ESTIMATED CUMULATIVE PRODUCTION OF COAL FROM THE APPALACHIAN BASIN

Future cumulative production of coal ($ECP_{(100)}$) from the Appalachian basin may be estimated by calculating the economic recoverability of known coal resource tonnages and (or) by projecting historical production trends into the future. Potential coal reserves for the Appalachian basin (the amount of coal potentially economically recoverable) were obtained by applying coal availability and coal recoverability factors and current production and reserve decline rates to estimates of original coal resources made by various government agencies (table 2). In general, coal recoverability studies indicate that about 10 percent of the original coal resources in the Appalachian basin are economically recoverable. In addition, approximate reserve estimates may be made by extrapolating current production decline trends into the future. In regions characterized by high-sulfur coal, such as Ohio and western Pennsylvania, declining production trends may provide a better estimate of the amount of economically producible coal in the current production cycle than calculations using availability and recoverability factors. For comparison, the resource assessment of Averitt (1975) was used as a base for calculating potential coal reserves, utilizing both historical production data and availability and recoverability factors. The two estimates of remaining reserves, 25.8 and 27.3 billion tons, respectively, differ by only a few percent. These estimates ($ECP_{(100)}$) are considered valid only for the current cycle of coal production and utilization. The reserve estimate will change as economic conditions change, as the technology of coal mining and utilization improves, and as societal concerns and limitations evolve. Indeed, the remaining large resources of coal in the northern part of the Appalachian basin, which are currently only marginally economic because of their high sulfur content, may eventually become the coal reserves of the future.

The coal reserve estimate for the Appalachian basin of 55.4 billion tons made by the Energy Information Administration (EIA) (1996) of the U.S. Department of Energy (table 3) is considerably higher than the estimates determined in this report. Of the amount reported by EIA, approximately 40 percent is classified as high-sulfur coal, which has limited value in today's market. In summary, depending on future trends and uses for the remaining coal in the Appalachian basin, estimated cumulative production ($ECP_{(100)}$) could range from about 60 to 90 billion tons. Scenarios based on declining production trends for 26, 32, and 55 billion tons of potential reserves are plotted for comparison (figs. 12, 13, 14, respectively). These projections cannot be considered to reflect accurately the rate of future coal production. Instead, they illustrate only a range of possible production scenarios that might occur, depending on the demand for high-sulfur coal). In general, the projections indicate that annual production from the Appalachian basin will fall below 200 million tons sometime between the middle and end of the 21st century. Supporting this conclusion is the data on reserves at mines published annually by DOE/EIA (Energy Information Administration, 1996). In the 18 years between 1978 and 1996, reserves at Appalachian mines declined by about 6 billion tons, from a little more than 10 billion to a little more than 4 billion tons (fig. 15). In contrast, coal reserves at mines in the Western States are not declining. Instead, reserves are added as fast as coal is produced, so that there is little net change in reserves from year to year (Energy Information Administration, 1982-1993 and 1994-1997).

CONCLUSIONS

The maps illustrate that there are three major groupings of counties, or supply regions, for coal produced from the Appalachian basin. These occur in the northern part of the basin, in Pennsylvania, Ohio, and northern West Virginia; in the central part of the basin, in southern West Virginia, eastern Kentucky, and southwestern Virginia; and in the southern part of the basin, Alabama. Many of the surrounding counties currently produce coal in low to moderate amounts and these counties commonly have relatively small resources of high-quality coal that can be produced inexpensively.

Except for Greene County, Pa., and Marshall County, W. Va., counties in the northern supply region are generally many years past peak production. Although several of the counties in this region have produced about a billion tons each, their current annual production is low. The sulfur content of coal produced in the northern supply region is generally moderate to high (Attanasi and Milici, 1998), which makes these deposits relatively uneconomic because of the restrictions imposed by the Clean Air Act of 1963 as amended (EIA, 1997). Large blocks of coal that can be mined underground with relatively low-cost, longwall mining methods, however, can be produced economically and this coal can be utilized by power plants equipped with scrubbers.

In contrast, counties in the central supply region are at or near peak production; county cumulative production is moderate to high and the current annual production from these counties is commonly moderate to high. The sulfur content of coal produced from these counties is comparatively low (Attanasi and Milici, 1998), so that coal from this region is valued for consumption in power plants as well as for other industrial purposes. Because of its relatively low sulfur content, much of the coal in the central supply region can be mined economically by large-scale surface mines as well as underground by longwall mining methods. The southern supply region in Alabama is relatively small and consists of three coal-producing counties that are generally above average in terms of current production of good quality coal. The sulfur content of coal in this region is generally moderate.

Without improved technology to facilitate the economic mining of remaining coal resources from thinner and deeper beds, and investment in scrubbers by the electric power industry that will permit the consumption of high-sulfur coal in power plants, coal production in the Appalachian basin can be expected to enter a period of long decline, thus decreasing employment in and taxes from the coal industry.

