



GLOBAL CARBON **BUDGET**
2025

Acknowledgements

The work presented here has been possible thanks to the enormous observational and modelling efforts of the institutions and networks below

Atmospheric CO₂ datasets

NOAA/GML (Lan et al., 2025)
Scripps (Keeling et al., 1976)

Atmospheric O₂ datasets

Scripps (Keeling 2025)

Fossil CO₂ emissions

Andrew and Peters, 2025
CDIAC-FF (Erb and Marland, 2025)
UNFCCC 2025
Energy Institute 2025

Consumption emissions

Peters et al., 2011
GTAP (Narayanan et al., 2015)

Land-use change

BLUE (Hansis et al., 2015)
OSCAR (Gasser et al., 2020)
LUCE (Qin et al., 2024)
GFED4 (van der Werf et al., 2017)
FAO-FRA and FAOSTAT
HYDE (Klein Goldewijk et al., 2017)
LUH2 (Hurtt et al., 2020)
MapBiomass (Souza et al., 2020)

Land models

CABLE-POP | CLASSIC | CLM6.0 | CLM-FATES | DLEM | eDV3 | ELM | ELM-FATES | GDSTEM | IBIS | iMAPLE | ISAM | JSBACH | JULES-ES | LPJ-GUESS | LPJmL | LPJ-EOSIM | LPX-Bern | OCN | ORCHIDEEv3 | SDGVM | VISIT | VISIT-UT | CARDAMOM

Climate forcing CRU (Harris et al., 2014) | JRA-55 (Kobayashi et al., 2015)

Ocean models

NEMO-PlankTOM12 | NEMO4.2-PISCES (IPSL) | MICOM-HAMOCC (NorESM1-OCv1.2) | MPIOM-HAMOCC6 | NEMO3.6-PISCESv2-gas (CNRM) | FESOM2.1-REcoM3 | MOM6-COALTv3 (Princeton) | CESM-ETHZ | MRI-ESM2-3 | ACCESS (CSIRO)

fCO₂ based ocean flux products

VLIZ-SOMFFN | Jena-MLS | CMEMS-LSCE-FFNNv2 | UExp-FNN-U | NIES-ML3 | JMA-MLR | OceanSODA-ETHZv2 | LDEO-HPD | CSIR-ML6

Surface Ocean CO₂ Atlas SOCATv2025

Atmospheric inversions

Jena CarboScope | CarbonTracker Europe (CTE) | NISMON-CO2 | CT-NOAA | CMS-Flux | CAMS-Satellite | GONGGA | COLA | GCASv2 | UoE | MIROC-ACTM | NTFVAR | THU | NISMON-CO2_GOSAT

Earth system models

CanESM5 | EC-Earth3-CC | IPSL-CM6A-CO2-LR | MIROC-ES2L | MPI-ESM1-2-LR | NorCPM-CC

Full references provided in [Friedlingstein et al 2025](#)

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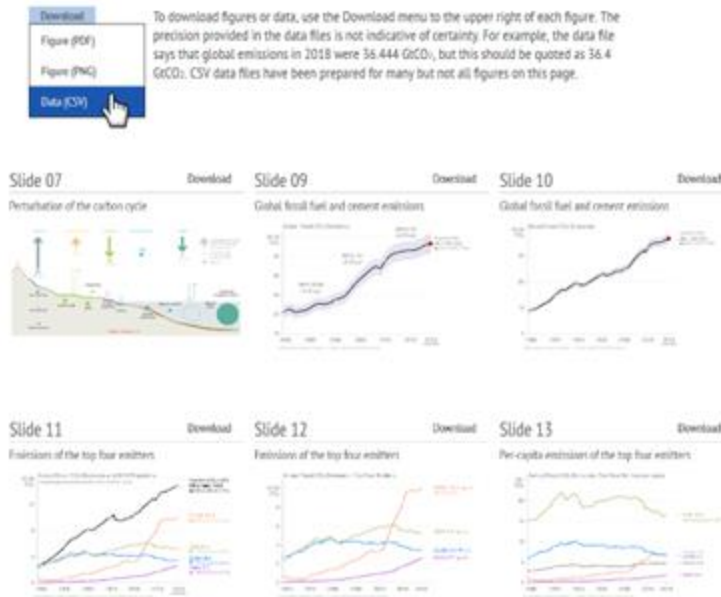


More information, data sources and data files:
<https://globalcarbonbudget.org/carbonbudget>

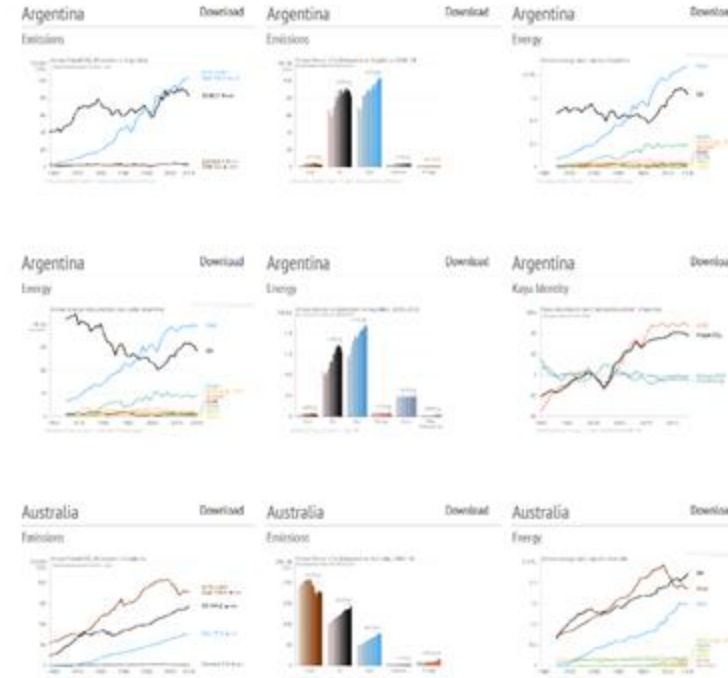


More information, data sources and data files:
www.globalcarbonatlas.org
(co-funded in part by BNP Paribas Foundation)

Global Carbon Budget



Additional country figures



Figures and data for most slides available from tinyurl.com/GCB25figs
and from <https://globalcarbonbudget.org/carbonbudget>

All the data is shown in billion tonnes CO₂ (GtCO₂)

1 Gigatonne (Gt) = 1 billion tonnes = 1×10^{15} g = 1 Petagram (Pg)

1 kg carbon (C) = 3.664 kg carbon dioxide (CO₂)

1 GtC = 3.664 billion tonnes CO₂ = 3.664 GtCO₂

(Figures are available from <https://globalcarbonbudget.org/carbonbudget>)

Most figures in this presentation are available for download as PNG, PDF and SVG files from tinyurl.com/GCB25figs along with the data required to reproduce them.

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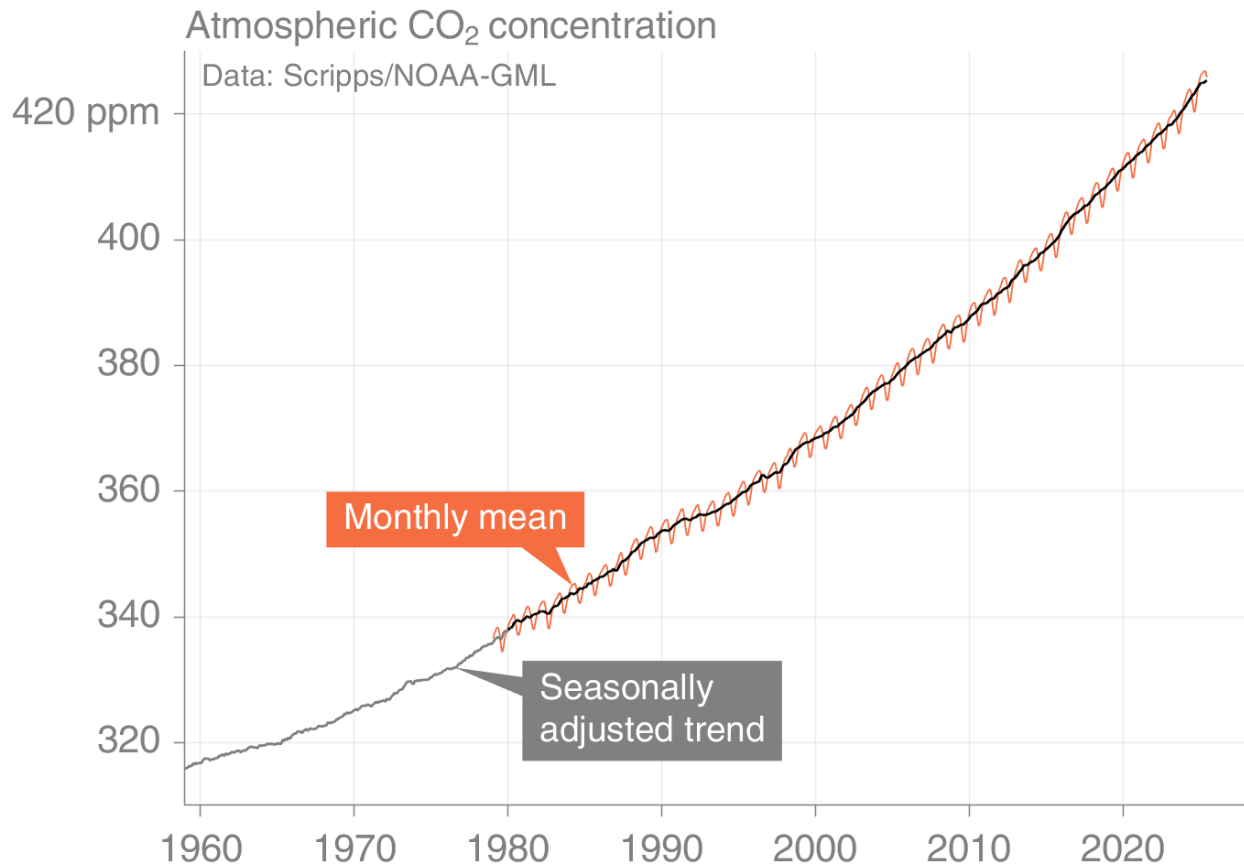
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Atmospheric CO₂ concentration

The global CO₂ concentration increased from ~277 ppm in 1750 to 422.8 ppm in 2024 (up 53%)



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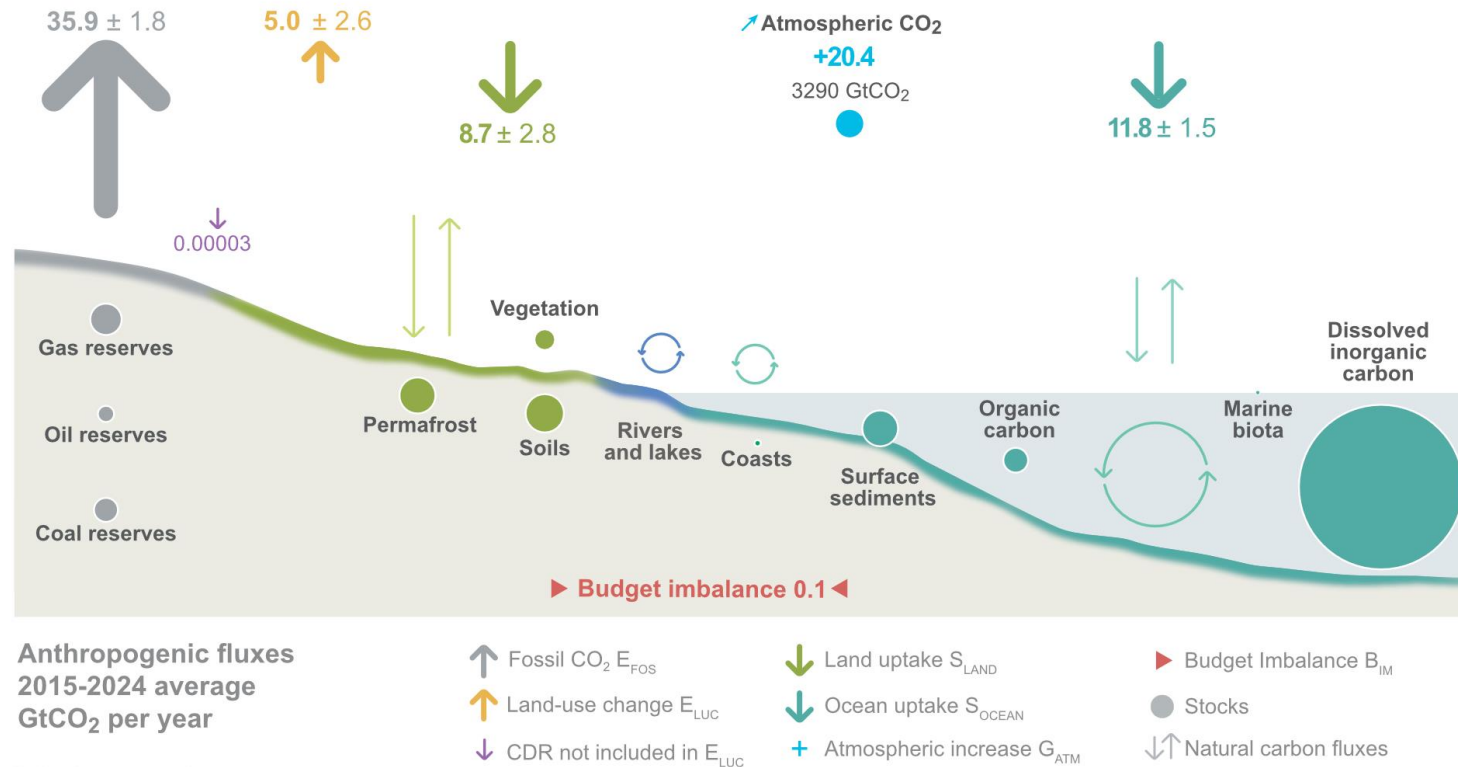
Globally averaged surface atmospheric CO₂ concentration. Data from: NOAA-GML after 1980; the Scripps Institution of Oceanography before 1980

Source: [NOAA-GML](#); [Scripps Institution of Oceanography](#); [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Anthropogenic perturbation of the global carbon cycle

Perturbation of the global carbon cycle caused by anthropogenic activities, global annual average for the decade 2015–2024 (GtCO₂/yr)

The global carbon cycle



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CDR here refers to Carbon Dioxide Removal besides those associated with land-use that are accounted for in the Land-use change estimate.

The budget imbalance is the difference between the estimated emissions and sinks.

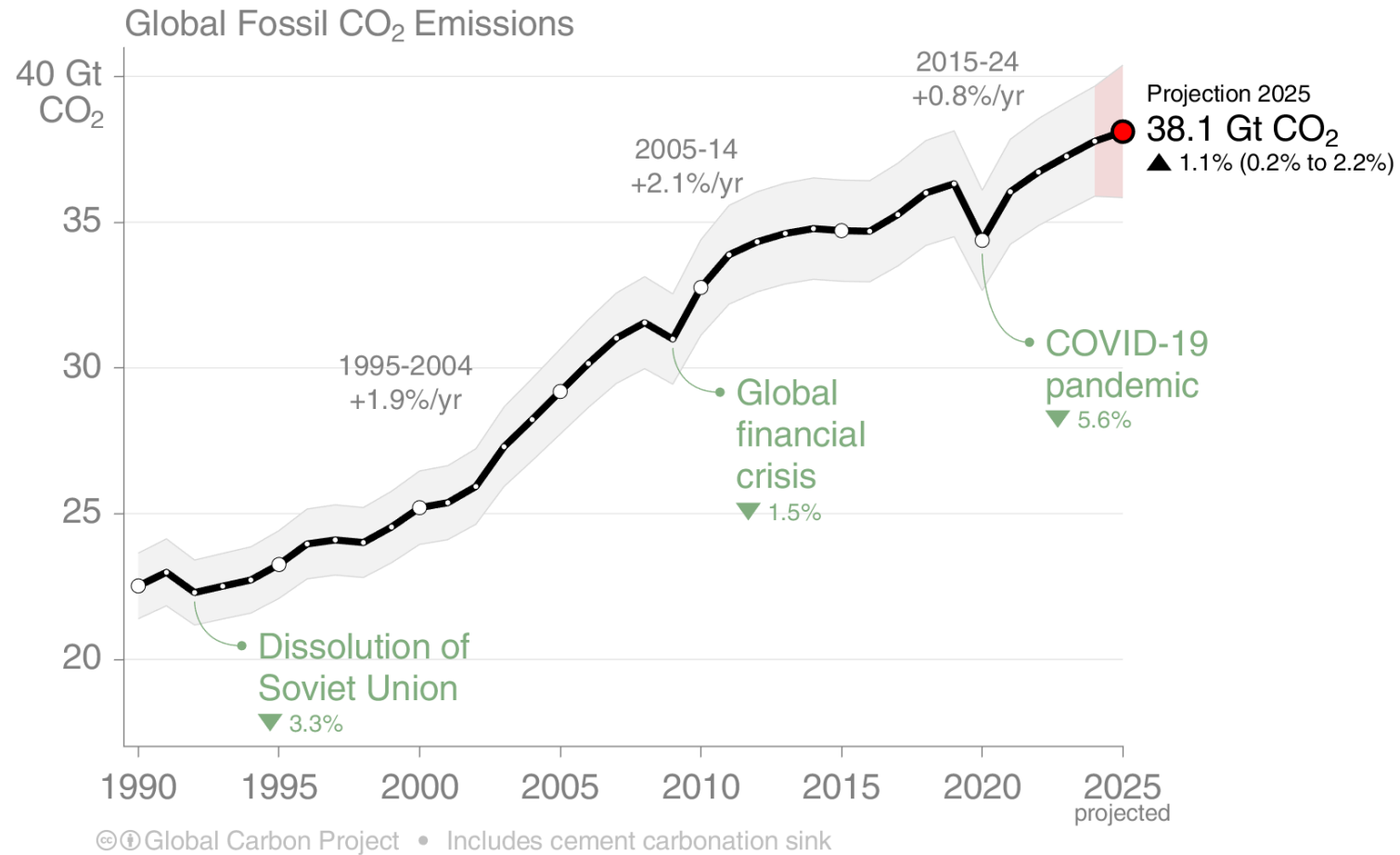
Source: [NOAA-GML](#); [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Key Highlights in 2025

