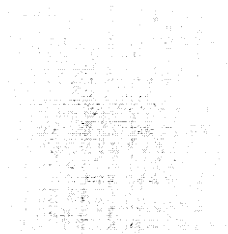
CHAPTER 1

Executive Summary



Contents

List of Tables

List of Figures

CHAPTER 1

Executive Summary

Overview

As of late **1980,** there were 565 Federal coal leases* in existence in 14 States covering 812,000 acres and containing 16.5 billion tons of recoverable reserves. This study examines the development potential and production prospects for the 548 Federal coal leases in the seven States of Wyoming, Montana, Colorado, Utah, New Mexico, North Dakota, and Oklahoma, with principal emphasis on the 502 leases in the first six States listed above: the six major Western Federal coal States. These six States contain over 98 percent of leased Federal reserves and account for over 99 percent of Federal coal production. The 17 small leases in Alabama, Alaska, California, Kentucky, Oregon, Pennsylvania, and Washington, with 0.5 percent of leased Federal coal reserves and 0.2 percent of Federal coal production, were not examined in this study. Furthermore, the development potential and production prospects of currently unleased Federal coal were not examined in this study. Therefore, the findings of this study on potential Federal coal production and its relation to likely markets for Federal coal refer only to currently leased Federal coal in the seven States of Colorado, Montana, New Mexico, North Dakota, Oklahoma, Utah, and Wyoming.

A Federal coal lease may be conveniently classified by its mine plan status: in an approved mine plan, or in a mine plan submitted to and pending approval by the U.S. Department of the Interior (DOI), or with no mine plan. The 565 Federal coal leases are grouped as follows:

1. There are 198 leases in approved mine plans covering nearly 280,000 acres, and containing 7.4 billion tons of recoverable reserves.

   Of these 198 leases, 182 are located in the six major Western Federal coal States listed above. The 182 leases are included in 69 approved mine plans. Of these 69 Federal mines, 64 produced coal in 1979; the remaining 5 are scheduled to begin production within a few years.

   Total coal production from these 64 Federal mines in 1979 was 138 million tons. The Federal portion of this production was 60 million tons, up from 7.3 million tons in 1970.** In 1979, Federal production in the six States of Wyoming, Montana, Colorado, Utah, New Mexico, and North Dakota accounted for 7.7 percent of the total U.S. coal production of 776 million tons, In 1980, Federal coal production in these six States grew to 69 million tons, or 8.4 percent of the total U.S. coal production of 820 million tons.
2. There are 118 leases in 32 pending mine plans covering nearly 195,000 acres and containing 2,5 billion tons of recoverable reserves.
3. There are 249 leases not in mine plans covering nearly 338,000 acres and containing 6.6 billion tons of recoverable reserves. (These leases are called undeveloped leases in this report.) However, many of these leases are in the process of being developed and could be in production within the decade.

*The leases sold in early 1981 under the new Federal coal management program are not included in this total and were not considered in this study.

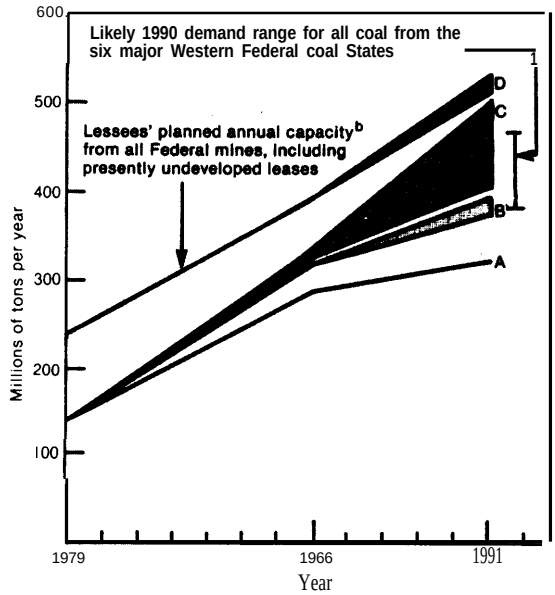
**Coal from Federal coal leases is referred to as Federal coal. A mine that includes a Federal lease is called a Federal mine. Sometimes, for the sake of efficiency of recovery or economy of operations, intervening State or private coal is mined with Federal lease(s) in the same mine. This practice is the rule in southern Wyoming and North Dakota, for example. Thus, many Federal mines produce both Federal and non-Federal coal. A mine that contains no Federal coal is called a non-Federal mine. Total coal production in a State or region is thus the sum of: 1) Federal coal production from Federal mines plus 2] non-Federal coal production from Federal mines plus 3) non-Federal coal product ion from non-Federal mines.

Approximately 5 percent of currently leased Federal reserves appear undevelopable because of poor property characteristics, remote location, or environmental prohibition. Considerable uncertainty surrounds the likelihood of the development of another 15 to 20 percent of leased Federal reserves (some of them in the pending mine plan category) because of factors such as construction of transportation systems, synfuels development, pace of associated powerplant construction, availability of additional Federal reserves, and lessee development priorities. Delays in development and production caused by these factors and by market uncertainties might result in leases containing over 7 billion tons of reserves, or 43 percent of all currently leased reserves, to fail to meet diligent development requirements by 1991; leases containing over 3.5 billion tons of recoverable coal are unlikely to meet diligence by 1991; leases containing approximately 3.4 billion tons of recoverable reserves have uncertainties surrounding attainment of diligence by 1991.

The following estimates of potential production from Federal leases are not forecasts of the coal that will be produced at a given price or a given demand. They are estimates of the total amount of coal that could be produced from operating Federal mines and from those Federal leases that have characteristics comparable to operating mines in the same region. Coal from these leases would thus be likely to have mining costs competitive with costs at currently operating mines in the same area. If the demand for Federal coal does not increase to these levels of potential production, then not all the Federal leases that could technically and economically be developed will go into production.

Production from existing Federal coal leases is likely to increase substantially over the next 10 years. Planned production capacity for 1986 for Federal mines is 400 million tons per year; for 1991, over 535 million tons per year (see fig. 1). OTA estimates that production from Federal mines could range between 410 million and 500 million tons per year in 1991 depending on markets, synfuels development, and rail construction. Actual production in 1991 could fall below this range, however, because of competition with non-Federal mines and new Federal coal leases in the West and from other coal-pro-

Figure 1.— Potential Production From and Planned 'Capacity of Federal Mines Summed Over the Six Major Federal Coal States[a]



Potential annual production, [b]

A: Lessees' planned annual production from Federal mines in currently approved mine plans only

B: Lessees' planned annual production from Federal mines in currently approved and pending mine plans

C: The sum of B, above, **plus estimates** of **potential** production from presently undeveloped Federal leases

[a] Wyoming, Montana. Colorado, Utah. New Mexico and North Dakota

[b] **Planned capacity for a given year is the upper** limit to potential production in **that year (although an even higher total capacity might be attainable in a very** strong market for coal) In many cases (e.g., currently approved mines m the Powder River Basin in 1991), the lessees' production plans call for them to produce at or **near capacity. In other cases, even optimistic production plans fall short of using planned capacity to the full. Some mines, particularly newer mines in the Southern Rockies will not attain their planned maximum capacity until the 1990's. In all cases, however, the capacities planned for 1986 or 1991 were used in deriving fig. 1, above, not the higher numbers for planned maximum capacities in the post 1991 period For most Federal mines in the Southern Rockies, the planned productions for 1986 and 1991 are close to the planned capacities for those years**

Explanation of ranges

C: 92 million tons per year range in 1991
65 mty = Dominant uncertainty is the development of markets for the coal
22 mty = Dominant uncertainty is the construction of two railroads, one to the Kaiparowits Plateau in Utah (14 mty) and one to the Star Lake. Bisti area of New Mexico (8 mty)
5 mty = Dominant uncertainty is the schedule of synfuels development
D 22 million ton per year range in 1991
Dominant uncertainty is the construction of the two railroads mentioned above, under C

SOURCE Office of Technology Assessment

ducing regions of the country and because overall demand for coal may not grow sufficiently during the next decade to support this level of production from Federal mines.

During the 1990's, demand for coal in general and Western and Federal coal in particular may grow rapidly, particularly if coal-based synfuels and exports of Western coal to foreign countries become important.

The Powder River basin of Wyoming and Montana was the source of about 50 percent of coal produced from Federal mines in 1979 (71.7 million tons) and contains 56 percent of recoverable Federal coal reserves under lease (9.2 billion tons). In 1979, there was more than 75 million tons of overcapacity in Federal mines in the Powder River basin. The Powder River basin can increase production substantially by 1990. For 1990, 186 million tons of Powder River basin coal have already been contracted: 159 million tons from currently operating Federal mines, 17 million tons from undeveloped Federal leases, and 10 million tons from currently operating non-Federal mines. Planned capacity for 1990 for all coal properties in the Powder River basin likely to be in production by that year is approximately 350 million tons per year. The likely demand range for Powder River basin coal for 1990 falls substantially below this planned mine capacity.

The States of Colorado, New Mexico, and Utah contain 360 Federal coal leases, about a third of which (113 leases) are in active mines, The five major coal-producing regions in these three States have a wide range of coal quality and mining conditions, The area contains both large and small active surface and underground mines.

In 1979, mines with Federal leases in Colorado, New Mexico, and Utah produced 35 million tons of coal, Little overcapacity in coal production existed in these three States in 1979, New mine plan proposals have been submitted for another 108 Federal leases and 96 out of the 139 leases that are not in mine plans might be developed over the next decade. By 1991, Federal mines in these three States could sustain 110 million to 146 million tons per year of production, 65 million tons per year from currently operating Federal mines, 28 million to 49 million tons per year from new Federal mines with plans are pending approval and 17 million to 32 million tons per year from presently undeveloped leases. These estimates are subject to two principal uncertainties: 1) whether demand for coal from this region will increase as generally expected; and 2) whether proposed coal transportation systems will be constructed to connect currently inactive coal mining areas in southwestern Utah and the San Juan basin of New Mexico with potential markets. At present, only the proposed Star Lake Railroad in the San Juan basin is nearing approval. However, the above numbers suggest that there will be little overcapacity in coal production in this three-State region over the next decade.

The potential for continued overcapacity in the Powder River basin over the next 10 years has caused questions to be raised about the timing, extent, and location of large-scale leasing under the new Federal coal management program. The debate focuses on the role of competition and the free market in resource supply, the potential costs to the social and physical environments of the coal-producing areas of "overleaping," the length of time needed to bring a new lease into full scale production, the margin of supply safety needed for prudent planning on a national and a corporate level, questions of equity raised by restricted opportunities for new entrants to Federal leaseholding, a fair return to the public for the use of its resources, and the levels of demand likely in the early to mid-1990's. Many proponents of large-scale new leasing in the Powder River basin in the near future cite the long moratorium on such leasing and its effect of restricting entry possibilities to leaseholding as one reason for prompt resumption. They also contend that postponing leasing will unduly interfere with the workings of the free market and will restrict competitition. They anticipate high demand for coal by 1995 and fear that the present leased reserve base in the Powder River

basin will not provide enough certainty or flexibility to meet that demand efficiently. Opponents of large-scale new leasing in the Powder River basin as scheduled in 1982 cite the potential for overcapacity through the early 1990's as proof that such leasing is not necessary at this time. They contend that leasing can be safely deferred until its necessity is clearly indicated by realistic demand forecasts. They hold that large-scale leasing substantially beyond that necessary to meet likely demand in 1990 will place an unnecessary strain on orderly planning in the communities of the region, shift demand to the Powder River basin that could have been met by Midwestern supply, depress the value of leases so that the public will not receive a fair return for its resources, and, moreover, be unlikely to increase competition significantly.

Minability of Federal coal reserves in the West is affected by administrative and regulatory decisions in several aspects of environmental concern. These areas of concern include air quality, water resources, alluvial valley floors, return to approximate original contour, and wildlife resources. The effect of environmental regulations on the production of Federal coal has been to remove small amounts of minable coal from the recoverable reserve base, to delay development of other recoverable reserves, to increase the complexity of the mine permit process, and to increase the overall cost of mining.

The percentage of recoverable Federal reserves currently under lease on which mining could be prohibited or delayed over the next 10 years because of environmental regulations is between 5 percent and 10 percent of the total currently leased reserves, Less than 1 percent of currently leased Federal reserves appear likely to be subject to complete prohibition from mining; the remainder of currently leased Federal reserves that may be affected may be subject to delay in mining because of unresolved environmental questions, but the available evidence indicates that most of these reserves will be mined. There are additional leased reserves (mainly in the Kaiparowits Plateau in southern Utah) over which there are potential environmental conflicts, but impediments to development of these reserves are primarily related to nonenvironmental factors such as transportation availability y.

Status of Federal Coal Leases

In terms of tonnage, a little over one-half of the U.S. recoverable coal reserves lies west of the Mississippi River; in terms of heat content, a little less than one-half lies west of the Mississippi River. According to the best available data, the Federal Government owns between 50 and 60 percent of the coal reserves in the six major Federal coal States;* the percentage varies considerably among coal regions.

Since 1920, DOI has leased rights to mine Federal coal to the private sector. During the past 60 years, over **16** billion tons of coal on 812,000 acres have been leased and remain in currently existing leases. Less than 20 percent of the total coal reserves owned by the Federal Government are presently under lease.

A lease is necessary to mine Federal coal. The lease grants the lessee exclusive rights to mine coal subject to stipulations in the lease established by DOI and subject to Federal and State laws. Historically, most leases have been issued in two ways: 1) competitively through bidding at lease sales, and 2) noncompetitively through an application process called preference right leasing. **About half of all existing leases have been issued by

*The six major Federal coal States are Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming.

