,550	0.002	6	0.02
Totals:	88,976,915	100.00	36,781	99.99

Source: Kentucky Department of Mines and Minerals, Annual Report, 1976.

APPENDIX B-3

EASTERN KENTUCKY COAL MINES, PRODUCTION, AND EMPLOYEES, UNDERGROUND AND SURFACE, BY COUNTY, 1977

County	Underground			Surface			Total		
	Mines	Tonnage	Employees	Mines	Tonnage	Employees	Mines	Tonnage	Employees
Bell	28	1,511,857	681	59	3,644,492	909	87	5,156,349	1,590
Boyd	--	--	--	13	561,125	213	13	561,125	213
Breathitt	12	97,275	61	87	5,629,078	1,199	99	5,726,353	1,260
Carter	1	4,000	5	42	405,547	326	43	409,547	331
Clay	29	371,673	379	51	876,414	531	80	1,248,087	910
Elliott	--	--	--	26	705,841	357	26	705,841	357
Floyd	167	2,635,354	1,234	52	2,909,417	633	219	5,548,771	1,867
Greenup	--	--	--	16	232,922	116	16	232,922	116
Harlan	163	9,000,062	3,998	71	1,813,598	749	234	10,813,660	4,747
Jackson	4	156,090	94	7	101,982	43	11	258,072	137
Johnson	10	122,848	144	70	2,993,057	1,367	80	3,115,905	1,511
Knott	152	2,817,900	1,879	103	2,511,334	820	255	5,329,234	2,699
Knox	12	104,614	148	65	1,390,153	920	77	1,494,767	1,068
Laurel	3	4,398	7	64	1,354,280	642	67	1,358,678	649
Lawrence	--	--	--	51	1,551,040	678	51	1,551,040	678
Lee	6	35,708	27	15	298,041	175	21	333,749	202
Leslie	115	1,839,893	813	103	2,078,378	1,080	218	3,918,271	1,893
Letcher	185	3,183,522	1,960	69	1,558,565	545	254	4,742,087	2,505
McCreary	8	189,852	110	16	466,626	206	24	656,478	316
Magoffin	11	72,421	77	48	2,150,735	729	59	2,223,156	806
Martin	36	2,645,751	1,368	61	6,297,782	3,378	97	8,943,533	4,746
Menifee	--	--	--	1	16,217	14	1	16,217	14
Morgan	1	22,000	5	40	1,094,047	758	41	1,116,047	763

(Continued)

Continued

County	Underground			Surface			Total		
	Mines	Tonnage	Employees	Mines	Tonnage	Employees	Mines	Tonnage	Employees
Owsley	2	--	--	23	499,747	227	25	499,747	227
Perry	89	2,534,125	1,495	174	6,127,865	2,278	263	8,661,990	3,773
Pike	462	13,963,233	7,616	124	4,024,995	1,058	586	17,988,228	8,674
Pulaski	4	52,500	31	11	396,770	150	15	449,270	181
Rockcastle	--	--	--	7	20,548	29	7	20,548	29
Wayne	--	--	--	9	284,266	121	9	284,266	121
Whitley	3	103,425	84	105	1,982,334	1,339	108	2,085,759	1,423
Wolfe	--	--	--	10	483,296	164	10	483,296	164
Totals:	1,503	41,472,501	22,216	1,593	54,460,492	21,754	3,096	95,932,993	43,970

Source: Kentucky Dept. of Mines and Minerals, Annual Report, 1977.

APPENDIX B-4

EASTERN KENTUCKY COAL PRODUCTION AND EMPLOYMENT
RANKED BY COUNTY PRODUCTION, 1977

County	Production		Employees	
	Tonnage	% of Total	Number	% of Total
Pike	17,988,228	18.75	8,674	19.73
Harlan	10,813,660	11.27	4,747	10.80
Martin	8,943,533	9.32	4,746	10.79
Perry	8,661,990	9.03	3,773	8.58
Breathitt	5,726,353	5.97	1,260	2.86
Floyd	5,548,771	5.78	1,867	4.25
Knott	5,329,234	5.55	2,699	6.14
Bell	5,156,349	5.37	1,590	3.62
Letcher	4,742,087	4.94	2,505	6.70
Leslie	3,918,271	4.08	1,893	4.31
Johnson	3,115,905	3.25	1,511	3.44
Magoffin	2,223,156	2.32	806	1.83
Whitley	2,085,759	2.17	1,423	3.24
Lawrence	1,551,040	1.62	678	1.54
Knox	1,494,767	1.56	1,068	2.43
Laurel	1,358,678	1.42	649	1.48
Clay	1,248,087	1.30	910	2.07
Morgan	1,116,047	1.16	763	1.73
Elliott	705,841	0.73	357	0.81
McCreary	656,478	0.68	316	0.72
Boyd	561,125	0.58	213	0.48
Owsley	499,747	0.52	227	0.51
Wolfe	483,296	0.50	164	0.37
Pulaski	449,270	0.47	181	0.41
Carter	409,547	0.43	331	0.75
Lee	333,749	0.35	202	0.46
Wayne	284,266	0.30	121	0.27
Jackson	258,072	0.27	137	0.31
Greenup	232,922	0.24	116	0.26
Rockcastle	20,548	0.02	29	0.06
Menifee	16,217	0.01	14	0.03
Totals:	95,932,993	100.04	43,970	100.99

Source: Kentucky Dept. of Mines and Minerals, Annual Report, 1977.

