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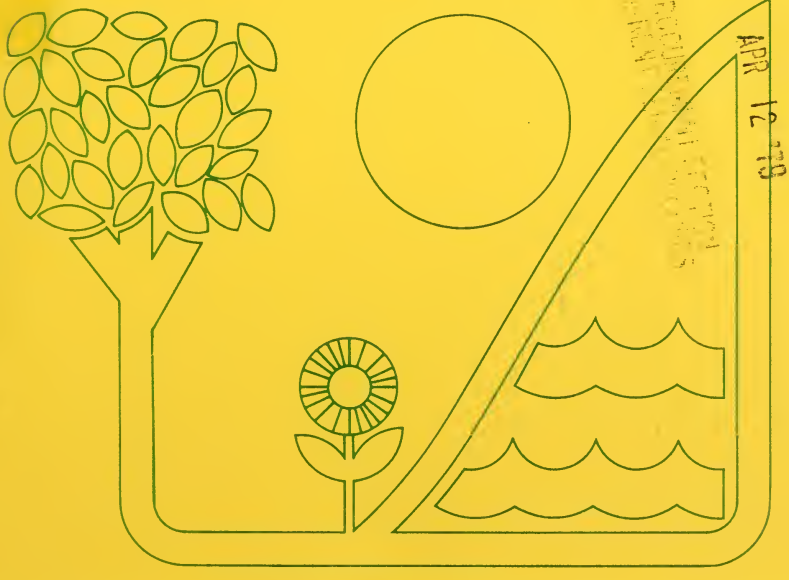

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RESOURCES OF THE INTERIOR REGION AND COAL DEVELOPMENT

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Wayne Bloch
EPA Project Officer

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Natural Resource Economics Division
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U.S. Department of Agriculture
Washington, D.C. 20250

ABSTRACT

Surface and under-ground mining of coal in the Interior Region is encountering new problems - environmental, legal, and economic. USDA economists are undertaking an integrated assessment of how alternative patterns of coal development and use might affect agriculture, rural people and communities, and the availability of land and water. This report, one of a series, is primarily descriptive, laying groundwork for analysis to be reported subsequently.

Twenty-four Coal Producing Areas (CPA's) are delineated, which together contain all the commercially recoverable coal reserves of the Region, or about 24 percent of the nation's total. The CPA's are mostly non-metro in character, with a total population of about 7.6 million. Population growth has been moderate but steady. In some CPA's, especially those in Southern Illinois and Western Kentucky, where the coal industry is a major employer, inmigration rates have been large and population has increased.

The Interior Region has about 24 percent of the nation's coal reserves, and usually accounts for from one fifth to one fourth of the total production. Since 1972 coal production has increased substantially in the United States but the Interior Region has not fully shared in the increase. Surface mining has been increasing and about 62 percent of the total production now comes from surface mines. The coal is generally high in sulfur content so there are serious problems of air quality associated with its use.

Most of the CPA's are rich in agricultural resources, with a favorable climate and highly productive land, nearly all of which is in private ownership. However, many of the surface mines are in the less favorable agricultural areas of the Region. State and Federal laws now require that all strip mined land be reclaimed, so that the loss in agricultural production is temporary on the reclaimed portion. On land used for permanent structure, however, the loss is permanent. Based on 1974 relationships the average annual gross farm income is equivalent to $93 per acre of land area. It is estimated that the average annual value of farm production lost to strip mining in the next 25 years would be about $17 million for the Region, which would represent about one fourth of 1 percent of the total production capacity of the CPA's. Coal development would affect the quality of water, mainly as a result of thermal pollution and acid mine drainage downstream from power plants and mines. Ample supplies of water are available in most locations so that water shortages are not expected to result from increased coal development--at least not to the extent anticipated in the western regions.

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This document is a preliminary draft. It has not been formally released by the U.S. Environmental Protection Agency nor the Department of Agriculture and should not be construed to represent policy of either EPA or USDA. The contents of this report reflect the views of the research team only. It is being circulated for comments on its technical merits and policy implications.

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ACKNOWLEDGEMENTS

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In addition, other individuals are engaged in related work on this project, and their contributions will appear in subsequent reports.

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SUMMARY

PEOPLE

During 1970-75, population expansion in the Interior coal Region was moderate, compared to the total U.S. population growth. The Region as a whole is similar to the overall U.S. population in most socioeconomic characteristics, but there is a good deal of variation among the coal producing areas (CPA's). However, when grouped into three types according to their levels of 1970 employment in agriculture, manufacturing, and mining, the CPA's of the manufacturing type, typified by IL-2, generally had higher levels of education, greater labor force participation rates, lower rates of poverty and higher median family incomes than the total U.S. population. Areas where mining historically has been the important industry, exemplified by KY-1, had a lower standard of living, manifested by a high incidence of poverty (22.3 percent), very low median family income, and lower levels of education.

However, the standard of living gap between the affluent manufacturing CPA's and the less affluent mining CPA's may diminish, because if coal production increases, higher levels of employment in mining and related secondary industries will result. In KY-1, total earnings during 1970-75 increased 68 percent while regional earnings increased 45 percent. This suggests an improved standard of living may be forthcoming for the Region's major coal producing areas.

Population growth varied with the size of town. Many towns of less than 1,000 people decreased in size between 1940 and 1970, especially

those in areas where agriculture is still the major source of employment. Middle size and larger towns (more than 1,000 people) increased at a faster rate than the Region's small towns. This was most evident in the manufacturing CPA's and in KY-1. Steady increases in coal production in KY-1 since 1960 induced a generalized population expansion in the area's larger towns.

COAL

The Interior Region contains about 24 percent of the U.S. coal reserves, a percentage adjusted to a common heat-value basis to compensate for different energy values per ton among coals. Total reserves in the Region are about 105 billion tons, of which about 22 percent are surface minable (strippable). More than half of the reserves are in Illinois, chiefly in IL-3, IL-6, and IL-5. Large reserves, both strippable and deep minable, are also found in Kentucky.

Interior coals are all bituminous in rank but all are high in sulfur content, so high that only about 2 percent are low enough to be considered "SO_2 compliance coal" according to the standards of the Clean Air Act. In addition, coal seams are thinner in the Interior Region than in either the Northern Great Plains Region (NGP) or the Rocky Mountain Region (RM), so coal yield per acre is substantially less. In Wyoming, for example, recoverable strippable reserves per acre are five times the reserves per acre in the Interior. However, most Interior coal reserves are favorably located with respect to load centers and thus have an advantage in transportation costs over western coal.

Historically, the Interior Region has been a major coal producing area, but in spite of the recent increase in demand, mining activity in the Interior has not shown a significant increase. The peak year for Interior was 1972, when production was 153 million tons. Since then production has dropped off somewhat, reaching 143 million tons in 1976. Part of the reason is the increased demand for SO_2 compliance coal.

For years half the coal produced in Interior came from Illinois, but by 1973 western Kentucky was a close rival for the lead in production. Even within these two states, production was highly localized. Two counties, Perry in IL-5 and Muhlenburg in KY-1, together produced about 23 percent of the total for the Interior Region. Indiana was third among the states followed by Missouri and Oklahoma. Production in Arkansas, Iowa, and Kansas was in each case less than one half of one percent of the Interior total.

Plans for expanding production include 38 mines, with an expected annual average production of about 1.5 million tons each. Thirteen of these are in Illinois, ten are in Kentucky, seven are in Oklahoma, and five are in Indiana.

Most of the coal produced in the Region is used in the Region; only about 28 percent was shipped out (1976 data). Twelve percent went to mine mouth generating plants, 79 percent was shipped by rail and eight percent by truck. In most Midwest markets, Chicago for example, Interior coal is at a locational advantage vis-a-vis Eastern or Western coal. Since transport distances are relatively short, mining costs are probably as important as transportation costs as market determi-

nants; this is the reverse of the situation for coal from the two western Regions. Mining costs, estimated by model mine cost budgeting methods, show that Interior coal would cost about $3.82 a ton, as compared with $2.61 in the NGP and $4.37 in Appalachia.

About 87 percent of Interior coal is used to generate electricity; there are 117 plants in the Region using coal as the principal source of fuel. In addition 86 coal fired plants are planned or under construction for states in the Interior Region.

Since much of Interior's surface minable coal lies under agricultural land, the increased demand for coal has created pressures to use farm land for strip mines and for energy processing plants. The process of reclamation, now required by both State and Federal laws, is designed to return surface mined land to productive uses. Reclamation costs are highly site-specific, depending on quantity of overburden, slope, mining method, and intended land uses after mining. According to one group of estimates, costs could range from about $5,800 an acre ($1.23 a ton) to about $14,700 an acre ($2.01 a ton).

LAND

Unlike the two western Regions, nearly all the land in the Interior Region is privately owned. However, there is substantial acreage of National Forest land in the Arkansas CPA and some Indian land in the Oklahoma CPA's. Mineral ownership is frequently separated from surface ownership, and conflicts in interest may result.

Most of the land in the CPA's in the Interior Region is used for commercial agriculture. In some CPA's, such as IL-4, IA-2, and KS-1, nearly all the land is used for farms and nearly all the farmland is cropland. However, some of the CPA's are less favorably endowed, especially the farms that are located in or near the Ozark Mountains. There are about 173,000 farms with over $2,500 gross sales, and about 42,000 "other" farms (those with less than $2,500 gross).

Corn and soybeans are by far the most important crops, though in some CPA's hay, sorghum, or wheat are important. Livestock are a more important source of farm income than crops, accounting for about $4.1 million out of a total of $6.8 million in gross farm sales. The most important classes of livestock are beef cattle and hogs, though in AR-1 poultry account for most of the gross farm sales.

There is a wide variation in gross sales per farm within the Region. The highest average, over $55,000 per farm, is in IL-2, though IL-3, IL-4, and IA-2 all average over $50,000 each. The Oklahoma CPA's are at the bottom of the income scale; $14,000 is the average for OK-3. For all the CPA's the gross sales per acre of land area was $93, which is in sharp contrast to the average of $13 per acre for the NGP and $11 for the RM. Within the Interior Region the range was from $12 per acre for OK-3 to $157 for IA-2 and $159 for IL-2.

To anticipate the degree to which future coal development might affect agriculture it is necessary to make assumptions such as to the rate of development, the type of mining (ie. surface or underground) and the use to which the coal is put. By one such set of assumptions, it is

estimated that there would be about 90 million tons of coal strip mined annually in the period 1976-2000, about a third of which would be in Kentucky, and a little more than one fourth in IL-5 and IN-3. Land taken out of production for mining and for energy processing plants would average about 226,000 acres for this period. While the value of production foregone would vary greatly from one CPA to another, the total is estimated at about $17 million annually, based on 1974 incomes. Of this 30 percent would be in Kentucky, with most of the rest in Illinois and Indiana. The total loss of production however, would be equivalent to only about one fourth of one percent of the total production capacity of all the CPA's in the Region. Hence, though the loss may be important to individual farmers and local communities, it is not significant on a national or even on a regional basis. Also, the use of prime farm land for mining requires special consideration under the new reclamation laws, though data showing number of acres of prime land in CPA's are not yet known.

Water availability is generally not a problem affecting coal development in the Interior Region because nearly all the CPA's are located in river basins where stream flow is adequate to take care of all anticipated future needs. Ground water is generally available in quantities adequate for local use. In some CPA's, especially those further west, shortages might occur in dry years if large increases in demand for water were to develop. Water quality, however, could become a serious problem whenever new coal development occurs because of the possibility of thermal pollution from steam-electric plants or from acid drainage from mining activities.

INTRODUCTION

ENERGY PROBLEMS, RESOURCES, AND THE ENVIRONMENT

Coal is being viewed as one part of a solution to this nation's problems of inadequate current supplies of energy from domestic sources and overdependence on imported oil. But the mining, transportation, and burning of coal raise problems of environmental degradation. Moreover, rapid development of massive coal mining operations and huge coal-burning electric power plants in a region also bring problems of major social and economic change, natural resource management, and competition for some of these resources between new and traditional activities. Coal development now underway in the Interior Region is a case in point.

Interior Region coal development, however, is being influenced to a significant extent by a new twist -- mitigation of environmental damage. As one major step to reduce degradation of air quality, federal standards established in 1971 and tightened in 1977 include regulation of sulfur dioxide emissions from fossil fuel combustion. Because one way to meet these emission standards is to burn very low sulfur coal, and because a major part of Interior reserves are relatively high in sulfur, development of these reserves is not increasing at as rapid a rate as in the Western Regions.

Even at modest rates of expansion, the coal industry in the region has some obvious problems. How can the past rate of development be maintained or increased while minimizing damage and maximizing benefits to

the region itself? Public policymakers and private enterprises alike still have many options concerning how to proceed with coal development and at what pace. Certain options are open even though a substantial portion of total potential inputs for coal development, such as capital investment in mining, has already been committed.

INTEGRATED ASSESSMENT AND THE ESCS PROJECT

What are some of the major options? What are some of the likely alternative patterns for Interior coal development? Previous reports have addressed these questions and laid important groundwork. (3, 4, 6, 9, 17, 19, 23, 35, 39) [1/] However, a more comprehensive analytical system is necessary. An analysis of these options should integrate many diverse impacts into an assessment of alternative systems for coal development and then evaluate the interregional tradeoffs attributable to these alternatives. Thus, ESCS has undertaken a comprehensive assessment in its project, "Integrated Assessment: Economic and Social Consequences of Coal and Oil Shale Development," performed in cooperation with EPA.

This research is scheduled to continue through 1981, with the objective of constructing an interregional analytical system based on a large linear programming model. Initially, work focused on coal and oil shale development in the Western States. Later in the Project, Eastern, Gulf, and Pacific States will be brought into the analysis.

[1/] Underscored numbers in parentheses refer to references listed at the end of the report.

This is the third in a series of regional profile reports examining the human and physical resources of each region. The first two covered the Northern Great Plains and the Rocky Mountain Regions. The focus of the reports is factual and descriptive. They depict the situation in which the Regions found themselves in the mid-1970's with respect to coal development, and lay the groundwork for analysis. As "situation reports" they can stand on their own, but they are not intended to represent the project's analysis of coal development alternatives and interregional tradeoffs. That analysis is reserved for future reports.

METHODOLOGY: COAL PRODUCTION AREAS

Despite the descriptive nature of this report, a key analytical concept is introduced -- that of Coal Production Areas (CPA's). This is basically a method of classifying data along subregional, geographical lines to facilitate later assessment of impacts of alternative development patterns upon relatively small areas.

In addition to small-area data, regional aggregate information is also needed. Defining a basic geographic unit for this report (the CPA) permits the subsequent economic model to aggregate and, later disaggrgate back down to this smallest geographic unit. In other words, the CPA is the basic geographic "building block" for the analytical system.

After considerable study of data availability, the research team decided that the county, or groups of similar counties, should be used to

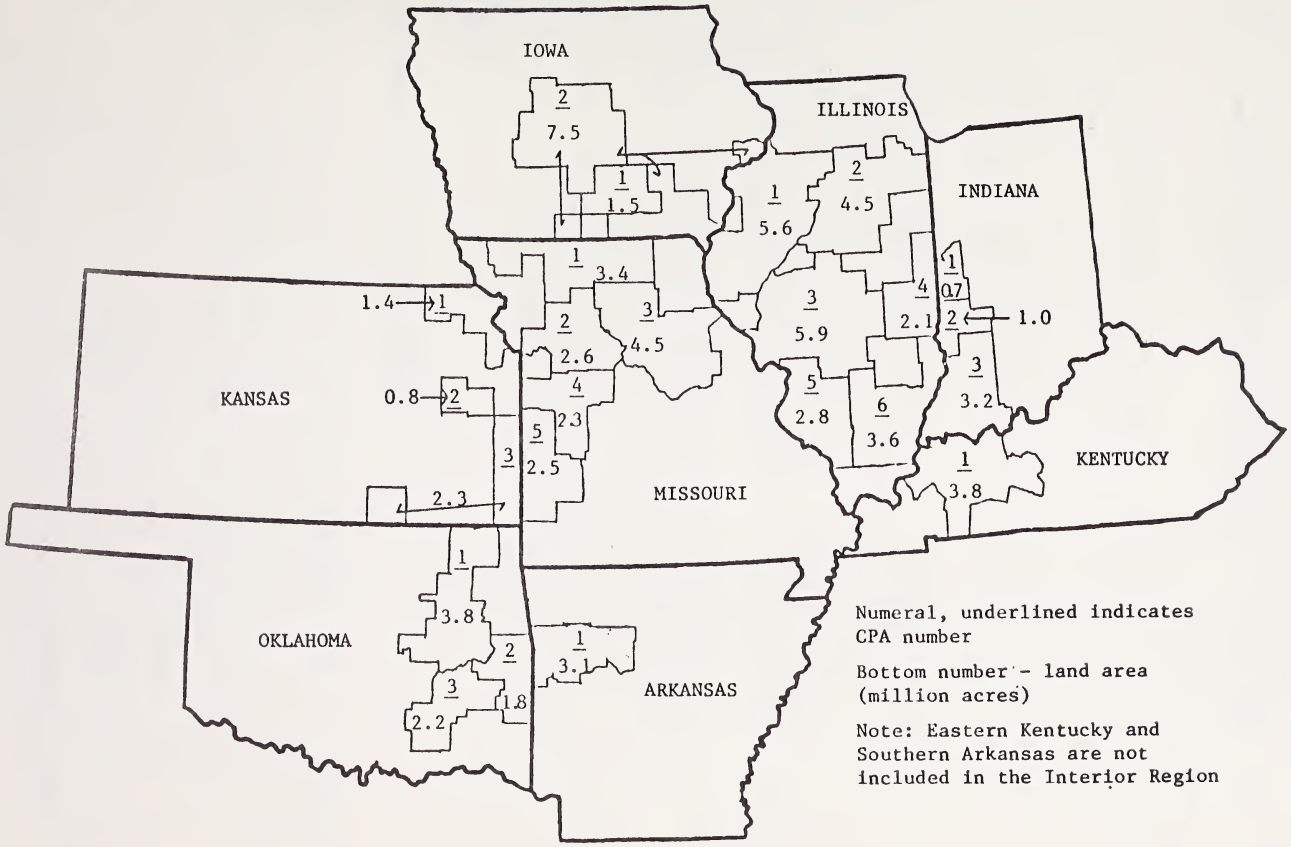
define the boundary lines of CPA's. At times, site-specific information may be used, but site-by-site data are not always available, uniform, or appropriate to the issue at hand. As a geographic unit for organizing and aggregating basic data, the county is the best compromise between specificity and generality.

However, when a topic or issue warrants, data will be assembled by areas unrelated to county lines, such as river basins, or electricity demand regions. It is acknowledged that effects of coal development, such as electric transmission lines or commercial development, often extend well beyond counties of coal production. The use of the CPA concept will not inhibit analysis of such wider geographic effects.

Counties are grouped into CPA's if they contain coal in commercial or potentially commercial quantities. Some CPA's may consist of only one county, but most contain more than one; in the Interior Region all of the CPA's have two or more. Counties where there is currently no known significant amount of coal will not be included in CPA's.

The Interior Region consists of six states -- Illinois, Indiana, Iowa, Kansas, Missouri, and Oklahoma, plus parts of two states, Western Kentucky and Northwestern Arkansas. Within this Region 24 CPA's were established. Each is identified by a symbol consisting of a two-letter abbreviation indicating the state, then a dash, followed by a numeral, e.g., IL-1, KS-3, etc. They range in size from 707,000 acres for IN-1 to 7.5 million acres for IA-2 (Figure 1). The total area of all the CPA's is 73 million acres or about 114,000 square miles. The total

Figure 1 . Coal Production Areas (CPA's) in the Interior Region



area of the six states, plus half of Arkansas and one third of Kentucky, is 406,540 square miles, so the 24 CPA's comprise about 28 percent of the total land area of the Region. The counties included in each CPA are listed in Table A-1. 2/

2/ Tables numbered with an "A" prefix are found in the Appendix.

PEOPLE

by

Paul R. Myers [1/]

The population of the Interior coal Region is distributed over an eight state area, ranging from areas of substantial manufacturing employment in Illinois, Indiana, and Arkansas, through areas that are largely agricultural in Missouri, Iowa, and Kansas, to the traditional energy development areas of Oklahoma and Kentucky. In general, the people of the Region are similar in most socioeconomic characteristics to the total population of the United States. Even though all the CPA's in the Region have a potential for coal production, in 1975 about three-fourths of the coal mined in the Region was from Illinois and Kentucky. Furthermore, most coal production was limited to a few counties in Southern Illinois and Western Kentucky. Currently, most of the socioeconomic impacts of coal production are also limited to these few counties (36).

POPULATION, MIGRATION, AND EMPLOYMENT

The population growth patterns of the Region resemble those of nonmetro United States, in that population gained but at a very slow rate, and migration rates during the 1950's and 1960's were mostly negative (Table 1). Population gain for the Region between 1940 and 1970, was 16.1 percent compared to 6.6 percent for the U.S. nonmetro areas and

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[1/] Myers is Social Science Analyst, Economic Development Division, ESCS, USDA, Washington, D.C.

Table 1.--Total population and population changes for United States, metro and nonmetro counties, and the Interior coal region, 1940, 1950, 1960, 1970 and 1975.

Areas	Total Population					Components of Population Change								
						1950-60			1960-70			1970-75		
	1940	1950	1960	1970	1975	Total Change	Natural Increase	Net Migration	Total Change	Natural Increase	Net Migration	Total Change	Natural Increase	Net Migration
	Thousands					Percent								
United States	132,165.6	151,698.8	179,323.1	203,212.8	213,054.	18.2	16.7	1.5	13.3	11.6	1.7	4.8	3.6	1.2
Metropolitan	80,386.1	100,081.3	126,455.4	147,996.3	155,039.	26.4	17.4	8.9	17.0	12.3	4.7	4.1	3.7	0.4
Nonmetropolitan	51,779.5	51,617.5	52,867.7	55,216.5	58,015.	2.4	15.4	-13.0	4.4	10.1	-5.6	6.6	3.2	3.4
Interior coal region, total	6,332.5	6,474.7	6,876.1	7,354.6	7,593.5	6.2	12.1	-5.9	7.0	7.7	-0.7	3.2	2.5	0.7
Arkansas-1	186.2	169.0	155.1	183.4	228.9	-8.3	14.1	-22.4	18.3	10.3	8.0	24.8 1/	3.2	21.6
Illinois-1	630.8	673.7	714.0	748.2	747.7	6.0	11.7	-5.7	4.8	8.1	-3.3	-0.1	2.3	-2.4
Illinois-2	500.0	557.3	683.3	794.7	848.4	22.6	15.8	6.9	16.3	11.6	4.7	6.8	5.0	1.8
Illinois-3	548.6	561.4	590.6	608.6	618.7	5.2	10.8	-5.6	3.0	6.7	-3.7	1.6	1.4	0.2
Illinois-4	197.8	195.4	207.3	211.4	210.7	6.1	11.1	-4.9	2.0	5.9	-3.9	-0.4	2.0	-2.4
Illinois-5	462.7	530.1	631.6	703.2	694.4	19.1	16.7	2.4	11.3	11.0	0.3	-1.2	3.4	-4.6
Illinois-6	357.0	337.6	300.6	291.2	299.2	-11.0	6.3	-17.3	-3.1	1.5	-4.6	2.8	-	2.8
Indiana-1	57.0	532.3	51.2	49.6	50.5	-3.8	7.6	-11.4	-3.0	3.6	-6.6	1.7	1.1	0.6
Indiana-2	164.1	164.5	165.8	170.5	167.6	0.8	8.3	-7.5	2.9	4.3	-1.4	-1.7	1.3	-3.0
Indiana-3	385.4	413.5	417.2	434.4	435.0	0.9	13.7	-12.8	4.1	7.7	-3.6	-0.1	1.8	-1.9
Iowa-1	126.9	121.9	117.0	110.2	108.5	-4.0	10.0	-14.0	-5.8	3.9	-9.7	-1.6	0.3	-1.9
Iowa-2	725.5	772.9	838.6	894.4	920.8	8.5	13.8	-5.3	6.7	9.5	-2.8	2.9	2.7	0.2
Kansas-1	97.5	92.8	95.5	96.0	96.1	2.9	10.4	-7.5	0.5	5.6	-5.1	0.1	1.7	1.8
Kansas-2	36.0	32.7	32.4	33.3	33.7	-0.9	7.0	-7.9	2.9	2.8	0.1	1.0	0.7	0.3
Kansas-3	145.1	131.5	121.5	117.4	115.7	-7.6	6.2	-13.7	-3.4	0.9	-4.3	-1.4	2.2	-0.8
Kentucky-1	325.5	317.5	330.6	345.0	376.0	4.1	13.9	-9.8	4.3	8.4	-4.1	9.0	3.6	5.4
Missouri-1	138.2	120.8	106.2	101.8	102.4	-12.1	4.6	-16.8	-4.1	-0.1	-4.0	0.5	-0.7	1.2
Missouri-2	153.7	155.2	192.4	228.4	240.2	24.0	11.1	12.9	18.7	8.2	10.5	5.1	3.2	1.9
Missouri-3	214.8	214.0	213.9	235.1	245.7	-0.1	7.3	-7.3	9.9	4.9	5.0	4.5	1.5	3.0
Missouri-4	109.9	102.1	121.4	133.9	145.4	18.9	7.5	11.4	10.2	5.4	4.9	8.6	2.8	5.8
Missouri-5	160.9	152.0	143.2	141.1	147.6	-5.8	5.3	-11.1	-1.5	1.2	-2.7	4.6	0.1	4.5
Oklahoma-1	428.9	463.9	532.4	594.8	625.4	14.8	15.6	-0.8	11.7	9.6	2.2	5.1	3.2	1.9
Oklahoma-2	86.3	68.4	56.2	65.1	71.2	-17.7	10.6	-28.4	15.8	7.8	7.9	9.4	3.6	6.8
Oklahoma-3	92.9	73.0	58.0	62.6	63.7	-20.6	9.6	-30.2	8.0	4.1	3.8	1.7	0.9	0.8

Source: Census of Population, 1940, 1950, 1960, 1970. The 1975 estimates taken from Current Population Reports, Series P-26.

1/ This large 1970-75 population growth rate and rate of inmigration, is mostly due to the placement of 24,178 Vietnamese into Sebastian County (AK-1), who were subsequently relocated in 1976. This sudden inmigration inflates the overall Interior region population numbers also.

53.8 percent for the U.S. total (27). One factor contributing to the moderate rate of growth for the Region was the general decline in agricultural employment, due to emerging technology, throughout most of the Region. Between 1940 and 1970, agricultural employment decreased 66.6 percent, or 370,744 people. This, no doubt, induced the negative net migration rates of the 1950's and 1960's, despite employment gains in manufacturing of 111 percent. Even though losses in agricultural employment were generalized for the Region, manufacturing gains were selective to some areas (29). Thus, some areas lost population and employment opportunities while other areas made large gains. Altogether, 13 of the 24 CPA's gained population between 1940 and 1970, while 11 CPA's declined.

Five CPA's that exhibited strong population increases were IL-2, IL-5, IA-2, MO-2, and OK-1. Along with IL-2, which had 33 percent of its workers employed in manufacturing, the areas were characterized by having large towns with steady urban growth. Cities such as East St. Louis (IL-5), Ames and Des Moines (IA-2), Kansas City (MO-2), and Tulsa (OK-1) contributed to the population increase in their respective areas (28).

