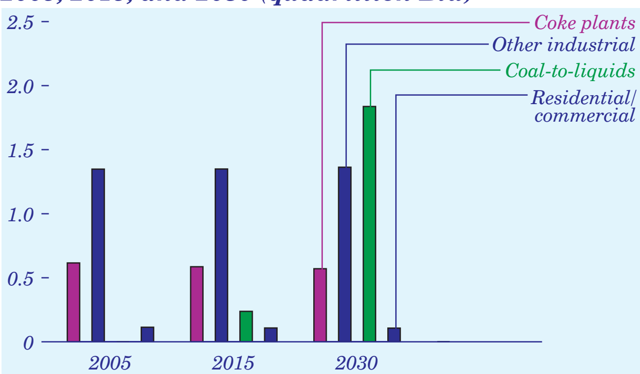
CTL Production Increases Coal Use Outside the Electric Power Sector

Figure 91. Coal consumption in the industrial and buildings sectors and at coal-to-liquids plants, 2005, 2015, and 2030 (quadrillion Btu)



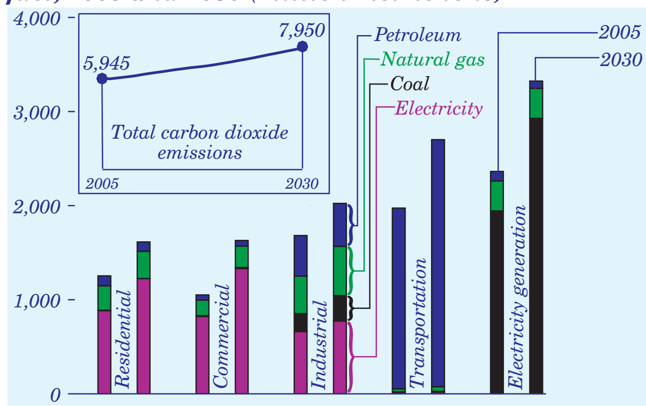
Although the electric power sector accounts for the bulk of U.S. coal consumption, 2.1 quadrillion Btu of coal currently is consumed in the industrial and buildings (residential and commercial) sectors (Figure 91). In the industrial sector, steam coal is used to manufacture or produce cement, paper, chemicals, food, primary metals, and synthetic fuels; as a boiler fuel to produce process steam and electricity; as a direct source of heat; and as a feedstock. Coal consumption in the other industrial sector (excluding CTL production) increases slightly in the *AEO2007* reference case.

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 steel. A continuing shift from coke-based production at integrated steel mills to electric arc furnaces, combined with a relatively flat outlook for U.S. steel production, leads to a slight decline in consumption of coal at coke plants.

Outside the electric power sector, most of the increase in coal demand in the reference case is for production of coal-based synthetic liquids. High world oil prices spur investment in the CTL industry, leading to the construction of new plants in the West and Midwest that produce a total of 440,000 barrels of liquids per day in 2030. In *AEO2007*, CTL technology is represented as an IGCC coal plant equipped with a Fischer-Tropsch reactor to convert the synthesis gas to liquids. Of the total amount of energy from coal consumed at each plant, 49 percent is retained in the liquid product, and the remainder is used to produce electricity—with 40 percent used at the plant and 60 percent available for sale to the grid.

Rising Energy Consumption Increases Carbon Dioxide Emissions

Figure 92. Carbon dioxide emissions by sector and fuel, 2005 and 2030 (million metric tons)

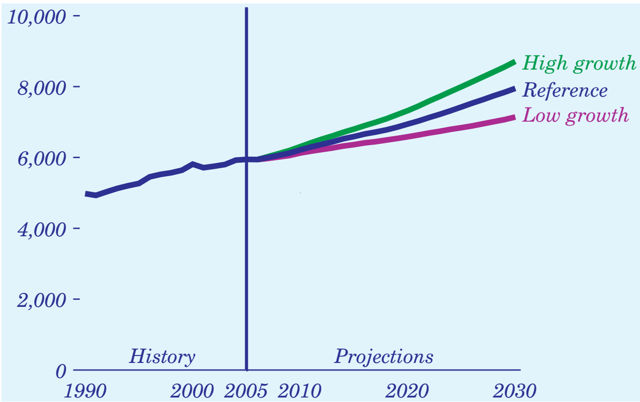


CO_2 emissions from the combustion of fossil fuels are proportional to fuel consumption and the carbon content of the fuel. Among commonly used fossil fuel types, coal has the highest carbon content and natural gas the lowest, with petroleum in between. In the *AEO2007* reference case, the shares of these fuels change slightly from 2005 to 2030, with more coal and less natural gas. The combined share of carbon-neutral renewable and nuclear energy is stable from 2005 to 2030 at 14 percent. As a result, CO_2 emissions increase by an average of 1.2 percent per year over the period, slightly higher than the average annual increase in total energy use (Figure 92). At the same time, the economy becomes less carbon intensive: the percentage increase in CO_2 emissions is almost one-third the increase in GDP, and emissions per capita increase by only 9 percent over the 25-year period.

