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Coal Resources of Illinois

Prepared for Task Force on the Future of Illinois

Introduction

Information presented here ~~is an attempt to~~ summarizes highlights of a number of recent reports on coal pertinent to consideration of the "Task Force on The Future of Illinois."

A number of illustrations appear in Appendix A. Most, but not all, relate directly to the discussion which follows. Some new data are presented, however, and insofar as practical, information has been updated through 1977. Appendix B presents an unpublished analysis of remaining recoverable reserves relative to past production by state.

A listing of several key reports that relate directly to this statement may be found in Appendix C. The references listed are highly selective and the reader is referred to these for more complete discussion of much of the information presented here in highly digested form.

I like condensed better

Coal Resources of Illinois

Historic Role of Coal in the State

Illinois is richly endowed with coal resources and has the largest resources of bituminous coal of any state. Resources of lower rank lignite and subbituminous are larger in Montana and North Dakota and probably in Wyoming than in Illinois.

For about 100 years, coal has contributed importantly to mineral production in the state and has played an important role in industrial development. From before 1910 to the late 1920's, 75,000 to over 100,000 men were employed in Illinois mines. The number of employees was under 10,000 during most of the 1960's, but has been steadily climbing in the 1970's to over ~~15,000~~ 16000 in ~~1976~~ 1977, and is expected to continue to grow through the remainder of this century. ~~Figure 1~~ Figure A-1 in Appendix A shows coal production, number of men employed and fatalities in Illinois mines from 1882 through 1977.

Approximately 36,800 acres, roughly two-thirds of Illinois is underlain by coal-bearing strata. Production has come from 20 or more seams mined in about 35 counties. The most recent estimate of coal resources for in-the-ground coal over 28 inches thick (includes coal 18 inches to 28 inches if less than 150 feet deep) is approximately 161 billion tons.

Nearly two-thirds of this total occurs in the Herrin (No. 6) Coal seam and the Harrisburg (Springfield) (No. 5) Coal seam. Over 97 billion tons of remaining coal over 42 inches thick has been estimated for these two coals. Maps A-8 and A-9 in Appendix A ~~Figures 4 and 5 from Coop Report No. 4~~ show the areas of thicker occurrences of these two seams.

Through 1977 approximately 4.68 billion tons of coal have been mined in Illinois. Nearly an estimated 1,150 square miles have been undermined and over 300 square miles mined by surface mining. Surface mined coal increased steadily as a percentage of total production from less than 1 percent in the early 1920's to more than 50 percent in 1963. From a high of 59.2 percent in 1968, percentage of production from surface mines has generally declined to 46.8 percent in 1976 and has been less than 50 percent since 1972. Surface mining currently disturbs about 8.5 square miles per year. ~~Figure~~ Map A-2 in Appendix A. shows the relationship of the Illinois coal fields to other coal fields of the United States.

The U.S. Bureau of Mines has estimated that of the total coal resources of all ranks in the U.S., a total of about 232 billion tons (adjusted date 1974) is technically and economically minable by present methods

and economy. Of this total, about 29.6 billion tons or nearly 13 percent lies in Illinois. It should be borne in mind that data for making such estimates on a state or national basis is seriously limited by inadequate data for broad area assessments. The U.S. Bureau of Mines (1974 data adjusted) estimated 26.66 billion tons of recoverable coal reserves in Illinois minable by underground methods and 2.98 billion tons by surface minable methods.

A recently published estimate of surface-minable coal in Illinois (ISGS Cir. 504, 1978) indicates approximately 6 billion tons in the ground that could be mined by surface methods in Illinois based on those technology and economic factors practical to assess at this time at about 80 percent recovery. This would represent nearly 5 billion tons of recoverable coal.

It is believed that the estimates for underground coal by the U.S. Bureau of Mines are similarly conservative although it is not practical at this time to indicate what the larger total should be. If we are correct, however, in estimating that 10 to 15 percent of total reserves are surface minable, underground reserves would be about 50 percent higher than estimates from the U.S. Bureau of Mines (whose estimates were on Illinois State Geological Survey data).

Since the late 1960s, Illinois coal production has averaged about 60 million tons per year, but has been below that figure for the past few years. There was a rather steady decline in production from a World War II high of 77.4 million tons in 1944 to ~~an average of about 47.5~~ a low of 47.5 million tons in the ~~1950s~~ 1950s. In the 1960s, production gained rather steadily to more than 60 million tons and reached 65.5 million tons in 1972, the highest production since World War II. Since that date, annual production has ranged from about 58 to 61.5 million tons. Of many possible causes for cessation of growth, three obvious influences were the Federal Coal Mine Health and Safety Act of 1969, the Federal Clean Air Act of 1970, and the growth of nuclear power in the state.

The Coal Mine Health and Safety Act ~~has~~ is considered to have had a large impact nationally ~~in reduction of~~ on productivity which has decreased by the order of about 40 percent or more in underground mines. A similar reduction in surface mining has also included other factors, but the trend is being reversed on national averages with the development of large western surface mines at shallow depths with much of the coal ranging to as much as 100 feet thick. As older mines are abandoned and newer mines are designed to better meet federal and state regulations, it is anticipated that future productivity will increase but is not likely to equal that of the late 1960s at any ~~early future~~ soon date. Productivity expressed as tons per man day (tpd) decreased in Illinois from 22.94 tpd in 1969 to 13.42 tpd in 1976 for Illinois underground mines and from 15.61 tpd in 1969 to 9.10 tpd in 1976 for the United States as may be seen in figure A-3 of Appendix A. Comparable data for surface mined coal can be seen in figure A-4 of Appendix A. Fatalities in Illinois mines have ~~had a relatively good record~~ been substantially reduced since the early 1950s as ~~may be seen~~ shown in figure A-1 of Appendix A.

The Clean Air Act of 1970 and subsequent amendments have ~~severely~~ restricted potential growth of Illinois coal markets. Present regulations to emissions limit sulfur in coal (without other systems of emission control) in major metropolitan areas or in new plants to about 0.7 percent sulfur in coals of the average rank of Illinois coals ~~without application to other systems of~~ of emission control. Although a significant amount of coal has been produced in the relatively low-sulfur range of 1 to 2 percent, most coal production in Illinois and reserves fall in the 3 to 5 percent sulfur range. Generally, no coal is available in Illinois that would meet new plant requirements in the absence of other installed desulfurization technology.

Increasing quantities of low-sulfur western coal, particularly from Montana and Wyoming have invaded traditional Illinois markets in Illinois as well as in surrounding states. Despite a greatly increased number of installations to remove sulfur from effluent gases, there remains no consensus that sulfur emission level regulations are best met in this manner. Sulfur removal installations must: 1) be technologically successful (a significant number of processes have been developed); 2) reliable in terms of long-time operation at high levels of efficiency (many questions on reliability through out the period of normal continuous boiler operation); and 3) economically reasonable (a number of utilities have opted for importation of western coal on the basis of economics).

As elsewhere, growth of nuclear power generating stations in Illinois has displaced potential growth of fossil fuel ~~use~~ in coal and particularly coal.

The total value of coal to the economy of the state is difficult to assess. The estimated value of the coal at the mine does not reflect the local multiplier effect, nor the impact on transportation, product use, and the numerous other satellite economic impacts. Further, the relative impact to the economy in a number of less affluent counties of the state has a much greater impact than simply the percentage contribution ~~of~~ to the total state economy.

For about 25 years following World War II, ~~in Illinois~~ in Illinois the price paid for coal at the mine was essentially constant with increasing productivity offsetting increased costs of mining. Through this period, the average mine price was ~~$3.79~~ less than $4.00 per ton. In the 1970s there has been a significant increase in the mine price of coal at a rate appreciably higher than cost-of-living increases. From an average mine price of $4.32 per ton of coal in 1969, there was an increase of 55 percent to $6.71 in 1973. Since 1973, the average mine price for coal has increased an additional 175 percent to $18.43 per ton in 1977.

The total value at the mine of minerals produced in Illinois in 1977 was 1.54 billion dollars. Of this amount nearly one billion dollars was the value of the 53.88 million tons of coal produced. As stated previously, support industries, transportation and processing of coal produced represents a significantly larger value than the billion dollars to impact the economy of the state and particularly the areas of mining.

Historically, major markets for Illinois coal have been electric utilities, railroads, industrial, domestic uses, and coke manufacture. Since

World War II, railroad consumption has essentially ceased and ~~the domestic~~ There has been significant reduction in all other uses except coke manufacture. ~~market essentially so also~~.

(1977)

Presently, markets for Illinois coal are 1) electric utilities, 83.6 percent; 2) industrial, 0.8 percent; 3) coke manufacture, 6.1 percent; 4) ~~all other~~ retail dealers and mine use, 9.5 percent.