APPENDIX B-5

WESTERN KENTUCKY COAL MINES, PRODUCTION, AND EMPLOYEES, UNDERGROUND AND SURFACE, BY COUNTY, 1976

County	Underground			Surface			Total		
	Mines	Tonnage	Employees	Mines	Tonnage	Employees	Mines	Tonnage	Employees
Butler	1	54,021	14	29	874,321	272	30	928,342	286
Christian	--	--	--	5	219,595	56	5	219,595	56
Daviess	--	--	--	6	1,004,726	148	6	1,004,726	148
Edmonson	--	--	--	1	--	--	1	--	--
Grayson	--	--	--	3	11,311	10	3	11,311	10
Hancock	--	--	--	5	130,602	39	5	130,602	39
Henderson	2	972,513	154	--	--	--	2	972,513	154
Hopkins	8	5,294,839	1,465	41	4,480,366	672	49	9,775,205	2,137
McLean	--	--	--	5	751,381	130	5	751,381	130
Muhlenberg	7	4,947,484	1,455	13	16,226,907	2,017	20	21,174,391	3,472
Ohio	4	3,183,190	1,362	35	6,177,605	1,007	39	9,360,795	2,369
Union	7	7,632,321	2,278	--	--	--	7	7,632,321	2,278
Warren	--	--	--	2	14,260	18	2	14,620	18
Webster	1	1,803,988	215	18	502,717	162	19	2,306,705	377
Totals:	30	23,888,356	6,943	163	30,394,151	4,531	193	54,282,507	11,474

Source: Kentucky Dept. of Mines and Minerals, Annual Report, 1976.

APPENDIX B-6

WESTERN KENTUCKY COAL PRODUCTION AND EMPLOYMENT
RANKED BY COUNTY PRODUCTION, 1976

County	Production		Employees	
	Tonnage	% of KY (W) Total	Number	% of KY (W) Total
Muhlenberg	21,174,391	39.00	3,472	30.26
Hopkins	9,775,205	18.00	2,137	18.62
Ohio	9,360,795	17.24	2,369	20.65
Union	7,632,321	14.06	2,278	19.85
Webster	2,306,705	4.25	377	3.29
Daviess	1,004,726	1.85	148	1.29
Henderson	972,513	1.79	154	1.34
Butler	928,342	1.71	286	2.49
McLean	751,381	1.38	130	1.13
Christian	219,595	0.40	56	0.49
Hancock	130,602	0.24	39	0.34
Warren	14,620	0.03	18	0.16
Grayson	11,311	0.02	10	0.09
Edmonson	0	0.00	0	0.00
Totals:	54,282,507	99.97	11,474	100.00

Source: Kentucky Dept. of Mines and Minerals, Annual Report, 1976.

APPENDIX B-7

WESTERN KENTUCKY COAL MINES, PRODUCTION, AND EMPLOYEES, UNDERGROUND AND SURFACE, BY COUNTY, 1977

County	Underground			Surface			Total		
	Mines	Tonnage	Employees	Mines	Tonnage	Employees	Mines	Tonnage	Employees
Butler	1	21,490	14	36	996,591	332	37	1,018,081	346
Caldwell	--	--	--	3	76,668	17	3	76,668	17
Christian	--	--	--	5	244,414	54	5	244,414	54
Daviess	--	--	--	5	965,485	137	5	965,485	137
Edmonson	--	--	--	2	1,865	6	2	1,865	6
Grayson	--	--	--	2	63,500	25	2	63,500	25
Hancock	--	--	--	5	32,928	38	5	32,928	38
Henderson	1	573,622	117	--	--	--	1	573,622	117
Hopkins	8	5,110,333	1,568	41	5,208,693	718	49	10,319,026	2,286
McLean	--	--	--	3	669,834	114	3	669,834	114
Muhlenberg	8	4,929,309	1,666	15	12,424,036	1,997	23	17,353,345	3,663
Ohio	4	2,822,428	1,442	42	7,118,080	1,326	46	9,940,508	2,768
Union	7	6,928,408	2,428	--	--	--	7	6,926,408	2,428
Warren	--	--	--	1	15,850	8	1	15,850	8
Webster	4	2,408,124	474	22	1,063,344	291	26	3,471,468	765
Totals:	33	22,793,714	7,709	182	28,881,288	5,063	215	51,673,002	12,772

Source: Kentucky Dept. of Mines and Minerals, Annual Report, 1977.

APPENDIX B-8

WESTERN KENTUCKY COAL PRODUCTION AND EMPLOYMENT
RANKED BY COUNTY PRODUCTION, 1977

County	Production		Employees	
	Tonnage	% of Total	Number	% of Total
Muhlenberg	17,353,345	33.58	3,663	28.68
Hopkins	10,319,026	19.97	2,286	17.90
Ohio	9,940,508	19.24	2,768	21.67
Union	6,926,408	13.40	2,428	19.01
Webster	3,471,468	6.72	765	5.99
Butler	1,018,081	1.97	346	2.71
Daviess	965,485	1.87	137	1.07
McLean	669,834	1.30	114	0.89
Henderson	573,622	1.11	117	0.92
Christian	244,414	0.47	54	0.42
Caldwell	76,668	0.15	17	0.13
Grayson	63,500	0.12	25	0.19
Hancock	32,928	0.06	38	0.30
Warren	15,850	0.03	8	0.06
Edmonson	1,865	0.003	6	0.05
Totals:	51,673,002	99.99	12,772	99.99

Source: Kentucky Dept. of Mines and Minerals, Annual Report, 1977.