Global Fossil CO₂ Emissions

Global fossil CO₂ emissions: 37.8 ± 2 GtCO₂ in 2024, 69% over 1990

- Projection for 2025: 38.1 ± 2 GtCO₂, 1.1% [0.2% to +2.2%] higher than 2024



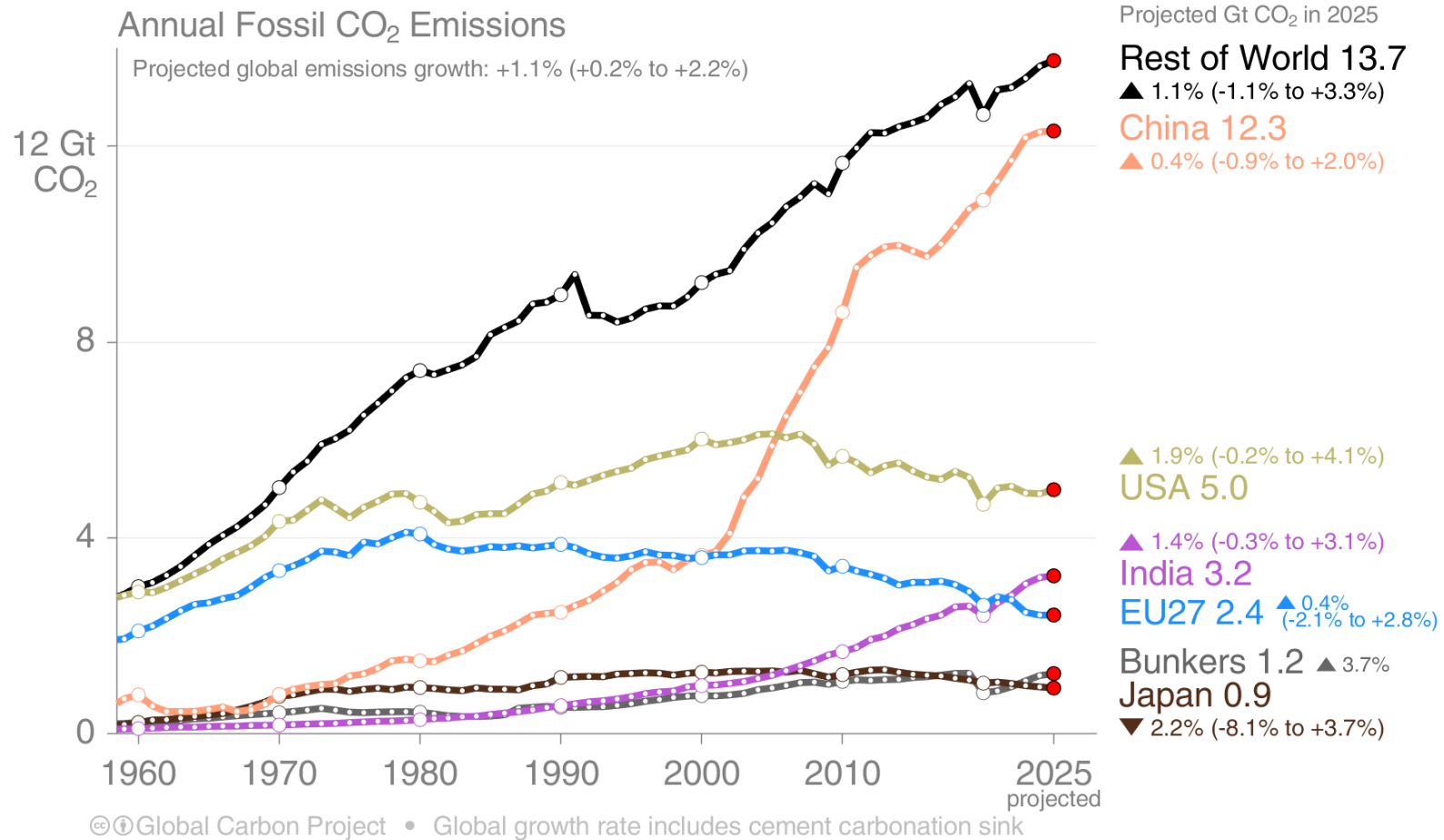
Uncertainty is ±5% for one standard deviation (IPCC “likely” range)

The 2025 projection is based on preliminary data and modelling. The global total includes a cement carbonation sink of 0.8 GtCO₂.

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Emissions Projections for 2025

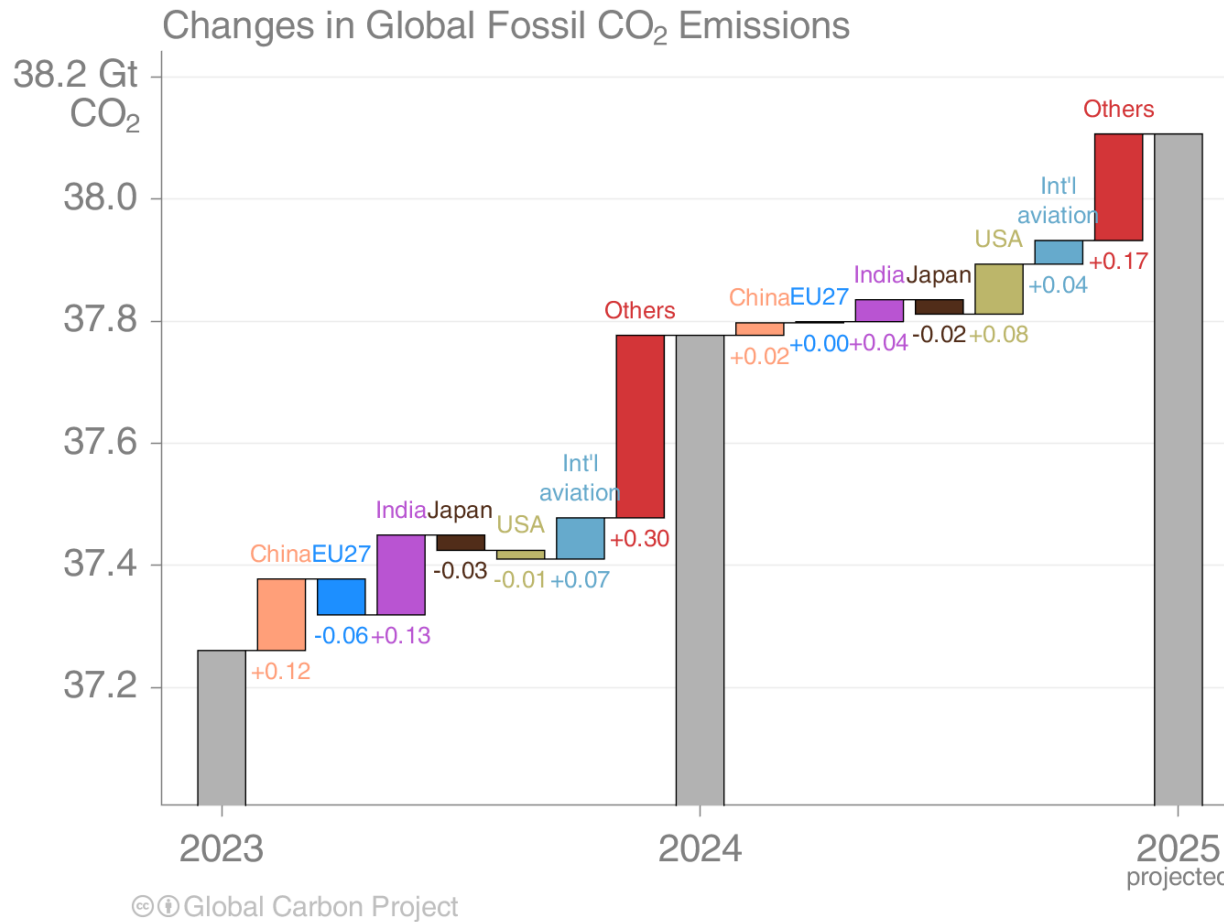
Fossil CO₂ emissions growth is from different regions in 2025 compared to 2024:
 The USA rising, and EU27 flat, reversing recent declines. China flat, India low growth, contrasting recent strong growth.



The 2025 projections are based on preliminary data and modelling.
 'Bunkers' are fossil fuels used for international shipping and aviation
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Fossil CO₂ emissions growth: 2023–2025

Emissions are projected to increase in USA and India, be flat to slight rise in China and the EU, decline in Japan, with growth in international aviation and the combined rest of the world (Others) in 2025



The 2025 projections are based on preliminary data and modelling.
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Summary of fossil CO₂ emissions in 2024 and 2025

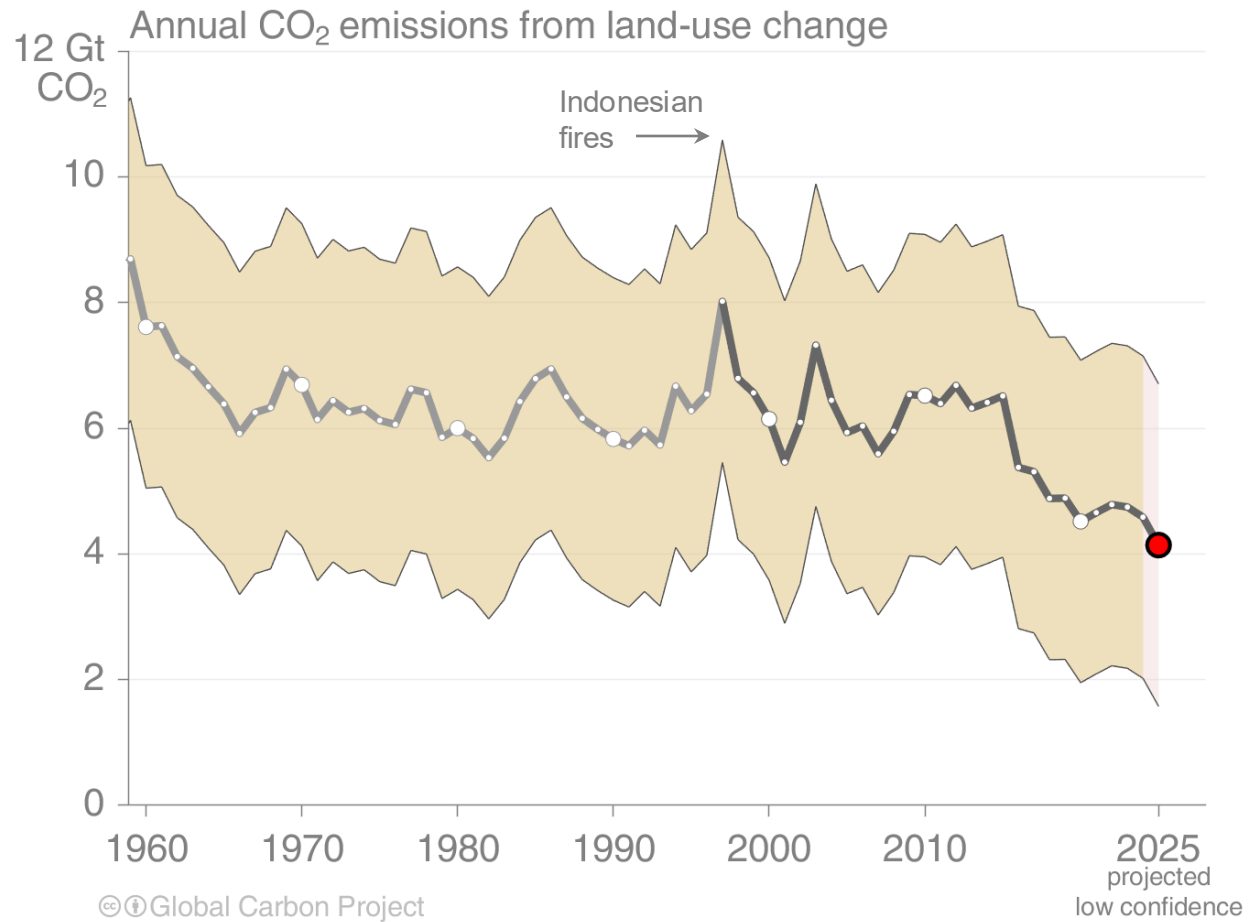
Region / Country	2024 emissions (billion tonnes/yr)	2024 growth (percent)	2025 projected emissions growth (percent)	2025 projected emissions (billion tonnes/yr)
China	12.3	0.7%	0.4%	12.3
USA	4.9	-0.6%	1.9%	5.0
India	3.2	4.0%	1.4%	3.2
EU27	2.4	-2.6%	0.4%	2.4
Japan	1.0	-2.8%	-2.2%	0.9
International bunkers*	1.2	9.8%	3.7%	1.2
All others	13.6	1.6%	1.1%	13.7
World	38.6	1.0%	1.0%	38.9
World (incl. cement carbonation)	37.8	1.1%	1.1%	38.1

*Emissions from use of international aviation and maritime shipping bunker fuels are not usually included in national totals. Cement carbonation sink only included in global (World) estimate.

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Land-use change emissions

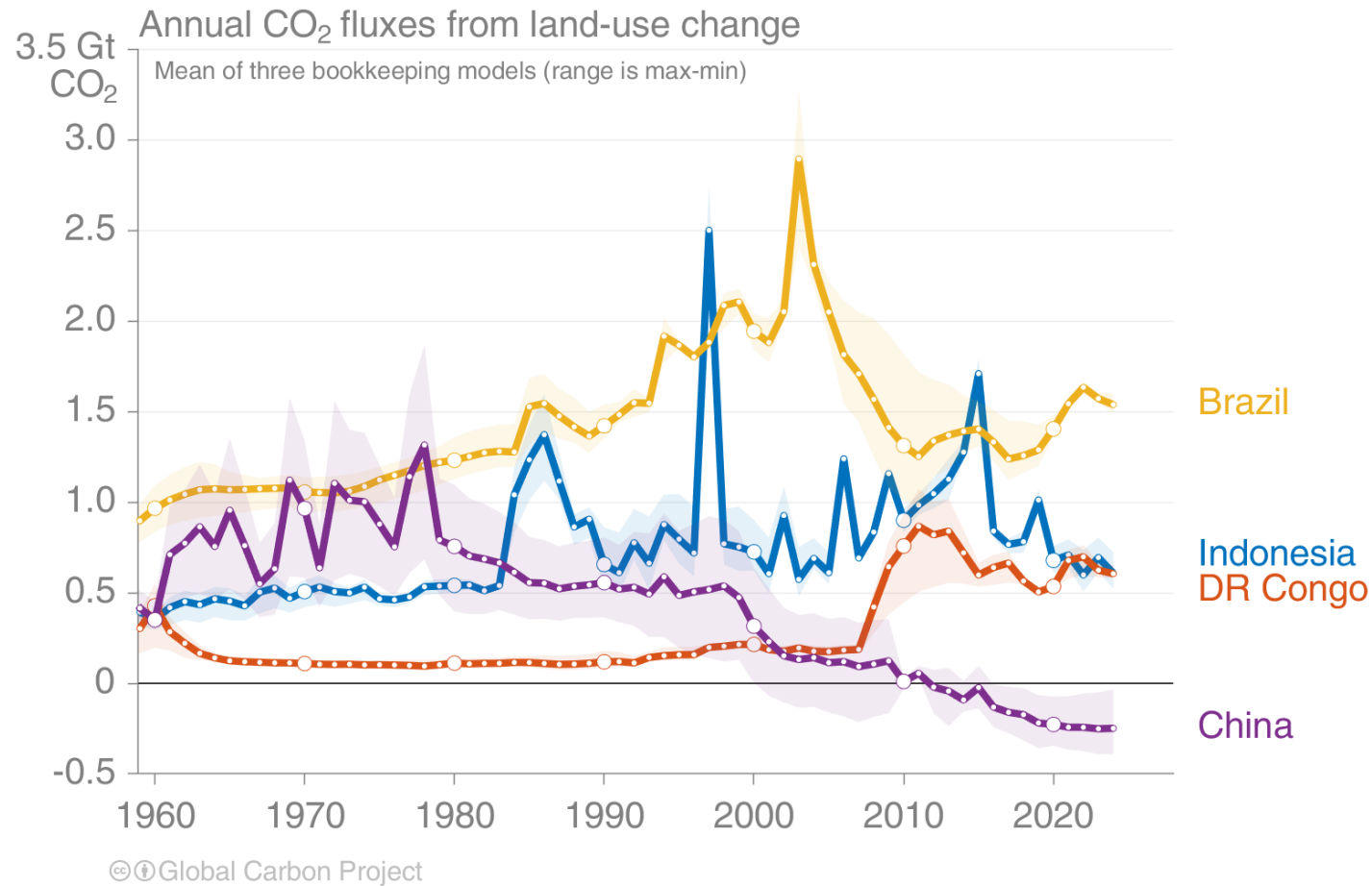
Land-use change emissions are 5.0 ± 2.6 GtCO₂ per year for 2015–2024, and show a negative trend in the last two decades, but estimates are still highly uncertain. ● Projection for 2025: 4.1 ± 2.6 GtCO₂



Estimates from three bookkeeping models
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Land-use change emissions