Current Status of Coal in Illinois

As indicated in the foregoing section, the latest estimate of coal resources for the state is based on coal 28 inches or more thick (and greater than 18 inches if less than 150 feet deep). The total resources, thus defined are approximately 161 billion tons.

Previous studies of resources less than 150 feet deep, considered technically minable by surface techniques (strip mining) in Illinois totalled, as defined above, about 20 billion tons.

A recently completed study published in August, 1978, assessed potentially surface minable reserves utilizing much more restrictive definitions in order to attempt to identify reserves that are technically, economically, and legally minable. Included were factors of thickness, depth, depth and thickness ratio, size of block and accessibility. Cultural or other features (parks, reserved natural areas, etc.) were excluded if underlain by otherwise surface minable coal.

Results of this recent study reported 183 identified blocks containing a minimum of six million tons in the ground. ~~Total~~ Reserves in these blocks totalled about 6 billion tons. Recovery rate is variable, but it is reasonable to assume that there may be 80 to 90 percent recovery although in this assessment it was not practical to determine if each acreage could be acquired for mining.

Although the latest fully comprehensive study of Illinois total coal resources was published as ISGS Bulletin 78 (1952) many comprehensive and detailed studies have been completed since that date for coal seams ~~on~~ selected areas. Estimates of 1952 indicated resources of about 137 billion tons. The latest estimate of 161 billion tons reflects identification of far more coal resources in the past 25 years than have been depleted by mining. A comprehensive

study of resources and reserves of Herrin (No. 6) and Harrisburg or Springfield (No. 5) Coals, the two principal seams in Illinois, were reported in Illinois Geological Survey-Illinois Water Survey Cooperative Report No. 4. Resources greater than 42 inches thick were respectively 59 billion tons for No. 6 Coal and 38 billion tons for No. 5 Coal (in the ground). No attempt was made to further identify the amount of the coal mapped that would be recoverable ~~principally~~ by underground mining methods. (the greatest percentage recoverable will be)

An effort is just being initiated to determine, ~~as fully as practical~~, the recoverable reserves of coal from underground mining. As many factors as practical that will identify technically, economically and legally recoverable deep mining reserves by current practice will be considered. Based on results of such an evaluation of surface minable recoverable reserves, it is fully anticipated that such reserves will be significantly higher than the 26.66 billion tons derived from ~~U.S. Bureau of Mines estimates~~ Geological Survey data of 1974 (based on assessment of published ISGS data).

Coal looms of greater potential importance to Illinois ~~as~~ than perhaps at least since early years of large scale mining any previous time. Energy shortages in the next 20 to 25 years from oil and gas are generally recognized. Under any scenario, much of the potential shortfall in meeting any reasonable level of energy demand will require a major input from coal sources. Although Illinois oil production contributes significantly to the State's economy, the current level of about 25 million barrels falls far short of meeting demands of the State. Although development of the limited supplies of gas are being ~~increasingly~~ viewed favorably because of more favorable prices, Illinois has been dependent on other states for more than 99 percent of the state demand. The dependency on other areas for oil and gas will remain. Coal is the major indigenous fossil ~~fired~~ fuel that can physically meet whatever level of demand that the state may ~~have~~ demand for at least several decades to come.

In 1978 there are _____ mines operating. Essentially this group of mines produced _____ tons of coal in 1977.

About 14 new mines have been announced or are under construction to be in operation from now until 1982 (one for 1984). ~~It is estimated that about 2 million tons per year of~~ A major portion of this new mine capacity would be required to replace ~~only~~ those mines which are to be abandoned by 1985. Much increased production must generally come from new mines not yet announced.

The current direct value at the mine of about one billion dollars from coal has a direct multiplier effect to the total state economy. As pointed out previously, also, much of the coal is developed in ~~what has~~ been chronically depressed areas of the state so that direct economic impact of such areas of the state have even greater impact than "average" economic impact on the total state economy.

After a four fold increase in mine price of coal in the past 10 years, it is anticipated that the price of coal is ~~more~~ likely in the immediate future to more closely parallel the cost-of-living.

Future of Coal in Illinois

1985 - 2001

Projections of coal production and consumption beyond about 1985 are somewhat speculative, because they must be based largely on presently known plans. Since mine development requires not less than 3 years and more commonly 6 to 8 years (and more) from "decision" to ~~mine, until~~ full production ~~is achieved~~, there are no "immediate" solutions to significant growth in mine production in this area. If markets warranted, of course, there is some greater capacity in current mines than is being utilized. Projected demands for coal from Illinois in 1985 cannot be fully met by the increased production from new mines announced after deducting losses from mine abandonments in this period.

In a 1976 study by Malhotra and Simon (Illinois Mineral Note 65), projected growth demand rate for 1985 based on three rates was estimated for the period 1980-1985. A low rate of 1.5 percent, characteristic of 1950 to 1960 production yields an estimate of demand of about 85 million tons. A medium rate of 4 percent, which is slightly less than the growth rate of the period 1960-1969 would require production of 93 million tons by 1985. A high growth rate of 7 percent, characteristic of the World War II period, would require productive capacity to increase to over 112 million tons.

The medium growth rate is still considered the most likely to occur, but may be high.

Many uncertainties concerning coal still limit the accuracy of projections to 1985. These same uncertainties cloud even more the projections to 1990 and the year 2000. Certainly not all, but important factors influencing future growth of production of Illinois coal include: 1) further amendments to the Clean Air Act; 2) extent of further development of western coals and intrusion into areas traditionally served by Illinois coals; 3) degree of expansion of nuclear power generation; 4) magnitude of the projected shortfall in supply of competitive fuels; 5) ultimate impact of new federal strip mine legislation; and 6) federal, state, and local government policies regulating the mining and utilization of coals.

Many new technologies for utilization of coal and control of emissions from coal burning will certainly occur in the next 20 years. It is considered unlikely, however, that most such methods can have a very significant impact much before the end of this century (i.e. gasification, liquifaction, fluidized bed combustion, etc.). Perhaps a principal potential is for stack gas cleaning which will probably be nearly universally applied in the next few years. Uncertainty remains, however, if these installations

can fully meet present emission standards when using Illinois coal. If successful in providing adequate control, the immediate future for Illinois coal is very bright indeed.

A recent study by Malhotra in 1977 (Illinois Mineral Note 67) indicated a strong future potential market in states generally to the south and ~~east~~ southeast of Illinois ~~in the future~~ under favorable combinations and solutions of problems of a number of present constraints. The principal use of Illinois coal will continue to be for production of electricity and will probably continue to provide on the order of 85 percent of coal demand.

The relatively large reserves, thickness, favorable mining conditions and proximity to major markets provides a basis for major expansion of development of Illinois coal. If solutions for several problems referred to previously can be attained, by the year 2000 (and in most of the interim period) coal reserves in Illinois are sufficiently favorable that it should be possible to achieve <u>any</u> reasonable level of demand which may develop, given sufficient development time.

APPENDIX A

Selected Figures to Supplement "Coal Resources"
Prepared for Task Force on the Future of Illinois

A-1 Production, Employees, and Fatalities in Illinois Coal Mines - 1882 through 1977.

A-2 Coal Fields in the United States (adapted from U.S. Geological Survey Bulletin 1412).

A-3 Trends in Underground Coal Mine Productivity in Illinois and the United States - 1900 through 1976.

A-4 Trends in Strip Mine Productivity in Illinois and the United States.

A-5 Productivity of Underground Coal Mines in Illinois and Other States - 1963 through 1976.

A-6 Productivity of Strip Mines - Comparison of Illinois with Appalachian Region, Adjacent States in the Midwest, and Western States - 1963 through 1976.

A-7 Distribution of Demonstrated Coal Reserves - by Tonnage - by Heat Value (Source of data on figures - 1974 data).

A-8 Generalized Distribution Map of Herrin (No. 6) Coal in Illinois with Broad Thickness Classes Shown (ISWS-ISGS Co-op Report No. 4).