APPENDIX C

APPENDIX C-1

ENERGY AND ECONOMIC GROWTH IN THE UNITED STATES

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The MIT Press
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THE FUTURE OF COAL

Introduction

The long-term competitive position of the relatively abundant coal reserves has apparently improved significantly as a result of dwindling domestic supplies of oil and natural gas. Coal is now the cheapest of the fossil fuels on a Btu basis, but the costs of burning it are rising, primarily as a consequence of federally mandated pollution controls and other regulatory measures. Whereas in 1976 coal seemed assured of a larger and rapidly growing share of the public utility and industrial fuels markets, replacing oil and natural gas, this outcome now is much less certain.

In President Carter's National Energy Plan (NEP), there is the statement (1):

> Industry and utilities consumed 4.8 million barrels of oil per day and 5.9 million barrels of oil equivalent in the form of natural gas in 1976. Oil and natural gas are scarce, and generally they are needed more by other sectors of the economy. Industry and utilities can convert to other energy sources more readily than can other users; therefore a large scale conversion by industry and utilities from oil and gas to more abundant resources is needed.

The future quantities of coal consumed will depend upon (i) the interpretation of federal legislation already enacted or yet to pass the Congress and (ii) the success of research, development, and demonstration (RD&D) programs designed to make the burning of coal more acceptable environmentally.

Institute for Energy Analysis projections of base-line domestic coal demand

by the year 2000 range from 31.5 to 38.8 quads in the two scenarios given in this study, compared to 13.7 quads in 1976. This is a compound annual growth of from 3.0 to 3.9 percent. It is anticipated that the fastest growth will come in the western Great Plains states and will increase the proportion of low-sulfur coal mined. However, western reserves are extensive and the rates of growth projected are well within the bounds of present manpower and equipment availabilities. The industry can be characterized as one of relatively constant cost, with ease of entry, modest capital requirements, long-term contract marketing arrangements for most of its products, and abundant reserves. Hence, the increase in output is not supply-limited in raw materials, manpower, or capital. Cost increases in mining coal are primarily a consequence of four developments: (i) higher health and safety standards for coal miners, (ii) mandated restoration of strip-mined areas, (iii) environmental and legal complications on the federal leasing of coal lands, and (iv) highly inflationary wage settlements granted to the United Mine Workers of America. Each of these developments is discussed briefly below.

Mine Health and Safety Costs

Much eastern coal must be recovered from deep mines, which historically has meant a high rate of attendant loss of life or incapacitation caused by accidents and pulmonary disease. A consequence of the Coal Mine Health and Safety Act of 1969 has been the issuance of new health and safety standards by the Department of the Interior for both underground and surface mines. One major problem is coal dust, which is linked to the incidence of black lung; benefit payments plus administrative expense under programs operated by the Social Security Administration and the Department of Labor now amount to about $1 billion a year (2). In addition, costs of coal mine accidents amounted to $57 million in 1974 (3). One federal government report estimates that, if the fatality and disability injury rate does not improve greatly from the 1975 rate, from 3400 to 4700 miners could be killed and 253,000 to 351,000 disabled in the 25-year period from 1975 to 2000 [(4), p. 4137]. The difference in these predictions represents two different estimates of coal production to 2000.

Since the passage of the Coal Mine Health and Safety Act of 1969, there has been an 8-year decline in productivity which cumulatively totaled more than 50 percent. Underground mines registered an average output per man per day of only 8.5 tons in 1976 (5). Not all of the decline in productivity may be

attributable to the 1969 act, although the statistics on productivity record a decline thereafter. Declines in productivity have been reflected in higher prices since 1970. If the productivity trend continues to be negative, then the long-term competitive position of coal will weaken. A complicating factor has been the laws passed during the Carter Administration designed to slow the expansion of highly efficient western coal mines and to stimulate output in the Appalachian and midwestern states where productivity is comparatively low. This development is discussed below in the paragraphs on the best available control technology. Table B-1 compares the performance of the high-production states to Pennsylvania, even though about half of Pennsylvania's coal is strip-mined.

Strip-Mining Costs

The passage of a strip-mining law in 1977 requires, among some 25 provisions, that mining companies restore stripped land to a condition capable of supporting whatever function for which it was used prior to coal mining (7). The law sets up a $4.1 billion fund to pay for the restoration of strip-mined land already abandoned. It also includes restrictions on mining coal under agricultural land and gives farmers and ranchers veto power over mining on their land, even though the mineral rights belong to others including the federal government. Implementing regulations were announced late in 1977 and have been criticized as being far more severe than the law requires. It undoubtedly will be several years before the financial and production implications of tighter control over strip-mining will be measurable, but there is no question that mining costs will increase as a consequence.

Table B-1.
Coal mining average output (in tons per man per day), 1975 (6)

State	Output
Arizona	69.66
Montana	127.25
North Dakota	86.86
Texas	76.49
Pennsylvania	11.46

Federal Leasing of Coal Lands

The policies and actions of the federal government on the leasing of government-owned coal lands are important in the development of the industry because the western lands owned by the federal government contain an estimated 40 percent of the nation's coal reserves. Most of this coal is located on federal lands, but only a few percent of U.S. coal output in 1975 came from this source. Concern over inactive leases led to the imposition of a 2-year leasing moratorium (May 1971 to February 1973). Only a few short-term leases have been granted since then.

