U.S. Energy-Related Carbon Dioxide Emissions, 2023

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Independent Statistics and Analysis
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Executive Summary

This report highlights notable trends in energy-related carbon dioxide (CO_2) emissions in the United States in 2023, based on preliminary data.

U.S. energy-related CO_2 emissions decreased slightly in 2023 compared to 2022. Although emissions decreased across many economic sectors, more than 80% of U.S. energy-related CO_2 emissions reductions in 2023 occurred in the electric power sector. These reductions were caused largely by reduced coal-fired electricity generation, as natural gas and solar power made up a larger portion of the generation mix. This change in the generation mix away from coal, which has the highest carbon intensity among fossil fuels, decreased electric power sector CO_2 emissions by 7% relative to 2022.

We observed notably less energy-related CO_2 emissions in the residential and commercial sectors as milder weather reduced energy demand for space heating and cooling in buildings.

Emissions from the industrial and transportation sectors remained relatively unchanged.

Table 1. Total U.S. energy-related CO_2 emissions by sector, 2019–2023

million metric tons of carbon dioxide

Sector	2023	2022	2021	2020	2019
Residential	311	339	325	319	347
Commercial	250	261	245	233	255
Industrial	963	960	977	952	1,007
Transportation	1,856	1,840	1,807	1,630	1,921
Electric power	1,427	1,542	1,551	1,450	1,618
Total	**4,807**	**4,941**	**4,905**	**4,584**	**5,147**

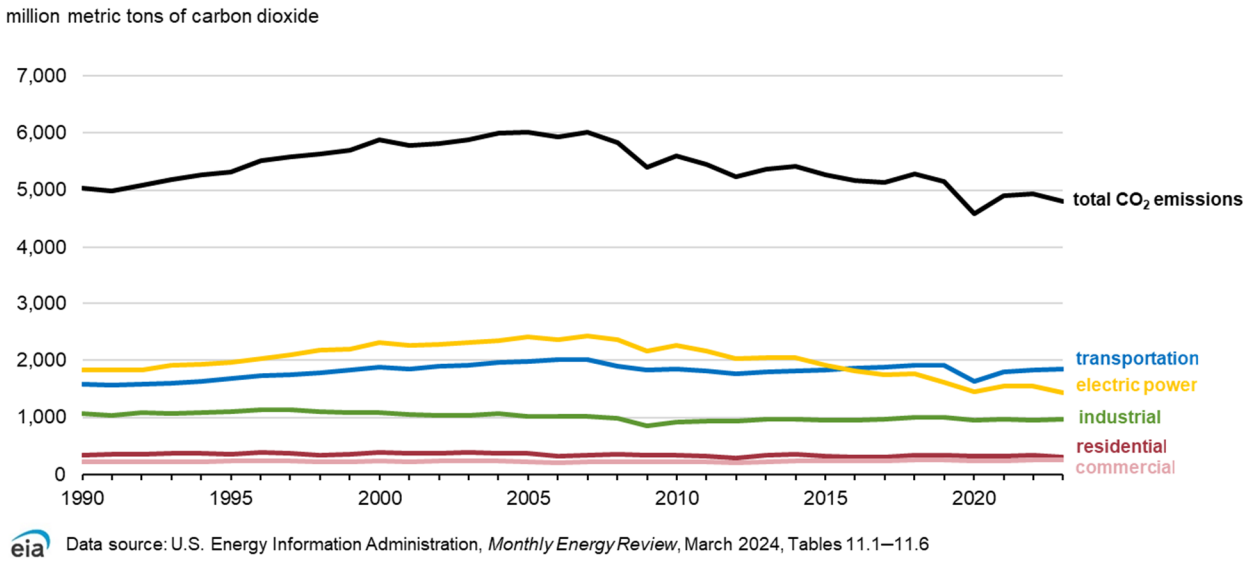
Data source: U.S. Energy Information Administration, *Monthly Energy Review*, March 2024, Tables 11.1–11.6
Note: Totals may not equal sum of components due to independent rounding.