Population continued to increase for these five CPA's into 1970, mainly due to growth in their larger urban centers and a stable manufacturing base. OK-1, however, experienced a large increase in mining employment between 1970 and 1975. Coal mining employment increased from 216 workers in 1970 to 444 workers in 1975 to meet the labor demand of strip mines located in OK-1 (36).

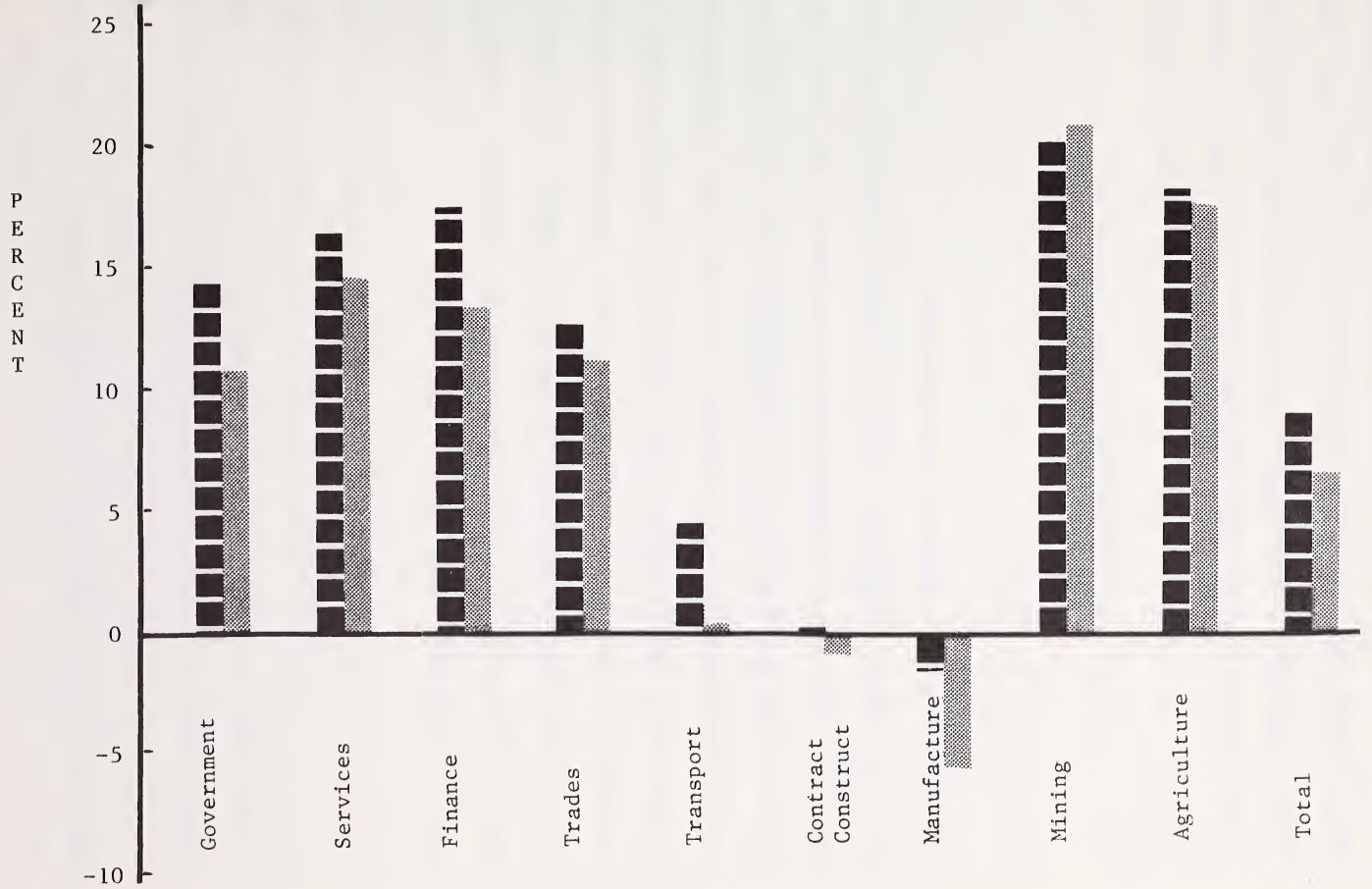
Again, the common characteristic of the CPA's that lost population was the large decline in agricultural employment, uncompensated by gains in manufacturing. This pattern was true for IL-6, MO-1 (which had only 12.2 percent of its employment in manufacturing in 1970) and especially OK-2 and OK-3. For example, in 1940, OK-2 had 57.4 percent of its employment in agriculture, and by 1970, only 6.5 percent. This represented a loss of 9084 agricultural jobs in the area and induced a decline in population of 21 thousand people between 1940 and 1970. However, increases in coal mining employment between 1970 and 1975 in some of these areas stimulated new economic activity, especially in IL-6 where coal mining employment increased from 4640 workers in 1970 to 6086 workers in 1975.

As previously mentioned, most of the coal production in 1975 was in four CPA's, KY-1, IL-5, IL-6, and IL-1. However, two counties, Perry (IL-5) and Muhlenberg (KY-1), together produced about 22.6 percent of the Interior coal Region's total in 1975 (36).

The population of Perry County increased moderately from 19,757 to 20,300 people during the 1970 to 1975 time period, although the CPA lost population. Muhlenberg County, in KY-1, increased in population by 10 percent, partly as a result of continuing increases in coal production. There was an inmigration of 2000 people during the 1970-75 period (28).

For the Region as a whole, total employment increased 9.3 percent, or at a slightly greated pace than the U.S. employment (Figure 2). All sectors of employment, except mining, at the regional level increased

Figure 2 . Changes in Employment by Sector for the Interior Coal Region and the United States, 1970-75



Source: Regional Information System, Bureau of Economic Analysis.

more, or decreased less than the comparable U.S. change in employment. Mining employment increases were similar at about 20 percent, and coal mining employment in particular increased about 50 percent for both the Interior Region and the United States. This suggests that increased demand for domestic energy has impacted the Interior Region no more than the rest of the United States.

SELECTED CHARACTERISTICS

In 1950, about 5.2 percent of the Interior Region's total population was either Black or American Indian. Blacks numbered about 336 thousand people and lived predominantly in the large cities of the Region such as: East St. Louis (IL-5), Bloomington (IL-2), and Tulsa (OK-1). Due to their relatively small numbers and their location in the metropolitan areas, Blacks probably will experience very little impact from increased coal production. American Indians lived mostly in the three CPA's of Oklahoma, primarily OK-1, around the Cherokee Recreational Area. They represented about one half of one percent of the total population in the region (27).

Overall, the Interior Region's population was similar to the total population of the United States, except more of its people worked in the mining industry, and the Region had a smaller percentage of nonwhite people. However, characteristics varied across the Region according to the industrial orientation of the CPA's. For example, in MO-1 which had the highest percentage of agricultural workers, the people were older, less educated, had lower labor force participation rates, and a

very low median family income compared to the United States. On the other hand, in IL-2, which is most representative of the Region's manufacturing CPA's, the people were younger, equally educated, had higher labor force participation rates for males, and a higher median family income than the United States average (Table 2).

KY-1, the leading CPA in coal production, had 6.2 percent of its 1970 employed people working in the mining industry. There was a net inmigration of over 18,000 people during the 1970-75 time period, and population expansion of 9 percent. Total earnings for KY-1 increased 68 percent during the period. This gain in earnings outpaced the Regional gain of 44.9 percent and the overall U.S. gain in total earnings. In 1970, KY-1 compared unfavorably to the manufacturing and the agricultural CPA's of the Region in educational levels, dependency rates and labor force participation rates. The incidence of poverty in KY-1 was 22.4 percent in 1969 compared to a 13.7 percent of the U.S. rate. Improved earnings and increased employment opportunities in mining and such secondary employment as transportation, trades, and finance industries may bring an elevated standard of living to the area during the 1970's.

TOWN GROWTH

The Interior coal Region was heavily agricultural in 1940 and characterized by numerous small towns that were basic agricultural service centers. As agriculture declined as a major employer in most of the Region's CPA's, so did the population of many small towns. For example

Table 2. Selected Demographic Characteristics

Item	U.S.	Nonmet	Interior	MO-1	KY-1	IL-2
Population increase - 1970-75 - percent	4.8	6.6	3.2	0.5	9.0	6.8
Total earnings increase 1970-75 - percent	48.0	57.7	44.9	45.1	68.0	59.9
Agricultural employment - percent	3.7	9.7	6.6	21.6	7.0	4.8
Manufacturing employment - percent	25.2	24.9	24.5	12.2	23.1	33.0
Mining employment - percent	.8	1.8	1.5	0.6	6.2	0.4
Median age - years	28.1	28.3	29.6	33.6	28.1	27.3
Dependency rate 1/ - percent	79.5	86.5	83.3	81.1	86.1	82.9
Fertility rate 2/ - number	2956	3245	3053	3094	3100	3112
Mobility rate 3/ - percent	47.0	44.1	43.6	46.1	45.3	43.1
Husband-wife families - percent	86.0	87.2	88.3	89.8	86.3	89.6
High school completion - percent	52.3	45.0	51.5	49.0	37.8	52.9
Median school years completed	12.1	11.2	12.0	11.8	9.8	12.1
Labor force participation - percent:						
Males, 1970	72.9	68.8	71.2	65.4	68.9	74.2
Females, 1970	39.6	36.1	37.6	34.6	32.9	39.2
Median family income in dollars - 1969	9590	7615	N.A. 4/	5995	7070	10763
Incidence of poverty - 1969 - percent	13.7	20.2	13.8	22.3	22.4	7.7
Black and American Indians - percent	11.5	11.0	5.2	5.5	8.1	4.2

Source: U.S. Department of Commerce, Bureau of the Census, Census of the Population, 1970.

1/ Dependency rate is the number of people under 18 and over 64 years of age divided by the number 18-64 years old.

2/ Fertility rate is all children ever born per 1,000 women age 35-44 years.

3/ Mobility rate is the percent of people who changed homes in the period 1965-70.

4/ N.A. - Not available.

in MO-1, Powersville had 294 people in 1940 and declined steadily to 125 people by 1970. Lucern and Livonia in MO-1 experienced similar declines during the same period. Small towns in other agricultural CPA's in Kansas, Iowa, and Missouri also declined in population. Small town decline also occured in KY-1. Towns such as Bremen, South Carrollton, and Rosewood; all in Muhlenberg County (KY-1), steadily declined during the 1940-70 period. Even in CPA's such as IN-2, where the decline in agricultural employment was offset by increased manufacturing employment, small towns generally declined.

Most middle size towns with population between 1,000 and 2,499 people have grown throughout the Region, due mainly to steady increases in manufacturing and mining employment. For example, Greenville in Muhlenberg County, Kentucky increased from 2,661 people in 1940 to 3,875 people in 1970. Ohio County in KY-1, had two towns, Beaver Dam and Hartford, that grew in size by 125 and 35 percent respectively, while coal production from the County increased.

Large towns, those with more than 10,000 people, gained in population between 1940 and 1970. Again, the growth was very evident in KY-1 with Hopkinsville, Christian County, growing from 11,724 people in 1940 to 21,250 people in 1970. Henderson in KY-1 also increased from 9,108 people to 22,976 people during the thirty year period.

Collectively, small town growth (less than 1,000 people), although positive, was moderate, and gave way to greater rates of growth in the Region's middle to larger size towns (more than 1,000 people). This was most evident in the CPA's with major employment in manufacturing or mining in 1970.

COAL

by

Virgil Whetzel [1/]

RESOURCES AND RESERVES

The Interior Region contains about 13 percent of those U.S. coal resources at depths shallower than 3,000 feet and about 13 percent of U.S. coal resources, measured as estimated tons in the ground (2). However, of all U.S. coal reserves, about 24 percent are in the Interior Region.[2/]

These comparisons are made without adjustments for differing heat values among coals. To make accurate comparisons of coal reserves among regions, or even comparisons among different coals of the same region, the units of measure should be common. For this report the British Thermal Unit (BTU) is used as a common measuring unit. The average

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1/ Whetzel is an Agricultural Economist, Natural Resource Economics Division, ESCS, USDA. He prepared this section under the title: Coal Resources and the Mining Industry of the Interior Region.

2/ The terms coal "resources" and coal "reserves" which must be distinguished, are used here as defined by the U.S. Geological Survey and the U.S. Bureau of Mines (2, 10). In general the term "resources" means the total quantity of coal in the ground within a certain depth, and within a specified limit of coal bed thickness. By contrast, the term "reserves," that is "reserve base," is much more restrictive, denoting only some of the "demonstrated resources' and of these only those legally and eocnomically minable with present tecnology and equipment. Even though a deposit is classified as a "reserve" it is not necessarily attractive for near term development. A deposit may be reclassified from "resource" to "reserve" if both economic factors and extraction technology improve.

heat value per ton of Interior coal is almost the same as that for all U.S. coal (10, 22).[3/]

When the tonnages of all U.S. coal reserves are adjusted to a "standard BTU coal" basis, the estimate of the proportion of U.S. coal reserves located in the Interior changes hardly at all -- only from 24.0 to 23.9 percent.[4/] On a standard basis, 15 percent of all U.S. coal reserves is in Illinois, about 3 percent in both Indiana and Western Kentucky and 2 percent in Missouri. Arkansas, Iowa, Kansas, and Oklahoma each have less than 1 percent of U.S. coal reserves. At the 1976 rate of Interior coal production -- about 143 million tons -- the Region's reserves would last about 732 years. This is merely an illustration of size, not a forecast, since annual production of coal in the Interior is not likely to remain constant.

[3/] The heat content of Interior coal averages 22.5 million BTU per ton, ranging from 20.2 million average for Iowa to a 27.5 million average for Arkansas coal. A typical eastern bituminous coal contains 26.2 million BTU per ton. An approximate national average is 22.6 million BTU's per ton.

[4/] A "standard BTU coal" is defined in this report as that coal which yields 22.6 million BTU per ton. Therefore, a quantity of any other coal of a nonstandard BTU value per ton, yielding a certain total heat value for that tonnage can be adjusted to a standard BTU coal tonnage yielding an equivalent total heat value. The adjusted quantity is called "standard equivalent."

Strippable and Deep-minable Reserves

Interior coal reserves are all of bituminous rank.[5/] Unadjusted for heat value differences, Interior coal reserves total about 104.7 billion tons (1974) of which 81.2 billion were classified by the U.S. Bureau of Mines as accessible only by underground mining, and 23.4 billion by surface mining alone. All but a negligible amount of these coal reserves are located in the 24 CPA's as defined above.

With the exception of the three Kansas CPA's, which have only surface minable coal, and Iowa, IA-2, which has only deep-minable coal, all Interior CPA's have both deep-minable and surface-minable reserves (Table 3). Of the 23.4 billion tons of surface-minable (strippable) reserves, about 52 percent is located in the CPA's of Illinois, 17 percent in those of Western Kentucky, 15 percent in Missouri, 7 percent in Indiana, 6 percent in Kansas, and 2 percent in Oklahoma. Arkansas and Iowa each have less than 1 percent of the Interior's strippable reserves. Since the heat content of Interior coal approximates that of a standard ton (22.6 million BTU's per ton) these percentages are about the same on both an actual and standard equivalent basis.

5/ Rank is assigned to a coal according to its percentage of fixed carbon, the main determinant of its heat value. In general, the higher the percentage of fixed carbon, the higher the rank. However, the rank is calculated on a mineral - matter-free basis. Minerals and ash content are used to calculate a coal grade (quality) within a rank; in general, the greater the mineral and ash content, the lower the quantity.

Table 4. Coal Reserves of the Interior Region, 1974

Coal production areas	Quantity: A.R. 1/ Underground	A.R. 1/ Strip	A.R. 1/ Total	Standard Coal Equivalent 2/ Underground	Standard Coal Equivalent 2/ Strip	Standard Coal Equivalent 2/ Total	Percent of 3/ total	Heat Value 1/ Per pound	Heat Value 1/ Per ton	Standardization factor 4/	Contents per Quantity Unit: Moisture 1/	Ash 1/	Sulfur A.R. 1/	Sulfur Standard coal equivalent 5/
	million tons						percent	-BTU-	million BTU	--units--	percent			
Arkansas-1	306	231	537	373	282	655	.6	13,760	27.5	.82	2.1	9.1	1.5	1.23
Illinois-1	1,661	5,191	6,852	1,567	4,897	6,464	6.2	10,697	21.4	1.06	14.4	10.6	3.4	3.60
Illinois-2	3,646	824	4,470	3,540	800	4,230	4.2	11,000	22.0	1.03	12.9	10.5	3.8	3.91
Illinois-3	21,021	1,258	22,279	19,646	1,176	20,822	20.0	10,621	21.2	1.07	13.2	11.4	3.9	4.17
Illinois-4	3,955	357	4,312	3,955	357	4,312	4.1	11,231	22.5	1.00	12.4	9.5	2.9	2.90
Illinois-5	6,837	3,377	10,214	6,703	3,311	10,014	9.6	11,026	22.1	1.02	10.1	11.8	3.8	3.67
Illinois-6	16,321	1,216	17,537	17,363	1,294	18,656	17.9	12,042	24.1	0.94	7.4	9.7	2.1	1.97
sub-total	53,442	12,223	65,665	52,774	11,335	64,609	62.0	11,137	22.3	1.01	11.2	10.7	3.3	3.33
Indiana-1	562	108	669	562	108	669	.6	11,328	22.7	1.00	11.4	9.9	2.9	2.90
Indiana-2	3,303	640	3,942	3,303	640	3,942	3.8	11,280	22.6	1.00	12.4	9.4	1.9	1.90
Indiana-3	5,084	926	6,010	5,135	935	6,071	5.8	11,380	22.8	0.99	10.8	9.7	3.1	3.07
sub-total	8,949	1,674	10,623	9,000	1,683	10,683	10.2	11,337	22.7	1.00	11.2	9.6	2.6	2.60
Iowa-1	1,526	180	1,706	1,375	162	1,537	1.5	10,214	20.4	1.11	14.2	13.0	4.2	4.66
Iowa-2	1,359	0	1,359	1,213	0	1,213	1.2	9,925	19.8	1.14	13.7	14.8	5.2	5.93
sub-total	2,885	180	3,065	2,588	162	2,750	2.6	10,083	20.2	1.12	14.0	13.8	4.6	5.15
Kansas-1	0	42	42	0	39	39	6/	10,410	20.8	1.09	9.6	17.1	6.4	6.98
Kansas-2	0	71	71	0	66	66	.1	10,470	20.9	1.08	12.3	11.1	4.9	5.29
Kansas-3	0	1,275	1,275	0	1,342	1,342	1.3	11,851	23.7	0.95	6.7	12.8	2.8	2.66
sub-total	0	1,388	1,388	0	1,447	1,447	1.4	11,737	23.5	0.96	7.1	12.8	3.0	2.89
Kentucky-1	8,720	3,904	12,624	9,277	4,153	13,430	12.9	12,012	24.0	0.94	7.1	10.7	3.4	3.20
Missouri-1	2,195	206	2,401	1,977	186	2,163	2.1	10,152	20.3	1.11	14.4	13.1	4.5	5.00
Missouri-2	271	420	691	253	393	646	.6	10,584	21.2	1.07	11.6	13.5	5.8	6.21
Missouri-3	2,658	1,235	3,893	2,581	1,199	3,780	3.6	10,990	22.0	1.03	10.6	12.3	4.8	4.94
Missouri-4	480	966	1,446	480	966	1,446	1.4	11,359	22.7	1.00	8.5	12.7	4.3	4.30
Missouri-5	469	588	1,057	494	619	1,113	1.1	11,879	23.8	0.95	6.4	12.9	3.8	3.61
sub-total	6,074	3,414	9,487	5,785	3,363	9,148	8.8	10,902	21.8	1.04	10.9	12.7	4.6	4.78
Oklahoma-1	265	251	516	301	285	586	.6	12,801	25.6	0.88	5.4	8.2	2.7	2.38
Oklahoma-2	354	112	466	432	137	569	.6	13,852	27.7	0.82	2.6	7.7	1.2	0.98
Oklahoma-3	241	71	312	274	81	355	.3	12,820	25.6	0.88	4.5	8.1	1.9	1.65
sub-total	860	434	1,294	1,007	503	1,510	1.5	13,184	26.4	0.86	4.2	8.0	2.0	1.72
Region Total	81,236	23,448	104,683	80,804	23,428	104,232	100.0	11,257	22.5	1.00	10.6	10.8	3.4	3.40

1/ AR-analysis on an as received basis; there has been no beneficiation. Contrast with standard BTU coal equivalent. (see text)
2/ Quantity adjusted to a standard 22.6 million BTU ton.
3/ Percentages of Interior CPA total based on standard coal equivalents.
4/ The standardization factor indicates the number of tons of nonstandard BTU coal necessary to produce the same BTU value produced from one ton of standard BTU coal (22.6 million BTU). The factor is used to adjust sulfur content percentage from a nonstandard or A.R. basis to a standard basis.
5/ Percent sulfur on a standard coal equivalent basis; that is, adjusted sulfur percentage.
6/ Less than .05 percent.

SOURCES: The Reserve Base of U.S. Coal, by Sulfur Content (in two parts) 1. The Eastern States, U.S. Bureau of Mine Information Circular 8680 (22)
The Reserve Base of U.S. Coal, by Sulfur Content (in two parts) 2. The Western States, U.S. Bureau of Mine Information Circular 8693 (10)

Deep minable reserves are also concentrated in Illinois, 53.4 billion tons. Indiana and Kentucky each have nearly 9 billion tons, Missouri 6 billion tons and Iowa 2.9 billion tons. Arkansas and Oklahoma each have less than 1 billion tons and there are no deep-minable reserves in Kansas.

Sulfur Content

Sulfur content is a key factor in determining coal quality, especially in light of federal air quality standards. If sulfur content is low enough, a coal when burned, will meet 1971-1977 Clean Air Act sulfur dioxide emission standards without using scrubbers to desulfurize flue gasses (but not the standards in effect for 1978 and beyond.[6/]

6/ Sulfur in coal burned by electric power plants contributes to equipment corrosion and the formation of boiler deposits. Sulfur oxides as combustion products emitted to the atmosphere can be injurious to many forms of life, including humans, crops, and forests. In recognition of these deleterious effects, sulfur dioxide in the atmosphere and sulfur dioxide from certain emissions are limited by the Clean Air Act (CAA) through its provisions for 1) air quality standards to be achieved by "State implementation plans" (SIP), and 2) new source performance standards (NSPS) for new electric generating plants and other new facilities constructed since 1971. The NSPS in effect from 1971 through 1977 required that no more than 1.2 pounds of sulfur dioxide be emitted per million BTU of fuel burned. Sulfur dioxide is formed at that approximate rate during normal combustion of coal containing 0.6 pound of sulfur per million BTU. Therefore, at this rate of sulfur dioxide formation no more than 0.6 pound of sulfur per million BTU can be present (in order to comply with NSPS) in a fuel intended for combusion without the use of flue gas desulfurization equipment (stack gas scrubbers). It follows that for a standard BTU coal containing 22.6 million BTU per ton, the defacto upper limit is 14 pounds of sulfur per ton or 0.7 percent sulfur, if the coal is to yield sulfur dioxide emissions (without scrubbers) no greater than the legal limit for 1971-77 "new sources." NSPS mandated by the 1977 Clean Air Act Amendments prescribe "best available control technology," generally interpreted as stack gas scrubbers. Nevertheless, sulfur content is still an important consideration since scrubbers are not required for 1971-77 new sources, and since coal sulfur content affects scrubber operations. In general, the lower the coal sulfur content, the easier the scrubber operation and the better the potential for removing a high percentage of a coal's sulfur content.

Coal containing 0.6 pound or less of sulfur per million BTU will meet these emission standards and is therefore defined in this report as "SO_2 compliance coal."[7/]

It is important to know how much of the Interior's coal reserves can be classified as SO_2 compliance coal. Burning this low sulfur coal without stack gas scrubbers is a major alternative to installing stack gas scrubbers for thos electric plants governed by the 1971-1977 NSPS (new source of performance standards).

Researchers at Argonne National Laboratory have estimated the amount of NSPS coal available, on a county basis, for the United States using the following formula:

$$(\text{pounds } SO_2 \text{ emitted/ton coal fired}) = 38S$$

where 38 is a constant and S is the percentage sulfur in the coal (for coal containing 2 percent sulfur, S = 2). If the heating value of coal is H (in 10^3 BTU/lb.), then a generating unit meeting the NSPS must have

$$\begin{aligned}(\text{lb. } SO_2 \text{ emitted}/10^6 \text{ BTU}) &= 38S \text{ (lb. } SO_2 \text{ emitted/ton coal fired)} \\ &\quad \times (1/2000)^2 \text{(ton/lb.)}_3 \\ &\quad \times 1/H \text{ (lb. of coal}/10^3 \text{ BTU)} \\ &= 1.2 \text{ (lb. } SO_2/10^6 \text{ BTU) (NSPS limit)} \\ &\quad \text{or, } (S/H) = .0632 \text{ for NSPS}\end{aligned}$$

As an example, with 12,000 BTU/lb. (H = 12), the sulfur content must be 0.76 percent (= .0632 X 12) or less to meet NSPS (21).

7/ The concept of "compliance coal" is already established. The term is used in the coal trade, and refers to likely compliance with SO_2 NSPS. Also, the concept is used by the U.S. Bureau of Mines in a recent report on coal sulfur content (4).

Roughly 2 billion tons, or only about 2 percent of the Interior's total reserves are estimated to be SO_2 compliance coal. Illinois, Iowa, Kansas, and Missouri have no SO_2 compliance coal (Table 4).

Reserve Characteristics and Mining Economics

Although many factors affect the economic feasibility of strip mining of coal at any given site, the main factor is the thickness of overburden relative to the thickness of the coal seam, that is, the stripping ratio. The lower the stripping ratio, the better. For the Interior strippable coal reserves, overburden averages 62 feet and seam thickness 42 inches, for an average stripping ratio of 18.0:1. Among the states in the Interior, variation ranges from a maximum average of 60 feet of overburden and 25 inches of seam thickness, 28.8:1 ratio, in Arkansas, to minimum average of 30 feet of overburden and 24 inches seam thickness, 15.0:1 ratio in Missouri and Oklahoma (10, 22, 38).

Another way to express these relationships is as cubic yards of overburden per ton of coal. By this concept, Interior strippable reserves average 19.8 cubic yards overburden per ton, ranging from 32.3 cubic yards in Arkansas to 16.8 cubic yards in Missouri and Oklahoma (10, 22, 38). On still another basis -- tons of recoverable coal per acre of surface area above the coal -- CPA IL-5 leads, averaging 8,235 tons of reserves (standard BTU coal) per acre.[8/] CPA KS-2 is lowest with 1,555

8/ Recoverability is assumed to be 80 percent of the coal in the block being mined. Although recoverability varies, this figure is usually accepted as a fair average for most strip mining operations.