**About 6 percent of existing leases have been created in a third way, segregation or partial assignment, whereby a lease tract is split into two or more units. A new lease(s) is issued for the new unit(s) and the acreage of the original lease is correspondingly reduced.

each method, but the Federal Coal Leasing Amendments Act of 1976 abolished the preference right system and required competitive leasing of all Federal coal. As of January 1, 1980, 176 preference right lease applications (PRLAs) covering nearly 404,000 acres and containing 5.8 billion tons of recoverable reserves were in existence, All these applications are scheduled to be processed by DOI by 1984,

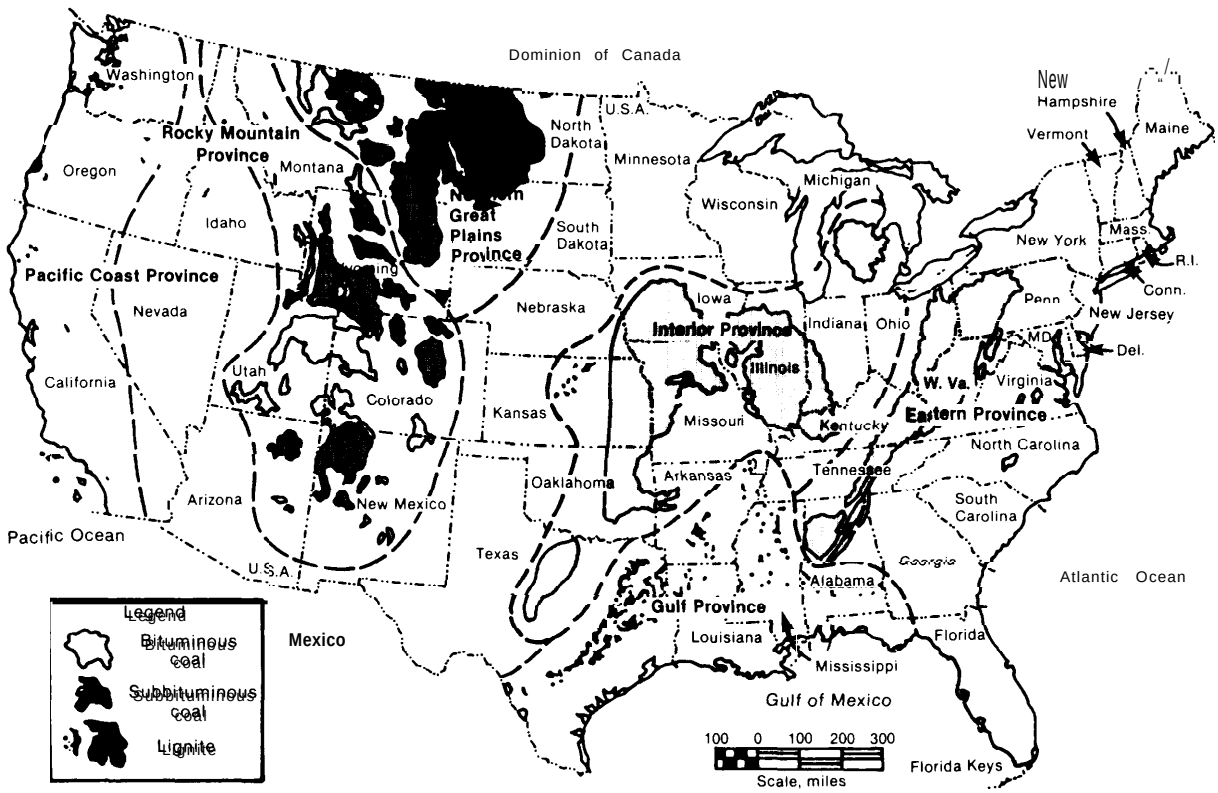
DOI began issuing leases under the new coal management program in January 1981, after a lo-year moratorium on all but leasing for special purposes. * Given the 5- to 12-year leadtime required to develop a coal mine, production from presently unleased land will be relatively small during most of the 1980's.

*Those leases issued under the new Federal coal managemen t program are not included in this report.

Federal Coal Resources and Production

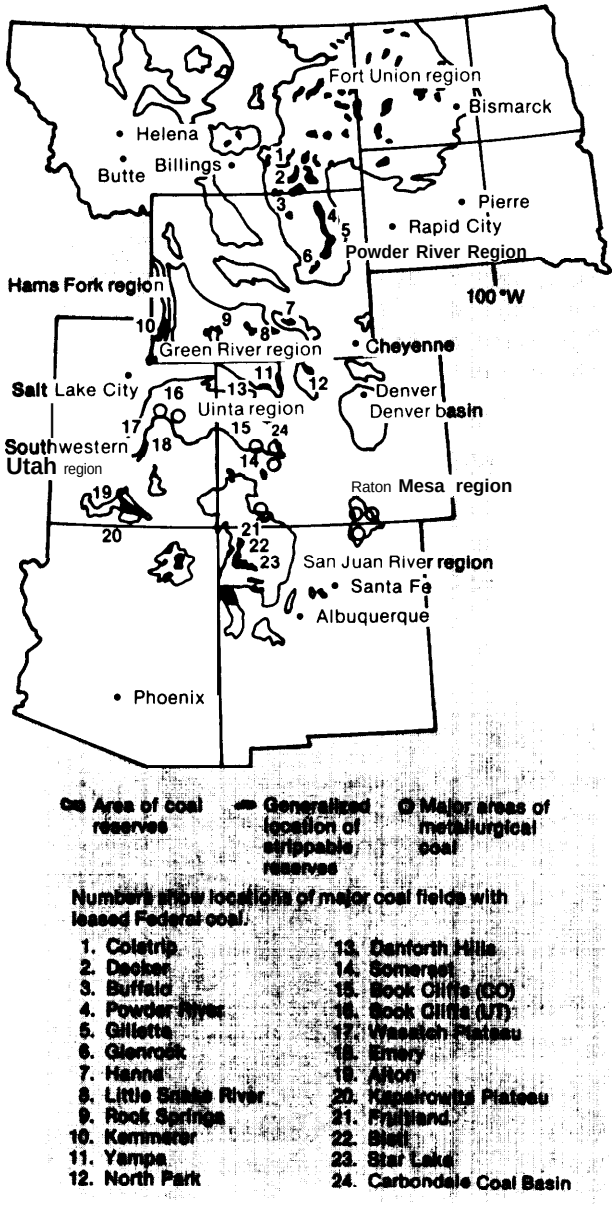
The Federal Government owns coal resources in all the major coal regions of the United States. However, the vast majority of Federal coal is located in two coal regions in the Northern Great Plains coal province and seven regions in the Rocky Mountain coal province. Federal leases in these two provinces include over 98 percent of the 16.5 billion tons of recoverable coal currently under lease. Three-quarters of the Federal coal reserves on leases outside of the Northern Great Plains and Rocky Mountain coal provinces are contained in 46 leases in Oklahoma, which is geologically part of the Interior coal province, The remaining reserves (0.5 percent of the total under lease) are in 17 leases in the States of Alaska, Alabama, California, Kentucky, Oregon, Pennsylvania, and Washington (see figs. 2 and 3).

Figure 2.—Generalized Coal Provinces of the United States



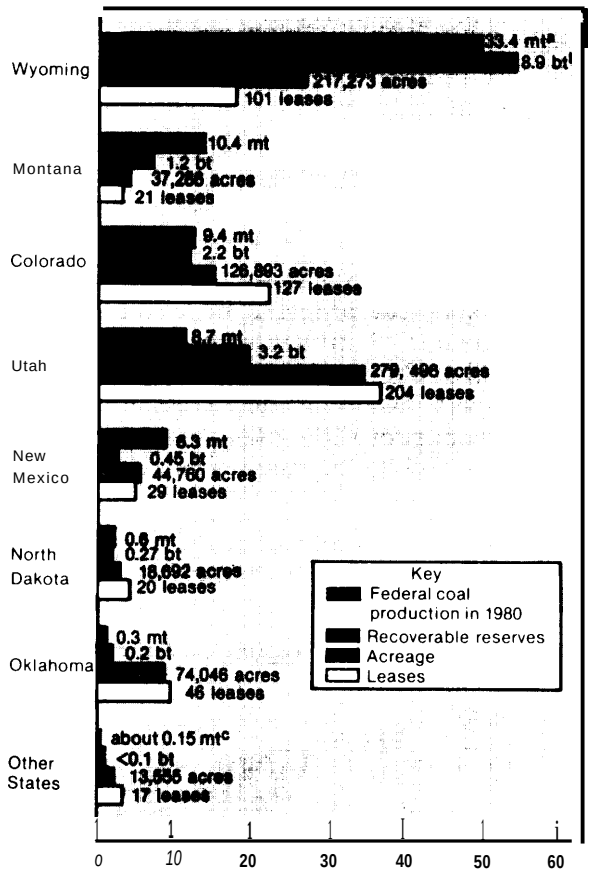
SOURCE: U S Bureau of Mines, adapted from USGS Coal Map of the United States, 1960

Figure 3.—Sketch Map Showing Major Coal Regions With Leased Federal Coal, and Generalized Location of Strippable and Metallurgical Coal Deposits



SOURCE Base Map National Academy of Sciences, *Rehabilitation Potential of Western Coal Lands,* Cambridge, Mass, Ballinger Press, 1974)

Figure 4.— Distribution of Production, Reserves. Acres, and Number of Leases by State ‘



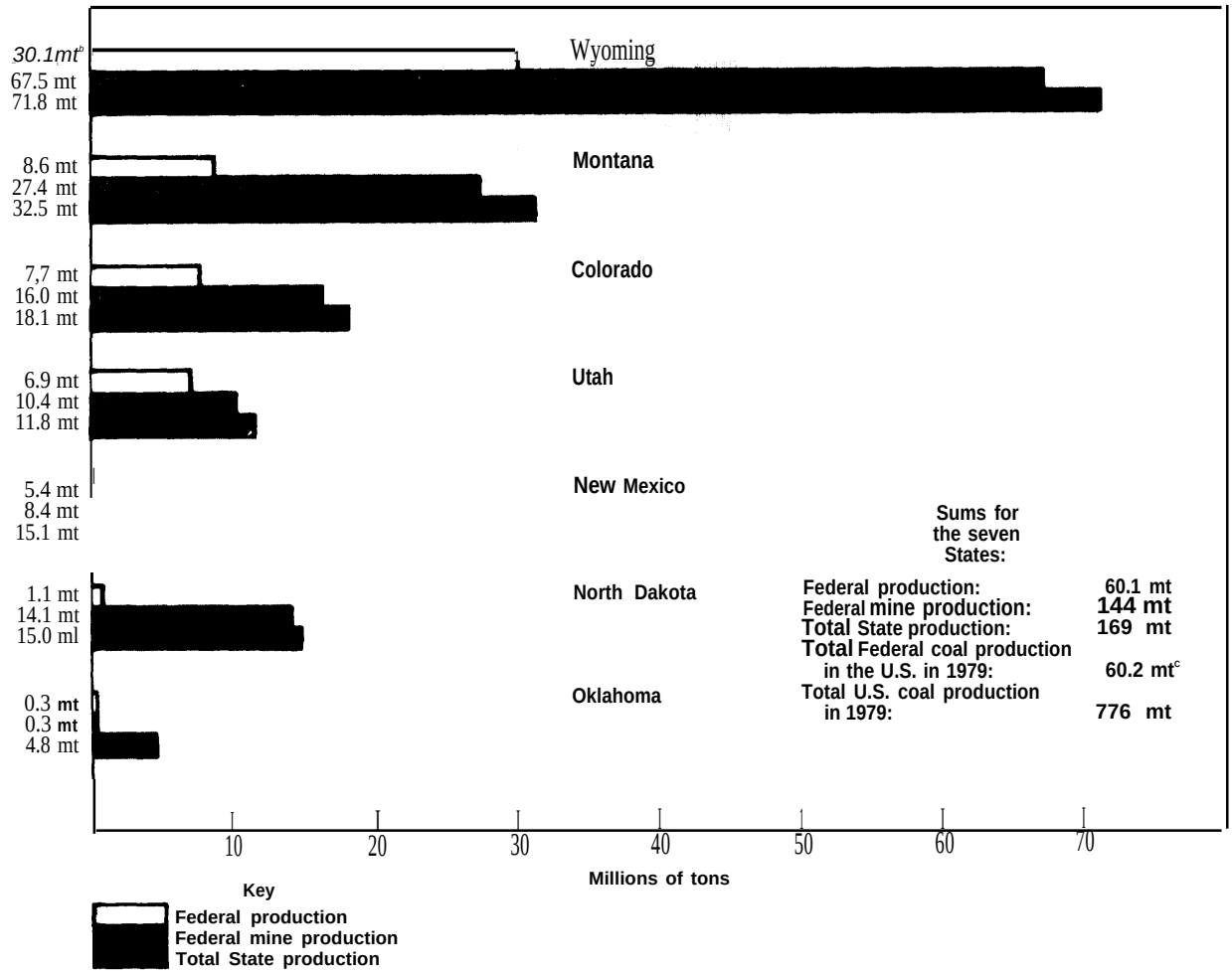
Totals	
69.2	million tons (ret) of Federal coal production in 1980
16.5	billion tons (bt) of recoverable coal reserves under Federal coal lease
812,001	acres under Federal coal lease
565	Federal coal leases

[a] mt million tons
[b] bt billion tons
C. 14 million tons in 1979

SOURCE Off Ice of Technology Assessment

Figure 4 summarizes 1980 Federal coal production and the distribution of leases, leased acreage, and leased recoverable reserves among the Federal coal States. Figure 5 summarizes 1979 Federal production, Federal mine production, and total production by State for those seven States. The States of Wyoming and Montana together contain 61 percent of leased reserves and accounted for 63 percent of Federal production in 1980.