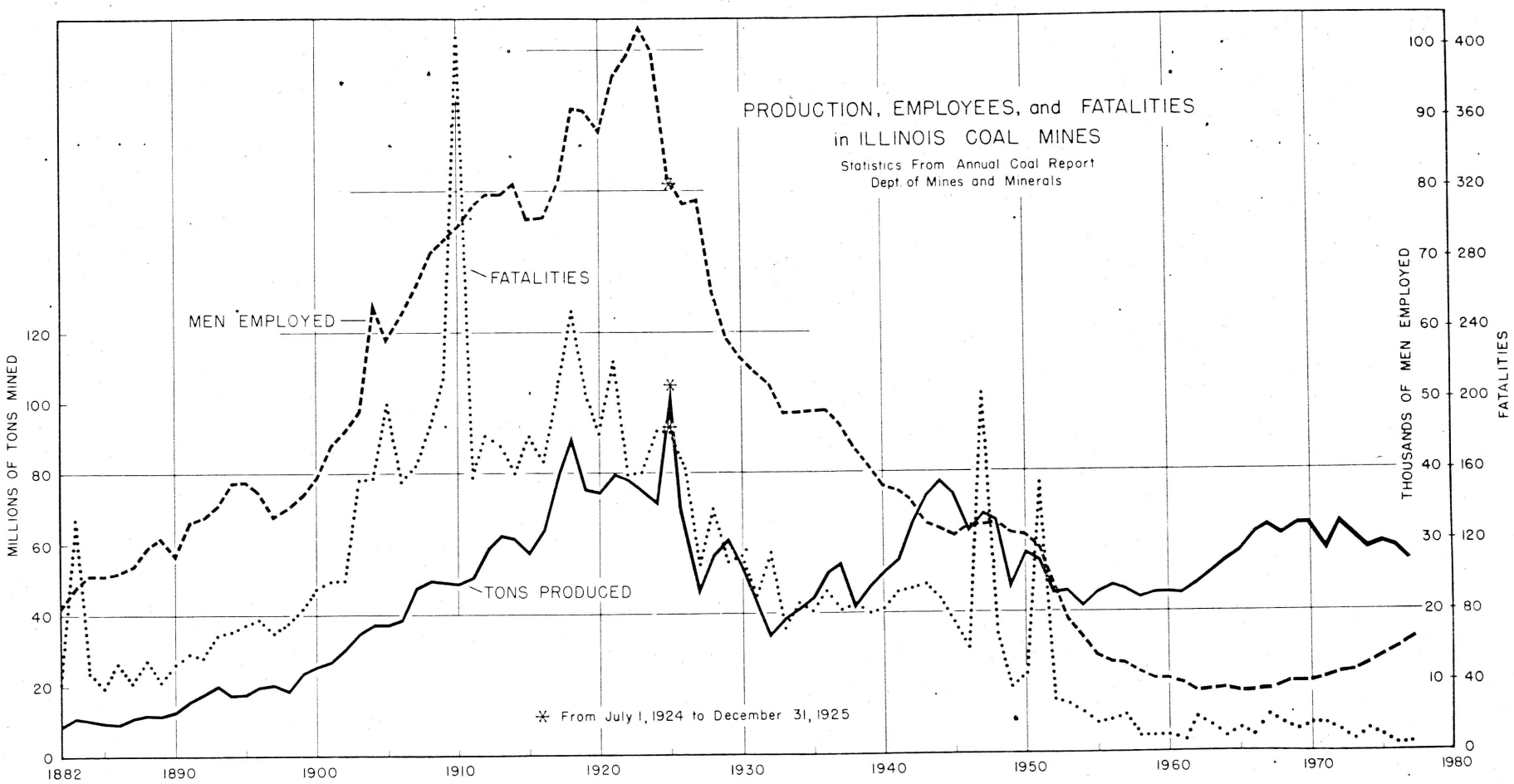
A-9 Generalized Distribution Map of Harrisburg or Springfield (No. 5) Coal in Illinois with Broad Thickness Classes Shown (ISWS-ISGS Co-op Report No. 4).

A-10 Trends in Coal Supply from Illinois Basin, 1930-1975 (Illinois Minerals Note 65, 1976).

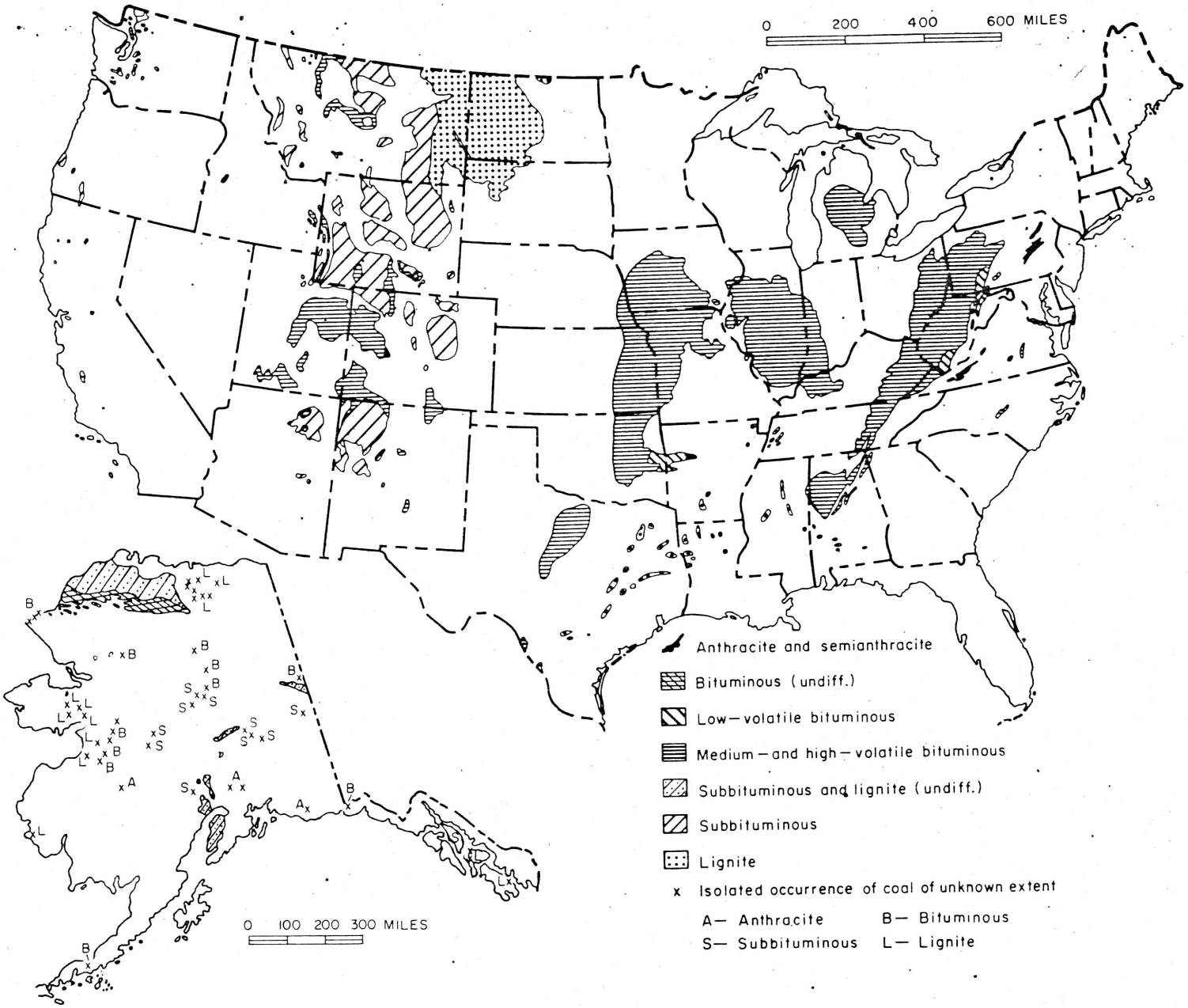
A-11 United States Coal Consumption in 1975 (Sources cited on figure).

A-12 Projected Demand for Coal in the United States - 1985 (Sources cited on figure).

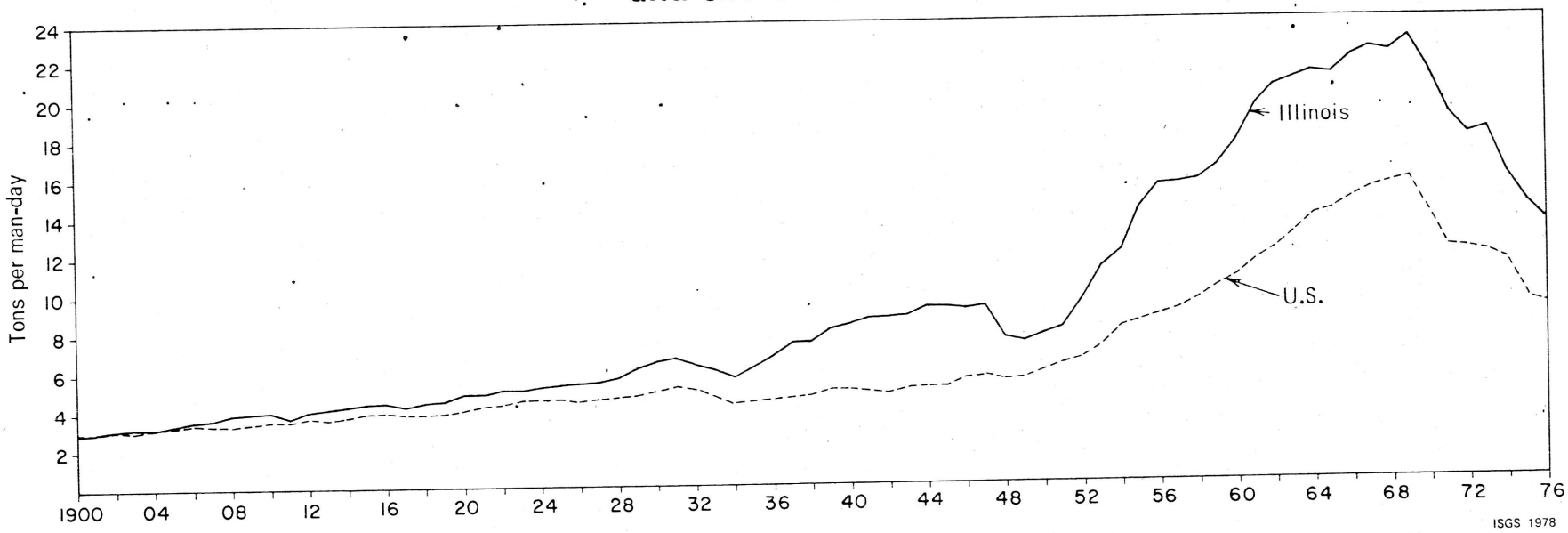
A-13 Projected Use of Western Coal by Electric Utilities in the United States - 1984 (sources cited on figure).


