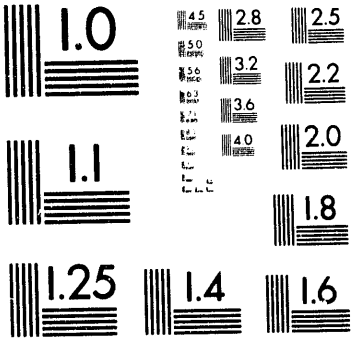
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DOE/FE/61679--T19

October 23, 1989

MEMORANDUM

TO: John Pyrdol, DOE/FE

FROM: Daniel E. Klein

SUBJECT: Text for Projections Section of NES Coal Chapter

Attached are the pages we have drafted so far on the EIA projections as they relate to coal. Per your directions, we have kept this section out of FE's 10/16/89 submission.

AC01-88FE61679

TABLE OF CONTENTS

EIA PROJECTIONS OF COAL SUPPLY AND DEMAND

NOTE: Forecast numbers are based upon EIA projections identified as "DACC 332: Mid price, mid macro; new macro; benchmarking on". Forecasting report is dated 10/04/89.

FORECASTED COAL SUPPLY AND TRANSPORTATION

U.S. coal production is forecasted to continue growth at a modest pace. Between 1988 and the year 2000, coal production rises 216 million tons to 1,163 million tons, an average annual growth of 1.7 percent. This rate of growth accelerates after the year 2000; the increase to 1,546 million tons in the year 2010 represents an average annual increase of 2.9 percent over the 2000-2010 period.

Growth in U.S. coal production will continue to be faster in some of the western coal fields than in the east. As a result of the lower heat content of some of these western subbituminous coals and lignites, the national average Btu/ton of coal will continue to decline over the forecast period. In 1988, U.S. coals average 21.3 million Btu/ton; these averages are forecast to decline to 20.9 by the year 2000 and 20.7 by the year 2010.

EIA forecasts coal mining productivity to continue to improve, but at a substantially slower rate than has been realized over the past decade. EIA's forecasts assume labor productivity to increase at one percent per year through the year 2000, and increase at one-half percent per year thereafter.

Average mine-mouth prices for coal have been declining in recent years as a result of increasing labor productivity and an increasing share of production coming from low-cost western mines. EIA forecasts these effects to continue to reduce average coal prices into the early 1990s, and hold down average prices to small increases thereafter. From a 1988 average price of $23.24 per ton, EIA forecasts a reduction to an average $22.39 per ton in the year 1991. Thereafter, prices increase at about one percent per year, reaching $24.43 per ton in the year 2000 and $27.12 per ton in the year 2010.

EIA assumes increasing coal transportation rates in the forecast period, averaging 0.5 percent per year on a per-mile basis. However, EIA also forecasts shorter average transportation distances and/or relatively lower tonnages shipped to the higher-rate non-utility sectors. As a result, the average per-ton coal transportation rate is forecasted to decline from current levels. From a 1988 average transportation rate of $10.40 per ton (1989$), average rates are forecasted to decline to $9.24 per ton by the year 2000 and $8.85 per ton by the year 2010.

Coal imports are forecasted to rise from current low levels, but will still remain below one percent of domestic production. EIA forecasts imports at seven million tons in the year 2000, rising to 15 million tons by the year 2010.

FORECASTED COAL DEMAND BY CONSUMING SECTOR

Coal consumption can be identified by consuming sector. EIA's forecasts identify coal demand according to four domestic sectors (Residential/Commercial, Industrial, Coking Plants, and Electric Utilities) and Coal Exports. By definition, domestic coal production plus coal imports and net storage withdrawals, equals domestic coal consumption and exports.

EIA forecast total U.S. coal consumption (including exports) to increase from 978 million tons in 1988 to a total of 1,169 million tons by the year 2000, an average annual growth of 1.5 percent. By the year 2010, EIA forecasts total consumption of 1,555 million tons, a 2.9 percent average annual increase over the 2000-2010 period.

The electric utility sector will remain the dominant coal-consuming sector and will also account for the greatest share of the tonnage increases. From a 1988 level of 758 million tons, electric utilities are forecasted to increase consumption to 904 million tons by the year 2000 and to 1,182 million tons by the year 2010. The rate of increase is faster after the year 2000 primarily because EIA forecasts very few additions to coal-fired generating capacity before the year 2000, but substantial additions thereafter.