Table 4 --Interior Region coal reserves by sulfur content to heating value ratio

State and CPA	Coal reserves[1/]							
	Sulfur Content/Heating value (% $S/10^3$ Btu/lb.)							
	.021	.042	.050	.063[2/]	.100	.210	.246	.316
	Million tons							
Arkansas[3/]								
AK-1	0	0	21	26	397	633	633	633[4/]
Illinois								
IL-1	0	0	0	0	28	52	64	3,460
IL-2	0	0	0	0	179	544	628	1,854
IL-3	0	0	0	0	347	2,610	2,742	3,396
IL-4	0	0	0	0	170	1,414	1,478	3,008
IL-5	0	0	0	0	205	257	664	2,614
IL-6	0	0	0	0	5,281	6,557	7,925	10,747
Total	0	0	0	0	6,210	11,434	13,501	25,079
Indiana								
IN-1	0	0	0	274	284	294	299	370
IN-2	0	0	0	544	1,894	2,960	2,960	3,256
IN-3	0	0	0	225	360	885	2,209	4,617
Total	0	0	0	1,043	2,538	4,139	5,468	8,243
Iowa								
IA-1	0	0	0	0	0	0	0	510
IA-2	0	0	0	0	0	0	0	279
Total	0	0	0	0	0	0	0	789
Kansas								
KS-1	0	0	0	0	0	9	15	23
KS-2	0	0	0	0	0	0	0	1
KS-3	0	0	0	0	0	274	480	770
Total	0	0	0	0	0	283	495	794
Western Kentucky								
KY-1	0	220	232	973	1,422	1,698	2,489	9,184
Missouri								
MO-1	0	0	0	0	0	0	183	189
MO-2	0	0	0	0	0	0	50	51
MO-3	0	0	0	0	0	0	218	225
MO-4	0	0	0	0	0	0	12	12
MO-5	0	0	0	0	0	0	453	468
Total	0	0	0	0	0	0	916	945

Table 4 --continued

State and CPA	Coal reserves[1/]							
	Sulfur Content/Heating value (% $S/10^3$ Btu/lb.)							
	.021	.042	.050	.063[2/]	.100	.210	.246	.316
	-Millions tons-							
Oklahoma								
OK-1	0	6	53	99	122	272	274	493
OK-2	0	9	9	99	447	465	465	465
OK-3	0	1	1	5	96	252	252	252
Total	0	16	63	203	665	989	991	1,210
Interior Total	0	236	316	2,245	11,232	19,176	24,493	46,877
	-Percent[5/]							
Arkansas								
AK-1	0	0	3.0	4.1	62.7	100.0	100.0	100.0
Illinois								
IL-1	0	0	0	0	0.4	0.8	0.9	50.5
IL-2	0	0	0	0	4.0	12.2	14.1	41.5
IL-3	0	0	0	0	1.6	11.7	12.3	15.2
IL-4	0	0	0	0	3.9	32.8	34.3	69.8
IL-5	0	0	0	0	2.0	2.5	6.5	25.6
IL-6	0	0	0	0	30.1	37.4	45.2	61.3
Total	0	0	0	0	9.4	17.4	20.6	38.2
Indiana								
IN-1	0	0	0	41.0	42.5	44.0	44.7	55.3
IN-2	0	0	0	13.8	48.1	75.1	75.1	82.6
IN-3	0	0	0	3.7	6.0	14.7	36.8	76.8
Total	0	0	0	9.8	23.9	39.0	51.5	77.6
Iowa								
IA-1	0	0	0	0	0	0	0	29.9
IA-2	0	0	0	0	0	0	0	20.5
Total	0	0	0	0	0	0	0	25.7
Kansas								
KS-1	0	0	0	0	0	21.4	35.7	54.8
KS-2	0	0	0	0	0	0	0	1.4
KS-3	0	0	0	0	0	21.5	37.7	60.4
Total	0	0	0	0	0	20.4	35.7	57.2
Western Kentucky								
KY-1	0	1.7	1.8	7.7	11.3	13.5	19.7	72.8

Table 4 --continued

State and CPA	Coal reserves[1] Sulfur Content/Heating value (% S/10^3 Btu/lb.)							
	.021	.042	.050	.063[2]	.100	.210	.246	.316
	Percent[5]							
Missouri								
MO-1	0	0	0	0	0	0	7.6	7.9
MO-2	0	0	0	0	0	0	7.2	7.4
MO-3	0	0	0	0	0	0	5.6	5.8
MO-4	0	0	0	0	0	0	0.8	0.8
MO-5	0	0	0	0	0	0	42.9	44.3
Total	0	0	0	0	0	0	9.7	10.0
Oklahoma								
OK-1	0	1.2	10.8	19.2	23.6	52.7	53.1	95.5
OK-2	0	1.9	1.9	21.2	95.9	99.8	99.8	99.8
OK-3	0	0.3	0.3	1.6	30.8	80.8	80.8	80.8
Total	0	1.2	5.2	15.7	51.4	76.4	76.6	93.5
Total Interior	0	0.2	0.7	2.1	10.7	18.3	23.4	44.8

1/ Excludes reserves that do not meet the minimum of requirements of two sets of standards related to air quality, New Source Performance Standards (NSPS) and National Ambient Air Quality Standards (NAAQS). Entries indicate reserves with S/H ratio less than or equal to value, hence are cumulative.

2/ Meets federal New Source Performance Standards (NSPS) without flue gas desulfurization.

3/ Excludes the lignite area of Arkansas which is included in the Gulf Region.

4/ Includes 96 million tons of anthracite.

5/ Cumulative percent of CPA reserve.

Source: Argonne National Laboratory. Coal Supply and Air Quality Limitations on Fossil Fueled Energy Centers. August 1976. (21)

tons (standard) per acre (10, 22, 38). This compares to the average for the entire Interior of 5,040 tons (standard) per acre.

Recoverable coal reserves per acre of these magnitudes are relatively small. By comparison, recoverable strippable coal reserves average about 15,900 tons per acre in New Mexico, 27,200 tons per acre in Montana and 33,000 tons per acre in Wyoming (all standard BTU coal). The coal seams in the Interior Region are much thinner than in the Rocky Mountain and Northern Great Plains Regions. As a result, recoverable strippable reserves per acre in Wyoming, for example, are 5 times the reserves per acre in the Interior. When mining commences, the amount of recoverable reserves per acre is a major influence on production of coal per acre, and on mining costs per ton.

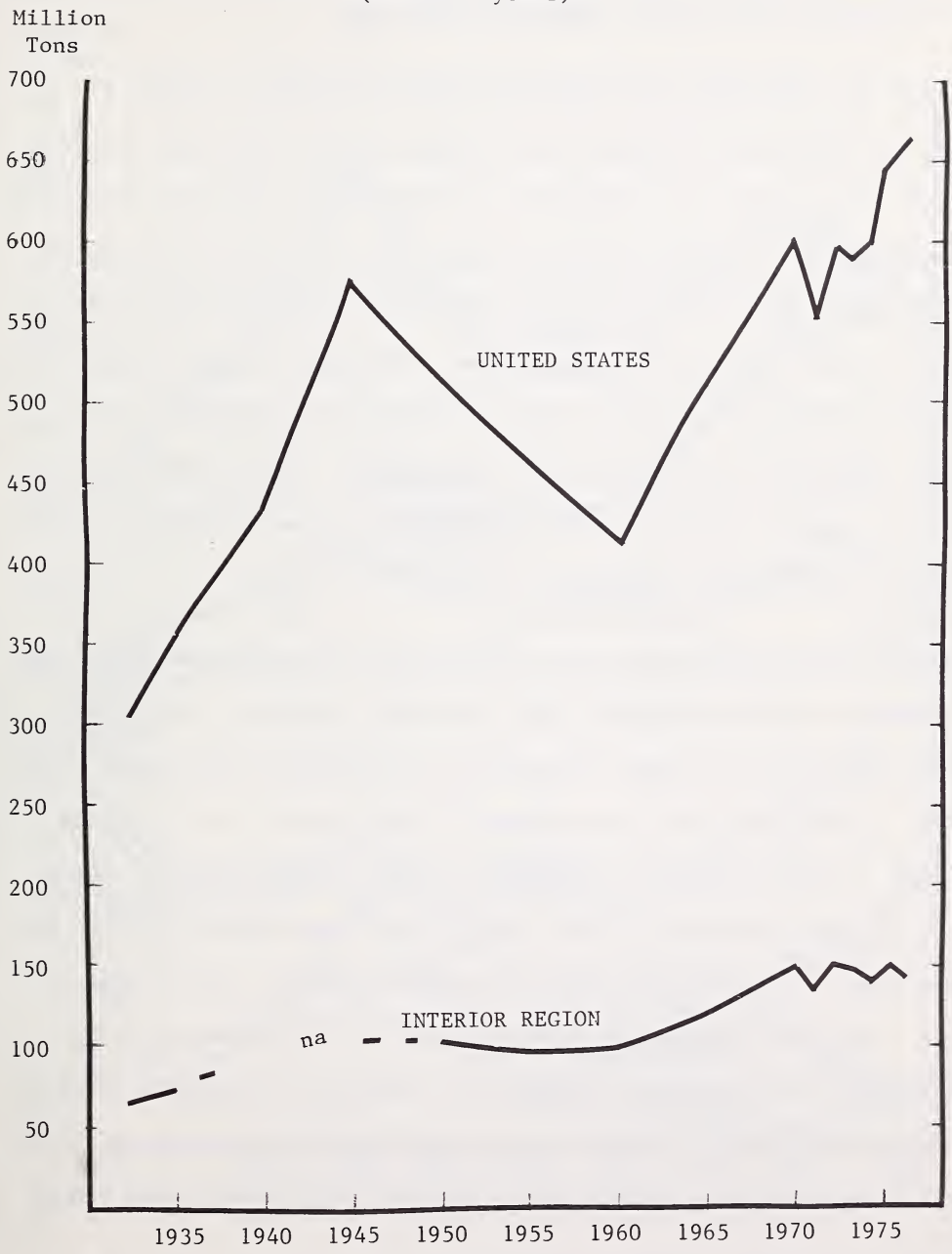
PRODUCTION AND UTILIZATION

Historical Trends

Historically, the Interior Region has been considered a major coal producing area. However, in recent years as the demand for coal has increased, especially the demand for SO_2 compliance coal, mining activity in the Interior has not shown a significant increase (Figure 3).

In 1932, the Interior Region produced about 68.5 million tons of coal, 22.1 percent of total U.S. production. Subsequently, with the exception of the mid-1950's, when 20.7 percent of total U.S. production came from the Interior, relative production increased from 1940 through 1972, when 153.5 million tons of coal were produced, 25.8 percent of U.S. total.

Figure 3. Coal Production, United States and Interior Region, 1932-76 (selected years)



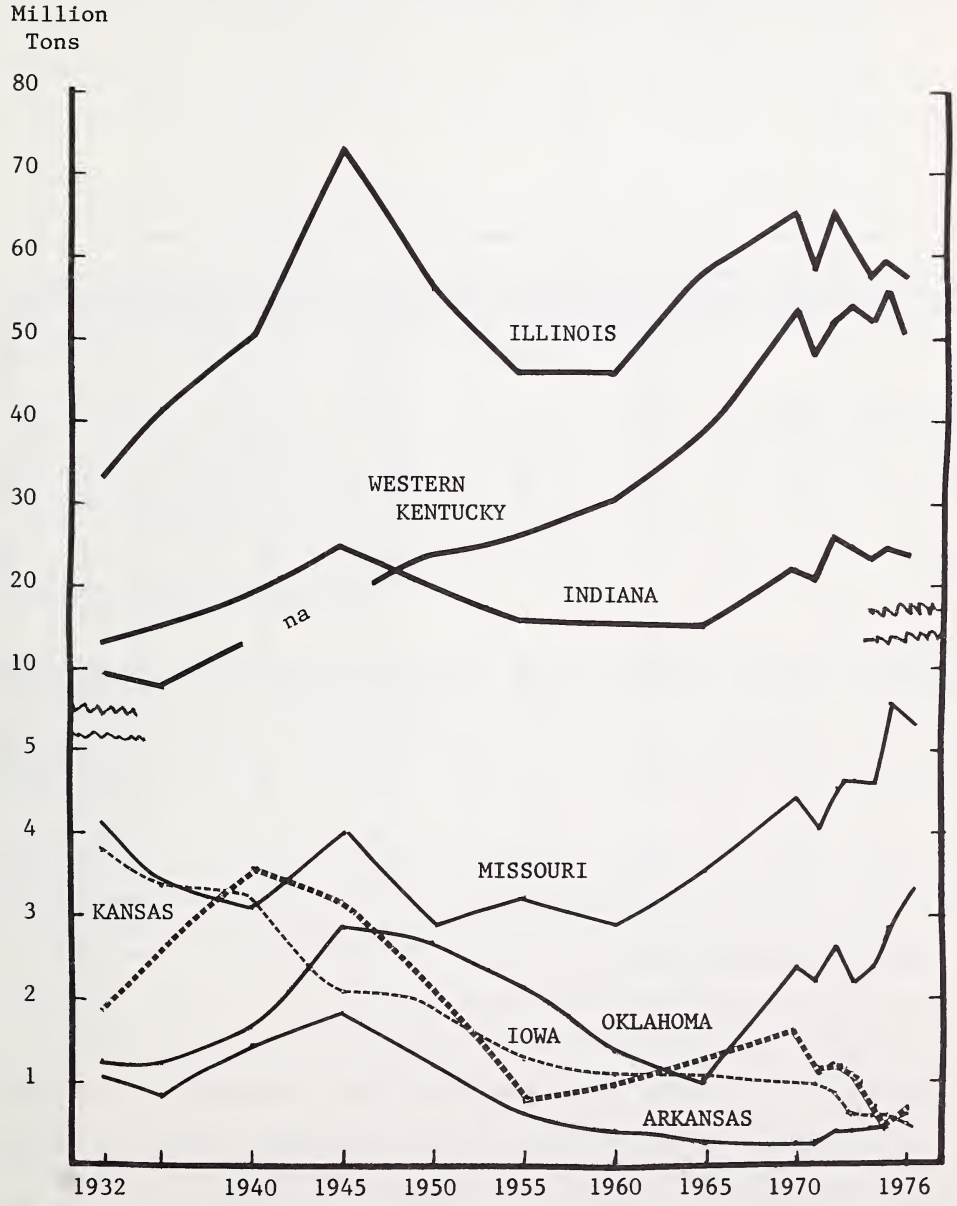
SOURCE: U.S. Bureau of Mines, Minerals Yearbooks. Various years. (36)

By 1976, production from the Interior had decreased to 143 million tons, 21.5 percent of U.S. total (Table A-2) (33, 36).

Historical trend data for individual states are shown in Figure 4 With the exception of Arkansas and Oklahoma, which have shown sustained growth since 1971, coal production in the Interior states has fluctuated considerably. In 1976, production from each state, with the exception of Kentucky, Missouri, and Oklahoma, was less than 1945 production, the year of peak production for most states. Illinois has consistently been the top producing state with a peak production of 73 million tons in 1945, dropping to about 58 million tons in 1976. Western Kentucky has had the greatest absolute growth in production, from 26 million tons in 1950 to a peak of 56 million tons in 1975.

As annual coal production in the Interior has fluctuated the amount extracted by surface mining has also fluctuated. However, the general trend has been for a larger proportion to be mined by this method. In 1940, 35 percent of the coal produced in the Interior was by surface mining. In 1976, about 62 percent was surface mined. In 1975, there were 368 mines operating in the Interior. Of these mines, 306 were surface mines, 52 underground mines, nine surface-auger, and one auger mine. Coal was extracted by surface mining in each of the Interior states. Of the 306 surface mines in the Interior, 55 produced 500,000 tons or more in 1975. These 55 mines accounted for 52 percent of total coal production and 85 percent of production from surface mines (Table 5).

Figure 4. Coal Production of the Interior States, 1932-76
(selected years)



SOURCE: U.S. Bureau of Mines, Minerals Yearbooks. Various years. (36)

Table 5. Number of mines and quantity of production by State, size and type of mine for the Interior Region, 1975.

State and type of mine	500,000 tons and over		200,000-499,999 tons		100,000-199,999 tons		50,000-99,999 tons		10,000-49,999 tons		Less than 10,000 tons		TOTAL	
	Mines No.	Quantity 1,000	Mines No.	Quantity 1,000	Mines No.	Quantity 1,000	Mines No.	Quantity 1,000	Mines No.	Quantity 1,000	Mines No.	Quantity 1,000	Mines No.	Quantity 1,000
Arkansas														
Strip	-	-	1	211	1	106	1	95	3	70	2	5	8	485
Total	-	-	1	211	1	106	1	95	3	70	2	5	8	485
Illinois														
Underground	19	31,322	1	453	1	101	-	-	-	-	-	-	21	31,875
Strip	18	26,237	2	765	-	-	5	379	9	270	3	9	37	27,661
Total 1/	37	57,559	3	1,218	1	101	5	379	9	270	3	9	58	59,537
Indiana														
Underground	-		-	-	-	-	2	188	-	-	-	-	2	188
Strip	13	22,176	1	814	5	751	10	668	18	474	13	53	60	24,935
Total 1/	13	22,176	1	814	5	751	12	857	18	474	13	53	62	25,124
Iowa														
Underground	-	-	1	W	-	-	1	W	-	-	-	-	2	363
Strip	-	-	-	-	-	-	2	W	5	128	1	W	8	259
Total 1/	-	-	1	W	-	-	3	220	5	128	1	W	10	622
Kansas														
Strip	-	-	1	W	1	W	-	-	1	46	1	W	4	479
Total	-	-	1	W	1	W	-	-	1	46	1	W	4	479
Kentucky, West														
Underground	21	24,270	1	426	1	168	2	112	2	78	-	-	27	25,054
Strip	17	24,961	8	2,581	9	1,247	11	715	53	1,257	48	261	146	31,022
Strip-auger	-	-	-	-	1	144	1	86	4	88	3	13	9	331
Total 1/	38	49,181	9	3,007	11	1,560	14	912	59	1,424	51	274	182	56,357
Missouri														
Strip	5	4,454	3	1,080	-	-	-	-	1	W	3	W	12	5,639
Auger	-	-	-	-	-	-	1	W	-	-	-	-	1	W
Total 1/	5	4,454	3	1,080	-	-	1	W	1	W	3	W	13	5,638
Oklahoma														
Strip	2	1,426	-	-	7	959	2	149	13	304	7	35	31	2,872
Total	2	1,426	-	-	7	959	2	149	13	304	7	35	31	2,872
Interior														
Underground	40	55,542	3	879	2	269	5	300	2	78	-	-	52	57,430
Strip	55	79,254	16	5,451	23	3,063	31	2,006	103	2,549	78	363	306	93,354
Strip-auger	-	-	-	-	1	144	1	86	4	88	3	13	9	331
Auger	-	-	-	-	-	-	1	W	-	-	-	-	1	W
Total 1/	95	134,796	19	6,330	26	3,471	38	2,612	109	2,716	81	376	368	151,117

W Data withheld to avoid disclosure of individual mines.

1/ Data may not add to totals shown because of independent rounding and withheld data.

Source: U.S. Bureau of Mines. Coal--Bituminous and Lignite in 1975. (33)

In 1975, Illinois had the largest production, producing 59.5 million tons from 21 underground and 37 surface mines. Western Kentucky was a close contender, producing 56.4 million tons from 182 mines, 146 surface, 27 underground, and nine surface-auger. Indiana was third with 62 mines, 60 surface, producing 25.1 million tons. Iowa was the only other state in the Interior with undergound mine production, producing 0.6 million tons from two underground and eight surface mines. Arkansas and Kansas, having eight and four mines respectively, produced about 0.5 million tons each. Missouri with 12 surface mines and one auger mine produced 5.6 million tons and Oklahoma with 31 surface mines produced 2.9 million tons.

Projections and Future Plans

Projections of coal mine development in the Interior have been made by the Bureau of Mines, based on known conditions. Planned coal mine development, including new mines, reopening of old mines, and expansion of existing mines, is projected to add nearly 60 million tons of coal mining capacity in the Interior. This, however, may not be an increase in net capacity due to closing or decreased production of existing mines (5, 37).

The planned development includes a total of 38 mines -- 27 underground, 10 strip, and one undergound-strip. About one-third of these mines, 13, are planned for Illinois. Kentucky, Oklahoma, and Indiana have plans for 10, seven, and five mines, respectively. Arkansas, Iowa, and Kansas each have one. Nearly all new production is scheduled for the steam coal market (Table 6).

Table 6. Planned coal mine development in the Interior Region, 1976-1985

State and company	Mine name and county	Type of operation	Initial production date year	Full capacity date year	Capacity at full operation mil. tons	Present capacity mil. tons	Planned markets
Arkansas							
Sugarloaf Mining Company	SP-7, Sebastian	Underground		1977	0.2		Metal.
Illinois							
Ziegler Coal Company	Zeigler No. 11, St. Clair	Underground	1976	1979	2.0		Steam
Midland Coal Company	Rapatee-Fulton, Knox	Strip	1976	1977	0.7		Steam
Freeman United	Crown No. 2, Macoukin	Underground	1976	1977	2.4		Steam
Monterey Coal Company	Monterey No. 2, Clinton	Underground	1976	1980	3.6		Steam
Monterey Coal Company	Burning Star No. 2, Jackson	Underground	1976	1977	2.8		Steam
Freeman United	Orient No. 5, Franklin	Underground	Possible reopening		1.5		Steam
Old Ben Coal Company	Old Ben No. 25, Franklin	Underground	1977	1981	2.0		Steam
Old Ben Coal Company	Old Ben, No. 27, Franklin	Underground	1977	1981	2.0		Steam
Amax Coal	New Delta, Saline	Strip	Expansion	1978	2.4	0.7	Steam
Inland Steel Company	Inland No. 2, Hamilton	Underground	1978	1981	2.5		Steam
Ziegler Coal Company	Zeigler No. 5, Douglas	Underground	Expansion	1977	3.0	0.5	Steam
Amax Coal	Wabash, Wabash	Underground	Expansion	1977	3.6	1.8	Steam
Amax Coal	Ayrcat, Vermillion	Strip	N.A.	1978	1.5		Steam
Indiana							
Old Ben Coal Company	Unnamed, Gibson	Underground	N.A.	1982	2.0		Steam
Peabody Coal Company	Spur Mine, Warrick	Underground	1976	1976	0.5		Steam
Old Ben Coal Company	Old Ben No. 2, Pike	Strip	Expansion	1977	2.6	1.7	Steam
Amax Coal Company	Unnamed, Knox	Strip	1982	1982	1.0		Steam
Amax Coal Company	Chinook Mine, Clay	Strip	expansion	1978	2.2	1.0	Steam
Iowa							
Big Ben Coal Company	Big Ben No. 1, Lucas	Underground	Expansion	1977	0.2	N.A.	N.A.
Kansas							
Bill's Coal Company	Bill's Coal Co., Osage	Strip	1977	1978	0.25		Steam
Kentucky							
Peabody Coal Company	Panama, Henderson	Underground	1977	1977	2.3		Steam
Island Creek Coal Co.	No. 9, Hopkins	Underground	N.A.	N.A.	1.2		Steam
Pittsburgh and Midway	Nortonville, Hopkins	Strip	1978	1979	1.0		Steam
Peabody Coal Company	Alston No. 4, Ohio	Underground	Expansion	1976	2.0	1.3	Steam
Peabody Coal Company	Alston No. 3, Ohio	Underground	Expansion	1975	2.0	1.9	Steam
Peabody Coal Company	Alston 1-East, Ohio	Underground	N.A.	N.A.	1.0		Steam
Peabody Coal Company	Alston 1-West, Ohio	Underground	N.A.	N.A.	1.0		Steam
Pittsburgh and Midway	Drake No. 5, Muhlenberg	Underground	N.A.	1979	0.5		Steam
Gibraltar Coal Corp.	Gibraltor, Muhlenberg	Strip	N.A.	N.A.	2.0		Steam
Peabody Coal Company	Sinclair, Muhlenberg	Strip	N.A.	1978	6.0		Steam

Table 6. Planned coal mine development in the Interior Region, 1976-1985 (continued)

State and company	Mine name and county	Type of operation	Initial production date, year	Full capacity date, year	Capacity at full operation, mil. tons	Present capacity, mil. tons	Planned markets
Oklahoma							
Carland Coal Company	Bakoshe No. 10, LeFlore	Strip-Underground	Reopen	1976	0.25		Foreign & Domestic Contracts Coking Coal
CF & I Steel Company	Unnamed, LeFlore	Underground	Proposed				
Peabody Coal Company	Unnamed, LeFlore	Underground	Proposed		Unknown		Unknown
Armco Steel	Unnamed, Pittsburg	Underground	Proposed		Unknown		Unknown
Armco Steel	Unnamed, Haskell	Underground	Proposed		Unknown		Unknown
Armco Steel	Unnamed, LeFlore	Underground	Proposed		Unknown		Unknown
Kerr-McGee Corp.	Choctaw, Haskell	Underground	1977		Bleeding Methane		Unknown

N.A. - Data not available

Sources: Projects to Expand Fuel Sources in Western States: Survey of Planned or Proposed Coal, Oil Shale, Tar Sand, Uranium and Geothermal Supply Expansion Projects and Related Infrastructure, in States West of the Mississippi River (as of May 1976). U.S. Bureau of Mines Information Circular 8719. (5)

Projects to Expand Fuel Sources in Eastern States: Survey of Planned or Proposed Coal Mines, Coal and Noncoal Conversion Plants, Oil Refineries, Uranium Enrichment Facilities, and Related Infrastructure in States East of the Mississippi River (as of June 1976). U.S. Bureau of Mines Information Circular 8725. (37)

It should be noted that these are planned mines, so various factors, economic, environmental, legal, etc., could cause additions to, or deletions from, this number.

Origin and Destination

Demand for Interior coal outside that region, on a relative basis, did not change much during the period, 1967-1976, ranging from 27.1 to 31.4 percent of regional production. On an absolute basis, out of region shipments increased from about 38 million tons in 1968 to 47 million tons in 1975, then dropped back to 42 million tons in 1976 (Table 7). In 1976, shipments were made to 13 non-Interior states (32).

The geographic distribution pattern is different for coal from each of the states of the Interior. In 1976, Illinois consumed about 25 million tons (43 percent) of its own coal production, shipping 41 percent for use elsewhere in the Interior (Figure 5). Indiana used 21 million tons (81 percent) of its own coal production, shipping 9 percent to other Interior states and 10 percent outside the region. Data on shipments to Eastern and Western Kentucky were not distinguished. However, about 33 percent of Western Kentucky's coal was consumed in the State of Kentucky, 13 percent in other Interior states, and 54 percent shipped out of the Region. Iowa consumed its entire coal production, .5 million tons. Data on coal shipments from Arkansas, Kansas, Missouri, and Oklahoma are not available on an individual state basis. However, as a group, about 94 percent of the coal production from these states was consumed within the Region (32).