PRODUCTION, EMPLOYEES, and FATALITIES
in ILLINOIS COAL MINES
Statistics From Annual Coal Report
Dept. of Mines and Minerals
MEN EMPLOYED
FATALITIES
TONS PRODUCED
* From July 1, 1924 to December 31, 1925
MILLIONS OF TONS MINED
THOUSANDS OF MEN EMPLOYED
FATALITIES
0
20
40
60
80
100
120
10
30
50
70
90
40
80
160
200
240
280
320
360
400
1882
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
ISGS 1978

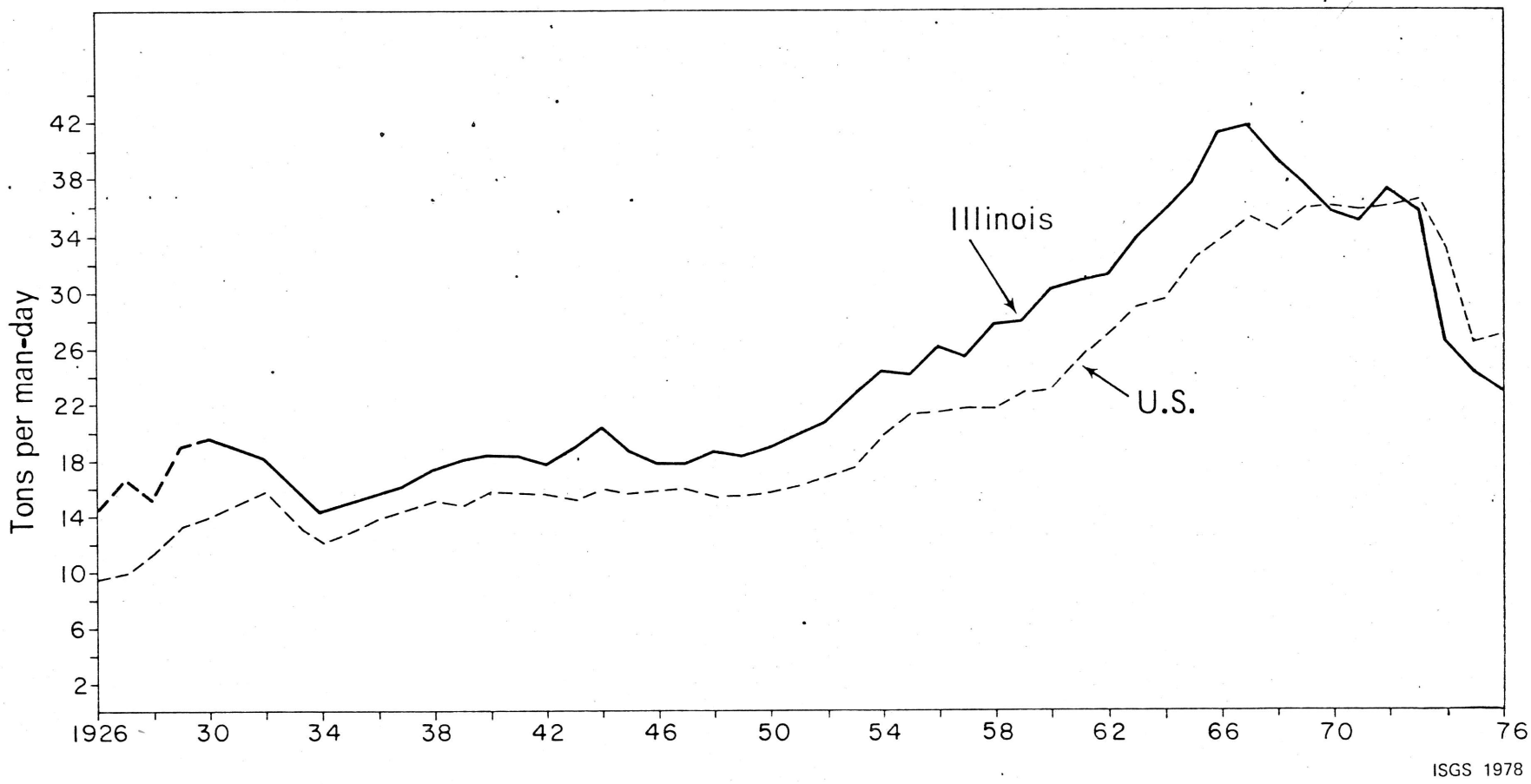
Coal Fields in the United States



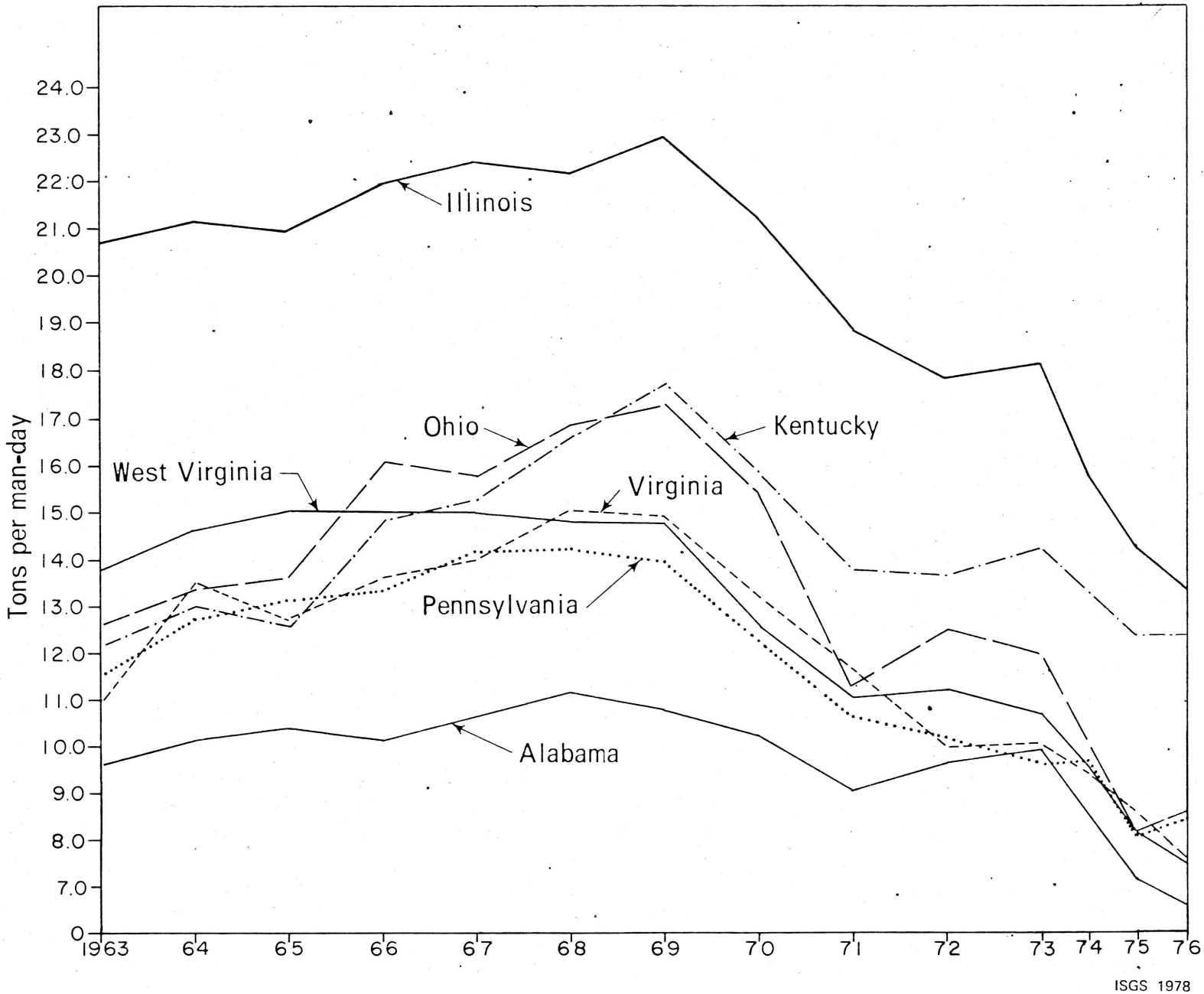
Trends in Underground Coal Mine Productivity in Illinois and the United States



