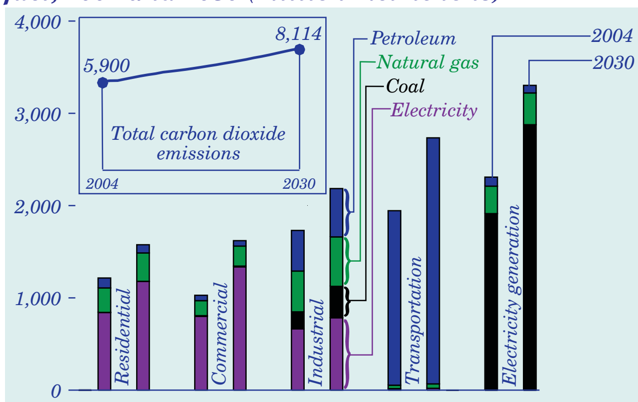
Higher Energy Consumption Forecast Increases Carbon Dioxide Emissions

Figure 107. Carbon dioxide emissions by sector and fuel, 2004 and 2030 (million metric tons)

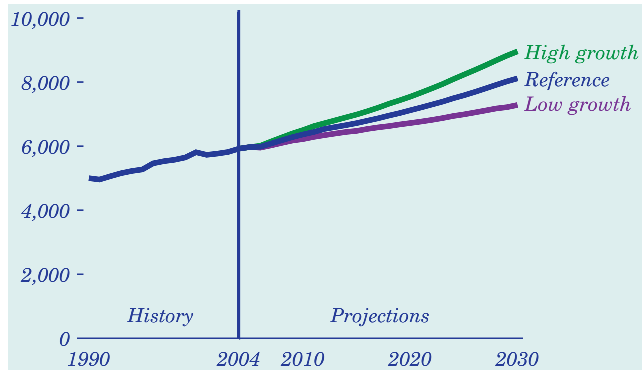


CO_2 emissions from the combustion of fossil fuels are proportional to fuel consumption. Among fossil fuel types, coal has the highest carbon content, natural gas the lowest, and petroleum in between. In the *AEO2006* reference case, the shares of these fuels change slightly from 2004 to 2030, with more coal and less petroleum and natural gas. The combined share of carbon-neutral renewable and nuclear energy is stable from 2004 to 2030 at 14 percent. As a result, CO_2 emissions increase by a moderate average of 1.2 percent per year over the period, slightly higher than the average annual increase in total energy use (Figure 107). At the same time, the economy becomes less carbon intensive: the percentage increase in CO_2 emissions is one-third the increase in GDP, and emissions per capita increase by only 11 percent over the 26-year period.

The factors that influence growth in CO_2 emissions are the same as those that drive increases in energy demand. Among the most significant are population growth; increased penetration of computers, electronics, appliances, and office equipment; increases in commercial floorspace; growth in industrial output; increases in highway, rail, and air travel; and continued reliance on coal and natural gas 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 programs could result in lower CO_2 emissions levels than projected here.

Emissions Projections Change With Economic Growth Assumptions

Figure 108. Carbon dioxide emissions in three economic growth cases, 1990-2030 (million metric tons)



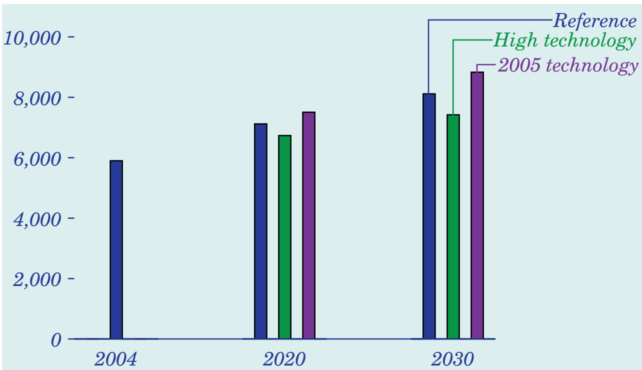
The high economic growth case assumes higher growth in population, labor force, and productivity than in the reference case, leading to higher industrial output, higher disposable income, lower inflation, and lower interest rates. The low economic growth case assumes the reverse. The spread in GDP projections increases over time, with GDP in the alternative cases varying by about 15 percent from the reference case in 2030.