The factors that influence growth in CO_2 emissions are the same as those that drive increases in fossil energy demand. Among the most significant are population and economic growth; increased penetration of computers, electronics, appliances, and office equipment; increases in commercial floorspace; increases in highway, rail, and air travel; and continued reliance on coal for electric power generation. The increases in demand for energy services are partially offset by efficiency improvements and shifts toward less energy-intensive industries. New CO_2 mitigation programs, more rapid improvements in technology, or more rapid adoption of voluntary CO_2 emissions reduction programs could result in lower CO_2 emissions levels than projected here.

Emissions Projections Change With Economic Growth Assumptions

Figure 93. Carbon dioxide emissions, 1990-2030 (million metric tons)



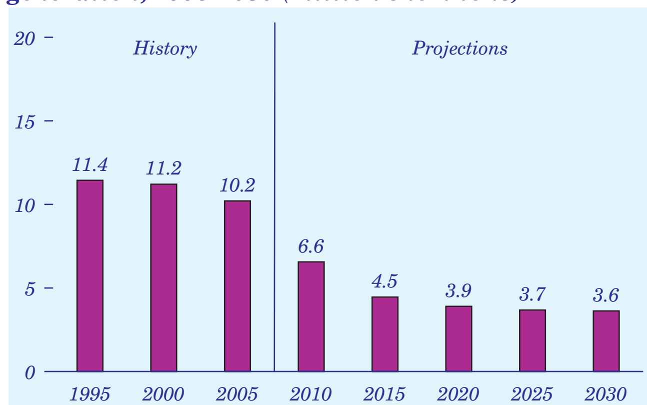
Higher growth in population, labor force, and productivity is assumed in the high economic growth case than in the *AEO2007* reference case, leading to higher industrial output, higher disposable income, lower inflation, and lower interest rates. The low economic growth case assumes the reverse. In the high and low growth cases, GDP projections vary by about 15 percent and population projections by about 8 percent from the reference case projections for 2030.

Alternative projections for industrial output, commercial floorspace, housing, and transportation in the economic growth cases influence the demand for energy and result in variations in CO_2 emissions (Figure 93). Emissions in 2030 are 10 percent lower in the low economic growth case and 10 percent higher in the high growth case than in the reference case. The strength of the relationship between economic growth and emissions varies by end-use sector. It is strongest for the industrial sector and, to a lesser extent, the transportation sector, where economic activity strongly influences energy use and emissions, and where fuel choices are limited. It is weaker in the commercial and residential sectors, where population and building characteristics have large influences and vary less across the three cases.

In the electricity sector, changes in electricity sales across the cases affect the amount of new, more efficient generating capacity required, reducing somewhat the sensitivity of energy use to GDP. However, the choice of coal for most new baseload capacity increases CO_2 intensity in the high growth case while decreasing it in the low growth case, offsetting the effects of changes in efficiency across the cases.

Clean Air Interstate Rule Reduces Sulfur Dioxide Emissions

Figure 94. Sulfur dioxide emissions from electricity generation, 1995-2030 (million short tons)



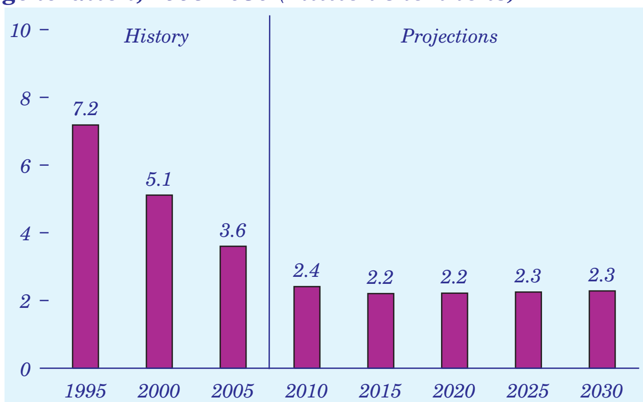
In March 2005, EPA promulgated the CAIR to limit formation of fine particles and ozone in nonattainment areas [*171*]. States can achieve mandated emissions reductions in two ways: by requiring power plants to participate in the EPA's national cap and trade program or by requiring them to meet State-specific emissions milestones through measures chosen by the State.

The reference case projects a drop in national SO_2 emissions from electricity generation, from 10.2 million short tons in 2005 to 3.6 million in 2030 (Figure 94). The reduction results from both use of lower sulfur coal and projected additions of flue gas desulfurization equipment on 143 gigawatts of capacity. SO_2 allowance prices are projected to rise to $900 per ton in 2015, remain between $900 and $1,100 per ton until 2025, and then fall to $800 per ton in 2030.