Analysis

Most CO_2 reductions in 2023 came from the electric power sector

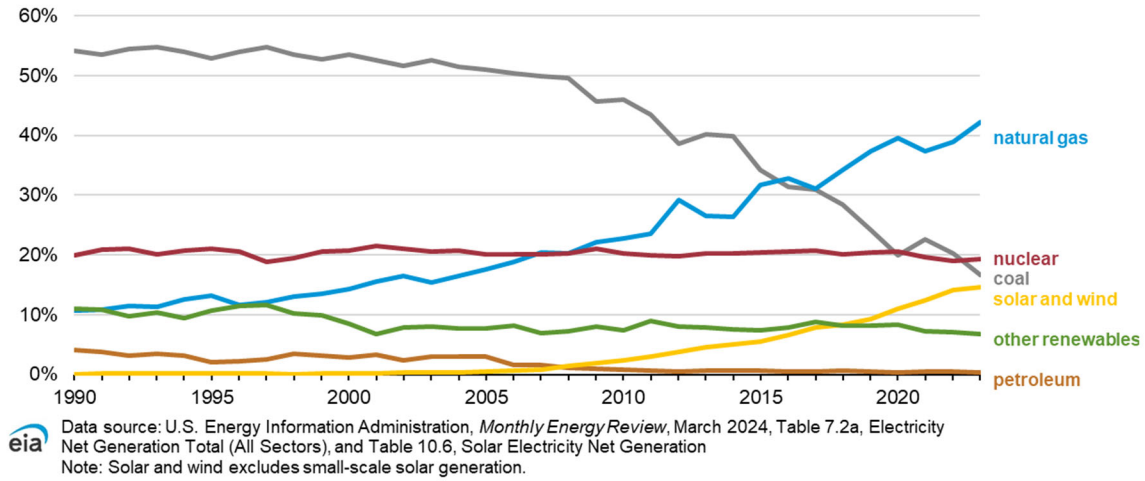
U.S. energy-related CO_2 emissions declined by 3%, or 134 million metric tons (MMmt), in 2023. Most of this decrease occurred in the electric power sector, with smaller reductions in the residential and commercial sectors. Emissions from the industrial and transportation sectors remained like those in 2022.

Figure 1. U.S. energy-related CO_2 emissions by sector, 1990–2023



CO_2 emissions from the electric power sector declined by 7% (115 MMmt) in 2023, making up 85% of net energy-related CO_2 emissions reductions observed over the year. The reduction was due to both a slight decrease in electricity demand, which fell by around 1% in 2023, and a significant decrease in coal-fired electricity generation caused by reduced coal-fired generating capacity prompted by competition with other generation sources. Electric power generation from coal fell by 19%, or 155 terawatthours (TWh), in 2023. Most of this generation was displaced by natural gas which increased by 7% (113 TWh) and by solar which increased by 14% (21 TWh). Because coal-fired generation emits more CO_2 per kilowatthour than natural gas when combusted, replacing coal-fired with natural gas-fired generation reduces CO_2 emissions overall.

Figure 2. Share of U.S. electric power sector generation by fuel source, 1990–2023

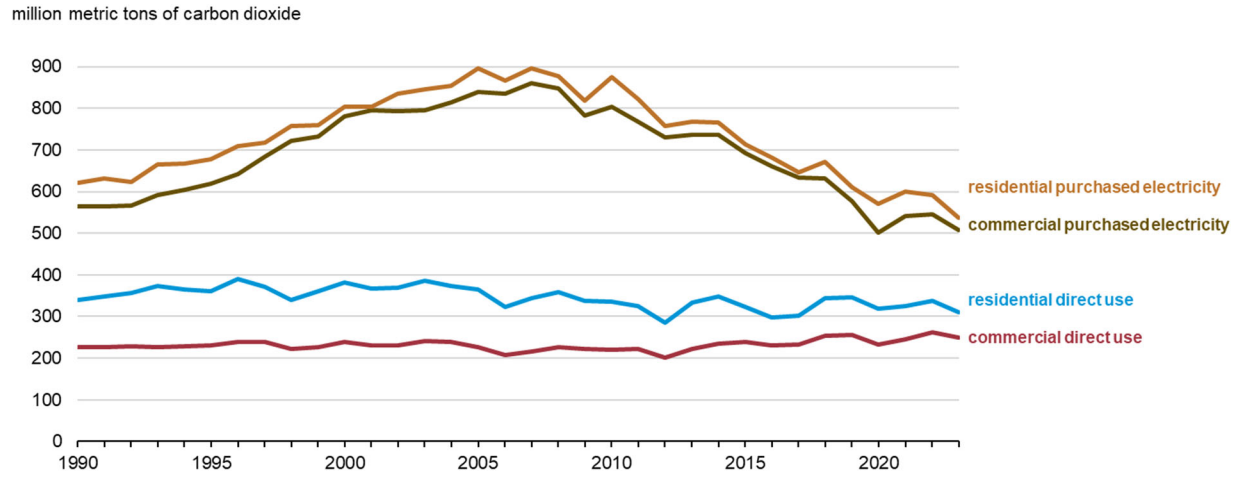


Mild weather decreased emissions from the residential and commercial sectors

We also observed notable declines in CO_2 emissions in the residential and commercial sectors due largely to milder weather which decreased demand for space heating and cooling. Demand for heating fell as annual U.S. population-weighted heating degree days (HDDs), a measure of how cold a location is, decreased by 10% in 2023. Cooling demand also fell as population-weighted cooling degree days (CDDs), a measure of how hot a location is, fell by 5%. While there are some indications of technological shifts in space heating and cooling, weather remained the dominant driver of heating and cooling demand in 2023.