Coal exports are forecasted to grow substantially over the forecast period, particularly after the year 2000. From a 1988 level of 95 million tons (steam and metallurgical coals), U.S. exports are forecasted to rise to 136 million tons by the year 2000, reaching 234 million tons by the year 2010.

Steam coal use by the industrial sector is forecasted to increase at an average 1.3 percent annual rate. From a 1988 level of 76 million tons, EIA forecasts consumption of 84 million tons in the year 2000, rising to 101 million tons by the year 2010. At this rate of increase, coal's share of the industrial energy mix will remain essentially unchanged.

Metallurgical quality coals are used in the steel industry to make coke for use in blast furnaces. With the decline of the steel industry since the early 1970s, the domestic consumption of coking coal has fallen sharply, reaching 42 million tons in 1988. While further significant declines in the tonnage of steel production are not expected, there are expected to be continuing improvements in the efficiency of coke ovens and blast furnaces, as well as greater penetration of electric furnaces and continuous casting methods. As a result, EIA forecasts coking coal consumption to decline slightly to 39 million tons by the year 2000, falling further to 33 million tons by the year 2010.

The residential/commercial use of coal has been in long-term decline, and this trend is expected to continue. From a 1988 consumption of only seven million tons, EIA forecasts a decline to four million tons by the year 2010.

FORECASTED COAL DEMAND IN THE ELECTRIC UTILITY SECTOR

Just as electric utilities will remain the major market for coal, coal will remain the major fuel for the electric utilities. In 1988, coal accounted for 55.1 percent of electric utility fuel consumption (including nuclear, hydro, and other non-fossil sources). EIA forecasts this to decline slightly to 49.6 percent in the year 2000, but then to increase to 57.8 percent by the year 2010.

Future use of coal by electric utilities will be driven by the amount of coal-fired capacity and the extent to which that capacity is used. For most of the 1980s, the electric utilities have had excess generating capacity as a result of slower-than-expected load growth failing to keep up with powerplant construction plans. Now, few capacity additions are being made, with the result that increasing electricity demands are gradually working off the excess capacity.

During most of the 1990s, EIA forecasts relatively few additions to coal-fired capacity, with a total increase of only 4.4 percent over the 1988-2000 period. However, EIA also forecast an 18.9 percent increase in coal-fired generation, indicating that much of the increase in electricity demands will be met through higher utilization of existing coal-fired capacity.

EIA forecasts few additions of generating capacity to come on-line over the next several years, but that substantial capacity additions will be made beginning in the late 1990s and beyond. Between 1988 and 2010, EIA forecasts an additional 159 gigawatts of capacity to come on-line, with a net increase of 99 gigawatts of coal-fired capacity.

This additional coal-fired capacity leads to a substantial increase in coal-fired generation in the post-2000 period. Between 2000-2010, coal-fired generation increases at an average annual rate of 2.7 percent, producing an additional 543 billion kilowatt-hours. This increase is actually greater than the total increase generation by electric utilities, reflecting generation decreases by gas, oil, nuclear, and other sources.

Generation by non-utility sources is forecasted to increase at a rapid rate. EIA forecasts increases in non-utility generation both for the generator's own use as well as for sales to electric utilities. Sales to utilities, in 1988 about 3.2 percent of the utilities' own generation, if forecasted to increase to 9.3 percent by the year 2010. Coal comprises only about one-fifth of this non-utility generation, with natural gas and biomass accounting for larger shares of the fuel mix.

POLICY DISCUSSION
(forthcoming)

To Nigel
11/28/89

EXECUTIVE SUMMARY

In the past, coal has played a major role in U.S. energy markets. Coal fueled the railroads, heated the homes, powered the factories, and provided the raw materials for steelmaking. In 1920, coal supplied over three times the amount of energy of oil, gas, and hydro combined (Figure 1). From 1920 until the mid 1970's, coal production remained fairly constan. at 400 to 600 million short tons a year. Increases in energy demands, which began during and after World War II, were mostly met by oil and gas. By the mid 1940's, coal represented only half of total energy consumption in the U.S. In fact, post-war coal production, which had risen in support of the war effort and the postwar Marshall plan, decreased approximately 25 percent between 1945 and 1960.

Up until the early 1970s, the electric utility sector offered the only significant growth in the use of coal. However, this of increased use of coal to meet rapidly growing demand for electricity was offset by coal's losses to oil and gas in other markets.

