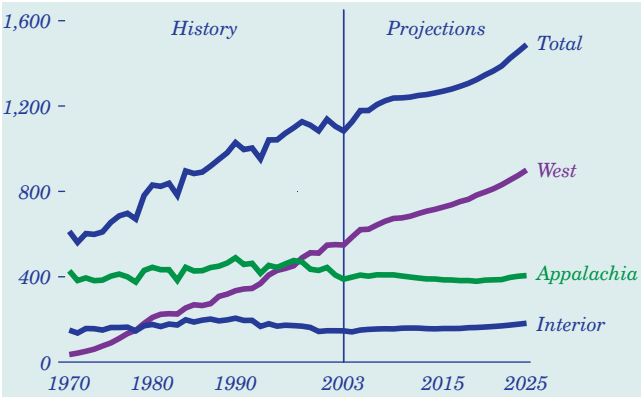
Emissions Caps Lead to More Use of Low-Sulfur Coal From Western Mines

Figure 102. Coal production by region, 1970-2025 (million short tons)



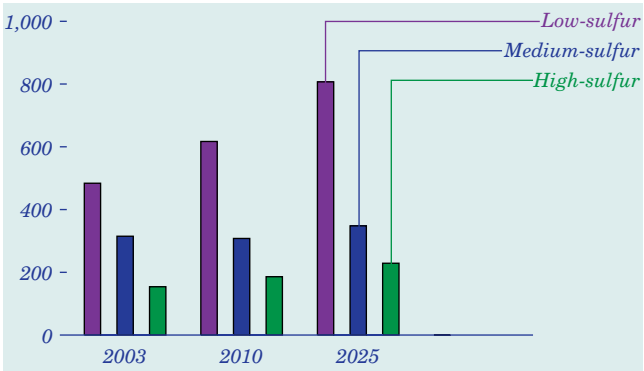
U.S. coal production has remained near 1,100 million tons annually since 1997. In the early years of the *AEO2005* forecast, a projected increase in coal use for electricity generation leads to an increase in production, to 1,238 million tons in 2010. After 2010, coal production increases with projected additions of new, unplanned coal-fired generating capacity, particularly from 2015 to 2025.

Little change is projected for Appalachian coal production (Figure 102). The region has been mined extensively, and increases in demand are likely to be met with coal from other areas. In the Interior region, production is projected to increase by 36 million tons from 2003 to 2025. Western coal production, which has grown steadily since 1970, is projected to continue to increase through 2025, especially in the Powder River Basin, where vast reserves are contained in thick seams accessible to surface mining. Easing of rail transportation bottlenecks will be key for coal producers in the West to take advantage of market opportunities presented by slower growth in Appalachian production, fuel switching at existing power plants, and demand from new power plants expected to be built in the West and Southeast regions.

The use of Western coals can reduce sulfur dioxide emissions by up to 85 percent relative to many types of higher sulfur eastern coals. As coal demand grows over the forecast, however, new coal-fired generating capacity is required to use the best available control technology (scrubbers or advanced coal technologies), which can reduce sulfur emissions by 90 percent or more, providing market opportunities for higher sulfur coal later in the forecast.

Low-Sulfur Coal Continues To Gain Share in the Generation Market

Figure 103. Distribution of domestic coal to the electricity sector by sulfur content, 2003, 2010, and 2025 (million short tons)



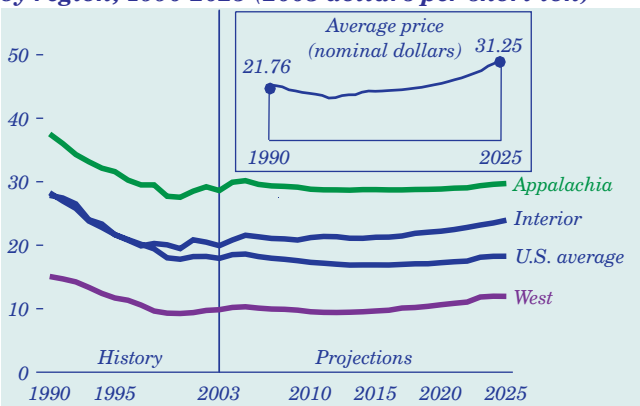
To reduce sulfur dioxide emissions as required under Phase 1 of CAAA90, many generators switched from higher sulfur coals to low-sulfur coal, leading to an excess of sulfur dioxide allowances. The excess allowances generated were banked or sold for use in Phase 2, which took effect on January 1, 2000. Low-sulfur coal will continue to be used in generator compliance strategies and is also expected to be attractive to many generators where it is the least expensive coal available.

