2. Carbon Dioxide Emissions

Overview

U.S. Anthropogenic Carbon Dioxide Emissions, 1990-2000

	Carbon Dioxide	Carbon Equivalent
Estimated 2000 Emissions (Million Metric Tons)	5,806.1	1,583.3
Change Compared to 1999 (Million Metric Tons)	174.8	47.7
Change from 1999 *(Percent)*	*3.1%*	*3.1%*
Change Compared to 1990 (Million Metric Tons)	836.2	228.0
Change from 1990 *(Percent)*	*16.8%*	*16.8%*
Average Annual Increase, 1990-2000 *(Percent)*	*1.6%*	*1.6%*

Total emissions of carbon dioxide in the United States and its territories were 1,583.3 million metric tons carbon equivalent in 2000—47.7 million metric tons carbon equivalent (3.1 percent) more than the 1999 total (Table 4). The increase in emissions from 1999 to 2000 was the highest since 1996, when demand for heating fuels related to abnormally cold weather resulted in a 3.4-percent increase from the 1995 level. The large growth in carbon dioxide emissions in 2000 can be attributed to a return to more normal weather, a reduction in hydroelectric power generation (which was replaced with generation from fossil fuels), and strong economic growth. The average annual growth in emissions since 1990 has been about 1.6 percent (Figure 1).

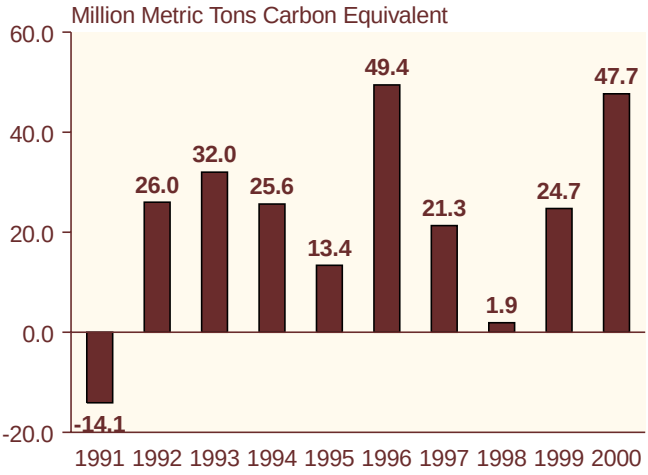
In the United States, most carbon dioxide (98 percent) is emitted as the result of the combustion of fossil fuels; consequently, carbon dioxide emissions and energy use are highly correlated. Historically, economic growth, the weather, the carbon and energy intensity of the economy, and movements in energy prices have caused year-to-year fluctuations in energy consumption and resulting carbon dioxide emissions. After several years of warmer-than-normal winters, the winter weather in 2000 was close to normal, and energy consumption for heating was an important factor in the increase from the 1999 level of carbon dioxide emissions.

The increased use of heating fuels can be seen in the residential and commercial sectors, where energy consumption is dominated by electricity use for air conditioning and fuel use for winter heating. Emissions for these sectors combined increased by 5.3 percent (Table 5). In the residential sector, emissions of carbon dioxide rose by 4.9 percent (from 298.8 million metric tons carbon equivalent in 1999 to 313.4 million metric tons carbon equivalent in 2000), while commercial sector emissions increased by 5.8 percent (from 253.1 million metric tons carbon equivalent in 1999 to 267.8 million metric tons carbon equivalent in 2000).

Industrial energy consumption, particularly in the manufacturing subsector, is much less affected by the weather and more strongly affected by economic fluctuations than are the buildings sectors (i.e., residences and commercial establishments). In 2000, however, energy-related carbon dioxide emissions from the industrial sector were essentially unchanged from 1999, at 465.7 million metric tons carbon equivalent.

In 2000, the six energy-intensive industry groups appeared to be still recovering from downturns in their 1997 growth rates. Their 2000 annual growth rates were lower than those for the overall economy (4.1 percent), the industrial sector (5.6 percent), and the manufacturing component of industrial production (6.1 percent). For the six energy-intensive industries, 2000 growth rates were 2.5 percent (primary metals), 1.8 percent (chemicals), -0.9 percent (paper), 2.3 percent (stone, clay

Figure 1. Annual Change in U.S. Carbon Dioxide Emissions, 1990-2000



Source: Estimates presented in this chapter.

and glass), 1.6 percent (petroleum products), and 1.9 percent (food). The industries that grew rapidly in 2000 were primarily those with lower energy intensities, including computer equipment, which grew by 43 percent, and semiconductors and related components, which grew by 76 percent.[45]

In this year's report, for the first time, energy-related carbon dioxide emissions for the industrial sector do not include emissions from nonutility power producers, including cogenerators. Removing nonutility power production from the industrial sector gives a more clearly defined split between industrial carbon dioxide emissions and those from the electric power sector. When emissions from this rapidly growing source are subtracted from the total for the industrial sector, the reported growth in industrial-sector emissions is lower than it would be if emissions from nonutility power producers were included. See the box below and Appendix A for a discussion of the methodology employed.

Method Used for Reallocation of Nonutility Power Producers' Emissions to Energy End-Use Sectors

For this report a methodology was developed that not only estimates emissions for the electric power sector (as was done last year) but also reallocates the nonutility power producer portion of those emissions to the end-use sectors based on their shares of total electricity sales and removes the appropriate portion from industrial sector emissions (which was not done last year). This means that, going back to 1990, emissions reported for the industrial sector are lower, and emissions reported for the other end-use sectors are higher, than those in previous editions of this report (see Appendix A for further details on the new methodology). There is little change in the emissions reported for the transportation sector, where only a small amount of electricity is used.

The reallocation process has four steps:

Step One: *Estimate and separate the electrical energy component from the thermal energy component of the fuel consumed by nonutility power producers (NUPPs).* For recent years (1999 and 2000), EIA has separated the thermal and electrical components of NUPP energy consumption data. As a result, it is possible to derive a heat rate (the amount of input energy used per kilowatthour of electricity produced) by comparing the amount of energy consumed with the amount of electricity generated. Using this heat rate as a proxy for heat rates previous to 1999, the thermal energy component of NUPP energy use is separated from the energy used to generate electricity by multiplying kilowatthours of NUPP generation (a number that is available for all years from 1989 to the present) by the proxy heat rate.

Step Two: *Subtract the energy value of the fuel used by NUPPs for electricity generation from total fuel use in the industrial sector.* The value calculated for the electrical energy component of industrial energy consumption by fuel is subtracted from industrial sector fuel use, leaving only the energy that is consumed directly in the industrial sector for process heat and other applications not related to electricity generation.

Step Three: *Apply the appropriate emissions factors to the energy values of the fuels reallocated from the industrial sector to the electric power sector.* When the energy value of the fossil fuel used to generate electricity has been reallocated from the industrial sector to the electric power sector, the emissions associated with that energy consumption can be estimated. The reallocated amounts of energy are multiplied times the appropriate emissions factors for the electric power sector. Because fuel-specific emissions factors for the electric power sector may vary from those for the industrial sector, this part of the reallocation can cause small changes in the estimates of total emissions, in the range of 0.1 to 0.2 million metric tons carbon equivalent out of total energy-related emissions of more than 1,500 million metric tons carbon equivalent in recent years.

