CO_2 Emissions in 2023

A new record high, but is there light at the end of the tunnel?

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Executive Summary

- Global energy-related CO_2 emissions grew by 1.1% in 2023, increasing 410 million tonnes (Mt) to reach a new record high of 37.4 billion tonnes (Gt). This compares with an increase of 490 Mt in 2022 (1.3%). Emissions from coal accounted for more than 65% of the increase in 2023.

- The global shortfall in hydropower generation due to droughts drove up emissions by around 170 Mt. Without this effect, emissions from the global electricity sector would have fallen in 2023.

- Between 2019 and 2023, total energy-related emissions increased around 900 Mt. Without the growing deployment of five key clean energy technologies since 2019 - solar PV, wind, nuclear, heat pumps, and electric cars - the emissions growth would have been three times larger.

- Thanks to growing clean energy deployment, emissions are seeing a structural slowdown. In the decade to 2023, global emissions grew slightly more than 0.5% per year, the slowest rate since the Great Depression.

- Advanced economy GDP grew 1.7% but emissions fell 4.5%, a record decline outside of a recessionary period. Having fallen by 520 Mt in 2023, emissions are now back to their level of fifty years ago. Advanced economy coal demand, driven by evolutions in the G7, is back to the level of around 1900. The 2023 decline in advanced economy emissions was caused by a combination of structural and cyclical factors, including strong renewables deployment, coal-to-gas switching in the US, but also weaker industrial production in some countries, and milder weather.

- Emissions in China grew around 565 Mt in 2023, by far the largest increase globally and a continuation of China's emissions-intensive economic growth in the post-pandemic period. However, China continued to dominate global clean energy additions. Cyclical effects, notably a historically bad hydro year, contributed about one-third of its emissions growth in 2023. Per capita emissions in China are now 15% higher than in advanced economies.

- In India, strong GDP growth drove up emissions by around 190 Mt. But a weak monsoon increased demand for electricity and cut hydro production, contributing around one-quarter of the increase in its total emissions in 2023. Per capita emissions in India remain far below the world average.

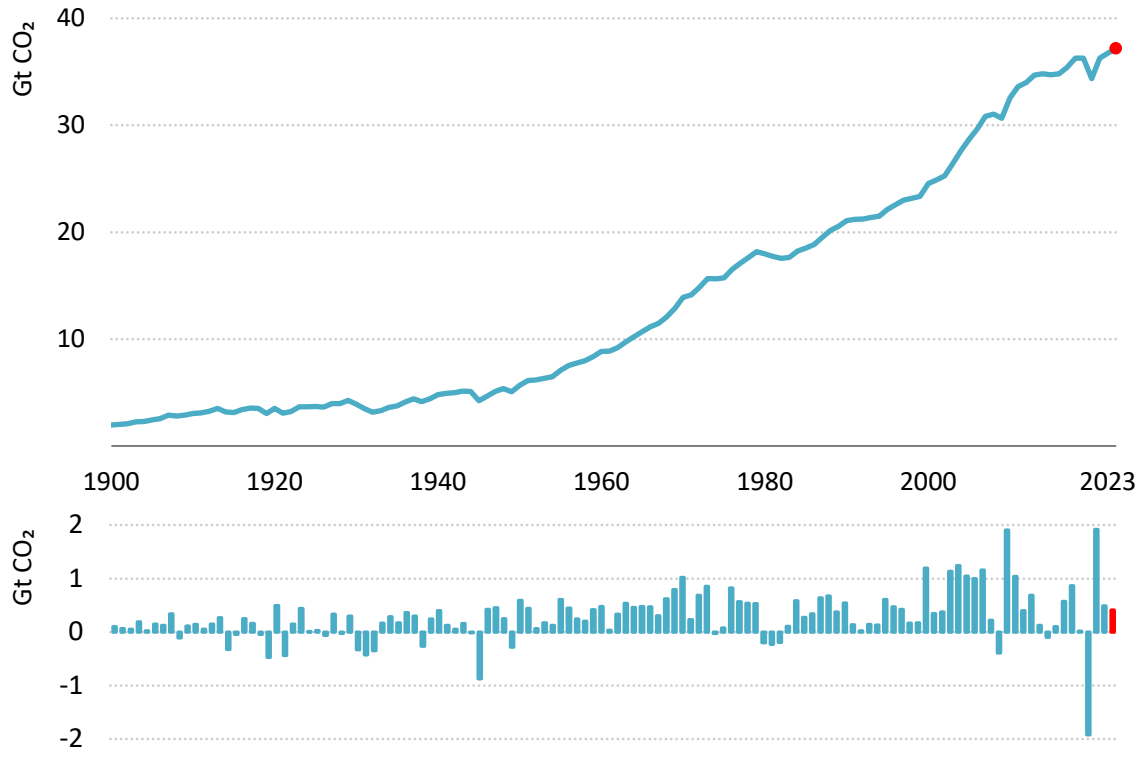
Emissions grew in 2023, but clean energy is limiting the growth

Emissions increased in 2023

Total energy-related CO_2 emissions increased by 1.1% in 2023. Far from falling rapidly - as is required to meet the global climate goals set out in the Paris Agreement - CO_2 emissions reached a new record high of 37.4 Gt in 2023.[1] This estimate is based on the IEA's detailed, cutting-edge region-by-region and fuel-by-fuel analysis of the latest official national energy data, supplemented by data on economic and weather conditions.

Understanding the various drivers behind this emissions growth provides insights into the progress and prospects for the energy transition. This report provides a timely analysis of both the latest emissions trends and the underlying energy sector drivers in 2023. It represents a companion piece to our first ever Clean Energy Market Monitor, released in parallel.

Figure 1: Global energy-related CO_2 emissions and their annual change, 1900-2023



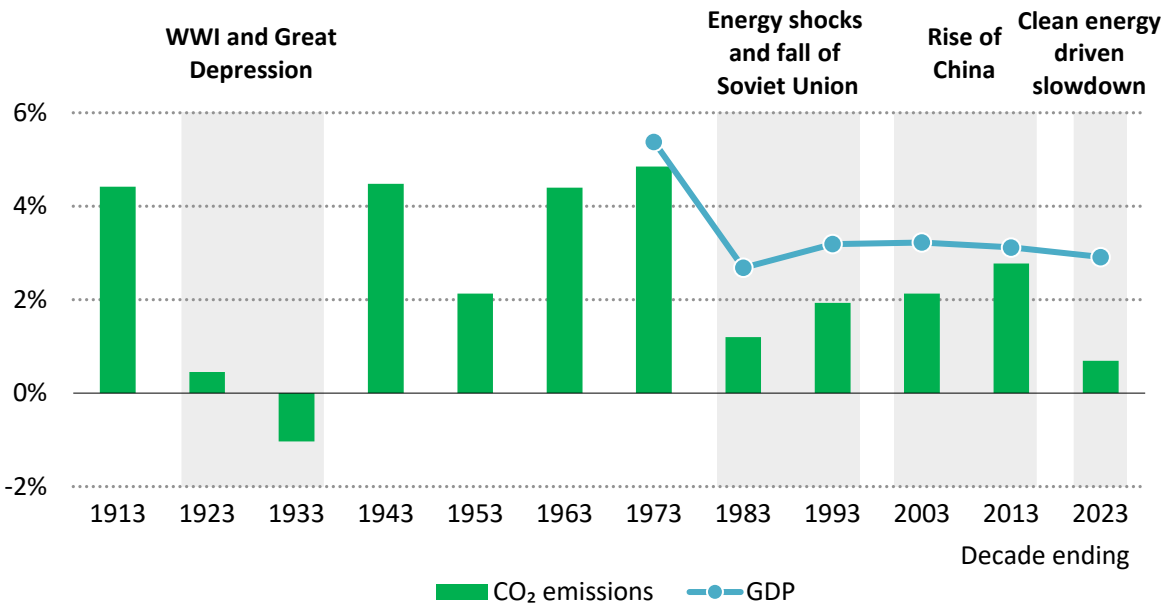
[1] This includes CO_2 emissions from energy combustion, industrial processes, and flaring. Elsewhere in this report, unless explicitly mentioned, CO_2 emissions refers to emissions from energy combustion and industrial processes excluding flaring.