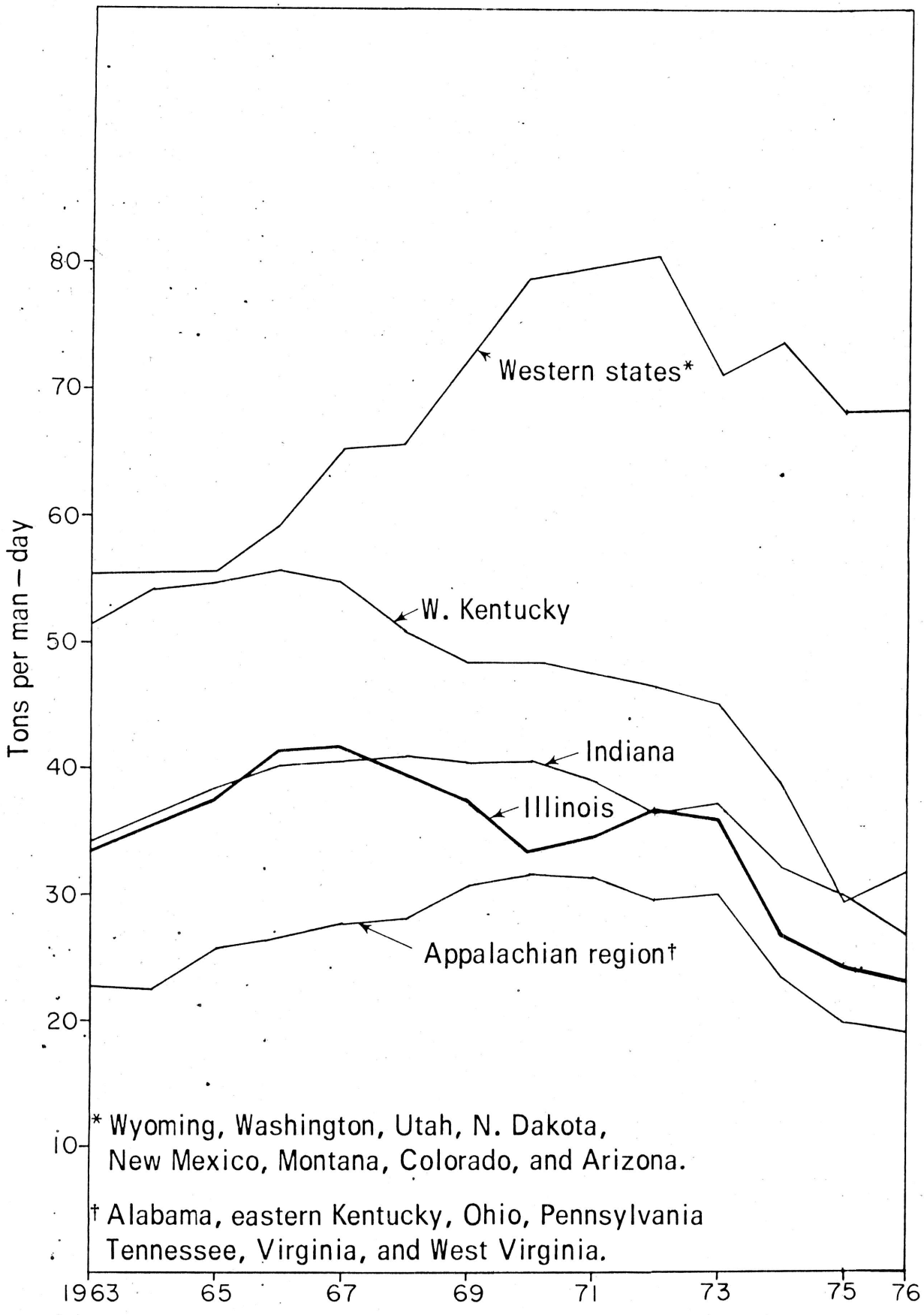
Trends in Strip Mine Productivity in Illinois and the United States



Productivity of Underground Coal Mines in Illinois and Other States

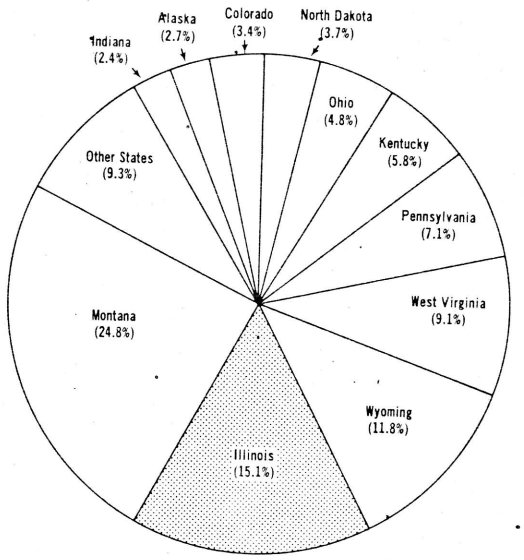


Productivity of Strip Mines



ISGS 1978

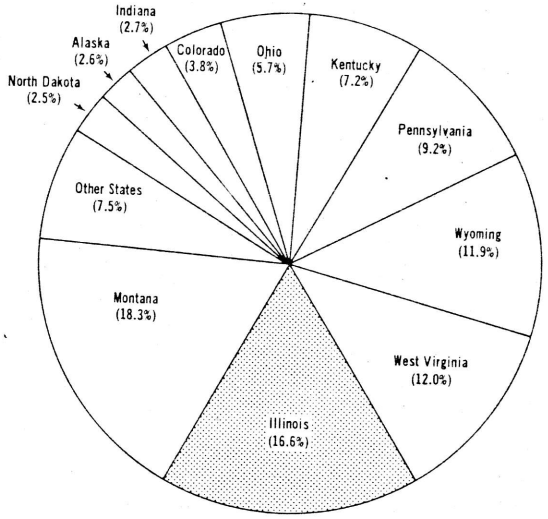
DISTRIBUTION OF DEMONSTRATED COAL RESERVES
(by tonnage)



Total tonnage: 433,948 million short tons

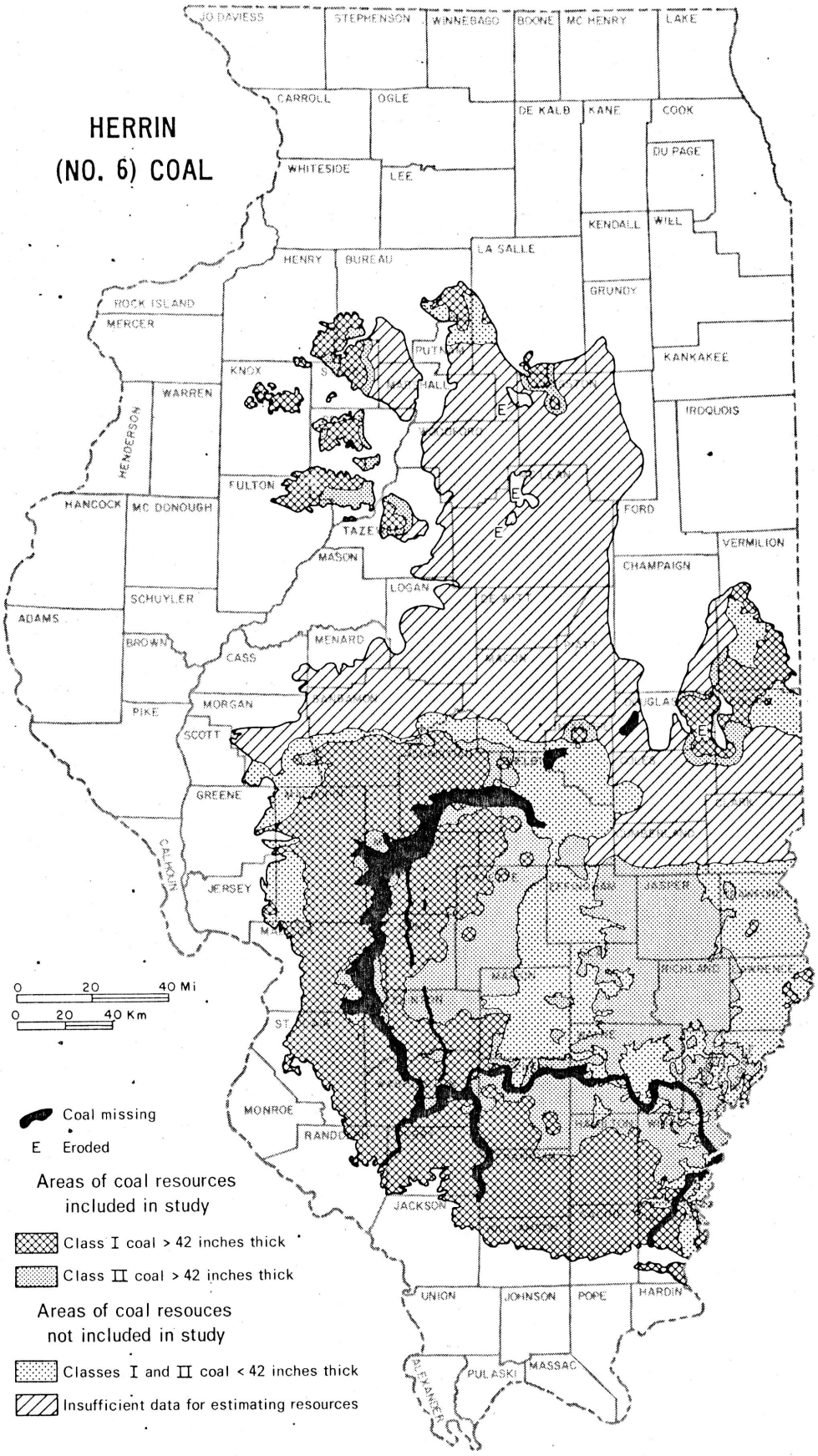
Source: U.S.B.M. (1974)