Step Four: *Combine all the electricity-related emissions and share them out to the end-use sectors for the estimation of total emissions by sector.* To complete the process, the total emissions for the electric power sector—including electric utilities, NUPPs, and the electricity component of industrial cogenerators—are shared out to the four end-use sectors (residential, commercial, industrial, and transportation) according to each sector's share of total electricity sales. It is assumed that all NUPP direct sales to end users are to other large industrial entities, because no data are available to indicate how much of that electricity may be going to large commercial customers.

[45] All industrial and manufacturing growth rates are taken from U.S. Federal Reserve Board, "G17 Historical Data: Industrial Production and Capacity Utilization." Although the Federal Reserve Board, in calculating indexes, bases its estimates on two main types of source data, output measured in physical units and data on inputs to the production process, it also adjusts its indexes on the basis of technological improvements in factor productivity and outputs. This could be particularly important for indexes related to computers and semiconductors, for which productivity and quality of outputs have improved dramatically over time.

Energy End-Use Sector Sources of U.S. Carbon Dioxide Emissions, 1990-2000

Sector	Million Metric Tons Carbon Equivalent		Percent Change	
	1990	2000	1990-2000	1999-2000
Transportation	431.8	514.8	*19.2%*	*3.1%*
Industrial	452.7	465.7	*2.9%*	*0.0%*
Commercial	210.3	267.8	*27.4%*	*5.8%*
Residential	257.0	313.4	*21.9%*	*4.9%*

Note: Electric utility emissions are distributed across sectors.

Industrial sector emissions grew by only 2.9 percent from 1990 to 2000, and were essentially unchanged from 1999 to 2000 (465.8 and and 465.7 million metric tons carbon equivalent, respectively). It is difficult to discern at this point whether industrial emissions are being suppressed by increases in energy efficiency, by changes in industrial processes (such as less coal use in the metals industry), or by the changing mix of production activity in the industrial sector.[46]

Transportation sector energy demand is driven largely by income growth, fuel prices, and fuel economy trends. Propelled by gross domestic product (GDP) growth of 4.1 percent in 2000 and real disposable income growth of 3.3 percent, transportation energy-related carbon dioxide emissions increased by 3.1 percent, from 499.4 million metric tons carbon equivalent in 1999 to 514.8 million metric tons carbon equivalent in 2000.

Net generation of electricity increased by 3.4 percent in 2000, and total carbon dioxide emissions from the electric power sector increased by 4.7 percent (from 612.6 million metric tons carbon equivalent in 1999 to 641.6 million metric tons carbon equivalent in 2000). In this report, the electric power sector includes all generators and cogenerators.

Nonfuel uses of fossil fuels, principally petroleum, sequestered 87.9 million metric tons carbon equivalent in 2000, down by 2.0 million metric tons carbon equivalent (2.3 percent) from 1999. The major fossil fuel products that sequester carbon include liquefied propane gas (LPG), feedstocks for plastics and other petrochemicals, and asphalt and road oils. It is estimated that of the amount of carbon sequestered in the form of plastic, about 7.1 million metric tons carbon equivalent was emitted as carbon dioxide from the burning of the plastic components of municipal solid waste as well as other waste burning.

Emissions of carbon dioxide from non-energy-consuming industrial processes contributed 1.1 million metric tons carbon equivalent to the increase in emissions from 1999 to 2000 (Table 4). Emissions from cement production processes (excluding the energy portion) rose from 10.9 to 11.3 million metric tons carbon equivalent, while emissions from natural gas flaring rose from 4.0 to 4.5 million metric tons carbon equivalent.

Energy Consumption

The consumption of energy in the form of fossil fuel combustion is the largest single contributor to greenhouse gas emissions in the United States and the world. Of total 2000 U.S. carbon dioxide emissions (adjusting for U.S. Territories and bunker fuels), 98 percent, or 1,547.4 million metric tons carbon equivalent, resulted from the combustion of fossil fuels. This figure represents a 3.1-percent increase over 1999 levels. In the short term, year-to-year changes in energy consumption and carbon dioxide emissions tend to be dominated by weather, economic fluctuations, and movements in energy prices. Over longer time spans, changes in energy consumption and emissions are influenced by other factors such as population shifts and energy consumers' choice of fuels, appliances, and capital equipment (e.g., vehicles, aircraft, and industrial plant and equipment). The energy-consuming capital stock of the United States—cars and trucks, airplanes, heating and cooling plants in homes and businesses, steel mills, aluminum smelters, cement plants, and petroleum refineries—changes slowly from one year to the next, because capital stock is retired only as it begins to break down or becomes obsolete.

The Energy Information Administration (EIA) divides energy consumption into four general end-use categories: residential, commercial, industrial and transportation. Emissions from electricity generators, which provide electricity to the end-use sectors, are allocated in proportion to the electricity consumed in each sector (Table 5). Electricity-related emissions from independent power producers and industrial cogenerators are included in the electric power sector estimates along with emissions from integrated electric utilities. EIA is in the process of reclassifying the data in the integrated data reports on fuel consumed for electricity generation in the industrial sector into total fuel consumption for

[46]Because assumptions made in the reallocation of industrial emissions to electric power generators may change, industrial sector emissions may be adjusted in future estimates.

electricity generation. In the interim, this report provides, below, a preliminary estimate of the entire electric power sector for the 1990 to 2000 time period.[47]

In last year's report, emissions for nonutility power producers were not reallocated from the industrial sector. In this year's report a method was applied to the underlying data that removed the emissions attributable to nonutility power producers from the industrial sector and shared them out to the end-use sectors in proportion to the electricity consumed by those sectors. Although there is a small amount of electricity production in the commercial sector, this adjustment was made only for the industrial sector.

Residential Sector

At 313.4 million metric tons carbon equivalent, residential carbon dioxide emissions represented 20 percent of U.S. energy-related carbon dioxide emissions in 2000. The residential sector's pro-rated share of electric power sector emissions accounts for about two-thirds of that amount (211.5 million metric tons carbon equivalent).[48] Since 1990, residential electricity-related emissions have grown by 2.4 percent annually. In contrast, emissions from the direct combustion of fuels in the residential sector have grown by 1.3 percent annually since 1990.

Total carbon dioxide emissions from the residential sector increased by 4.9 percent in 2000 (Table 6). Year-to-year, residential sector emissions are heavily influenced by weather. For example, in 1996, a relatively cold year, carbon dioxide emissions from the residential sector grew by 5.8 percent over 1995. In 1997, they declined by 0.4 percent due to warmer winter weather.

Since 1990, the growth in carbon dioxide emissions attributable to the residential sector has averaged 2.0 percent per year. As a result, residential sector emissions in 2000 were 56.3 million metric tons carbon equivalent higher than in 1990, representing 27 percent of the total increase in U.S. energy-related carbon dioxide emissions since 1990. Long-term trends in residential carbon dioxide emissions are heavily influenced by demographic factors, living space attributes, and building shell and appliance efficiency choices. For example, the movement of population into the Sunbelt tends to increase summer air conditioning consumption and promote the use of electric heat pumps, which increases indirect emissions from electricity use. Growth in the number of households, resulting from increasing population and immigration, contributes to more residential energy consumption.