Decreases in demand for heating and cooling in the United States helped reduce CO_2 emissions by 8% in the residential sector and 4% in the commercial sector. The effect that milder winter weather has on CO_2 emissions is evident, as more U.S. homes use natural gas for space heating than any other energy source and we calculate CO_2 emissions from direct natural gas use in each sector. In 2023, U.S. natural gas-related CO_2 emissions declined by 10% (26 MMmt) in the residential sector and by 6% (11 MMmt) in the commercial sector. Overall, CO_2 emissions associated with electricity consumption decreased by 9% (55 MMmt) in the U.S. residential sector and by 7% (38 MMmt) in the commercial sector. Although some of this decline was due to reduced space cooling demand, other factors, such as changes in the U.S. electric generation mix, also contributed to reducing CO_2 emissions (Figure 2).

Figure 3. U.S. CO_2 emissions associated with the residential and commercial sectors, 1990–2023

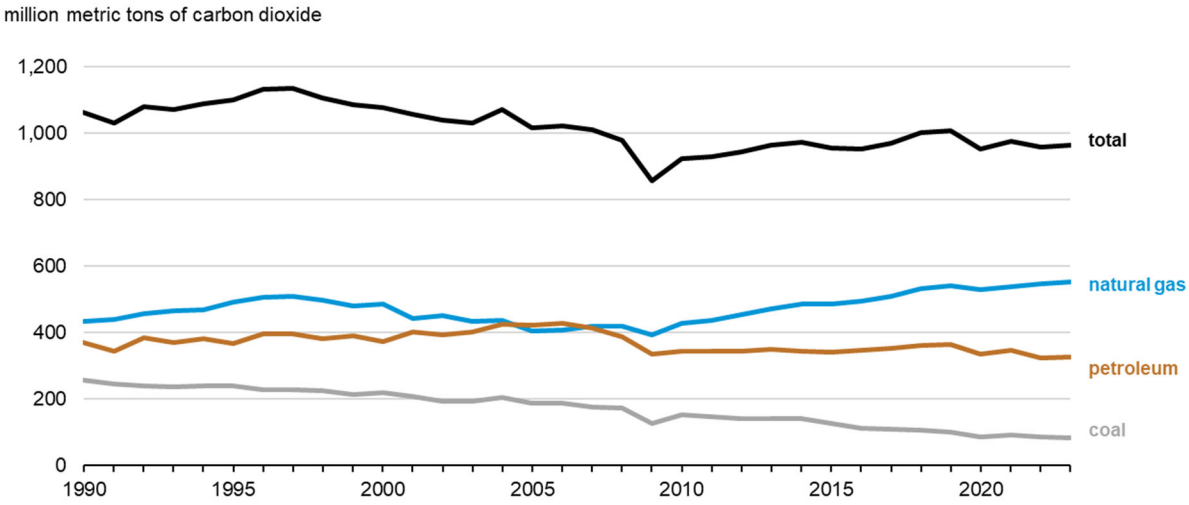


eia Data source: U.S. Energy Information Administration, *Monthly Energy Review*, March 2024, Tables 11.2 and 11.3

Industrial CO_2 emissions remained unchanged in 2023 as industrial production growth slowed

CO_2 emissions from the U.S. industrial sector remained unchanged compared with 2022, changing by less than 1%. Industrial sector natural gas emissions increased slightly over the year by around 1% (5 MMmt), while emissions from coal and petroleum remained essentially unchanged. The slight increase in natural gas emissions was due to a small increase in U.S. industrial production between 2022 and 2023, most notably in bulk chemicals.

Figure 4. U.S. industrial sector direct CO_2 emissions by fuel source, 1990–2023



eia Data source: U.S. Energy Information Administration, *Monthly Energy Review*, March 2024, Tables 11.4, Carbon Dioxide Emissions from Energy Consumption: Industrial Sector
Note: Total represents only direct emissions from the industrial sector and does not include emissions associated with the use of utility-scale electric power.