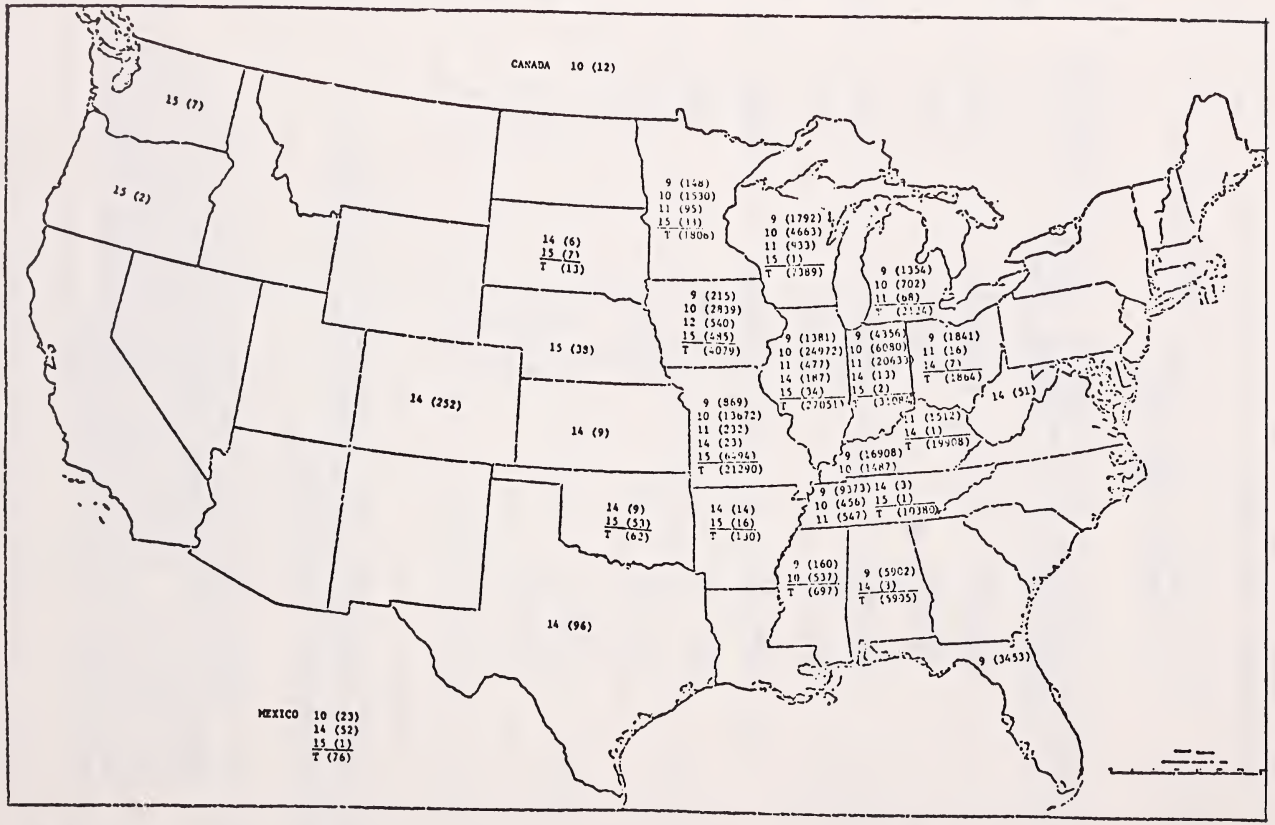
Table 7 . Out-of-Region coal shipments from Interior States, 1967-1976.

Year	Total distribution 1/	Out of region	Percent
	(1,000 tons)	(1,000 tons)	
1967	139,263	38,267	27.5
1968	135,427	37,757	27.9
1969	142,088	38,541	27.1
1970	153,168	45,225	29.5
1971	138,382	41,423	29.9
1972	155,722	46,788	30.0
1973	152,558	46,366	30.4
1974	143,844	44,160	30.7
1975	150,630	47,240	31.4
1976	147,319	41,833	28.4

1/ Production from Texas which is included in U.S.B.M. District 15 is excluded in distribution. Shipments to Eastern Kentucky are excluded.

Source: U.S. Department of the Interior, Bureau of Mines. Mineral Industry Surveys., Bituminous Coal and Lignite Distribution. Calendar year 1976 (and earlier years).(32) For conceptual reasons total distribution amounts differ slightly from total production amounts reported in other Bureau of Mines time series.

Figure 5 Distribution of coal from the Interior, by state of destination, 1976 (000 tons)



9 - Dist 9 — West Kentucky
10 - Dist. 10 — Illinois
11 - Dist. 11 — Indiana
12 - Dist. 12 — Iowa
14 - Dist. 14 — Arkansas, east central Oklahoma
15 - Dist. 15 — Kansas, Missouri, Texas, Oklahoma not included in Dist. 14

(1,000 tons)

T - Total coal delivered from the above states

Source: U.S. Bureau of Mines. Mineral Industry Surveys (10)

Mining and Transportation Costs

The cost of mining coal in the Interior is one important determinant of its competitive position in demand areas with respect to alternative fuels and costs of most other regions. Of course, allowances for transportation costs are necessary to determine, for example, how far east or west Interior coal can be competitive with Western and Appalachian coal. In general, the cost of mining a ton of coal in the Interior is less than in Appalachia, but more than in either the Mountain or Northern Great Plains Regions (14, 15, 34).

Several approaches are used to estimate average cost of mining a ton of coal in the Interior. Cost budgeting for "model" mines with different configurations typical of the Interior has been employed by the U.S. Bureau of Mines. Assumptions are made about the kinds and sizes of mining equipment suited for assumed layouts, overburden, and mining plans. Then costs are estimated based on the variables.
Study of the several BOM reports leads to the conclusion that (1) there are economies of size. As a rule, the larger the annual mine output, the lower the total operating costs per ton of coal mined; and, (2) the stripping ratio is an important element in determining the mining costs. In general, the lower the stripping ratio the lower the unit cost of mined coal.

Model mine cost budgeting is a site cost technique which requires detailed knowledge of mining and is not easily adaptable for assessment of mining costs for the large number of potential mine sites in the

Interior. Since these costs are affected by many factors, they will have to be considered in relation to each mine's own special situation and requirements. With this in mind, model mine operating costs may be useful in comparing the relative production costs of mines between regions. In a recent BOM publication, these costs were shown to be $3.82 per ton in the Interior in 1975 (Table 8). This compares with $2.61 per ton in the Northern Great Plains and $4.37 per ton in Appalachia (14).

Transportation costs of coal are a major determinant of a coal mine's market area. Transportation costs for coal may constitute over 50 percent of the total cost of the delivered product. Of 1975 Interior coal output, about 12 percent (on a raw tonnage basis) went to mine mouth generating plants, 79 percent was shipped by rail or water, and 8 percent by truck. On a percentage basis, Oklahoma was the largest user of rail and water shipment, moving 90 percent of its coal by those methods (6 percent by water). Arkansas, Illinois, Indiana, and Western Kentucky each shipped 80 percent or more of their coal by these methods. Most of Iowa's coal, about 82 percent, was moved by truck and most of Missouri's coal, 67 percent, went to mine mouth generating plants (38).

In Midwest markets, Chicago, for example, Interior coal is at a locational advantage vis-a-vis Eastern or Western coal; it is 1,278 miles from Billings-Chicago, compared to 255 miles Centralia, IL-Chicago. Major factors affecting rail transportation costs are (1) distance, (2) size of shipment, (3) type of equipment, unit or conventional. Characteristic shipping rates for coal from the Interior in 1973 ranged from 6.57 cents per ton mile for 35 miles to .49 cents per ton mile

Table 8 Estimated annual operating cost for a hypothetical 6.72 million ton surface mine in the Interior Region[1/]

	Annual cost	Cost per ton
Direct cost:		
Production:		
Labor	$1,400,600	$0.21
Supervision	316,500	.05
	1,717,100	.26
Maintenance:		
Labor	594,400	.09
Supervision	72,000	.01
	666,400	.10
Operating supplies:		
Spare parts	1,075,200	.16
Fuel, oil, and lubrication	672,000	.10
Drill bits	201,600	.03
Tires	336,000	.05
Explosives	1,411,200	.21
Miscellaneous	336,000	.05
	4,032,000	.60
Power	1,209,600	.18
Reclamation (contracted for mulching, liming, fertilizing, and seeding)	268,800	.04
Payroll overhead (40 percent of payroll)	953,400	.14
Union welfare[1]	5,250,400	.78
Royalty	3,360,000	.50
Strip license and bond	625,000	.09
Indirect cost:		
15 percent of labor, maintenance, and supplies	962,300	.14
Fixed cost:		
Taxes and insurance, 2 percent of mine cost	1,442,300	.22
Depreciation	5,209,100	.77
	6,651,400	.99
Total	25,696,400	3.82

Source: Basic Estimated Capital Investment and Operating Costs for Coal Strip Mines. U.S. Bureau of Mines Information Circular 8661. 1976. (14)

1/ Based on 1975 cost index

moving 272 miles (Table 9)(17). Economics of haul are generally realized with increases in shipping distance, train load, and annual tonnage. In 1975, unit train shipments accounted for 23 percent of all coal shipments from Interior mines.

When looked at from the standpoint of transmitting energy, costs of transmission from mine-mouth generating plants in the form of electricity can be compared with the cost of transporting the coal. One theoretical engineering study compared likely costs of transmitting extra high voltage electricity vs. transporting coal by unit train for an energy transmission distance of 1,000 miles. Comparisons were made between the costs of the two transmission modes in transferring energy (than is, the equivalent electrical energy contained in coal) for quantities of this equivalent contained in 3 million tons of coal per year, ranging to the equivalent of 18 million tons. Only for the extremely large electricity transfer quantities of 15 to 18 million tons of coal equivalent per year was extra high voltage transmission able to show economies of scale sufficient to bring per unit energy transmission costs to the cost level maintained by unit trains (Figure 6) (18).

Usage by Electric Utilities

Nationally, the continued growth in the demand for electricity has been the main force behind the recent surge in coal development. However, due to new air quality standards of the Clean Air Act, the Interior has not shared proportionally in this growth. Even so, nearly 87 percent of Interior coal is used to generate electric power (Figure 7). Most of this coal is used within the region.

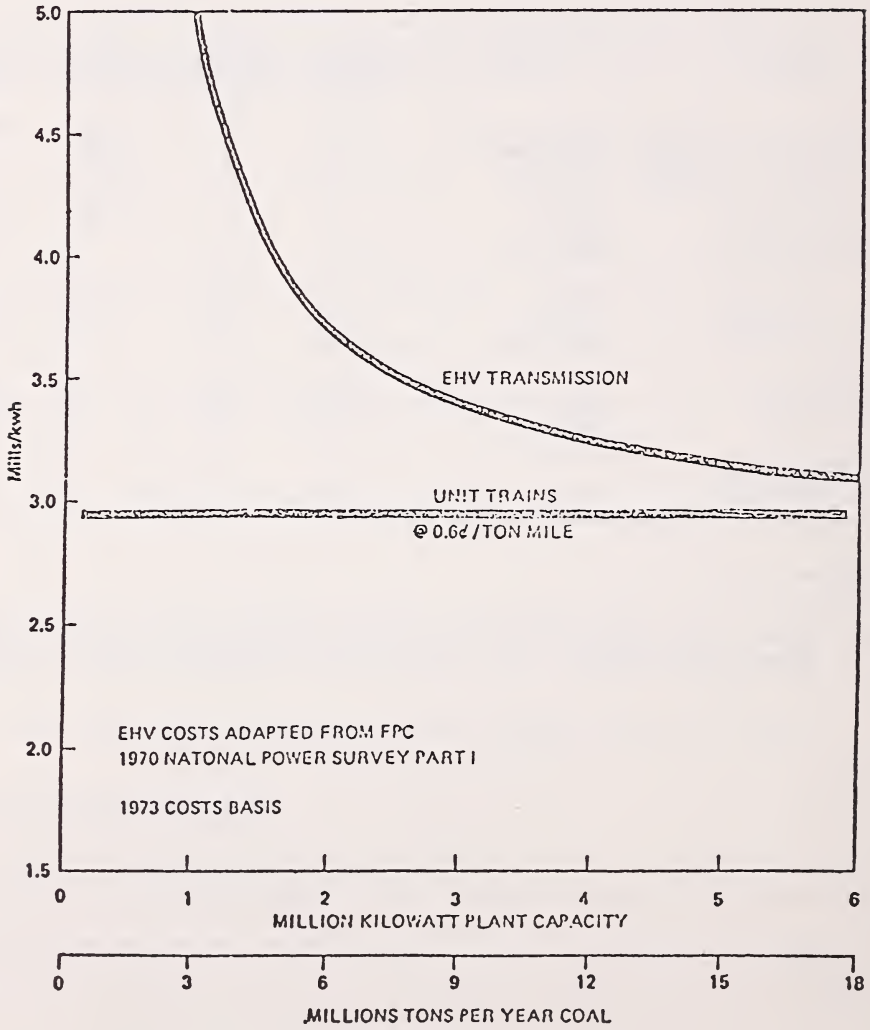
Table 9 . Costs for alternative configurations of coal shipments by rail from the Interior Region

Origin point within:	Consumption point within:	Shipping distance	Minimum trainload	Annual tonnage supplied	Costs per ton mile
		Miles	1,000 tons	1,000 tons	Cents
Dist. 9 (Western Kentucky)	Eastern Kentucky	88	1/	750	1.32
Dist. 9 (Western Kentucky)	Tennessee	272	6	1,000	.49
Dist. 9 (Western Kentucky)	Wisconsin	627	10	1,000	.50
Dist. 10 (Illinois)	Illinois	75	4	1,300	1.87
Dist. 10 (Illinois)	Iowa	35	1/	100	6.57
Dist. 10 (Illinois)	Minnesota	727	10	1/	.66
Dist. 11 (Indiana)	Indiana	38	3	500	2.74
Dist. 11 (Indiana)	Tennessee	454	1/	1/	1.11
Dist. 11 (Indiana)	Wisconsin	225	1	300	1.94
Dist. 12 (Iowa)	Iowa	272	1/	1/	1.32
Dist. 12 (Iowa)	Iowa	150	1/	1/	2.20
Dist. 12 (Iowa)	Missouri	100	1/	1/	2.28
Dist. 14 (Oklahoma, Arkansas)	Kansas	218	6	1/	.85

1/ None specified

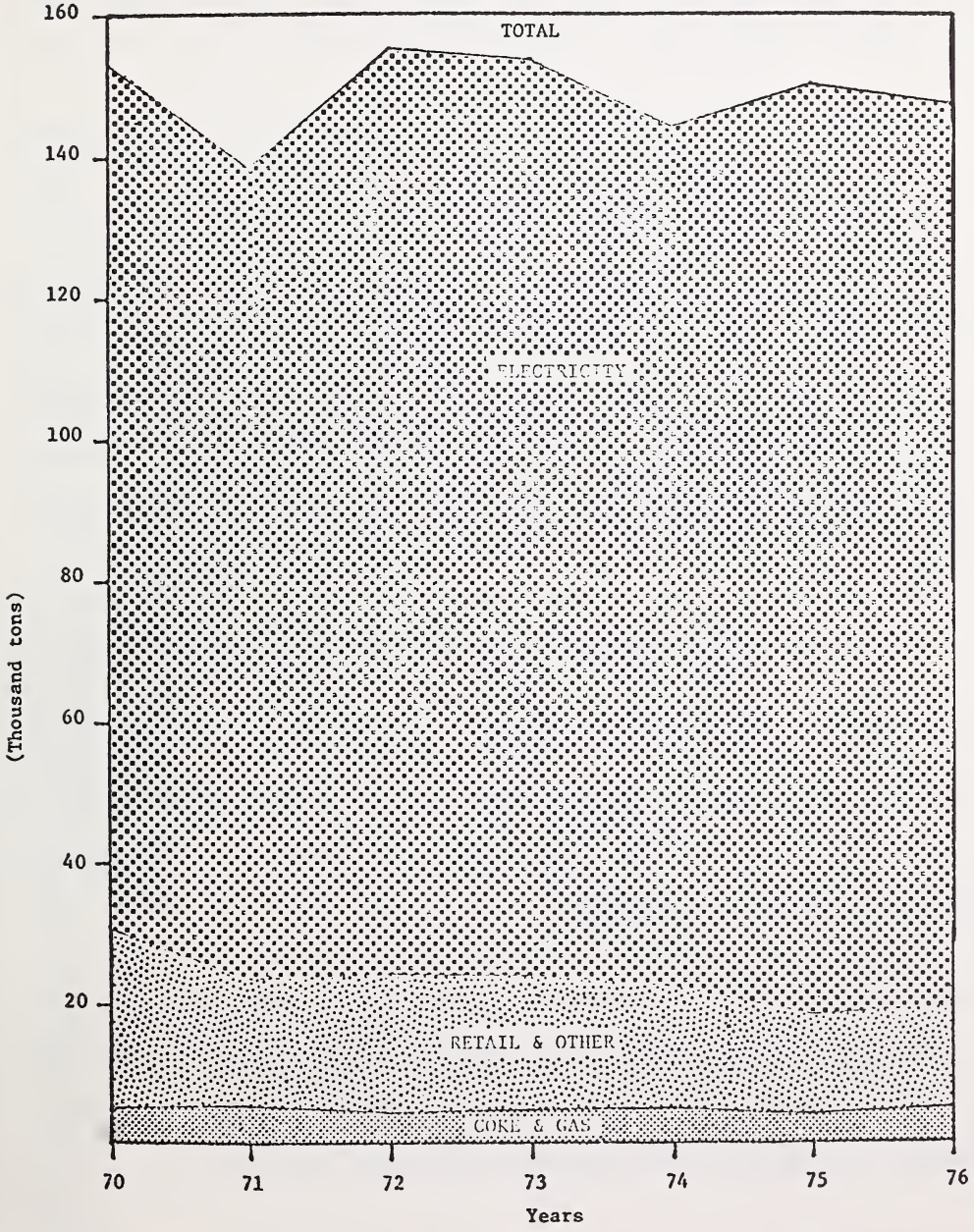
Source: Comparative Transportation Costs of Supplying Low-Sulfur Fuels to Midwestern and Eastern Domestic Markets. U.S. Bureau of Mines Information Circular 8614.(17)

Figure 6 Cost comparisons of alternative modes of coal energy transmission (for 1,000-mile transport distances)



Source: National Academy of Engineering: U.S. Energy Prospects: an Engineering Viewpoint. (18)

Figure 7 Consumption and End-use of Interior Coal, 1970-1976



Source: U.S. Bureau of Mines. Bituminous Coal and Lignite Distribution (33)

As of 1976, there were 117 electric power generating plants in the Interior using coal as the sole or a significant source of fuel. Coal use per plant ranged from 1,000 to 5,638,000 tons annually, while output capacity ranged from 2.5 to 2,553 megawatts (Table A-3).

Coal production costs (mine-mouth) in the Interior are lower in comparison with costs of Eastern coal but higher than Western coal (see previous section on mining costs). When compared to Eastern coal this is an initial competitive advantage for Interior coal. When compared with Western coal, before calculating transportation costs to any given consumption point, the initial competitive advantage favors Western coal. The competitive advantage of Interior coal is further weakened due to the shortage of available reserves of SO_2 compliance coal within the Region.

Further analysis of the competitive position of Interior coal in the U.S. markets is beyond scope of this report, but will be undertaken by the Interregional Coal Analysis Model referred to in the Introduction. The key roles played by transportation costs and capacities as well as public policy in determining this competitive position can be addressed through quantitative techniques.

Projections of the electric utility component of total demand for Interior coal have been made by the Bureau of Mines, based on known conditions. Demand for steam coal from the Interior is projected to increase, between 1975-1983, by about 42 million tons (35).

However, factors not tied to the mining process could easily change some of these conditions. For example, Federal sulfur dioxide emission standards or other air quality standards could be revised again, as they were in 1977. Therefore, the quantity of the Interior coal demanded within the Region as well as in other regions could be sharply affected by any change in emission standards.

In addition, other actions in the near future could affect the demand for Interior coal. Deregulation of natural gas prices could be one of these actions. The pricing of natural gas, even if not deregulated, is extremely important since coal and natural gas are substitutable in certain uses, especially medium to long term. Different patterns of coal transportation via rail or slurry pipeline might develop in response to various constraints, thereby altering demand patterns. All these actions and factors could come together in complex forms, which can be analyzed in the context of an econometric model.

Projections being made through 1985 have the advantage of taking account of implementation of actual plans for new electrical generating capacity. Lead time may take 8 years, sometimes longer. In the Interior, for the 1976-85 period, there are 86 additional coal fired plants under construction, planned or proposed, with electricity output ranging from 11 to 1,300 megawatts per plant, and using 40,000 to 3,000,000 tons of coal annually (Table A-4). Engineering plans for gasification and liquification plants in the Interior have been prepared, but firm decisions have not yet been made to construct any of them on a commercial basis.

RECLAMATION OF MINED LAND

By

Greg Stamm and Virgil Whetzel [1/]

The effects of abandoned and unsuccessfully reclaimed surface mine sites have long been known to the Interior Region (8, 23). The damages caused by erosion, sedimentation, impaired drainage, degraded water quality, loss of productivity and loss of aesthetics can be found in many areas where surface mining has occurred. In the Interior, much of the surface minable coal lies under agricultural land. It is estimated that from 1930-1976, 925,000 acres of land were disturbed by surface mining in the Interior. This includes 698,000 acres for actual mining and 227,000 acres for related mining activities (20, 38).

Since much of the Interior's surface-minable coal lies under agricultural land, the increased demand for coal has created pressures to use up farm land for coal production purposes. This has increased land use conflict based on controversies between economic, environmental, social, and aesthetic interest groups, and in many cases has heightened opposition to surface mining. The process of reclamation is intended to minimize adverse effects during and after mining, and return surface mined land to productive use.

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LEGISLATION

Although some mining companies have practiced reclamation techniques for years, due to the expenses involved, reclamation of mined land, in the past, was not the general practice. However, as an increasing amount of land became affected by surface mining, it became evident that reclamation requirements were needed to control physical and chemical pollution of land and water. Early laws passed in Indiana (1941), Illinois (1943), and Kentucky (1954) addressed the basics in surface mine reclamation. These early laws have been updated and expanded and presently cover various aspects of mining and post-mining activity. In those states where mining on a large scale has only recently begun legislation has been patterned after the older more technically oriented legislation (13).

The federal surface mining legislation, passed in 1977, altered the maturation process of state laws. This new legislation sets standards that each state must meet. In some states, however, legislation may be more stringent than that proposed by the federal act.

Table A-5is a matrix of state surface mining legislation in the Interior Region, showing the level of maturity of each state in the Interior in comparison with other states within the Region.

This comparison shows that:

(1) Six states have detailed guidelines for mining.

(2) Five provide regulations on all minerals.

(3) One has detailed water quality standards.

(4) All have detailed backfill, highwall, and toxic waste guidelines.

(5) Three allow for long range planning.

The data in Table 10 indicate some of the variations found in mining in the Interior Region. In states where topography is conducive to area mining there may be no concern about spoil fill methods. Whereas, a state with acid mine drainage may stress water quality regulations more than a state in which this is not a problem.

RECLAMATION COSTS

Reclamation costs are made up of three broad categories including planning, backfilling, and revegetation. Legislation sets the minimum level of reclamation to be achieved, thereby having some control on the cost of reclamation. The topography of the mine site may add to the cost, as it presents varying degrees of difficulty in completing the required reclamation.

Both area and contour mining are practiced in the Interior. The area method tends to suppress reclamation costs by limiting the handling of overburden material. The placing of overburden in the previous cut eliminates excessive handling and at the same time allows the same machinery to be used in both the mining and reclamation process.

The contour and similar methods require removal of the overburden and its return or placement in the fill. This added handling, along with decreased machinery effectiveness adds to reclamation costs. In addition, if a fill is used for deposition of spoil, this too must be reclaimed.

Table 10 Site parameters and reclamation costs for the Appalachian and Interior Regions, 1973

Region	Site	Mining method	Acres	Average slope	Premining		Backfilling		Revegetation		Total reclamation costs		
					Dollars per ton	Dollars per acre	Dollars per ton	Dollars per acre	Dollars per ton	Dollars per acre	Dollars per ton	Dollars per acre	Dollars per cu yd
I	1	Contour	65	25	0.36	721	3.34	6,684	0.18	355	3.88	7,760	0.23
	2	do	10	25	.19	186	3.72	3,723	.33	330	4.24	4,239	.34
	3	do	120	24	.29	508	4.27	7,396	.18	320	4.74	8,224	.31
	4[1]	do	10	25	.35	375	10.52	11,136	.40	420	11.27	11,931	.69
	5	do	180	25	.07	325	3.16	14,317	.09	430	3.32	15,072	.32
	6[1]	do	120	25	.08	167	5.76	11,994	.15	320	5.99	12,481	.37
	7	Area	90	10	.05	131	.94	2,625	.03	74	1.02	2,830	.13
	8	do	40	10	.04	257	1.26	7,872	.05	335	1.35	8,464	.20
	9	do	360	10	.13	444	1.92	6,838	.01	47	2.06	7,329	.26
Region I average			-	-	.16	367	2.66	7,065	.12	270	2.94	7,703	.25
II	1	Area	180	9	.04	181	1.11	4,915	.08	346	1.23	5,442	.15
	2	Contour	90	25	.10	205	3.75	7,510	.17	335	4.02	8,050	.31
	3	do	6	20	.08	200	2.47	6,163	.15	370	2.70	6,733	.19
	4	do	12	15	.05	173	3.20	11,996	.03	100	3.28	12,269	.37
	5	Area	29	10	.05	188	2.15	7,990	.06	228	2.26	8,405	.25
	6	do	100	8	.04	168	1.96	7,831	.07	269	2.07	8,286	.18
Region II average			-	-	.06	186	2.44	7,734	.09	275	2.59	8,198	.24
III	1	Area	220	10	.08	277	2.15	7,031	.11	370	2.34	7,678	.22
	2	Contour	460	15	.12	165	3.78	5,353	.27	388	4.17	5,906	.21
	3	Area	150	5	.05	333	1.94	14,206	.02	111	2.01	14,650	.23
	4	Contour	2,400	17	.12	302	3.80	9,488	.06	146	3.98	9,936	.18
	5	Area	192	5	.06	283	1.14	5,354	.03	119	1.23	5,756	.16
Region III average			-	-	.09	272	2.56	8,286	.10	226	2.75	8,785	.20
Total average, all sites			-	-	.11	280	2.56	7,627	.11	260	2.77	8,168	.24
Average--area mining			-	-	.06	251	1.62	7,185	.05	211	1.73	7,649	.20
Average--contour mining			-	-	.15	309	3.50	8,070	.16	308	3.81	8,688	.28
Average--sites with slope ≥20°			-	-	.18	358	3.45	7,632	.18	357	3.81	8,346	.29
Average--sites with slope <20°			-	-	.07	242	2.11	7,625	.07	211	2.25	8,079	.21
Average-ssites with production ≥500,000 tons per year			-	-	.08	289	2.38	8,438	.08	245	2.54	8,971	.22
Average--sites with production <500,000 tons per year			-	-	.13	274	2.71	6,979	.13	270	2.96	7,526	.26

[1]Averages do not include data from sites 4 and 6 in region I because these mine sites are operating under special conditions that result in a loss of money for present mining.