The oil price shocks of the 1970s, combined with natural gas shortages and problems with nuclear power, returned coal to a position of prominence. The greatly expanded use of coal was seen as a key building block in U.S. energy strategies of the 1970s.

Coal continues to play a major role in the U.S. energy markets. Coal production increased steadily from around 600 million short tons per year in 1970 to 997 million short tons in 1988, up over 50 percent. Production and use of coal in the U.S. now stand at all-time levels. This has enabled coal to maintain its market share of approximately 20 to 25 percent of total U.S. energy consumption, a position it has held since the early 1960's (Figure 2).

Coal is mostly used in the generation of electricity, although industrial plants, coke ovens, and export destinations also consume large quantities. In 1988, 77 percent of coal production was consumed by electric utilities, 8 percent by industrial plants, 4 percent went into coke production, and 10 percent was exported. The remaining 1 percent went into residential and commercial markets.

Concurrent with the rise in coal production in the 1970's was the passage of a number of new laws and regulations involving mine health and safety, and environmental issues. The Federal Coal Mine Health and Safety Act of 1969 imposed new safety regulations in underground mines, greatly reducing the dangers of explosions and cave-ins. The Federal Black Lung Benefits Act of 1977 and its amendments provided disability compensation for miners afflicted with Black Lung, a progressive respiratory disease resulting from the inhalation of coal dust.

A number of laws were also passed during the 1970's to mitigate the environmental impacts of coal mining and use. The Surface Mining Control and Reclamation Act of 1977 required surface mines to adhere to specific environmental standards and underground mines to take measures in control land subsidence. The Resource Conservation and Recovery Act of 1976 regulated the disposal of solid wastes at both the mine site and at coal-fired power plants. The Federal Water Pollution Control Act of 1972, later incorporated into the Clean Water Act of 1977

and its amendments, contained guidelines for maintaining water quality control, especially as it pertained to acid water drainage problems, during coal mining and preparation.

Air pollution concerns caused by the burning of coal were addressed in the Clean Air Act of 1970 and its amendments which established New Source Performance Standards. These standards set allowable emission levels for sulfur dioxide, nitrogen oxides, and particulates. Electric utilities and other industrial coal-fired boilers built before 1971 are subject to emission controls set by the States and approved by the Environmental Protection Agency. Those constructed after 1971 must meet the Federal New Source Performance Standards. These standards were tightened in 1978 for electric utilities and in 1987(?) for industrial boilers.

The net effect of these laws is that coal is now much safer and cleaner to mine and to use. In 1987, there were 63 mining fatalities, the lowest number in this century. Accidents, when measured according to hours worked or tons of coal mined have steadily decreased since the enactment of the Federal Coal Mine Health and Safety Act of 1969 (Figure 3). Compliance with the Resource Conservation and Recovery Act of 1976 and the Clean Water Act of 1977 (and its predecessor, the Federal Water Pollution Control Act of 1972) has greatly reduced acid drainage, which can render water unfit for use and sometimes toxic. Since the passage of the Clean Air Act, total emissions of sulfur dioxide have declined. Between 1970 and 1987, emissions from coal-fired power plants declined by 10 percent despite a 50 percent increase in coal consumption. Particulates have decreased 6-fold. Nitrogen oxides have decreased over 8 percent on a pounds per Btu basis.

Recently, new environmental concerns about acid rain and greenhouse gasses caused by emissions during coal mining and use have arisen. The Administration proposed amendments to the Clean Air Act, introduced in the 101st Congress, seeks to further reduce emission levels of sulfur dioxide and nitrogen oxides, the two principal contributors to acid rain. Three global warming bills have been introduced, one in the House and two in the Senate. These were all introduced in the 100th Congress (1988) and are aimed at cutting CO_2 by 20 percent or more by the early 2000's. Although passage of acid rain and/or greenhouse gas legislation could initially affect the coal industry by increasing the costs of coal use and shifting regional production and demands, the industry has historically shown the capability to adjust to the changes; as exemplified by the growth in coal use during the 1970's and 1980's despite the enactment of the previously discussed legislation.

Coal has several intrinsic strengths. It is the largest domestic energy resource with recoverable reserves estimated at nearly 300 billion short tons or 6,402 quads Btu equivalent. As a consequence it represents a secure energy source and the potential for decreasing U.S. dependance on foreign fuel sources. In addition, it is relatively inexpensive to mine and on a per Btu basis much less costly to produce than other energy sources. Its chief drawbacks are the environmental, health, and safety risks involved in its production and consumption. Mitigation of these concerns must strike a balance between keeping coal cost-competitive while making it more safe to produce, and environmentally acceptable. These considerations extend across production, transportation and utilization.