Alternative projections for industrial output, commercial floorspace, housing, and transportation influence the demand for energy and result in variations in CO_2 emissions (Figure 108). Emissions in 2030 are 10 percent lower in the low growth case and 10 percent higher in the high growth 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 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 case, offsetting the effects of changes in efficiency across the cases.

Technology Advances Could Reduce Carbon Dioxide Emissions

Figure 109. Carbon dioxide emissions in three technology cases, 2004, 2020, and 2030 (million metric tons)



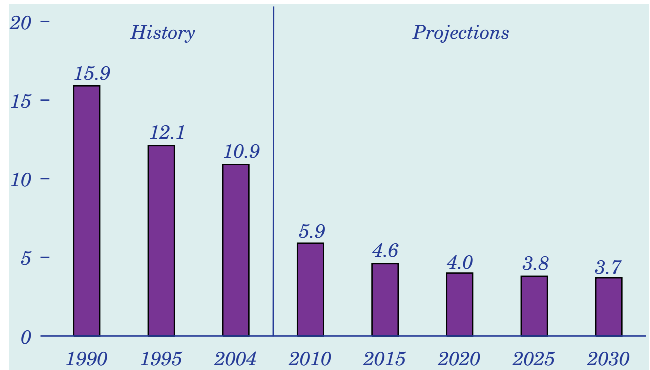
Future CO_2 emissions depend, in part, on the timing, effectiveness, and costs of new energy technologies. The reference case assumes continuing improvement in energy-consuming and producing technologies. The high technology case assumes earlier introduction, lower costs, and higher efficiencies for energy technologies in the end-use sectors, as well as improved costs and efficiencies for advanced fossil-fired and new renewable generating technologies in the electric power sector [*94*]. As in the reference case, however, technology adoption is assumed to be consistent with past patterns of market behavior.

Energy use grows more slowly in the high technology case, with prospects for greater energy savings constrained by gradual turnover of energy-using equipment and buildings. Increased use of renewables and less new coal-fired generating capacity accompany the efficiency improvements in the high technology case. As a result, CO_2 emissions in 2030 are 9 percent lower in the high technology than in the reference case, while total energy consumption is only 8 percent lower (Figure 109).

In contrast, the 2005 technology case assumes that only the equipment and vehicles available in 2005 will be available through 2030, with no further improvements in efficiency for new building shells and electric power plants. Consequently, more energy is used, and CO_2 emissions in 2030 are 9 percent higher than in the reference case, with the difference quantifying the effects of technology improvement assumptions on the reference case projections.

Sulfur Dioxide Emissions Fall Sharply in Response to Tighter Regulations

Figure 110. Sulfur dioxide emissions from electricity generation, 1990-2030 (million short tons)

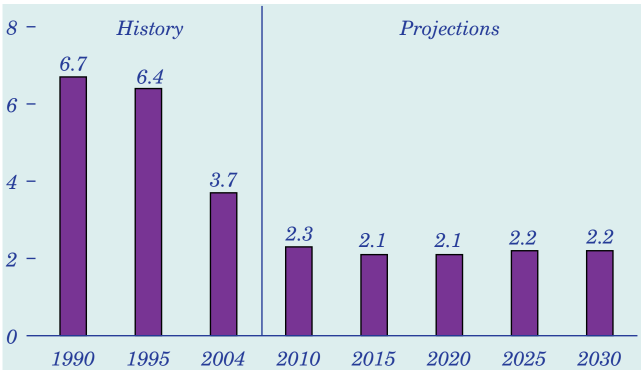


EPA's CAIR regulation, promulgated in March 2005, caps emissions of SO_2 for the District of Columbia and 28 eastern and midwestern States that were determined by the EPA to contribute to nonattainment of the NAAQS for $PM_{2.5}$ and ozone. CAIR is scheduled to supersede Title IV of the Clean Air Act through the use of a cap and trade approach. Phase I of CAIR comes into effect in 2010 for SO_2. Phase II takes effect in 2015. States can achieve the required emissions reductions by using one of two compliance options: meet the State's emissions budget by requiring power plants to participate in an EPA-administered interstate cap and trade system that caps emissions in two stages; or meet an individual State emissions budget through measures of the State's choosing.