Formerly, it was possible for a private firm or an individual to obtain a prospecting permit to explore for commercial deposits of coal on specific locations (up to 5120 acres) of federally owned lands. The Mineral Leasing Act of 1920 provides for the issuance of such permits, but on January 26, 1976, the Secretary of the Interior decided on a leasing policy under which no further prospecting permits would be issued. Moreover, the 1976 amendments to the Mineral Leasing Act impose an additional role for government regulation, including the requirement that leases be developed within a decade (8).

The requirement for an environmental impact statement as part of the development plan submitted to the Department of the Interior's Bureau of Land Management has been an additional source of delay. Environmental lawsuits are delaying new leases as well. A spokesman for the General Accounting Office believes that the mass of restrictions will hold 1985 coal output below 1×10^9 tons, compared to the federal goal of 1.265×10^9 tons. The NEP projects that coal use by utilities in 1985 will equal 16.6 quads, compared to 9.8 quads in 1976. It is most unlikely that utilities will consume this much coal in 1985 [(4), p. 2].

United Mine Workers Wage Settlement

With the growth of western coal mining, the share of the national production accounted for by miners affiliated with the United Mine Workers (UMW) has been dropping. Currently, the UMW accounts for only slightly over half of the total production. The 1978 wage settlement was preceded by a very large wage increase in 1974. In order that wage increases be noninflationary, they are supposed to be tied to productivity increases. But, since productivity trends have been negative in coal mining, wage increases are automatically inflationary. Initial estimates are that the 1978 wage settlement will increase the miner's pay by about $4.50 an hour over the 3-year period of the contract (9). However, the impact on coal prices will depend very importantly on what happens to productivity. Unless productivity begins to improve, the incentives to shift to coal in President Carter's 1977 energy program may well be eroded.

The BACT Requirement

Apart from the four major factors discussed above which affect coal mining costs, there are additional regulatory actions which increase the cost of coal use. The best available control technology (BACT) requirement is the most important of these.

Regulations controlling the emission of sulfur dioxide (SO_2) seriously inhibit additional coal use. Environmentalists, regional political groups, state governments, and the U.S. Environmental Protection Agency (EPA) have combined to impose more stringent requirements. In 1977, the option of using low-sulfur western coal to meet environmental standards was circumscribed by the amendments to the Clean Air Act.

A major stimulus to the mining and use of low-sulfur coal in the West was the passage of the Clean Air Act Amendments of 1971, which required new coal-fired power plants built after that time to emit not more than 1.2 pounds of SO_2 per 10^6 Btu of heat input. The utilities turned to the use of so-called conforming coal, that is, coal that could be burned without scrubbers and still conform to the new federal standards. The new requirement boosted the competitive position of low-sulfur western coal, particularly from the northern Great Plains region of Wyoming and Montana. This coal quickly penetrated into the East North Central states to meet the new source performance standards. Utilities in Illinois, the largest coal-producing state in the Midwest, were drawing one-third of their coal supply from the West by 1975. Virtually no western coal was burned in Michigan and Ohio in 1973 because of the greater shipping distances, but by 1975 over 3×10^6 tons were burned by utilities in these two states (10).

For existing power plants, the individual states were given jurisdiction over the environmental standards. State implementation plans vary widely, and many states now have emission standards that are more stringent than the federal regulations.

The passage of the Clean Air Act Amendments of 1977 (11) introduced a new regulation of great regional importance to the coal industry, since it negated the competitive positions of western coal in midwestern markets. It requires the use of BACT, which today means stack scrubbers (a stack scrub-

ber is designed to remove pollutants, such as SO_2 or particulate matter, from stack gas emissions before these gases are emitted into the atmosphere). There are two primary difficulties with stack scrubbers: (i) they do not work very well, and (ii) they are very expensive.

Section III of the Clean Air Act Amendments of 1977 [(11), p. 29] states that for new stationary power plants

> . . . a standard of performance shall reflect the degree of emission limitation and the percentage reduction achievable through application of the best technological system of continuous emission reduction.

The standard of performance established by the EPA requires a fixed percentage reduction in emissions regardless of the sulfur content of the coal being burned, which effectively removed much of the economic incentive to transport low-Btu western coal long distances. The EPA has the authority to set the percentage reduction that will apply. In a draft document (12), it proposed 90 percent sulfur removal as the general requirement. This proposed standard may be eased before the issuance of a regulation. However, it is probable that any new utility plants constructed after early 1978 will need to incorporate flue gas desulfurization (FGD). The EPA is required to review the situation every 4 years and set new standards for BACT, and standards may become stiffer.

The impact of the BACT requirement is to increase utility investment costs by 20 percent or more. There is also an additional operating cost for absorbent materials, additional energy needed to operate the scrubbers, and the expense of disposing of the sludge. Overall, these cost increases would seem to favor additional nuclear-powered steam-generating plants in cases where coal-fired steam-generating plants had been comparable in cost.