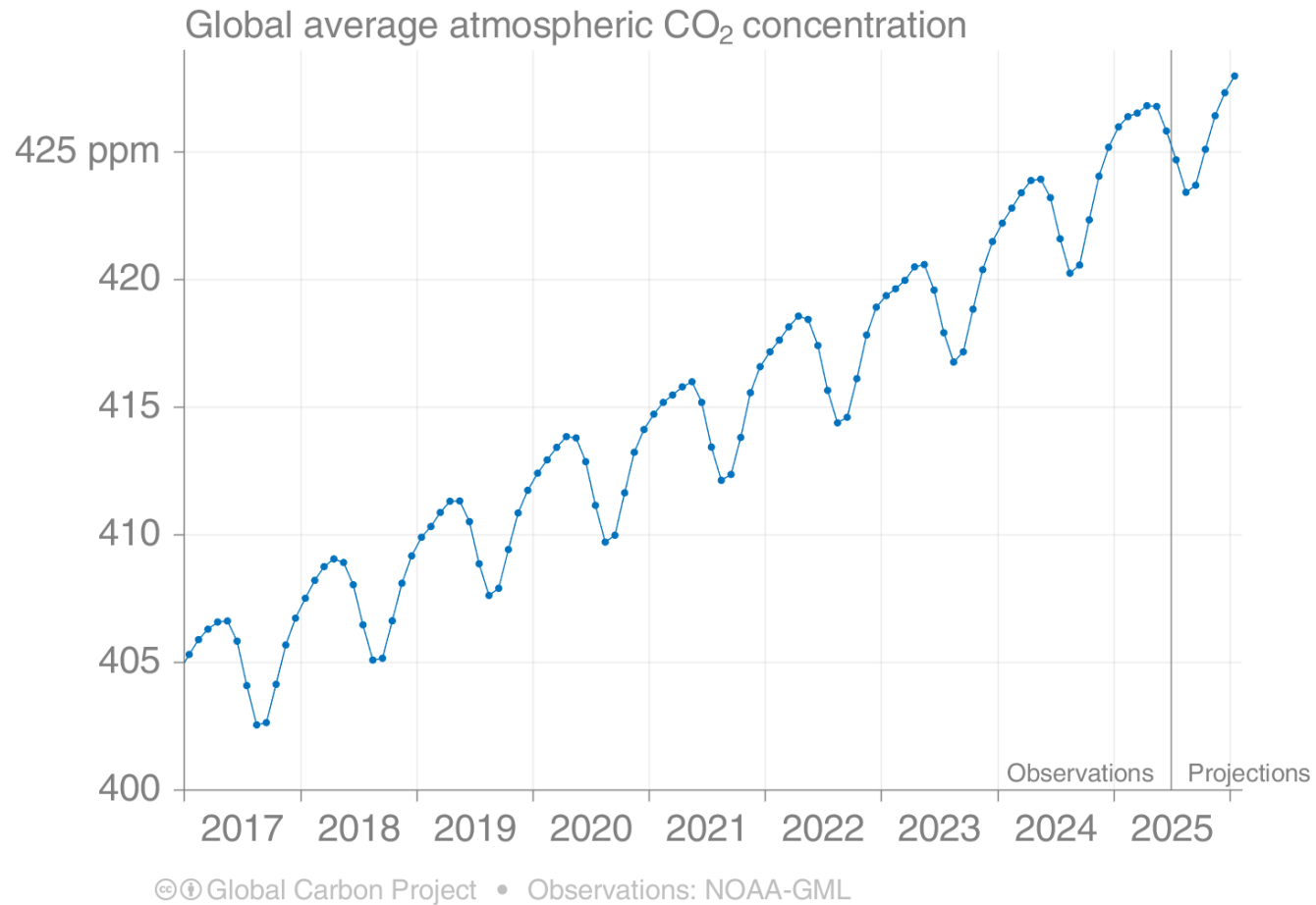
Combined land-use change emissions from Brazil, Indonesia, and the DR Congo make up over half of the global net land-use change emissions. China moved from being a top emitter during 1960–1980 to the largest net remover in 2015–2024.



Estimates from three bookkeeping models
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Forecast of global atmospheric CO₂ concentration

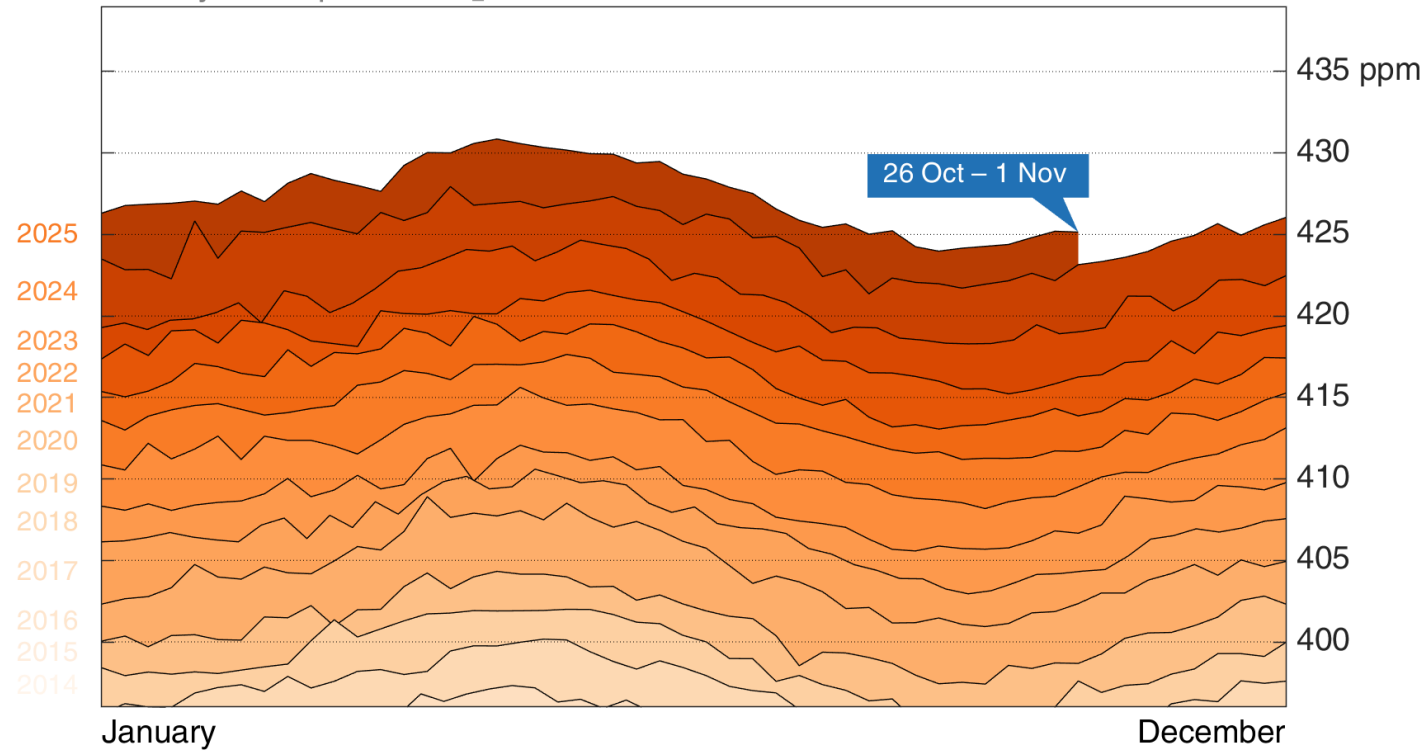
The global atmospheric CO₂ concentration is forecast to average 425.7 parts per million (ppm) in 2025, increasing by 2.3 ppm.



Mauna Loa atmospheric CO₂

Atmospheric CO₂ concentration has increased every single year, including in 2020 – despite the drop in fossil CO₂ emissions – because of continued emissions

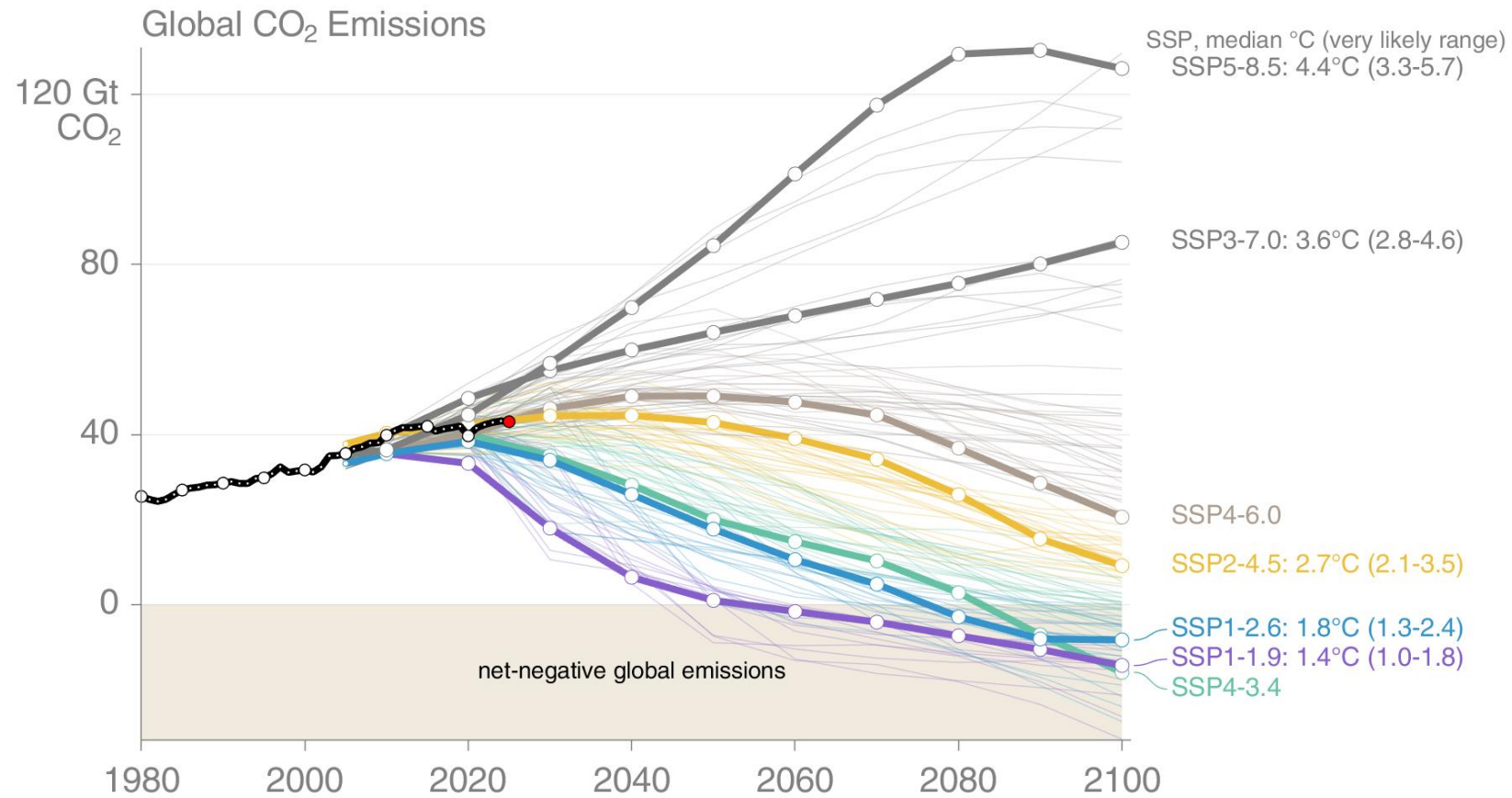
Weekly atmospheric CO₂ at Mauna Loa



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Shared Socioeconomic Pathways (SSPs)

The SSPs were designed to span the range of potential outcomes. Total CO₂ emissions are currently tracking in the middle of the range. The temperature outcomes are based on assessed scenarios in IPCC AR6 Working Group I.



© Global Carbon Project • Data: Riahi et al (2017), Rogelj et al (2018), SSP Database (version 2)

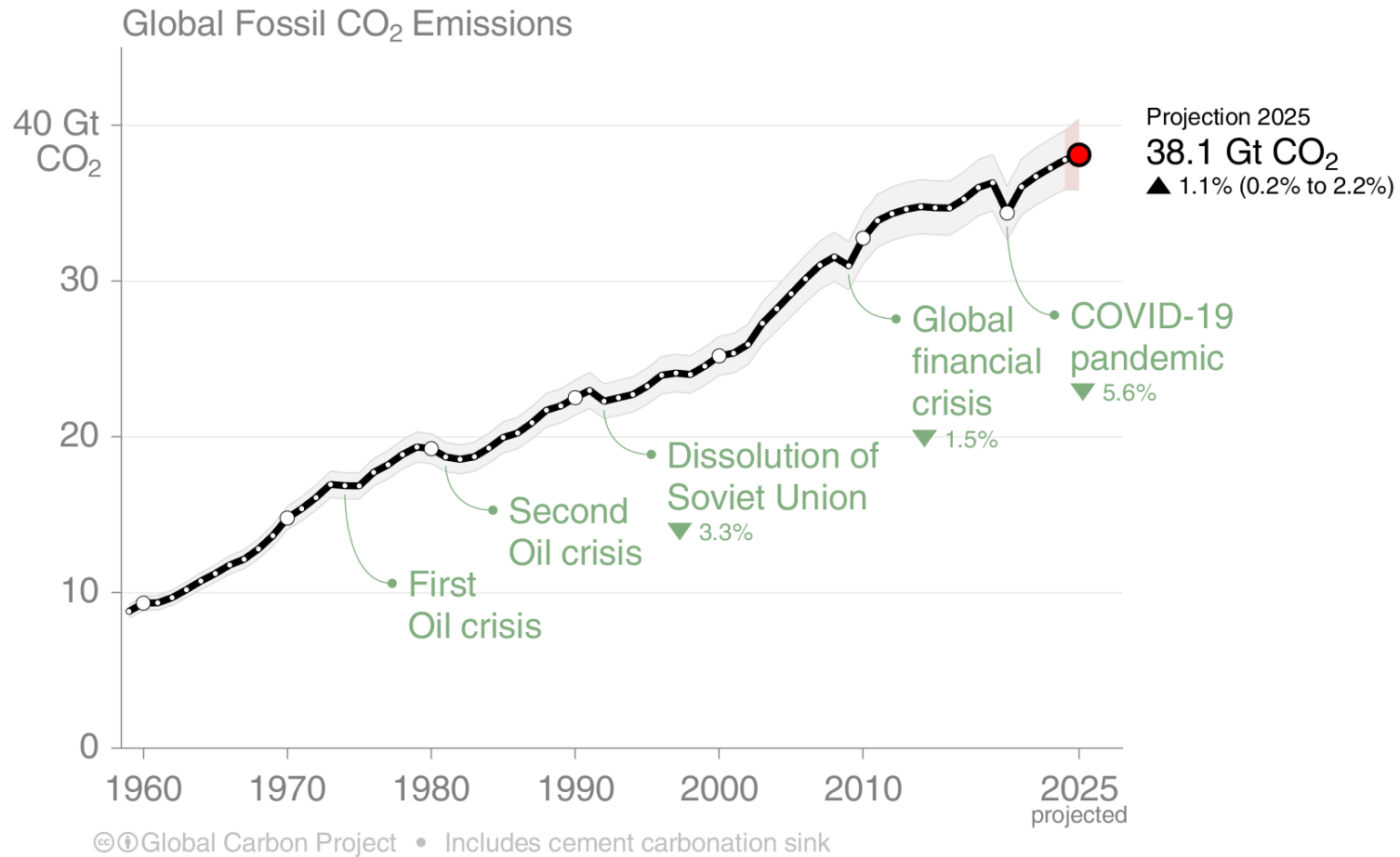
This set of quantified SSPs are based on the output of six Integrated Assessment Models (AIM/CGE, GCAM, IMAGE, MESSAGE, REMIND, WITCH).
 Net emissions include those from land-use change and bioenergy with CCS.

Source: [Riahi et al. 2016](#); [Rogelj et al. 2018](#); [IIASA SSP Database](#); [IAMC](#); [Global Carbon Project 2025](#)

Global fossil CO₂ emissions

Global fossil CO₂ emissions

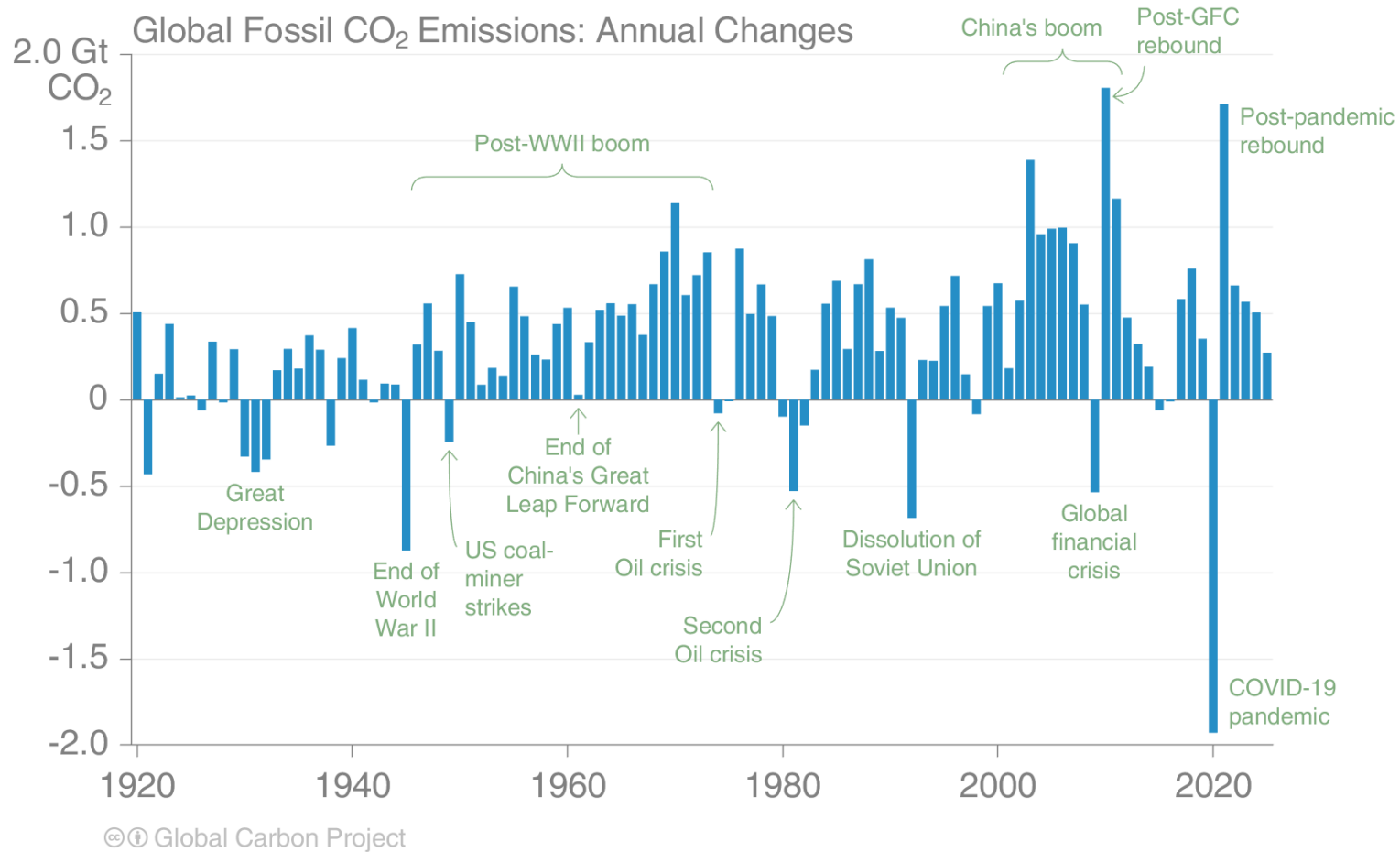
Global fossil CO₂ emissions have risen steadily over the last decades. Emissions are set to grow 1.1% in 2025, after growing 1.1% in 2024, and 0.8%/yr from 2015 to 2024.