… but clean energy is making a difference

The 1.1% increase in emissions in 2023 represented an increase of around 410 million tonnes (Mt CO_2). The percentage growth of emissions was substantially slower than global GDP growth, which was around 3% in 2023. Last year therefore continued the recent trend of CO_2 growing more slowly than global economic activity. Over the ten years ending with 2023, global CO_2 emissions have grown by slightly more than 0.5% per year. This is not just due to the Covid-19 pandemic: although emissions fell precipitously in 2020, by the following year they had already rebounded to the pre-pandemic level. It was also not caused by slow global GDP growth, which averaged a robust 3% per year across the course of the previous decade, in line with the annual average over the last 50 years.

The rate of emissions growth seen over the last decade is slower than that seen during the 1970s and 1980s, which saw major disruptions with the two energy shocks of 1973-4 and 1979-80, and a macroeconomic shock of global significance with the fall of the Soviet Union in 1989-90. When the last ten years are put in a broader historical context, a comparably slow rate of CO_2 emissions growth only occurred in the extremely disruptive decades of World War I and the Great Depression. Global CO_2 emissions are therefore undergoing a structural slowdown even as global prosperity grows.

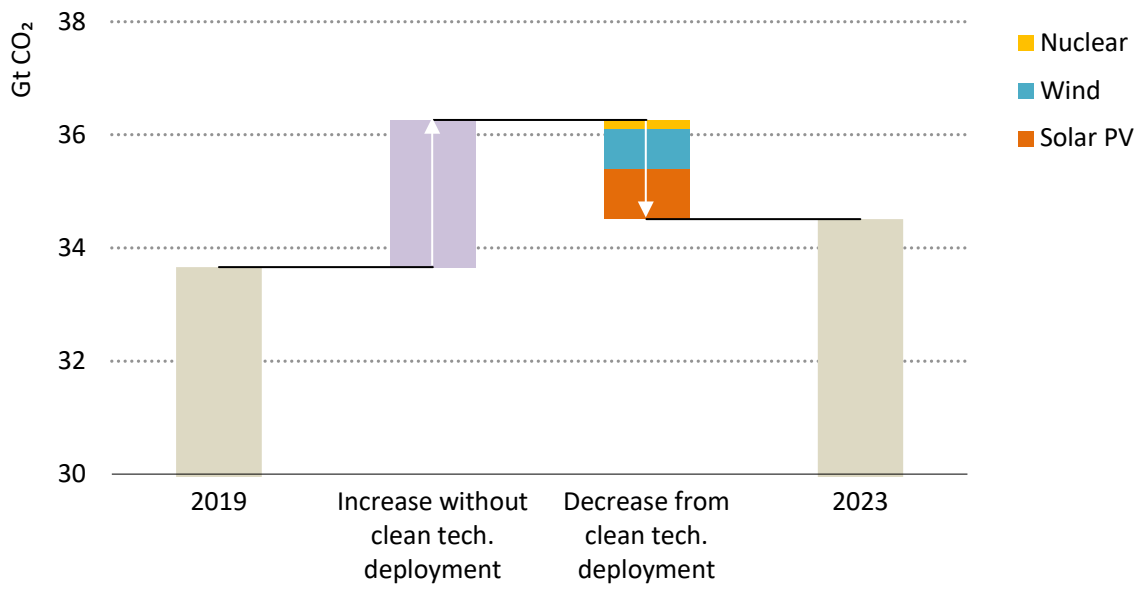
Figure 2: Annual average rate of global CO_2 emissions and GDP growth by decade, 1903-2023



Clean energy is at the heart of this slowdown in emissions. Global capacity additions of wind and solar PV reached a record almost 540 GW in 2023, up 75% on the level of 2022. Global sales of electric cars climbed to around 14 million, an increase of 35% on the level of 2022. Clean energy is having a significant impact on the trajectory of global CO_2 emissions.

On the back of Covid-19 stimulus packages, there has been a significant acceleration in clean energy deployment since 2019. Between 2019 and 2023, total energy-related emissions increased around 900 Mt. Without the growing deployment of five key clean energy technologies since 2019 - solar PV, wind power, nuclear power, heat pumps, and electric cars - the emissions growth would have been three times larger.

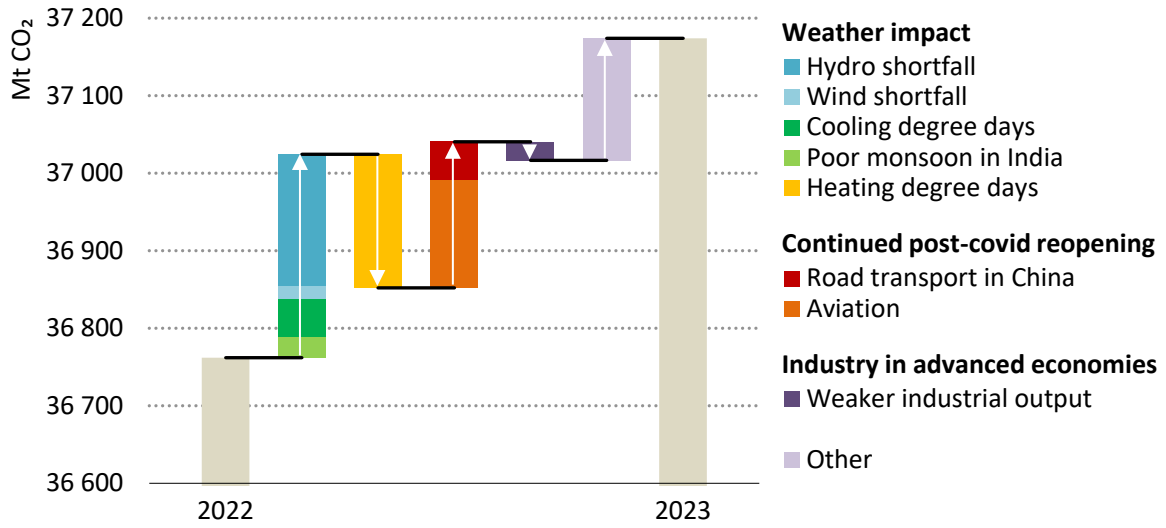
Figure 3: Change in CO_2 emissions from energy combustion and avoided emissions from deployment of major clean technologies, 2019-2023



Weather and continued Covid-19 reopening effects played an important role in the emissions increase

The following sections outline a series of factors - both positive and negative - that shaped the change in CO_2 emissions between 2022 and 2023. In summary, the cumulative net impact of these effects accounts for nearly two-thirds of the overall increase in emissions, or around 255 Mt CO_2 of the 410 Mt of observed increase.