RD&D and Future Coal Demand

The foregoing analysis leads us to the conclusion that coal demand is likely to fall far short of the tonnages projected in Carter Administration plans. Those who are optimistic about coal's future expect that research and development will mitigate the major environmental obstacles that now inhibit the mining and burning of coal. In President Carter's NEP, coal has been chosen to play a key role as the "swing fuel" for the rest of this century at least or until the so-called "inexhaustibles" (solar power and the breeder reactors primarily) can be brought into general commercial use. Coal represents 90 percent of the nation's conventional fuel reserves; its production could be expanded relatively quickly if it can be made environmentally acceptable. But greater coal utilization may require environmental compromises with present regulatory requirements even if RD&D programs are successful.

The energy demand scenarios of IEA for the year 2000 anticipate that electricity will expand its share of the total energy supply to 46 percent or more, compared to 28 percent in 1975, and that electric power utilities provide the largest coal market. A number of Department of Energy (DOE) research and development (R&D) programs are designed to make coal burning environmentally acceptable. These are described below. If additional large-scale expansion of direct coal burning proves to be unacceptable, a long-run alternative could be the production of synthetic gas from coal.

Coal Mining

Except for in situ gasification, there are no federally sponsored R&D efforts on coal mining of significance. There are small programs on technology and health and safety. Since productivity in deep (underground) mining has fallen from over 15 tons per man per day in the late 1960s to 8.5 tons in 1976, coal costs have risen sharply. Clearly, there is a need for new technologies for deep mining as well as the related safety equipment—improved ventilation systems and techniques for coping with various mine gases and with coal and rock dust.

Direct Combustion of Coal

Technologies in development designed to meet the problem of direct combustion applications include improved FGD and fluidized-bed combustion (FBC). The problems of the disposal of sludge from stack scrubbers and waste from FBC systems are serious and have not yet been solved. Other technologies under study are front-end coal cleaning by grinding and washing and the solvent-refined coal processes, which use chemical means to remove most of the sulfur content. The White House has stated, with respect to coal research (13), that

> the highest immediate priority is the development of more effective, economical methods to meet air pollution control standards.

Flue Gas Desulfurization

The leading short-run technology is stack gas cleaning. In early 1978, there were about 30 such units in operation, an equal number under construction, and 65 in the planning stage or beyond (14). This represents significant mar-

ket penetration. Operational problems have been mainly mechanical, associated with corrosion and erosion. First-generation scrubbers have worked best on low-sulfur coal (these are all lime-limestone systems). The second-generation scrubbers, some of which are in the design stage, are expected to be much improved in efficiency and reliability. Although the improved operational aspects are important, the more elaborate equipment incorporated in second-generation models means that capital costs will probably increase.

The Fluidized Bed

When fluidized-bed technologies become commercially available (these are expected before or by 1990), they could help to make coal the key transitional fuel. At present, there is no operating commercial utility plant that utilizes the fluidized bed. The three major future uses of coal, all of which would be appropriate markets for the fluidized bed, in order of probable quantities of coal consumed, are (i) electric utility boilers, (ii) industrial steam boilers, and (iii) commercial establishments (schools, hospitals, office complexes) above a minimum size.

In FBC, the fuel that is burned has earlier been mixed with some inert material and expanded (fluidized) into a relatively thick layer by the passage of air through it. At a gas velocity of three to five times the fluidizing velocity, the bed behaves like a violently boiling liquid. The bubbling action provides a high degree of particle mixing and good circulation with the exposure of a large surface area of particles.

The FBC system uses coal particles and limestone sorbent. The limestone reacts with the SO_2 produced during the combustion and is further oxidized to produce calcium sulfate which is removed with the ashes. This reaction eliminates the need to remove the oxides of sulfur (SO_x) from the stack gases.

Two varieties of fluidized-bed combustors are distinguished on the basis of whether they are "atmospheric," air being supplied to the bed at near atmospheric pressure, or "pressurized," air supplied at 4 to 10 atmospheres. As with stack scrubbers, there are problems of corrosion, erosion, and waste disposal with fluidized beds. The strategy of FBC systems development is to make coal acceptable or a substitute for oil and gas in utilities and major electricity-generating plants (15). At current rates of development, it will probably be 1985 or later before the atmospheric system is tested in a major utility mode.

The justification for a pressurized fluidized-bed system operating at 10 atmospheres rests on burning high-sulfur coal—at much increased conversion efficiencies, to be achieved with advanced power systems. Combined cycle efficiencies await the development of a gas turbine for pressurizing and for power generation. There is one report of the pressurized fluidized-bed system achieving very high SO_x removal efficiencies, on the order of 99 percent (16). The development program is in an early stage.

It was estimated in 1976 that, by the year 2000, direct combustion systems could replace between 6 and 8 quads of oil and gas [(15), p. 22]. Perhaps 2 quads of this total would be in electric utilities. This would mean an additional 300×10^6 to 400×10^6 tons of coal consumed, depending upon the proportion of low-Btu western coal in the mix. If roughly one-half of the success of advanced direct combustion systems was reflected in increased coal output (200×10^6 tons), this would be an equivalent oil saving of 2.3×10^6 barrels a day [(4), p. 9.16].

Market Penetration

One major reason for believing that coal could take over a large share of the industrial energy market, as well as the utility market, is the support of the Carter Administration for the expansion of coal use as reflected in the NEP. Under this plan, the capital cost of steam-generating facilities fired by coal are assumed to be reduced very significantly as a result of the proposed tax and rebate provisions. These provisions may be eliminated or modified by the Congress when an NEP finally emerges.