Region I - Alabama, Kentucky, Tennessee
Region II - Maryland, Pennsylvania, Virginia, West Virginia
Region III - Illinois, Indiana, Ohio

Source: Coal Surface Mining Reclamation Costs - Appalachian and Midwestern Coal Supply Districts. U.S. Bureau of Mines Information Circular 8695. (7)

Data on various combinations of surface mining methods, slope degrees, and production capacity indicate that per ton reclamation costs are less (1) for area mines (2) on sites with less than 20^{o} slope (3) on sites with 500,000 tons or more annual production (7).

Given these general relationships, it is important to realize that surface mining is a site specific undertaking. Each mine is different and presents a different reclamation situation which is, to a large extent, dependent upon the topography of the mine site and the degree of reclamation required.

Interaction of various factors limit the accuracy of predicting reclamation costs. However, a comparison of costs for similar types of mines in similar areas may act as a range for predicting reclamation costs in the Interior CPA's.

THE LAND RESOURCE

By

Wallace McMartin [1/]

LAND OWNERSHIP

Unlike the Rocky Mountain and Northern Great Plains Regions, most of the land in the Interior Region is privately owned. In Iowa, Federal agencies own less than 1 percent of all the land area, and in Kansas and Illinois, less than 2 percent (Table 11). The largest amount of Federal land is administered by the Forest Service, with about 2.5 million acres in Arkansas and 1.5 million acres in Missouri. In Oklahoma there is about 1.3 million acres of Indian land and 27,000 acres in Kansas. The U.S. Army Corps of Engineers controls about 3 million acres of land, the major portion of which is located in Oklahoma, Arkansas, and Missouri. An undertermined portion of the Corps of Engineers land is water surface, not land area, so the data in the percentage column in Table 11 may be somewhat exaggerated. Complete data by counties are available for Forest Service land and for Indian land, thus permitting a tabulation by CPA's. Forest Service land is found in Six CPA's, mostly in AR-1, as shown below (25):

CPA	1,000 acres	Percentage of CPA land area
AR-1	1,004	32.4
IL-5	41	1.4
IL-6	24	0.7
IN-3	65	2.1
MO-3	13	0.3
OK-2	201	11.0

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Table 11. Federal Land Ownership in Interior Region States, 1975 [1/]

State	Department of Defense			Other Federal agencies	Indian land [2/]	Total Federal [3/]	Total land area [4/]	Federal land as a percent of total
	Forest service	Corps of engineers	Military	Fish and wildlife				
	1,000 acres							
Arkansas	2,463	533	94	132	31	0	3,254	33,245	9.8
Illinois	254	191	51	56	11	0	563	35,679	1.6
Indiana	179	116	176	8	8	0	486	23,102	2.1
Iowa	0	176	20	26	3	4	228	35,802	0.6
Kansas	108	320	167	22	96	27	739	52,344	1.4
Kentucky	648	311	162	2	227	0	1,349	25,376	5.3
Missouri	1,452	495	73	43	86	*	2,150	44,157	4.9
Oklahoma	291	865	182	80	95	1,306	2,819	44,020	6.4
Region Total/ Average	5,394	3,007	925	369	557	1,337	11,588	293,725	3.9

* Less than 500 acres.

1/ As of June 30, 1975. Except as noted, data are from (31).

2/ Includes tribal and alloted land as well as land owned by the U.S. Bureau of Indian Affairs (30).

3/ Includes all of the columns to the left.

4/ From (26).

Indian land is found in only four of the CPA's -- KS-1, and all three of those in Oklahoma, as follows (30):

CPA	1,000 acres	Percentage of CPA land area
KS-1	6	0.4
OK-1	93	2.5
OK-2	39	2.1
OK-3	45	2.0

The land controlled by other Federal agencies is usually not minable, either by virtue of its use or its location. Land used for wildlife refugees or located on the shores of Corps of Engineers reservoirs probably would not be minable even if coal deposits were known to exist. Coal mining is kept from such land by rather rigid institutional barriers.

Land owned or controlled by the states in the Interior Region is usually not minable, because it is dedicated to some specific use such as parks, forests, wildlife refuges, or state experimental or demonstration farms. Comprehensive statistics on state owned land are not available by counties so a tabulation by CPA's is not possible, but the aggregate acreage of such land in the Interior Region is not large in relation to the total. The impact of state and federal ownership on mining is not significant to the same degree in the Interior Region as it is in either the NGP or RM Regions, mostly because the acreage of public land is so small in relation to the total area. In some localities, however, public ownership of land or other institutional barriers may influence its availability for coal development, so in planning for a particular mine it is especially important to obtain site specific ownership data.

MINERAL OWNERSHIP

As is typical in areas where coal production has occured, there is frequently a division between surface ownership and mineral ownership, and the owner of the surface may have little or no right to the coal underneath. In the case of the federal and state land, the agency owning or controlling the surface usually owns or controls the mineral rights. In areas where coal mining has been increasing or where increased mining is contemplated, coal companies have been actively purchasing rights to the coal either by means of leases or by the purchase of both surface and mineral rights. In such areas individual owners may find it difficult to decide whether or not to lease or sell their mineral rights. In some locations distrust of the intentions of the coal companies and other agencies have created an area of public concern. In southern Illinois, for example, a pamphlet has been published to give landowners advice on how to react when approached by a coal company with an offer to lease or buy mineral rights (12). Patterns of coal ownership, as well as concentration of ownership are of considerable concern in many areas, though a detailed study of this problem is beyond the scope of this paper.

LAND USE

One of the most important differences between the Interior Region and the two Western Regions is in agricultural land use. Because of more favorable climate and soils, the land in most CPA's in the Interior Region is used much more intensively than in the RM and NGP Regions.

Here agriculture is the most important land use and the type of farming is based on high-value crops such as corn and soybeans. Most of the CPA's are located in the Corn Belt, one of the richest agricultural areas in the world. Out of a total area of 73 million acres included in the CPA's, about 41 million acres are in farms, of which 31.5 million acres were harvested cropland in 1974 (Table). In some CPA's such as IL-4, IA-2, and KS-1 nearly all the land is used for farming, and nearly all the farm land is cropland, indicating a high degree of arability (Table 13).

Some of the CPA's are less favorably endowed with agricultural potential. In AR-1, only about a third of the area is in farms because there is a large acreage of National Forest Land and a military reservation of 71,000 acres (41). In OK-2 less than half the land is in farms; here too there is a large acreage of National Forest land. In the three Oklahoma CPA's and also in AR-1 there is more pasture and "other" land than cropland. This is partly because of the terrain -- most of the area in these four CPA's is located within the Ozark Mountains, where the land is hilly and rough, and a substantial part of the non-crop portion of the farmland is woodland.

By comparing the acreages of harvested cropland to the total land area the disparity in agricultural potential between CPA's is emphasize. In IL-2 and IL-4 nearly 3 quarters of the land surface was harvested for crops. Between three fourths and one half the total surface area was cropland harvested in IL-1, IL-3, IL-5, and IA-2. On the other end of

Table 12. Land Area and Major Land Use, All Farms, 1974

Coal producing areas	Land area	Non-farm land	Land in Farms						
			Cropland				Pasture range, & other	Total 1/	Irrigated land
			Harvested	Pastured	Other	Total 1/			
	1,000 acres								
Arkansas-1	3,095	2,035	189	332	19	539	521	1,060	9
Illinois-1	5,577	732	3,233	398	168	3,799	1,046	4,845	3
Illinois-2	4,514	565	3,387	123	69	3,578	371	3,949	11
Illinois-3	5,878	763	3,831	288	156	4,276	839	5,114	2
Illinois-4	2,115	180	1,559	77	49	1,686	250	1,935	*
Illinois-5	2,831	699	1,465	144	105	1,714	418	2,132	3
Illinois-6	3,610	1,030	1,714	236	158	2,108	471	2,579	4
Indiana-1	707	171	341	41	17	399	137	536	*
Indiana-2	1,040	398	386	54	40	481	162	642	1
Indiana-3	3,155	1,053	1,280	221	92	1,593	509	2,102	2
Iowa-1	1,520	232	677	229	40	946	343	1,288	*
Iowa-2	7,487	753	4,510	744	134	5,388	1,346	6,734	1
Kansas-1	1,394	156	655	196	42	894	344	1,238	2
Kansas-2	822	127	301	89	18	407	287	694	2
Kansas-3	2,281	377	763	240	46	1,050	854	1,904	2
Kentucky-1	3,823	1,430	968	520	104	1,591	802	2,393	1
Missouri-1	3,434	505	1,198	763	75	2,035	894	2,930	*
Missouri-2	2,580	391	1,133	443	81	1,657	532	2,189	2
Missouri-3	4,487	941	1,645	708	131	2,484	1,062	3,546	6
Missouri-4	2,325	506	758	442	40	1,240	579	1,819	2
Missouri-5	2,506	547	855	424	47	1,327	632	1,959	13
Oklahoma-1	3,767	1,288	454	511	48	1,013	1,466	2,479	4
Oklahoma-2	1,829	988	110	219	12	341	499	841	3
Oklahoma-3	2,237	805	89	252	13	354	1,077	1,431	3
Region Total	73,014	16,673	31,500	7,694	1,707	40,900	15,441	56,341	78

* Less than 500 acres

1/ Detail may not add to totals due to rounding

Compiled from U.S. Census of Agriculture, Volume 1. (26)

Table 13. Land Use Ratios, 1974

Coal production areas	Farmland to land area	Cropland to farmland	Harvested cropland to total cropland	Harvested cropland to land area
	percent			
Arkansas	34.2	50.8	35.0	6.1
Illinois-1	86.9	78.4	85.1	58.0
Illinois-2	87.5	90.6	94.6	75.0
Illinois-3	87.0	83.6	89.6	65.2
Illinois-4	91.5	87.1	92.5	73.7
Illinois-5	75.3	80.4	85.5	51.7
Illinois-6	71.5	81.7	81.3	47.5
Indiana-1	75.8	74.4	85.4	48.2
Indiana-2	61.7	74.8	80.4	37.1
Indiana-3	66.6	75.8	80.4	40.6
Iowa-1	84.7	73.4	71.6	44.5
Iowa-2	89.9	80.0	83.7	60.2
Kansas-1	88.8	72.2	73.3	47.0
Kansas-2	84.5	58.6	73.8	36.6
Kansas-3	83.5	55.1	72.7	33.5
Kentucky-1	62.6	66.5	60.8	25.3
Missouri-1	85.3	69.5	58.8	34.9
Missouri-2	84.9	75.7	68.4	43.9
Missouri-3	79.0	70.1	66.2	36.7
Missouri-4	78.2	68.2	61.1	32.6
Missouri-5	78.2	67.7	64.5	34.1
Oklahoma-1	67.5	40.9	44.8	12.0
Oklahoma-2	46.0	40.5	32.3	6.0
Oklahoma-3	64.0	24.7	25.0	4.0
Region Total	77.2	72.6	77.0	43.1

1/ On farms with over $2,500 gross sales.

Compiled from U.S. Census of Agriculture, Volume 1. (26)

the scale, less than 10 percent of the land in AR-1, OK-2, and OK-3 was used for crops, and only 12 percent in OK-1.

Although there is some irrigated land in every CPA, irrigation is not an especially important part of the farm economy of any of them. Unlike the NGP and RM Regions, the climate in the Interior Region is subhumid to humid, and good crop growth is not usually dependent on artifically supplied water. The total irrigated cropland for the CPA's in the Region is only 78,000 acres, about 0.2 percent of the total. The largest amount of irrigation is found in MO-5 and IL-2. Most of the irrigation is by sprinklers, largely self propelled systems such as center pivot. The principal crops irrigated were corn, soybeans, and vegetables (26).

NUMBER OF FARMS

In the 24 CPA's there were more than 214,000 farms in 1974, and the average size was 263 acres (Table 14). Such a statement, without further explanation, could be misleading because the average combines two groups, one of which consists of two dis-similar sub groups. In the Census of Agriculture, farms are reported in two categories, "all farms" and "farms with gross sales of $2,500 and over." Data for "other farms" in Table were derived by subtracting the "over $2,500" from "all farms." The "other farms" consist of two sub groups, namely, places with more than $1,000 but less than $2,500[2/] in agricultural sales, and

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2/ Places with less than $1,000 farm sales were not reported as farms in Volume 1 (26). Data for abnormal farms, except for number of units, were not reported separately by county.

Table 14. Number of Farms and Average Size, Farms Over $2,500, and all Others, 1974 1/

Coal production areas	Number of Farms			Land in Farms 2/			Average Size			Cropland Average per Farm			Cropland Harvested per Farm		
	All farms	Over $2,500	Other	All farms	Over $2,500	Other	All farms	Over $2,500	Other	All farms	Over $2,500	Other	All farms	Over $2,500	Other
	number			1,000 acres			acres			acres			acres		
Arkansas-1	5,273	2,602	2,671	1,060	757	303	201	291	113	102	144	62	36	62	11
Illinois-1	18,321	16,362	1,959	4,845	4,723	121	264	289	62	207	228	32	176	197	9
Illinois-2	13,905	12,967	938	3,949	3,903	46	284	301	49	257	274	29	244	260	12
Illinois-3	18,822	16,489	2,333	5,114	4,995	120	272	303	51	227	256	26	204	231	9
Illinois-4	6,939	6,091	848	1,935	1,898	37	279	312	43	243	274	23	225	255	9
Illinois-5	9,710	8,246	1,464	2,132	2,045	87	220	248	60	177	202	31	151	175	12
Illinois-6	10,899	8,570	2,329	2,579	2,446	133	237	285	57	193	236	36	157	197	12
Indiana-1	1,952	1,592	360	536	514	21	274	323	60	204	243	32	174	211	10
Indiana-2	3,236	2,367	869	642	588	54	198	248	62	149	191	33	119	158	13
Indiana-3	10,022	7,919	2,103	2,102	1,958	145	210	247	69	159	192	34	128	159	11
Iowa-1	5,484	4,701	783	1,288	1,229	59	245	262	75	172	194	44	123	142	14
Iowa-2	25,829	23,391	2,438	6,734	6,568	166	261	281	68	209	226	38	175	191	13
Kansas-1	4,271	3,444	827	1,238	1,174	64	290	341	77	209	249	44	153	186	17
Kansas-2	2,173	1,742	431	694	663	32	320	381	73	187	224	40	138	169	16
Kansas-3	5,074	3,995	1,079	1,904	1,809	95	375	453	88	207	251	44	150	187	16
Kentucky-1	13,111	8,839	4,272	2,393	2,056	338	183	233	79	121	160	42	74	106	8
Missouri-1	9,623	7,841	1,782	2,930	2,748	181	304	351	102	212	245	64	124	149	18
Missouri-2	8,314	6,643	1,671	2,189	2,071	118	263	312	71	199	238	44	136	168	12
Missouri-3	12,814	10,019	2,795	3,546	3,275	271	277	327	97	194	233	53	128	160	15
Missouri-4	7,181	5,267	1,914	1,819	1,761	58	253	334	30	173	218	49	106	139	14
Missouri-5	7,309	5,339	1,970	1,959	1,778	181	268	333	92	181	229	52	117	156	12
Oklahoma-1	7,879	4,427	3,452	2,479	2,113	366	315	477	106	129	185	57	58	95	9
Oklahoma-2	2,857	1,433	1,424	841	651	189	294	454	133	119	175	64	39	68	9
Oklahoma-3	3,089	1,691	1,398	1,431	1,204	227	463	712	162	115	154	67	29	46	7
Region Total/ Average	214,087	171,977	42,110	56,341	52,930	3,411	263	308	81	191	227	45	147	180	11

1/ Other farms include those classified as "abnormal".
2/ Detail may not add due to rounding.

Compiled from U.S. Census of Agriculture, Volume 1. (26)

"abnormal farms." The "abnormal farms" group consists of institutional farms, experiment stations, and grazing associations or farms operated by an Indian Tribe. There are only a few of the "abnormal farms," so the "other" groups consists mostly of places with under $2,500 gross sales of agricultural products. They are mostly quite small, averaging only 81 acres per unit. There are about 172,000 farms over $2,500 in the Region or 80 percent of the total, and 42,000 "other farms." The largest number of the over $2,500 group are in IA-3, and in IL-3, -1, and -2. In relative terms, i.e. percent of the total for the CPA, the largest proportions of farms over $2,500 are in IL-2 with 93 percent and IA-2 with 91 percent. In AR-1 less than half the farms are in the over $2,500 class, and in OK-2 only slightly more than half. Farms over $2,500 average 368 acres in size, with the largest average in KS-3, and the smallest in KY-1. Even when the "other farms" are excluded, the average size tends to be misleading, whether measured in acres or gross income, because the distribution tends to be skewed toward the smaller size groups. This means that there are a larger number of very small farms (in acres) than would be expected if the size distribution were a normal curve, and fewer large farms.

For farms over $2,500 the average cropland for all the CPA's is 227 acres, but in IL-2 and IL-4 the average is 274 acres in each, while in AR-1 the average is only 144 acres. In AR-1, OK-2, and OK-3 less than half of the cropland was harvested for crops. The average acreage of harvested crops per farm for these three CPA's is much smaller than the averages for the other CPA's.

CROP ACREAGES

In the Region, corn and soybeans are by far the most prominent crops. There are over 12.5 million acres of corn and 11.2 million acres of soybeans, and together these two crops account for more than three fourths of the cropland harvested (Table 15 and A-6).

Corn and soybeans dominate the crop pattern in 15 of the 24 CPA's. In the other nine CPA's the pattern is somewhat mixed. In AR-1 and the three Oklahoma CPA's the acres of "other hay" exceeds that of both corn and soybeans. Acres of sorghum or wheat are either first or second in KS-1, -2, -3, and MO-5, whereas in MO-4 the acres of "other hay" is equal to that of beans and exceeds corn.

In each of the CPA's there is a substantial acreage reported as cropland pastured. In AR-1, OK-2, and OK-3 there is more cropland pastured than harvested for crops.

LIVESTOCK NUMBERS

Beef cattle are the most important class of livestock; they outnumber dairy cows in every one of the CPA's (Table 16). In total cattle the largest numbers are in IA-2 with over a million head. Next in rank in numbers of cattle are IL-1, MO-3, and MO-1. The fewest cattle are in IN-1 and IN-2. In number of head there are somewhat more hogs than cattle, but the economic importance of hogs is not as great as cattle because the value per head is less. The most hogs are found in IA-2 and IL-1, the fewest are in the three Oklahoma CPA's and in AR-1. Sheep are not numerous, relatively, in any of the CPA's.

Table 15. Acres of Principal Crops, By Coal Production Areas, 1974 1/

Coal production areas	Corn	Soybeans	Wheat	Oats and Barley	Sorghum	Alfalfa hay	Other hay	Potatoes and vegetables	Field seeds	Land in orchards	All other crops 2/	Total cropland harvested 3/	Cropland pastured	All other cropland	Total cropland 3/
	1,000 acres														
Arkansas-1	1	52	7	1	3	6	88	5	1	2	-4	161	201	12	374
Illinois-1	1,778	1,028	102	113	6	104	101	11	5	1	-33	3,215	362	159	3,736
Illinois-2	1,840	1,344	52	58	2	46	28	19	1	*	-15	3,376	108	67	3,551
Illinois-3	1,669	1,649	372	19	11	52	89	*	2	3	-55	3,811	259	144	4,214
Illinois-4	682	706	122	7	2	11	21	12	1	*	-13	1,552	68	47	1,666
Illinois-5	395	567	371	4	22	42	84	3	20	3	-65	1,446	123	99	1,669
Illinois-6	440	819	343	2	21	14	98	2	14	1	-68	1,685	194	145	2,024
Indiana-1	155	124	36	3	1	8	11	*	1	*	-2	337	35	15	387
Indiana-2	149	143	58	1	3	8	19	2	1	*	-8	375	42	36	452
Indiana-3	603	357	207	3	7	18	91	6	4	2	-41	1,258	180	84	1,522
Iowa-1	320	192	1	45	1	67	48	*	1	*	-10	666	208	38	911
Iowa-2	2,385	1,540	16	173	5	223	168	1	1	1	-34	4,479	689	127	5,294
Kansas-1	200	98	93	13	159	38	47	*	6	*	-12	641	178	39	858
Kansas-2	37	84	45	4	65	13	52	*	2	*	-7	294	80	16	390
Kansas-3	41	193	247	13	132	34	99	*	10	2	-24	746	213	43	1,002
Kentucky-1	358	370	101	5	4	14	130	1	7	1	-56	934	400	78	1,413
Missouri-1	407	340	24	23	8	120	258	*	8	*	-23	1,166	689	67	1,922
Missouri-2	402	430	85	9	24	42	142	*	7	2	-29	1,113	395	75	1,583
Missouri-3	418	668	135	17	60	36	295	*	21	2	-47	1,603	616	116	2,336
Missouri-4	154	178	72	10	92	24	178	*	54	*	-31	730	381	35	1,146
Missouri-5	102	226	164	9	130	22	163	*	66	2	-52	831	353	40	1,224
Oklahoma-1	5	106	61	13	40	19	166	2	2	11	-4	422	357	39	818
Oklahoma-2	*	29	7	1	1	6	50	3	*	1	-1	97	143	10	250
Oklahoma-3	1	2	3	1	5	2	56	*	*	1	4	78	173	9	260
Region Total 3/	12,544	11,243	2,722	546	803	966	2,480	70	234	35	-628	31,017	6,445	1,541	39,002

* Less than 500 acres.

1/ Includes only farms with over $2,500 gross farm sales.

2/ Includes allowances for double cropping.

3/ May not add due to rounding.

Compiled from U.S. Census of Agriculture, Volume 1. (26)

Table 16. Livestock Inventory, All Farms, December 31, 1974

Coal production areas	Milk cows	Beef cows	Other cattle	Total cattle	Hogs and pigs	Sheep and lambs
	number					
Arkansas-1	12,318	112,529	110,072	234,919	19,525	971
Illinois-1	14,448	227,039	386,886	628,373	1,636,784	58,444
Illinois-2	15,858	65,558	143,135	224,551	394,033	32,447
Illinois-3	17,086	157,154	253,559	427,799	958,074	33,814
Illinois-4	4,612	32,065	59,228	95,905	229,074	9,569
Illinois-5	40,550	55,054	113,032	208,636	335,633	8,842
Illinois-6	6,124	88,856	111,987	206,967	301,282	9,489
Indiana-1	800	19,212	25,683	45,695	76,416	4,922
Indiana-2	3,141	22,281	28,585	54,007	72,040	2,599
Indiana-3	20,527	89,920	138,772	249,219	436,694	3,632
Iowa-1	8,268	107,968	159,312	275,548	462,817	26,991
Iowa-2	30,874	394,686	641,376	1,066,936	1,950,041	137,971
Kansas-1	14,845	68,506	110,462	193,813	119,655	3,268
Kansas-2	4,936	36,574	61,235	102,745	37,353	5,572
Kansas-3	9,065	119,641	158,154	286,860	94,720	8,908
Kentucky-1	12,851	175,838	189,837	378,526	266,228	1,951
Missouri-1	18,912	261,519	276,949	557,380	285,833	42,158
Missouri-2	10,238	151,156	211,234	372,628	329,896	12,599
Missouri-3	9,602	249,342	301,526	560,470	460,161	36,911
Missouri-4	14,332	175,507	192,954	382,793	177,616	5,086
Missouri-5	18,146	190,299	199,792	408,237	93,908	3,608
Oklahoma-1	10,674	245,857	237,804	494,335	18,984	3,541
Oklahoma-2	891	92,710	83,640	177,241	4,578	35
Oklahoma-3	1,716	128,297	121,982	251,995	5,688	494
Region Total	300,814	3,267,568	4,317,196	7,885,578	8,766,533	453,823

Compiled from U.S. Census of Agriculture, Volume 1. (26)

AGRICULTURAL INCOME

Measures of net income from farming are not reported in the Census of Agriculture, and are not available on a county basis from any source. Gross sales of farm products are reported, however, and are used here as an indicator of income potential. Total sales for the Region were $6.8 million, of which $4.1 million was from livestock and $2.7 million was from crops (Table 17). IA-2 was the largest of the CPA's in terms of gross sales of crops, of livestock, and total sales. IL-3 and IL-2 were second and third, respectively, in sales of crops, while IL-1 and IL-3 were second and third, respectively in livestock sales. OK-2 and OK-3 were lowest in total sales, but unlike many other CPA's livestock was far more important than crops as a source of income. Other CPA's where livestock was more important than crops include AR-1, IA-1, MO-1, -4, -5, and all three Kansas CPA's. In AR-1 about $80 million or 75 percent of the livestock income is from poultry and poultry products. This is an area especially noted for its chicken farms, and in every county in the CPA poultry accounts for more than half of the gross sales (26). None of the other CPA's have such large concentrations of poultry farms.

Income distribution patterns are indicated by comparing the farms over $2,500 and "other farms." The "other farms," though numerous, account for less than 1 percent of the total farm sales of the Region, that is, about $60,000 out of a total of $6.8 million (Table 17, the two columns on the right). Farms "over $2,500" are, by definition, better situated with respect to income, averaging over $50,000 in three Illinois CPA's

Table 17. Gross Farm Sales, 1974

Coal production areas	Gross Sales From All Farms			Farms over $2,500	Other farms
	Livestock 1/	Crops 2/	Total 3/		
	$1,000				
Arkansas-1	106,517	15,000	121,516	118,451	3,065
Illinois-1	345,235	456,476	801,712	799,138	2,574
Illinois-2	129,403	588,853	718,255	716,726	1,529
Illinois-3	213,128	633,466	846,596	843,053	3,543
Illinois-4	50,752	257,439	308,192	307,192	1,000
Illinois-5	104,455	163,715	268,168	265,765	2,403
Illinois-6	66,600	191,056	257,651	254,974	2,677
Indiana-1	17,606	47,187	64,790	64,393	397
Indiana-2	18,433	50,443	68,874	67,611	1,263
Indiana-3	137,061	180,451	317,512	314,874	2,638
Iowa-1	112,159	63,094	175,253	174,105	1,148
Iowa-2	530,056	647,428	1,177,487	1,171,683	5,804
Kansas-1	59,962	49,784	109,747	107,645	2,102
Kansas-2	22,817	20,095	42,912	42,358	554
Kansas-3	65,808	58,865	124,674	123,301	1,373
Kentucky-1	72,858	158,359	231,221	225,667	5,554
Missouri-1	116,244	91,250	207,493	204,777	2,716
Missouri-2	109,300	111,335	220,632	218,575	2,057
Missouri-3	146,480	148,663	295,141	291,003	4,138
Missouri-4	75,367	58,734	134,100	131,770	2,330
Missouri-5	72,105	67,854	139,960	137,590	2,370
Oklahoma-1	62,792	31,094	93,887	89,664	4,223
Oklahoma-2	18,825	7,708	26,533	24,707	1,826
Oklahoma-3	22,478	3,889	26,367	23,908	2,459
Region Total	2,676,441	4,102,238	6,778,673	6,718,930	59,743

1/ Includes sales of livestock, livestock products, poultry, and poultry products.

2/ Includes small amounts of forest products, nursery, and green house products sold from farms.

3/ May not add due to rounding.

Compiled from U.S. Census of Agriculture, Volume 1. (26)

and in IA-2 (Table 18). In the three Oklahoma CPA's however, the average per farm for the "over $2,500" groups ranged from a little over $20,000 down to about $14,000.