Figure 4: Change in global CO_2 emissions by driver, 2022-2023



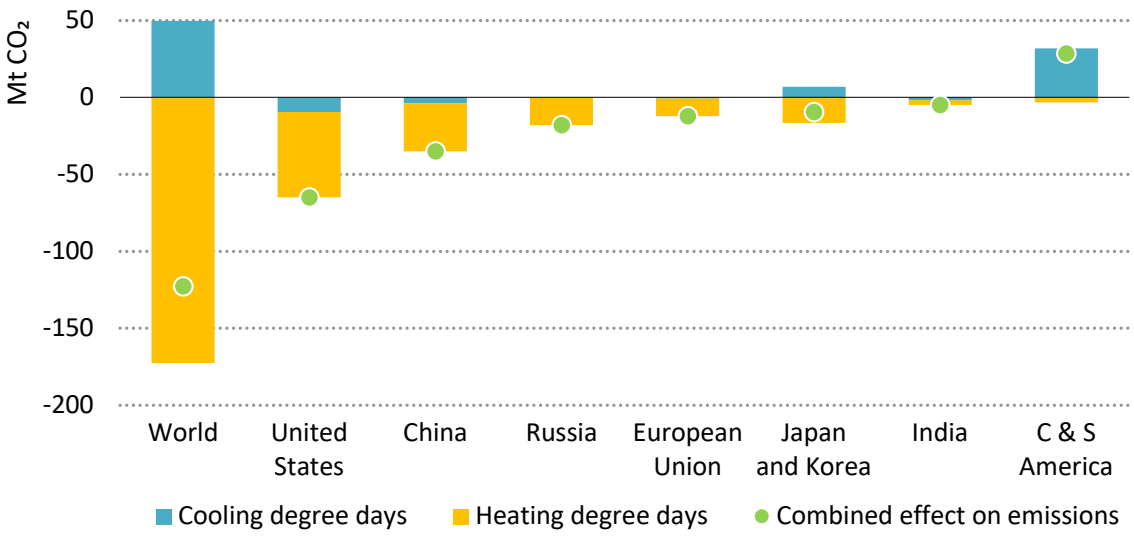
Temperature

Temperatures have significant impacts on energy sector emissions, by affecting energy demand for heating and cooling. 2023 was the hottest year on record. However, 2022 was also marked by extremely high temperatures in major regions with high ownership rates of air conditioning. 2023 was hot globally, but 2022 was hotter or just as hot in the regions accounting for a large share of global energy demand for air conditioning. The increase in emissions from more cooling demand globally in 2023 was therefore relatively small, at around 50 Mt CO_2.

In contrast, 2023 saw much milder winter conditions compared to 2022 in countries with large energy demand for heating, notably the United States and the People's Republic of China (hereinafter China). This significantly reduced energy demand for heating, saving emissions equivalent to 170 Mt CO_2. Globally, considering the net effects of moderately higher energy demand for cooling and

much lower energy demand for heating, temperatures reduced emissions by around 120 Mt CO_2 in 2023.

Figure 5: Impact of temperature variations between 2022 and 2023 on CO_2 emissions in selected regions



Note: C & S America refers to Central and South America.

Precipitation

Global hydropower capacity increased by around 20 GW in 2023. Despite this increase, the global generation of hydropower saw a record decline in 2023. This was primarily driven by severe and prolonged droughts that impacted major hydropower regions, exacerbated by the influence of El Niño.

Had the availability of the hydropower plant fleet in 2023 remained consistent with 2022 levels, an additional 200 TWh of electricity would have been generated globally. This would have avoided the emission of around 170 million Mt CO_2 from fossil fuel-based power plants. It would also have meant that electricity sector emissions would have fallen globally in 2023, instead of rising moderately.

China experienced a challenging period of 12 consecutive months of below-average rainfall from the middle of 2022 to the middle of 2023; the deficit was particularly severe during the second half of 2022. Even as rainfall gradually recovered over the course of 2023, additional water inflow was primarily utilised to refill hydro reservoirs rather than for electricity production. This meant that although the worst of the precipitation deficit was seen in the second half of 2022, the impact on hydropower output was only seen in 2023. In 2023, China's hydropower generation fell around 4.9%, the worst decline in the last twenty years. China's hydropower generation would have been 125 TWh higher in 2023 if its

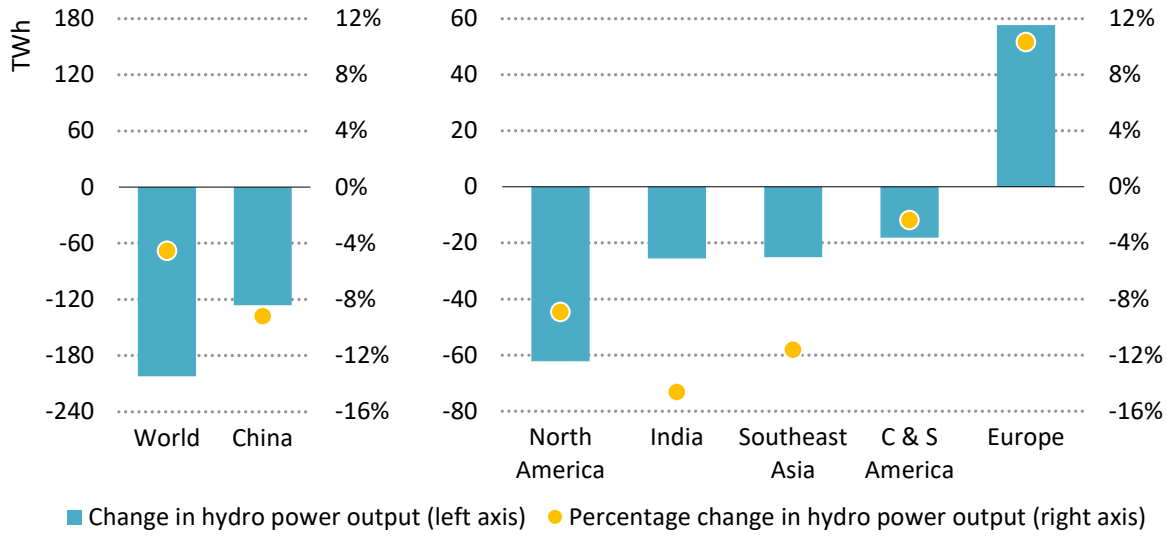
hydropower fleet availability had been the same as in 2022. China's hydropower shortfall accounted for nearly two-thirds of the global deficit in hydropower generation in 2023.

Southeast Asia and India grappled with warm and dry conditions throughout 2023, a probable consequence of the simultaneous occurrence of El Niño and the positive phase of the Indian Ocean Dipole - the Indian Ocean's counterpart to El Niño – in the second part of the year. India experienced a weakened monsoon season, with August the driest in at least 45 years.

North America also faced significant drought conditions. The influence of El Niño brought about warmer and drier conditions in Canada and the North-West of the United States, where half of the national hydropower capacity is situated. Additionally, unusually warm temperatures in spring accelerated snowmelt in these regions, resulting in a considerable depletion of hydropower resources. As a result, much of Canada grappled with drought conditions, with British Columbia, the second-largest hydropower province in the country, particularly hard-hit by severe drought. In Mexico, severe and prolonged droughts led to a hydro generation shortfall of almost 50% compared to 2022.