Considering the electric utility market, it is not clear that the success of FGD and FBC systems will result in any significant displacement of other fossil fuels or of nuclear-powered electricity-generating plants by 2000. Acting Energy Research and Development Administration administrator Robert Fri testified in September 1977 that, even adding the costs of waste disposal and decontamination and the decommissioning of nuclear power reactors, nuclear power would still have a cost advantage over coal-fired units (17). Projections of IEA to 2000 of electric power generation by natural gas and coal are quite small—3.1 quads in the 101- and 126-quad scenarios—and are confined to nonbase-load applications except in the case of New England.

Virtually all petroleum allocated in the IEA scenarios to industry in 2000 would be needed for feedstocks. However, after allowing for nonconvertible industrial uses of natural gas, there is an estimated 6.4 quads of convertible uses. Only about 1 quad of natural gas consumption by industry represents uses where gas would be essential.

More Advanced Technologies

In electric utility power generation, there are a number of advanced power systems still in the R&D stage which may be used if the technology of direct coal combustion proves to be unacceptable from an environmental or cost standpoint. The molten carbonate fuel cell with gasifier and the open-cycle gas turbine/integrated gasifier combined cycle are two of the more promising new coal-based electric-power generation technologies

Much of the available information on these two systems is based upon analytical studies rather than on data derived from pilot plant or industrial use (18). Production of electric power from coal-derived synthetic fuels with the open-cycle gas turbine appears promising. However, electric utilities have had problems with gas turbines used for peaking power because these units have been marketed after only a few hundred hours of prototype testing. Hence, any market penetration estimate and the associated capital costs are tentative.

Molten Carbonate Fuel Cell/Steam Power Plant

This system is believed to possess significant environmental advantages over fluidized-bed systems, with respect to SO_x, oxides of nitrogen, and particulates. High thermal efficiencies may possibly reduce the coal consumed by 25 percent compared to FGD plants. There are major uncertainties in fuel cell technology and in the complementary coal gasification system. Commercialization is not likely until the 1990s. The combined cycle systems may be available sooner or later, depending on whether emphasis is placed on higher efficiency or on more conventional technology.

Combined Cycle Turbine/Steam System

The combined cycle gas turbine/steam turbine is a promising, relatively clean, coal-based electric power-generating technology. It utilizes low-Btu gas produced at the power plant site. This gas is used to fuel a gas turbine generator system, exhausting to a heat recovery steam generator. This combination produces higher thermal efficiencies without environmental degradation. The thermal efficiencies of conventional steam power plants are limited to 38 to 40 percent. A pilot plant (Powerson) is at Pekin, Illinois (70 percent of costs have been paid by the federal government and 30 percent by private utilities) (19).

Open Cycle Magnetohydrodynamics

The open cycle magnetohydrodynamics system (MHD) in principle may be technologically attractive, since it could save about one-third on the coal requirement of a conventional plant equipped with FGD. Some aspects of the engineering feasibility of MHD have been demonstrated in small-scale tests with natural gas, but commercial operation is a long way off. The U.S.S.R. has been experimenting with this system. The environmental advantages of MHD over competitive advanced systems have yet to be established.

An MHD generator replaces both the steam turbine and the generator, and uses the combustion gases directly rather than operating through a water-heating, steam-producing unit which drives the turbine. Under the MHD principle, when gases are heated to high enough temperatures, some of the electrons are discharged from the gas molecules and the gas becomes "ionized," that is, it conducts electricity. The ionized gas can then be passed through a channel positioned in a magnetic field to induce a current flow (20).

With all coal-burning systems, there is some environmental degradation. Moreover, although carbon dioxide (CO_2) emissions may not be a direct hazard to human health, their accumulation in the atmosphere has potentially serious climatic effects. Some scientists have warned that, after CO_2 accumulates in the atmosphere to an as yet unspecified point, the warming trend will trigger global changes in climate and weather. More study is needed (21).

The environmental benefits of delaying conversions to coal may not, in themselves, be of sufficient magnitude to constitute a serious challenge to the Carter Administration's timing on the shift to coal. However, the problems of burning coal in larger quantities raise some serious questions, and both the Carter Administration and environmentalists will almost certainly be increasingly concerned with these.

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APPENDIX C-2

TABLE 9-5

EASTERN KENTUCKY PROJECTED NEW AND EXPANDED PRODUCTION BY 1985 (In million tons)

County	National Coal Association 1977	Bureau of Mines 1978	Coal Age/ Keystone 1979
Bell	1.30	1.30	1.50
Breathitt	4.30	7.68[a]	4.30
Floyd	0.50	--	--
Harlan	2.50	2.10	2.65
Johnson	0.50	0.50	--
Knott	0.88[b]	0.60	0.50
Knox	--	6.66[a]	2.10
Leslie	0.38[c]	--	--
Letcher	1.35	0.75	3.95
McCreary	--	--	--
Martin	4.50	4.50	4.70
Perry	1.26[b,c]	6.66[a]	1.35
Pike	8.00	6.90	9.25
Totals:	26.45	37.65	30.30[d]

[a]The Bureau of Mines reports that American Electric Power has announced 20.0 million tons for Breathitt, Knox, and Perry Counties. We have arbitrarily allocated one-third of the announced tonnage to each county. Although included in 1977 and 1978 Coal Age/Keystone projections, this item is dropped in the 1979 edition.