Commercial Sector

Commercial sector carbon dioxide emissions, at 267.8 million metric tons carbon equivalent, account for about 17 percent of total energy-related carbon dioxide emissions, of which almost three-quarters (202.5 million metric tons carbon equivalent) is the sector's pro-rated share of electricity-related emissions. Although commercial sector emissions largely have their origin in the space heating and cooling requirements of structures such as office buildings, lighting is a more important component of commercial energy demand than it is in the residential sector. Thus, although commercial sector emissions are strongly affected by the weather, they are affected less than residential sector emissions. In the longer run, because commercial activity is a factor of the larger economy, emissions from the commercial sector are more affected by economic trends and less affected by population growth than are emissions from the residential sector.

Emissions attributable to the commercial sector's pro-rated share of electric consumption increased by 3.1 percent in 2000, while emissions from the direct combustion of fuels (dominated by natural gas, as in the residential sector) increased by 8.8 percent. Overall, carbon dioxide emissions related to commercial sector activity increased by 5.8 percent—from 253.1 to 267.8 million metric tons carbon equivalent—between 1999 and 2000 (Table 7). Since 1990, commercial emissions growth has averaged 2.4 percent per year—the largest growth of any energy-use sector. Commercial sector carbon dioxide emissions have risen by 57.6 million metric tons carbon equivalent since 1990, accounting for 27 percent of the total increase in U.S. energy-related carbon dioxide emissions.

Transportation Sector

Transportation sector emissions, at 514.8 million metric tons carbon equivalent, accounted for one-third of total energy-related carbon dioxide emissions in 2000. Almost all (98 percent) of transportation sector emissions result from the consumption of petroleum products, particularly motor gasoline at 59 percent of total transportation sector emissions; middle distillates (diesel fuel) at 21 percent; jet fuel at 13 percent of the total;

[47] Note that Table 12.6 of the *Annual Energy Review 2000* includes thermal energy in the data for 1996 and earlier, and some thermal energy for Other Power Producers is included in all years, whereas the numbers in this report do not include thermal energy.

[48] Sectoral (residential, commercial, and industrial) energy-related carbon dioxide emissions are based on the share of total electric power sector carbon dioxide emissions that can be attributed to each end-use sector. The share is based on the percentage of total electricity sales purchased by the sector. All carbon dioxide emissions associated with nonutility power production that is not sold into the grid are allocated to the industrial sector as either direct use or sales to end users. It is assumed for this estimate that all direct sales of nonutility power production to end users are from one industrial entity to another.

and residual oil (i.e., heavy fuel oil, largely for maritime use) at 4 percent of the sector's total emissions. Motor gasoline is used primarily in automobiles and light trucks, and middle distillates are used in heavy trucks, locomotives, and ships.

Emissions attributable to the transportation sector grew by 3.1 percent in 2000, from 499.4 to 514.8 million metric tons carbon equivalent (Table 8). The fuel-use patterns and related emissions sources in the transportation sector are different from those in the other energy-use sectors. By far the largest single source of emissions, motor gasoline, at 301.5 million metric tons carbon equivalent, grew by 0.6 percent. The highest rates of growth were for residual fuel emissions (which grew by 35.9 percent, from 17.0 to 23.1 million metric tons carbon equivalent) and distillate fuel emissions (which grew by 4.6 percent, from 101.9 to 106.6 million metric tons carbon equivalent). Since 1990, carbon dioxide emissions related to the transportation sector have grown at an average annual rate of 1.8 percent. The growth since 1990 has meant that transportation emissions have increased by a total of 83.1 million metric tons carbon equivalent, representing 39.5 percent of the growth in energy-related carbon dioxide emissions from all sectors. Transportation sector emissions have grown almost as rapidly as commercial sector emissions, but from a larger base. Transportation is the largest contributing sector to total emissions.

Industrial Sector

Industrial sector emissions, at 465.7 million metric tons carbon equivalent, accounted for about 30 percent of total U.S. energy-related carbon dioxide emissions in 2000. In terms of fuel shares, electricity consumption was responsible for 48.7 percent of total industrial sector emissions (226.7 million metric tons carbon equivalent), natural gas for 22.3 percent (104.0 million metric tons carbon equivalent), petroleum for 18.8 percent (87.6 million metric tons carbon equivalent), and coal for 9.8 percent (45.7 million metric tons carbon equivalent).

Estimated carbon dioxide emissions related to energy consumption in the industrial sector were 465.7 million metric tons carbon equivalent (Table 9) in 2000, compared with 465.8 million metric tons carbon equivalent in 1999. For this year's calculation, the energy allocated to nonutility power producers has been reallocated from the industrial sector total to the end-use sectors for which the electricity is generated.[49] When these emissions are reallocated, growth in carbon dioxide emissions attributable to industrial sector energy consumption has averaged 0.3 percent per year since 1990. Because of this low growth rate, total energy-related industrial emissions in 2000 were only 2.9 percent (13.1 million metric tons carbon equivalent) higher than in 1990, despite a much larger economy. The increase in industrial sector emissions from 1990 to 2000 represents 6.2 percent of the total growth in U.S. energy-related carbon dioxide emissions over the same period.

A contributing factor to the low growth in industrial sector carbon dioxide emissions is the erosion of the older energy-intensive (and specifically coal-intensive) industrial base. For example, coke plants consumed 38.9 million short tons of coal in 1990, as compared with 28.9 million short tons in 2000. Additionally, other industrial coal consumption has declined from 76.3 million short tons in 1990 to 65.1 million short tons in 2000. When the increase in coal for electricity generation in the industrial sector is accounted for, the remaining industrial coal consumption for thermal energy production is reduced even further. Nonutility power producers consumed 131.6 million short tons of coal in 2000, compared with 32.3 million short tons in 1990.

Electric Power Sector

Electric Power Sector Carbon Dioxide Emissions by Fuel Input, 1990-2000

	Million Metric Tons Carbon Equivalent		*Percent Change*	
Fuel	1990	2000	1990-2000	1999-2000
Petroleum	28.2	26.0	*-7.9%*	*-11.6%*
Natural Gas	58.3	93.2	*59.9%*	*10.2%*
Coal	420.4	522.4	*24.3%*	*4.8%*
Total	507.0	641.6	*26.5%*	*4.7%*

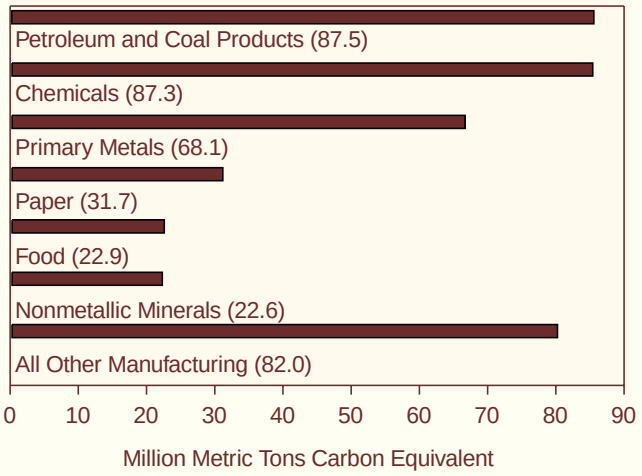
In last year's report, *Emissions of Greenhouse Gases in the United States 1999*, Table 10 (U.S. Carbon Dioxide Emissions from Electricity Generation, 1990-1999) showed estimates of carbon dioxide emissions for both electric utilities and nonutility power producers (NUPPs), including cogenerators. This was a "standalone" table, in that the emissions estimates shown were not integrated with the rest of the report, where all fuel inputs to NUPPs were counted in the industrial sector—with

[49]Because this report is the first time that energy consumption (and related emissions) from nonutility power producers and cogenerators has been subtracted from the industrial sector total, the estimates should be viewed as preliminary. It is possible that some of the assumptions made in order to perform the calculation may be reconsidered for future reports, and that the results may be revised accordingly.