The 2025 projection is based on preliminary data and modelling.
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Global fossil CO₂ emissions

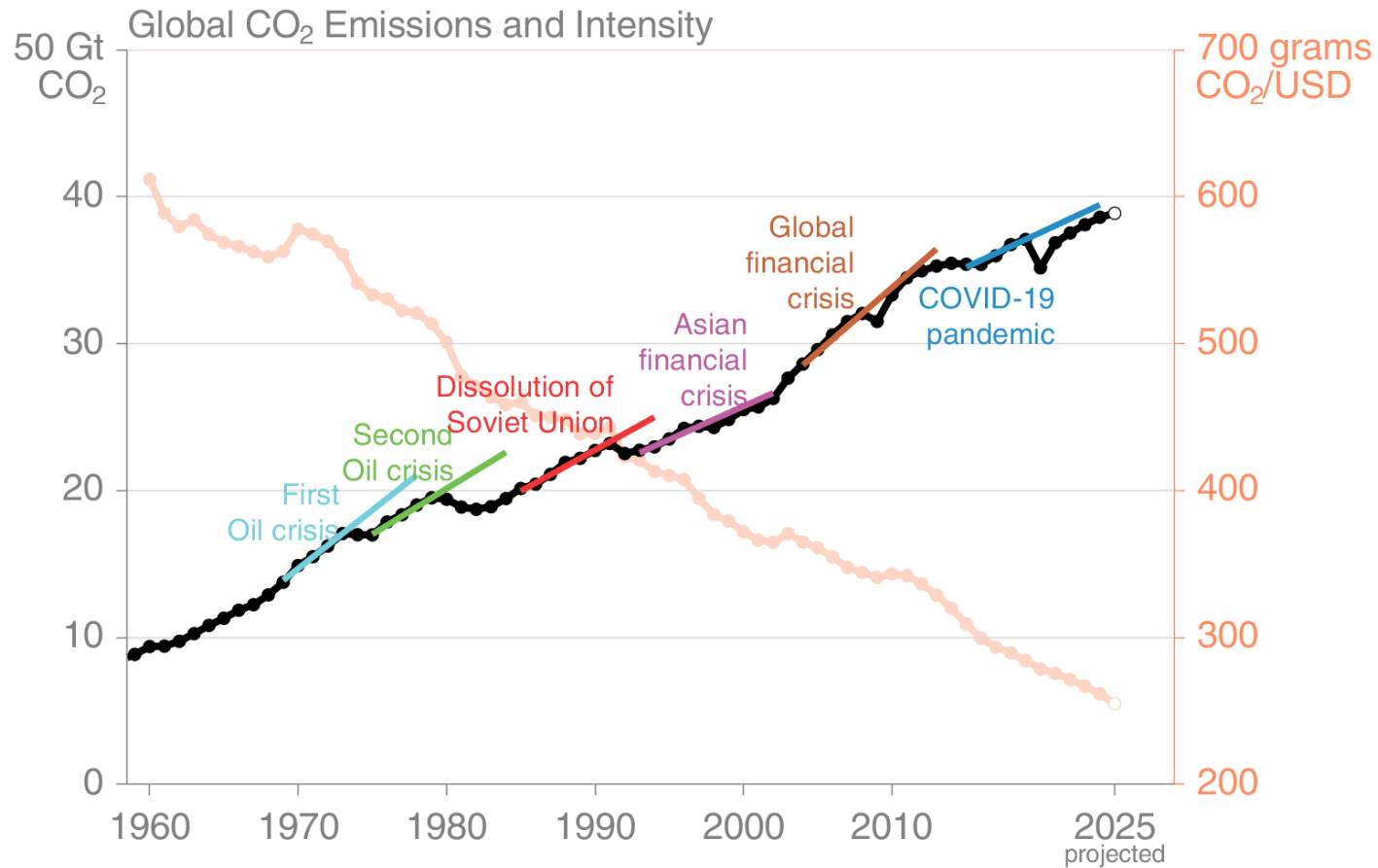
For the last 100 years, it has generally taken a crisis to drive global emissions reductions. To stabilise temperatures, intentional, planned, sustained global reductions must begin.



The 2025 projection is based on preliminary data and modelling.
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Fossil CO₂ emission intensity

Global CO₂ emissions growth has generally resumed quickly from global crises. Emission intensity has steadily declined but not sufficiently to offset economic growth.



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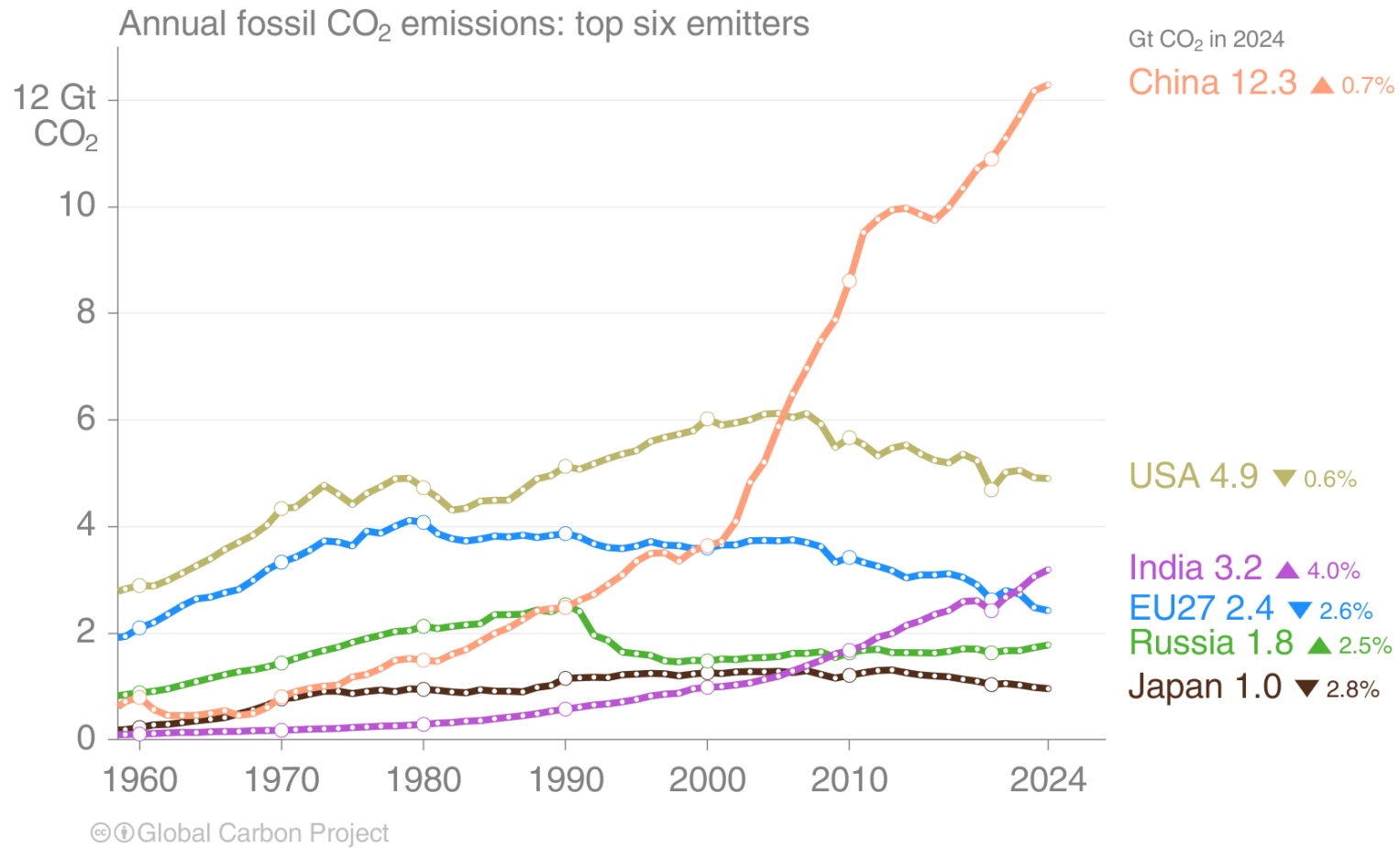
Each trend line is based on the five years before the crisis and extended to five years after. Economic activity is measured in purchasing power parity (PPP) terms in 2017 US dollars.

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Fossil CO₂ emissions by country

Top emitters: Fossil CO₂ emissions to 2024

The top six emitters in 2024 covered 66% of global emissions
 China 32%, United States 13%, India 8%, EU 6%, Russia 5%, and Japan 2%

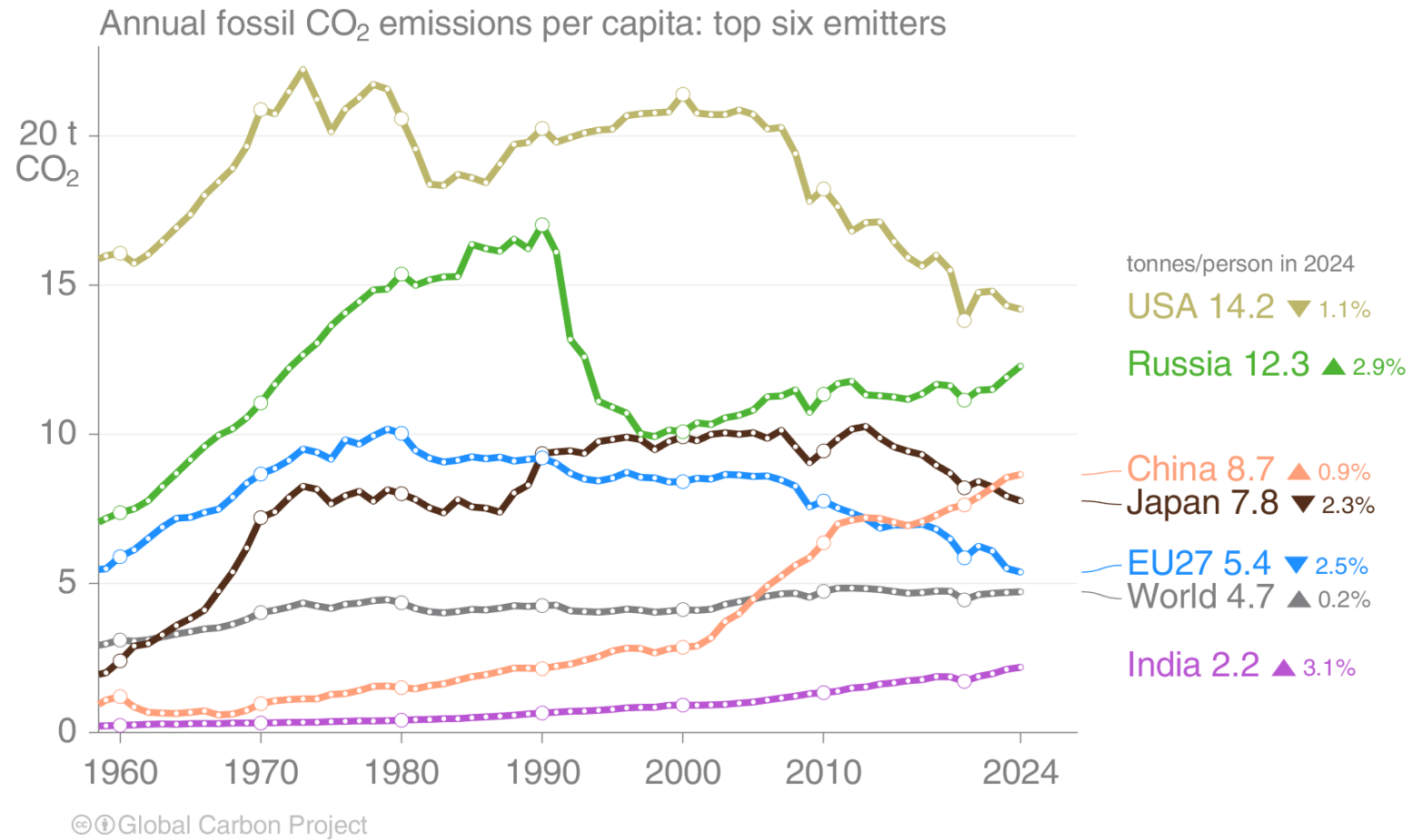


International aviation and maritime shipping (bunker fuels) contributed 3.1% of global emissions in 2024.

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Top emitters: Fossil CO₂ emissions per capita to 2024

Countries have a broad range of per capita emissions reflecting their national circumstances

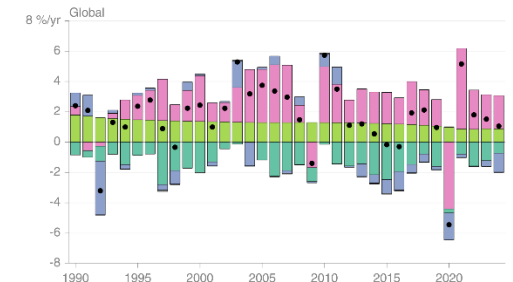
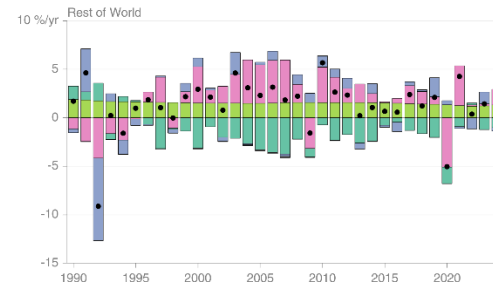
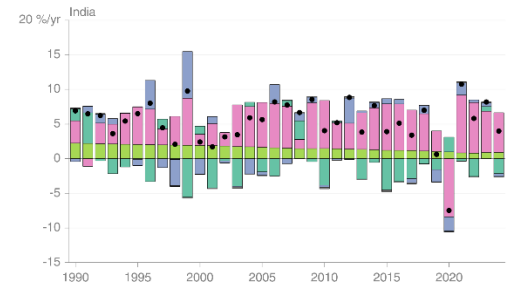
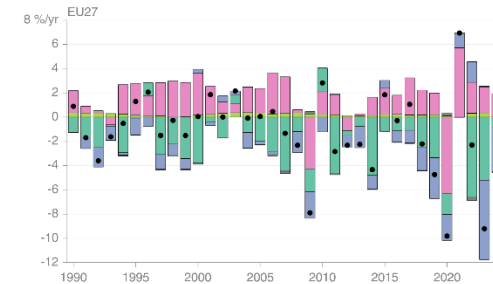
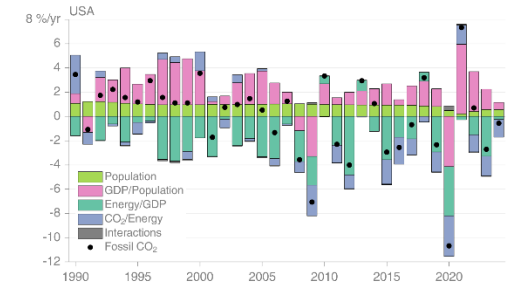
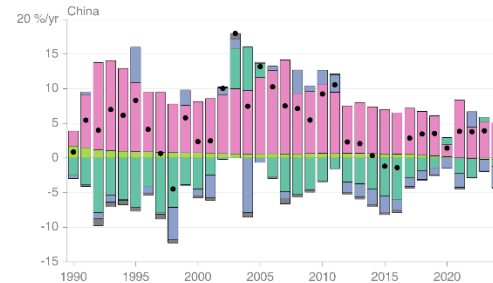
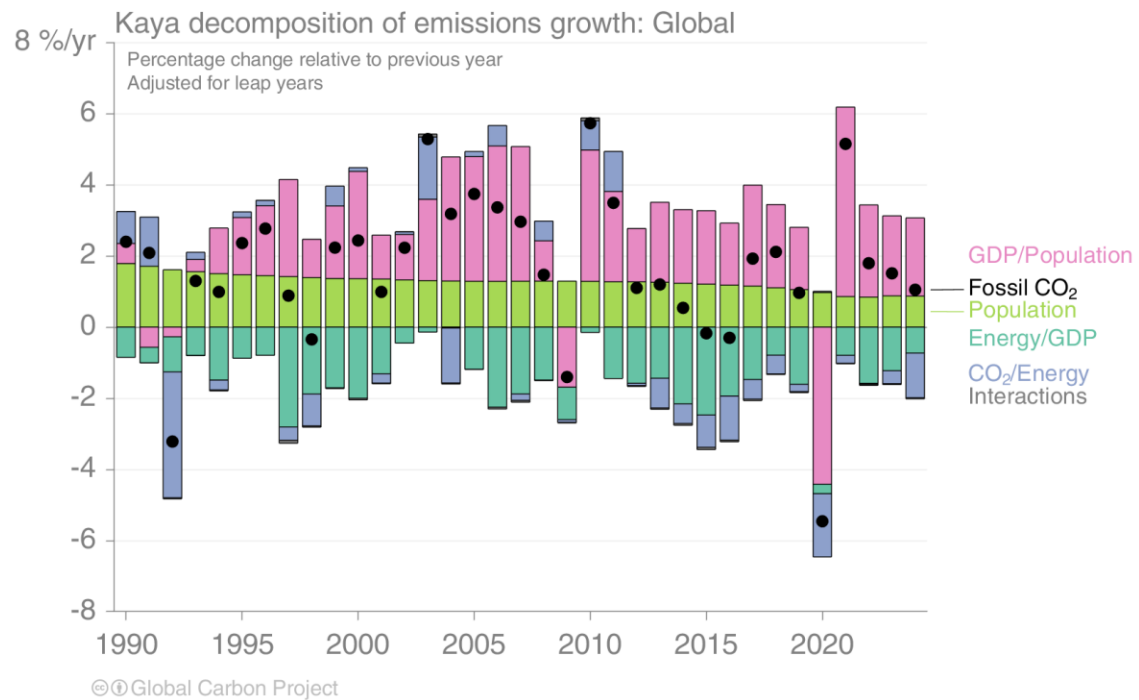


International aviation and maritime shipping (bunker fuels) contributed 3.1% of global emissions in 2024.