Improvements in mining techniques, transportation methods and utilization have improved the outlook for coal in the past and will continue to do so in the future. Increasing mechanization of underground coal mining has increased the efficiency and productivity of coal mining, thereby

helping coal to remain cost-competitive. Productivity, or the number of tons a miner produces per day, rose moderately during the first half of the century (Figure 4). Then during the 1950's and 1960's dramatic increases in productivity were seen as first continuous mining systems and then longwalls were introduced. Roof-bolting also allowed for the safer development of larger scale underground mines. This period also saw increased production from surface mines which in general are more productive and less labor intensive. During the 1970's, coal mine productivity dipped as the industry adjusted to the various laws and regulations enacted due to health, safety, and environmental concerns. However, since 1980, productivity has increased dramatically, especially in underground mines. Additional technological improvements, as well as increased labor productivity, should maintain or improve coal's competitiveness in the energy markets of the future.

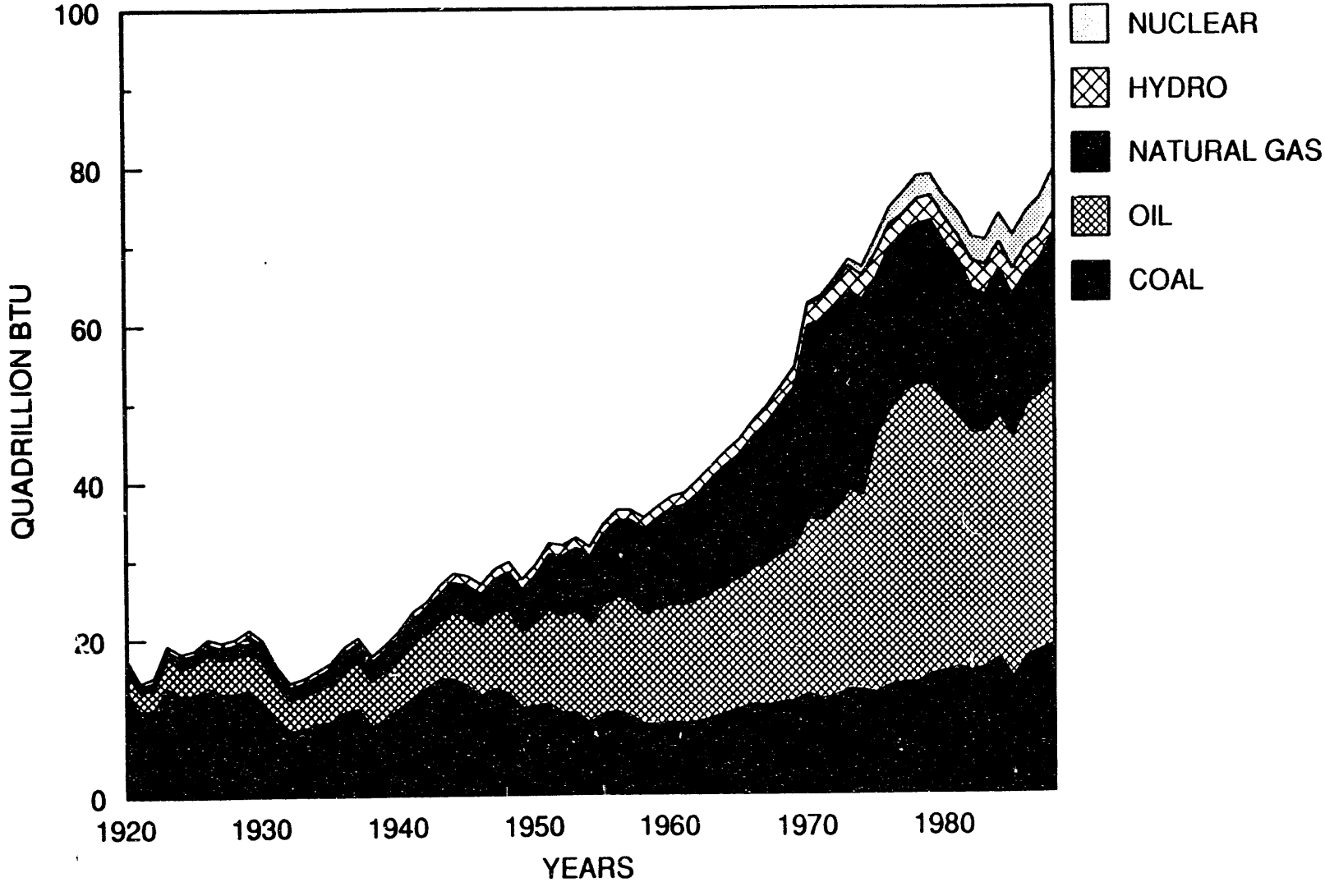
Transportation costs are a more significant component of the delivered price of coal relative to otherfuel sources. Historically, the bulk of coal transportation has been by railroad. Although, its share of the market has slipped recently, railroads remain the foundation of the coal distribution system. In 1988, railroad originated 57.5% of coal delivered domestically and an even higher percentage of exported coal. Most of the remaining shipments were about evenly divided between inland water shipment (river barges and Great Lakes movements), trucks, and tramways and conveyors. Railroads, though, are the principal means by which large volumes of coal are shipped to electric utilities, the major consumer of coal.