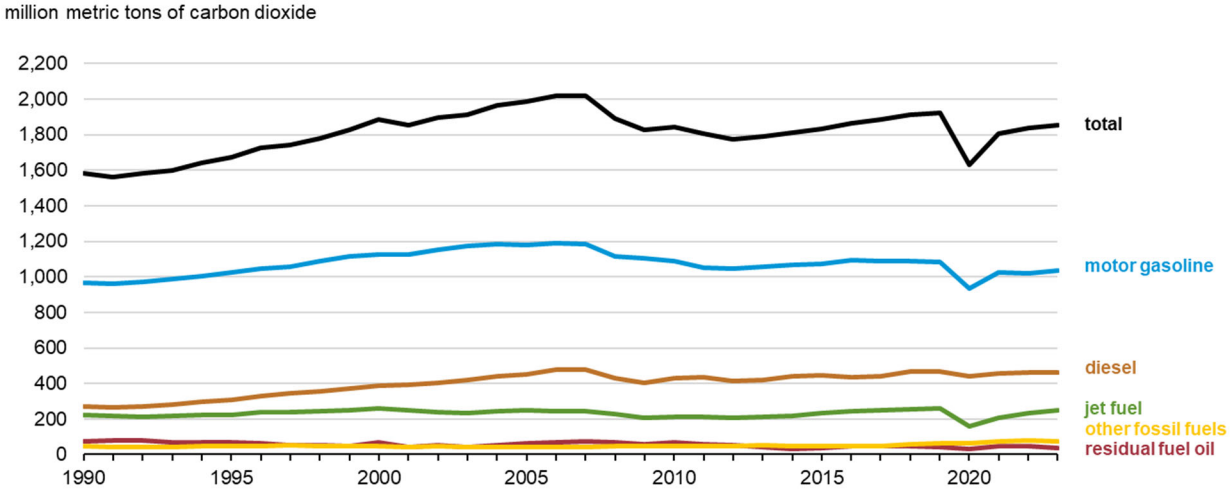
Transportation sector emissions remained unchanged between 2022 and 2023, as increased consumption of some petroleum products offset decreases in others

U.S. transportation sector emissions remained unchanged relative to 2022, but emissions related to individual petroleum product differed. Emissions from motor gasoline and jet fuel increased slightly over the year as both vehicle and air travel grew.

CO_2 emissions from motor gasoline have remained relatively flat over the last 20 years (Figure 5) despite increasing vehicle travel. This longer-term trend is due to increased vehicle fuel economy and, to a lesser extent, increased deployment of electric drive vehicles.

The motor gasoline and jet fuel emissions increases were offset by fewer emissions from diesel because of less consumption from on-road diesel vehicles as well as decreased emissions from residual fuel oil because of less consumption from marine shipping.

Figure 5. U.S. transportation sector CO_2 emissions by fuel source, 1990–2023



Data source: U.S. Energy Information Administration, *Monthly Energy Review*, March 2024, Tables 11.5, Carbon Dioxide Emissions from Energy Consumption: Transportation Sector
Note: Total represents only direct emissions from the transportation sector and does not include emissions associated with the use of electric power.

Background and Data

We based our analysis of U.S. energy-related CO_2 emissions in this report on data published in our *Monthly Energy Review* (MER), and this initial analysis is based on preliminary 2023 data first published in the March 2024 edition of the MER. These values are subject to change as we finalize survey data for 2023. We expect relatively minor differences between the preliminary and revised estimates based on past years (Table 2); however, we will update the information and analysis presented in this report to reflect final 2023 data. Supplemental analysis, figures from past reports, and a discussion of the methodology and terminology used in this report are available in the Appendix.

Table 2. Preliminary and revised U.S. energy-related CO_2 emissions estimates, 2018–2022

Year	Preliminary CO_2 estimates (million metric tons)	Revised CO_2 estimates (million metric tons)	Difference (million metric tons)	Percentage difference
2018	5,274	5,269	-5	-0.1%
2019	5,138	5,149	11	0.2%
2020	4,571	4,575	4	0.1%
2021	4,870	4,904	34	0.7%
2022	4,970	4,941	-29	-0.6%

Data source: U.S. Energy Information Administration, *Monthly Energy Review*, Tables 11.1–11.6, March and September editions, 2019-2023

Emissions values and analysis presented in this report pertain only to U.S. CO_2 emissions associated with fossil fuel combustion and non-combustion applications of energy products (for example, as industrial feedstocks). We do not include estimates of CO_2 emissions outside this scope or other greenhouse gas emissions burned or released in the production, extraction, or distribution of energy products. Our approach may result in discrepancies between our emissions estimates and those of other organizations, including other U.S. government agencies.

We make short-term forecasts and long-term projections of U.S. energy-related CO_2 emissions available in many EIA products. You can find a short-term forecast of U.S. energy-related CO_2 emissions and key drivers in our monthly *Short-Term Energy Outlook*, which includes forecasts by fuel source over the next calendar year (currently through the end of 2025) and the latest estimates of the effects of recent events on energy markets and energy-related CO_2 emissions. We publish long-term U.S. emissions projections in our *Annual Energy Outlook*, which provides annual projections of energy-related CO_2 emissions by fuel source, sector, and end use, as well as projections of other elements of energy markets through 2050. Projections of international energy-related CO_2 emissions through 2050 are available in our *International Energy Outlook*.