In contrast to other regions, 2023 proved to be a robust year for hydropower electricity generation in Europe. The hydropower sector recovered from the drought experienced in 2022, with the water level of hydropower reservoirs back to historical averages in key regions. This recovery enabled European hydropower plants to produce around 45 TWh more electricity compared to 2022.

Figure 6: Change in hydropower output by major region in 2023 versus 2022



Notes: C & S America refers to Central and South America. Changes in hydropower outputs are calculated assuming that the availability of the hydropower plant fleet in each region remained consistent with 2022 levels throughout 2023 and take into account capacity additions in 2023.

Reopening in China and continued reopening in global aviation

The effects of Covid-19 on the energy sector are still unwinding, and this process of cyclical recovery back to pre-pandemic levels of transport activity played an important role in driving up emissions in 2023. This is evident in the global aviation sector and in China's road passenger transport sector.

Total global aviation traffic, measured in revenue passenger kilometres (RPKs), soared by more than 35% in 2023 compared to 2022. Despite this increase, global aviation traffic was still around 6% lower than the pre-pandemic level, due to the persistence of lower levels of international travel. This continued cyclical recovery of global aviation demand resulted in around 140 Mt of extra emissions in 2023.

China relaxed its stringent lockdowns at the beginning of 2023, which led to a huge rebound in passenger transport demand. Highway passenger kilometres surged by around 50% compared to 2022, although they remained substantially below the 2019 level. Total gasoline consumption rose by around 10% in China in 2023 compared to 2022. In contrast to passenger transport, road freight transport activity levels were never as affected by the Covid-19 lockdowns compared to passenger transport. Considering therefore the cyclical recovery of road passenger transport, the reopening in China accounted for around 50 Mt of additional emissions.

Weaker industrial output in advanced economies

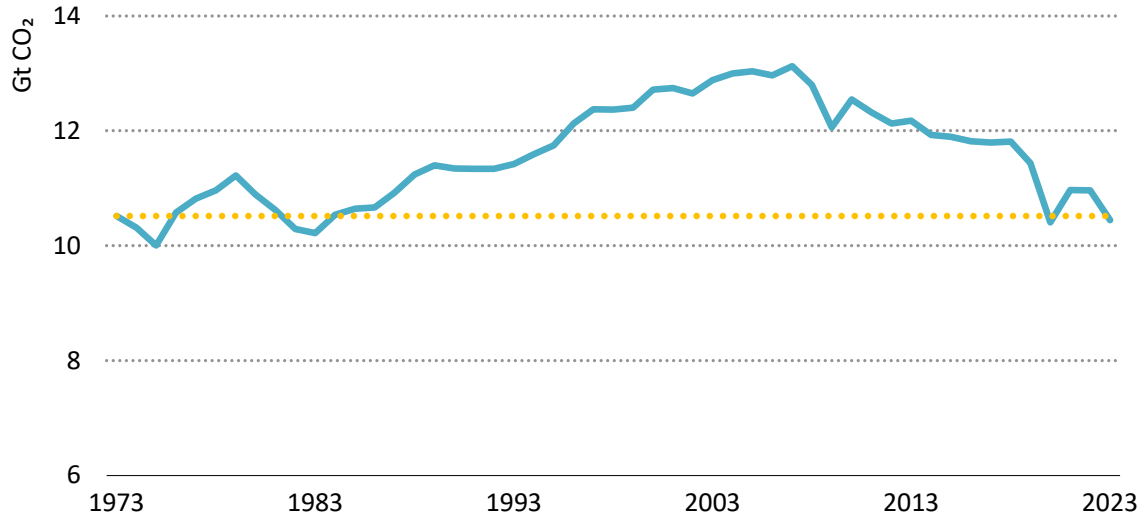
In 2022, as the world reeled from the effects of the energy shock, the decrease in energy-intensive industrial production contributed significantly to avoiding emissions. In 2023, this effect was more muted. The output of key energy-intensive goods declined modestly in advanced economies in the aggregate, although there were differences depending on the industrial commodity and regions. We estimate that this pushed down emissions by around 25 Mt.

Emissions in advanced economies fell to their level of 50 years ago

Advanced economies saw a record decline in their emissions …

After falling by around 4.5% in 2023, emissions in advanced economies were lower than they were fifty years ago in 1973. Although emissions in this group of countries have plumbed similar lows in 2020, 1974-75 and 1982-83, there are two important differences. Firstly, in contrast with the previous temporary declines in 1974-75 and 1982-83, advanced economy emissions have been in a structural decline since 2007. Secondly, advanced economy GDP expanded by around 1.7% in 2023, compared to stagnation or outright recession in these other periods. The decline in 2023 therefore represents the largest percentage drop in advanced economy emissions outside of a recessionary period.

Figure 7: CO_2 emissions from combustion in advanced economies, 1973-2023



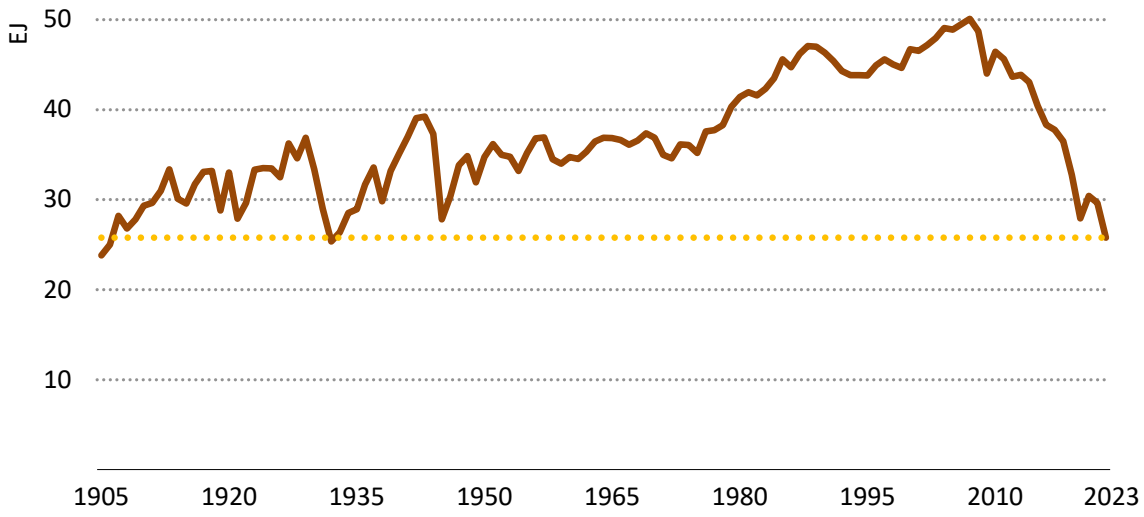
… with coal demand back to around its 1900 level…

Nearly two-thirds of the decline in emissions from advanced economies in 2023 occurred in the electricity sector. For the first time in history, electricity generation from renewables and nuclear reached 50% of total generation in advanced economies, with renewables alone accounting for an unprecedented 34% share. Conversely, coal's share plummeted to an historic low of 17%.