Distribution of low-sulfur coal to the electricity sector is projected to increase on average by 3.1 percent per year between 2003 and 2011 (Figure 103) as most banked allowances are used. After 2017, low-sulfur coal maintains about a 58-percent share of domestic coal use for generation, up from 51 percent in 2003. Most of the low-sulfur coal used in 2025 is projected to come from the West, primarily the Powder River Basin and the Rocky Mountain regions. Projected declines in transportation rates contribute to the expected growth in sales of western low-sulfur coal, for which transportation costs are a relatively large part of delivered costs—typically over 60 percent for coal originating from the Powder River Basin, compared with under 25 percent for Central Appalachian coal.

Despite tighter emissions limits in CAAA90 Phase 2, the market for higher sulfur coals will continue in some regions, with 27 gigawatts of capacity expected to be retrofitted with scrubbers by 2025. Although use of higher sulfur coals at unscrubbed plants is expected to decline, their use at retrofitted or new units is projected to increase from 2003 levels.

Average Minemouth Coal Prices Are Not Projected To Rise Significantly

Figure 104. Average minemouth price of coal by region, 1990-2025 (2003 dollars per short ton)



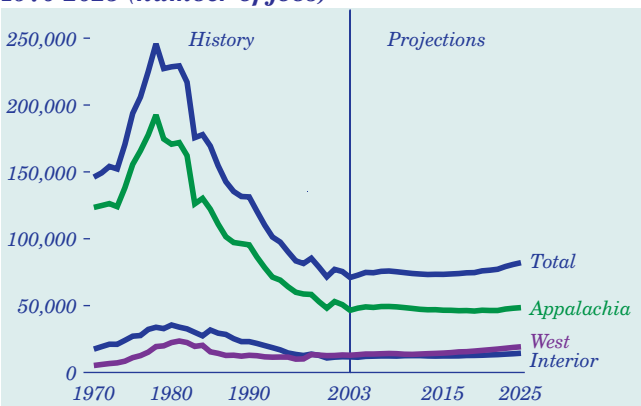
Between 1990 and 1999, the average minemouth price of coal declined by 4.9 percent per year, from $28.26 per ton (2003 dollars) to $18.01 per ton (Figure 104). Increases in U.S. coal mining productivity of 6.3 percent per year during the period helped to reduce mining costs and contributed to the decline in prices. Since 1999, growth in U.S. coal mining productivity has slowed to 1.3 percent per year, and minemouth coal prices have remained virtually unchanged despite some short-term fluctuations. The average in 2003 was $17.93 per ton.

Minemouth coal prices are projected to rise initially in the *AEO2005* reference case, primarily in response to strong growth in the demand for coal in the electric power sector. After 2005, when natural gas prices are in decline, natural-gas-fired generating capacity becomes more competitive, and coal demand grows more slowly. The combination of moderate growth in demand, improvements in mining productivity, and a continuing shift to low-cost coal from Wyoming's Powder River Basin leads to a projected decline in the average minemouth price, from $18.61 per ton in 2005 to around $17.00 per ton shortly after 2010, and it continues at about that level through 2020. After 2020 the price is projected to increase to $18.26 per ton in 2025, as rising natural gas prices and the need for baseload generating capacity result in the construction of new coal-fired generating capacity.

Increases in coal production in the Interior and Western supply regions, combined with limited improvement in coal mining productivity, result in projected minemouth price increases of 0.8 and 0.9 percent per year, respectively, in those regions from 2003 to 2025.

Coal Mine Employment Is Expected To Remain Near Current Levels

Figure 105. U.S. coal mine employment by region, 1970-2025 (number of jobs)



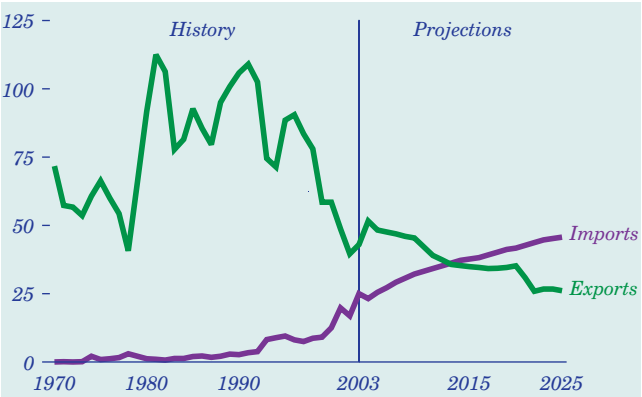
Most jobs in the U.S. coal industry remain east of the Mississippi River, mainly in the Appalachian region (65 percent of total mining jobs in 2003). Most coal production, however, occurs west of the Mississippi River (56 percent in 2003), with the major share from the Powder River Basin. As coal demand increases, pressure to keep prices low will shift more production to mines with higher labor productivity. Large surface mines in the Powder River Basin take advantage of economies of scale, using large earth-moving equipment and combining adjacent mines to increase operating flexibility. Underground mines in northern Appalachia, the Illinois Basin, and the Rocky Mountain region use highly productive and increasingly automated longwall equipment to maximize production while reducing the number of miners required.

