

Economic Commentary

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The Shift to Western Coal

by Gerald H. Anderson

The U.S. coal industry has taken on an increasingly important role in recent years as a source of energy. The Organization of Petroleum Exporting Countries (OPEC) has increased the price of oil 15-fold since 1973, making coal a lower-priced alternative. For example, the delivered cost of oil purchased by electric utilities in 1982 has averaged \$4.81 per million Btu's, while coal has cost \$1.65 per million Btu's. The prospect that oil will become more scarce as energy demand grows also increases coal's attraction, because it is a much more abundant mineral. Moreover, the embargo that some OPEC nations imposed on oil shipments to the United States in 1973-74 made Americans realize the importance of this nation's domestic coal reserves.

U.S. coal production historically has been concentrated in Appalachia, which produced 69 percent of

the nation's coal supply in 1970. By 1981, Appalachia's share of U.S. coal production dropped to 52 percent (see table 1).¹ In the same period, coal producers in the western United States increased their share of national coal production from 6 percent to 27 percent, providing 87 percent of the increase in national coal output.

Because western coal is cheaper than other American coals and because it is closer to areas of market growth, it is likely to play an increasingly important role in U.S. coal production. Western coal also is lower in sulfur content than midwestern and Appalachian coals—a major factor in conforming to state and federal regulations on sulfur emissions. These causes of the westward shift in coal production are examined in this *Economic Commentary*.

1. The western coal states include Alaska, Arizona, Colorado, Montana, New Mexico, North Dakota, Utah, Washington, and Wyoming. Midwestern producers are in Arkansas, Illinois, Indiana, Iowa, Kansas, western Kentucky, Missouri, Oklahoma, and Texas. The Appalachian coal region includes Alabama, Georgia, eastern Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia.

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goals of avoiding land scarring and water pollution have led to the Surface Mining Control and Regulation Act of 1977, which has raised coal-mining costs.

Coal-mining costs also have been increased by efforts to protect worker health and safety. The Coal Mine Health and Safety Act of 1969 is believed to be the primary cause of the 26 percent decline in coal output per miner per day between 1969 and 1978. Worker productivity at underground mines fell 46 percent in the same period, after tripling in the preceding two decades; productivity at surface mines fell by 28 percent. The smaller loss of productivity in surface mines enhanced the cost advantage of western coal. Between 1978 and 1981, however, workers' productivity increased 16 percent in underground mines and 10 percent in surface mines.

With so many conflicting forces affecting domestic coal demand, it is difficult to project how much domestic coal consumption will grow. Most observers, however,

agree that energy demand will increase too rapidly to be met, at least over the next few decades, without a very large increase in coal production. One study, using conservative assumptions, projects domestic energy consumption to expand 32 percent between 1977 and 2000. Coal's share of domestic energy is seen increasing from 19 percent to 30 percent in the period, as oil and gas consumption fall and growth of nuclear, solar, and other energy sources is insufficient to meet growing needs. The result would be a doubling of domestic consumption of coal in the period. Using more optimistic (for coal) assumptions, coal consumption could triple by the year 2000 as coal's share of domestic energy increases to 38 percent.⁶ In conclusion, it appears that, with domestic coal consumption and coal exports growing strongly in the years ahead, the outlook is bright for domestic coal production.

6. *Coal—Bridge to the Future*, p. 245.

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ton annual rate. Coal is expected to supply more than one-half of the world's additional energy needs during the next 20 years, and doing so will require at least a ten-fold increase in world trade in steam coal.³ (Coals are of two types—steam and metallurgical. Metallurgical coals have a high carbon content and low content of volatile matter and are used to add carbon in steelmaking; steam coals have a lower carbon content and a higher percentage of volatile matter than metallurgical coals and are used primarily as a heat source.) U.S. coal exported to Europe currently is higher-priced than coal from other major suppliers—Australia, Poland, and South Africa—and is on a par with coal from Canada.⁴ U.S. coal will continue to be in demand abroad, however, even if it is somewhat higher-priced, because of consumers' preference for diversifying their sources and because the United States is likely to be a reliable supplier. U.S. market share will be affected, however, by the size of the gap between delivered prices of U.S. and foreign coals.⁵ In the past, Appalachian coal producers have dominated exports, which have consisted mostly of metallurgical coals. Steam coal is the growth product in coal exports, however, and western producers seem likely to obtain a larger share of that

market, particularly as western and Gulf port facilities are improved. That appears to be happening already: western producers' share of U.S. coal exports has increased from 0 percent in 1979 to 4.4 percent in 1981.