Energy-Related Carbon Dioxide Emissions in Manufacturing

Manufacturing is the single largest source of carbon dioxide emissions in the U.S. industrial sector. This industrial subsector, which excludes agriculture, mining, and construction, accounts for 85 percent of industrial energy-related carbon dioxide emissions and also accounts for approximately 84 percent of industrial energy consumption. The figure below shows the latest estimate of energy-related carbon dioxide emissions from the manufacturing subsector, based on energy consumption statistics from EIA's 1998 Manufacturing Energy Consumption Survey (MECS).

Total Energy-Related Carbon Dioxide Emissions for Selected Manufacturing Industries, 1998



Source: Energy Information Administration, Form EIA-846, "1998 Manufacturing Energy Consumption Survey," and Form EIA-810, "Monthly Refinery Report" (1998).

The carbon intensity of energy use is the amount of carbon emitted per unit of energy used. Both the mix of energy sources and the uses of energy affect carbon intensity. Overall, manufacturing industries had carbon intensities of 17.16 and 16.90 million metric tons per quadrillion Btu in 1994 and 1998, respectively; however, the carbon intensities of the various industries differed markedly.

The petroleum industry and the chemical industry both transform energy sources into products such as petrochemical feedstocks, asphalt, and plastics. Only a part of the carbon content of the energy inputs for such products is emitted into the atmosphere; the remainder is sequestered in the products (see Table A2 in Appendix A). Because both industries use energy for nonfuel purposes, the petroleum and chemical industries have lower carbon intensities than the manufacturing average: 12.91 and 11.95 million metric tons per quadrillion Btu for the petroleum industry in 1994 and 1998, respectively, and 14.69 and 14.40 million metric tons per quadrillion Btu for the chemicals industry.

The paper industry uses wood byproducts extensively, yielding carbon intensities of 11.87 and 11.54 million metric tons per quadrillion Btu in 1994 and 1998, respectively. The carbon dioxide emissions from wood consumption are considered to be zero, because the carbon emitted has been recently sequestered and the regrowing of trees will re-sequester the emitted carbon. The primary metals industry, however, is a heavy user of energy sources with relatively high carbon content, such as coal. As a result, the overall carbon intensities for the primary metals industry were 26.19 and 26.62 million metric tons per quadrillion Btu in 1994 and 1998, respectively.

The 1994 MECS estimated carbon dioxide emissions from the manufacturing subsector as a whole at 371.7 million metric tons carbon equivalent. The corresponding estimate for 1998 is 402.1 million metric tons carbon equivalent—an increase of 30.4 million metric tons carbon equivalent, or 8.2 percent. Over the same interval, real manufacturing output increased by 20.1 percent.

From 1994 to 1998, carbon dioxide emissions associated with electricity use by manufacturing industries increased by 19.4 million metric tons carbon equivalent (15 percent), and emissions associated with natural gas use increased by 8.5 million metric tons carbon equivalent (9 percent). Electricity use continues to account for the largest share of manufacturers' carbon dioxide emissions—36 percent (131.1 million metric tons carbon equivalent) and 38 percent (150.4 million metric tons carbon equivalent) in 1994 and 1998, respectively. Smaller changes, which are not statistically significant, are estimated for emissions associated with manufacturing use of coal (a slight decrease) and petroleum and other fuels (a slight increase).

It should be noted that statistical comparisons of the 1994 and 1998 estimates of carbon dioxide emissions by industry based on MECS data are imperfect, because the 1994 data are categorized by industry under the Standard Industrial Classification (SIC) system, whereas the 1998 data re-categorized under the North American Industry Classification System (NAICS), in accordance with the practice of the U.S. Office of Management and Budget. One relevant example is the reclassification of *Coke Ovens, Not Integrated With Steel Mills*, which was moved from *Primary Metals* (SIC 3312) to *Petroleum and Coal Products* (NAICS 324110). Details on the two classification systems are available on web site www.eia.doe.gov/emeu/mecs/mecs98/naics/naics8.html.

the exception of coal consumed by "Other Power Producers."[50]

The data in Table 10 represent estimates of carbon dioxide emissions for the entire electric power industry. These emissions when taken as a whole account for 41 percent of total U.S. energy-related carbon dioxide emissions. This year's report is the first to show these emissions as an integrated whole, with the estimated emissions from NUPPs reallocated from the industrial sector in Table 9. Appendix A includes a discussion of the method employed for that calculation.

Carbon dioxide emissions from the electric power industry increased by 4.7 percent (29.0 million metric tons carbon equivalent) from 612.6 million metric tons carbon equivalent in 1999 to 641.6 million metric tons carbon equivalent in 2000 (Table 10). Emissions from natural-gas-fired generation increased by 10.2 percent, emissions from coal-fired generation increased by 4.8 percent, and emissions from petroleum-fired generation fell by 11.6 percent. Carbon dioxide emissions from the electric power industry have grown by 26.5 percent since 1990, while total carbon dioxide emissions have grown by 15.5 percent.

Nonfuel Use of Energy Inputs

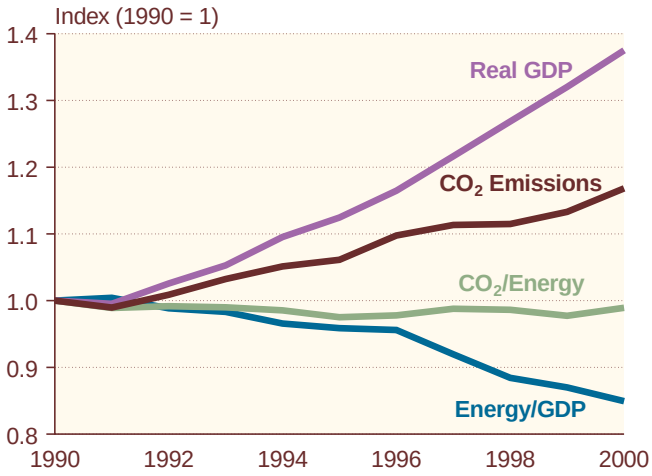
In 2000, 87.9 million metric tons carbon equivalent was sequestered through nonfuel uses of fossil fuels (Table 11). A small amount of this was coal-based (less than 0.5 million metric tons carbon equivalent), about 5.3 million metric tons carbon equivalent was natural-gas-based, and the remainder (82.1 million metric tons carbon equivalent) was petroleum-based. The products that sequester carbon include feedstocks for plastics and other petrochemicals, asphalt and road oil, liquefied petroleum gas, lubricants, and waxes. The amount sequestered in 2000 was 2.3 percent lower than in 1999, when 89.9 million metric tons carbon equivalent was sequestered. Since 1990 sequestration of carbon in this manner has increased by 19.1 million metric tons carbon equivalent or 27.8 percent. This translates to an annual average growth rate of 2.1 percent.