[b]National Coal Association reports that Falcon Coal Company has announced 1.75 million tons for Knott and Perry Counties. We have arbitrarily allocated one-half of the announced tonnage to each county.

[c]National Coal Association reports Falcon Coal Company has announced a total of 0.75 million tons for Leslie and Perry Counties. We have arbitrarily allocated one-half of the announced tonnage to each county.

[d]The Coal Age figures include 8.85 million tons of 1977 production from expanding mines. Reprinted from Coal Age, February, 1979.

WESTERN KENTUCKY PROJECTED NEW AND EXPANDED PRODUCTION
BY 1985 (In million tons)

County	National Coal Association 1977	Bureau of Mines 1978	Coal Age/ Keystone 1979
Henderson	3.20	--	3.20
Hopkins	1.00	1.00	1.50
McLean	1.20[a]	--	--
Muhlenberg	5.50[a,b]	4.00	5.70[b]
Ohio	6.30[b]	3.00	5.00[b]
Union	0.75[c]	--	--
Webster	1.55[c]	--	2.30
Totals:	19.50	8.00	17.70[d]

[a]National Coal Association reports that Peabody Coal Company has announced a total of 2.4 million tons for McLean and Muhlenberg Counties. We have arbitrarily allocated one-half of the announced tonnage to each county.

[b]National Coal Association reports that Peabody Coal Company has announced a total of 2.0 million tons for Muhlenberg and Ohio Counties. We have arbitrarily allocated one-half of the announced tonnage to each county. Coal Age reports this same projection.

[c]National Coal Association reports that Peabody Coal Company has announced a total of 1.5 million tons for Union and Webster Counties. We have arbitrarily allocated one-half of the announced tonnage to each county.

[d]The Coal Age figures include 4.95 million tons of 1977 production from expanding mines. Reprinted from Coal Age, February 1979.

APPENDIX D

Distribution Of Coal Severance Tax Revenues

C. Gilmore Dutton

Background

Kentucky's Coal Severance Tax Law was enacted in the 1972 regular session of the General Assembly. The 30 cents per ton, or 4% of gross value, tax rate was selected to produce revenues sufficient to offset a loss to the General Fund occasioned by the exemption of food for home consumption from the sales tax. (The 1976 regular session increased the tax to 50 cents per ton or 4½ % of gross value.)

The 1974 session of the General Assembly decided to return a part of the severance tax receipts to the counties of production. The question arose again in the 1976 regular session, and it promises to be a significant issue in 1978. That the coal producing counties have some claim to the revenues is not the point of contention, rather, it is the size of the claim that is so vigorously argued.

The "mountain caucus" in 1974 successfully promoted legislation to return to the coal producing counties half of any severance tax surplus realized during fiscal years 1973-74 and 1974-75. "Surplus" was defined as any amount above the official coal severance tax revenue estimate made by the Department of Revenue for the two fiscal years.

An unprecedented demand for coal resulted in record production and prices during the 1974-76 biennium, and produced an unexpected windfall in severance tax receipts, benefiting both the state's general fund and the Coal Producing County Development Fund. Revenues returned to the counties totaled $6.2 milion (11% of total receipts) for 1974-75 and $27 million (27% of total receipts) for 1975-76. Revenues distributed in a fiscal year were based upon receipts from the previous fiscal year.

The 1976 General Assembly replaced the 1974 revenue sharing program with a series of programs and appropriations labeled the "coal severance tax package." Of seven programs in the "package" only three have some technical tie-in with the severance tax and just one of those represents an actual earmarking of severance tax receipts. The latter program provides for the payment of severance tax receipts to meet the debt service of bonds issued to construct "resource recovery roads." The initial project under this program, reconstruction of KY 80, incurred a $14 million annual cost, with the first payment due in fiscal year 1977-78.

A "coal severance economic aid fund" was established for capital construction projects, except roads and schools, in coal-producing counties. A general fund appropriation of $5 million a year is divided according to severance tax collections and per capita income in each county.

An "energy road fund" was established for road projects in coal producing counties. General fund appropriations of $12 million and $13 million respectively for fiscal years 1976-77 and 1977-78 are divided according to coal tonnage produced in each county.

Four programs or appropriations associated with the severance tax include:

1. A $9 million a year general fund appropriation to the workmen's compensation special fund. Coal miners' black lung benefits are paid from this fund.
2. An "area development fund" from which each of the state's fifteen area development districts will receive money for capital projects. The fund received a $6 million a year general fund appropriation.
3. A $7 million a year general fund appropriation for the construction of the Jefferson Freeway. Road fund monies were substituted for the general fund appropriation during the 1976 Extraordinary Session.
4. A "power equalization fund" from which payments will be made to local school districts to equalize the revenue-producing power of local school tax rates. A $10 million general fund appropriation was made to the fund for the fiscal year 1977-78.

The total cost of the package for the biennium is $89 million, or 38% of the expected $234 million severance tax revenues for the period. The cost of the three programs having a technical tie-in with the severance tax will be $49 million for the biennium, or 21% of the estimated revenues.

Issue

If the General Assembly decides to return a portion to the coal producing counties, how is an equitable return to be achieved? And, what is a fair return of the severance tax to the coal-producing counties?