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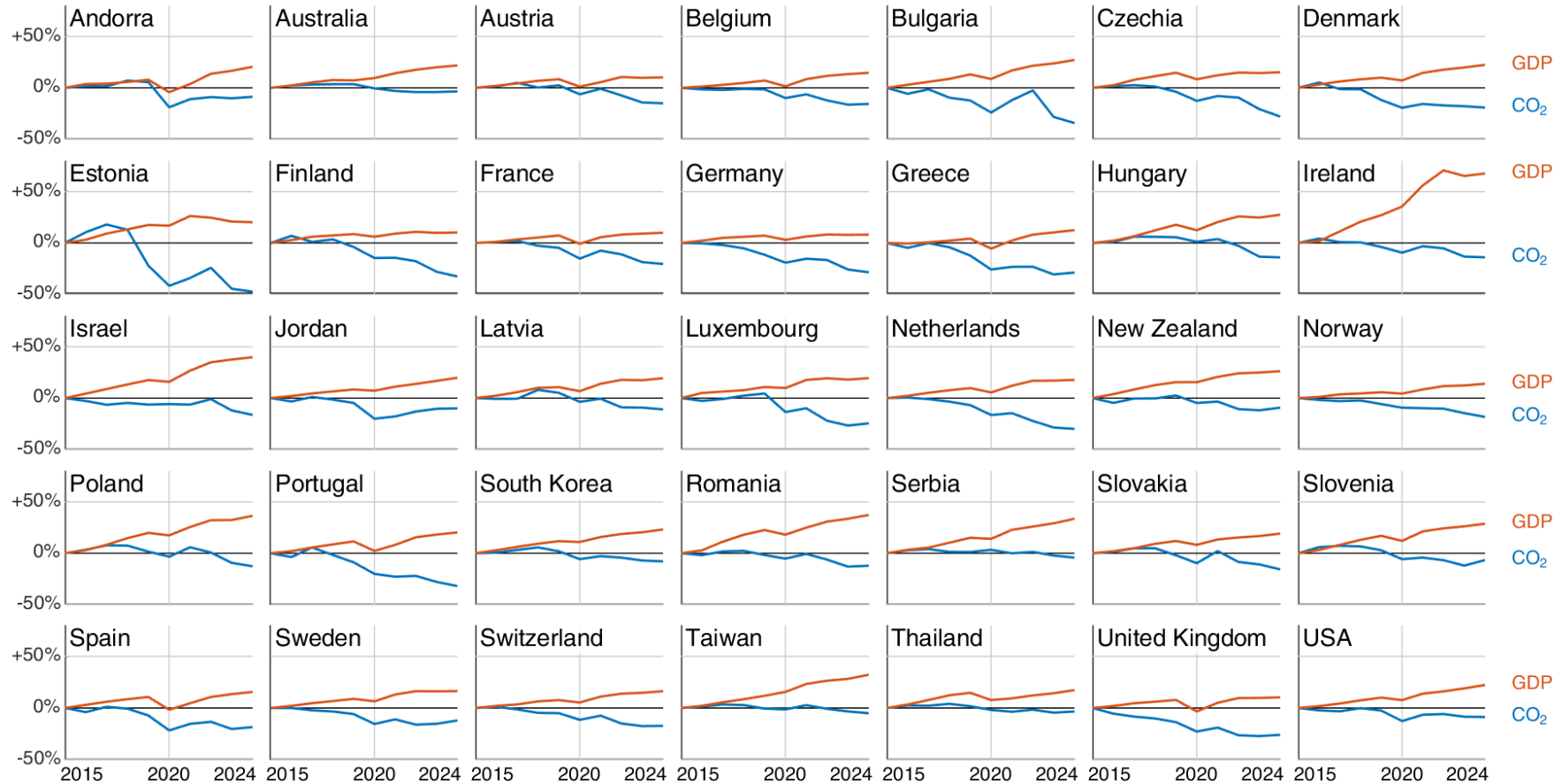
Fossil CO₂ emissions — Kaya decomposition

Globally, decarbonisation and declines in energy per GDP are largely responsible for the reduced growth rate in emissions over the last decade. 2020 was a clear outlier with a sharp decline in GDP.



Decarbonisation progress

Fossil CO₂ emissions are declining in 35 countries while economic output is rising (2015–2024)

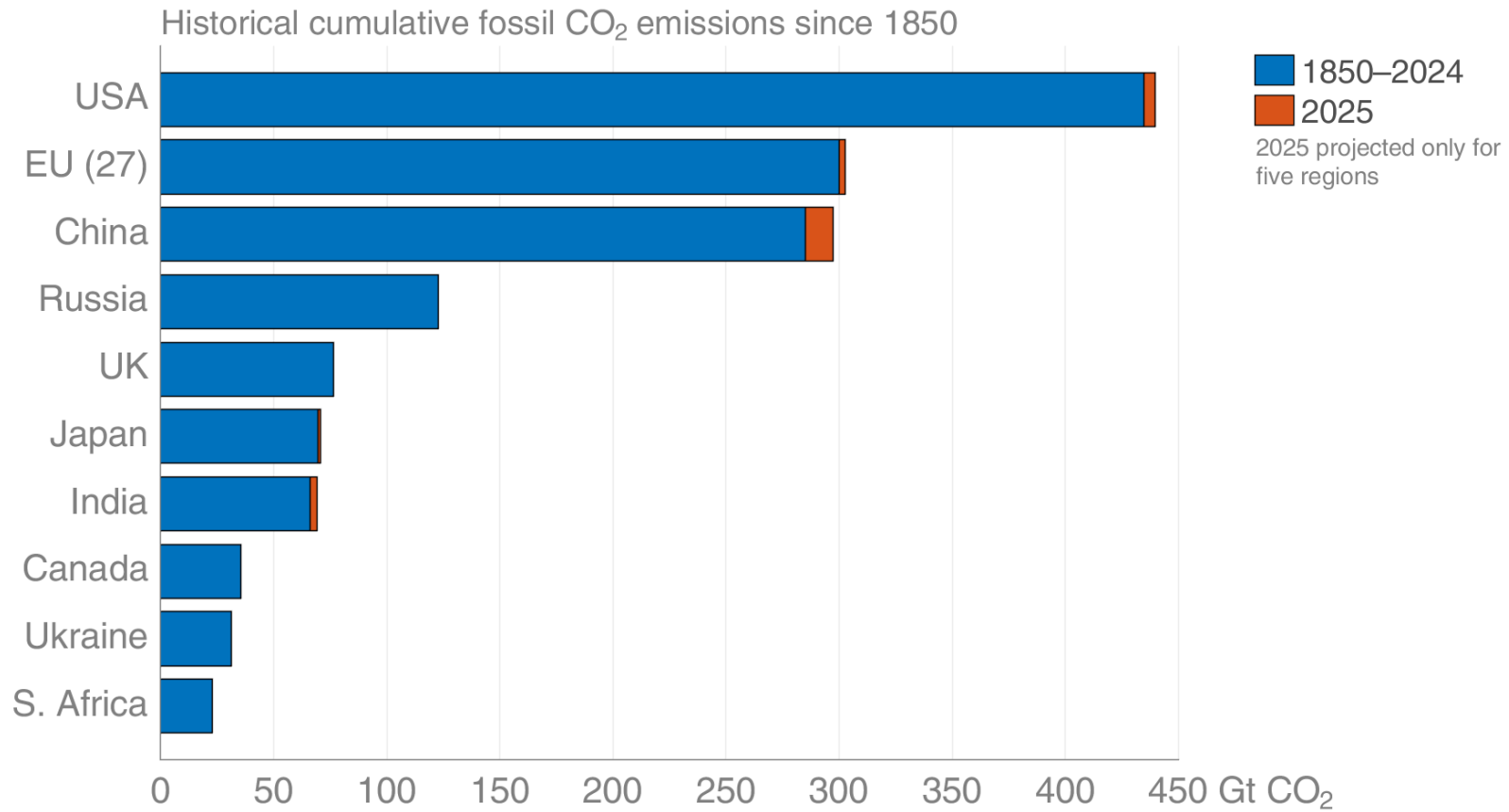


© Global Carbon Project • Trends are statistically significant at p=0.05

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Historical cumulative fossil CO₂ emissions

The USA and EU have the highest accumulated fossil CO₂ emissions since 1850, but China is a close third.



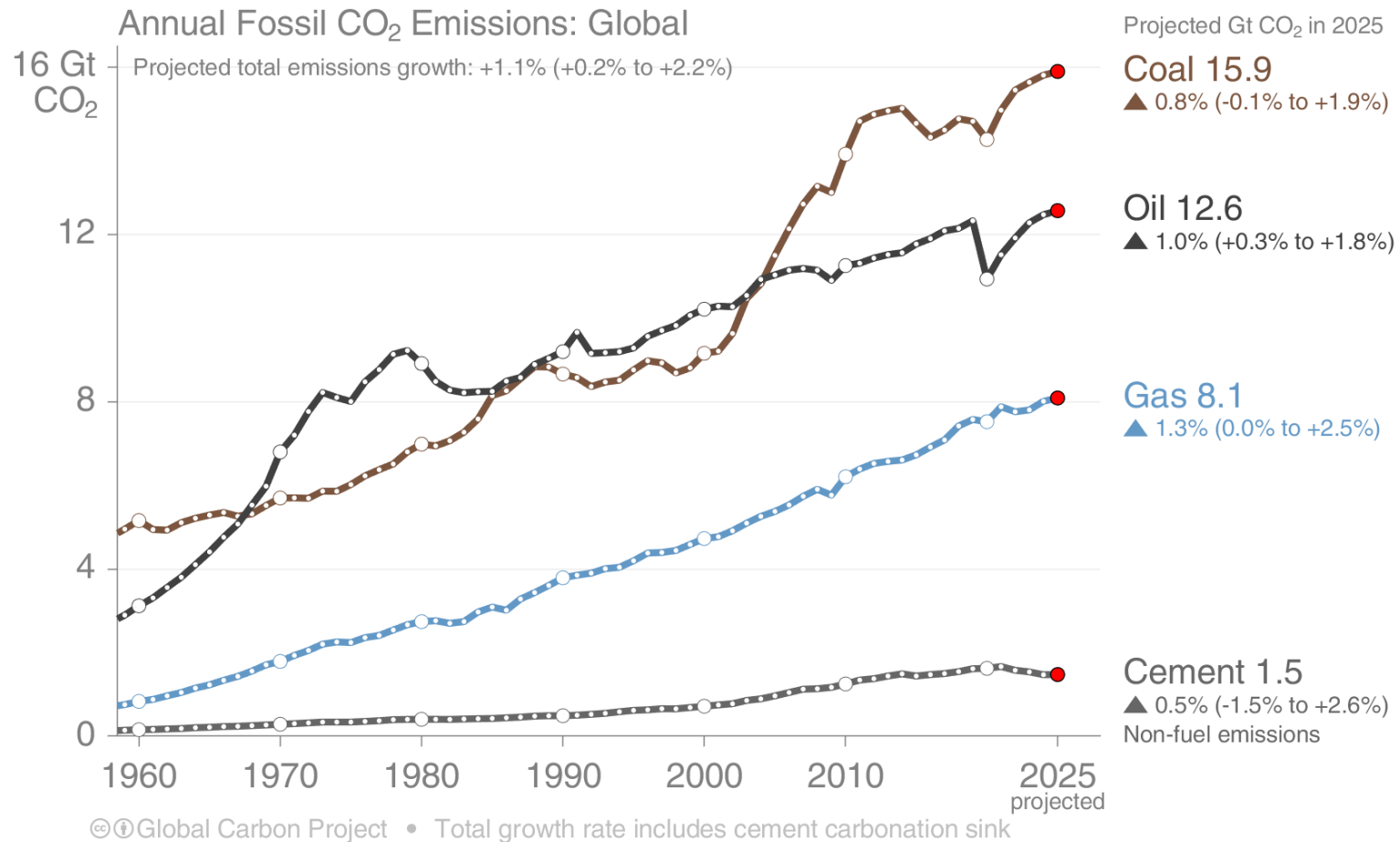
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Calculated using territorial emissions.
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Fossil CO₂ emissions by source

Fossil CO₂ emissions by source

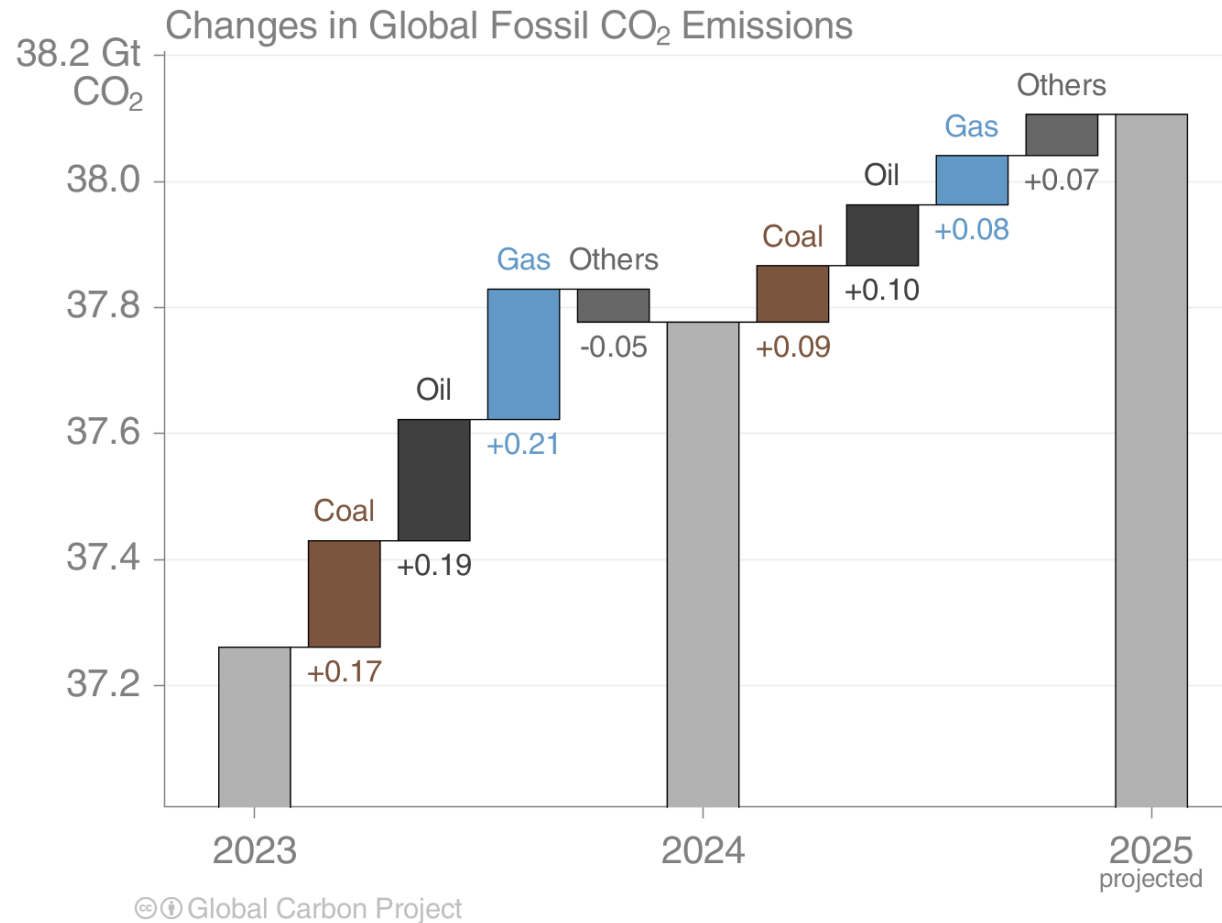
Share of global fossil CO₂ emissions in 2025: coal (41%), oil (32%), gas (21%), cement (4%), flaring and others (2%, not shown)



The 2025 projection is based on preliminary data and modelling.
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

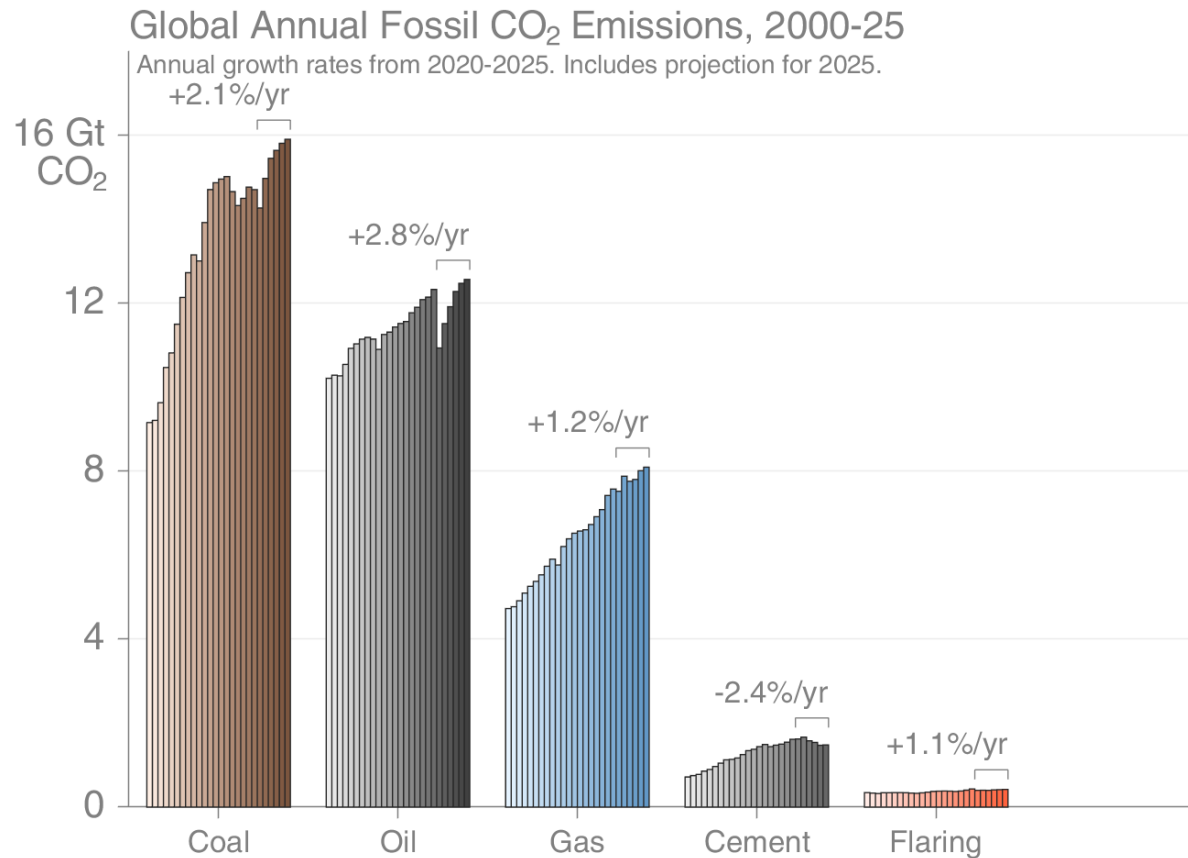
Fossil CO₂ emissions growth: 2023–2025

Global emissions grow in all categories in 2025, but more slowly than in 2024 apart from the “Others” category, which includes cement, lime, and flaring.