SO_2 emissions projections are not greatly affected by economic growth assumptions. In the *AEO2007* high growth case, with more coal-fired power plants added, the new plants are equipped for SO_2 capture before beginning operation, which is less costly than retrofitting existing plants. Therefore, allowance prices do not differ by much from those in the reference case. Fuel price assumptions have a greater effect on SO_2 allowance prices. More CTL plants are constructed in the high price case, and they are expected to have more efficient SO_2 capture equipment than advanced pulverized coal plants. Thus, in the last few years of the projections, SO_2 allowance prices are nearly 50 percent lower in the high price case than in the reference case, while the inflexible CAIR cap keeps emissions at nearly the same level in all cases.

Nitrogen Oxide Emissions Also Fall As CAIR Takes Effect

Figure 95. Nitrogen oxide emissions from electricity generation, 1995-2030 (million short tons)



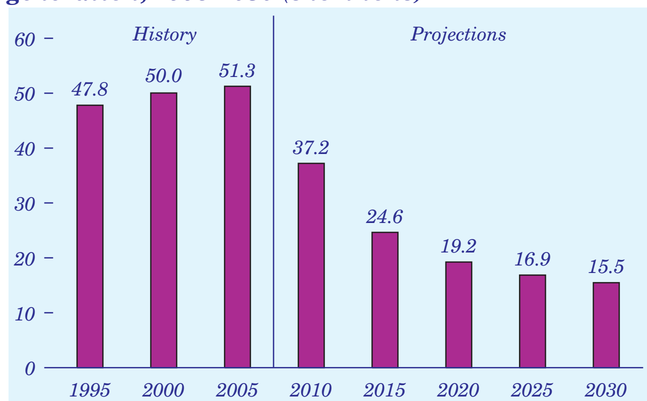
CAIR also mandates NO_x emission reductions in 28 States and the District of Columbia [*172*]. The required reductions are intended to reduce the formation of ground-level ozone, for which NO_x emissions are a major precursor. As with the CAIR-mandated SO_2 reductions, each State can determine a preferred method for reducing NO_x emissions. Options include joining the EPA's cap and trade program and enforcing individual State regulations. Each State will be subject to two NO_x limits: a 5-month summer season limit and an annual limit.

In the reference case, national NO_x emissions from the electric power sector are projected to fall from 3.6 million short tons in 2005 to 2.3 million short tons in 2030 (Figure 95). Because the CAIR caps are inflexible, different assumptions in the high and low growth and high and low fuel price cases do not affect the projections for aggregate NO_x emissions.

Between 2009 and 2030, after mandatory compliance begins, NO_x allowance prices are projected to range from $2,400 to $3,300 per ton emitted in the reference case, tending to rise as the emission caps tighten. By 2030, selective catalytic reduction equipment is projected to be added to an additional 116 gigawatts of coal-fired generating capacity. In the high price case, with more CTL capacity built, allowances are projected to be less costly, because CTL plants emit less NO_x than the coal-fired power plants they would displace. In the high economic growth case, with more coal-fired capacity in operation, allowance prices are projected to be slightly higher than in the reference case, even with the requirement for NO_x emission controls on all new plants.

Clean Air Mercury Rule Reduces Mercury Emissions

Figure 96. Mercury emissions from electricity generation, 1995-2030 (short tons)



EPA's CAMR, also promulgated in 2005, imposes a national cap on emissions of mercury, to be implemented in two phases [*173*]. As with CAIR, States can enact their own programs or participate in the EPA cap and trade system. Although no States have made final decisions, more stringent regulations have been proposed by several States in the East where many power plants use coal with higher mercury content.

AEO2007 assumes that all States will participate in the cap and trade program and meet the CAMR restrictions, with no mandates for further reductions. In the reference case, national mercury emissions are projected to be reduced by 70 percent, from 51.3 short tons in 2005 to 15.5 short tons in 2030 (Figure 96). Nationally, power producers are projected to retrofit 133 gigawatts of coal-fired capacity with activated carbon injection technology. (Mercury controls also are expected to help the States to meet CAIR targets, because the retrofits reduce SO_2 and NO_x emissions as well.) The 2030 projection is slightly higher than the final EPA cap of 15 short tons, however, because allowances banked from earlier years could be used by some power plants. Allowance prices are expected to climb to a high of $68,000 per pound in 2030.

Overall trends in mercury allowance prices are not greatly affected by economic growth or fuel price assumptions. The *AEO2007* high growth case projects more coal-fired generation than the reference case, causing allowance prices to rise more rapidly than in the reference case. In the high price case, more efficient CTL facilities are built, leading to a 6-percent decrease in total annual mercury emissions in 2030 relative to the reference case projection.