Figure 5.— Distribution of Federal Production, Federal Mine Production and Total State Production in 1979, by State, for the Seven Federal Coal States Considered in This Report[a]



[a]See the footnote on page 8 for definitons of Federal production, Federal mine production, and total production
[b]mt = milion tons
[c]The other States contributed 0.14 mt of Federal production in 1979

SOURCE Office of Technology Assessment

Most of this came from the large surface mines in the Powder River basin. Colorado and Utah, which have 59 percent of leases, contain 33 percent of recoverable reserves and produced 26 percent of Federal coal in 1980. Mines are smaller on the average in these two States than in the Powder River basin and underground mining currently accounts for about 40 percent of production. New Mexico and North Dakota contain predominantly large surface mines; coal properties in North Dakota have relatively small amounts of Federal reserves in conjunction with large amounts of private coal.

Heat content of Colorado and Utah coal is generally higher than that of the Powder River basin; leased New Mexico coal is generally of higher heat content than Powder River basin coal, but lower than Colorado and Utah coals. Utah, Colorado, New Mexico, and Oklahoma all contain metallurgical grade coal under lease, North Dakota coal is all lignite of low heat content and in general is suitable only for onsite use.

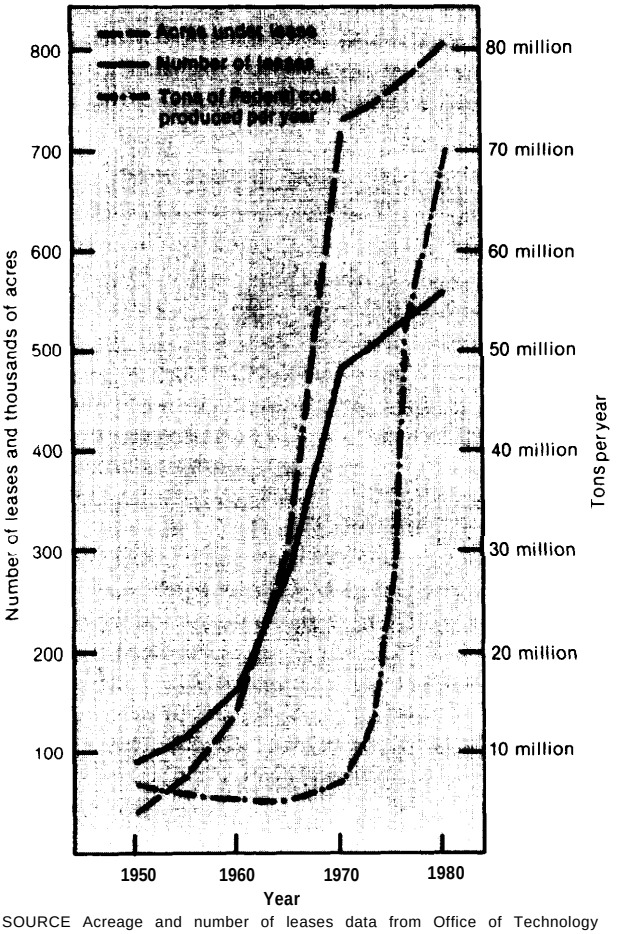
The quality of coal reserves presently under lease and PRLA does not appear to impose any serious limitations for meeting the demand that is likely for Western coal over the next 10 to 15 years. Most leased reserves have low-sulfur and ash content and are suitable for use by utilities, which constitute the single largest user of Western coal.

Because of low heat content, the coal on all Federal leases in the Fort Union region of North Dakota and Montana and about 50 million tons of potential annual production capacity from Federal reserves under lease and PRLA in the Wyoming Powder River basin* are probably suitable only for onsite development for electric power or synfuel plants. (The large majority of leased Federal reserves are, however, of sufficiently high quality to be exported out of the producing State.) Deposits of metallurgical-grade coal are relatively limited in the West, but demand for Western metallurgical coal is also limited; the availability of Federal and non-Federal Western metallurgical coal is probably sufficient to meet the limited demand for this coal anticipated in the foreseeable future.

Federal coal production has risen steadily over the past 10 years. Figure 6 shows the change since 1950 in the number of leases, the acreage under lease, and Federal coal production. Whereas the sharp rise in leasing occurred in the 1960's, the sharp rise in production from leased land started 10 years later, in the 1970's. Figure 7 compares Federal coal production and total coal production in the six major Federal coal producing States. Production from leased land started its sharp rise approximately 5 years later than overall Western production and has risen faster in most years since then. During the next decade, coal production from Federal leases will probably increase at a faster rate than non-Federal coal production in the West because of the large increases in Federal production expected in the Powder River basin.

*Forty-five million tons out of the 50 million tons are unlikely to be in production by 1991 but could come into production in the 1990'5.

Figure 6.—Number of Leases, Acreage Under Lease, and Federal Coal Production From 1950 to 1980



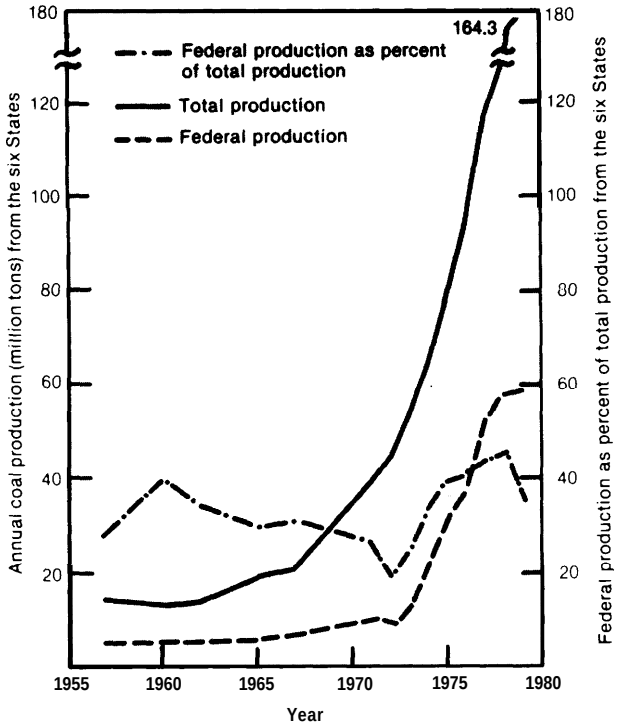
SOURCE Acreage and number of leases data from Office of Technology Assessment review of U S Department of Interior case files Federal coal production from the U S Department of the Interior, *Federal Coal* Management *Report, F/sea/ Year 1978,* March 1979 and from the ACLDS.

Ownership of Federal Coal Leases

The ownership of Federal coal leases has undergone marked changes over the last 30 years. Figure 8 shows how the leaseholdings of 11 groups of lessees and two major leaseholding companies have changed since 1950.

Independent coal companies and unincorporated individuals dominated coal leasing in the 1950's and 1960's, but their relative importance has steadily declined since 1950. In contrast, the electric utilities, major energy companies, and natural gas pipeline companies have increased their Federal coal hold-

Figure 7.—Annual Coal Production From the Six Major Federal Coal-Producing States in the West, 1957-79[a]



[a]The six states are Colorado, Montana, New Mexico, North Dakota, Utah. and Wyoming

SOURCES Data for 1957-77 from table 27 U S Department of Interior *Final Environmental States Federal Coal Management Program* (Washington, D.C.; U.S. Government Printing **Office 1979) 1978 data from table A 2, U S Department of Interior Federal Coal Management Report Fiscal Year 1979 (Washington D C U S Government Prlntlng Office. 1980), 1979 data from table 16, ch. 3 of this report**

ings significantly since 1965 both in absolute and relative terms. Steel companies and metals and mining companies were early leasing participants, but steel industry influence has declined steadily in relative terms since 1950, although the acreage held by the steel industry has steadily increased since 1950. Metals and mining company leaseholdings have varied widely, due in part to the 1977 sale of Peabody Coal Co. by Kennecott Copper Corp. Independent land companies played a significant role in leasing in the 1950's and 1960's, but they have largely liquidated their holdings over the past decade.

Table 1 shows the acres held under lease by the principal categories of leaseholders and the amount of Federal coal they produced in the early and late 1970's. There is a fairly close correspondence between the share of Federal leased acreage and the share of coal production in 1979. A striking exception is the case of the metals and mining companies, which accounted for 16 percent of Federal coal production in 1979 while holding only 2 percent of leased acreage.

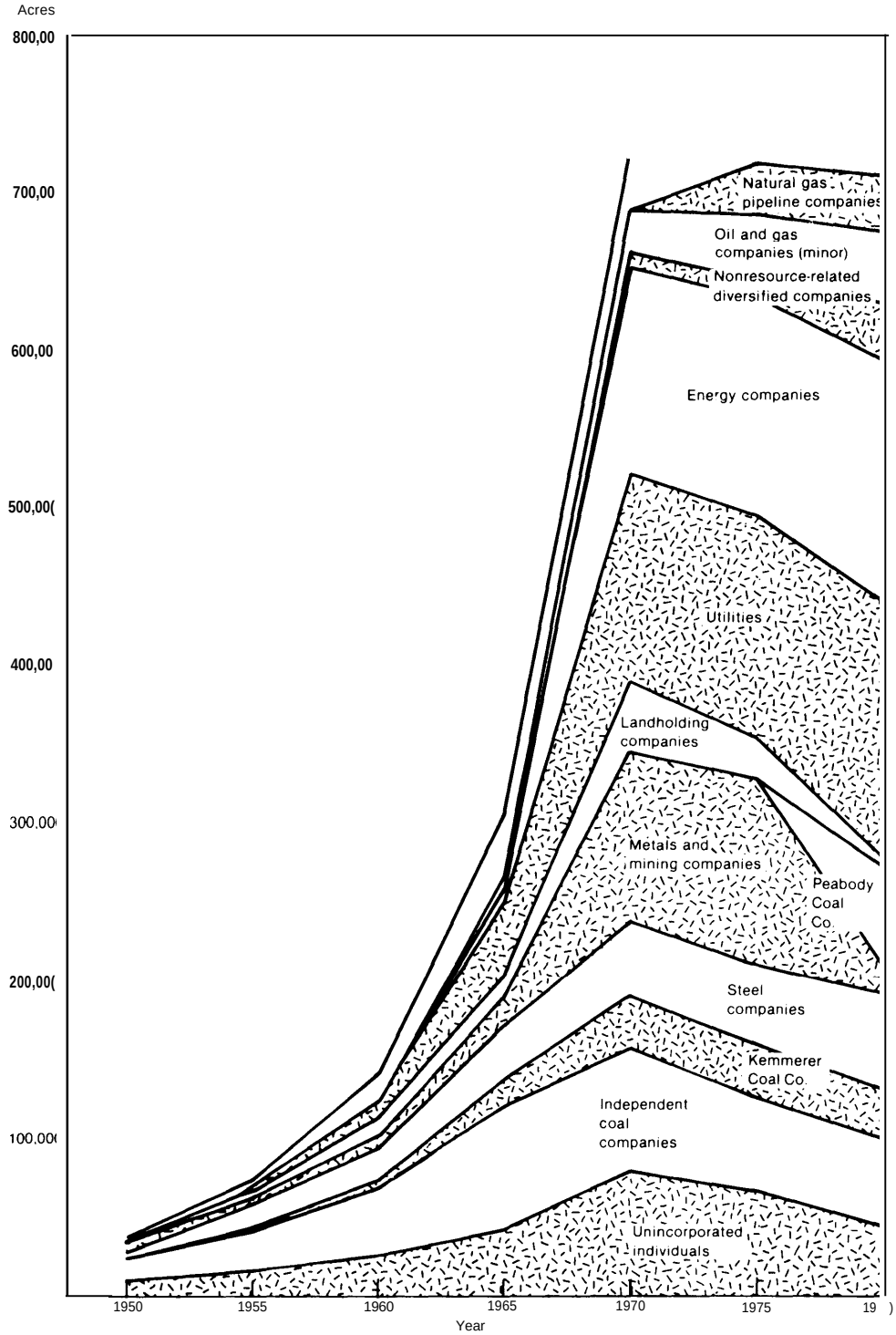
The ownership data reveal little evidence of concentration of leaseholdings between 1950 and 1980. The number of leaseholders approximately doubled in that period, from 84 to over 160 while the number of leases increased sixfold from 88 to 565 and the leased acreage increased by nearly a factor of 20, from about 41,000 acres to 812,000 acres, The four largest leaseholders in 1950 controlled 32 percent of all land under lease while the largest eight controlled 34 percent in 1980. Leaseholders in 1980 came from nine business categories, up from four categories in 1950. On the average, a leaseholder held three times as many leases and 10 times the acreage in 1980 as in 1950.

Three trends in the nature of leaseholders are noteworthy: 1) There is a growing involvement in the leasing program by horizontally integrated companies, The energy companies, natural gas pipeline companies, and the smaller oil and gas companies together hold 31 percent of leased acreage and produced 29 percent of Federal coal in fiscal year 1979. 2) There is a growing involvement of companies for which coal production represents a vertical integration of business activities. Steel companies and electric utilities are the principal examples of vertical integration among leaseholders, Together, the two groups hold 29 percent of coal land under lease. 3) There is a growing involvement of large, already diversified companies in coal leasing, including metals and mining companies and chemical and high technology companies.