Several developments in the last 10 to 15 years have eased transportation costs for coal users, especially the passage of the Staggers Rail Act of 1980, the development of the unit train concept, and measures taken by railroads to increase productivity. The Staggers Rail Act of 1980 partially deregulated the industry, placing reliance on the marketplace to set most rates and to encourage efficient operations. Since passage of the Act, rail rates have fallen significantly in inflation-adjusted dollars. The unit train concept uses dedicated equipment, operates on a predetermined schedule, and hauls coal form one source to one destination on a continuous basis. The commencement of unit train movements significantly reduced the per ton transportation costs for electric utilities, the major consumer of coal. Railroad productivity has been enhanced in recent years by the reduction to three-man crews, the use of aluminum and larger capacity cars, and the use of both dedicated (coal only) and unit train movements. Further improvements in rail transportation, increased intermodal competition especially from trucks and barges, and developing transport technologies such as slurry pipelines collectively should provide enough inducement for the maintenance of balanced transportation costs and options.

Finally, developing and new technologies for coal utilization could potentially expand the demand for coal in the future. Technologies that make coal a cleaner burning fuel and a greater source of chemicals should be encouraged. In fact, many of the organic chemicals today produced from petroleum were originally products of the coke-making process. The technologies being investigative include more effective pre-combustion coal-cleaning processes, such as methods for keeping sulfur and nitrogen pollutants inside the furnace, and designing scrubber systems capable of removing pollutants without producing wet sludges, which create a disposal problem. Others include coal gasification, coal liquefaction, solvent refined coal processes, underground coal gasification, coalbed methane production, coal and oil/water mixtures, fluidized-bed combustion, formcoke to replace coke in the iron-making process, magnetohydrodynamic systems for generating electricity, and advanced coal preparation methods that could remove up to 90 percent of sulfur and ash.

FIGURE 1

U.S. ENERGY CONSUMPTION



SOURCES: 1920-1974 Bureau of Mines

1975-1988 Energy Information Administration, Dept. of Energy

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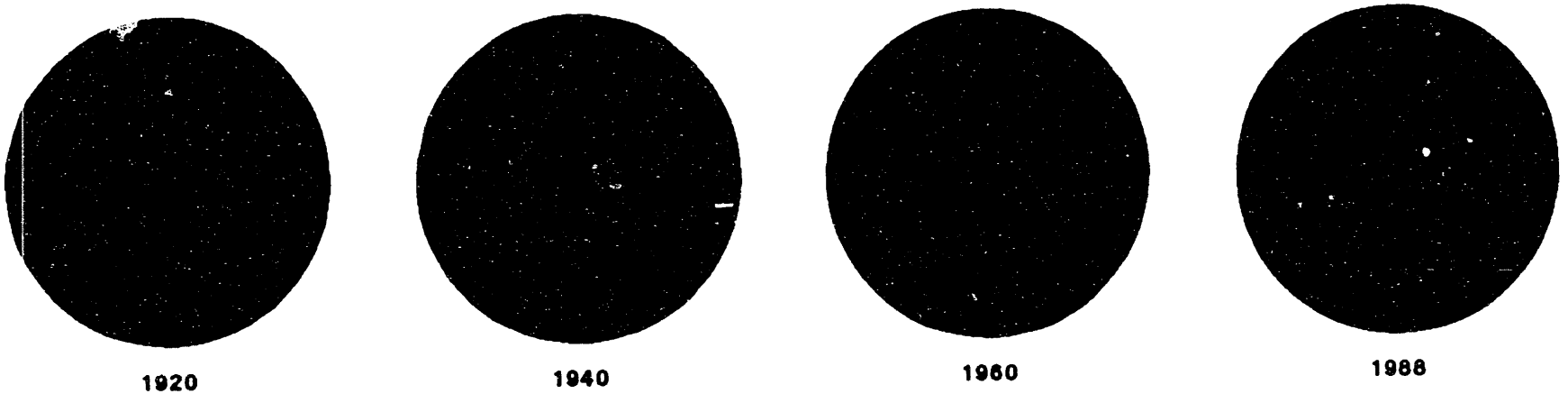
FIGURE 2