Labor productivity is expected to continue to improve in most regions but at a decreasing rate. Higher stripping ratios and the added labor needed to maintain more extensive underground mines offset productivity gains achieved from improved equipment, automation, and technology. Productivity in some areas of the East is projected to decline as operations move from mature coalfields to marginal reserve areas. Regulatory restrictions on surface mines and fragmentation of underground reserves limit the benefits that can be achieved by Appalachian producers from economies of scale.

About 11,000 additional jobs are projected to be created in the U.S. coal industry by 2025 (Figure 105). The new mining jobs will be in the most productive surface and underground mines, but jobs will be lost in the less productive mines of Central Appalachia.

Declining U.S. Coal Exports, Rising Imports Are Projected

Figure 106. U.S. coal exports and imports, 1970-2025 (million short tons)



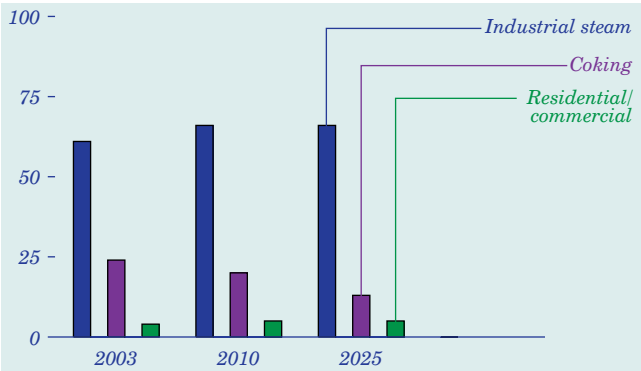
U.S. coal exports declined steadily from 1996 through 2002, from 90 million tons to 40 million tons, despite a substantial increase in world coal trade from 503 million tons in 1996 to 656 million tons in 2002. During the same period, low-cost supplies of coal from China, Colombia, Indonesia, Russia, and Australia satisfied much of the growth in international demand for steam coal, while low-cost supplies of coking coal from Australia supplanted substantial amounts of U.S. coking coal in world markets. Since 2002, U.S. exports have rebounded, however, including increases in exports of steam coal to Canada in 2003 and to overseas customers in 2004.

Although U.S. coal exports are projected to remain above the 2003 level for the next several years, the U.S. share of total world coal trade is ultimately projected to fall from 6 percent in 2003 to 3 percent in 2025, as international competition intensifies and imports of coal to Europe and the Americas grow more slowly or decline. Following a projected rise in 2004, U.S. coal exports decline gradually in the forecast, from 43 million tons in 2003 to 26 million tons in 2025 (Figure 106).

U.S. imports of low-sulfur coal are projected to grow from 25 million tons in 2003 to 46 million tons in 2025. The addition and expansion of existing coal import facilities and the need to meet tighter emission targets are expected to make coal imports an increasingly attractive option for U.S. coal-fired power plants located near the Gulf Coast and the Atlantic seaboard. Much of the additional import tonnage is expected to originate from mines in Colombia, Venezuela, and Indonesia.

U.S. Consumption of Coking Coal Declines in the Forecast

Figure 107. Coal consumption in the industrial and buildings sectors, 2003, 2010, and 2025 (million short tons)



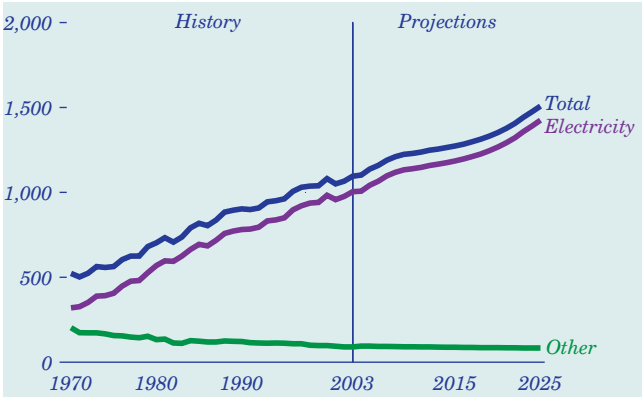
Although most coal is used to generate electricity, 91 million tons (8 percent of consumption) is used annually in the industrial and buildings (residential and commercial) sectors (Figure 107). Steam coal is used in manufacturing paper, chemical, food, and textile products. The key use of coal in these sectors is to produce process steam, which provides heat and mechanical power. Electricity is often produced in conjunction with steam (cogeneration) and is used in the manufacturing process or sold into the electric power grid. Coal is used by the cement industry as an important source of fuel for dry kilns, and the chemical industry also uses coal as a feedstock. Consumption of steam coal in the industrial sector is projected to remain relatively constant in the forecast.