Lease Development Status

A principal objective of this study is to assess the development potential of existing

Figure 8.— Number of Federal Coal Acres Under Lease by Business Activity Category, 1950-80



SOURCE: Off Ice of Technology Assessment

Table 1 .—Federal Leaseholdings and Production by Business Category

Business activity category	1970 leased acres	1972 coal production from Federal leases	1980 leased acres	Fiscal year 1979 coal production from Federal leases
Electric utilities . .	18% 132,038	47% 4.8	21 % 163,259	30% 17.8
Energy companies. .	18% 132,274	5% 0.51	20% 155,024	16% 9.9
Metals and mining companies	12% 107,504	12% 1.2	2 % 17,620	16% 9.3
Oil and gas com- panics (minor)	4%0 26,911	2 % 0.23	6 % 45,926	9 % 5.3
"Other" companies . .	6 % 41,153	4 % 0.46	10% 77,861	9 % 5.2
Independent coal companies . . .	11 % 78,297	20% 2.0	7% 55,410	7% 4.4
Natural gas pipe- line companies ., . .	0% 0	0% 0	5% 36,317	4% 2.4
Peabody Coal Co.	8% [a] a	0% [a] a	8 % 62,009	4 % 2.2
Steel companies . . .	6 % 46,114	7 % 0.77	8 % 60,015	2 % 1.3
Non resource diversified companies	1% 10,015	0% 0	5 % 35,675	*2 %* 1.0
Unincorporated individuals . .	11 % 78,995	3 % 0.27	6 % 43,215	1 % 0.72
Kemmerer Coal Cob	5 % 33,793	0 % 0	4 % 32,191	below 1% 0.06
Total	94% 687,094	100% 10,3	99% 784,522	100% 59.5

NOTE. Percentage sums might not equal totals because of rounding All land holdings listed as acres. All production listed in million tons of coal.

[a] **Peabody** 1970 land holdings and 1972 productions totaled In metals and mining category

[b] In March 1981, Kemmerer Coal Co was purchased by Gulf Oil Corp.

SOURCE Office of Technology Assessment

leases, For this analysis, OTA combined the existing leases into units or blocks, A lease block, as defined in this report, consists of one or more leases owned by the same lessee(s) that are contiguous or sufficiently close together to form a compact minable unit,

Using this approach, OTA divided the 565 existing coal leases into 256 blocks. The smallest blocks contain one lease covering 40 acres, The largest, located in southern Utah, includes 21 leases and 47,000 acres.

OTA conducted a comprehensive study of mining and development activities and production prospects for the 548 Federal leases in 244 lease blocks located in the seven States of Colorado, Montana, New Mexico, North Dakota, Oklahoma, Utah, and Wyoming. To facilitate this analysis, OTA grouped the lease units in three categories based on the status of the mine plan.

Before a coal mine can produce coal from Federal land, a mine plan must be approved by DOI. Hence, determining mine plan status is a useful first step in assessing lease development potential, Accordingly, the lease blocks in this report are grouped in the following three development categories based on a review of all mine plans on file at the Office of Surface Mining (OSM) on September 30, 1980:*

. producing or have approved mine plans,
- have mine plans submitted and pending approval, and
- have no submitted mine plan ("undeveloped"),

Figure 9 summarizes the mine plan status of leases, leased acreage, and recoverable reserves by State for the seven principal Federal coal States.

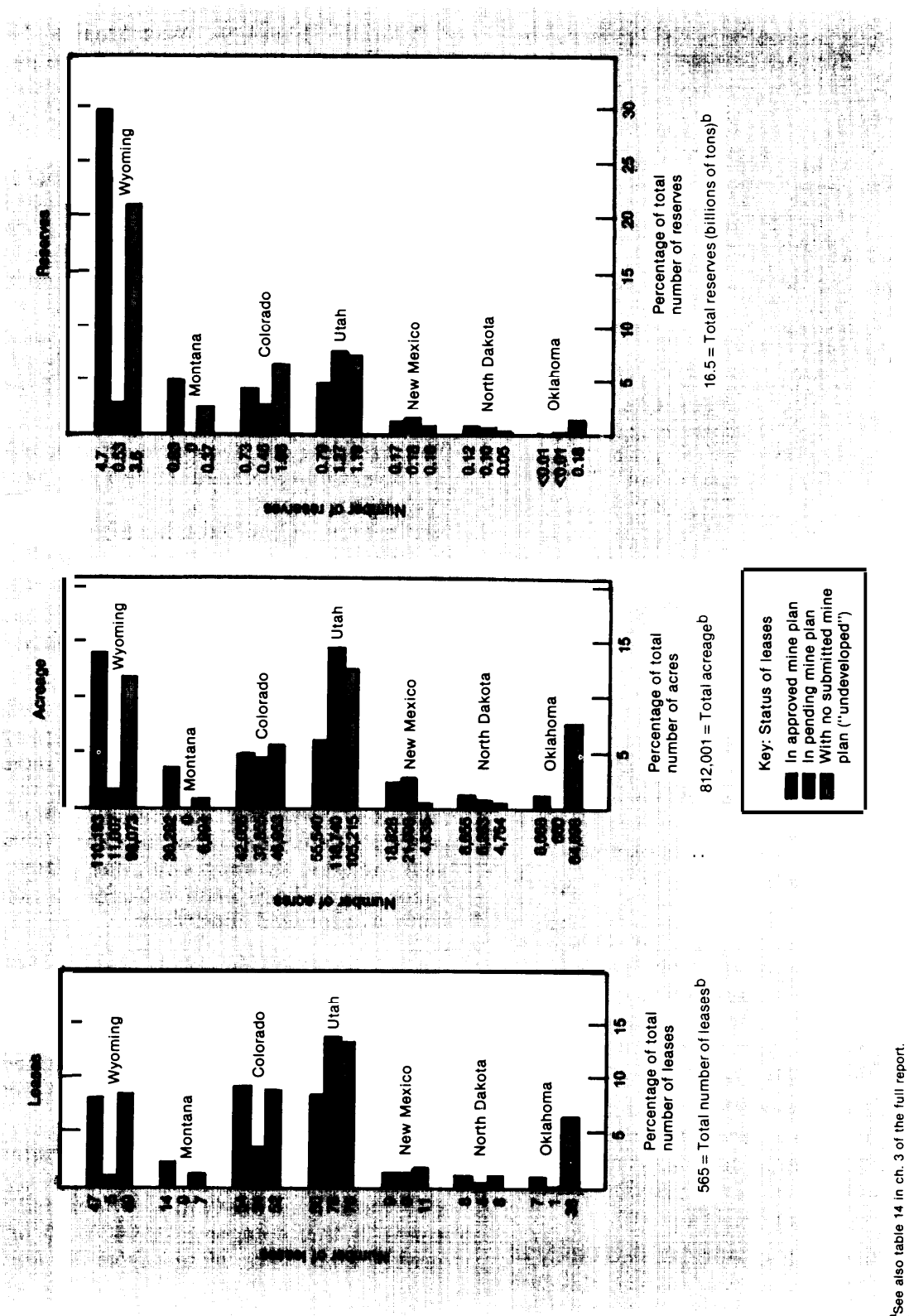
Approximately one-third of all Federal leases are either producing or have approved mine plans. This category also includes leases issued in 1979 and 1980 to permit the continued operation of existing mines (regardless of whether or not they have formally been included in approved mine plans) and leases which have been included in amendments to approved mine plans.

The highest percentage of leases in the approved mine plan category is in Montana: 67 percent of leases covering 69 percent of the leased reserves in the State. Utah and Oklahoma have the smallest percentages of leases and the lowest percentage of leased reserves in the approved categroy.

Although not every lease falling into the approved mine plan category is producing coal, all Federal coal production was mined from leases in this category. In 1979, 60 million tons of coal were mined from 83 Federal

*Both surface and underground mine plans are on file at the U.S. Office of Surface Mining.

Figure 9.—The Development Status of Federal Coal Leases[a]



[a]See also table 14 in ch. 3 of the full report.
[b]Although 17 leases in seven States covering 3,555 acres and with about 0.1 billion tons of recoverable reserves are not plotted in this figure, these leases, their acreage and their reserves are contained in these totals.

SOURCE: Office of Technology Assessment

leases, over 40 percent of the leases in the approved category. * In 1979, Federal coal contributed 36 percent of all production from the seven Federal coal States shown in figure 9. Federal coal provided 58 percent of Utah's coal production, 42 percent of Wyoming's coal production, 7 percent of the coal mined in North Dakota, and 6 percent of the coal mined in Oklahoma (see fig. 5). The pattern is similar for 1980 (table 2).

Approximately 20 percent of all leases and 15 percent of leased reserves are included in mine plans which are pending approval at OSM. This category does not distinguish among lease units according to the quality of submitted mine plans, their date of submission, or the present position of the mine plan in the regulatory review process.

Utah and New Mexico have the highest percentage of leases in the pending mine plan category, 38 and 31 percent, respectively. On the other hand, no pending mine plans for Montana leases have been submitted to DOI and only one of Oklahoma's 46 leases is included in a pending mine plan.

Forty-four percent of all leases, 42 percent of all leased acreage, and 40 percent of leased reserves have not been developed to the point of a mine plan submission to OSM. Preliminary development activity varies widely on these undeveloped units, from extensive exploration drilling and mine plan preparation on some units to no activity at all on others.

Oklahoma has the highest percentage of leases and leased acres and reserves in the undeveloped category; five of the seven Western States have over 30 percent of their leased Federal reserves in this category. Thirty-eight percent of New Mexico's leases and 40 percent of North Dakota's leases have no mine plans but they cover just 22 percent and 19 percent, respectively, of leased reserves. These are lowest percentages of reserves in the undeveloped lease category among the seven Western States.

*Because only a portion of the approved permit area is mined in any given year, it is unlikely that all Federal coal leases in approved mine plans will be producing at one time.

Table 2.—1979 and 1980 Coal Production From the Seven Federal Coal States Studied in This Report[a] (all production in millions of tons per year)

State	1979 Federal production	1979 Production from Federal mines[b]	1979 Total State production	1980 Federal production	1980 Total State production
Colorado	7.7	16.0	18.1	9.4	19.5
Montana	8.6	27.4	32.5	10.4	36.1
New Mexico	5.4	8.4	15.1	6.3	16.5
North Dakota	1.1	14.1[c]	15.0	0.6	17.2
Oklahoma	0.3	0.3	4.8	0.3	4.9
Utah	6.9	10.4	11.8	8.7	13.1
Wyoming	30.1	67.5	71.8	33.4	94.0
Totals	60.1	144.1	169.1	69.1	201.4

[a]TOTAL U S COAL PRODUCTION IN 1979 776 MILLION TONS.
TOTAL U S COAL PRODUCTION IN 1960 820 MILLION TONS.
[b]Coal from Federal coal leases is referred to as *Federal coal* A mine which Includes a Federal lease is called a *Federal mine.*
Sometimes, for the sake of efficiency of recovery or economy of operations, intervening State or private coal is mined with Federal lease(s) in the same mine This practice is the rule in Southern Wyoming and North Dakota, for example Thus, many Federal mines produce both Federal and nonfederal coal A mine which contains no Federal coal is called a *non-Federal* mine Total coal production in a State or region is thus the sum of 1) Federal coal production from Federal mines *plus* 2) Non. Federal coal production from Federal mines plus 3) Nonfederal coal production from nonfederal mines
[c]This figure includes 56 million tons of production from operating mines with Federal leases in pending mine plans Al I of this 56 million tons is from non-Federal reserves

SOURCES 1979 Federal productlion from U S Geological Survey accounting office
1979 State production from the U S Energy Information Agency, *Weekly Coal Production Report,* Aug. 16, 1980
1980 Federal production from U S Geological Survey, *Federal and Indian Lands,* Coal, *Phoshpate, Potash, Sodiurn and Other Mineral Production,* Royalty Income *and Related* Statistics (Washington, D C U S Government Printing Office, June 1981).
1980 State production from the U S Energy Information Agency, personal communication to OTA, July 27, 1981

Potential Production From Federal Coal Leases in 1986 and 1991

The development and production estimates presented in this report are based on information in mine plans, the deliberations of the OTA State task forces* and communications with the lessees. Although OTA based its evaluations of likelihood of development and levels of potential production on the best data available for each lease at the time, as additional information based on further exploration and development becomes available, the prospects for any given lease could change.

These estimates of potential production from Federal leases are not forecasts of the coal that will be produced at a given price or given demand. They are estimates of the total amount of coal that could be produced from currently operating Federal mines and from those Federal leases that have characteristics comparable to operating mines in the same region. Coal from these leases would thus be likely to have mining costs competitive with costs at currently operating mines in the same area. If the overall demand for Federal coal does not increase to the production levels that are possible, then not all of the Federal leases that could technically and economically be developed will go into production.

*OTA task forces were held in Colorado, New Mexico. Oklahoma. Utah, and Wyoming. For a complete listing of task force participants, see p. vii of this report.