This transformation in the electricity sector has pushed advanced economy coal demand back to a level that had not been seen – outside of briefly in the Great Depression – since around 1900. Since its peak in 2007, coal demand has nearly

halved. This reduction was driven by the remarkable increase in the share of renewables, which more than doubled from 16% to 34% of electricity generation during this period. Additionally, there has been significant coal-to-gas switching, with the share of natural gas in electricity generation rising from 22% to 31%.

Figure 8: Energy supply from coal in advanced economies, 1905-2023



Note: IEA analysis with data from 1900 to 1971 estimated using IIASA PFU database.

…on the back of a clean energy boom, but also mild weather and somewhat weaker industrial production

European Union

Total CO_2 emissions from energy combustion in the European Union declined by almost 9% in 2023 (-220 Mt). While this reduction is of similar magnitude to the decline observed in 2020 during the Covid-19 pandemic, the context in 2023 differs significantly, with the European Union experiencing – admittedly weak – economic growth of around 0.7%. Clean energy growth accounted for half of the decline in emissions in 2023, and was the largest driver.

The primary driver behind this decline was the deployment of renewables in the electricity sector. For the first time, wind power surpassed both natural gas and coal in electricity generation, marking an historic milestone for the energy transition in the region. Electricity production from coal dropped by 27% in 2023, while natural gas-based electricity generation declined by 15%. The recovery of hydroelectric power from the droughts of 2022 and a partial recovery in nuclear power also played a role in reducing the reliance on fossil fuels in the power sector.

Nuclear power saw an historic fall in 2022 in the European Union, due to forced maintenance outages. Several of the reactors taken offline in 2022 were gradually

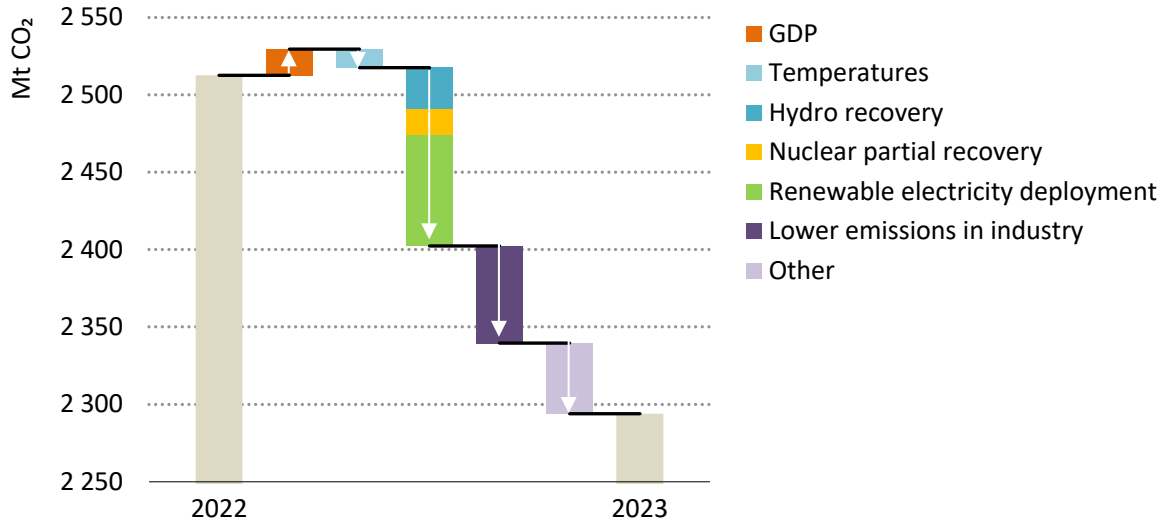
reconnected to the grid in the first part of 2023, and Covid-19 related maintenance delays began to subside. However, the nuclear power fleet availability did not recover back to its 2021 level. If the EU's nuclear fleet availability had achieved the 2021 level, an additional 70 TWh would have been generated, despite capacity retirements in some countries. This would have resulted in a further reduction of 40 Mt CO_2.

High energy prices, interest rates, weak domestic demand and strong international competition pushed down industrial production in the European Union. Reductions in the industry sector account for around 30 percent of the total annual decrease in emissions. However, the percentage fall in industry CO_2 was substantially larger than the fall in value added, and larger than the decline in the output of heavy industry goods. This indicates that beyond output declines, energy efficiency and fuel-switching played a role in reducing emissions for the industry sector in the European Union.

A mild winter in 2023 lowered energy demand in the residential and services sectors. However, the 2022 winter was already mild. Temperature variations therefore played a marginal role in emissions reduction in the region.

Some of the tensions on European energy markets receded in 2023, resulting in a decrease in wholesale energy prices from the record highs observed in 2022. However, retail energy prices continued to rise in 2023 following the lifting of some of the financial support mechanisms implemented in 2022; this effect likely contributed to some of the decline in residential energy demand.

Figure 9: Change in total CO_2 emissions from combustion in the European Union by driver, 2022-2023



United States

Total CO_2 emissions from energy combustion in the United States declined by 4.1% (-190 Mt), while the economy grew by 2.5%. Two-thirds of the emissions reduction came from the electricity sector.

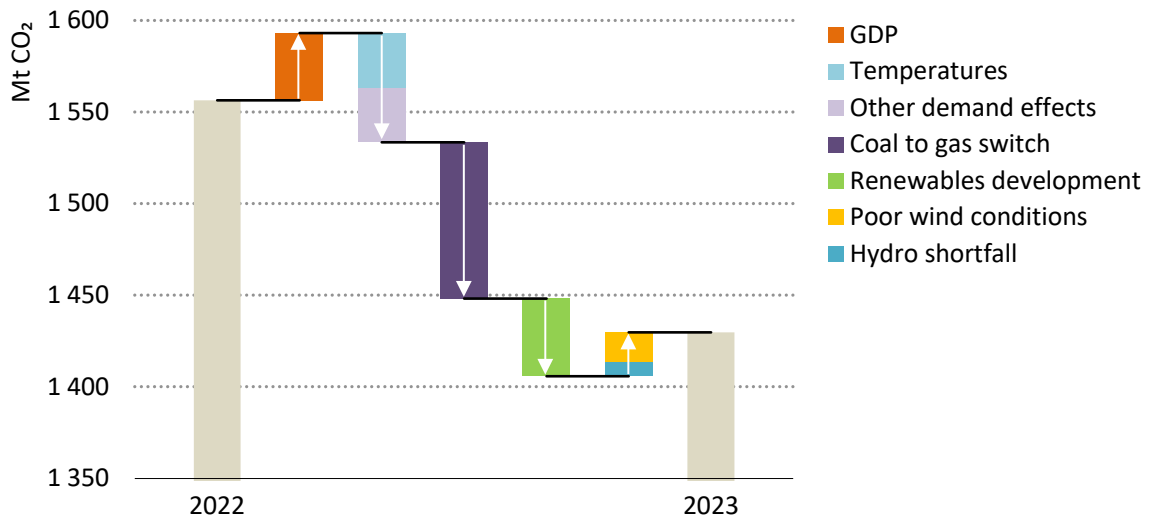
The United States experienced a substantial shortfall in hydropower generation in 2023, which fell around 6% or 15 TWh. The United States also experienced a shortfall in wind power generation. In 2022, favourable wind conditions prevailed in key regions for wind generation across the United States. However, in 2023, partly due to El Niño, average daily wind speeds in these regions plummeted to their lowest levels of the decade. If wind conditions had been the same as 2022, 16 Mt CO_2 would have been avoided in the United States in 2023.