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CURRENT (1996) ANNUAL COAL PRODUCTION BY COUNTY

The map of 1996 coal production from the Appalachian basin (sheet 4) illustrates the current state of the industry. In the northern part of the basin, only Greene County, Pa., and Monongalia County, W. Va., produced more than 10 million tons in 1996. Eleven counties in the central part of the basin, including 2 in Virginia, 5 in Kentucky, and 4 in West Virginia continue to produce more than 10 million tons each annually. Jefferson County, Ala., was the only county in the southern part of the basin to produce more than 10 million tons of coal in 1996.

Comparison of the 1996 coal production map with a map that shows the variation of sulfur content in washed Appalachian coals (Attanasi and Milici, 1998) illustrates the current emphasis of industry in mining the low-sulfur coals in West Virginia, eastern Kentucky, Virginia, and Alabama. In the Appalachian basin, intermediate- to high-sulfur coals occur generally in a broad band that extends from western Pennsylvania, western Maryland, and northern West Virginia, westward into Ohio. The very high content of sulfur in Ohio's coals (greater than 2.5 percent) limits its use for power generation into the forseeable future.

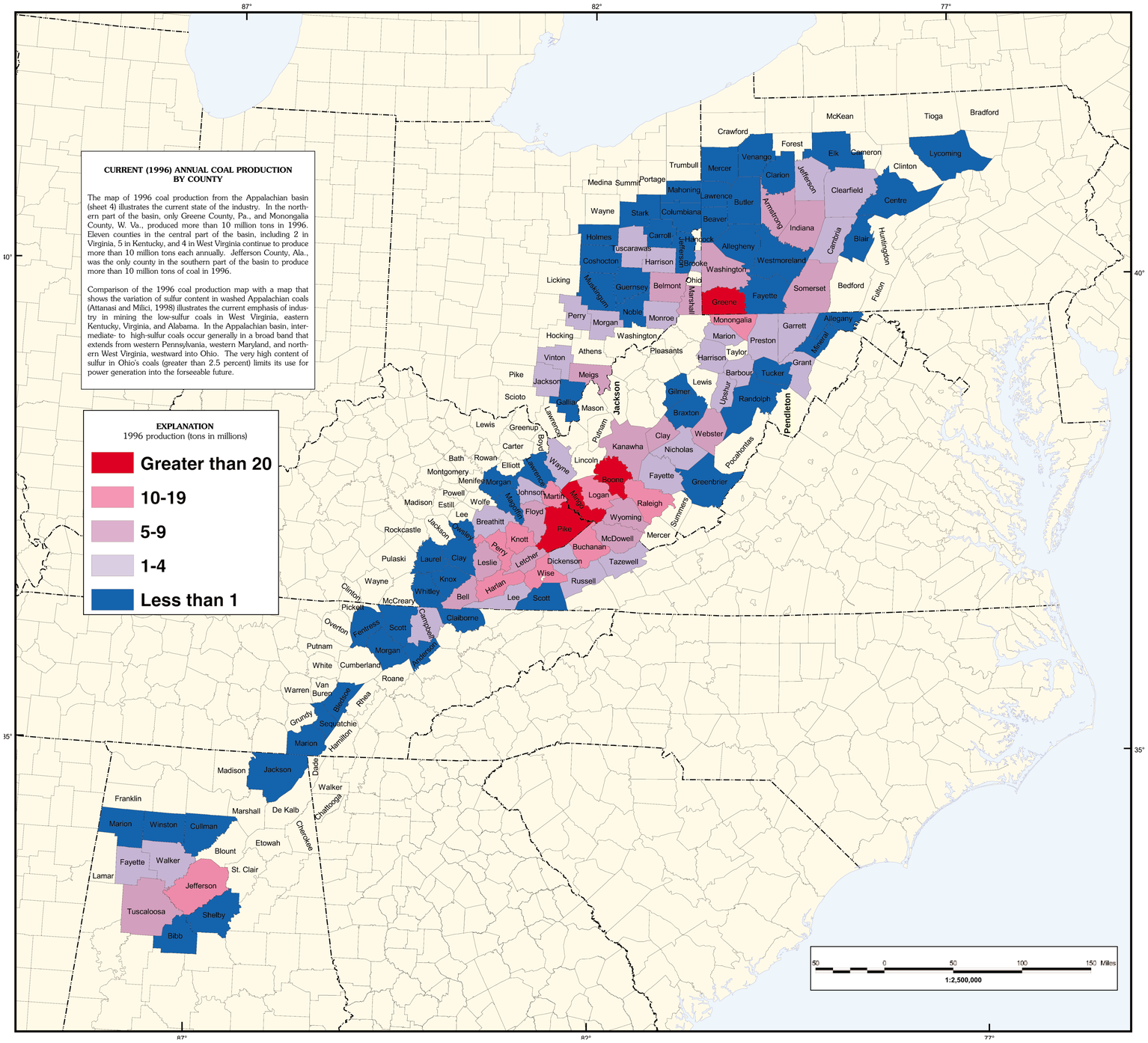


Figure 12. Graph showing Appalachian basin coal production and projected production based on 26 billion tons of potential reserves.