Development Prospects of Undeveloped Federal Coal Leases

Of the 502 leases in the six major Western coal States of Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming, 203 are not in mining plans. These leases cover nearly 265,000 acres, contain 6.4 billion tons of recoverable reserves, and have the potential to contribute substantial coal production within the next 10 years. Along with five leases in three pending mine plans in Wyoming, OTA called these leases "undeveloped" and has evaluated the likelihood that they will be developed within the next 10 years (see table 3), Geological, technical, ownership, environmental, transportation, and community factors were considered in the evaluation process,

Of the 208 leases analyzed as undeveloped, 80 leases containing 4.1 billion tons of recoverable reserves have favorable prospects for development by 1991. The majority of these reserves are concentrated in the Wyoming portion of the Powder River basin (3,2 billion tons of surface-minable reserves) and in the

Table 3.— Development Potential of Undeveloped Leases[a]

State	Number of undeveloped leases	Amount of undeveloped reserves (Billions of tons)	Undeveloped leases with favorable development potential		Undeveloped leases with uncertain development potential		Undeveloped leases with unfavorable development potential	
			No. of leases	Amount of reserves	No. of leases	Amount of reserves	No. of leases	Amount of reserves
Wyoming, ...	**54**	**4.2**	**35**	**3.5**	**7**	**0.67**	**12**	**0.03**
Montana	7	0.37	2	<0.1	1	<0.1	4	<0.3
Colorado.	52	1.06	10	0.08	21	0.82	21	0.16
Utah.	76	1.19	30	0.42	28	0.70	18	0.06
New Mexico	11	0.10	2	0,09	5	0.001	4	<0.001 [b]
North Dakota	8	0.05	1	<0.01	3	0.05	4	0.006
Total	208	6.9	80	4.1	65	2.3	63	0.5

[a]Includes **five leases in** Wyoming in three pending mine plans.
[b]One-half million tons.

SOURCE Office of Technology Assessment

Uinta region of Utah (0.4 billion tons of underground reserves). In almost all cases, the lessees are actively developing these leases.

Another 65 leases containing 2.3 billion tons of recoverable reserves have uncertain prospects for development by 1991. The large majority of these reserves (about 90 percent) are about evenly divided among the Kaiparowits Plateau coalfield of southwestern Utah, the Green River region of Colorado and the Wyoming portion of the Powder River basin, Development depends on factors such as pace and scale of construction of associated powerplants or synfuels projects, development of in situ gasification, availability of additional Federal reserves from pending PRLAs or from new lease sales, construction of transportation systems, and lessee development priorities.

Considerable uncertainty faces the three lease blocks (with a total of 0.6 billion tons of recoverable reserves) in the Powder River basin whose development is dependent on in-situ gasification, a technology in the experimental stage which is not likely to be ready for commercial application before the 1990's. Considerable uncertainty also faces the 25 undeveloped leases with 0.7 billion tons of reserves located on the Kaiparowits Plateau coalfield of southwestern Utah. The leases in this large, isolated, rugged area face uncertainty in potential development over the next decade because construction of the rail or slurry transportation systems to connect the area with potential markets depends on a minimum production in the area of over 30 million tons per year—a scale that is unlikely to be reached in the next decade.

Finally, 63 leases with approximately 0.5 billion tons of recoverable reserves are unlikely to be developed. Most of these leases lack sufficient minable reserves of marketable quality to be developed as new mines. Many also have difficult mining conditions that would make them expensive to develop. Some of the leases are located outside active mining areas and lack adequate transportation. For example, a seven-lease block in Colorado that meets the minimum requirements for an average new mine in its region is located in a remote area without rail service. It is unlikely that it will be developed in the next decade, given the availability of other coal sources with adequate transportation and which are closer to potential markets.

Production and Capacity Estimates for 1986 and 1991: Developed and Undeveloped Leases

Production estimates for 1986 and 1991 were made on a lease-by-lease basis and summed by region and State. The 63 undeveloped leases in the above six States with unfavorable development prospects were assumed to have zero production. A range of production was usually estimated for the 145 undeveloped leases with favorable or uncertain prospects for development. With a few exceptions, the lessee's estimates for production were used for leases in mine plans.

North Dakota, Montana, and Wyoming

In 1979, mines with Federal leases in these three States produced 109 million tons of coal, over 90 percent of the total amount of coal produced in this area. The lessees plan to increase production from currently operating Federal mines substantially, to 280 million tons in 1991. Currently undeveloped leases could add another 20 to 80 million tons per year of production in 1991, for a total production from Federal mines in that year of 300 million to 360 million tons.

In the Powder River basin of Wyoming and Montana, Federal mines accounted for 88 percent of total coal mine capacity in 1980. This percentage is projected to remain relatively constant throughout the decade, However, production from Federal leases themselves is projected to increase from less than 40 percent of total coal production in the basin in 1979 to approximately 80 percent in 1991. In southern Wyoming, essentially all coal production is from Federal mines, with about one-third of the production from the Federal reserves. This pattern is expected to continue, with the contribution from Federal

reserves rising to perhaps 40 percent by 1991. In 1979, Federal mines in the North Dakota portion of the Fort Union region accounted for over 90 percent of the State's coal production; the amount produced from Federal reserves was less than 7 percent. This situation is expected to continue, with however, production from Federal reserves rising to perhaps 20 percent in 1991.

Figure 10 summarizes potential production and planned mine capacity for Federal mines over the next decade for the Fort Union region of North Dakota and Montana, for the Powder River basin of Montana and Wyoming, and for southern Wyoming. The upper capacity lines (lines D) in this figure represent OTA's estimate of the maximum coal production from Federal mines that could be achieved in these three regions under strong market conditions. Several features of figure 10 should be noted:

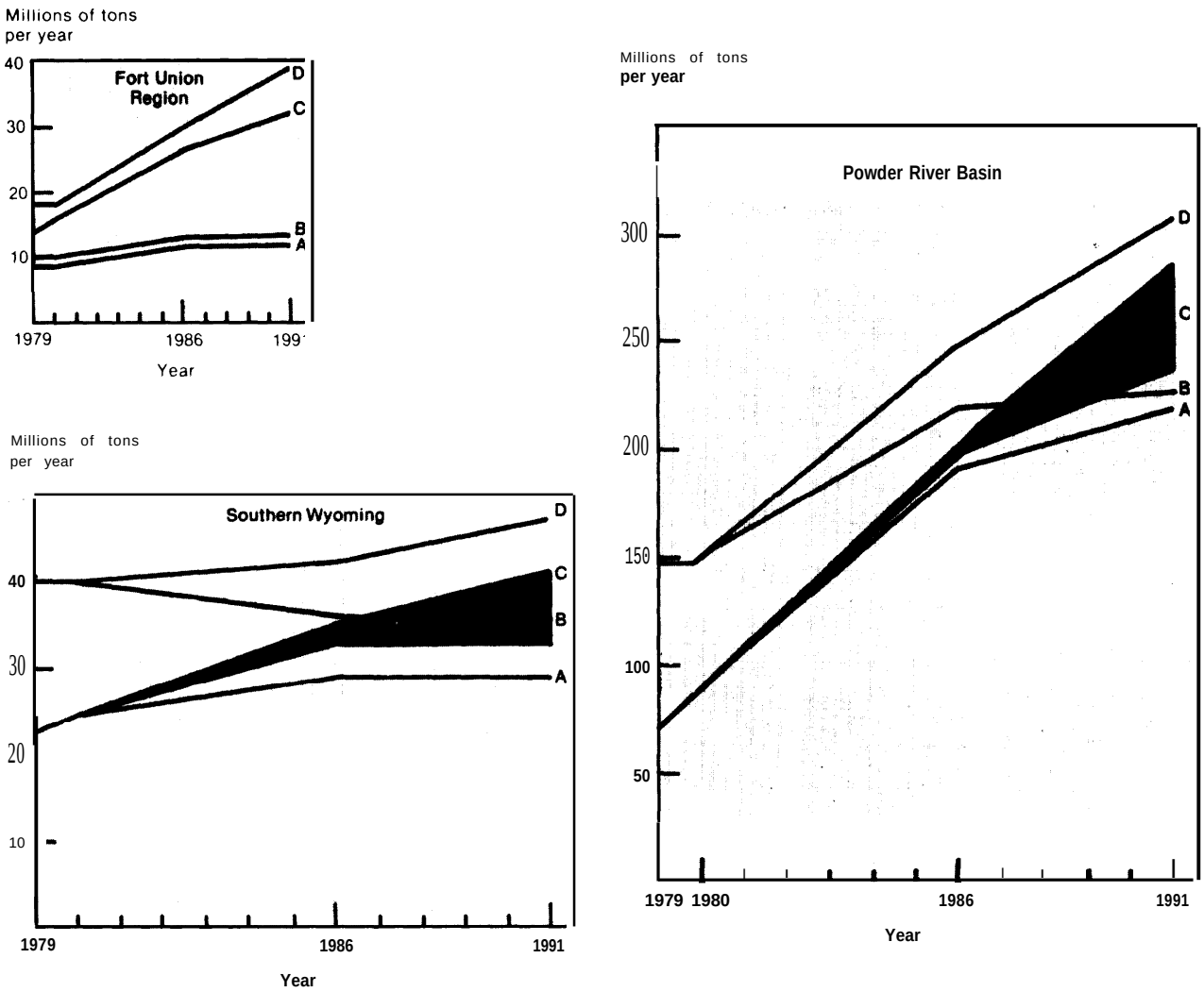
1. The Powder River basin will continue to increase in importance as a coal-producing region. By 1991, Federal mine production in the Powder River basin could account for about 80 percent of Federal mine production in these three States.
2. All estimated Federal mine production for 1991 for the Powder River basin comes from currently approved mines and from undeveloped leases with favorable development potential. (Undeveloped leases with uncertain development potential contribute no production through 1991.) The large range in estimated production from undeveloped leases arises from demand uncertainty. However, several undeveloped leases in the Powder River basin have contracts for delivery of coal before 1990.
3. By 1991, the capacity of Federal mines in the Powder River basin could be as high as 310 million tons per year. According to the lessee's plans, the overcapacity in presently operating Federal mines in the Powder River basin, which was greater than 75 million tons per year in 1979 will diminish to nearly zero by 199l.
4. The maintenance of total capacity of Federal mines in southern Wyoming depends on the development of new mines. Although capacity of presently operating mines is projected to decrease over the next 10 years, their production will probably not decline. Most of the range in production arises from uncertainty in the pace of a synfuels project.
5. The potential increase in production and capacity of Federal mines in the Fort Union region will occur largely from mines in North Dakota with leases in currently pending mine plans. Undeveloped leases are not likely to contribute more than 1 million tons per year by 1991. Federal mine production in the Montana portion of the region is likely to remain constant at 0.3 million ton per year.

Colorado, New Mexico, and Utah

In 1979, mines with Federal leases in these three States produced a total of 35 million tons of coal, about 77 percent of the total amount of coal produced in this area. Many of the Federal mines in the area are relatively new and have not yet reached full production levels; consequently, the lessees plan to increase production from currently operating mines substantially, to 65 million tons per year by 1991. Over the next decade, several operating mines are expected to be at, or near, depletion of their current mine plan reserves. Part of this reduction in capacity will be offset by replacement capacity from new mines on Federal leases. About 5 million to 10 million tons are potentially involved.

If all currently operating and proposed mines that include Federal leases are developed and produced as planned, production from these mines could reach 75 million tons by 1986, and between 110 million and 146 million tons by 1991. The production increase would be greatest in Utah, where production from Federal mines might rise from about 10 million tons in 1979 to as much as 74 million tons by 1991.

Figure I0.— Planned Capacity and Potential Production of All Mines With Federal Leases in the Powder River Basin, Southern Wyoming, and Fort Union Region



A: Lessee's planned annual production from Federal **mines in currently approved mine plans only**

B: Lessee's planned annual capacity for Federal mines in currently approved mine plans only

C: The sum of *A,* **above, plus estimates of potential production from Federal mines in pending mine plans and from presently undeveloped Federal leases**

D: Planned annual capacity for all Federal mines, including Federal mines in pending mine plans and presently undeveloped Federal leases

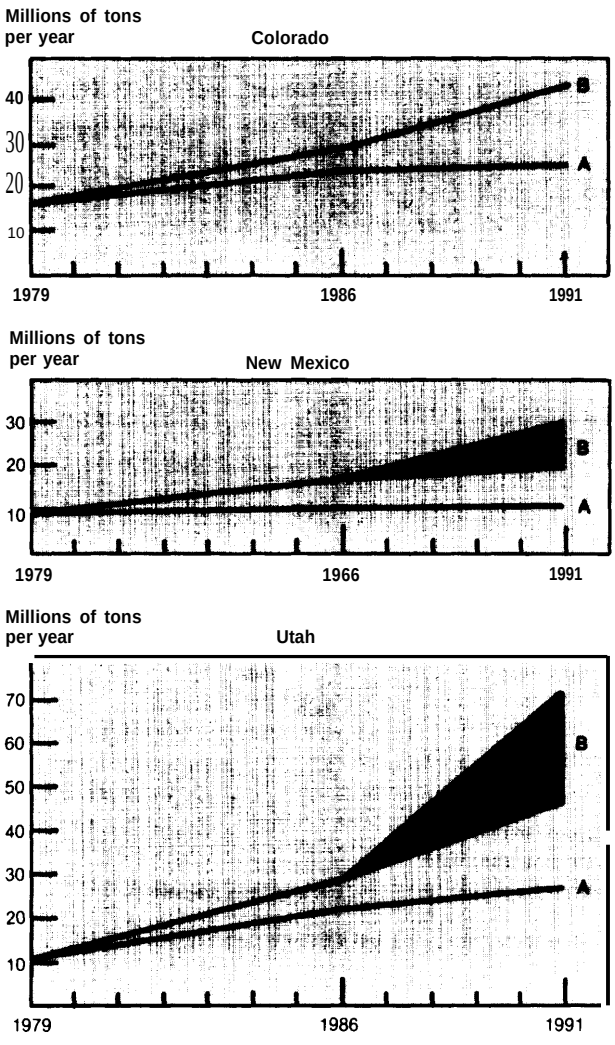
SOURCE Office of Technology Assessment

Over the next decade, the percentage of total State production coming from existing Federal coal leases is expected to increase in Utah and Colorado as new, large Federal mines reach full operation, The percentage of Federal production from existing leases in New Mexico is expected to remain relatively stable, although, output from PRLAs could increase the total share of annual State production from Federal reserves.