Fossil CO₂ emissions by source

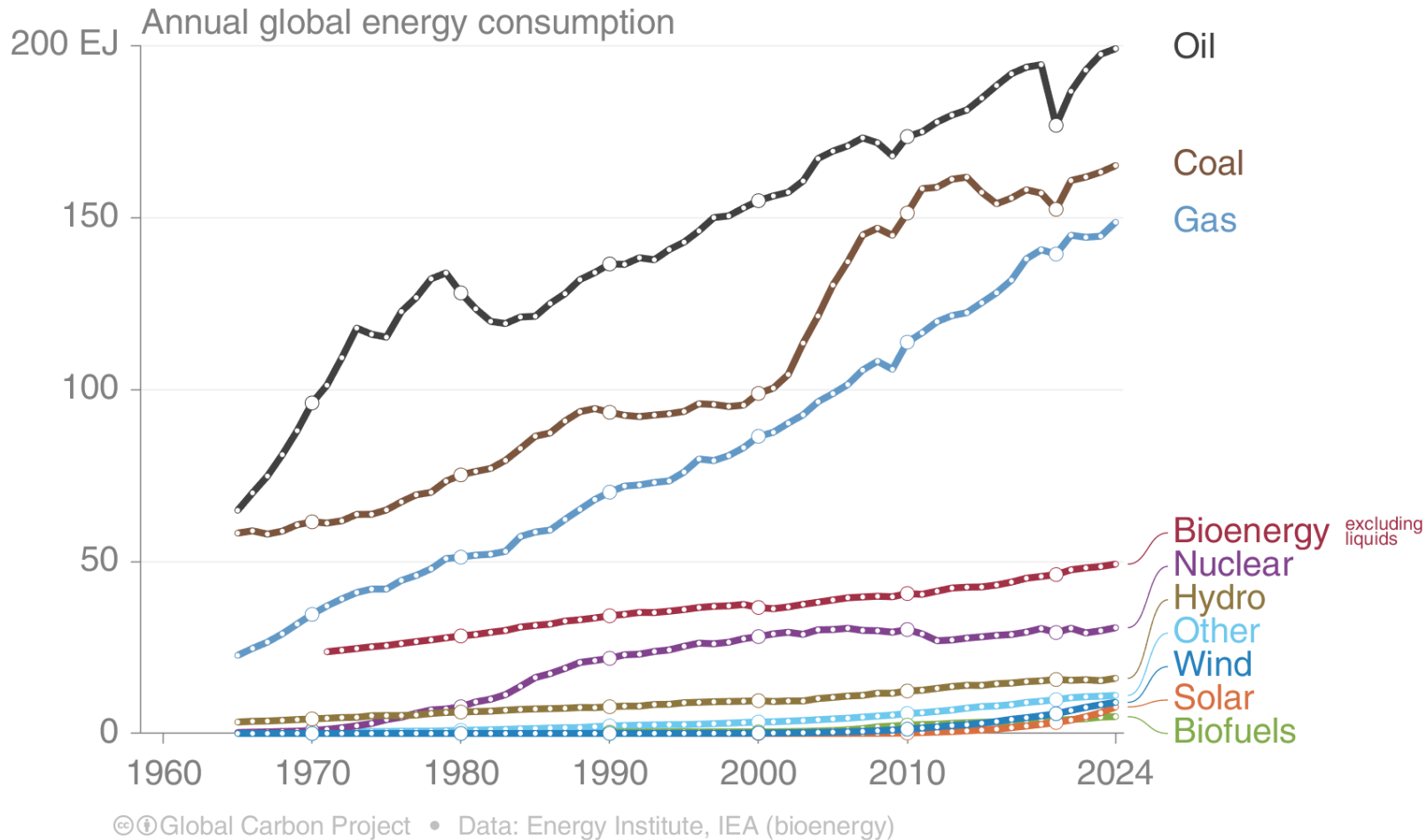
Emissions by category from 2000 to 2025, with growth rates indicated for the more recent period of 2020 to 2025
 Both coal and oil declined sharply in the pandemic year 2020, but are at record levels in 2025



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Energy use by source

Consumption of natural gas picked up again in 2024, while oil and coal continue to grow
Renewable energy continued to grow but needs to grow even faster to replace fossil energy consumption.

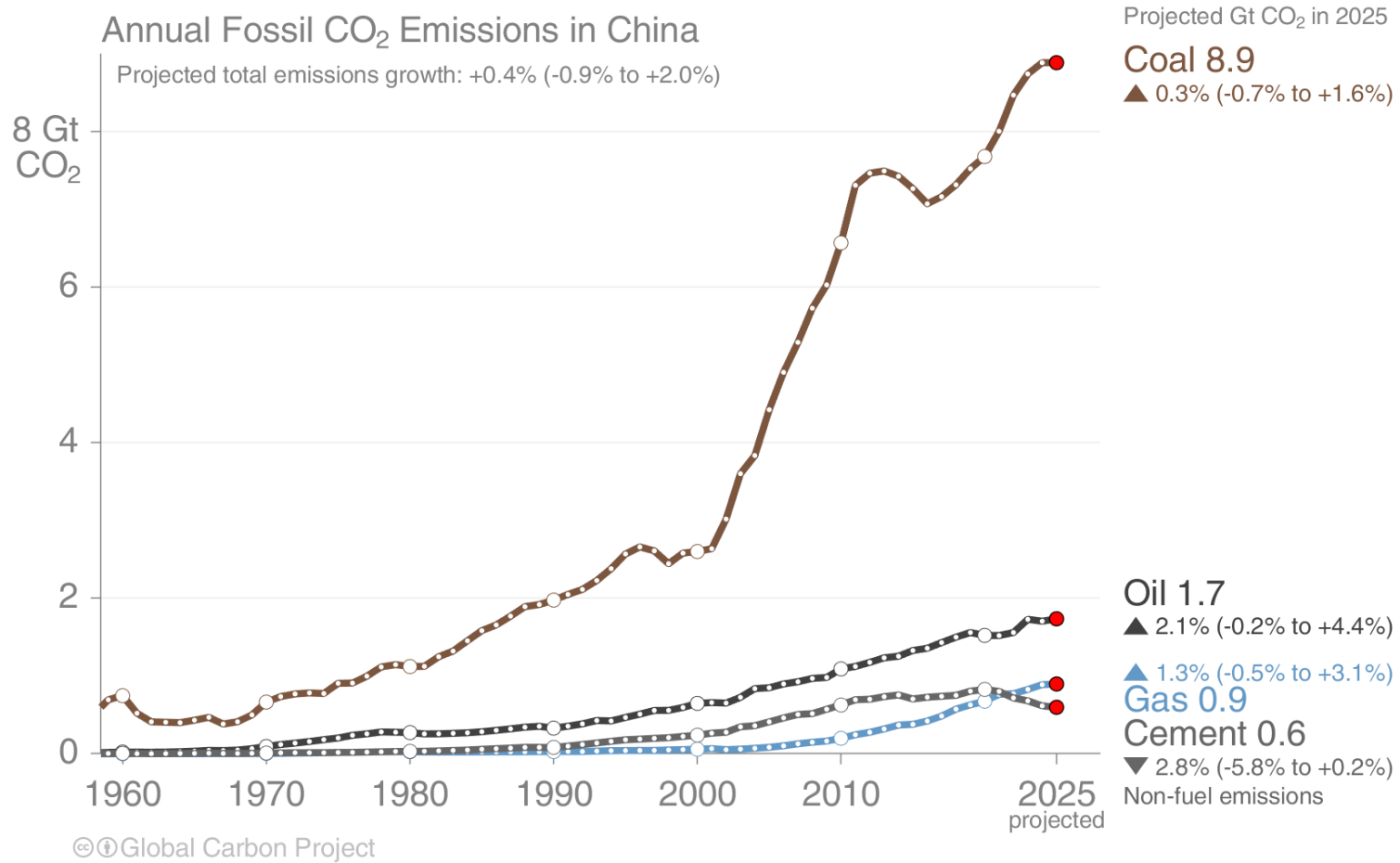


Data are for Total Energy Supply using Primary Energy accounting (Physical Energy Content method), based on the original data source.
Source: [Energy Institute 2025](#); [Global Carbon Project 2025](#)

Fossil CO₂ emission by source for top emitters

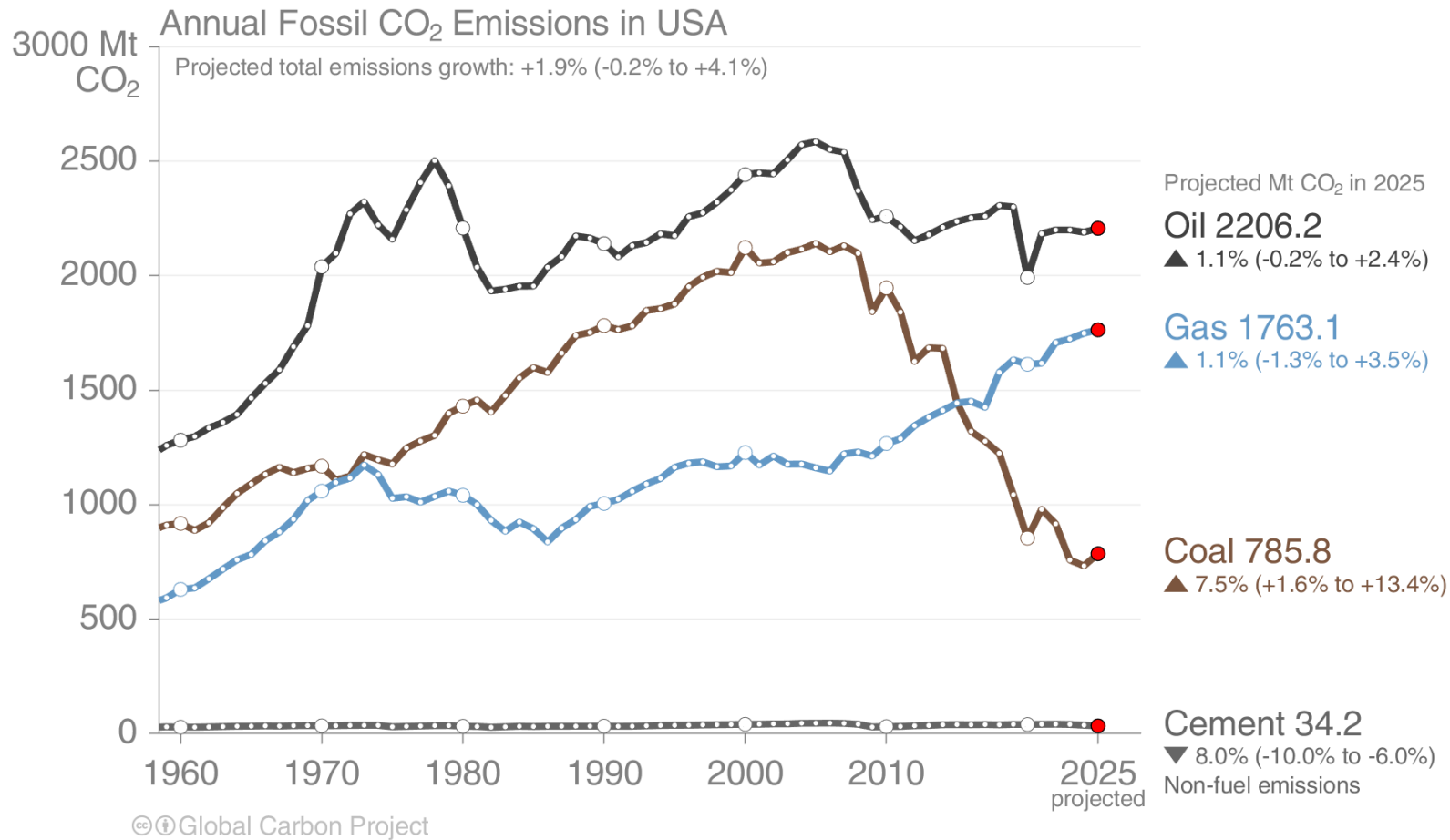
Fossil CO₂ emissions in China

China's coal consumption was flat in 2025, with only weak growth in oil and gas, and cement emissions continuing their decline



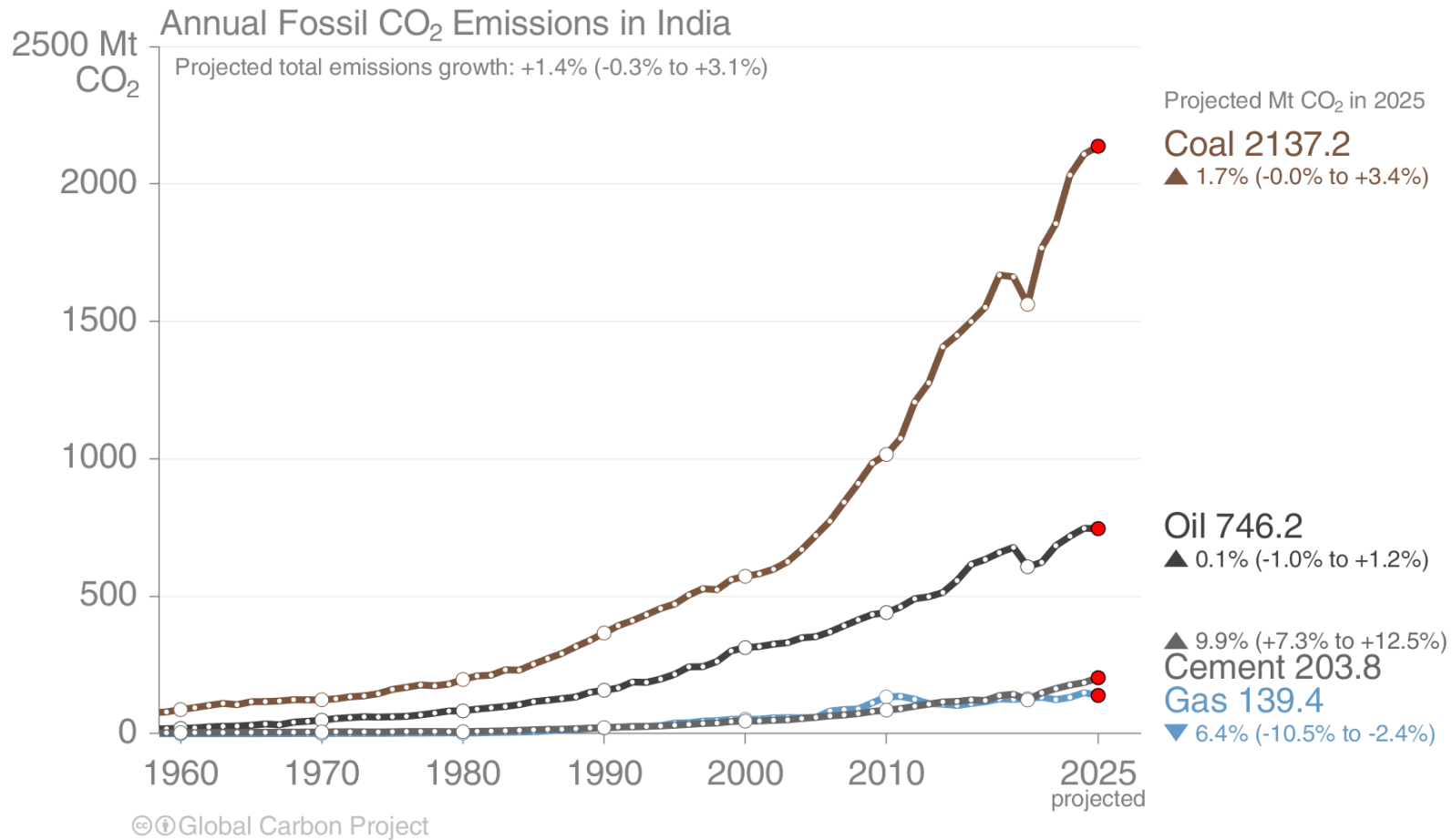
Fossil CO₂ emissions in USA

The USA's emissions from coal have been declining for many years, and despite an expected rebound in 2025, are still at their lowest level since 1902. Emissions from oil are still below 2019's level.