Power companies are projected to add flue gas desulfurization equipment to 141 gigawatts of capacity in order to comply with State or Federal initiatives. As a result of those actions and the growing use of lower sulfur coal, SO_2 emissions drop from 10.9 million short tons in 2004 to 3.7 million short tons in 2030 (Figure 110). The SO_2 emissions allowance price rises to nearly $890 per ton in 2015 and remains between $880 and $980 per ton from 2015 through 2030. The reference case projections indicate that the level of SO_2 reductions called for in CAIR can be achieved without significantly raising electricity prices, which are determined by many factors, including natural gas prices, environmental compliance costs, and the status of electricity deregulation activities.

Nitrogen Oxide Emissions Fall As New Regulations Take Effect

Figure 111. Nitrogen oxide emissions from electricity generation, 1990-2030 (million short tons)



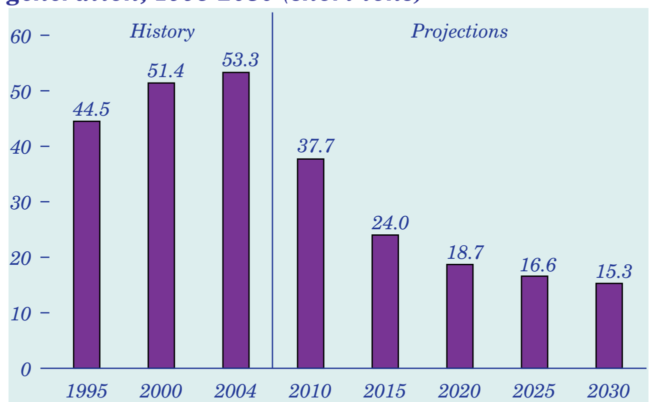
In the reference case, NO_x emissions from electricity generation in the U.S. power sector fall as new regulations take effect. The required reductions are intended to reduce the formation of ground-level ozone, for which NO_x emissions are a major precursor. Together with VOCs and hot weather, NO_x emissions contribute to unhealthy air quality in many areas during the summer months.

EPA's CAIR will apply to NO_x emissions from 28 eastern and midwestern States and the District of Columbia. Each State will be subject to two NO_x limits under CAIR: a 5-month summer season limit and an annual limit. These caps are expected to stimulate additions of emission control equipment to some existing coal-fired power plants.

National NO_x emissions fall from 3.7 million short tons in 2004 to 2.2 million short tons in 2030 in the reference case (Figure 111). The largest decrease occurs in 2009, when Phase I of CAIR is implemented, and there is a smaller reduction in 2015 with the start of Phase II caps. Between 2009 and 2030, NO_x allowance prices range from roughly $2,000 to $2,500 per ton, and they are expected to be highly volatile as the emission caps tighten. These projections are indicative of the general range and direction of the allowance prices. Power companies are expected to add selective catalytic reduction equipment to 118 gigawatts of coal-fired capacity in order to comply with both Federal and State initiatives; however, as with the requirements for SO_2 compliance, the CAIR NO_x caps are not expected to lead to significantly higher electricity prices for consumers.

New Environmental Regulations Reduce Mercury Emissions

Figure 112. Mercury emissions from electricity generation, 1995-2030 (short tons)



EPA's CAMR regulation, also promulgated in March 2005, establishes a cap and trade program to reduce mercury emissions from coal-fired power plants in the United States. In addition to nationwide caps, each new and existing coal-fired power plant must meet mercury emissions standards based on coal type. Emissions of mercury must be reduced in two phases: the national Phase I mercury cap is 38 short tons in 2010, and the Phase II cap is 15 short tons in 2018.

Emissions of mercury depend on a variety of site-specific factors, including the amounts of mercury and other compounds (such as chlorine) in the coal, the boiler type and configuration, and the presence of pollution control equipment, such as fabric filters, electrostatic precipitators, flue gas desulfurization, and selective catalytic reduction equipment.

The *AEO2006* reference case assumes that States will comply with CAMR regulations. As a result, mercury emissions decline from 53.3 short tons in 2004 to 15.3 short tons in 2030 (Figure 112). National emissions will be slightly higher than the Phase II cap in 2018 due to the use of banked allowances from earlier years. Electricity generators are expected to retrofit about 126 gigawatts of coal-fired capacity with ACI technology in order to comply with the CAMR caps. Mercury allowance prices increase steadily from 2010 on, to about $62,000 per pound in 2030. As with the CAIR requirements for SO_2 and NO_x compliance, the CAMR mercury caps are not expected to lead to significantly higher electricity prices for consumers.