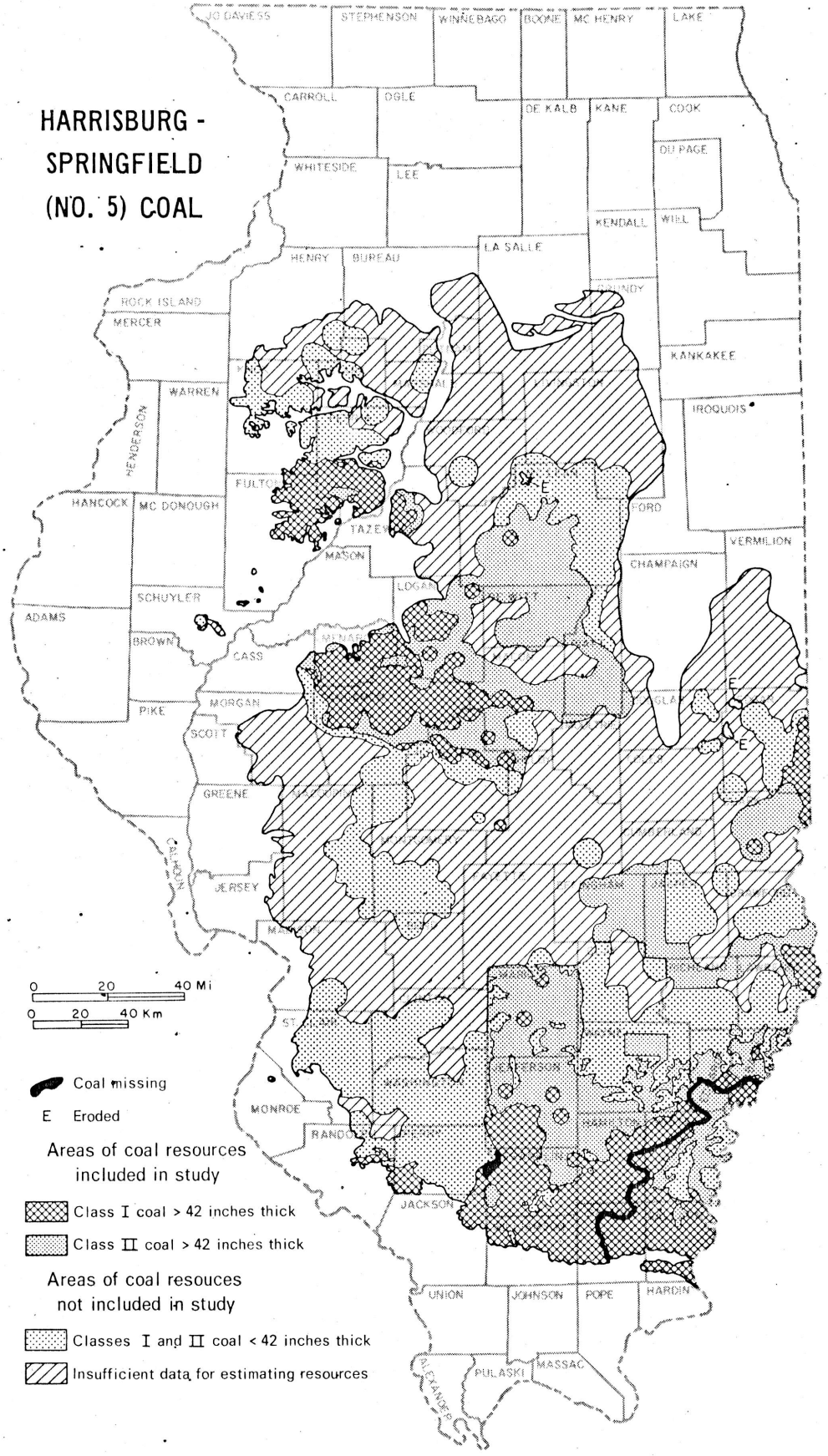
DISTRIBUTION OF DEMONSTRATED COAL RESERVES
(by heat value)

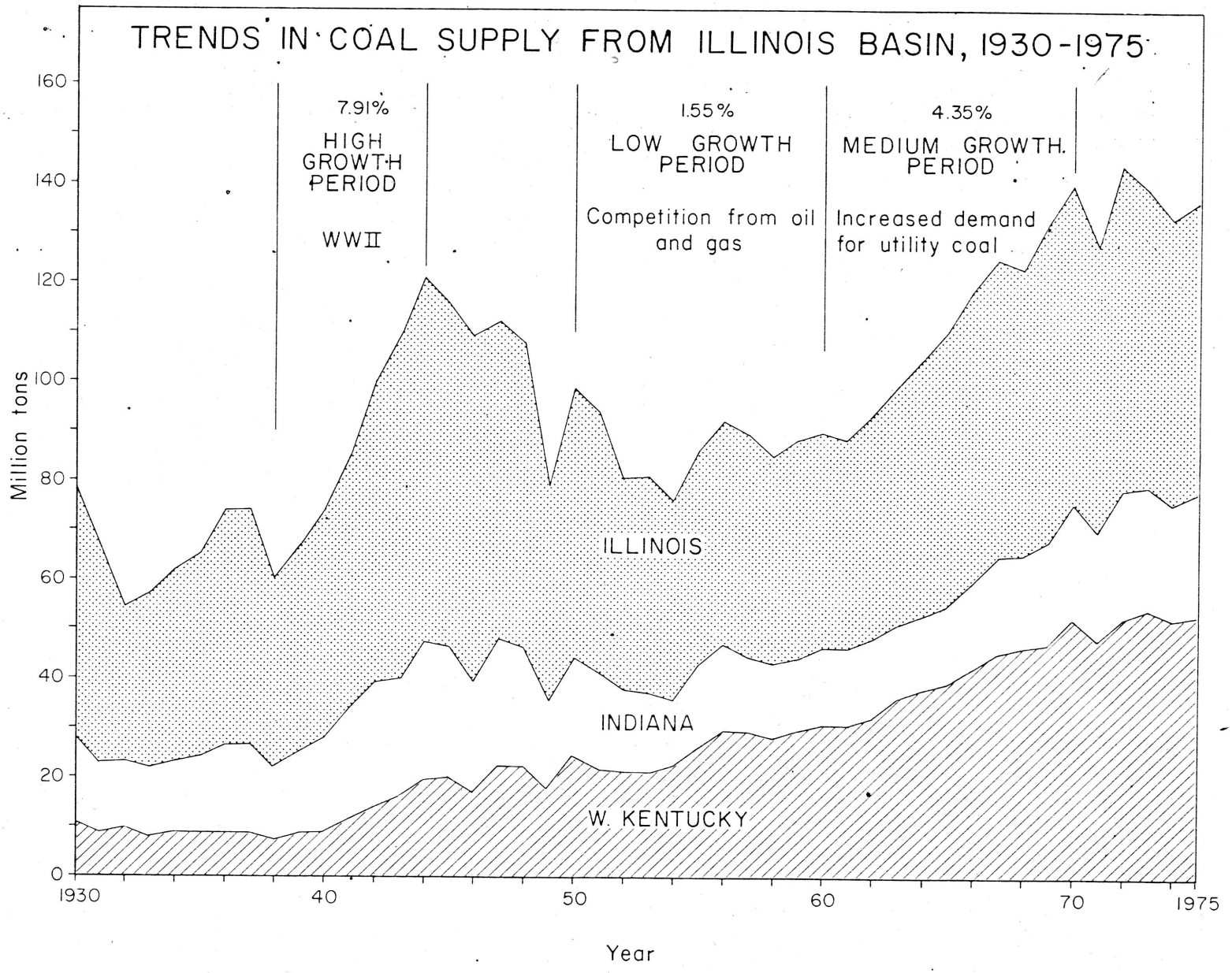


Total potential energy: 8,915,028 trillion Btu

Source: Illinois State Geological Survey (1975)