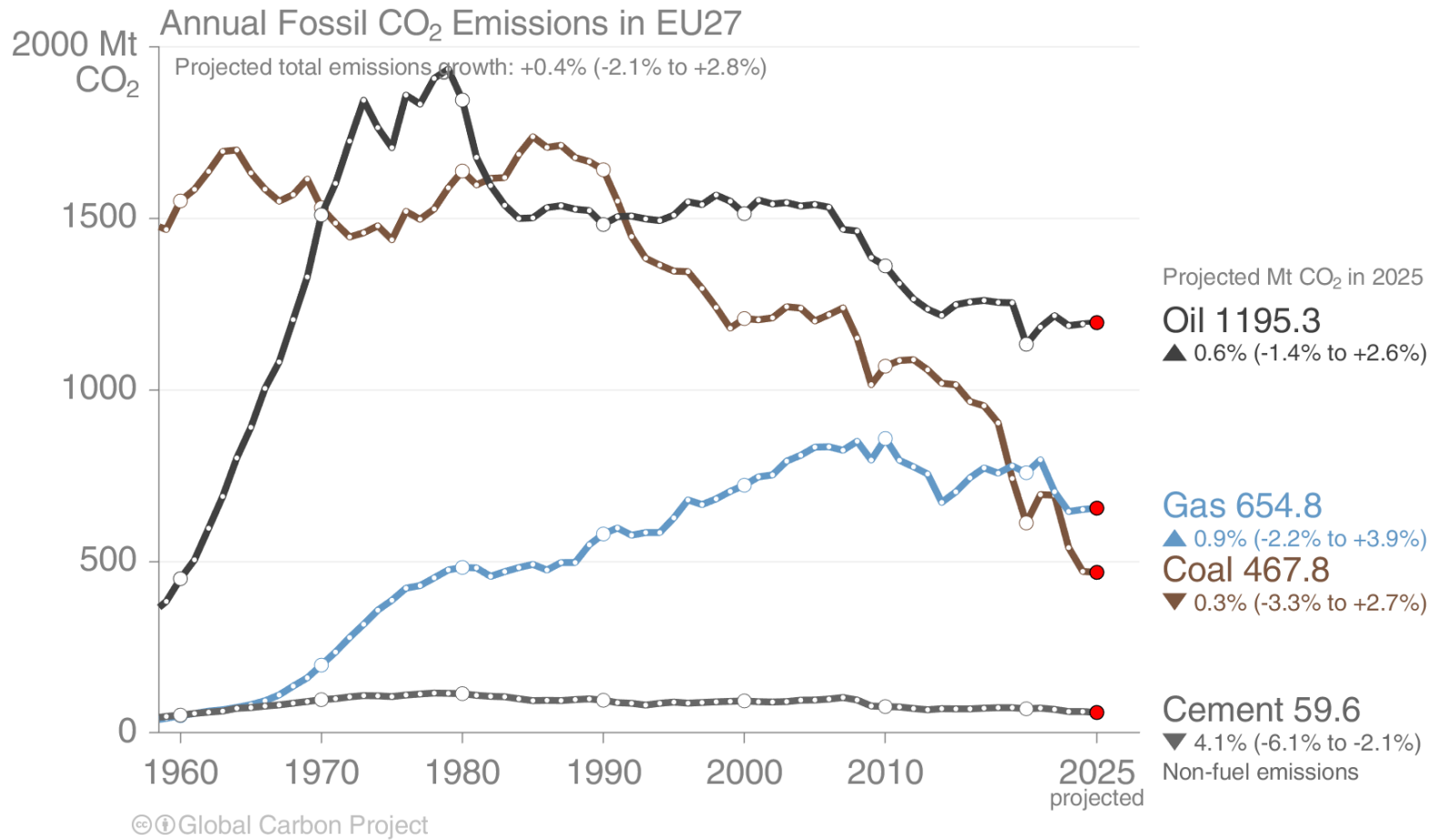
Fossil CO₂ emissions in India

India's emissions growth dropped in 2025 as an early monsoon reduced cooling demand and solar capacity grew strongly



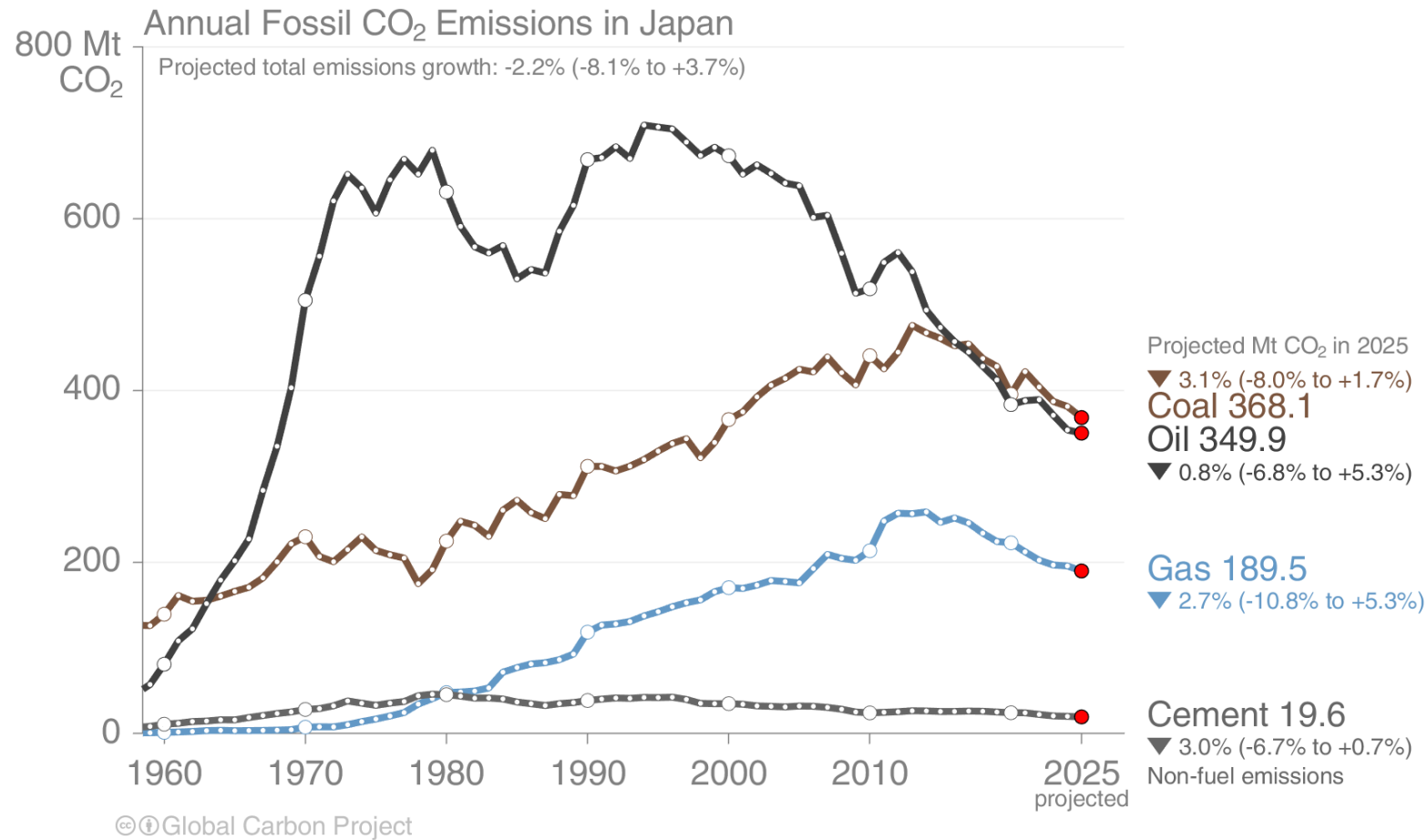
Fossil CO₂ emissions in the European Union

The were only small changes in most categories of the EU's emissions
 The long-term decline in coal was interrupted by weather conditions



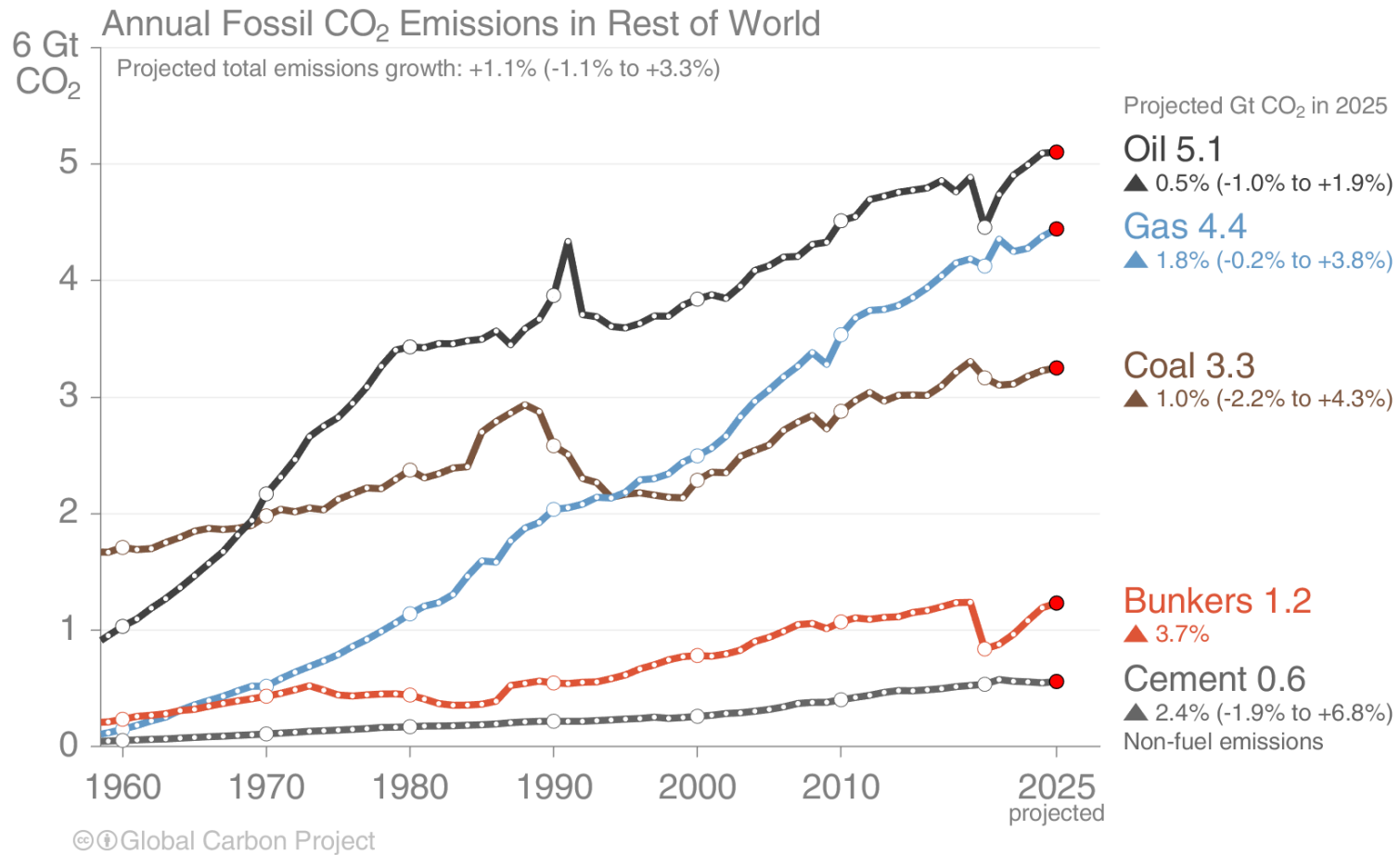
Fossil CO₂ emissions in Japan

Japan's emissions continue their long decline, with lower emissions in 2025 driven by further restarts of nuclear reactors and strong growth in solar PV



Fossil CO₂ emissions in Rest of World

In the rest of the world, emissions from all categories are growing.
Oil in international aviation grew strongly again, surpassing pre-pandemic levels.



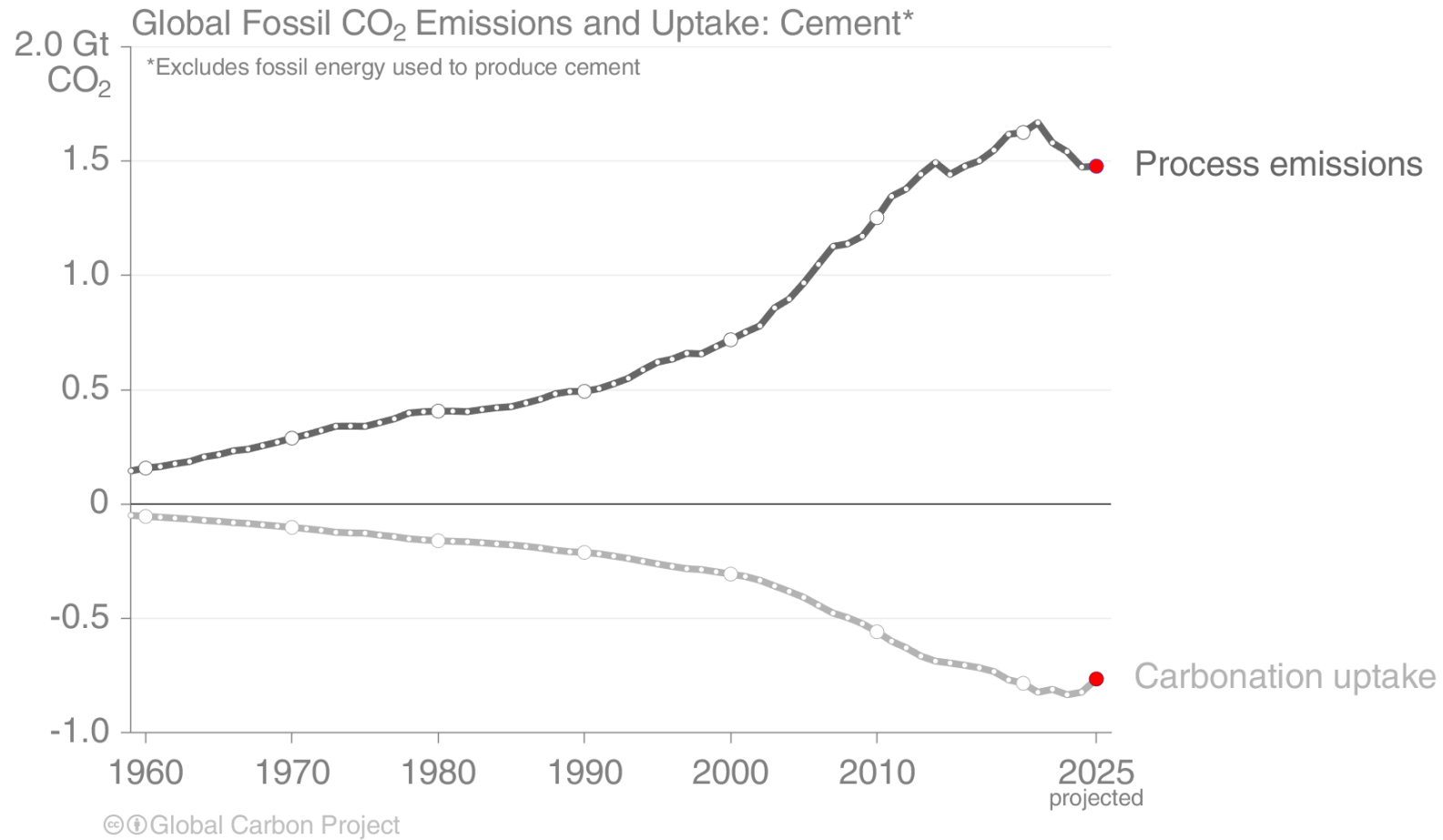
The Rest of the World is the global total less China, US, EU, India, and Japan.

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Cement carbonation sink

Cement carbonation sink

The production of cement results in ‘process’ emissions of CO₂ from the chemical decomposition of carbonates (a source). During its lifetime, cement re-absorbs some CO₂ from the atmosphere (a sink).