Despite the hydro and wind shortfalls that impacted the United States, renewables in the electricity sector reduced emissions by around 20 Mt. If poor wind conditions and poor hydro conditions had not occurred, the deployment of renewables would have reduced emissions by around 40 Mt.

Coal-to-gas switching was the largest driver behind emissions reduction in the US electricity sector. This shift was driven by advantageous gas prices compared to coal since 2022, combined with the ongoing retirement of coal-fired power plants. While electricity generated from coal decreased by almost 20% in 2023, electricity generated from natural gas grew by 6%.

The mild winter experienced in the United States in 2023 was also a driver behind emissions reduction in the country. Milder temperatures compared to 2022 led to a notable decrease in electricity and fossil fuel demand in the residential and services sectors, contributing to 35% of the total emissions reductions from the energy sector in the United States.

Figure 10: Change in CO_2 emissions from electricity generation in the United States by driver, 2022-2023



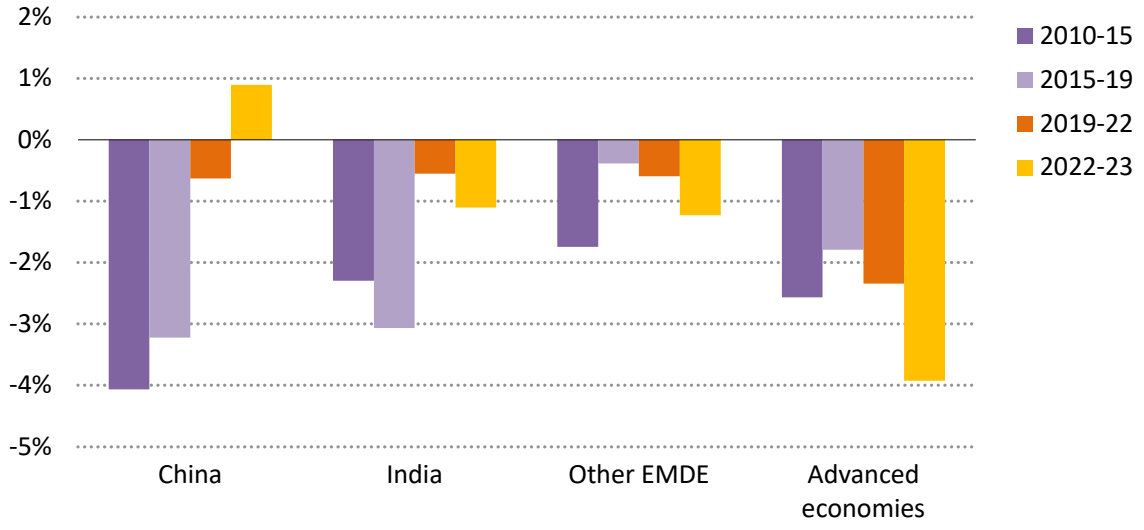
Energy-intensive economic growth, compounded by unfavourable weather, pushed emissions up in China and India

The economic recovery has been energy-intensive, particularly in China

Both China and India have experienced robust economic growth in recent years, considering the impacts of pandemic lockdowns in both countries and the property sector disruption in China. From 2019 to 2023, GDP growth averaged 4.6% in China and 4.1% in India. In 2023, the two countries registered 5.2% and 6.7% GDP growth respectively.

However, in both countries - but especially in China - the economic recovery during the period impacted by the Covid-19 pandemic has been quite energy-intensive. In the decade to 2019, China saw energy intensity improvements of around 3.3% per year, while India achieved improvements of around 2.8% per year. Both countries, however, experienced a slowdown in energy intensity improvements after the pandemic, and China even saw a deterioration of its energy intensity in 2023.

Figure 11: Average annual rate of energy intensity improvement by economic region



Notes: EMDE = emerging market and developing economies.

Yearly variations in energy intensity need to be analysed with caution, as one-off effects, including weather, can play an important role. However, the broader, multiyear slowdown in energy intensity improvements is clear. A key driver in this

trend appears to be the structure of economic growth in both countries after the pandemic. In China, the share of investment and net exports - both more energy-intensive than household consumption - in GDP growth increased from slightly more than 40% in the period 2015-19 to 45% in the period 2019-23. Continued investment in infrastructure, manufacturing capacity and real-estate has been a major driver of Chinese growth, pushing up energy intensity. In the case of India, the share of investment in GDP growth increased from around 35% from 2015-19 to nearly 50% in the period 2019-23, as the government has pushed investment in much-needed infrastructure to compensate for relatively weaker consumption growth.

Bad hydro and economic reopening pushed up the increase in China's emissions

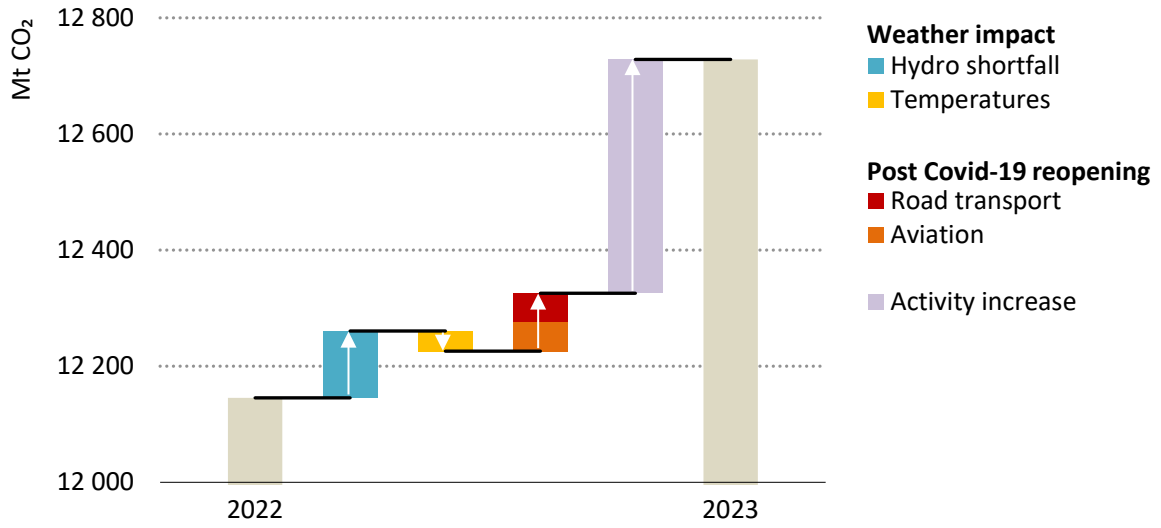
China's CO_2 emissions grew 565 Mt in 2023 to reach 12.6 Gt. This represents an increase of 4.7%, as emissions from energy combustion increased 5.2% while those from industrial processes stayed broadly stable. This occurred despite China's overwhelming lead in the global clean energy economy. In 2023, China contributed around 60% of the global additions of solar PV, wind power and electric vehicles. From 4% in 2015, the share of solar PV and wind in total electricity generation reached 15% in 2023, close to the level of advanced economies (17%). China's share of EVs in total car sales was more than double the level of advanced economies in 2023.