Figure 11 summarizes potential production for Federal mines over the next decade for the States of Colorado, New Mexico, and Utah. Several features of figure 11 should be noted.

1. Most of the projected increases in production will come from new mines on leases in pending mine plans and on currently undeveloped leases that will not achieve full design capacity until after 1991. The projected 1991 production range of 110 million to 146 million tons is less than the total capacity of about zoo million tons per year that could be supported by mines on existing Federal leases in these States by the mid-1990's. In the late 1990's, however, the capacity supported by existing leases will begin to decline as many of the mines that are now operating exhaust their reserves.
2. For Colorado, the increased production comes from new mines with pending mine plans and from undeveloped leases. The new mines could add from 25 million to 30 million tons of new annual capacity split almost evenly between surface and underground operations. About 1.9 million tons of projected 1991 production is tied to synthetic fuel projects but could be sold to other customers if the proposed projects were delayed. The major uncertainty facing increased production in Colorado is whether expanded markets will materialize as expected.
3. The range of potential production from new mines in New Mexico in 1991 reflects the uncertainties in the rate of mine development because of possible delays in the construction of the Star Lake Railroad and in the availability of reserves in pending PRLAs associated with two new mines. Production levels and mine capacity for the Black Lake Mine will also be influenced by the requirements of a proposed coal gasification project. Two other new mines are unaffected by PRLA availability or railroad construction, but are tied to the coal needs of new powerplants.
4. The range of 27 million tons per year in 1991 production in Utah arises from uncertainties in development in the Alton and Kaiparowits coalfields of southwestern Utah. Coal development in southwestern Utah depends on expansion of potential markets only the Alton

Figure 1 1.— Potential Production Capacity of All Mines With Federal Leases in Colorado, New Mexico, and Utah



A: Lessees' planned annual production capacity for Federal mines in currently approved mine plans only.
B: The sum of A, above, plus estimates of production capacity for Federal mines in pending mine plans and for presently undeveloped Federal leases.

SOURCE. Office of Technology Assessment

mine currently has a purchaser for its coal) and, more importantly, on the construction of a rail or slurry transportation system to serve potential consumers, A minimum of 30 million tons annual production is required to offset the costs of constructing a rail line onto the Kaiparowits Plateau,

Oklahoma

In **1979,** approximately 0.3 million tons of Federal coal was produced in Oklahoma. Four mines with Federal leases are currently producing coal in this State; however, the Federal reserves on three of these mines are expected to be depleted before 1986. No undeveloped leases in Oklahoma are expected to produce coal in commercial quantities before 1991, Three main reasons account for the unfavorable production prospects of these leases: 1) difficult and costly underground mining conditions, 2) a depressed metallurgical coal market, and 3) a high Federal royalty relative to royalties charged for fee coal in the State.

Diligent Development

Federal coal leases issued before August 4, 1976 (527 out of the 565 leases in this study)* are required to produce 2½ percent of logical mining unit** (LMU) recoverable reserves by June 1, 1986, or be subject to cancellation proceedings. Under certain specific circumstances, the Secretary of the Interior may grant an extension to mid-1991, (See ch. 9 for more detail.)

Most leases with potential for production by 1991 could qualify for extensions under existing guidelines. The exceptions are mines that do not fit clearly into any of the current guidelines, specifically several proposed small- to medium-sized mines that are intended to serve spot markets and several underground mines with difficult mining conditions requiring longer construction periods.

OTA has examined estimated production schedules to assess the likelihood that a lease block will achieve diligence by 1986 or 1991.

By 1991, over 70 percent of the 502 leases in the six major Western Federal coal States might meet the existing diligence requirements.

- **216** leases with 7.4 billion tons of reserves are likely to meet diligence by 1986 (45 percent of total leased reserves).
- 29 additional leases with 2.1 billion tons of reserves are likely to meet diligence by 1991 with extensions (13 percent of total leased reserves).
- 112 leases with 3.4 billion tons of reserves (20 percent of total leased reserves) are uncertain to meet diligence by 1991. Major uncertainties are tied to delays in powerplant, synfuels and transportation system construction, fluctuations in captive coal needs, development of markets for the coal, and difficulties in defining the logical mining unit for leases with very large reserves in multiple seams. Development of markets for the coal constitutes a particularly important uncertainty in the Powder River basin where market demand will be an important factor in determining whether 1.2 billion tons of recoverable reserves under lease will meet diligence by 1991.

Thirty percent of the leases in the six major Western Federal coal States containing 20 percent of total leased reserves are unlikely to meet diligence by 1991 even were they to be granted extensions:

- Production for 61 leases in the Kaiparowits Plateau with 1.4 billion tons of reserves is dependent on construction of a coal transportation system that is unlikely to be in place by 1991. Moreover, even if the Kaiparowits Plateau leases begin producing at the earliest feasible date, 1987, it is unlikely that they would

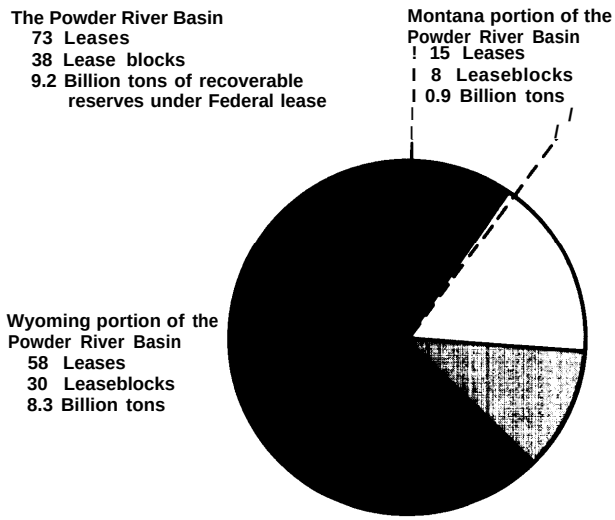
* Thc **38 leases issued** after August 4, 1976. are subject to a slightly **different** requirement. None of these leases are anticipated to have difficulty in meeting that requirement t.

**The Bureau of Land Management has defined every lease as an LMU. This definition may be, but is not necessarily, superseded when a mine plan is approved. In a mine plan, an LMU may consist of more than one Federal lease and may include non-Federal coal 1.

produce enough to meet diligence requirements because of the large amount of underground reserves involved.

- Development of 10 leases in the Powder River basin with 1.4 billion tons of reserves depend on onsite synfuels development; 0.6 billion tons of these are suitable only for in situ gasification, assuming that technology is developed.
- The remaining 74 leases are primarily small, scattered leases with poor quality reserves that are unlikely to be developed.

Figure 12.— Dilligent Development Summary for the Powder River Basin



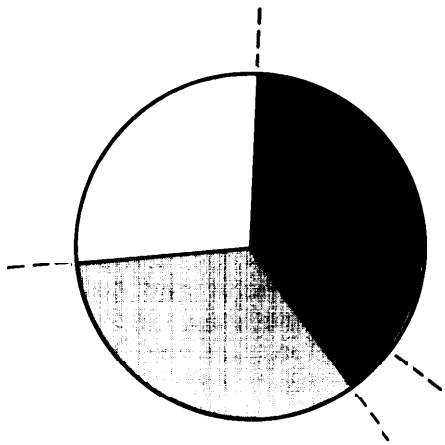
Key	Reserves[a]	Percent of reserves
Likely to achieve diligence by 1986:	4.8	52%
Likely to achieve diligence by 1991:	1.7	18%
Uncertain whether will achieve diligence by 1991:	1.2	13%
Unlikely to achieve diligence by 1991:	1.5	16%

[a]Billions of tons.

SOURCE: Office of Technology Assessment.

Figures 12 and 13 graphically summarize the results of OTA's diligent development analysis for the Southern Rocky Mountain region (Colorado, Utah, and New Mexico) and for the Powder River basin.

Figure 13.— Diligent Development Summary for the Southern Rocky Mountain Region
(Colorado, New Mexico, and Utah)



Key	Number of leases	Percent of leases	Reserves[a]	Percent of reserves
Likely to meet diligence by 1986	136	28	2.0	34
Likely to meet diligence by 1991	15	4	0.3	5
Uncertain to meet diligence by 1991	95	26	2.0	34
Unlikely to meet diligence by 1991	114	32	1.6	27

[a]Billions of tons.

SOURCE Office of Technology Assessment

The Powder River Basin

The Powder River basin is particularly important to Federal coal development because it contains over one-half the recoverable reserves under lease, accounts for about one-half the coal produced from Federal mines, contains the largest pool of Undeveloped leased Federal coal reserves in the United States, and has the largest market area of any Western coal-producing region. Federal mines accounted for 88 percent of mine capacity in the Powder River basin in 1980. This Percentage is projected to remain relatively

constant throughout the decade. However, production from the leases themselves is projected to increase from less than 40 percent of total coal production in the basin in 1979 to approximately 80 percent in 1991. *

A number of projections for this region suggest that the most likely range of demand for Powder River basin coal in 1990 will be 200 million to 225 million tons per year (see fig. 14), The Department of Energy (DOE) interim midrange production goal of 275 million tons per year is probably high.**

Contracts already exist for delivery of 186 million tons per year of Powder River basin coal in 1990. Of this amount of contracted coal production, 159 million tons is from currently producing mines with Federal leases, 10 million tons is from non-Federal mines, and 17 million tons is from presently undeveloped Federal leases,

For 1990, lessees and non-Federal mine operators have plans to produce a total of nearly 100 million tons per year more than the presently contracted level for that year. Production plans for 1990 total 280 million tons per year; of this amount, 215 million tons is from currently producing mines with Federal leases, 10 million tons is from non-Federal mines, and 55 million tons is from presently undeveloped leases which have favorable production prospects for 1990 under strong market conditions. Only 6 million tons of this production is contingent on synfuels development.

Mine design capacity planned by lessees and non-Federal mine operators for 1990 is considerably higher: 348 million tons per year. Mine design capacity is an upper limit to long-term production levels that can be reached with a leadtime of a year or so. Currently operating Federal mines are scheduled to reach 97 percent of mine design capacity by 1991. Therefore, given sufficient market demand, production levels of close to 350 million tons per year are attainable in the early 1990's from currently operating mines plus good quality properties currently being actively developed.

These levels of capacity and production depend on all plans being realized for both Federal and non-Federal properties, If only 11 out of the 17 undeveloped properties contributing to this projection are developed, total design capacity could be reduced by up to 60 million tons per year; total design capacity would then be 290 million tons per year. Nevertheless, planned capacity in the Powder River basin seems likely to be adequate to meet demand into the early 1990's.

Potential capacity in the post-1990 period is considerably more difficult to estimate, as is potential demand. An additional 155 million tons per year of capacity could perhaps become available in the post-1990 period from undeveloped Federal leases, PRLAs and new non-Federal mines. About 70 million tons per year of this capacity would be suitable only for onsite development because of low coal quality, This amount (155 million tons per year) should be considered an upper limit rather than a likely value of additional post-l990 capacity without additional leasing of Federal coal. For the post-1990 period, demand projections become very uncertain, The DOE preliminary midlevel production goals, the ICF CEUM* midlevel production forecast and the DOE midlevel final production goals for 1995 for the Powder River basin are 382, 306, and 491 million tons per year, respectively. The DOE final production goal. 491 million tons per year. reflects several policies about increased coal use (e. g., coal for synfuels), that cause the number to be higher than other forecasts. Although all demand projections past 1990 should be regarded as very uncertain, the lower numbers above are, as of now, more likely to be realized.

The potential for continued high overcapacity in the Powder River basin has caused

*The percentage of Federal coal production will be less than the percentage of Federal mine capacity, because Federal mines commonly produce some non-Federal coal. See fool" note on p 3 and table 59

** The demand projections are discussed in greater detail on pp 169-173 and Fig. 34. See also pp 100-102 for a discussion of the DOE final production goals.

* See footnote on fig. 14 for citation.