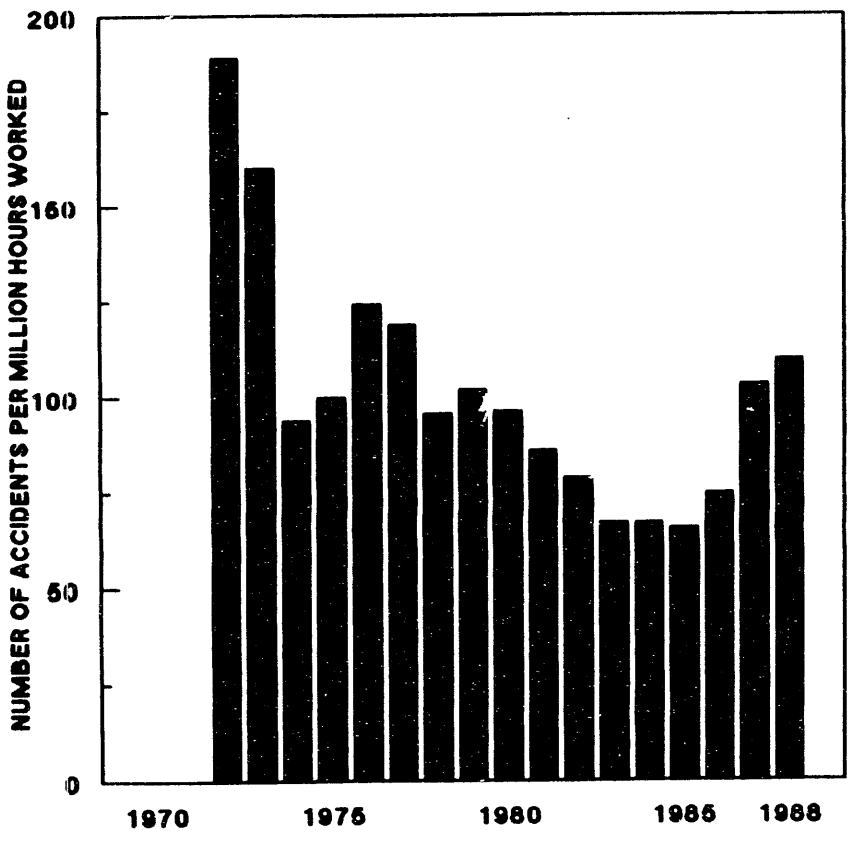
COAL'S SHARE OF TOTAL U.S. ENERGY CONSUMPTION