However, the growth in clean energy was not sufficient to keep pace with surging energy demand, which increased by around 6.1% - a percentage point more than GDP. Since the pandemic, China's GDP growth has been driven by energy-intensive sectors: from 2015 to 2019, services value added accounted for two-thirds of GDP growth; from 2019 to 2023, that fell to around half. Fixed asset investment in infrastructure and manufacturing capacity grew on average 7.1% and 6.4% in 2023, above the rate of GDP growth; and although investment in new real estate projects fell, 2023 construction activity was higher than in 2022 as developers worked to clear a large backlog of already started projects. According to data from China's National Bureau of Statistics, total floorspace completed was 4% above the 2019 level in 2023, and 16% above the 2022 level, even as new floorspace started was 30% below 2022 and 60% below 2019 levels.

Alongside these structural drivers, China's emissions were also pushed up by cyclical factors. After the reopening from Covid-19 lockdowns, highway passenger kilometres increased nearly 50% and aviation passenger kilometres by more than 160% in 2023. However, they both remain below the 2019 level. This cyclical recovery pushed up China's emissions by around 100 Mt. The shortfall of hydropower generation pushed up emissions by a further 115 Mt. Milder weather

reduced both heating and cooling demand, pushing down emissions by around 35 Mt. Taken all together, clearly identifiable cyclical factors accounted for around one-third of China's emissions growth.[2]

Figure 12: Change in CO2 emissions in China by driver, 2022-2023



A poor monsoon drives up India's emissions

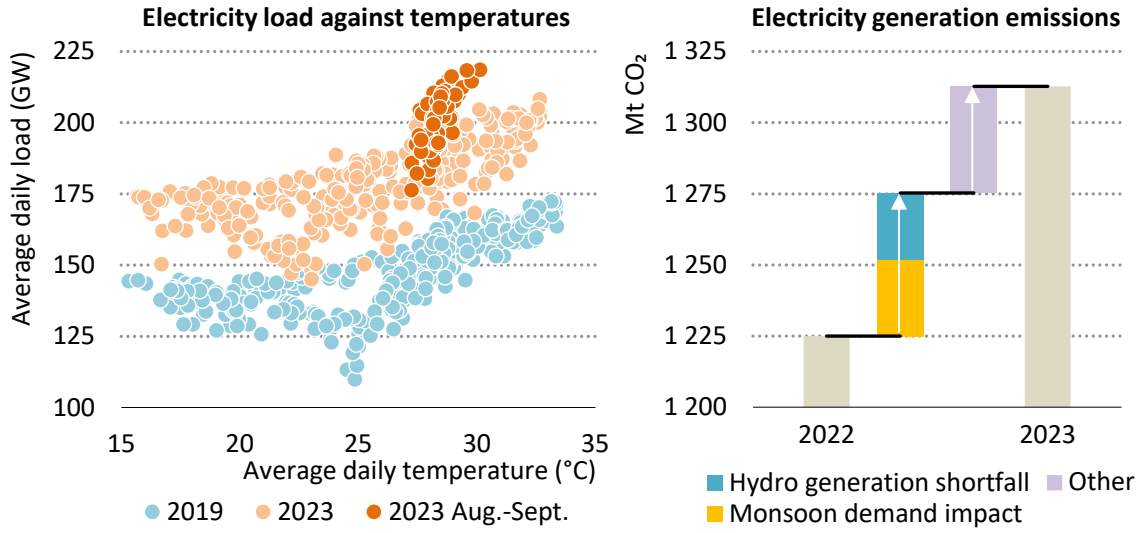
India's economy saw rapid growth in 2023, expanding by 6.7%. The country's emissions grew faster than GDP, at slightly more than 7%, rising around 190 Mt to reach 2.8 Gt. However, India's per capita emissions remain very low, at around 2 tonnes, less than half the world average of 4.6 tonnes. The large increase in India's total emissions was driven by the continued rapid recovery in economic activity from the lows of the Covid-19 pandemic. Steel and cement output both soared – in both cases faster than GDP. Electricity demand also grew rapidly. However, closer examination of the data reveals some important cyclical drivers.

The Indian summer monsoon occurs between the months of June to September, and sometimes into October. In 2023, electricity demand in the monsoon months grew at four times the rate of electricity demand in the non-monsoon months, when compared to 2022 (12% versus 3% year-on-year). The monsoon affects electricity demand by driving up demand for agricultural pumping, with the agricultural sector accounting for nearly one-fifth of electricity consumption. Due to a poor monsoon in 2023, India also lost a substantial amount of hydropower output, which fell nearly 15%, an absolute decline of around 25 TWh. Considering the impacts of a poor monsoon on both electricity demand and hydropower supply, we estimate

[2] This may somewhat understate the importance of cyclical factors, as it is difficult with available data to disentangle the impact of the reopening on the services sector.

that it contributed nearly 60% of the increase in India's electricity sector emissions in 2023. In turn, the electricity sector accounted for more than half of the increase in India's total emissions, implying that cyclical weather-related events accounted for around one-quarter of the total emissions increase.

Figure 13: Impact of weak monsoon on Indian electricity demand and associated emissions, 2023

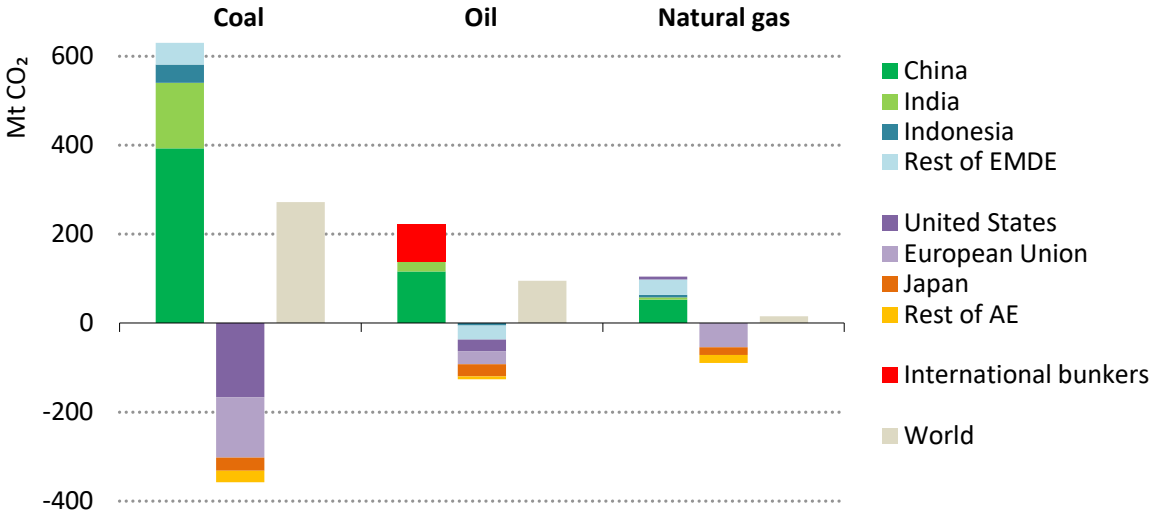


Coal demand in emerging market and developing economies was the biggest driver in global emissions growth

Coal has contributed by far the most to the increase of global CO_2 emissions in the post-pandemic era. Global emissions from energy combustion have increased by around 850 Mt since 2019; those from coal have grown by 900 Mt, gas emissions have increased moderately, and oil emissions are still slightly below their 2019 level.