AGRICULTURAL INTENSITY

One characteristic of most of the CPA's in the Interior Region is that the agriculture is much more intensive than in most of the coal producing areas in either the Rocky Mountain or the Northern Great Plains Regions.[3/]

Three measures were chosen to illustrate the relative degree of intensity among the CPA's. The first is gross sales per acre of land area. By this measure IL-2 and IA-2 are the most intensive, with an average of $159 and $157, respectively, in farm sales for each acre of land area (Figure 8). By way of contrast, OK-3 had only about $12 per acre and OK-2 about $15. The average for all CPA's was $93 per acre, as compared with an average of $13 per acre for the NGP and $11 for the RM Regions.

A second measure is the number of farms per township. The township, the smallest political subdivision, is also a unit of land measurement by government survey, typically a square area six miles on each side. In both Iowa CPA's there are an average of more than 70 farms per township (Figure 9). There were more than 60 farms per township in each

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3/ One exception in the RM Region is CO-7, which is dominated by Weld County, the most important cattle feeding county in Colorado (26).

Table 18. Average Gross Sales Per Farm, 1974

Coal production areas	Farms with over $2,500 gross sales	Other farms 1/	All farms
	dollars		
Arkansas	45,523	1,148	23,045
Illinois-1	48,841	1,314	43,759
Illinois-2	55,273	1,630	51,654
Illinois-3	51,128	1,519	44,979
Illinois-4	50,434	1,179	44,414
Illinois-5	32,230	1,641	27,618
Illinois-6	29,752	1,149	23,640
Indiana-1	40,448	1,103	33,192
Indiana-2	28,564	1,453	21,284
Indiana-3	39,762	1,254	31,682
Iowa-1	37,036	1,466	31,957
Iowa-2	50,091	2,381 2/	45,588
Kansas-1	31,256	2,542 3/	25,696
Kansas-2	24,316	1,285	19,748
Kansas-3	30,864	1,272	24,571
Kentucky-1	25,531	1,300	17,636
Missouri-1	26,116	1,524	21,562
Missouri-2	32,903	1,231	26,537
Missouri-3	29,045	1,481	23,033
Missouri-4	25,018	1,217	18,674
Missouri-5	25,771	1,203	19,149
Oklahoma-1	20,254	1,223	11,916
Oklahoma-2	17,241	1,282	9,287
Oklahoma-3	14,138	1,759	8,536
Region Total	39,069	1,419	31,663

1/ Includes "abnormal" farms.
2/ Includes at least 11 "abnormal" farms, of which 5 have sales of $250,000 or more.
3/ Includes 9 "abnormal" farms in Leavenworth County. The two largest of those had combined sales of about $3 million.

Compiled from U.S. Census of Agriculture, Volume I. (26)

Figure 8 . Gross Sales per Acre of Land Area, 1974

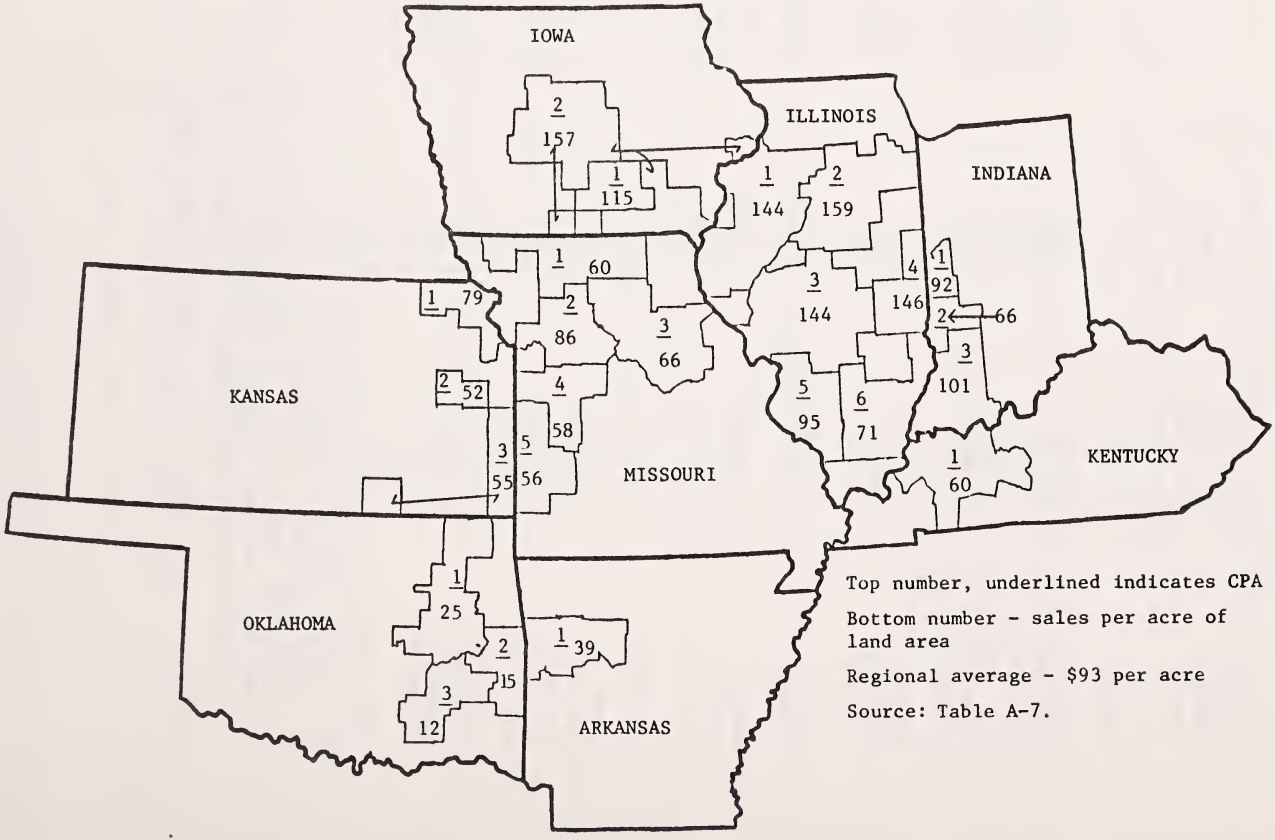
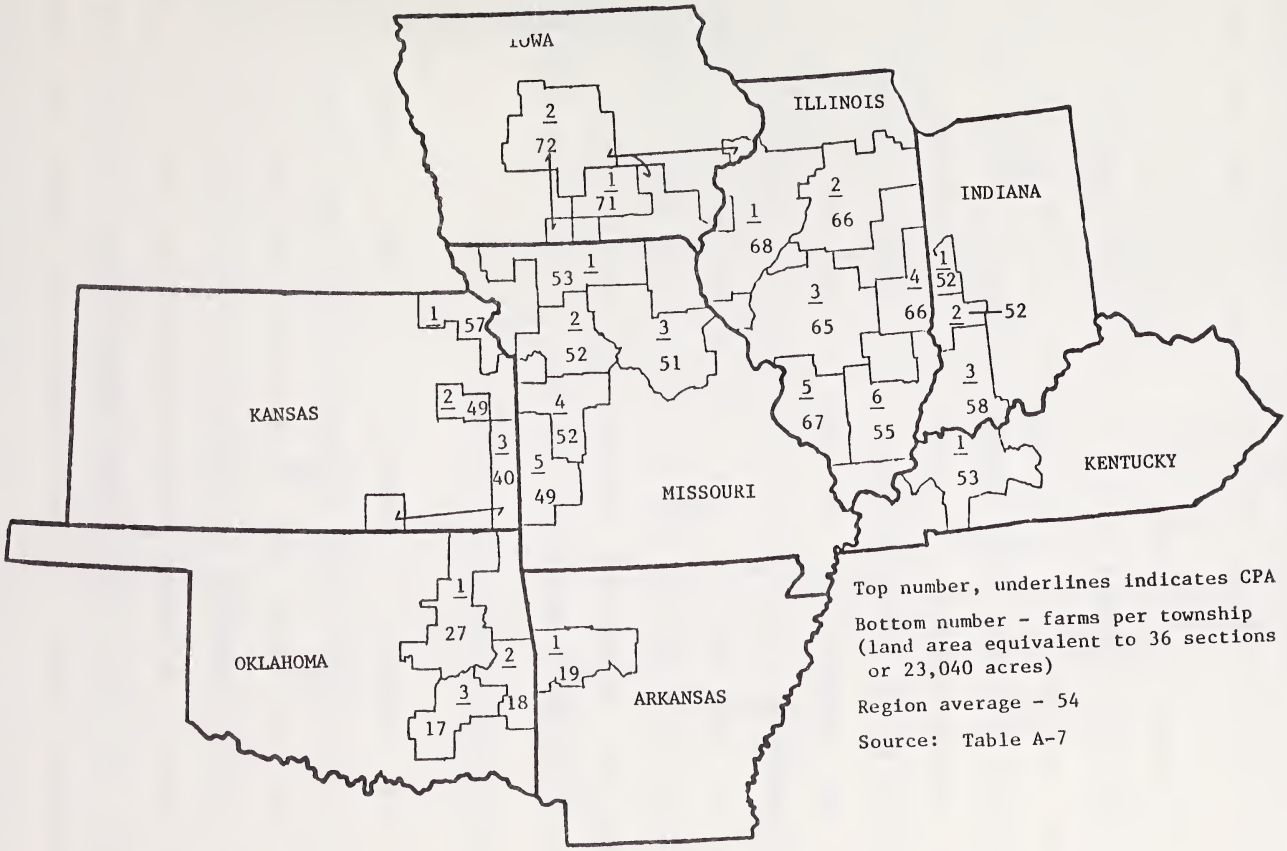


Figure 9 . Number of Farms per Township



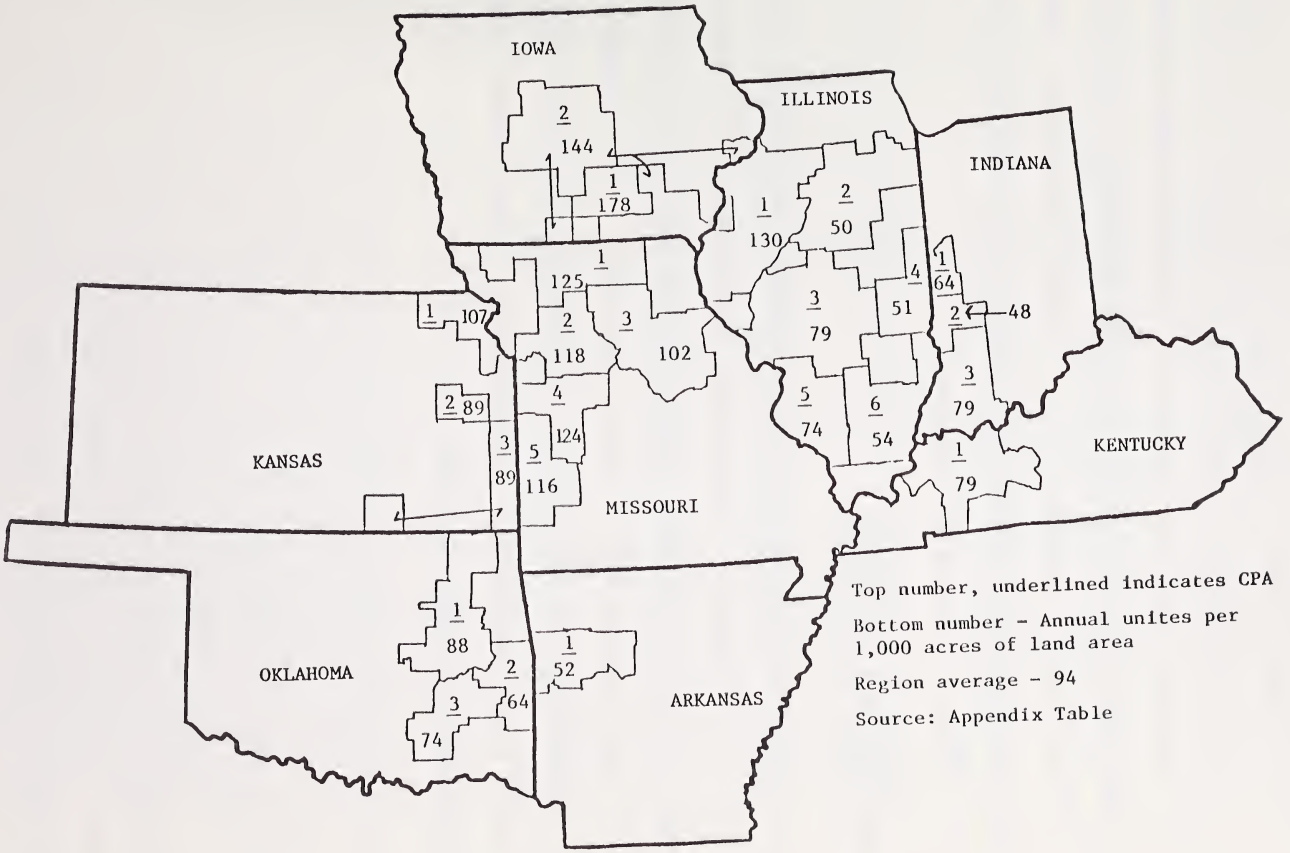
of the Illinois CPA's except IL-6. In AR-1, OK-2, and OK-3 there are less than 20 farms per township. In the NGP Region the average was seven farms per township, in the RM Region the average was three.

A third measure of intensity is the relationship of livestock numbers to land area, expressed as animal units (AU) per 1000 acres of land area. An animal unit, defined in Footnote 2, Table A-7,is a measure devised to provide a rough common denominator for adding together cattle, hogs, and sheep. IA-1 has the most intensive livestock population with 178 AU per 1000 acres (Figure 10). IA-2 was second with 144 and IL-1 was third with 130. The lowest CPA's were IN-2 and IL-2. In most other measures used to describe agricultural production the two lowest CPA's are OK-2 and OK-3, but in livestock intensity they rank higher than the three CPA's in Illinois and two of the three in Indiana. The average for the Region is 94 animal units per 1000 acres, as contrasted with an average of about 26 in the NGP and 16 in the RM Regions.

GENERAL CHARACTERISTICS OF AGRICULTURE

From the preceeding it is apparent that the CPA's in general constitute a rich agricultural resource, though there are some substantial dissimilarities among them. Those in Iowa and Northern and Central Illinois are the most productive, and probably are representative of the best of the Corn Belt, an area widely known for its rich crops of corn and soybeans. The CPA's in Northern and Central Indiana, Northern Missouri, Northeastern Kansas, and Western Kentucky, are somewhat less productive, but nevertheless represent a type of agriculture of great economic

Figure 10. Index of Livestock Intensity



importance. In all these CPA's the farms are relatively large in both acreage and gross income. Of the remaining CPA's, those in Oklahoma and the one in Arkansas are less favorably endowed by topography and soil resources. The farms are fewer in number and tend to be smaller and with less income potential than the other CPA's in the Region. By comparison, however, even the least productive CPA's in the Interior Region have greater productive potential on a per acre basis than most of the CPA's in the NGP and RM Regions.

COMPETITION FOR RESOURCES

As in the RM and NGP Regions, coal development competes with agriculture for the use of resources, especially land and water. In RM and NGP competition for water poses the most serious threat to agriculture because water is scarce while land is plentiful. In the Interior Region, on the other hand, water supplies are adequate (see WATER, page 90) while land is less plentiful and its productivity for agriculture is much higher than in either RM or NGP.

To anticipate the degree to which coal development might affect agriculture it is necessary to make a number of projections, most of which must be based on conjecture, surmise, or prophecy because the data base is inadequate, fragmentary, or missing altogether. Despite such uncertainties it is possible to make a set of assumptions which are sufficiently realistic to show the extent to which coal development might infringe on farm production. For example, studies in Illinois show that the land taken out of farming by strip mining without reclamation

is substantial (11, 19). Federal and state laws now require reclamation, so it is reasonable to assume that in the future the loss of production from land mined will be only temporary.

Basic to any estimate of agricultural losses is a projection of the number of strip mines and their anticipated production. It was assumed that future production would be similar to that of 1975-76 for mines now operating, plus company plans for new or expanding mines. Under these assumptions more than a third of all the strip mining in the Region would be in KY-1, 34.5 million tons annually (Table 19). IL-5 would produce 17.5 million tons and IN-3, almost 10 million. Seven CPA's are not expected to have any strip mines of significant capacity. Land to be used for coal development was estimated in three categories -- land actually mined, land used for mine facilities, and land used for energy conversion (mostly electric thermogenerators). Land actually mined is assumed to be reclaimed and thus out of production only temporarily. The basis for estimating the amount of land is a function of the rate of future production, and the coal yield per acre, which in turn is a function of seam thickness. It is noteworthy that the seams of coal in the Interior Region are much thinner than in the RM and NGP Regions, hence more acres are required here to produce a given quantity of coal. The land required for mine facilities, such as high walls, haul roads, preparation plants, shops, and offices is generally not reclaimable, and is difficult to estimate in general terms because each mine site has its own peculiar characteristics. Thus the estimates used for Table 19 are arbitrary and may not faithfully represent any specific

Table 19. Projection of Land to be Used for Surface Mining and Coal Processing 1976-2000.

Coal production areas	Surface mines 1/	Projected Production		Land mined per million tons 4/	Land to be used for Mining - Average Annual			
		Annual 2/	Total 1976-2000 3/		Mined land 5/	Mine facilities 6/	Energy conversion 7/	Total
	number	-million tons-			----------acres----------			
Arkansas-1	5	0.4	10	333	1,170	830	80	2,080
Illinois-1	8	6.3	158	219	12,140	4,260	1,260	17,660
Illinois-2	0	--	--	238	--	--	--	--
Illinois-3	0	--	--	253	--	--	--	--
Illinois-4	1	1.5	38	203	2,680	870	300	3,850
Illinois-5	9	17.5	438	119	18,330	6,110	3,500	27,940
Illinois-6	11	6.1	152	152	8,160	3,410	1,220	12,790
Indiana-1	0	--	--	167	--	--	--	--
Indiana-2	5	5.0	125	170	7,480	2,620	1,000	11,100
Indiana-3	18	9.7	242	170	14,510	5,910	1,940	22,360
Iowa-1	2	0.1	2	231	200	250	20	470
Iowa-2	0	--	--	231	--	--	--	--
Kansas-1	0	--	--	490	--	--	--	--
Kansas-2	1	0.3	8	595	1,570	580	60	2,210
Kansas-3	2	0.4	10	333	1,170	530	80	1,780
Kentucky-1	55	34.5	862	185	56,170	21,450	6,900	84,520
Missouri-1	1	0.7	18	260	1,600	570	140	2,310
Missouri-2	0	--	--	362	--	--	--	--
Missouri-3	2	1.3	32	347	3,970	1,310	260	5,540
Missouri-4	2	1.8	45	362	5,730	1,830	360	7,920
Missouri-5	2	2.0	50	379	6,670	2,100	400	9,170
Oklahoma-1	6	2.3	58	439	8,890	3,150	460	12,500
Oklahoma-2	4	0.6	15	298	1,570	850	120	2,540
Oklahoma-3	0	--	--	225	--	--	--	--
Total/ Average	134	90.5	2,263	198	152,010	56,630	18,100	226,740

1/ Number of mines for which production data are available

2/ For new or expanded mines, capacity at full operation (Table 6). For existing mines: (a) if 1976 production was larger than 1975, 1976 was used, and (b) if 1975 production was larger than 1976, the average of 1975-76 was used (from 44).

3/ Annual production x 25 years.

4/ Based on coal yield per acre (44).

5/ Annual production x land mined per million tons x 1.1 (assuming 10 percent overrun) x 8 (assuming each mined acre is out of production for 8 years during the mining and reclamation process).

6/ Assumed to be out of production permanently. Based on arbitrary assumption of 100 acres per mine plus 10 percent of land mined annually, representing high wall, haul roads, preparation plant, office, yard, etc.

7/ Arbitrarily assumed to be 200 acres per million tons of annual production; in many cases this land might be located near load centers rather than near the mine. Land required for plants to process coal from underground mines is not included.

situation. The same is true for the estimates for land used for energy conversion plants. In addition, the conversion plants may be located anywhere -- near the mine, or near the load center or somewhere in between. For this study, it was assumed that the plant would be located somewhere within the CPA where the coal is mined.

The sum of the assumptions thus far suggests that in any given year from now to 2000 there would be about 226,000 acres out of production, and that 84,500 acres of this or 37 percent would be in KY-1. Nearly 28,000 acres or 12 percent would be in IL-5, and 10 percent in IN-3.

The value of the production lost to strip mining from an acre of land varies considerably from one CPA to another. The average value of all sales of farm products for all CPA's is $93 per acre of land area, but the range is from $12 per acre in OK-3 to $157 in IA-2 and $159 in IL-2.

By assuming that the land mined would be equal in productivity to the average in each CPA- the annual value of farm sales lost can be calculated. The total would be $16.9 million, of which $5.1 million, or 30 percent would be in KY-1 (Figure 11). In IL-1 and IL-5 the loss would be more than $2.5 million each and $2.2 million in IN-3.

While the loss in absolute terms might seem impressive, $17 million worth of raw food and fiber represents only one fourth of 1 percent of the total productive capacity of the CPA's in the Region. In KY-1, where the loss is largest, it represents only 2.19 percent of the total for the CPA (Table 20).

Figure 11. Estimated Agricultural Productive Capacity of Land to be Used for Mining

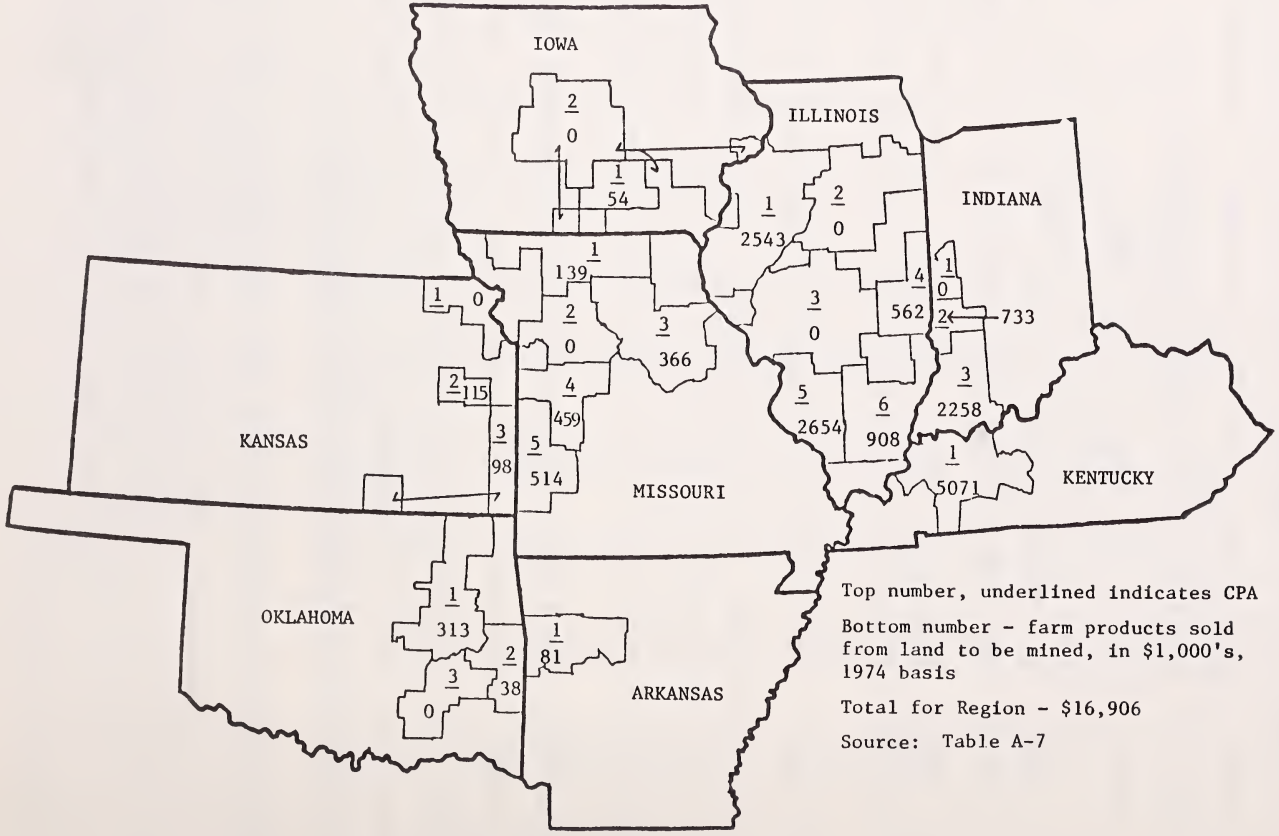


Table 20. Annual Gross Sales from Land to be Used for Mining - 1974 Basis, Alternate Assumption

Coal production areas	Based on Total Land Area			Based on Farm Land Only		
	Sales per acre 1/	Annual total 2/	Percent of CPA total 3/	Sales per acre 4/	Annual total 2/	Percent of CPA total 3/
	dollars	$1,000	percent	dollars	$1,000	percent
Arkansas-1	39	81	0.07	115	239	0.20
Illinois-1	144	2,543	0.32	165	2,914	0.36
Illinois-2	159	0	--	182	0	--
Illinois-3	144	0	--	166	0	--
Illinois-4	146	562	0.18	159	612	0.20
Illinois-5	95	2,654	0.99	126	3,520	1.31
Illinois-6	71	908	0.35	100	1,279	0.50
Indiana-1	92	0	--	121	0	--
Indiana-2	66	733	1.06	107	1,188	1.72
Indiana-3	101	2,258	0.71	151	3,376	1.06
Iowa-1	115	54	0.03	136	64	0.04
Iowa-2	157	0	--	175	0	--
Kansas-1	79	0	--	89	0	--
Kansas-2	52	115	0.27	62	137	0.32
Kansas-3	55	98	0.08	65	116	0.09
Kentucky-1	60	5,071	2.19	97	8,198	3.55
Missouri-1	60	139	0.07	71	164	0.08
Missouri-2	86	0	--	101	0	--
Missouri-3	66	366	0.12	83	460	0.16
Missouri-4	58	459	0.34	74	586	0.44
Missouri-5	56	514	0.37	71	651	0.47
Oklahoma-1	25	313	0.33	38	475	0.51
Oklahoma-2	15	38	0.14	32	81	0.31
Oklahoma-3	12	0	--	18	0	--
Total/ Average	93	16,906	0.25	120	24,060	0.35

1/ Total sales divided by acres of land area
2/ Sales per acre multiplied by land used for coal development from Table 19 .
3/ Annual total expressed as a percent of total sales for each CPA.
4/ Total sales divided by acres of land in farms.

The above analysis is based on the assumption that the land mined would be equal in productivity to the average for the CPA. In each CPA there is some non-farm land, and if a mine were located on such land there would be no loss in agricultural production, though of course, other values such as recreation, forestry, or wildlife might be jeapordized. On the other hand, if in any CPA all mines were located entirely on farm land the losses would be substantially greater than those shown in Figure 11. If all the mines in all the CPA's were ib farm land the average loss in production would be $24 million, of which more than a third would be in KY-1. Even so that would be only about one third of 1 percent of the total production of all CPA's, but about 3½ percent of the total for KY-1.