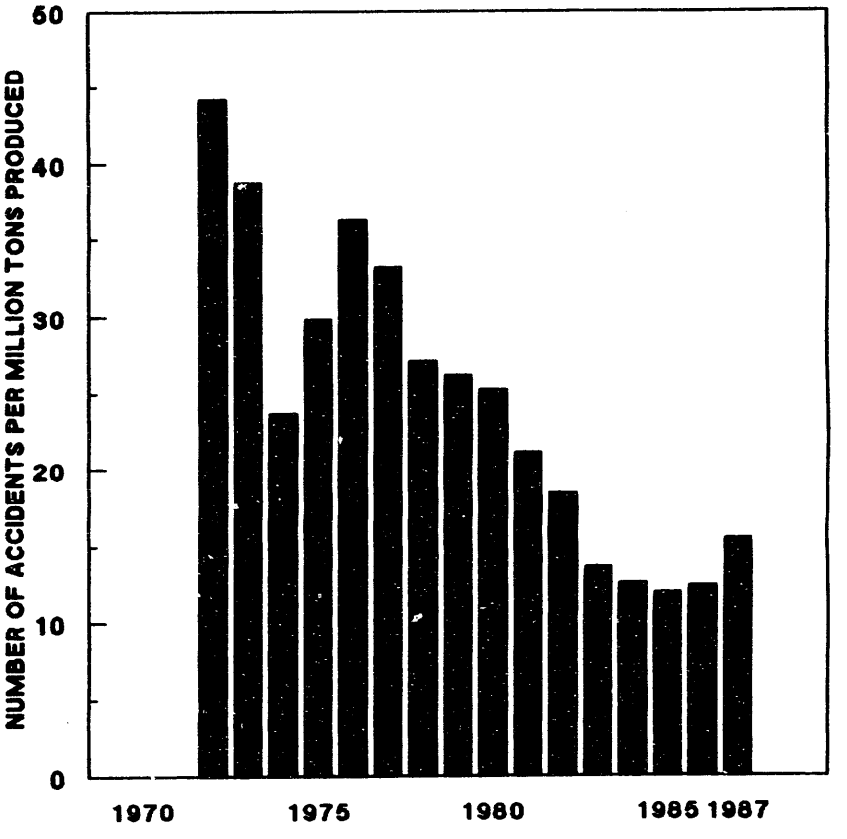
(quadrillion Btu equivalents)