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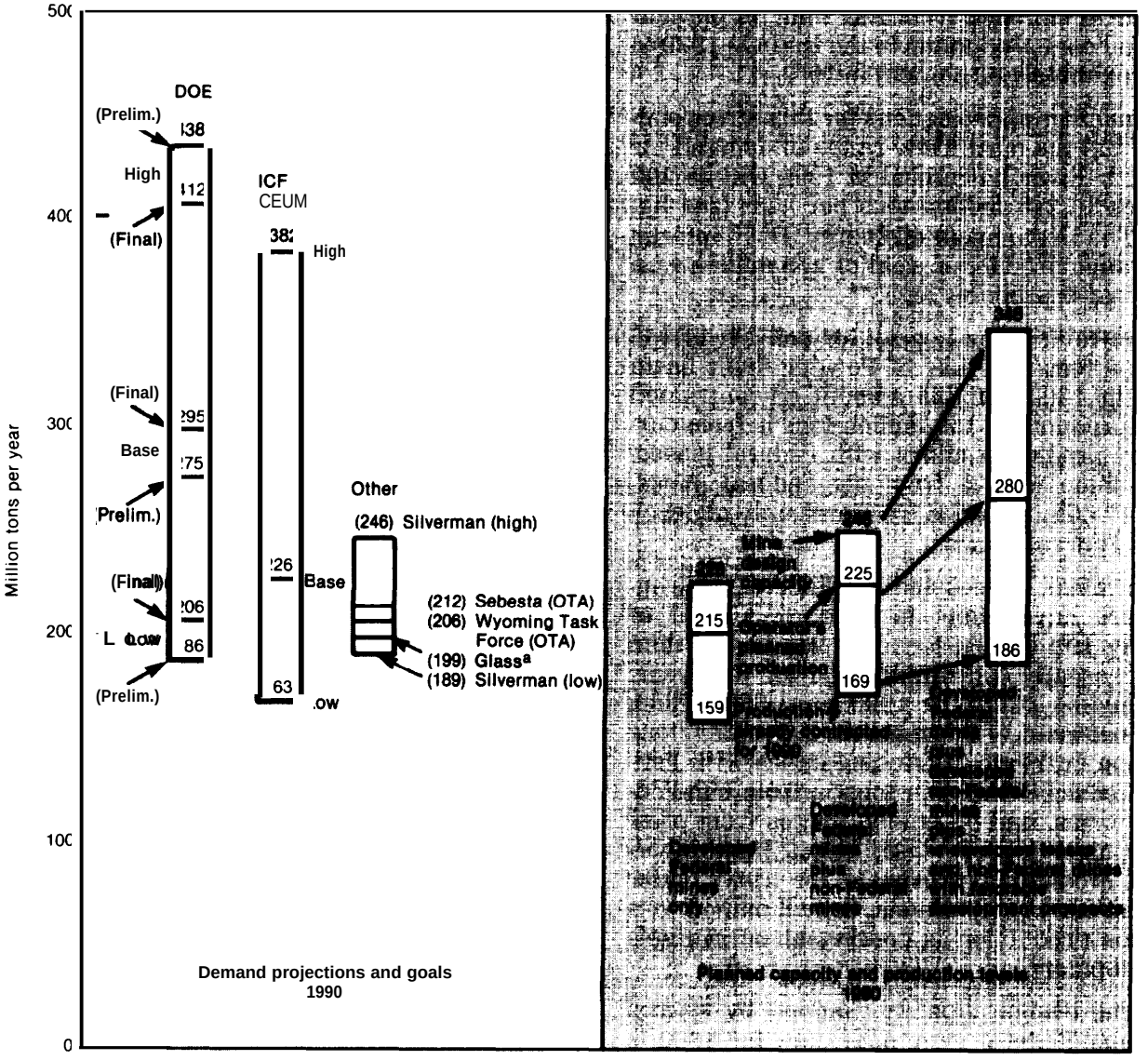
Figure 14.—Comparisons of Powder River Basin Demand Projections With Planned Capacity and Production Levels for 1990



a Calculated by adding Sebesta's figure for the Montana portion of the Powder River Basin (68 mmt) to Glass' figure for the Wyoming portion (133 mmt).

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DOE: The 1980 Biennial Update of National and Regional Coal Production Goals for 1985, 1990 and 1995. U.S. Department of Energy (Washington D.C., January 1981).

questions to be raised about the timing, extent and location of renewed large-scale leasing under the Federal Coal Management Program. The debate focuses on the role of competition and the free market in resource supply, the potential costs to the social and physical environments of the coal producing areas of "overleasing," the length of time needed to bring a new lease into full-scale production, the margin of supply safety needed for prudent planning on a national and corporate level, questions of equity raised by restricted opportunities for new entrants to Federal leaseholding, a fair return to the public for use of its resources, and the levels of likely demand in the early to mid-1990's,

Many proponents of large-scale new leasing in the Powder River basin in the near future cite the long moratorium on such leasing and its effect of restricting entry possibilities to leaseholding as one reason for prompt resumption. They also contend that postponing leasing will unduly interfere with the workings of the free market and will restrict competition. They anticipate high demand for coal by 1995 and fear that the present leased reserve base in the Powder River basin will not provide enough certainty or flexibility to meet that demand efficiently. Opponents of large-scale new leasing in the Powder River basin as scheduled in 1982 cite the potential for overcapacity through the early 1990's as proof that such leasing is not necessary at this time. They contend that leasing can be safely deferred until its necessity is clearly indicated by realistic demand forecasts. They hold that large-scale leasing substantially beyond that necessary to meet likely demand in 1990 will place an unnecessary strain on orderly planning in the communities of the region, shift demand to the Powder River basin that could have been met by Midwestern supply, depress the value of leases so that the public will not receive a fair return for its resources, and, moreover, be unlikely to increase competition significantly.

Factors Affecting Federal Lease Development and Federal Coal Production

There are a number of market, environmental, legal and regulatory, transportation, and socioeconomic factors that could affect Federal lease development and coal production.

Market Factors

Most energy forecasts predict that the major Federal coal States in the West will attract larger shares of the total coal market over the next 10 years. Several studies project that Western coal, which supplied 28 percent of the 1979 U.S. demand, will supply as much as 49 percent of the market by 1990. *

Many factors will influence the demand for Western coal and the competition between Western coal States for markets, but three are particularly significant: demand by domestic electric utilities, growth of new nonutility markets, and transportation availability y and cost.

The principal markets for Western coal are utilities in the Western coal-producing States, the Midwest, and the Southcentral States. The electrical growth rates in these regions will probably be the single most important factor affecting demand for Western coal. Also, growth rates and fuel preferences of utilities for new plants in regions such as California, which currently do not burn coal, and the extent of conversion of existing oil- or gas-fired powerplants to coal will shape Western coal demand. The present new

*Western coal here refers to *all* coal mined west of the Mississippi River.

source performance sulfur dioxide (SO_2) emission standards, which require sulfur reduction of all coals (thus, reducing the cost advantage to utilities of burning low-sulfur coal), and the decline in electrical growth rates in recent years suggest that the growth in Western coal demand might not be as high as some earlier forecasts had predicted.

New nonutility markets could increase the demand for Western coal, These include foreign coal users, particularly Japan, and the incipient domestic synfuels industry, although neither is likely to substantially affect Western coal demand before 1990. Moderate increases in industrial coal use could increase demand for Western coal somewhat.

Access to reliable, efficient, and low-cost transportation is critical to the success of Western coal producers in selling to out-of-State coal markets. In all Western coal regions, coal transportation costs are increasing, Because these costs can account for over 70 percent of the delivered price of coal in out-of-State markets, the competititive position of Western coal in these markets is not likely to be as favorable in the next 10 years as it was in the previous 10 years.

Environmental Factors

Because almost all Federal coal reserves are located in the Western United States, the environmental and reclamation concerns about Federal coal development are largely those characteristic of Western coal mining. The dominant issues include concern about fugitive dust and its impact on the good to very good air quality of the West, the effect of mining on the sparse water resources of the region, the ability to revegetate mined areas with semiarid and arid climates, the effect of various spoil handling and recontouring requirements on the ability to mine coal, the effect of mining and associated population growth on the region's wildlife populations, and the effect of mining on the region's archeologic resources.

Several important laws and regulations have been adopted to deal with these concerns, The effect of these regulations on Federal coal production has been to remove small amounts of minable coal from the recoverable reserve base, to delay development of other recoverable reserves, to increase the complexity of the mine permit process, and to increase the overall cost of mining, The percentage of recoverable Federal reserves currently under lease that may be prohibited, or subject to delay from mining over the next 10 years because of environmental regulations is between 5 percent and 10 percent of the total currently leased reserves.

Less than 1 percent of currently leased Federal reserves appear likely to be subject to complete prohibition from mining. The remainder of currently leased Federal reserves that may be affected may be subject to delays in mining because of unresolved environmental questions, but the available evidence indicates that most of these reserves will be mined. There are additional leased reserves (mainly in the Kaiparowits Plateau in southern Utah) over which there are potential environmental conflicts, but impediments to development of these reserves are primarily related to nonenvironmental factors such as transportation availability. These estimates of Federal leased reserves adversely affected by environmental requirements are considerably lower than earlier estimates by DOI which indicated that as much as 10 percent of leased reserves might not be developed because of environmental considerations.

The Surface Mining Control and Reclamation Act of 1977 (SMCRA) addresses most of the concerns about the environmental effects of Western coal mining. The act establishes performance standards for mining and reclamation and criteria that must be met before mining permits can be approved. The act is administered in the West largely by the States, with oversight responsibility remaining with OSM. Various other statutes, such as the Clean Water Act, the Clean Air Act, and legislation to protect wildlife also affect coal mining operations. Also, the Federal Land Management Policy Act included environ-

mental provisions in the Federal coal leasing program,

The coal mining industry has severly criticized the regulatory programs generated by these statutes. Criticism has centered on overlapping and inconsistent regulations, problems with enforcement, excessive paperwork requirements, and increases in the costs of mining and in the time needed to develop mines,

This report does not evaluate the issues of cost or the lengthened development process caused by regulations nor does it evaluate the extent to which recoverable Federal reserves will be affected by environmental concerns under the renewed Federal coal leasing program. However, this report does examine the amount of currently leased Federal coal that has been or that may be prohibited from development or subjected to extra delay from recovery. Table 4 summarizes the results of this analysis.

Air-quality concerns. North Dakota coal is lignite, which is uneconomical to transport over any distance and which must therefore

Table 4.—Summary of Impacts to Federal Recoverable Reserves From Environmental and Reclamation Considerations

Issue area	Specific issue	Location of affected area	Federal reserves affected[1] (millions of tons)	Effect[2]
Air resources	**Expansion of mine production rate** in a non-attainment area	Rosebud Mine, Colstrip, Montana	1.5 ret/y after 1985 or about 30 mt of reserve	U[3], effect would be to limit production rate, not prohibit any mining areas
	Permitting of additional power plants near class 1 area where SO_2 levels for existing and permitted but not constructed facilities are currently predicted to be at maximum PSD level. The additional power plants would be fueled by lignite mines in the vicinity.	**West Central** North Dakota	<1oo	U[4], improved air quality modelling techniques being developed
Lands unsuitable for mining	Impacts of coal mining will damage important aesthetic values of Bryce Canyon National Park	Alton Coalfield, Southern Utah	24	Ap[5]-on portion of proposed mine area designated as unsuitable; rest of leasehold unaffected.
Water resources	Subsidence of mine will divert surface and ground water and adversely affect other uses	Mt. Gunnison Mine West Central Colorado	23	U, approval likely if mine will buy or replace senior water rights affected.[6]
	Alluvial Valley floor (AVF) in areas significant to farming	CX Ranch leases Montana portion of the Powder River basin	<100	Ap uncertain[7]
	Developed mines with stream valleys under study as potential AVF where mine plan development has been delayed	Powder River basin, Buckskin, and Spring Creek mines	95	D, mining of valleys expected[8]
	Designated AVF in developed mines. Valleys not significant to farming. Mine plan development affected	Powder River basin, Eagle Butte, Rawhide, Coal Creek mines	61	U, mining of valley expected[9]

Table 4.—Summary of Impacts to Federal Recoverable Reserves From Environmental and Reclamation Considerations—Continued

Issue area	Specific issue	Location of affected area	Federal reserves affected [1] (millions of tons)	Effect[2]
	Potential alluvial valley floors which existed in developed mines prior to passage of SMCRA. Reclamation plans must still be approved	Powder River basin, Big Sky, East Decker, Eagle Butte, Wyodak, Belle Ayr, Jacobs Ranch, and Black Thunder mines	240	U, mining of valleys expected*
	Potential AVFS in undeveloped coal lease areas	Powder River basin	219	U, mining of most valleys expected[8]
Spoil handling and protection of raptor habitat	Limitation on out-of-pit spoil area	Black Butte Mine Green River-Hams Fork region	5	Ap[10]
	Limitation on out-of-pit spoil area	Green River-Hams Fork region	50	Possible problem; resolution uncertain [6,9]
	Mining in environmentally sensitive woody draws	Glen Harold Mine West Central North Dakota	29	D[11]

[1]Total Federal reserves under lease are 16,500 million tons.
[2]Ap-absolute prohibition; D-delay in approval, U-unresolved.
[3]Jurisdiction lies with the Montana Department of Health and Environmental Sciences
[4]Jurisdiction lies with the North Dakota State Department of Health.
[5]Decision made by the Department of the Interior, 1980. Decision under appeal to Federal courts
[6]Jurlsdtction lies with Colorado Department of Natural Resources and U.S. Office of Surface Mining
[7]Under Section 510(b)(5) of SMCRA. Jurisdiction lies with the Montana Department of State Lands The department has ruled that the alluvial valley floor is significant to farming. The lessee has asked the department to reconsider its decision.
[8]Jurisdiction lies with Montana Department of State Lands (Spring Creek) and Wyoming Department of Environmental Quality (Buckskin)
[9]Jurisdiction lies with Wyoming Department of Environmental Quality
[10]Lead decision made by OSM
[11]Permit application denied by North Dakota Public Service Commission on grounds that plans for reclamation of wooded draws were inadequate

be sold to onsite or nearby powerplants or synfuels facilities. Permitting of additional coal conversion facilities in west-central North Dakota is currently being delayed, pending further information on the effect of existing and permitted plants on the air quality of nearby Theodore Roosevelt National Park.

Additional Federal coal development could be affected by possible fugitive dust problems. At Colstrip, Mont., where fugitive dust levels presently exceed ambient air standards, future mine expansion will have to address and minimize air impacts.

Lands unsuitable for mining. In Utah, 24 million tons of Federal coal have been removed from mining because of adverse impacts on nearby Bryce Canyon National Park. The remainder of the leased surface minable reserves in the area, about 270 million tons, are unaffected by the decision. The decision has been challenged in Federal court.

Water resource concerns could affect over 700 million tons of Federal recoverable reserves. However, less than 100 million tons may be prohibited from mining. These reserves are located beneath an alluvial valley floor significant to farming and thus can be absolutely prohibited from mining under SMCRA. * Alluvial valley floor concerns may affect another 600 million tons; however mining of these reserves is likely, with especially stringent reclamation standards applied. Development of over 20 million tons may hinge on purchase or replacement of senior water rights that could be affected by mine subsidence.