Alternatives

Four of the other nine states which levy a coal severance tax return some fixed portion to the county of production. The percentage returned varies from 5% in North Dakota to 99% in Tennessee. Additional amounts are earmarked for local governments in two states, with allocations based upon demonstrated need. One state, Wyoming, levies a "coal impact" tax, the entire proceeds of which are returned to local governments for street, road, water and sewer projects impacted either directly or indirectly by coal production.

Four states have established trust funds with a portion of the severance tax revenues. In these states, the principal of the fund cannot be spent until it reaches a predetermined amount. Interest earned by the fund is used for capital improvements, applied to the state general fund for reclamation of strip mines, or to aid communities impacted by coal production facilities.

The solution to the problem of equitable return appears to rest in the determination of the needs of the coal-producing counties and the state, particularly the needs resulting from the production of coal. Once the needs have been ascertained, the rate of return should naturally follow.

At the direction of the Interim Joint Committee on Appropriations and Revenue, its staff prepared and presented the following proposal for the allocation of coal severance tax revenues. As yet, the Committee has not acted on the proposal. The philosophical basis of the proposal is:

1. Coal is a depletable, natural resource which should benefit all citizens of the state;

2. Coal-producing counties should be reimbursed for extraordinary expenses incurred because of the impact of coal production;
3. The state is obligated to correct problems caused by coal production which are outside the normal jurisdiction of counties; and
4. The state is obligated to plan for the eventual economic replacement of coal.

The "needs assessment" basis for the proposal is:

1. The citizens of the state have general health, welfare, education, etc. needs which must be met with the resources available to the state;
2. Coal producing counties are adversely impacted by coal production, resulting in unusual expenditures for local schools, county road and city street construction and maintenance, water and sewer facilities, garbage disposal facilities, and recreational facilities;
3. The state is adversely impacted by coal production, resulting in unusual expenditures for state maintained roads and streets, for reclamation of land, and for securing the health and safety of persons engaged in coal production; and
4. The state will eventually incur expenses to retrain, temporarily maintain and provide job replacement for those persons currently employed in the coal mining industry.

The proposal:

1. Half of all severance tax receipts would be deposited in the state's general fund to support programs for the general welfare of all Kentucky's citizens.
2. Fifteen to twenty-five percent of all severance tax receipts would be deposited to a "coal producing county impact trust fund" from which allocations would be made on a demonstrated impact basis. The amount earmarked for the fund would be flexible within the given range, and adjusted biennially to reflect demand experience. A statutorily constituted body representing the interests of the coal-producing counties would allocate the funds. Statutorily defined bodies would be empowered to submit applications in behalf of each county. Interest earned on monies deposited in the fund would accrue to the fund.
3. Twenty-five to thirty-five percent of all severance tax receipts would be deposited to the general fund, transportation fund, or special trust funds for expenditure on direct "state coal production impact" programs.

Special trust funds which would be established are:

1. A "coal industry annuity fund." One percent of all severance tax receipts would be earmarked for this fund. The principal of the fund would not be spent and would be allowed to accumulate until the balance reached some predetermined amount—$150 million at a minimum. Interest earned on fund monies would not be spent until the fund balance reached the predetermined figure, at which point interest could be used for coal economic depletion impact programs, e.g., employee retraining, unemployment benefits, industrial development.
2. A "coal industry replacement" industrial development fund. Monies would be appropriated to the fund, with expenditures limited to industrial devlopment projects benefiting the coal-producing counties. (Such projects would not

necessarily have to be located in coal-producing counties.) Emphasis would be placed on development of industries not having a reliance upon coal, except as an energy source. Both principal and interest would be expended for the projects.

The balance of the severance tax revenues identified for statewide coal related programs (the balance of the 25% — 35% portion) would be appropriated for:

1. Construction, repair and maintenance of coal haul roads;
2. Coal related health programs;
3. Coal related workmen's compensation benefits; and
4. Mine safety programs.

In summary, the "plan" would:

- Allocate fifty percent of all severance tax receipts to the general fund without restriction;
- Allocate thirty to fifty percent of the remaining half (15% to 25% of all receipts) to a "coal producing county impact trust fund."
- Allocate fifty to sixty-five percent of the remaining half (25% to 35% of all receipts) to a series of coal related programs.

The "coal producing county impact trust fund" would have first call on the "2nd half" monies, up to the maximum specified.

APPENDIX E

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COST EVALUATION OF ROADWAY DAMAGE

The following equation was used to approximate the roadway damage cost resulting from a loaded coal truck traveling over one mile of eastern Kentucky highways.

$$C = (A \times f) \times \frac{1}{d} \times \frac{L}{Pxt}$$

C . . . Repair cost for roadway deterioration due to coal truck traffic in terms of dollars per mile traveled by a laden coal truck

A . . . Cost of annual roadway maintenance for roads restored to their pre-coal conditions
. . . $31.7 million

f . . . Percentage of road maintenance cost attributed to coal haul traffic
. . . 75%

d . . . Average distance traveled by coal trucks (mine to tipple) in eastern Kentucky
. . . 9 miles

L . . . Approximated average load per coal truck
. . . 25 tons

P . . . Annual regional production of coal
. . . 90 million tons

t . . . Percentage of annual production transported by coal trucks
. . . 85%

C - $.86 per mile

(or about 3.4¢ per ton per mile)

SOURCE: Appalachia - Science in the Public Interest, Citizens Coal Haul Handbook, 1978, p. 38.