SOURCES: 1920-1960 U.S. Bureau of Mines
1988 Energy Information Administration

FIGURE 3
COAL MINING RELATED ACCIDENTS
COMPARED TO NUMBER OF HOURS WORKED AND TONS OF COAL PRODUCED

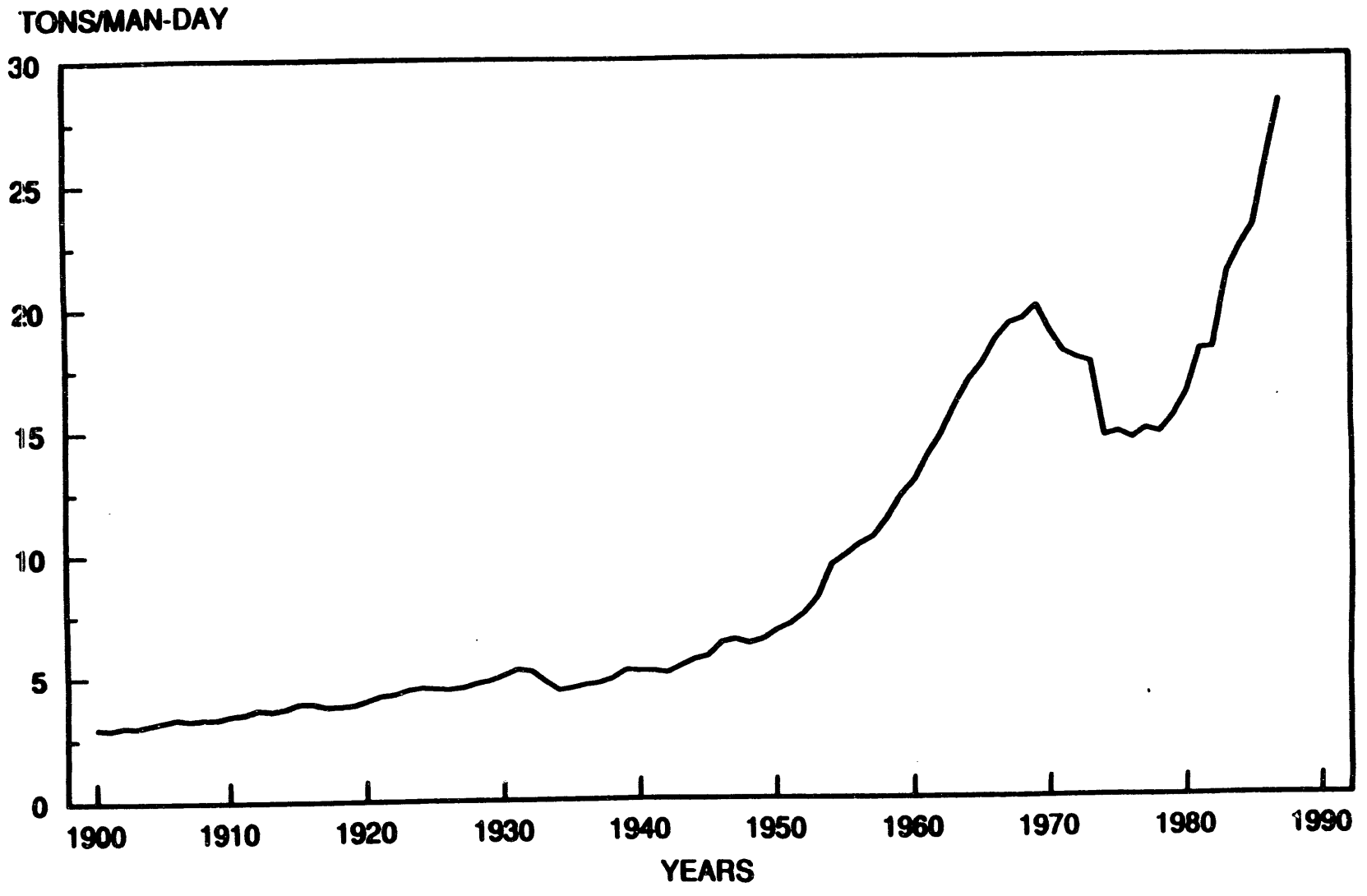




SOURCE: Mining Safety and Health Administration

FIGURE 4

HISTORICAL COAL MINING PRODUCTIVITY



SOURCES: US DOE/EIA Coal Data: A Reference 1989

HISPROD8 WK1

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July 2, 1990

MEMORANDUM

TO: John Pyrdol, DOE/FE

FROM: Daniel E. Klein
Katherine C. Manger

SUBJECT: Files for "Coal Sector Profile"

Enclosed are two floppy disks, each containing the PC files used in the June 5, 1990 report entitled "Coal Sector Profile".

Each disks contains several files, including the main document file. The main document was prepared using WordPerfect 5.1, and is identified by the file name 06W00582. Several other files on the disk represent tables and graphs that were prepared using separate software packages, where the printed version was taped to the master WordPerfect printout. Additionally, some of the figures represent graphics that were not made using PCs.

The table on the following page indicates the section of the report, the page(s) where located, the associated filename on the enclosed disks, and the PC software used in preparation.

Please call me if you have any questions.

IDENTIFICATION OF FILES USED IN "COAL SECTOR PROFILE"

Section	Page(s)	File Name	PC Software Used
Main Text	i - 84	06W00582	WordPerfect 5.1
Table 1	2	06W00582	WordPerfect 5.1
Figure 1	3	Figure1.drw	FL3
Figure 2	4	Figure2.drw	FL3
Figure 3	6	Figure3.drw	FL3
Table 2	7	06W00582	WordPerfect 5.1
Table 3	9	06W00582	WordPerfect 5.1
Figure 4	11	Figure4.drw	FL3
Figure 5	12	Figure5.drw	FL2
Figure 6	13	Figure6.drw	FL3
Figure 7	15	Figure7.drw	FL3
Figure 8	16	Figure8.drw	FL3
Figure 9	18	Figure9.drw	FL2
Figure 10	19	F9d0381a.drw	FL3
Table 4	20	06W00582	WordPerfect 5.1
Table 5	22	06W00582	WordPerfect 5.1
Figure 11	23	--	not a computer graphic
Table 6	24	06W00582	WordPerfect 5.1
Figure 12	26	Figure12.drw	FL3
Table 7	27	06W00582	WordPerfect 5.1
Table 8	28	06W00582	WordPerfect 5.1
Figure 13	30	Figure13.drw	FL3
Figure 14	31	Figure14.drw	FL2
Figure 15	32	Figure15.drw	FL3
Figure 16	33	Figure16.drw	FL3
Figure 17	34	Figure17.drw	FL3
Figure 18	35	Figure18.drw	FL3
Figure 19	36	Figure19.drw	FL3
Figure 20	38	Figure20.drw	FL3
Table 9	39	06W00582	WordPerfect 5.1
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Figure 22	42	Figure22.drw	FL3
Figure 23	44	F9d038-2.drw	FL3
Figure 24	46	Figure24.drw	FL3
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Figure 25	49	Figure25.drw	FL3
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Figure 27	53	--	not a computer graphic
Figure 28	54	Figure28.drw	FL3
Figure 29	59	--	not a computer graphic
Figure 30	60	--	not a computer graphic
Figure 31	62	--	not a computer graphic
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Table 13	83	06W00582	WordPerfect 5.1

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