*The Montana Department of State Lands has ruled that the alluvial valley floor in question is significant to farming. The lessee has asked the Department to reconsider its decision.

Spoil handling and protection of raptor habitat* have removed 5 million tons of Federal recoverable reserves from mining in southern Wyoming. Spoil handling concerns could affect perhaps as much as another 50 million tons in southern Wyoming and northern Colorado. Development of 29 million tons has been delayed in west-central North Dakota because of concerns about reclamation of wooded draws.

In summary, approximately 1 billion tons of leased Federal recoverable reserves out of 16.5 billion tons of leased Federal recoverable reserves have been or could possibly be affected in the following ways by environmental laws and regulations:

- 29 million tons have been absolutely prohibited from mining;
- up to another 100 million tons may be absolutely prohibited from mining;
- 124 million tons have been delayed in the approval process;
- 573 million tons could be affected or delayed but approval is likely; and
- up to another 150 million tons could be affected or delayed and approval is uncertain.

Several reclamation issues where further data are needed or where regulatory decisions have yet to develop a clear pattern, such as the long-term success of revegetation, the hydrologic effects of mining, and the ability to achieve approximate original contour, have not yet resulted in any prohibitions to mining but could become important issues in the future. The long-term success of reclamation in the West is still unproven, but regulatory authorities have approved continued mine expansion based on the short-term success achieved to date.

Laws and Regulations on Management of Existing Federal Leases

The development of existing Federal coal leases may be affected to varying degrees by the resolution of the following legal issues:

- application and enforcement of diligent development requirements;
- exchange of lease and PRLA reserves for unleased Federal coal;
- processing of pending PRLAs; and
- designation of areas unsuitable for surface mining under SMCRA.

Diligent Development

Under current regulations, leases issued before passage of the Federal Coal Leasing Amendments Act of 1976 (FCLAA) (pre-FCLAA leases) that do not produce 2 l/z percent of the lease's logical mining unit reserves by June 1, 1986, can be canceled, Extensions to this diligence deadline may be granted by the Secretary of the Interior under certain circumstances; however, lack of markets is not solely a basis for extensions. Leases issued after August 4, 1976 (post-FCLAA leases) will be terminated automatically if they do not produce coal in commercial quantities within 10 years after the lease is issued. Section 3 of FCLAA (30 U.S.C. 201(a)(2)(A)) also provides that, with a few exceptions, after August 4, 1986, no new leases can be issued to any lessee who is still holding a coal lease from which he has not produced coal for 10 or more years.

The current regulations defining diligence as actual production of coal were first promulgated in May 1976 in response to concerns over the large amounts of Federal coal that had been leased in the 1960's during a period of declining Federal coal production.

Since May 1976, the diligence regulations have been modified slightly to include provisions required by FCLAA and minor editorial clarifications, but the production requirements for pre-FCLAA leases have remained virtually unchanged. *

According to OTA's analysis, under existing regulations, many pre-FCLAA leases

*Especially eagle habitat.

*In 1977, **the Department of** Energy organization" Act transferred the Secretary of the Interior's authority to establish diligence requirements and minimum production rates for Federal leases to the Secretary of Energy.

will meet diligence by the 1986 deadline or, with extensions, by 1991; a number of others will not and prospects for some remain uncertain. (See Diligent Development section on p. 21,) Since the current diligence standard could change within the broad limits set by statute as a result of policy redirection or court decisions, it is difficult to predict the precise impact of diligence requirements on pre-FCLAA leases.

DOI's diligence standard requiring production of coal on existing leases within 10 years was opposed by mining industry trade groups and many lessees. Legal challenges by lessees to the reasonableness of the regulations and their applicability to pre-FCLAA leases are likely.

The impact of diligence requirements on pre-FCLAA leases will depend on the interact ion of many factors besides the legal precedents that may be established on the applicability of the regulations. These factors include: 1) the extent of voluntary compliance by lessees; 2) how many extensions to the 1986 deadline are granted; 3) how many existing leases are combined with other leases or non-Federal coal reserves to meet diligence by forming an approved LMU; 4) how LMU reserves are defined for each lease: 5) the extent to which leases are readjusted on schedule; 6) the extent of effective enforcement of the 1976 regulations by DOI and the Department of Justice; and 7) how many nonproducing leases are relinquished,

Exchanges

Because of requirements in FCLAA that all new leases must be offered by competitive bid, the possibilities for trading new Federal leases for Federal leases where mining poses problems is limited to exchanges specifically authorized by Congress and to leases in alluvial valley floors where mining is prohibited by SMCRA. The congressionally authorized exchanges would offer unleased Federal coal for relinquishment of certain existing leases in Wyoming and New Mexico and PRLAs in Utah, and for contested leases on Indian lands in Montana, Exchanges of non-Federal coal lands in alluvial valley floors that cannot be mined for available Federal coal reserves is also authorized under SMCRA. Generally, to be approved by DOI, the tracts exchanged must be approximately equal in value and the exchange must serve the public interest. Exchanges can thus offset possible losses in coal production from areas that cannot be mined.

Preference Right Lease Applications

Processing of the 176 PRLAs over the next 3 years will confront several legal, administrative, and procedural issues before the potential for coal production from pending applications will be known. Among the questions to be resolved are: 1) how many PRLAs will be affected by conflicting mining claims, 2) how many rejected prospecting permits and PRLAs will be reinstated on appeal, and 3) how many PRLAs will fail to meet the more stringent commercial quantities test for discovery of a valuable deposit. The production potential from PRLAs could range from 35 million to 60 million tons per year in the 1990's, depending on the extent that legal, planning, and environmental considerations affect the issuance of preference right leases. * This is considerably less than earlier estimates made by DOI on production potential from PRLAs but still represents a significant contribution from Western coal in the 1990's.

Areas Unsuitable for Mining

Section 522 of SMCRA allows DOI to designate areas on Federal lands as unsuitable for mining. Two petitions affecting Federal coal have been filed. One petition involving existing leases in southwestern Utah has been decided, In December 1980, the Secretary of the Interior declared 8 percent of the leased surface minable reserves in the Alton area (about 24 million out of 290 million tons) as unsuitable for mining because of ad-

*This range includes about 10 million tons of PRLA production capacity associated with new mines on existing Federal leases. Additional PRLA production is possible from PRLAs in eastern Colorado and Wyoming if a very strong demand arises for coal that is suitable for synthetic fuels development in the 1990's.

verse impacts on nearby Bryce Canyon National Park. The Secretary found that mining activities would significantly reduce visibility and scenic vistas from park overlooks and increase noise levels in the park, damaging the values for which the park was established and the experience of the park's visitors. The decision has been challenged in Federal court in Utah by both the environmental groups who brought the petition and by the Alton lessees.

The second petition submitted jointly to OSM and the State of Montana involves intermingled Federal, State and private lands in the Tongue River area of Montana, The petition area does not cover any existing Federal leases but does include the non-Federal Montco Mine with a proposed capacity of 12 million tons per year as well as areas under consideration for the 1982 Powder River region coal lease sale.

Transportation Considerations

The two most important modes of transporting Western coal in 1979 were by rail and wire. Railroads originated more than 60 percent of all Western coal production in 1979. Most Federal coal was hauled by rail to utilities. Mine-mouth and other nearby generating plants use locally mined coal and distribute it as electricity through high-voltage transmission lines.

Other transport modes are currently less important to Western coal production. Only one coal slurry pipeline presently operates, It has a 4.8-million-ton-per-year capacity. Trucks handle about 15 percent of Western coal tonnage, mainly for local markets in Utah and Colorado. About 2 percent of Western coal is moved by rail to port terminals on the Great Lakes, and another 4 percent to river connections, About 23 percent was moved by tramway, conveyor, or private railroad.

The Western rail transportation network has the ability to increase its capacity to move coal from mine to market during the 1980's and 1990's. Most Federal coal leases are and will be served by rail. The mine-to-market transportation cost of Western coal ranges from about 10 percent to over 70 percent of delivered fuel costs and constitutes an important factor in determining future demand. The existing rail transportation network in the West was generally adequate to move coal production from Federal leases and private tracts in 1980, although a number of specific bottlenecks have been identified. The principal constraint that might materialize in moving leased coal to its markets is the willingness of the railroads to invest sufficient capital in time to satisfy demand for increased rail service from all shippers, including Federal coal,

Increasing amounts of Federal coal are likely to be burned at nearby powerplants and the electricity transmitted by wire. However, plans for construction of powerplants in the West to export electricity must consider air quality standards, competition for water, and possible opposition to granting of rights-of-way for high-voltage transmission lines. These plants are attractive to utilities which own both the generating plant and distribution system and, thereby, become independent of other carriers. Various studies have reached different conclusions regarding the relative cost efficiency of rail v. wire transportation.

Although coal slurry pipelines have not played a significant role in coal transportation to date, a number of slurry pipelines are planned or proposed. Nearest to construction is the Energy Transportation Systems Inc. line that is planned to ship 25 million tons per year of Powder River basin coal to Oklahoma, Louisiana, and Arkansas. OTA found in an earlier study* that:

> . . . [coal slurry pipelines] . . . do represent under some specific circumstanecs the least costly available means for transporting coal measured in economic terms.

*Office off Technology Assessment, U.S. Congress. Coal Slurry Pipelines, Summary, Washington, D.C., U.S. Government Printing Office, September 1980) p. 8 This summary updates an earlier report. *A Technology Assessment of Coal Slurry Pipelines* (Washington, 1). (:.1' S Government Printing [)ffice. March 1978).

This report also stated that:

> . . . the introduction of coal slurry pipelines is not likely to affect materially the rate of coal resource development and use on a national scale. It may, however, affect the regional pattern of coal mining and distribution in such a way as to expand the use of Western coal to greater distances from its area of origin,

Revenues and Socioeconomic Considerations

Energy development, including recent large-scale coal mining, has frequently brought rapid growth to Western rural towns. Many communities have been hard pressed to deal with the sudden influx of people. Typically, they have found themselves short of housing, municipal services, health care facilities, and other elements of an extensive community infrastructure. Some towns have shown symptoms of social disruption, such as increased crime, alcoholism and suicide, and of economic dislocation, such as local business failures and labor shortages.

The communities have had varied degrees of success in coping with these boomtown problems. Mitigation is complicated because it is hard to anticipate which towns are apt to have severe difficulties. Both public and private sectors are engaged in preventive efforts; industry actively participates because successful mitigation helps stabilize its work force.

The ability to solve the problems is hampered by a lack of timely revenues; expanded facilities and services are needed before new local taxes are available, Planning and construction must start in the early stages of rapid growth, but this is before mines or other industries come on the local tax rolls. Several ways have been used to meet the early costs. These include State revenue mechanisms, such as severance taxes, and private contributions, such as the prepayment of taxes. The States' share of Federal mineral leasing revenues can be used, but these payments do not increase substantially until coal is produced. Consequently, State and local governments have looked to other Federal programs for assistance.

Each Western State (except Alaska) receives 50 percent of the revenues from mineral leases of public lands in the State. These funds are distributed according to priorities set by each State legislature. Section 10 of FCLAA directed OTA to provide an estimate of future rentals and royalties from existing Federal coal leases. Based on potential production and expected coal prices for each region, OTA has derived estimates for 1986 and 1991. Table 5 shows the current allocation and estimates by State. The estimates indicate a substantial increase over the amount

Table 5.— Federal Royalties and State Distributions From Potential Coal Production on Federal Leases 1980 (actual), 1986, and 1991 (estimated)

State	1980[a] Federal lease production (millions of tons)	1980[a] Royalty total (millions of dollars)	1980[a] State share (millions of dollars)	1986[b] Federal lease production (millions of tons)	1986[b] Royalty total (millions of dollars)	1986[b] State share (millions of dollars)	1991[b] Federal lease production (millions of tons)	1991[b] Royalty total (millions of dollars)	1991[b] State share (millions of dollars)
Colorado	9.4	8.9	4.5	27	49	24	33-40	78-94	39-47
Montana	10.4	2.7	1.3	23-31	21-27	10-14	25-40	23-37	12-19
New Mexico	6.3		3.5	9-11	15-16	7-8	12-16[c]	21-28[c]	11-14C
North Dakota	0.6	(0.3)	0	about 6	about 4	2	6	5	2
Utah	8.7	4.5	4.4	26	48	24	34-66	64-122	32-66
Wyoming	33.4			113-150	57-71	28-36	133-238	145-258	73-129
Total (West)	68.8	31.5	16	204-250	193-215	95-108	245-405	336-544	168-277

Details may not add to totals because of independent rounding.

[a] U.S. Department of the Interior, Geological Survey, **Conservation Division Federal and Indian Lands, Coal, Phosphate, Potash, Sodium,** and Other Mineral Production, Royalty Income, and Related Statistics, Calendar Year 1980 (June 1981).

[b] Royalty estimates assume timely readjustment of leases to a minimum royalty of 125 percent for surface coal and 8 Percent for underground coal

[c] Excludes about 8 million tons of Federal PRLA production and about $15 million in PRLA royalties.

SOURCE: Off Ice of Technology Assessment.

of revenues distributed in 1980, These revenue increases come primarily from expanded Federal production and readjustments to the higher royalty rates required by FCLAA,

There is, however, considerable debate over whether existing private and governmental programs will be adequate to meet the financing and other needs arising from the management of energy development growth. Federal coal development in the 1980's, especially in areas where other kinds of rural industrialization (such as synfuels and powerplant development) are occurring, could strain the capacities of communities in the Powder River basin, the western slope of Colorado, central and southern Utah, and the San Juan basin of New Mexico.