Carbon Dioxide Emissions and Economic Growth

The United States experienced a prosperous period between 1990 and 2000, with economic growth that averaged 3.2 percent per year, despite a recession early in the decade. Energy-related carbon dioxide emissions, however, grew by an average of 1.6 percent annually. As shown in Figure 2, U.S. energy intensity (energy consumed per dollar of GDP) fell by an average of 1.6 percent per year from 1990 to 2000. The carbon dioxide intensity of energy use (carbon-equivalent emissions per unit of energy consumed) has remained slightly below the 1990 level, declining by an average of 0.1 percent per year. Thus, it is primarily the use of less energy per unit of economic output, not the use of low-carbon fuels, that has kept the growth rate of carbon dioxide emissions at about half the GDP growth rate.

The decrease in the energy intensity of the U.S. economy has resulted, in part, from an increase in the non-energy-intensive sectors of the economy relative to the traditional energy-intensive manufacturing industries, as well as energy efficiency improvements. For example, economic growth in 2000, while robust, occurred for the most part in industries that are less energy-intensive than the traditional basic industries: for example, computer equipment manufacturing grew by 43 percent, and the manufacture of semiconductors and related components grew by 76 percent in 2000. This growth in the so-called "new economy" means that less energy is used and less carbon dioxide is emitted per dollar of

Figure 2. Growth in U.S. Carbon Dioxide Emissions and GDP, Energy Intensity of GDP, and Carbon Dioxide Intensity of Energy Use, 1990-2000



Sources: Energy Information Administration, *Annual Energy Review 2000*, DOE/EIA-0384(2000) (Washington, DC, July 2001), Tables 1.1 and E1; and estimates presented in this chapter.

[50]The terms "nonutility generators" (NUGs) and "nonutility power producers" (NUPPs) are synonymous. Independent power producers (IPPs) are NUPPs engaged only in the generation of electricity. Cogenerators, also classified as NUPPs, are further divided into conventional cogenerators, which produce industrial process heat for their own use and produce electricity as a co-product or byproduct, and cogenerators that produce both heat and electricity but sell both to other parties. These are also called "Other Power Producers." Currently the coal inputs for both the heat and electricity generation of Other Power Producers are counted as inputs to the electric power sector in EIA's integrated data.

GDP. The production of computer software takes little additional energy as compared to an industrial process such as steelmaking.

As long as U.S. economic growth continues to be led by industries that use relatively little energy per unit of output, it will have little *direct* effect on energy consumption and related carbon dioxide emissions. Economic growth of this kind does, however, have an *indirect* effect on emissions as consumers with more disposable income use more energy services (such as travel) and tend to live in larger houses. On the other hand, such income effects can be offset somewhat by more energy-efficient vehicles, building shells, appliances and heating and cooling equipment.

Adjustments to Energy Consumption

Total energy consumption and the carbon dioxide emissions upon which they are based correspond to EIA's coverage of energy consumption, which includes the 50 States and the District of Columbia. Under the United Nations Framework Convention on Climate Change (UNFCCC), however, the United States is also responsible for counting emissions emanating from its territories, and their emissions are added to the U.S. total. Conversely, because the Intergovernmental Panel on Climate Change (IPCC) definition of energy consumption excludes international bunker fuels from the statistics of all countries, emissions from international bunker fuels are subtracted from the U.S. total. Additionally, military bunker fuels are subtracted because they are also excluded by the IPCC from the national total. These sources and subtractions are enumerated and described as "adjustments to energy."

U.S. Territories

Energy-related carbon dioxide emissions for the U.S. territories are added as an adjustment in keeping with IPCC guidelines for national emission inventories. The territories included are Puerto Rico, the U.S. Virgin Islands, American Samoa, Guam, the U.S. Pacific Islands and Wake Island. Most of these emissions are from petroleum products; however, Puerto Rico and the Virgin Islands consume coal in addition to petroleum products. For 2000, total carbon dioxide emissions from the U.S. Territories are estimated at 13.6 million metric tons carbon equivalent (Table 4).

International Bunker Fuels

In keeping with the IPCC guidelines for estimating national greenhouse gas emissions, carbon dioxide emissions from international bunker fuels are subtracted from the estimate of total U.S. energy-related emissions of carbon dioxide. The estimate for bunker fuels is based on purchases of distillate and residual fuels by foreign-bound ships at U.S. seaports, as well as jet fuel purchases by international air carriers at U.S. airports. Additionally, U.S. military operations that consume fuel originally purchased in the United States are subtracted from the total, because they are also considered international bunker fuels under this definition.

For 1999, the most recent year for which data are available, the carbon dioxide emissions estimate for bunker fuels is 2.7 million metric tons carbon equivalent.[51] In 2000, approximately 27.8 million metric tons carbon equivalent was emitted in total from international bunker fuels (25.1 million metric tons carbon equivalent) and military bunker fuels (assuming the latter was close to the 1999 estimate). This amount is subtracted from the U.S. total in Table 4. Just over half of the carbon dioxide emissions associated with international bunker fuels are from the combustion of jet fuels; residual and distillate fuels account for the other half, with most coming from residual fuel.

Other Carbon Dioxide Emissions

Energy Production

In addition to emissions resulting from fossil energy consumed, oil and gas production leads to emissions of carbon dioxide from sources other than the combustion of those marketed fossil fuels. The two energy production sources estimated for this report are:

- Flared natural gas, which is flared either because the cost of bringing the gas to market is prohibitive or because the gas is of insufficient quality to sell
- Carbon dioxide scrubbed from natural gas to improve its heat content and quality and subsequently vented to the atmosphere.

Because many States require flaring of natural gas, EIA assumes that all gas reported under the category "Vented and Flared" is actually flared and therefore is a carbon dioxide emissions rather than a methane emission. In 2000, about 4.5 million metric tons carbon equivalent was emitted in this way (Table 4).

[51] Military bunker fuels decreased steadily from 1990 (4.9 million metric tons carbon equivalent) to 1994 and appear to have stabilized at the 1994 level of 2.5 ± 0.2 million metric tons carbon equivalent.

By computing the difference between the estimated carbon dioxide content of raw gas and the carbon dioxide content of pipeline gas, the amount of carbon dioxide that has been removed (scrubbed) in order to improve the heat content and quality of natural gas can be calculated. This amount was about 5.0 million metric tons carbon equivalent in 2000 (Table 4). Appendix D contains additional energy production sources that are excluded from this report.