Coal is also used to produce coke, which in turn is used as a source of energy and as a raw material input at blast furnaces to produce iron. Coking coal is the most important source of energy in the iron and steel industry, accounting for 51 percent of the energy consumed in 2003. In the forecast, U.S. consumption of coking coal declines by 2.7 percent per year, from 24 million tons in 2003 to 13 million tons in 2025, as production shifts from coke-based production at integrated steel mills to electric arc furnaces. Coking coal's share of total energy use in the U.S. steel industry is projected to decline to 35 percent in 2025.

Although coal is used to generate much of the electricity consumed in the buildings sectors, its direct consumption accounts for only a minor portion of total energy use in those sectors. Annual coal consumption in the building sectors is projected to remain constant at about 5 million tons.

Coal Consumption for Electricity Continues To Rise in the Forecast

Figure 108. Electricity and other coal consumption, 1970-2025 (million short tons)



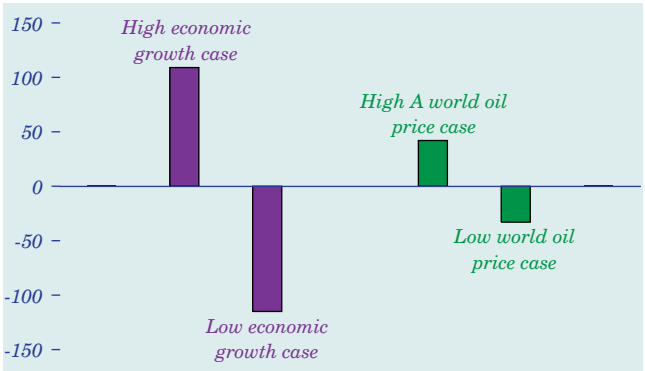
Domestic coal demand is projected to increase by 413 million tons (38 percent) in the reference case forecast, from 1,095 million tons in 2003 to 1,508 million tons in 2025 (Figure 108). Of all the coal consumed in 2003, 92 percent was used for electricity generation, and that share is expected to rise to 94 percent in 2025. Coal use for electricity generation is expected to increase on average, by 1.6 percent per year from 2003 to 2025. Coal accounted for 51 percent of U.S. electricity generation (including combined heat and power) in 2003 and is projected to account for 50 percent in 2025, when more natural gas is expected to be used for generation.

Overall, coal consumption in the electric power sector is expected to grow as existing coal-fired plants are used more intensively and new ones are added after 2011. Nationally, capacity utilization for coal plants (excluding combined heat and power) is expected to rise from 72 percent in 2003 to 83 percent in 2025. Only 3 gigawatts of coal-fired capacity is expected to be retired in the forecast, and 87 gigawatts of new capacity, including 16 gigawatts of integrated gasification combined cycle, is expected to be added—more than half in regions west of the Mississippi River.

New coal-fired generating capacity is expected to result in large increases in coal consumption in the Mountain and East South Central Census Divisions. Western coal will continue to account for the largest share of coal use for electricity generation in the Mountain Census Division, and its share in the East South Central Division is projected to increase from 32 percent in 2003 to 37 percent in 2025.

Higher Economic Growth Stimulates Electricity Generation from Coal

Figure 109. Projected variation from the reference case projection of total U.S. coal demand in four cases, 2025 (million short tons)



Domestic coal consumption in 2025 is projected to range from 1,393 million tons in the low economic growth cases to 1,617 million tons in the high economic growth case, with coal use for electricity generation making up 219 million tons (98 percent) of the difference. The most significant impact on coal occurs in the later years of the forecast period, when economic conditions influence plans for new electricity generation capacity. Projected additions of coal-fired capacity from 2003 to 2025 are 39 gigawatts higher in the high economic growth case than in the reference case and 37 gigawatts lower in the low economic growth case. Regionally, the Mountain and East South Central Census Divisions show the largest increases in coal consumption in the high economic growth case and the largest declines in the low economic growth case relative to the reference case.

Compared with the economic growth cases, a smaller impact on coal consumption is expected in the world oil price cases (Figure 109). The projection for total U.S. coal demand in 2025 is 33 million tons lower in the low world oil price case than in the reference case and 42 million tons higher in the high A world oil price case. Low oil prices encourage electricity generation from existing oil-fired units, reducing generation from other fuels, including coal. For electricity generation, the low oil price case projects 34 million tons less coal use in 2025 than is projected in the reference case. In the high A world oil price case, elevated prices for low-sulfur distillate are projected to stimulate the coal-to-liquids market. In 2025, 48 million tons of coal is projected to be consumed at coal-to-liquids plants, yielding 62 million barrels of fuel liquids and 34 billion kilowatthours of electricity.