Coal's share of the domestic energy market is affected by the conflicting impacts of the pursuit of energy-related national goals. Energy independence would be advanced by using domestically produced coal instead of imported oil to generate electricity, and federal law currently requires some utilities to convert from oil to coal. Preserving natural gas for use in home heating and for industrial processes that require clean fuel also is advanced by burning coal in generating plants. Use of coal will increase in the future for production of synthetic fuels to substitute for costly oil and natural gas. Coal gasification, for example, converts coal into clean-burning natural gas. Avoiding nuclear hazards and nuclear wastes also argues for burning coal. While national policy on nuclear energy is by no means clear, the combination of rising capital costs of nuclear plants and strong opposition from environmentalists has sharply curtailed the move toward nuclear power and has increased utilities' preference for coal.

Pursuit of other national goals discourages coal use. The goal of cleaner air argues against burning coal, particularly high-sulfur coal. In fact, in the early 1970s, the federal government required some electric utilities to convert from coal to cleaner-burning oil. The

3. *Coal—Bridge to the Future*, Report of the World Coal Study, Ballinger Publishing Company, 1980, p. xvi.

4. *Coal—Bridge to the Future*, p. 126.

5. U.S. Department of Energy, *Interim Report of the Interagency Coal Export Task Force*, January 1981, pp. 4-6.

Table 1 U.S. Coal Production by Region: 1970-81

Region	1970		1981		Change, 1970-81		
	Million short tons	Share, percent	Million short tons	Share, percent	Million short tons	Percent	Share of total change, percent
Appalachia	417.8	69	430.3	52	12.4	3	6
Midwest	149.9	25	166.0	20	16.1	11	7
West	35.1	6	224.5	27	189.4	539	87
United States	602.8	100	820.8	100	217.9	36	100

SOURCES: The President's Commission on Coal, *Coal Data Book*, February 1980, p. 93; U.S. Department of Energy, *Coal Distribution January—December 1981*, p. 10.

Causes of the Westward Shift

The primary reason that western coal is capturing an increasing share of the market is that it is cheaper than other American coals. Montana and Wyoming coals, for example, sell at the mine for about one-half the price of Ohio coal, when prices are quoted per million Btu's.² The major source of the west's price advantage is that almost all western coal is surface-mined. Coal output per miner per day is about three times higher at surface mines than at underground mines. (Underground mining requires workers to bolt ceilings, install lighting, control dust, and provide ventilation, tasks generally not needed at surface mines.) Western coal seams are from 20 feet to 100 feet thick; thicker seams reduce mine preparation and land restoration costs for a given yield

2. Prices are compared per million Btu's instead of per ton, because coals from different regions differ significantly in energy content.

and lead to larger mines and economies of scale in both mining and shipping. Also, western coal generally has relatively little overburden (soil and rock that covers the coal) to be removed for surface mining.

In contrast, only about one-half of Appalachian coal is surface-mined, with the balance produced from more expensive underground operations. Moreover, because Appalachian coal fields have been mined longer, many of the more accessible deposits have already been exploited, and the remaining deposits are more costly to work.

A second reason for the dramatic increase in western coal production is its proximity to the areas where U.S. coal consumption is growing most rapidly. The West North Central, West South Central, Mountain, and Pacific census regions nearly quadrupled their combined coal consumption between 1970 and 1980, and accounted for 84 percent of the increase in national consumption (see table 2). Coal consumption expanded by less than 7 percent in