Industrial Process Emissions

Industrial emissions of carbon dioxide not caused by the combustion of fossil fuels accounted for only 1.2 percent (19.38 million metric tons carbon equivalent) of total U.S. carbon dioxide emissions in 2000 (Table 4). Process-related emissions from industrial sources depend largely on the level of activity in the construction industries and on production at oil and gas wells. These sources include limestone and dolomite calcination, soda ash manufacture and consumption, carbon dioxide manufacture, cement manufacture, and aluminum production.

Estimated industrial process emissions of carbon dioxide in 2000 were 3.02 million metric tons carbon equivalent (18.5 percent) higher than in 1990 and 0.52 million metric tons carbon equivalent (2.8 percent) higher than in 1999 (Table 12). Fifty-eight percent of the carbon dioxide emissions from industrial processes are from cement manufacture. When calcium carbonate is heated (calcined) in a kiln, it is converted to lime and carbon dioxide. The lime is combined with other materials to produce clinker (an intermediate product from which cement is made), and the carbon dioxide is released to the atmosphere. In 2000, the United States manufactured an estimated 90.60 million metric tons of cement, resulting in the direct release of carbon dioxide containing 11.30 million metric tons carbon equivalent into the atmosphere. This calculation is independent of the carbon dioxide released by the production of energy consumed in making cement. This represents an increase in carbon dioxide emissions of 2.21 million metric tons carbon equivalent (24.3 percent) compared with 1990 and an increase of about 0.37 million metric tons carbon equivalent (3.4 percent) compared with 1999.

There are numerous other industrial processes in which carbonate minerals are used in ways that release carbon dioxide into the atmosphere, including the use of limestone in the production of lime and in flue gas desulfurization and the manufacture and some uses of soda ash. Carbon dioxide is also released during aluminum smelting, when carbon anodes (with the carbon derived from nonfuel use of fossil fuels) are vaporized in the presence of aluminum oxide. Approximately 8.08 million metric tons carbon equivalent was released in emissions from these other industrial process sources in 2000.

Municipal solid waste that is combusted contains, on average, a portion that is composed of plastics, synthetic rubber, synthetic fibers, and carbon black. The carbon in these plastics has normally been accounted for as sequestered carbon, as reported in Table 11. However, according to the IPCC, to properly account for that carbon, emissions from the plastics portion of the municipal solid waste must be counted in total national emissions inventories. These emissions produce about 7.09 million metric tons carbon equivalent, as calculated by the U.S. EPA, with the most recent estimate being for 1999. The 1999 value has been used as an estimate for 2000.

Table 4. U.S. Carbon Dioxide Emissions from Energy and Industry, 1990-2000
(Million Metric Tons Carbon Equivalent)

Fuel Type or Process	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Energy Consumption											
Petroleum	590.4	576.1	586.6	587.7	600.3	596.3	618.7	624.6	634.4	649.3	657.7
Coal	487.9	482.0	486.0	501.9	507.1	510.3	532.6	547.4	550.4	552.6	572.8
Natural Gas	273.2	278.1	286.3	295.5	301.5	314.5	320.4	321.5	310.5	315.3	331.2
Geothermal	0.1	0.1	0.1	0.1	*	*	*	*	*	*	*
Energy Subtotal	**1,351.6**	**1,336.2**	**1,359.0**	**1,385.1**	**1,409.0**	**1,421.1**	**1,471.7**	**1,493.4**	**1,495.4**	**1,517.2**	**1,561.7**
Adjustments to Energy											
U.S. Territories (+)	8.4	9.7	9.7	10.8	10.9	11.4	10.0	10.9	12.3	12.8	13.6
Military Bunker Fuels (-)	4.9	3.6	3.3	3.0	2.6	2.4	2.5	2.6	2.7	2.7	2.7
International Bunker Fuels (-)	27.3	29.1	26.7	24.2	24.1	25.1	25.4	27.3	28.6	26.6	25.1
Total Energy Adjustments	**-23.8**	**-23.0**	**-20.3**	**-16.4**	**-15.8**	**-16.1**	**-17.9**	**-19.0**	**-19.0**	**-16.4**	**-14.3**
Adjusted Energy Total	**1,327.9**	**1,313.1**	**1,338.7**	**1,368.7**	**1,393.2**	**1,405.0**	**1,453.8**	**1,474.4**	**1,476.4**	**1,500.8**	**1,547.4**
Other Sources											
Gas Flaring	2.5	2.8	2.8	3.7	3.8	4.7	4.5	4.2	3.9	4.0	4.5
CO_2 in Natural Gas	3.8	4.0	4.2	4.4	4.6	4.6	4.8	4.9	4.9	4.9	5.0
Cement Production	9.1	8.9	8.9	9.5	10.0	10.1	10.1	10.5	10.7	10.9	11.3
Other Industrial	7.3	7.2	7.2	7.1	7.2	7.6	7.9	8.0	8.1	7.9	8.1
Waste Combustion	4.8	5.3	5.4	5.7	6.0	6.3	6.5	7.0	6.9	7.1	7.1
Total Other Sources	**27.4**	**28.0**	**28.5**	**30.5**	**31.7**	**33.2**	**33.8**	**34.6**	**34.5**	**34.9**	**35.9**
Total	**1,355.3**	**1,341.2**	**1,367.2**	**1,399.2**	**1,424.8**	**1,438.2**	**1,487.7**	**1,509.0**	**1,510.9**	**1,535.7**	**1,583.3**

*Less than 50,000 metric tons carbon equivalent.
P = preliminary data.
Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding. Adjusted energy total includes U.S. Territories.
Sources: EIA estimates presented in this chapter.

Table 5. U.S. Carbon Dioxide Emissions from Energy Consumption by End-Use Sector, 1990-2000
(Million Metric Tons Carbon Equivalent)

End-Use Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Residential	257.0	261.6	261.8	278.4	275.8	277.9	293.9	292.8	293.7	298.8	313.4
Commercial	210.3	210.4	210.8	217.2	220.4	224.6	233.1	245.4	250.4	253.1	267.8
Industrial	452.7	439.8	455.1	452.9	463.3	461.1	476.1	481.5	469.5	465.8	465.7
Transportation	431.8	424.2	431.1	436.4	449.3	457.8	468.9	473.6	481.5	499.4	514.8
Total	**1,351.7**	**1,336.0**	**1,358.7**	**1,384.8**	**1,408.8**	**1,421.3**	**1,471.9**	**1,493.3**	**1,495.2**	**1,517.1**	**1,561.7**
Electric Power	507.0	506.0	512.0	532.4	540.7	542.5	562.1	583.1	607.2	612.6	641.6

P = preliminary data.
Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding. Electric power sector emissions are distributed across the end-use sectors. Emissions allocated to sectors are unadjusted. Adjustments are made to total emissions only (Table 4).
Sources: EIA estimates presented in this chapter.