Serious concern has been expressed over the prospect of using "prime" farm land for coal development, and this ocncern has been reflected in the Surface Mining Control and Reclamation Act of 1977 and the regulations provided for implementing it (24), Sec. 515 (b) (7) and (40), Par. 716.7. Responsibility for identifying and mapping prime farm land under the new regulations was assigned to the U.S. Soil Conservation Service (SCS). For most areas the amount and location of prime farm land at any given plant or mine site could be determined by the SCS from maps and other data in the files of their field offices. Summaries showing aggregate acres are not yet available for all the counties in the region, so totals by CPA's cannot be presented here.

In a report published in 1976 Ostendorf made estimates of "prime" farm land in Illinois using standards similar to those now being used by SCS

under the new law (19). His data show that in IL-5, where most of the strip mining in Illinois is expected to take place, the proportion of "prime" farm land ranges from 40 percent in Perry County to 88 percent in Madison County. In IL-1 the proportions ranged from 66 percent in Henry County to 100 percent in Knox, McDonough, and Warren Counties.[4/]

While it is not possible to estimate with available data the difference in productivity between average land and prime land, it seems unreasonable to suppose that strip mining would seriously threaten supplies of agricultural products on a regional or state scale even if most of the mining took place on prime land. In addition, the provisions of the Federal law for protecting prime land seem adequate to insure that the reclamation process sould return it to a useful level of productivity, if it were not indeed fully restored.

WATER

THE RIVER BASINS

The availability of water is an important factor affecting the location of coal processing plants and coal transportation facilities, and therefore may influence the location of new mines. River basin boundaries are important because of the variation in water supplies among basins. The coal production areas of the Interior Region are situated in four different Water Resources Regions, each of which drain into the Gulf of

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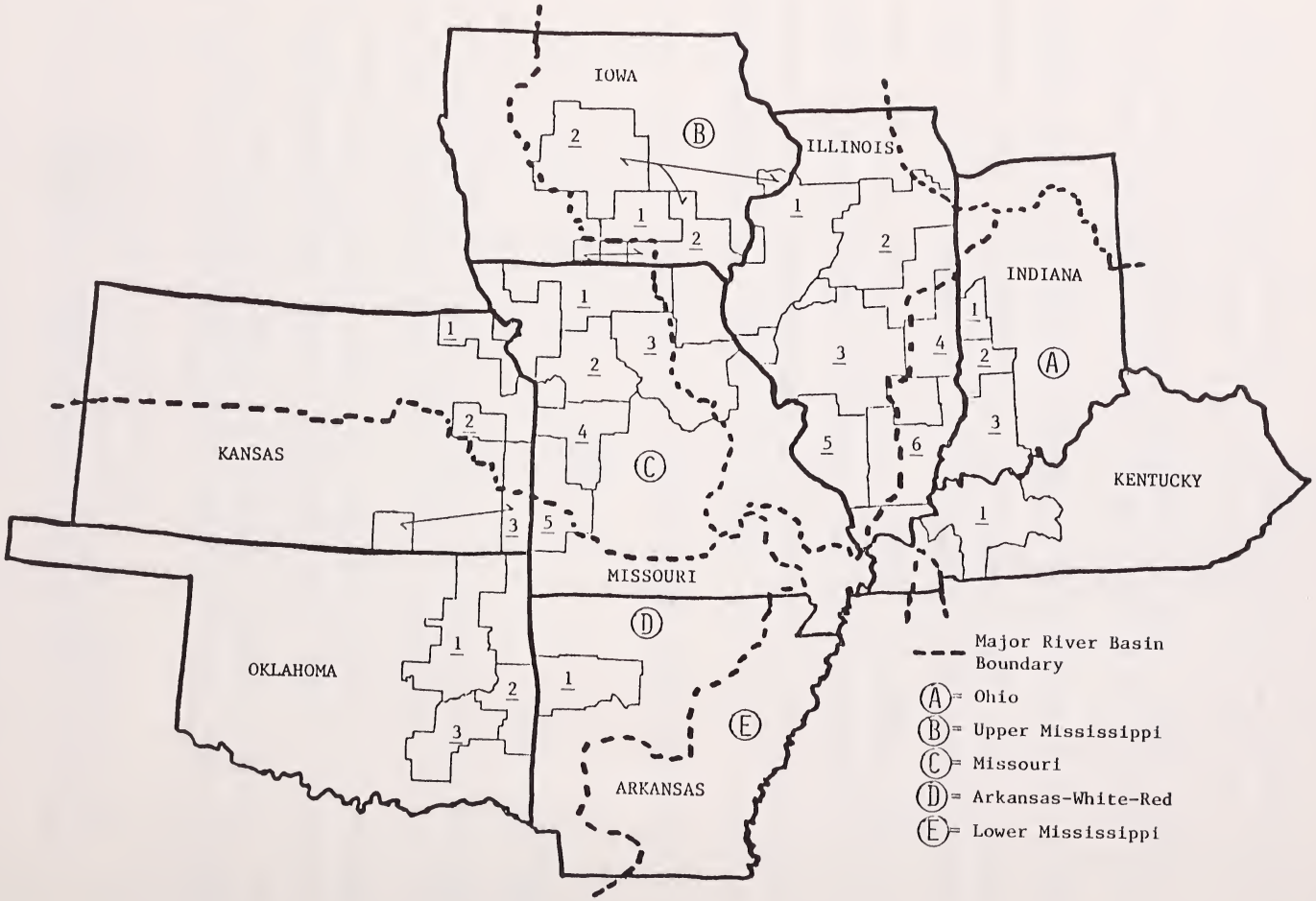
4/ These percentages seem unrealistically high. According to the Census, the land in farms is 89, 94, and 93 percent, respectively, of the land area in the last three counties named.

FIGURE 12. Major River Basins and Coal Producing Areas, Interior Region



Mexico via the Mississippi River system.[5/] All three of the Indiana CPA's, KY-1, IL-4, and part of IL-6 are in the Ohio River Basin (Figure 12). All the remaining Illinois CPA's, plus IA-1, most of IA-2, and parts of MO-1 and MO-3 are in the Upper Mississippi River Basin. All of the Missouri CPA's except parts of MO-1 and MO-3, all of KS-1, KS-2, and part of KS-3 are located in the Missouri River Basin. Part of KS-2, all of AR-1, and three Oklahoma CPA's are in the Arkansas-White-Red River Basins.

SURFACE WATER

To make a reliable projection of the amount of water available in a given stream or river basin requires a substantial quantity of data and a considerable input of hydrologic expertise, both of which are beyond the scope of this study. A number of regional studies are available which show the quantity of water in a particular river basin or stream, the depletions by various classes of use, and estimates of the quantity remaining. A summary of such information with particular reference to energy is found in "A Nationwide Assessment of Water Quantity Impacts of the National Energy Plan" (6). This report shows that in the Ohio and Upper Mississippi River Basins the average low flows are more than adequate for all projected consumptive use for energy. In the Ohio Basin the maximum water to be consumed in energy related uses is 6.1 percent of the low flow of the Green River (Table 21). In the Upper Mississippi the maximum use for energy is 4.7 percent of the low flow of the Rock

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5/ With one exception - a portion of Will County in IL-2 drains into Lake Michigan.

Table 21. Downstream Accounting of Water Comsumption by Steam Electric Facilities for CPA's in the Interior Region 1/

River Basin and Stream	Sub region number	Low flow 2/	Withdrawal	Consumption	Percent of low flow consumed 3/	CPA's included in sub region
		1,000 acre feet per year			percent	
Ohio						
Green	511	246	127	15	6.1	KY-1p
Wabash	512	1,599	1,808	43	3.5	IL-4 , IL-6p, IN-1 , IN-2p, IN-3p
Lower Ohio	514	14,472	2,156	42	2.5	KY-1p, IL-6p, IN-3p
White	515	521	650	13	2.6	IN-2p, IN-3p
Upper Mississippi						
Rock	708	1,055	296	43	4.7	IA-1p, IA-2p, IL-1p
Mississippi, Quad Cities	710	11,423	649	44	1.4	IA-1p, IA-2p
Mississippi, Quincy	711	12,980	18	0	1.3	IL-1p, IA-2p, MO-1p, MO-3p
Illinois, Upper	712	2,327	88	54	2.3	IL-2p
Illinois, Lower	713	2,594	1,262	91	5.6	IL-1p, IL-2p, IL-3p
Mississippi, St. Louis	714	35,033	2,939	38	1.6 4/	IL-3p, IL-5 , IL-6p, MO-3p
Missouri						
Missouri-Nemaha-Nodaway	1024	4,897	286	12	2.3	KS-1p, MO-1p
Kansas	1027	221	32	19	15.6	KS-1p
Grand	1028	24	21	12	51.0	IA-2p, MO-1p, MO-2p, MO-3p
Osage	1029	383	64	21	5.5	KS-2 , KS-3p, MO-4p, MO-5p
Missouri-Kansas City	1030	3,914	1,053	40	5.6	MO-2p, MO-3p, MO-4p
Arkansas-White-Red						
Neosho-Verdigris	1107	126	46	30	23.6	KS-3p, MO-5p, OK-1p
North Canadian	1110	95	243	13	24.3	OK-1p, OK-3p
Lower Arkansas	1111	2,121	1,006	65	6.1	AR-1 , OK-1p, OK-2 , OK-3p
Lower Red	1114	1,770	448	69	3.9	OK-3p

p - Part of this CPA is in another sub region.
1/ National Energy Plan estimates, using system load factors, from (6, pp. 48-52).
2/ 7-day/10 year low flow.
3/ Total cumulative upstream consumptive use by energy facilities as a percent of low flow.
4/ Includes energy related consumptive use in Missouri Basin.

River, and 5.6 percent of the lower Illinois.[6/] In these two basins there is relatively little need to be concerned about water availability, except on a site specific basis. In most locations water could be made available if other ocnditions at the site were favorable. It should be noted that of the CPA's in which the annual production from strip mines is expected to exceed 5 million tons all are located in either the Ohio or the Upper Mississippi Basin (compare Tables 19 and 21). Also, about 88 percent of the entire coal resources of the Region are located in the two river basins where water supplies are most plentiful (compare Tables 3 and 21).

In the Missouri Basin surface water supplies are less plentiful, and there are some smaller streams, such as the Grand, which may develop serious water shortage for steam electric facilities in years of low flow. The same is true of the Arkansas-White-Red Basins, especially in the western parts. However, only a small part of the Region's coal reserves are located in those two river basins and only a small part of the Region's coal production is expected to take place there. The Grand River sub region water shortage problems would seem to be most severe in the Grand River sub region, judging from the data in Table 21. However, the Grand sub region includes only parts of three CPA's, MO-1, -2, and -3.[7/] The total coal reserves in those three CPA's is

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6/ Data in Table 21 show stream flow at a particular point on the stream and the depletions above that point. There is a possibility that shortages might occur at some other point on the stream, or on a tributary. In general, however, the data are representative of the entire sub region.

7/ It also includes parts of two counties of IA-2, an area so small that it can be discounted for the sake of discussion here.

only 6.3 percent of the regional total, and the projected production is only 2.2 percent of the total. This suggests that even if water shortages proved to be a problem, only a small part of the Region's coal production would be affected. Even in the sub regions where water is in short supply, some coal development could take place by locating the coal conversion plants (probably thermogenerators) at sites where water is available, either within the CPA or in some other favorable location. In short, surface water supplies are not expected to be a factor which might limit coal development in the Region.

GROUND WATER

Ground water is also available in most areas of the Region (43). In the Ohio River Basin ground water aquifers are extensive and of satisfactory quality, particularly in the alluvial material along the main stream and the lower reaches of its tributaries (42, p. 63). In the Upper Mississippi known ground water sources can provide approximately ten times the current use (42, Table 19). In the Missouri and the Arkansas-White-Red River Basins, ground water availability varies considerably from place to place. In general, however, supplies are more plentiful and of better quality in the eastern portions of the Region, where, fortunately, the CPA's are located. However, though ground water supplies are adequate for most current needs in most of the Region, it would be prudent to be site-specific in preparing any plans for expanded future use.

WATER QUALITY

Water quality in the Interior Region is generally good, and in most

prospective sites the quality is adequate for any type of coal development, either mining or processing. The real problems are not whether the available water is of the right quality for coal development, but rather the effect of coal development on existing water supplies. Water quality can be adversely affected by pollution from two principal sources. The first is pollution from the mining operation, primarily acid mine drainage. Since rainfall is plentiful in most of the Region, there is ample opportunities for the sulfur compounds exposed by the mining process to react with water to form acids, which drain away from the mine and pollute the streams below. Acid drainage may occur in either undergound mines or strip mines. It may originate in the mine itself, or as a leachate from the spoil banks of surface mines or the "gob" piles from underground mines.[8/] According to the Water Resources Council, "Two thirds of the acid mine drainage problems occur in the Ohio River Basin" (42, p. 64). However, present-day mining laws require that mining companies take appropriate measures to insure against damage to water supplies from any phase of the mining activity.

The second source of pollution is from coal processing plants, mainly thermogenerators. Cooling water passed thru such plants usually absorbs large quantities of heat. If the heated water is discharged directly into a stream it constitutes thermal pollution, which in turn may cause drastic changes in the aquatic life downstream from the point of discharge. Laws controlling such pollution are strict, so plans for energy conversion plants must take into account the technology required

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8/ "Gob" is a term used in mining areas to describe the refuse (soil, rock, slate, and other materials from underground mines) usually disposed of in piles near the mine mouth.

to avoid pollution (thermal or otherwise) of the natural waters below the plant. Again, the measures required are site-specific, so that only a generalized statement of the problem is possible in this report.

PRINCIPAL WATER USES

Consumptive uses of water in the four basins of the Region include stam-electric cooling, industrial, municipal, agricultural, and mining, listed in their approximate order of magnitude. As indicated above, for most uses in most locations, supplies are adequate to serve all present and anticipated future needs. In addition, two important non consumptive uses include hydropower generation and navigation. Hydropower generation is important only in the Missouri Basin, and there only at locations upstream from all of the CPA's. Navigation is important in all four basins, but is especially important to the coal industry on the Ohio. According to the Water Resources Council, "Navigation of the Ohio River is especially important to the production of energy" (42). About 80 percent of the nation's coal is mined in the Ohio Basin, though less than half of it is assigned to the Interior Region, as defined for this study.

Navigation is important in the other river basins but not as closely associated with coal development as in the case of the Ohio. Navigation facilities are available on the Upper Mississippi at points downstream from Minneapolis, on the Missouri below Sioux City and on the Arkansas below Tulsa. It is not anticipated that coal development will compete for the use of water that might be used for navigation on any of these streams.

Table A1. Counties Included in Coal Production AReas in the Interior Region

ARKANSAS

AR-1
Crawford
Franklin
Johnson
Logan
Pope
Scott
Sebastian

ILLINOIS

IL-1
Adams
Brown
Bureau
Fulton
Hancock
Henry
Knox
McDonough
Mercer
Peoria
Rock Island
Schuyler
Stark
Warren

IL-2
Grundy
Kankakee
LaSalle
Livingston
McLean
Marshall
Putnam
Tazewell
Will
Woodford

IL-3
Bond
Calhoun
Cass
Christian
Fayette
Green
Jersey
Logan
Macon
Macoupon
Menard
Montgomery
Morgan
Moultree
Sangamon
Scott
Shelby

IL-4
Clark
Coles
Cumberland
Douglas
Edgar
Vermillion

IL-5
Clinton
Jackson
Madison
Monroe
Perry
Randolph
St. Clair
Washington

IL-6
Crawford
Edwards
Franklin
Gallatin
Hamilton
Jefferson
Lawrence
Marion
Saline
Wabash
Wayne
White
Williamson

INDIANA

IN-1
Fountain
Parke
Vermillion

IN-2
Clay
Owen
Sullivan
Vigo

IN-3
Davies
Dubois
Gibson
Greene
Knox
Martin
Perry
Pike
Posey
Spenser
Vanderburg
Warrick

IOWA

IA-1
Lucas
Mahaska
Marion
Monroe
Wapello

IA-2
Appanoose
Boone
Dallas
Davis
Decature
Greene
Guthrie
Hamilton
Hardin
Henry
Jasper
Jefferson
Keokuk
Lee
Marshall
Polk
Scott
Story
VanBuren
Warren
Webster

KANSAS

KS-1
Atchison
Brown
Leavenworth
Nemaha

KS-2
Franklin
Osage

KS-3
Bourbon
Cherokee
Cowley
Crawford
Linn

KENTUCKY-WEST

KY-1
Butler
Christian
Crittendon
Davies
Edmonson
Grayson
Hancock
Henderson
Hopkins
McLean
Muhlenburg
Ohio
Union
Webster

MISSOURI

MO-1
Adair
Davies
Grundy
Harrison
Mercer
Nodaway
Putnam
Schuyler
Sullivan
Worth

MO-2
Caldwell
Carrol
Clay
Lafayette
Livingston
Ray
Saline

MO-3
Audrain
Boone
Callaway
Charitan
Howard
Linn
Macon
Montgomery
Ralls
Randolph

MO-4
Cass
Henry
Johnson
Pettis
St. Clair

MO-5
Barton
Bates
Cedar
Dade
Jasper
Vernon

OKLAHOMA

OK-1
Craig
McIntosh
Muskogie
Nowata
Okfuskee
Okmulgee
Rogers
Tulsa
Wagoner

OK-2
Haskell
LeFlore
Sequoyah

OK-3
Atoka
Coal
Latimer
Pittsburg

TABLE A-2. Total Coal Production, Interior Region, Selected Years

	1932	1935	1940	1945	1950	1955	1960	1965	1970	1971	1972	1973	1974	1975	1976[1/]
	million tons														
Arkansas	1.0	.9	1.5	1.9	1.2	.6	.4	.2	.3	.3	.4	.4	.5	.5	.6
Illinois	33.5	41.3	50.6	73.0	56.3	45.9	46.0	58.5	65.1	58.4	65.5	61.6	58.2	59.5	58.0
Indiana	13.3	14.8	18.9	25.2	20.0	16.1	15.5	15.6	22.3	21.4	25.9	25.3	23.7	25.1	24.1
Iowa	3.9	3.4	3.2	2.0	1.9	1.3	1.1	1.0	1.0	1.0	.9	.6	.6	.6	.5
Kansas	2.0	2.5	3.6	3.2	2.1	.7	.9	1.3	1.6	1.2	1.2	1.1	.7	.5	.7
Western Kentucky	9.5	8.2	na	na	24.0	26.3	30.6	39.2	52.8	47.8	52.3	53.7	51.8	56.4	50.8
Missouri	4.1	3.4	3.1	4.0	3.0	3.2	2.9	3.6	4.4	4.0	4.6	4.7	4.6	5.6	5.4
Oklahoma	1.3	1.2	1.6	2.9	2.7	2.2	1.3	1.0	2.4	2.2	2.6	2.2	2.4	2.9	3.3
Total [2/]	68.5	75.6	na	na	111.1	96.4	98.7	120.4	149.9	136.3	153.5	149.5	142.5	151.1	143.5
Total, United States	309.7	359.4	460.8	577.6	516.3	464.6	415.5	512.1	602.9	552.2	595.4	591.7	603.4	648.3	665.0

na Not available for Western Kentucky separately.

1/ Preliminary

2/ Detail may not add to total because of rounding.

SOURCE: U.S. Bureau of Mines, Mineral Yearbooks. Various years.

Table A3. Coal-fired electric power generating plants located in the Interior Region, 1976

State and company	Plant name and location	Capacity	Coal used		
			Source	Quantity	Pct. of total fuel used
		Megawatts	Location	1,000 tons 1/	Percent
Illinois					
Central Illinois Light Co.	R.S. Williams, East Peoria	246.3	Mont.	419	86.3
Central Illinois Light Co.	E.D. Edwards, Bartonville	755.8	Ill.	1,725	100.0
Central Illinois Light Co.	Duck Creek, Fulton County	2/	Ill.	322	100.0
Central Illinois Public Service Co.	Grand Tower, Grand Tower	190.0	Ill.	571	100.0
Central Illinois Public Service Co.	Hudsonville, Hudsonville	215.0	Ill., Ind.	419	97.0
Central Illinois Public Service Co.	Meredosia, Meredosia	367.0	Ill.	724	90.0
Central Illinois Public Service Co.	Coffeen, Coffeen	880.0	Ill.	2,208	100.0
Commonwealth Edison Co.	Fisk, Chicago	470.0	Mont.	833	81.0
Commonwealth Edison Co.	Crawford, Chicago	620.0	Mont., Wyo.	1,134	83.0
Commonwealth Edison Co.	Waukegan No. 1, Waukegan	816.0	Mont., Wyo.	1,812	100.0
Commonwealth Edison Co.	Joliet, Joliet	1,499.0	Ill., Mont.	2,924	85.0
Commonwealth Edison Co.	Powerton, Pekin	1,133.0	Ill., Mont.	4,238	100.0
Commonwealth Edison Co.	Dixon, Dixon	119.0	Ill.	168	100.0
Commonwealth Edison Co.	Will County, Joliet	1,073.0	Ill., Mont	2,852	100.0
Commonwealth Edison Co.	Kinkaid, Kindaid	1,212.0	Ill.	1,587	100.0
Electric Energy, Inc.	Joppa Steam Electric, Joppa	1,050.0	Ill., Ky., Ind.	3,043	100.0
Highland Electric Light Department	Highland, Highland	12.5	2/	18	100.0
Illinois Power Company	Hennepin Power, Hennepin	311.0	Ill., Ind., Ky., Ala.	705	99.5
Illinois Power Company	Vermillion Power, Oakwood	186.0	Ill., Ind.	505	99.98
Illinois Power Company	Wood River Power, Alton	651.0	Ill., Ky., Colo.	915	81.0
Illinois Power Company	Baldwin, Baldwin	1,815.0	Ill.	4,708	99.7
Mt. Carmel Public Utility Company	Mt. Carmel, Mt. Carmel	15.0	Ill., Ind.	24	66.7
Peru City of	Peru, Peru	15.3	2/	45	100.0

Table A3 (continued)

State and company	Plant name and location	Capacity	Coal used		
			Source	Quantity	Pct. of total fuel used
		Megawatts	Location	1,000 tons 1/	Percent
Rochelle Munic. Util.	Rochelle, Rochelle	31.5	2/	51	44.0
Southern Ill. Power Coop.	Marion, Marion	110.0	2/	373	100.0
Springfield Water, Light & Power	Dallman & Lakeside, Springfield	324.0	Ill.	730	98.9
Union Electric Co.	Venice No. 2, Venice	442.0	Ky.	87	67.8
Western Ill. Power Coop. Inc.	Pearl, Pearl	22.0	2/	77	99.5
Winnetka Municipal Electric & Water	Winnetha, Winnetka	25.5	Ky.	6	2/
Indiana					
Commonwealth Edison Co. of Indiana	State Line, Hammond	819.0	Ill., Mont., Wyo.	1,815	100.0
Crawfordsville Electric Light & Power	Crawfordsville, Crawfordsville	23.0	Ind.	76	100.0
Frankfort City Light & Power	Frankfort, Frankfort	32.5	Ind.	45	100.0
Hoosier Electric Coop.	Petersburg, Pike Co.	233.2	2/	654	100.0
Indiana-Kentucky Electric Corporation	Clifty Creek, 2/	1,290.0	Ind., Ky., Wyo.	4,400	99.98
Indiana-Michigan Electric Company	Tanners Creek, Lawrenceburg	1,015.0	Ky., Utah, Va., W.Va.	2,027	100.0
Indiana-Michigan Electric Company	Breed, S. of Terre Haute	400.0	Ind., Wyo.	1,129	100.0
Indianapolis Power & Light Company	Elmer E. Stout, Indianapolis	906.0	Ind.	1,585	97.8
Indianapolis Power & Light Company	C.C. Perry, Indianapolis	55.0	Ind.	411	100.0
Indianapolis Power & Light Company	H.T. Prichard, Martinsville	393.6	Ind.	548	96.4
Indianapolis Power & Light Company	Petersburg, Petersburg	718.0	Ind., Ky.	2,019	100.0

Table A3. (continued)

State and company	Plant name and location	Capacity	Coal used		
			Source	Quantity	Pct. of total fuel used
		Megawatts	Location	1,000 tons 1/	Percent
Jasper Munic. Utilities	Jasper, Jasper	21.5	Ind.	39	100.0
Logansport Elec. Light and Power	Logansport, Logansport	51.0	Ky.	71	100.0
Northern Ind. Public Service Company	Michigan City Generating, Michigan City	671.8	Ill.	1,487	94.2
Northern Ind. Public Service Company	Dean H. Mitchell, Gary	500.0	Wyo., Ill., Ind.	1,262	99.3
Northern Ind. Public Service Company	Bailly, Chesterton	587.0	Ind.	1,372	99.8
Northern Ind. Public Service Company	R.M. Schahfer, Wheatfield	320.0	Wyo.	45	97.8
Peru Electric Light Dept.	Peru, Peru	35.0	Ind.	49	100.0
Public Service Indiana	Wabash River, Terre Haute	889.0	Ind.	2,091	99.0
Public Service Indiana	Noblesville, Noblesville	106.0	Ind.	151	99.0
Public Service Indiana	Edwardsport, Edwardsport	165.0	Ind.	221	90.0
Public Service Indiana	Robert A. Gallagher, New Albany	637.0	Ky., Ind.	1,592	99.0
Public Service Indiana	Cayuga, Cayuga	1,036.0	Ind.	2,001	99.0
Public Service Indiana	Gibson, Carol	1,300.0	Ill., Ind., Ky.	2,527	99.0
Richmond Power & Light	Whitewater Valley, Richmond	90.0	Ind.	184	100.0
Southern Ind. Gas & Electric Company	F.B. Culley, Newburgh	414.9	Ind.	1,184	100.0
Southern Ind. Gas and Electric Company	Warwick, Yankeetown	161.0	2/	333	100.0
Washington Light & Power Department	Washington, Washington	18.0	2/	18	100.0
Iowa					
Ames Elec. Dept., City of	Municiple Light, Ames	68.2	Iowa	69	49.0
Cedar Falls Municipal Util.	Streeter, Cedar Falls	88.0	2/	30	71.3
Corn Belt Power Coop.	Humboldt, Humboldt	49.0	2/	41	2/
Corn Belt Power Coop.	Wisdom, Spencer	37.0	2/	43	2/

Table A3. (continued)