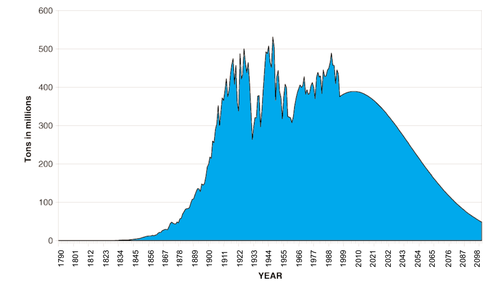


Figure 13. Graph showing historical Appalachian basin coal production and projected production based on 32 billion tons of potential reserves.

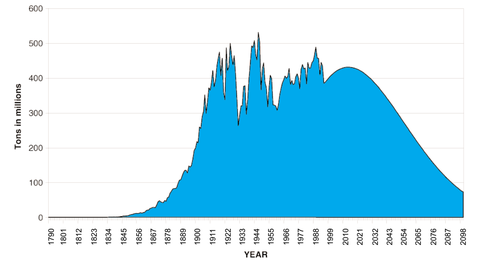


Figure 14. Graph showing Appalachian basin coal production and projected production based on 55 billion tons of potential reserves.

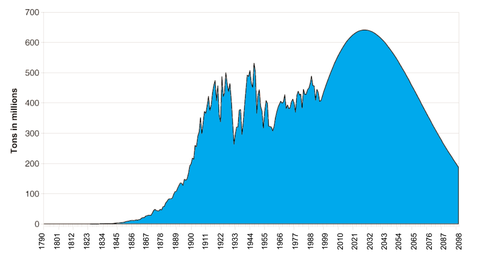


Table 2. Coal reserve estimates for the Appalachian basin (billions of tons)

STATE	ESTIMATED ORIGINAL RESERVES	1994 CUMULATIVE PRODUCTION	REMAINING RESERVES	ESTIMATED RESERVES (1994) (BASED ON AVERITT, 1975)
West Virginia	21.9	10.9	11.0	9.5
Eastern Kentucky	9.9	4.9	5.0	5.4
Alabama	3.4	1.7	1.7	1.2
Virginia	4.2	2.1	2.1	0.8
SUBTOTAL	**39.4**	**19.6**	**19.8**	**16.9**
Pennsylvania	14.6	10.8	3.8	6.1
Ohio	5.6	3.5	2.1	4.0
SUBTOTAL	**20.2**	**14.3**	**5.9**	**10.1**
Maryland	0.4	0.4	0.0	0.1
Georgia	0.0	0.0	0.0	0.0
Tennessee	0.7	0.6	0.1	0.3
SUBTOTAL	**1.1**	**1.0**	**0.1**	**0.3**
GRAND TOTAL	**60.7**	**4.9**	**25.8**	**27.3**

Table 3. Coal reserve estimates for the Appalachian basin (billions of tons)

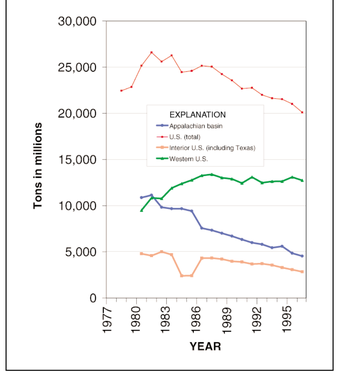
STATE	TOTAL RECOVERABLE RESERVES, 1995 (EIA, 1996)	TOTAL HIGH-SULFUR COAL AS OF JANUARY 1, 1995 (EIA, 1996)	RECOVERABLE RESERVES 1.68-2.5 lb. S/MM Btu	RECOVERABLE RESERVES >2.5 lb. S/MM Btu	RESERVES AT ACTIVE MINES (EIA, 1995)
West Virginia	19.6	5.7	2.5	3.2	1.8
Eastern Kentucky	7.0	1.5	0.9	0.7	0.7
Alabama	3.0	0.2	0.2	0.0	0.4
Virginia	1.4	0.0	0.0	0.0	0.2
SUBTOTAL	**31.0**	**7.4**	**3.6**	**3.9**	**3.1**
Pennsylvania	11.8	5.7	4.2	1.5	0.6
Ohio	11.7	10.1	2.6	7.5	0.4
SUBTOTAL	**23.5**	**15.8**	**6.8**	**9.0**	**1.0**
Maryland	0.4	0.2	0.2	0.0	0.0
Georgia	0.0	0.0	0.0	0.0	0.0
Tennessee	0.5	0.1	0.1	0.0	0.0
SUBTOTAL	**0.9**	**0.3**	**0.3**	**0.0**	**0.0**
GRAND TOTAL	**55.4**	**23.5**	**10.7**	**12.9**	**18.0**

- 23.5 Minus high-sulfur coal

31.9 Reserves of low- and medium- sulfur coal (EIA, 1996)

*** lb. S/MM Btu, pound of sulfur per million British thermal units.**
*** DOE- Department of Energy**
*** EIA- Energy Information Administration**
*** MM- 1,000,000**

Figure 15. Graph showing coal reserves at mines.



CURRENT (1996) ANNUAL COAL PRODUCTION BY COUNTY

BITUMINOUS COAL PRODUCTION IN THE APPALACHIAN BASIN – PAST, PRESENT, AND FUTURE

By Robert C. Milici

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1999

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