Table 6. U.S. Carbon Dioxide Emissions from Residential Sector Energy Consumption, 1990-2000
(Million Metric Tons Carbon Equivalent)

Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Petroleum											
Liquefied Petroleum Gas	6.3	6.7	6.6	6.8	6.8	6.9	7.5	7.5	7.4	9.1	9.3
Distillate Fuel	16.5	16.4	17.1	18.0	17.4	17.4	18.4	17.8	15.4	16.0	16.2
Kerosene	1.2	1.4	1.3	1.5	1.3	1.5	1.7	1.8	2.1	2.2	2.0
Petroleum Subtotal	**24.0**	**24.5**	**24.9**	**26.3**	**25.4**	**25.8**	**27.6**	**27.1**	**25.0**	**27.3**	**27.5**
Coal	1.6	1.4	1.5	1.5	1.4	1.4	1.4	1.5	1.1	1.2	1.2
Natural Gas	65.1	67.5	69.4	73.4	71.7	71.8	77.6	73.8	67.2	69.9	73.2
Electricity[a]	166.4	168.2	166.0	177.2	177.3	178.9	187.3	190.4	200.4	200.3	211.5
Total	**257.0**	**261.6**	**261.8**	**278.4**	**275.8**	**277.9**	**293.9**	**292.8**	**293.7**	**298.8**	**313.4**

[a]Share of total electric power sector carbon dioxide emissions weighted by sales to the residential sector.
P = preliminary data.
Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding.
Sources: EIA estimates presented in this chapter.

Table 7. U.S. Carbon Dioxide Emissions from Commercial Sector Energy Consumption, 1990-2000
(Million Metric Tons Carbon Equivalent)

Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Petroleum											
Motor Gasoline	2.1	1.6	1.5	0.6	0.5	0.4	0.5	0.8	0.8	0.9	0.9
Liquefied Petroleum Gas	1.1	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.6	1.6
Distillate Fuel	9.6	9.5	9.2	9.2	9.2	9.1	9.4	8.8	8.3	8.2	8.6
Residual Fuel	5.0	4.5	4.1	3.7	3.7	3.1	3.0	2.4	1.9	1.9	2.6
Kerosene	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.5	0.6	0.5	0.5
Petroleum Subtotal	**18.0**	**17.1**	**16.1**	**14.9**	**14.9**	**14.1**	**14.6**	**13.9**	**13.0**	**13.1**	**14.2**
Coal	2.4	2.2	2.2	2.2	2.1	2.1	2.1	2.2	1.7	1.8	1.8
Natural Gas	38.8	40.4	41.5	42.4	42.9	44.9	46.8	47.7	44.6	45.1	49.3
Electricity[a]	151.0	150.7	150.9	157.7	160.5	163.5	169.5	181.6	191.1	193.1	202.5
Total	**210.3**	**210.4**	**210.8**	**217.2**	**220.4**	**224.6**	**233.1**	**245.4**	**250.4**	**253.1**	**267.8**

[a]Share of total electric power sector carbon dioxide emissions weighted by sales to the commercial sector.
P = preliminary data.
Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding.
Sources: EIA estimates presented in this chapter.

Table 8. U.S. Carbon Dioxide Emissions from Transportation Sector Energy Consumption, 1990-2000
(Million Metric Tons Carbon Equivalent)

Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Petroleum											
Motor Gasoline	260.5	259.2	263.0	268.9	273.3	279.0	284.0	286.5	292.5	299.7	301.5
Liquefied Petroleum Gas	0.4	0.3	0.3	0.3	0.6	0.3	0.3	0.2	0.3	0.2	0.2
Jet Fuel	60.1	58.1	57.6	58.1	60.4	60.0	62.7	63.3	64.2	66.3	68.5
Distillate Fuel	75.7	72.6	75.3	77.3	82.5	85.1	89.7	93.5	96.4	101.9	106.6
Residual Fuel	21.9	22.0	23.0	19.4	19.1	19.7	18.4	15.5	15.2	17.0	23.1
Lubricants	1.8	1.6	1.6	1.6	1.7	1.7	1.6	1.7	1.8	1.8	1.8
Aviation Gasoline	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Petroleum Subtotal	**421.2**	**414.6**	**421.6**	**426.4**	**438.2**	**446.5**	**457.4**	**461.5**	**471.2**	**487.6**	**502.5**
Coal	*	*	*	*	*	*	*	*	*	*	*
Natural Gas	**9.8**	**9.0**	**8.8**	**9.3**	**10.2**	**10.4**	**10.6**	**11.3**	**9.5**	**11.0**	**11.4**
Electricity[a]	**0.7**	**0.7**	**0.7**	**0.7**	**0.9**	**0.8**	**0.8**	**0.8**	**0.9**	**0.9**	**0.9**
Total	**431.8**	**424.2**	**431.1**	**436.4**	**449.3**	**457.8**	**468.9**	**473.6**	**481.5**	**499.4**	**514.8**

*Less than 50,000 metric tons carbon equivalent.
[a]Share of total electric power sector carbon dioxide emissions weighted by sales to the transportation sector.
P = preliminary data.
Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding.
Sources: EIA estimates presented in this chapter.

Table 9. U.S. Carbon Dioxide Emissions from Industrial Sector Energy Consumption, 1990-2000
(Million Metric Tons Carbon Equivalent)

Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Petroleum											
Motor Gasoline	3.6	3.7	3.7	3.5	3.7	3.9	3.9	4.1	3.8	2.9	2.9
Liquefied Petroleum Gas	12.0	12.1	12.7	12.1	12.9	12.7	13.7	14.0	13.0	13.7	13.7
Distillate Fuel	23.0	22.2	22.2	21.2	21.3	20.6	21.7	21.8	21.9	20.0	20.8
Residual Fuel	7.5	5.5	6.4	7.4	6.7	4.9	4.9	3.8	2.5	0.1	0.5
Asphalt and Road Oil	*	*	*	*	*	*	*	*	*	*	*
Lubricants	1.9	1.7	1.7	1.7	1.8	1.8	1.7	1.8	1.9	1.9	1.9
Kerosene	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.2
Other Petroleum	50.8	47.7	54.3	48.3	50.8	48.1	53.9	54.9	52.6	53.0	47.6
Petroleum Subtotal	**98.9**	**93.1**	**101.2**	**94.4**	**97.5**	**92.3**	**100.1**	**100.8**	**96.2**	**91.8**	**87.6**
Coal	**63.4**	**59.3**	**56.1**	**55.6**	**55.8**	**55.9**	**54.2**	**54.5**	**50.4**	**49.6**	**45.7**
Coal Coke Net Imports	**0.1**	**0.2**	**0.9**	**0.7**	**1.5**	**1.5**	**0.6**	**1.2**	**1.7**	**1.5**	**1.7**
Natural Gas	**101.2**	**101.0**	**102.7**	**105.5**	**106.6**	**111.9**	**116.5**	**115.0**	**106.5**	**104.7**	**104.0**
Electricity[a]	**189.0**	**186.2**	**194.2**	**196.6**	**201.9**	**199.4**	**204.6**	**210.1**	**214.7**	**218.2**	**226.7**
Electricity Sales to Grid (-)	**7.7**	**4.8**	**4.9**	**7.4**	**8.4**	**7.0**	**6.8**	**8.2**	**12.8**	**13.2**	**13.2**
Total	**452.7**	**439.8**	**455.1**	**452.9**	**463.3**	**461.1**	**476.1**	**481.5**	**469.5**	**465.8**	**465.7**

*Less than 50,000 metric tons carbon equivalent.
[a]Share of total electric power sector carbon dioxide emissions weighted by sales to the industrial sector.
P = preliminary data.
Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding.
Sources: EIA estimates presented in this chapter.