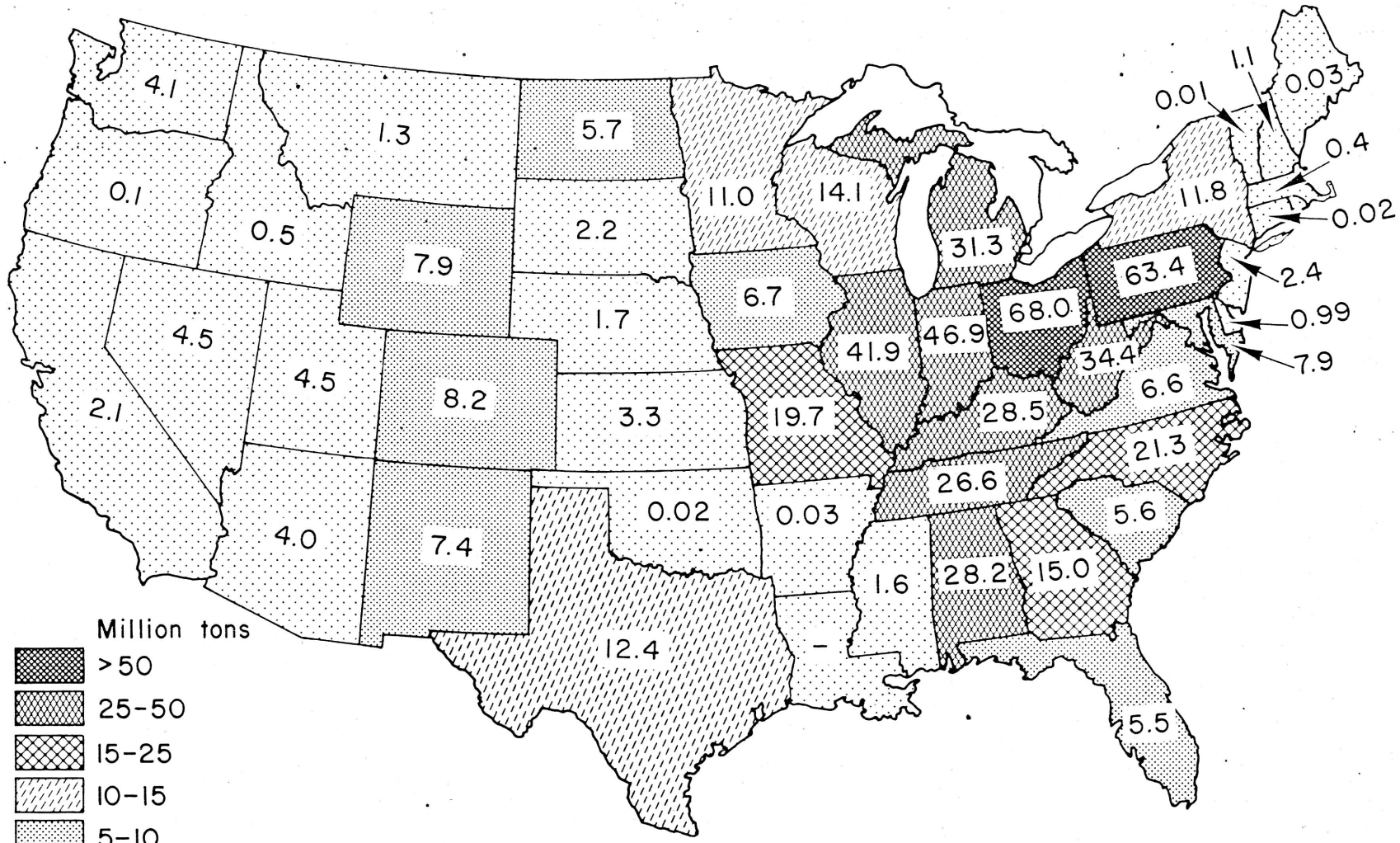

HERRIN
(NO. 6) COAL
JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MC HENRY
LAKE
CARROLL
OGLE
DE KALB
KANE
COOK
DU PAGE
WHITESIDE
LEE
KENDALL
WILL
HENRY
BUREAU
LA SALLE
GRUNDY
ROCK ISLAND
MERCER
KANKAKEE
KNOX
WARREN
HENDERSON
IROQUOIS
FULTON
HANCOCK
MC DONOUGH
FORD
VERMILION
MASON
CHAMPAIGN
LOGAN
SCHUYLER
ADAMS
BROWN
CASS
MENARD
MORGAN
PIKE
SCOTT
GREENE
CALHOUN
JERSEY
JASPER
MONROE
JACKSON
UNION
JOHNSON
POPE
HARDIN
PULASKI
MASSAC
ALEXANDER
0 20 40 Mi
0 20 40 Km
Coal missing
E Eroded
Areas of coal resources included in study
Class I coal > 42 inches thick
Class II coal > 42 inches thick
Areas of coal resouces not included in study
Classes I and II coal < 42 inches thick
Insufficient data for estimating resources


HARRISBURG - SPRINGFIELD (NO. 5) COAL
JO DAVIESS
STEPHENSON
WINNEBAGO
BOONE
MC HENRY
LAKE
CARROLL
OGLE
DE KALB
KANE
COOK
DU PAGE
WHITESIDE
LEE
KENDALL
WILL
HENRY
BUREAU
LA SALLE
GRUNDY
ROCK ISLAND
MERCER
KANKAKEE
WARREN
HENDERSON
IROQUOIS
FULTON
HANCOCK
MC DONOUGH
FORD
TAZEWELL
VERMILION
MASON
CHAMPAIGN
LOGAN
SCHUYLER
ADAMS
BROWN
CASS
MORGAN
PIKE
SCOTT
GREENE
CALHOUN
JERSEY
MONROE
JACKSON
UNION
JOHNSON
POPE
HARDIN
PULASKI
MASSAC
ALEXANDER
E
0 20 40 Mi
0 20 40 Km
Coal missing
E Eroded
Areas of coal resources included in study
Class I coal > 42 inches thick
Class II coal > 42 inches thick
Areas of coal resouces not included in study
Classes I and II coal < 42 inches thick
Insufficient data for estimating resources



Originally published in Illinois Minerals Note 65, Illinois State Geological Survey (1976).