Coal accounted for around 70% of the increase in global emissions from energy combustion in 2023 (+270 Mt). China and India saw substantial increases in emissions from coal combustion, only partially offset by declines in advanced economies. Oil emissions were pushed up by the reopening in China and in global aviation, increasing by around 95 Mt globally. Natural gas emissions increased only marginally at the global level.

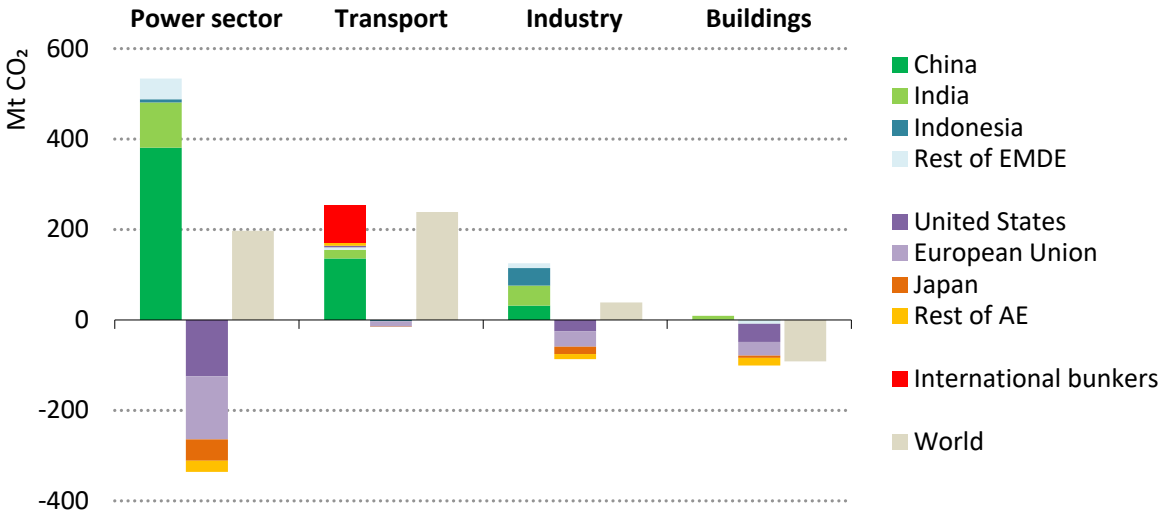
Figure 14: Change in CO_2 emissions from combustion by fuel and region, 2022-2023



Notes: AE = advanced economies; EMDE = emerging market and developing economies. International bunkers include the demand for fuels for international aviation and international maritime transport.

At the sector level, transport experienced the most pronounced growth in emissions, surging by nearly 240 Mt globally. The power sector contributed the second largest increase and shows the highest level of regional disparity, as emissions in advanced economies collapsed while those in emerging market and developing economies soared. Industrial emissions saw a slight uptick, as the combination of moderately weaker industrial output, efficiency gains, and fuel switching in advanced economies was insufficient to counterbalance the emissions increase from industrial development in emerging market and developing economies. Buildings was the only sector to see emissions fall at the global level, largely attributable to milder temperatures experienced in 2023.

Figure 15: Change in CO_2 emissions from combustion by sector and region, 2022-2023

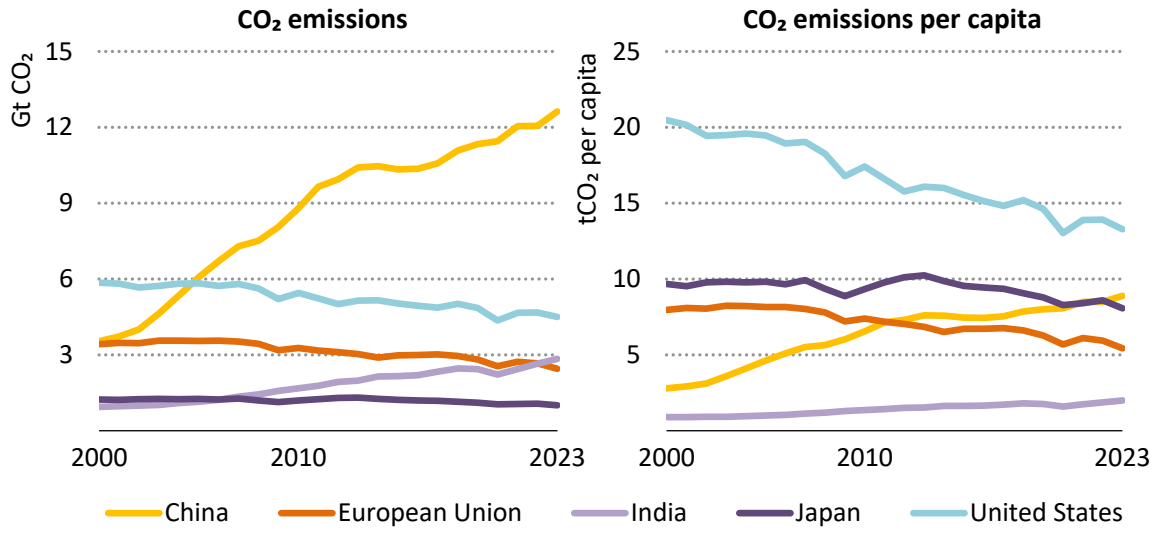


The changing landscape of global emissions

The landscape of emissions continues to change. China's total CO_2 emissions exceeded those of the advanced economies combined in 2020, and in 2023 were 15% higher. India surpassed the European Union to become the third largest source of global emissions in 2023. Countries in developing Asia now account for around half of global emissions, up from around two-fifths in 2015 and around one-quarter in 2000. China alone accounts for 35% of global CO_2 emissions.

Advanced economies continue to have relatively high per capita emissions, at about 70% higher than the global average in 2023. India's per capita emissions remain less than half of the global average, at around 2 tonnes. Per capita emissions in the European Union have fallen strongly and are now only around 15% higher than the global average and around 40% below those of China. China's per capita emissions exceeded those of the advanced economies as a group in 2020 and are now 15% higher; 2023 represented the first time that they surpassed those of Japan, although they remain one-third lower than those of the United States.

Figure 16: CO_2 total and CO_2 per capita by region



Data sources and methodology

The IEA draws upon a wide range of respected statistical sources to construct estimates of energy demand, energy-related CO_2 emissions for the year 2023. Sources include the latest monthly data submissions to the IEA Energy Data Centre, real-time data from power system operators across the world, statistical releases from national administrations, and recent data from the IEA Market Report series that covers coal, oil, natural gas, renewables, electricity and energy efficiency. Where data are not available on an annual or monthly basis, estimates are used. The definitions for regions, fuels and sectors are in Annex C of the World Energy Outlook 2023.

The scope of CO_2 emissions in this report includes emissions from all uses of fossil fuels for energy purposes, including the combustion of non-renewable waste, as well as emissions from industrial processes such as cement, iron and steel, and chemicals production. Estimates of industrial process emissions draw upon the latest production data for iron and steel, clinker for cement, aluminium, and chemicals.

Economic growth rates underlying this analysis are those published by the International Monetary Fund's January 2024 *World Economic Outlook Update*. All monetary quantities are expressed in USD (2022) in purchasing power parity (PPP) terms.

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