Table 2 U.S. Coal Consumption by Region: 1970-80

Census region	Million short tons		Change, 1970-80	
	1970	1980	Million short tons	Percent
New England	3.6	1.8	-1.8	-50.0
Middle Atlantic	91.0	79.4	-11.6	-12.7
South Atlantic	91.6	119.4	27.8	30.3
East North Central	206.0	207.9	1.9	0.9
East South Central	69.2	83.9	14.7	21.2
Subtotal	461.3	493.3	32.0	6.9
West North Central	35.1	83.6	48.5	138.2
West South Central	1.1	66.0	64.9	5900.0
Mountain	20.2	72.1	51.9	256.9
Pacific and Alaska	3.3	10.9	7.6	230.3
Subtotal	59.8	232.6	172.8	289.0
U.S. total	521.1	725.9	204.8	39.3

SOURCES: U.S. Department of the Interior, *Minerals Yearbook 1970*, vol. 1, p. 377; and U.S. Department of Energy, *Coal Distribution January—December 1980*, p. 81.

the other census regions in the same period.

Coal consumption has increased in the western United States mostly in response to an increased demand for energy rather than to replace high-priced oil and natural gas. About 72 percent of U.S. coal is used to generate electricity. In most western regions, oil and gas use in electricity generation either grew or was unchanged, while consumption of coal for that purpose expanded sharply. Only in the West North Central census region did annual consumption of oil and gas to generate electricity actually decline between 1970 and 1980; however, the decline was by the equivalent of only 13 million tons of coal, while actual consumption of coal to generate electricity expanded by 49 million tons.

A third advantage of western coal is its low sulfur content, which is preferred by consumers trying to reduce pollution-abatement costs. Low-sulfur coal (i.e., coal with 1 percent or less sulfur content) accounts for more than three-fourths of western coal reserves; only 2 percent of midwestern and 28 percent of Appalachian coal reserves are low-sulfur coal. Sulfur in coal is a significant pollutant. When burned, sulfur forms malodorous sulfur dioxide, which in turn forms corrosive sulfuric acid when combined with water. Burning coal thus produces acid rain, although coal's relative importance as a source of acid rain is hotly disputed. Utility plants that burn coal are estimated to be the source of about three-fifths of U.S. emissions of sulfur dioxide. The Clean Air Act

Coal in the Fourth District

States in the Fourth Federal Reserve District are major producers and consumers of coal. Kentucky, West Virginia, Pennsylvania, and Ohio ranked first, second, fourth, and seventh, respectively, in coal production in 1980, and together accounted for nearly one-half of national coal production. In consumption, Ohio ranked first among the states in 1981, using 9 percent of the nation's coal. Pennsylvania ranked third, West Virginia sixth, and Kentucky eighth, and together the four states accounted for more than one-fourth of U.S. coal consumption.

Despite the loss of market share to western states, coal-mining employment has increased in Fourth District states. Between 1970 and 1980, coal-mining employment expanded 68 percent in Kentucky, 60 percent in Pennsylvania, 57 percent in Ohio, and 13 percent in West Virginia. These employment increases resulted from a sharp decline in coal output per worker per day and a moderate increase in coal output.

Sulfur contents of coals produced in Fourth District states vary widely. Ohio and western Kentucky produce mostly high-sulfur coal, while Pennsylvania produces mostly medium-sulfur coal. West Virginia and eastern Kentucky produce mostly low-sulfur coal.

of 1968 and its 1970 and 1977 amendments are intended to reduce emissions of sulfur dioxide and other pollutants from coal and other sources. The low sulfur content of western coal will remain a significant competitive advantage unless there is a reversal in concern about air quality, or sulfur emission control technology becomes less expensive.

Western coal production has increased despite the fact that eastern coal has a significantly higher energy content. Most Appalachian coal is bituminous, averaging about 24.5 million Btu's per ton. Western coal is mostly sub-bituminous and lignite, averaging 17 million Btu's per ton and 14 million Btu's per ton, respectively. Higher energy content reduces the costs of mining, transporting, and handling coal

at electricity-generating stations for a given energy yield.

Outlook for U.S. Coal Production

Both domestic coal consumption and coal exports are likely to continue growing, providing opportunity for all coal-producing regions to increase their output. Because of their competitive advantages, however, western producers probably will take a greater share of the coal market.

Exports of U.S. coal are likely to continue growing. U.S. coal exports expanded from 66 million tons in 1979 to 113 million tons in 1981. Despite the current worldwide recession, which should retard demand for coal, U.S. coal exports in the first seven months of 1982 expanded slightly to a 114-million