State and company	Plant name and location	Capacity	Coal used		
			Source	Quantity	Pct. of total fuel used
		Megawatts	Location	1,000 tons 1/	Percent
Kansas					
Empire District Elec. Co.	Riverton Plant, Riverton	159.0	Kans., Okla.	209.5	71.02
Kansas City Board of Public Utilities	Quindaro Power Plants, Kansas City	327.0	2/	335.0	2/
Kansas City Board of Public Utilities	Kaw Power Stat., Kansas City	144.0	2/	157.0	2/
Kansas Gas and Elec. Co.	Neasho Station, Parsons	122.7	2/	0.2	0.3
Kansas Gas and Elec. Co.	La Cygne Stat., La Cygne	412	Kans., Mo.	885	98.4
Kansas Power and Light Co.	Tecumseh Power Station Tecumseh	330	Wyo.	294.2	47.6
Kansas Power and Light Co.	Lawrence Power Stat., Lawrence	575	Wyo.	637.8	48.2
Kentucky, Western					
Big Rivers Elec. Corp.	Kenneth D. Colemen, Hawesville	455	Ind., Ohio, Ky.	1,330	94.5
Big Rivers Elec. Corp.	Robert Reid, Sebree	430	Ky. (w)	1,231	97.4
Kentucky Utilities	Green River, Central City	253	Ky. (E, W)	669.3	100.0
Owensboro Munic Utilities	Elmer Smith, Owensboro	416	Ky. (w)	1,055	99.85
Owensboro Munic Utilities	Plant #1, Owensboro	50	Ky. (w)	12.6	96.6
Tennessee Valley Authority	Shawnee, Poducah	1,750	Ill., Ky., Mo., Ind.	4,770	100.0
Tennessee Valley Authority	Paradise, Drakesboro	2,558.2	Ky. (w)	5,573	100.0
Missouri					
Associated Elec. Corp.	Thomas Hill, Moberty	470	Mo.	1,375	100.0
Central Elec. Power Corp.	Chamois, Chamois	59	Ill.	59	100.0
Chillicothe Munic Util.	Chillicothe, Chillicothe	15	Ill., Mo.	19	100.0
Columbia Water & Light Department	Columbia, Columbia	102	Ill.	64.8	87.0
Empire District Elec. Co.	Asbury, Asbury	200	Mo., Kans., Okla.	564	100.0
Fulton Dept. of Util.	Fulton, Fulton	11.5	Mo.	22	86.0
Independence Pwr. & Light	Blue Valley, Independence	115	2/	131	2/
Kansas City Pwr. & Light Company	Grand Avenue, Kansas City	99	Mo., Okla.	198	85.7

Table A3. (continued)

State and company	Plant name and location	Capacity	Coal used		
			Source	Quantity	Pct. of total fuel used
		Megawatts	Location	1,000 tons 1/	Percent
Eastern Iowa Lt. & Power Coop	Montpelier, Montpelier	65.0	Ill.	95	63.0
Interstate Power Co.	Lansing, Lansing	64.0	Ill., Mont.	148	99.0
Interstate Power Co.	Dubuque, Dubuque	84.6	Ill., Mont.	160	68.0
Interstate Power Co.	M.L. Kapp, Clinton	238.5	Ill., Mont.	549	99.4
Iowa Elec. Light & Power Company	Prairie Creek, Cedar Rapids	235.0	Ill., Colo., Mo., Ky.	89	82.0
Iowa Elec. Light & Power Company	Sixth Street, Cedar Rapids	88.0	Ill., Colo., Mo.	173	66.0
Iowa Elec. Light & Power Company	Boone, Boone	29.0	Colo., Mo.	20	59.0
Iowa Elec. Light & Power Company	Iowa Falls, Iowa Falls	9.0	Mo.	6	55.0
Iowa Elec. Light & Power Company	Sutherland, Marshalltown	149.0	Colo., Iowa., Mo.	268	62.0
Iowa-Ill. Gas & Elec. Co.	Riverside, Bettendorf	211.9	Ill.	464	72.0
Iowa Power & Light Compant	Council Bluffs Power, Council Bluffs	139.0	Wyo.	317	94.2
Iowa Power & Light Co.	Des Moines No. 2, Des Moines	277.0	Iowa, Wyo.	496	74.4
Iowa Public Service Co.	Carroll, Carroll	10.6	2/	4	67.0
Iowa Public Service Co.	Eagle Grove, Eagle Grove	9.8	2/	3	63.8
Iowa Public Service Co.	Maynard, Waterloo	81.0	Ky.	48	42.0
Iowa Public Service Co.	George Neal, Salix	573.0	Wyo.	1,375	97.6
Iowa Public Service Co.	Hawkeye, Storm Lake	22.8	2/	6	2/
Iowa Southern Util. Co.	Bridgeport, Eddyville	61.0	Iowa, Ill.	21	59.7
Iowa Southern Util. Co.	Burlington, Burlington	207.0	Ill., Iowa, Wyo.	534	100.0
Mt. Pleasant Light & Water Dept.	Mt. Pleasant, Mt. Pleasant	12.0	2/	3	100.0
Muscatine Power & Water	Muscatine, Muscatine	120.0	2/	252	2/
Pella Munic. Pwr. and Light Dept.	Pella, Pella	43.5	2/	41	2/
Sibley, Iowa, City of	Sibley Munic. Light & Heat, Sibley	2.5	Ill.	1	18.0

Table A3. (continued)

State and company	Plant name and location	Capacity	Coal used		
			Source	Quantity	Pct. of total fuel used
		Megawatts	Location	1,000 tons 1/	Percent
Kansas City Power & Light Company	Hawthorn, Kansas City	836	Mo., Okla., Wyo.	1,214	83.1
Kansas City Power & Light Company	Montrose, Clinton	546	Mo.	1,691	99.4
Kansas City Power & Light Company	La Cygne-Linn Co. La Cygne (KS)	824	Kans., Mo., Wyo., Okla.	1,776	98.0
Missouri Public Ser. Co.	Sibley, Sibley	460	Okla.	862	2/
N.E. Missouri Elec. Power Corporation	South River, Palmyra	22.5	2/	3.7	89.24
N.W. Missouri Elec. Power Corporation	Cameron, Missouri City	46	2/	18	2/
St. Joseph Light & Power Company	Lake Road, St. Joseph	231	Mo., Okla.	179	39.7
Springfield City Util.	James & Southwest, Springfield	462	2/	400	67.19
Union Electric Company	Meramec, St. Louis	881	Ill., Ind., Ky.	1,943	100.0
Union Electric Company	Sioux, West Alton (IL)	904	Ill.	2,002	99.82
Union Electric Company	Labadie, Labadie	2,300	Ill., Wyo.	5,638	2/
Union Electric Company	Rush Island, Crystal City	575	2/	1,211	97.99
Oklahoma					
NONE					

1/ Coal equivalent tons. For electric generation an equivalent ton equals 25,400,000 BTU.

2/ Data not reported.

Source: Keystone Coal Indsutry Manual, 1977. (16)

Table A4. Projected coal-fired power generating plants for the Interior Region, as of 1976

State and company	Plant name & county	Capacity	Coal required	Due on stream
		Megawatts	1,000 tons	Date
Arkansas				
Southwestern Electric Power	Flint Creek #1, Benton	528	1,700	5/78
Arkansas Electric Co-op	Unsited #1	300	1,066	6/78
Arkansas Power & Light Co.	White Bluff #1, Jefferson	700	2,500	4/79
Arkansas Electric Co-op	Unsited #2	300	1,067	6/79
Arkansas Power & Light Co.	White Bluff #2, Jefferson	700	2,500	1/81
Arkansas Electric Co-op	Unsited #3	500	1,067	6/81
Arkansas Electric Co-op	Unsited #4	265	1,067	6/82
Arkansas Electric Co-op	Unsited #5	300	1,067	6/82
Arkansas Power & Light Co.	White Bluff #3, Jefferson	700	2,800	1/82
Arkansas Power & Light Co.	White Bluff #4, Jefferson	700	2,800	1/83
Arkansas Power & Light Co.	Unsited #1	700	2,500	1/83
Arkansas Electric Co-op	Unsited #6	700	2,500	6/83
Arkansas Power & Light Co.	Unsited #2	700	2,500	1/85
Total		7,093	25,134	
Illinois				
Central Illinois Light Co.	Duck Creek #1, Fulton	400	1,080	4/76
Illinois Power Co.	Baldwin #3, Randolph	635	1,710	4/76
City of Springfield	Dallman #3, Sangamon[1/]	200	540	5/77
Central Illinois Public Service	Newton #1, Jasper	575	1,550	5/77

Table A4.(continued)

State and company	Plant name & county	Capacity	Coal required	Due on stream
		Megawatts	1,000 tons	Date
Illinois (cont.)				
Southern Illinois Power Co-op	Marion #4, Williamson	160	430	6/78
Illinois Power Co.	Havanna #6, Mason	450	660	5/78
Central Illinois Light Co.	Duck Creek #2, Fulton	400	1,080	5/80
Central Illinois Public Service	Newton #2, Jasper	575	1,550	4/81
Central Illinois Light Co.	Edwards #2, Peoria	500	1,350	/82
Southern Illinois Power Co-op	Marion #5, Williamson	150	400	/83
Central Illinois Public Service	Newton #3, Jasper	550	1,480	/83
Total		4,595	11,830	
Indiana				
Public Service of Indiana	Gibson #2, Gibson	650	1,500	4/76
Northern Indiana Public Service	Schahfer #14, Jasper	520	1,200	7/76
Indianapolis Power & Light	Petersburg #3, Pike	515	1,200	10/77
Public Service of Indiana	Gibson #3, Gibson	650	1,500	3/78
Indiana & Michigan Electric	Sullivan #1, Sullivan	1,300	3,000	/78
Public Service of Indiana	Gibson #4, Gibson	650	1,500	/79
Public Service of Indiana	Gibson #5, Gibson	650	1,500	/79
Indianapolis Power & Light	Petersburg #4, Pike	600	1,400	/79
Indiana & Michigan Electric	Sullivan #2, Sullivan	1,300	3,000	/79
Northern Indiana Public Service	Schahfer #15, Jasper	500	1,200	/79
Southern Indiana Gas & Electric	Brown #1, Brown	255	700	4/79
Indianapolis Power & Light	Petersburg #5, Pike	515	1,200	/81
Hoosier Energy Division	Merom #1, Sullivan	490	1,350	12/81
Hoosier Energy Division	Merom #2, Sullivan	490	1,350	/84
Total		9,085	21,600	

Table A4.(continued)

State and company	Plant name & county	Capacity	Coal required	Due on stream
		Megawatts	1,000 tons	Date
Iowa				
Iowa Public Service	George Neal #3, Woodbury	520	1,750	1/76
Interstate Power Co.	Lansing #4, Allomakee	260	800	5/77
Iowa State University	Heating Plant #3, Tory	11	40	5/77
Iowa Public Service	George Neal #4, Woodbury	575	1,750	1/79
Iowa Power & Light	Council Bluffs #3, Pottawatonie	650	2,000	1/79
Iowa Southern Utilities	Ottumwa #1, Wapello	675	2,500	1/81
City of Ames	Ames #8, Tory	55	150	6/81
Muscatine Munciple	Muscatine #9, Muscatine	150	250	5/82
Total		2,896	9,240	
Kansas				
Kansas City Power & Light Co.	La Cygne #2, Linn	630	1,860	4/77
Kansas City Power & Light Co.	Jeffery Energy #1, Pottawatomie	720	2,100	6/78
Kansas City Board of Public Utilities	Nearman Creek #1, Wyandotte	246	850	4/79
Kansas City Power & Light Co.	Jeffery Energy #2, Pottawatomie	720	2,100	6/80
Kansas City Power & Light Co.	Jeffery Energy #3, Pottawatomie	720	2,110	6/82
Kansas City Board of Public Utilities	Nearmen Creek #2, Wyondotte	320	850	6/82
Kansas City Power & Light Co.	Jeffery Energy #4, Pottawatomie	720	2,110	6/84
Total		4,076	11,970	
Kentucky				
East Kentucky Rural Electric Corp.	John S. Cooper, Pulaski	300	1/	/76
East Kentucky Power Coop.	Spurlock #1, Floyd	330	1,000	9/76
Louisville Gas & Electric	Mill Creek #3, Jefferson	425	1/	/77
Kentucky Utilities Co.	Ghent #2, Carroll	511	1/	/77
Big Rivers Electric Corp.	Robert Reid, Webster	200	700	/78
Ashland Oil & ERDA	Cattlesburg, Ky., Boyd	1/	219	9/78
Big River Electric Corp.	Robert Reid, Webster	200	700	/79

Table A4 (continued)

State and company	Plant name and county	Capacity	Coal required	Due on stream
		Megawatts	1,000 tons	Date
Kentucky (cont.)				
Louisville Gas & Electric	Mill Creek #4, Jefferson	495	1/	/79
Cincinnati Gas & Electric	East Bend #1, Boone	600	1/	/80
East Kentucky Rural Electric Coop.	Charleston Bottom #2, Mason	300	1,000	/80
East Kentucky Rural Electric Coop.	John S. Cooper, Pulaski	500	1/	/80
Louisville Gas & Electric	Wise Landing #1, Trimble	495	1/	/81
Kentucky Utilities	Ghent #3, Carroll	500	1/	/81
Cincinnati Gas & Electric	East Bend #2, Boone	600	1/	/82
Louisville Gas & Electric	Wise Landing #2, Trimble	500	1/	/83
Kentucky Utilities	Ghent #3, Carroll	650	1/	/85
Total		6,606	3,619	
Missouri				
Springfield Utilities	Southwest #1, Greene	200	650	6/76
Union Electric Co.	Rush Island #1, Jefferson	575	1,400	1/76
Union Electric Co.	Rush Island #2, Jefferson	575	1,800	4/77
Associated Electric Coop.	New Madrid #2, New Madrid	600	1,900	6/77
Kansas City Power & Light	Iaton #1, Platte	1/	1/	3/80
Associated Electric Co-op	Thomas Hill #3,	600	800	6/81
Empire District Electric Corp.	Asburg #2, Jasper	300	1,000	6/84
Total		2,850	7,550	
Oklahoma				
Oklahoma Gas & Electric	Muskogee #4, Muskogee	515	1,650	2/77
Oklahoma Gas & Electric	Muskogee #5, Muskogee	515	1,650	2/78
Oklahoma Gas & Electric	Sooner #1, Noble	515	1,650	2/79
Public Service of Oklahoma	Northeastern #3, Rogers	450	1,450	5/79
Oklahoma Gas & Electric	Sooner #2, Noble	500	1,650	2/80
Public Service of Oklahoma	Northeastern #4, Rogers	450	1,450	5/80
Farmers Electric Coop.	Unnamed #2,	300	1,000	6/81
Public Service of Oklahoma	Unsited #2	700	2,250	2/82

Table A4.(continued)

State and company	Plant name and county	Capacity	Coal required	Due on stream
		Megawatts	1,000 tons	Date
Oklahoma (cont.)				
Public Service of Oklahoma	CRS Joint	280	800	5/82
Farmers Electric Coop	Unnamed #3	300	1,000	5/83
Total		4,525	14,550	
Total, Interior Region		41,726	105,493	

1/ Not reported.

Sources: U.S. Bureau of Mines. Projects to Expand Fuel Sources in Eastern States. Information Circular 8725.(37)

Federal Power Commission. Status of Coal Contracts for New Electric Generating Units. (39)

Table A5. Matrix of state surface mine legislation in the Interior Region

1	2	3	4	5	6	7	8	9	10	11	12	13
Stage of program development				State law				Reclamation — Main actions required and standards set				
State	Act(s)	Rules and regulations	Technical guidelines	Title of Act(s)	Administering agency (ies)	Mineral or commodity covered	Rules vary by mining method	Control water flow and quality	Conserve and replace topsoil	Backfill and grade	Reduce highwall or pitwall	Bury or neutralize toxic wastes
ARKANSAS	X	X	X	The Arkansas Open Cut Land Reclamation Act of 1971.	Department of Pollution Control and Ecology.	All minerals	--	X	Standards vary according to original natural conditions.	All grades will be ≤33%; blade and grade to approximate original surface conditions.	X	With 3 ft of earth or permanent water body.
ILLINOIS	X	X	X	Surface-Mined Land Conservation and Reclamation Act.	Department of Mines and Minerals.	All minerals	--	X	*Row crops*, 18 in.; *Other uses*, replace as practicable.	Varies by planned use, i.e.: original grade for row crops; ≤30% forest and wildlife; ≤50% hay and pasture.	To grade of ≤50%.	With 4 ft of water or suitable material.
INDIANA	X	X	X	Chap. 344, Acts of 1967, Indiana Statutes.	Department of Natural Resources.	Coal, clay, and shale.		X		Grades: row crops ≤8%, pasture and hay ≤25%, forest and range ≤33% (slope lengths limited).	To grade of ≤10% or create lake in pit.	With 2 ft of soil, overburden, or water.
IOWA	X	X	X	An Act Relating to Surface Mining, as amended.	Department of Soil Conservation.	All minerals	--	X	In coal mine reclamation, strata more suitable than top soil may be used.	Grade spoil to ≤25%, except where original land was steeper, then, blend with adjacent land.	To grade of ≤33%.	With 2 ft of spoil.
KANSAS	X	X	X	Mined-Land Conservation and Reclamation Act.	State Corporation Commission.	Coal	--	X	As necessary to provide plant growth material.	Rolling topography traversable for planned use. Grade ≤25% (slope lengths limited).	To grade of ≤25% unless impounded, as by a lake.	With 2 ft of spoil or permanent water body.
KENTUCKY	X	X	X	Chapter 350, Kentucky Revised Statutes.	Department for Natural Resources and Environmental Protection.	All minerals	-- For contour mining, limits are placed on cut benches and slope.	Detailed standards.		Approximate original contour. Grade beech tables to ≤10%.	Auger mining face to ≤45°; other mining, backfill and cover coal to 4 ft.	With 4 ft of overburden.

Table A5. Matrix of state surface mine legislation in the Interior Region (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13
	Stage of program development			State law					Reclamation — Main action required and standards set			
State	Act(s)	Rules and regulations	Technical guidelines	Title of Act(s)	Administering agency(ies)	Mineral or commodity covered	Rules vary by mining method	Control water flow and quality	Conserve and replace topsoil	Backfill and grade	Reduce highwall or pitwall	Bury or neutralize toxic wastes
MISSOURI	X	----------	----------	(1) Reclamation of Mining Lands and (2) The Land Reclamation Act.	Department of Natural Resources.	Act (1) coal and barite; Act (2) clay, limestone, sand, and gravel.	----------	----------	----------	Act (1) traversable for farming; Act (2) traversable for intended uses and strike-off top of spoil pile to width of ≥20 ft (forest and pasture).	Act (1), slope of face will be ≤25%.	With 4 ft of earth supportive of vegetation.
OKLAHOMA	X	----------	----------	Mining Lands Reclamation Act.	Department of Mines.	All minerals --	----------	----------	----------	Topography will be traversable for approved end use. Slope of box cut overburden will be ≤25°.	Suitable to serve end-use objective.	With 8 ft of overburden.

Explanation of entries in table

Entry	Meaning
----------	Indicates the absence of a specific requirement or program element. No specific mention of this topic is made in the State Act or in the rules or regulations, but the topic may be addressed in administrative orders or in current professional practice extant in that State.
X ----------	Affirms the existence of a requirement or program element; means that the wording in the column heading applies to the given State.
An entry phrase or sentence not in parentheses	Affirms that the subject of the column heading is covered in the State. Also supplies detailed information useful in showing the individual character of the State program.
(A note set in parentheses)	Used to modify an X entry or note entry by giving an example, showing an exception (if so stated), or refining the main information presented.

Explanation of Symbols

≥ Greater than
≧ Greater than or equal to
≤ Less than or equal to

NOTE: Local governmental land-use controls and permit activities may be applicable to mining and reclamation.

Table A5. Matrix of state surface mine legislation in the Interior Region (continued)

1	14	15	16	17	18	19	20	21	22	23	24
			Requirements for land-use planning				Special Provisions				
State	Revegetate for beneficial use	Other rules or remarks	Resources information required	Alternative uses will be considered	Coal use will be declared	Role of local public planning	Minerals protected from nonmining development	Exclusion of areas from consideration for mining	Long-range or regional mine planning	Substitute lands allowed	Financial or economic analyses required
ARKANSAS	X	Construct fire lanes or access in areas of reforestation.	Soils	Any "productive use."	X					X	
ILLINOIS	Replant row crops if soils suitable. Detailed standards for other uses.	Separate permits required for refuse disposal (landfill).	Geology, land use, minerals, soils, topography (USGS), vegetation, water resources, and wildlife.	Agency will "encourage" consideration of multiple land use.	X	County board may recommend land use, and may request hearings.			Rules "encourage" long-range reclamation planning.	X	Land values, tax base, state & regional economy, employment & effect of plan.
INDIANA	X	Other standards pertain to lakes, soil texture, and waste disposal.	Geology, land use, minerals, soils, topography, and water resources.	X	X					Prohibited.	
IOWA	X (Detailed guidelines available.)		Mineral, soils, and water resources.								
KANSAS	X	Other standards pertain to removal of boulders and formation of lakes.	Geology, soils, topography (USGS), and water resources.		X				Rules allow 5-yr plans for "contiguous" mined areas.	X	
KENTUCKY	X (Detailed guidelines available, e.g., time of planting.)	Other detailed standards on: access roads, lakes, and sediment control.	Soils, topography (USGS), and water resources.			State permits must comply with local zoning laws.			Rules allow the development of "area plans" for mined areas.		

Table A5. Matrix of state surface mine legislation in the Interior Region (continued)

Stage of program / State	14	15	16	17	18	19	20	21	22	23	24
			Requirements for land-use planning				Special Provisions				
	Revegetate for beneficial use	Other rules or remarks	Resources information required	Alternative uses will be considered	End use will be declared	Role of local public planning	Minerals protected from mountaining development	Exclusion of areas from consideration for mining	Long-range or regional mine planning	Substitute lands allowed	Financial or economic analyses required
MISSOURI	Appropriate to type of end use declared.	Exceptions allowed in grading on: Act (1), subdivisions and wildlife; Act (2), flood plains.		×	×					×	
OKLAHOMA	× (Exemptions: soils, with poor fracture, toxicity, and nutrient deficiency).				×						

Source: A Guide to State Programs for the Reclamation of Surface Mined Areas. Geological Survey Circular 731. 1976. (13)

Table A6. Percent Distribution of Principal Crops, Farms With Gross Sales Over $2,500, 1974

Coal production areas	Corn	Soybeans	Wheat	Oats and Barley	Sorghum	Alfalfa hay	Other hay	Field seeds	All other crops	Total cropland harvested 1/	Cropland pastured	All other cropland	Total cropland
	percent												
Arkansas-1	.3	13.8	1.9	.2	.7	1.5	23.4	.3	.8	42.9	53.8	3.3	100.0
Illinois-1	47.6	27.5	2.7	3.0	.2	2.8	2.7	.1	-.6	86.1	9.7	4.2	100.0
Illinois-2	51.8	37.9	1.5	1.6	.1	1.3	.8	*	.1	95.1	3.0	1.9	100.0
Illinois-3	39.6	39.1	8.8	.5	.3	1.2	2.1	*	-1.2	90.4	6.2	3.4	100.0
Illinois-4	40.9	42.3	7.3	.4	.1	.7	1.2	.1	2/	93.1	4.1	2.8	100.0
Illinois-5	23.7	34.0	22.3	.2	1.3	2.5	5.0	1.2	-3.5	86.7	7.4	5.9	100.0
Illinois-6	21.7	40.5	17.0	.1	1.0	.7	4.9	.7	-3.2	83.3	9.6	7.1	100.0
Indiana-1	40.1	32.0	9.3	.7	.3	2.0	2.9	.2	-.5	87.0	9.0	4.0	100.0
Indiana-2	32.9	31.6	12.9	.3	.6	1.7	4.1	.1	-1.3	83.0	9.2	7.8	100.0
Indiana-3	39.6	23.5	13.6	.2	.5	1.2	6.0	.3	-2.2	82.6	11.9	5.5	100.0
Iowa-1	35.2	21.1	.1	4.9	.1	7.4	5.2	.1	-1.1	73.1	22.8	4.1	100.0
Iowa-2	45.0	29.1	.3	3.3	.1	4.2	3.2	*	-.6	84.6	13.0	2.4	100.0
Kansas-1	23.3	11.4	10.8	1.5	18.5	4.4	5.5	.6	-1.3	74.8	20.7	4.5	100.0
Kansas-2	9.4	21.5	11.6	1.1	16.6	3.3	13.2	.4	-1.7	75.3	20.5	4.2	100.0
Kansas-3	4.1	19.3	24.6	1.3	13.1	3.4	9.9	1.0	-2.2	74.5	21.2	4.3	100.0
Kentucky-1	25.4	26.2	7.1	.4	.3	1.0	9.2	.5	-3.9	66.2	28.3	5.5	100.0
Missouri-1	21.2	17.7	1.3	1.2	.4	6.2	13.4	.4	-1.2	60.7	35.8	3.5	100.0
Missouri-2	25.4	27.1	5.4	.6	1.5	2.6	8.9	.5	-1.7	70.3	25.0	4.7	100.0
Missouri-3	17.9	28.6	5.8	.7	2.6	1.5	12.7	.9	-1.9	68.6	26.4	5.0	100.0
Missouri-4	13.5	15.5	6.3	.8	8.0	2.1	15.5	4.7	-2.7	63.7	33.2	3.1	100.0
Missouri-5	8.3	18.5	13.4	.7	10.6	1.8	13.3	5.4	-4.1	67.9	28.8	3.3	100.0
Oklahoma-1	.6	12.9	7.4	1.6	4.9	2.4	20.3	.3	1.2	51.6	43.6	4.8	100.0
Oklahoma-2	.2	11.6	2.7	.2	.6	2.2	20.1	.1	1.2	38.8	57.1	4.1	100.0
Oklahoma-3	.5	.8	1.0	.5	2.0	.9	21.4	.1	2.8	29.9	66.5	3.6	100.0
Region Average	32.2	28.8	7.0	1.4	2.1	2.5	6.4	.6	-1.3	79.5	16.5	4.0	100.0

* Less than .05%

1/ Detail may not add due to independent rounding

2/ Between -.05% and .05%

Compiled from U.S. Census of Agriculture, Volume 1

Table A7. Selected Measures of Agricultural Intensity, 1974

Coal production areas	1974 Gross sales per acre of land area	Farms with gross sales over $2500 per township 1/	Animal units per 1,000 acres of land area 2/
	----- dollars -----	------- number -------	----- number ------
Arkansas-1	39.26	19.4	52.2
Illinois-1	143.76	67.6	130.1
Illinois-2	159.10	66.2	49.5
Illinois-3	144.04	64.6	79.3
Illinois-4	145.69	66.3	50.7
Illinois-5	94.72	67.1	74.0
Illinois-6	71.38	54.7	54.0
Indiana-1	91.61	51.9	63.7
Indiana-2	66.21	52.4	48.1
Indiana-3	100.63	57.8	79.2
Iowa-1	115.29	71.3	178.2
Iowa-2	157.28	72.0	144.0
Kansas-1	78.74	56.9	107.1
Kansas-2	52.22	48.8	89.0
Kansas-3	54.65	40.3	89.5
Kentucky-1	60.48	53.3	79.0
Missouri-1	60.42	52.6	125.2
Missouri-2	85.52	59.3	118.0
Missouri-3	65.77	51.4	101.9
Missouri-4	57.67	52.2	123.7
Missouri-5	55.86	49.1	115.6
Oklahoma-1	24.93	27.1	87.8
Oklahoma-2	14.51	18.1	64.4
Oklahoma-3	11.79	17.4	74.5
Region Average	92.84	54.3	94.4

1/ A township is defined here as the land area equivalent to 36 sections or 23,040 acres.

2/ Animal units are milk cows=1.0, other cows =0.8, other cattle=0.5, hogs=0.2, and sheep=0.15.

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