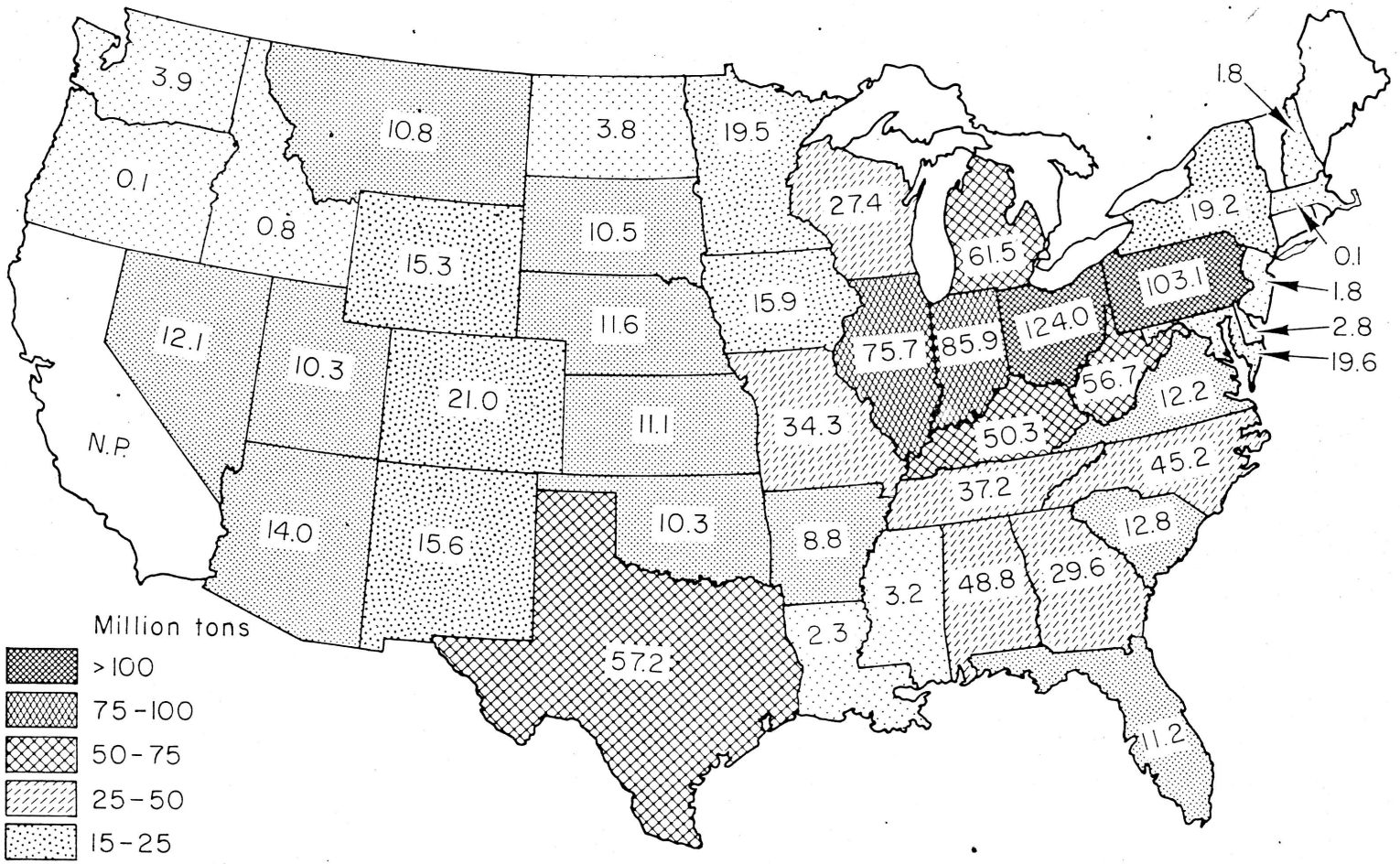
UNITED STATES COAL CONSUMPTION IN 1975



Map originally published in Illinois Minerals Note 65, Illinois State Geological Survey (1976).

Source of data: U.S. Bureau of Mines (1976)

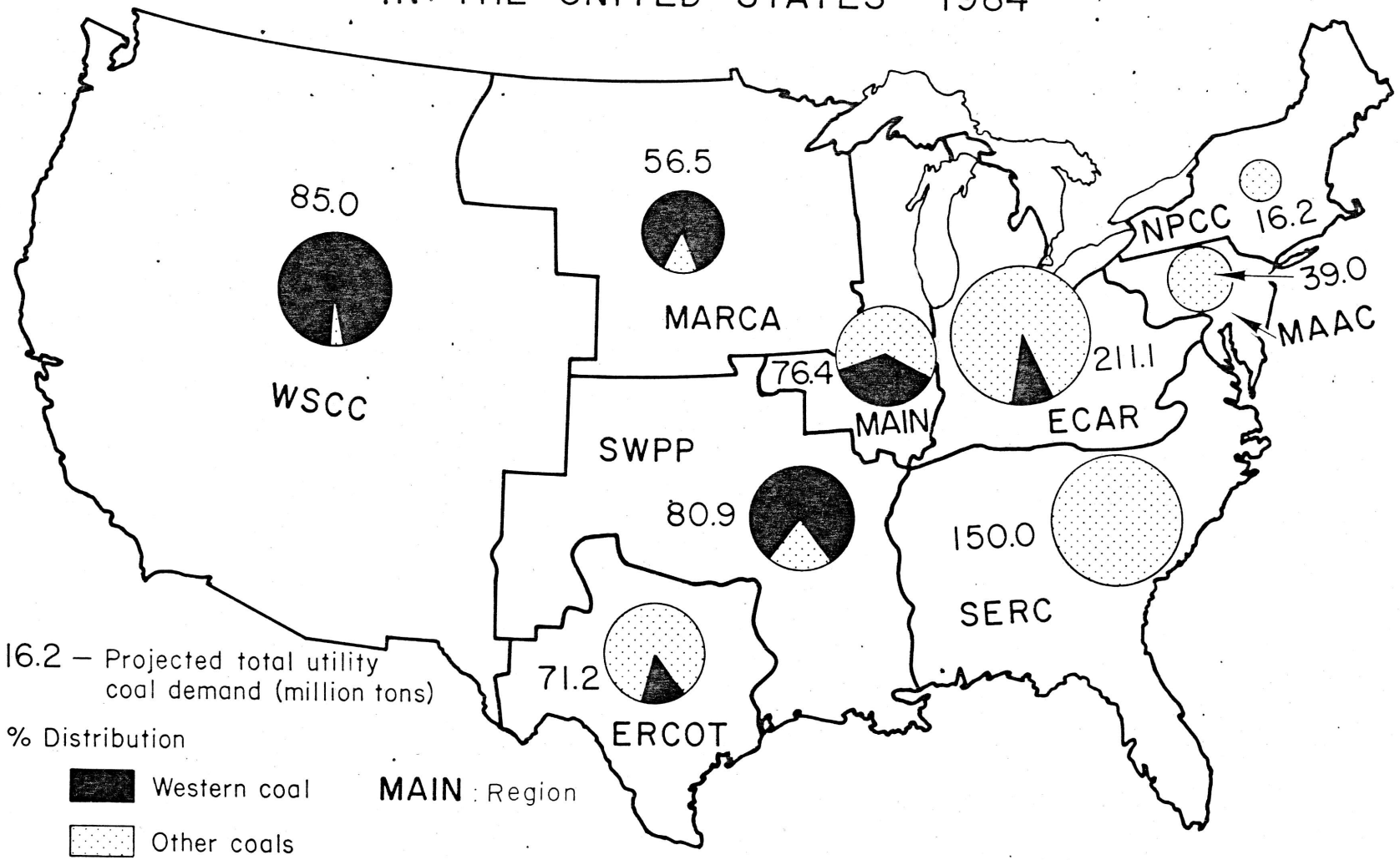
PROJECTED DEMAND FOR COAL IN THE UNITED STATES - 1985



Map originally published in Illinois Minerals Note 65, Illinois State Geological Survey (1976).

Source of data: U.S. Bureau of Mines (1976)

PROJECTED USE OF WESTERN COAL BY ELECTRIC UTILITIES IN THE UNITED STATES—1984



Map originally published in Illinois Minerals Note 65, Illinois State Geological Survey (1976).

APPENDIX B

Recoverable Reserves and Depletion

An important aspect of remaining coal reserves is the extent to which original reserves have been depleted. As with most minerals, the most favorable deposits in any area (thickness, quality, location, etc.) are mined first. Accordingly, in any state, the quantity of remaining reserves must be assessed also in terms of the extent to which the more choice reserves have been mined. As may be seen below, Montana and Wyoming have very favorable remaining recoverable reserves of principally subbituminous and lignite. Of the states with principal bituminous coal reserves east of the Mississippi River, Illinois is in a most favorable position relative to remaining recoverable reserves and relatively low percentage of original recoverable reserves which have been mined.

Percent of Original Recoverable Reserves Mined (1974)	Current Estimate of Remaining Recoverable Reserves (Millions of tons)*	Percent of U.S. total
0-2 Percent		
Alaska	6,520	2.8
**Montana	66,680	28.7
**North Dakota	12,800	5.5
**South Dakota	300	0.1
Texas	1,290	0.5
**Wyoming	30,780	13.3
2-8 Percent		
Arizona	380	0.2
Colorado	7,470	3.2
Missouri	4,170	1.8
New Mexico	3,500	1.5
13-16 Percent		
ILLINOIS	29,640	12.8
Utah	2,030	0.9
Washington	850	0.4
18-23 Percent		
Arkansas	370	0.2
Indiana	5,390	2.3
Iowa	1,620	0.7
Kentucky (Western)	5,040	2.2
Ohio	9,440	4.1

Percent of Original Recoverable Reserves Mined (1974)	Current Estimate of Remaining Recoverable Reserves (Millions of tons)	Percent of U.S. total
27-34 Percent		
Kentucky (Eastern)	5,290	2.3
Oklahoma	530	0.2
West Virginia	19,000	8.2
37-45 Percent		
Kansas	370	0.2
Maryland	460	0.2
Pennsylvania	15,350	6.6
Virginia	1,640	0.7
56-59 Percent		
Alabama	920	0.4
Tennessee	350	0.2
TOTAL	232,180	

* Data developed from U.S. Geological Survey Bulletin 1412, "Coal Reserve Base of the United States: January 1, 1974;" and U.S. Bureau of Mines Information Circular 8531, "Strippable Reserves of Bituminous Coal and Lignite in the United States." (NOTE: Data have been adjusted through 1974 for both reports.

**Data from "Northern Great Plains Resources Study Program, 1974" revised as of July 1, 1975.

APPENDIX C

Selected Bilbiography for "Coal Resources"
Prepared for Task Force on the Future of Illinois

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