Table 10. U.S. Carbon Dioxide Emissions from Electric Power Sector Energy Consumption, 1990-2000

(Million Metric Tons Carbon Equivalent)

Generator Type and Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Petroleum											
Heavy Fuel Oil	24.9	23.6	19.3	21.4	19.7	13.3	14.6	16.5	22.9	20.8	17.6
Light Fuel Oil	2.0	1.8	1.7	2.0	2.4	2.3	2.5	2.3	3.1	3.8	3.9
Petroleum Coke	1.3	1.3	1.8	2.2	2.1	2.0	1.9	2.6	3.0	4.8	4.4
Petroleum Subtotal	**28.2**	**26.8**	**22.8**	**25.6**	**24.1**	**17.6**	**18.9**	**21.4**	**29.0**	**29.4**	**26.0**
Coal	420.4	418.8	425.3	441.9	446.3	449.4	474.3	487.9	495.5	498.6	522.4
Natural Gas	58.3	60.3	63.9	64.9	70.2	75.5	68.9	73.7	82.6	84.7	93.2
Geothermal	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**507.0**	**506.0**	**512.0**	**532.4**	**540.7**	**542.5**	**562.1**	**583.1**	**607.2**	**612.6**	**641.6**

P = preliminary data.

Notes: Estimates differ from those contained in Energy Information Administration, *Annual Energy Review 2000*, DOE/EIA-0384(2000) (Washington, DC, July 2001), Table 12.7, because of the removal of the thermal energy component. Totals may not equal sum of components due to independent rounding.

Sources: EIA estimates presented in this chapter.

Table 11. U.S. Carbon Sequestered by Nonfuel Use of Energy Fuels, 1990-2000

(Million Metric Tons Carbon Equivalent)

End Use and Type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Industrial											
Petroleum											
Liquefied Petroleum Gases	16.2	18.6	18.7	18.2	20.9	21.4	22.3	22.6	21.6	24.4	25.1
Distillate Fuel	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Residual Fuel	0.5	0.7	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Asphalt and Road Oil	24.1	22.2	22.7	23.7	24.2	24.3	24.2	25.2	26.0	27.3	26.3
Lubricants	1.9	1.7	1.7	1.8	1.8	1.8	1.7	1.8	1.9	2.0	1.9
Other *(Subtotal)*	*19.7*	*19.3*	*20.5*	*22.6*	*23.3*	*23.5*	*24.1*	*25.6*	*27.5*	*28.1*	*26.4*
Pentanes Plus	1.2	0.7	0.9	4.0	3.8	4.4	4.6	4.4	3.9	4.8	4.6
Petrochemical Feed	12.6	12.6	13.4	13.6	14.1	13.6	13.8	15.9	16.1	15.1	15.7
Petroleum Coke	2.6	2.2	3.4	2.3	2.5	2.7	2.9	2.5	4.3	5.2	3.1
Waxes and Miscellaneous	3.4	3.7	2.7	2.7	2.9	2.7	2.7	2.8	3.2	3.0	3.0
Coal	0.4	0.4	0.8	0.6	0.5	0.6	0.6	0.5	0.5	0.5	0.5
Natural Gas	4.1	3.9	3.5	3.9	5.0	4.7	4.7	5.0	5.0	5.2	5.3
Transportation											
Lubricants	1.8	1.6	1.6	1.7	1.7	1.7	1.6	1.7	1.8	1.8	1.8
Total	**68.7**	**68.3**	**70.2**	**73.0**	**78.1**	**78.6**	**79.9**	**83.1**	**85.0**	**89.9**	**87.9**

P = preliminary data.

Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding.

Sources: EIA estimates presented in this chapter.

Table 12. U.S. Carbon Dioxide Emissions from Industrial Processes, 1990-2000

(Million Metric Tons Carbon Equivalent)

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	P2000
Cement Manufacture											
Clinker Production	8.90	8.66	8.75	9.25	9.82	9.85	9.91	10.24	10.48	10.69	11.05
Masonry Cement	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Cement Kiln Dust	0.18	0.17	0.18	0.19	0.20	0.20	0.20	0.20	0.21	0.21	0.22
Cement Subtotal	**9.09**	**8.85**	**8.94**	**9.46**	**10.04**	**10.07**	**10.13**	**10.47**	**10.72**	**10.93**	**11.30**
Other Industrial											
Limestone Consumption											
Lime Manufacture	3.39	3.36	3.47	3.58	3.73	3.96	4.11	4.22	4.30	4.20	4.30
Iron Smelting	0.47	0.44	0.37	0.31	0.30	0.31	0.30	0.31	0.30	0.29	0.31
Steelmaking	0.08	0.09	0.07	0.13	0.15	0.14	0.11	0.09	0.10	0.07	0.12
Copper Refining	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.04
Glass Manufacture	0.03	0.03	0.04	0.05	0.08	0.09	0.05	0.02	0.05	0.05	0.05
Flue Gas Desulfurization	0.18	0.19	0.19	0.18	0.19	0.24	0.26	0.28	0.27	0.29	0.29
Dolomite Manufacture	0.13	0.10	0.08	0.07	0.07	0.06	0.09	0.09	0.09	0.04	0.04
Limestone Subtotal	***4.33***	***4.24***	***4.27***	***4.36***	***4.57***	***4.85***	***4.98***	***5.05***	***5.15***	***4.98***	***5.16***
Soda Ash Manufacture	0.92	0.92	0.94	0.91	0.92	1.04	1.03	1.08	1.04	1.00	0.99
Soda Ash Consumption											
Glass Manufacture	*	*	*	*	*	*	*	*	*	*	*
Flue Gas Desulfurization	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02
Sodium Silicate	0.05	0.05	0.05	0.06	0.06	0.07	0.06	0.07	0.07	0.06	0.07
Sodium Tripolyphosphate	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.01	0.01
Soda Ash Subtotal	***0.10***	***0.10***	***0.10***	***0.11***	***0.11***	***0.13***	***0.12***	***0.14***	***0.12***	***0.10***	***0.11***
Carbon Dioxide Manufacture	0.24	0.25	0.26	0.26	0.27	0.29	0.30	0.31	0.32	0.34	0.35
Aluminum Manufacture	1.62	1.65	1.62	1.48	1.32	1.35	1.43	1.44	1.48	1.51	1.48
Shale Oil Production	0.05	*	*	*	*	*	*	*	*	*	*
Other Industrial Subtotal	**7.27**	**7.16**	**7.19**	**7.12**	**7.19**	**7.65**	**7.86**	**8.02**	**8.12**	**7.93**	**8.08**
Total	**16.36**	**16.02**	**16.14**	**16.58**	**17.23**	**17.72**	**17.99**	**18.49**	**18.84**	**18.86**	**19.38**

*Less than 50,000 metric tons carbon equivalent.

P = preliminary data.

Notes: Data in this table are revised from the data contained in the previous EIA report, *Emissions of Greenhouse Gases in the United States 1999*, DOE/EIA-0573(99) (Washington, DC, October 2000). Totals may not equal sum of components due to independent rounding.

Sources: EIA estimates presented in this chapter.