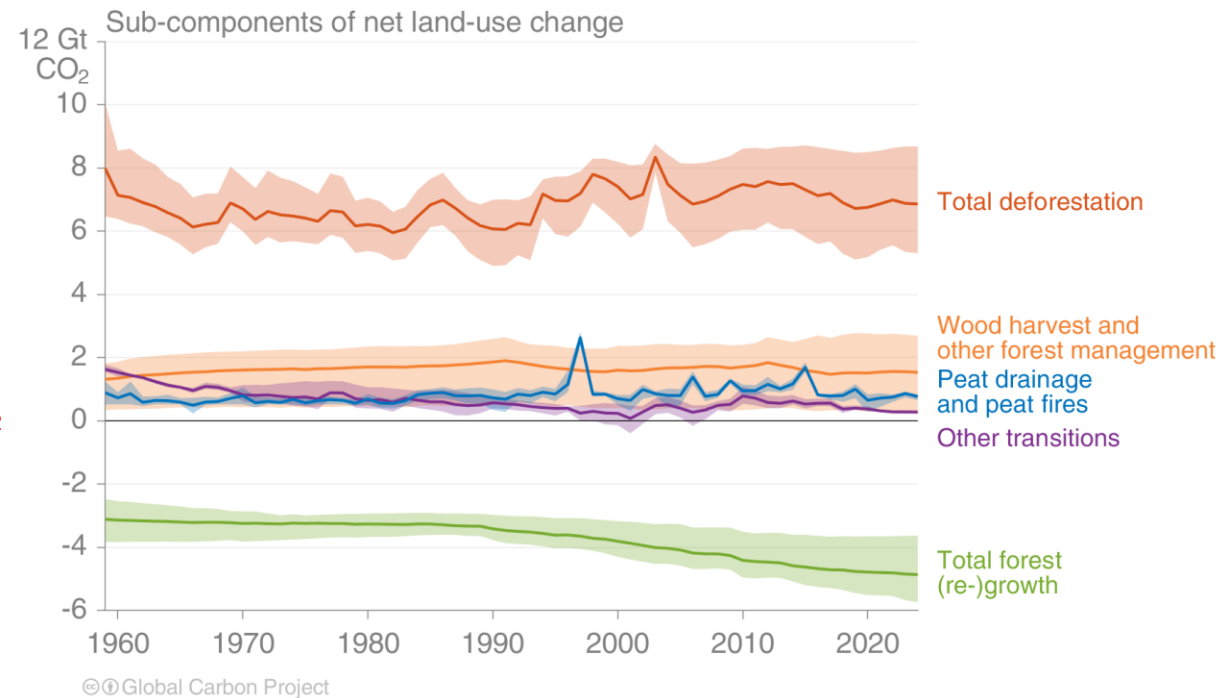
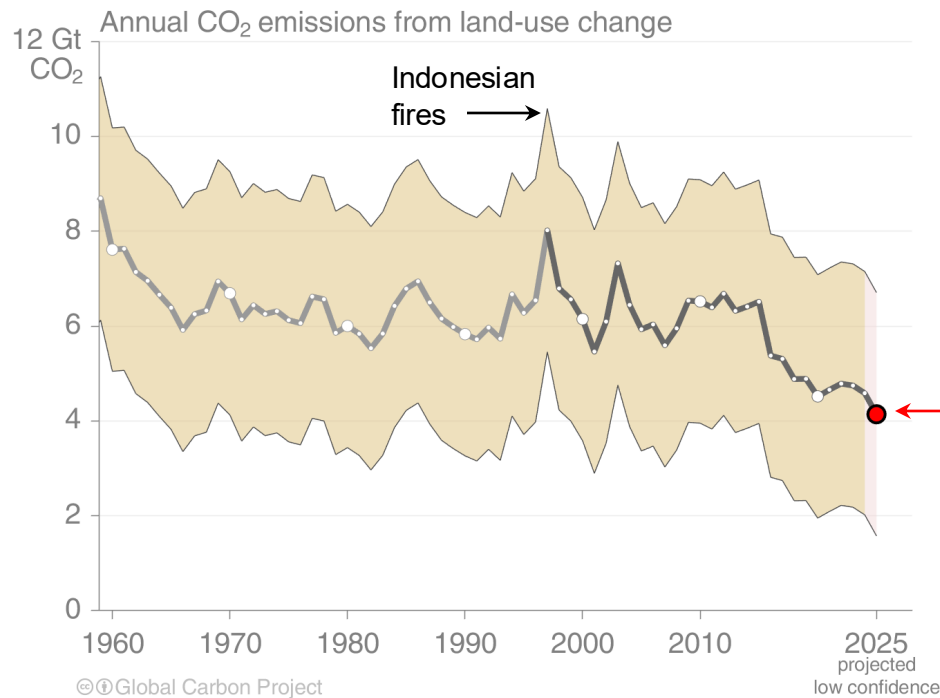


Land-use change emissions

Land-use change emissions

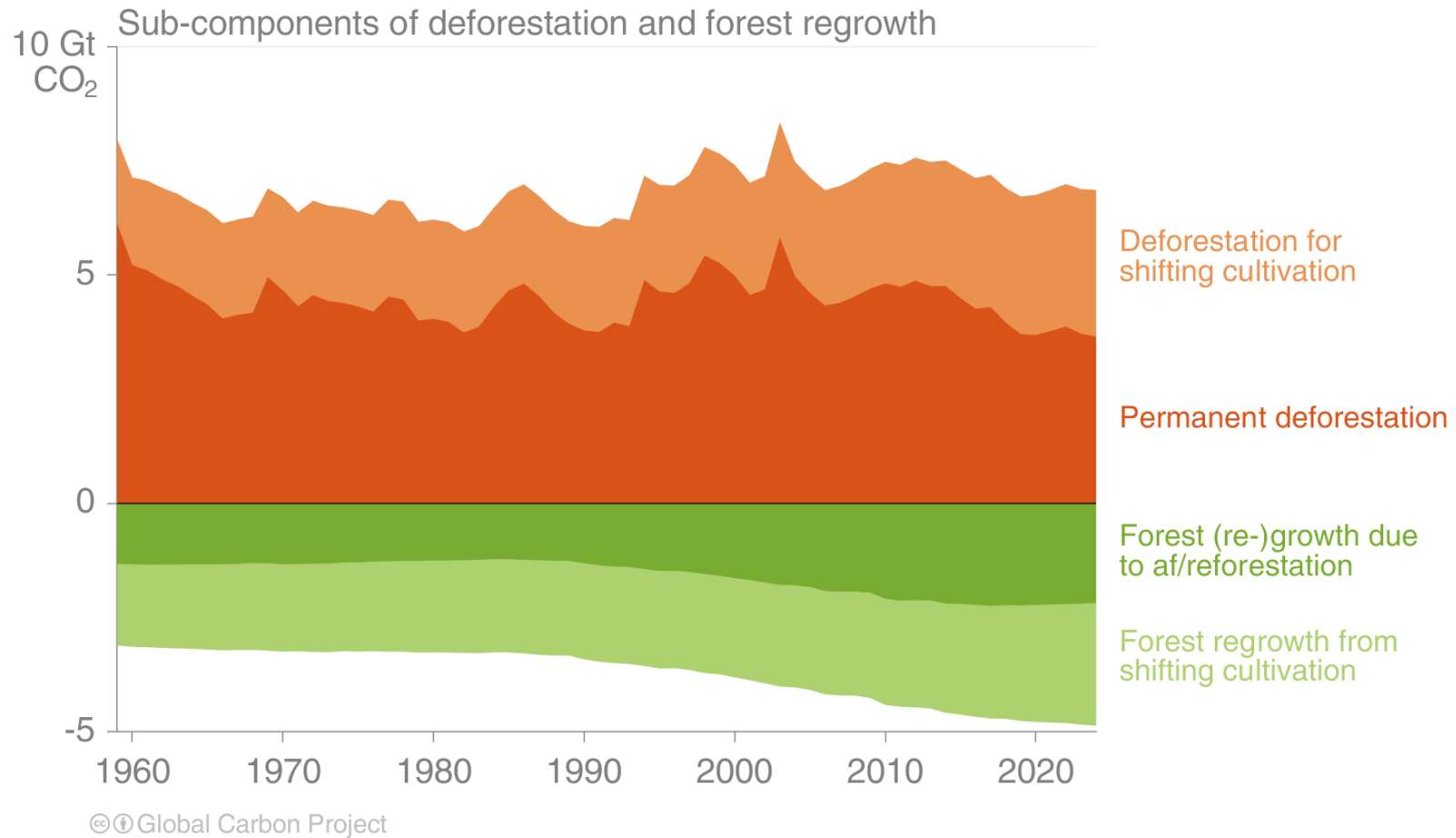
Land-use change emissions were 5.0 ± 2.6 GtCO₂ per year for 2015–2024 and show a negative trend in the last two decades, but estimates are still highly uncertain.

Net land-use emissions are the result of multiple anthropogenic activities on land that lead to CO₂ emissions or removals



Land-use change emissions

Annual emissions from permanent deforestation declined over 2015–2024 but remain high at around 3.9 GtCO₂. Carbon dioxide removals through permanent af/reforestation are 2.2 GtCO₂ per year over the same period.

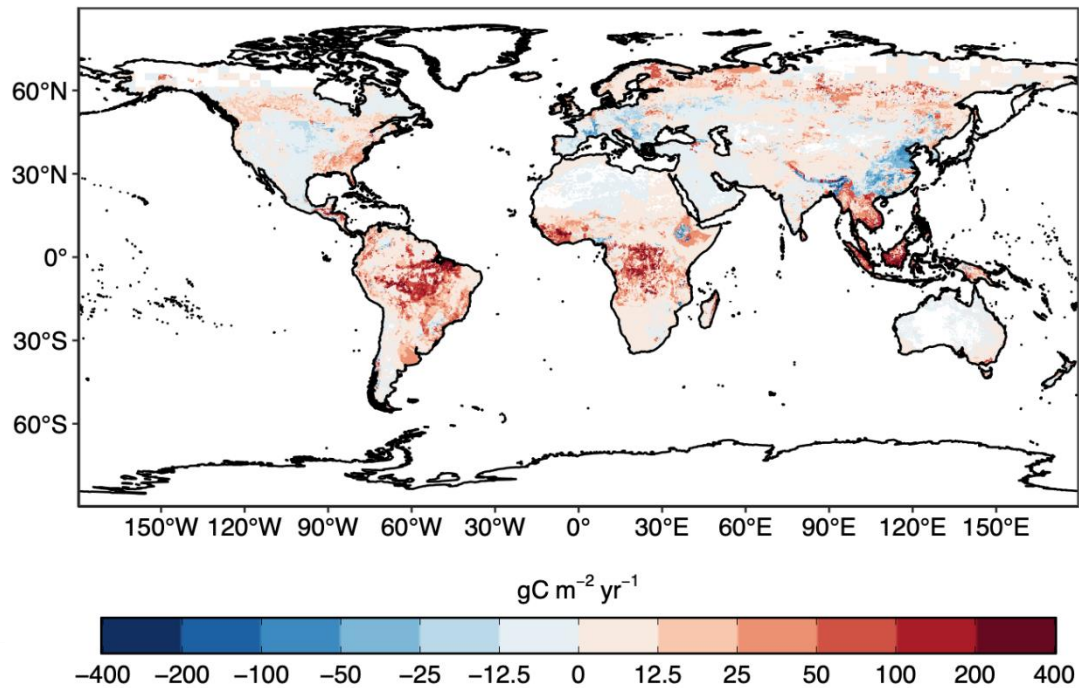


Estimates from three bookkeeping models
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

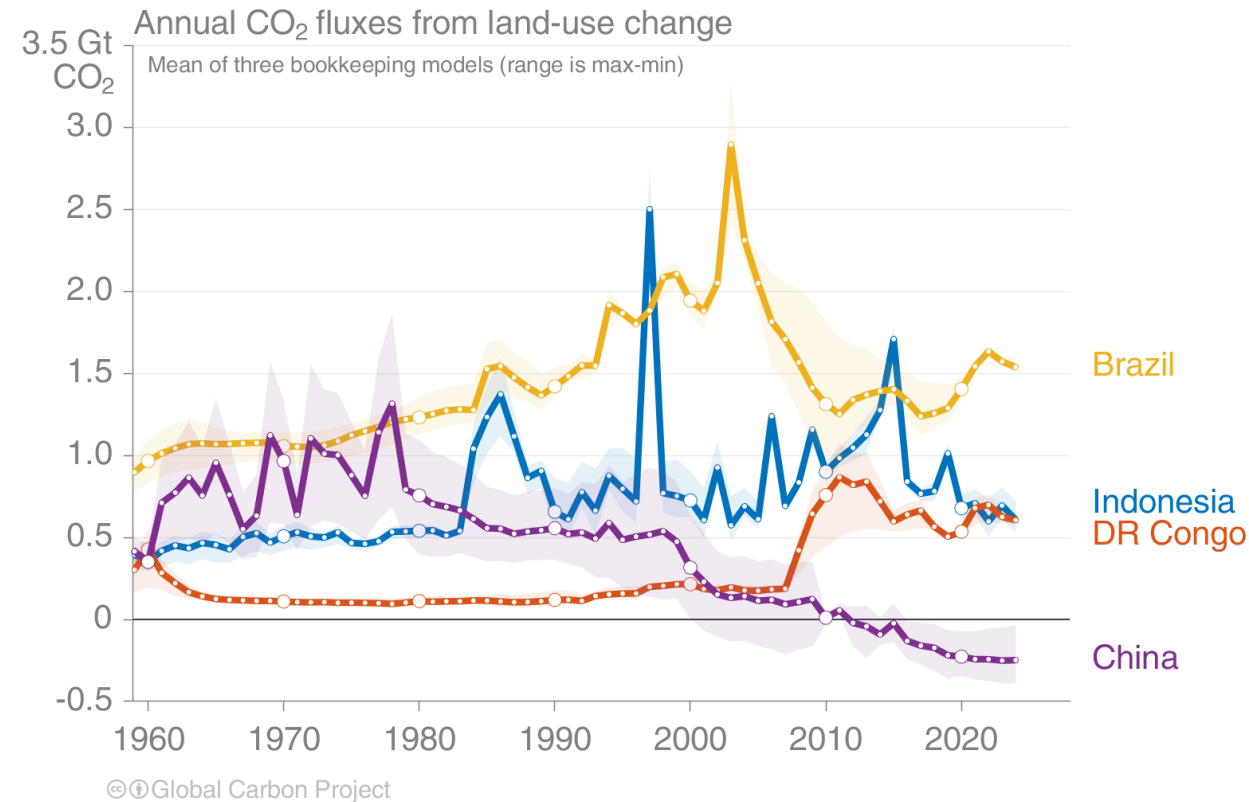
Regional patterns of land-use change emissions

Land-use emissions are high in the tropics, driven largely by deforestation. Net sinks occur in regions of re/afforestation such as parts of Europe and China.

Land-use emissions, decadal average 2015–2024



The top three emitters over 2015–2024 – Brazil, Indonesia, and the Democratic Republic of the Congo – contribute more than half of the global net land-use emissions, while China is now the largest remover.

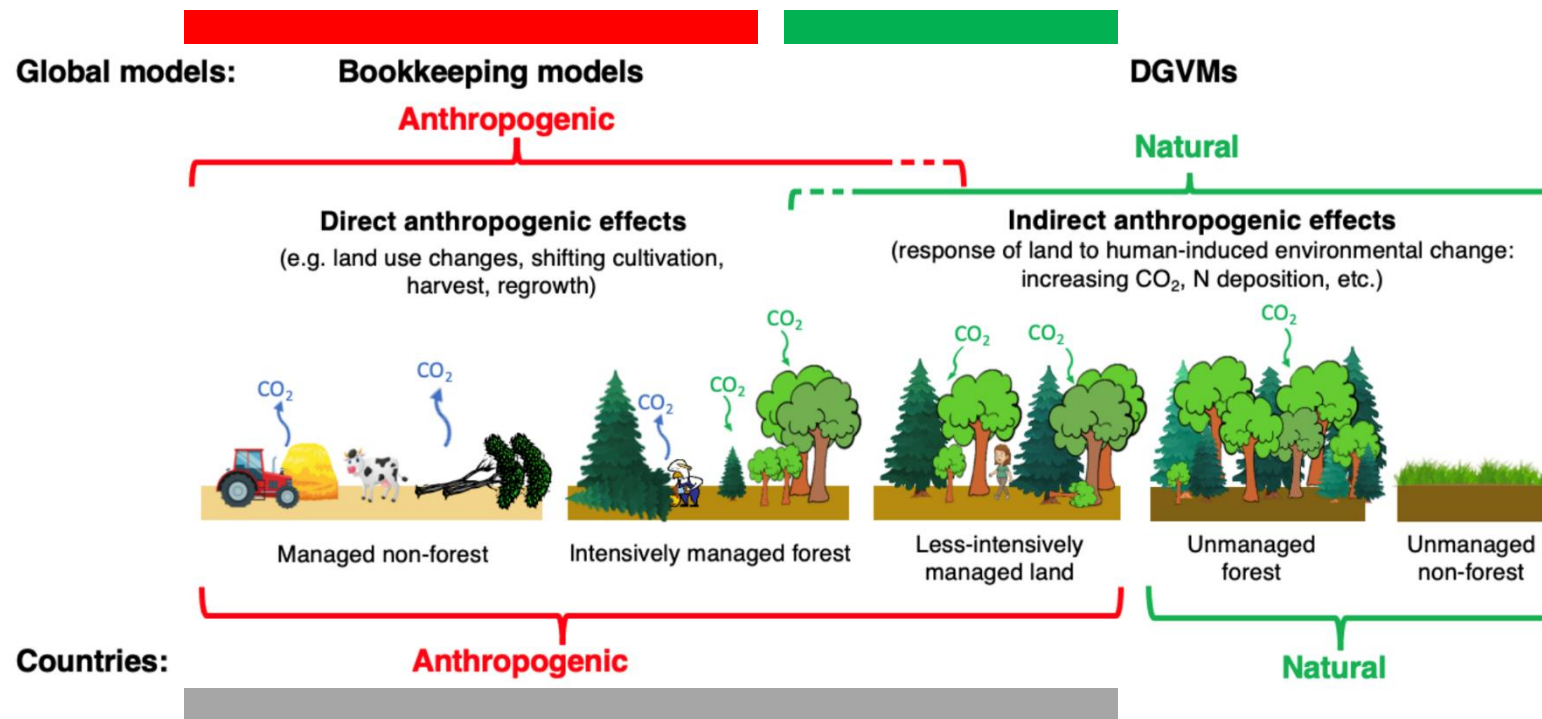


The peak in Indonesia in 1997 was the Indonesian peat fires.

Linking global models to country reports

Mapping of global carbon cycle model land flux definitions to the definition of the LULUCF net flux used in national Greenhouse Gas Inventories (NGHGI) reported to UNFCCC

When natural fluxes on managed forests (-6.9 GtCO₂ per year for 2014–2023) are added to land-use emissions (5.0 GtCO₂ per year), the GCB2025 estimates (-1.9 GtCO₂ per year) are closer to the country-reported data (-3.8 GtCO₂ per year), linking the anthropogenic carbon budget estimates of land CO₂ fluxes directly to the Global Stocktake as part of UNFCCC Paris Agreement.

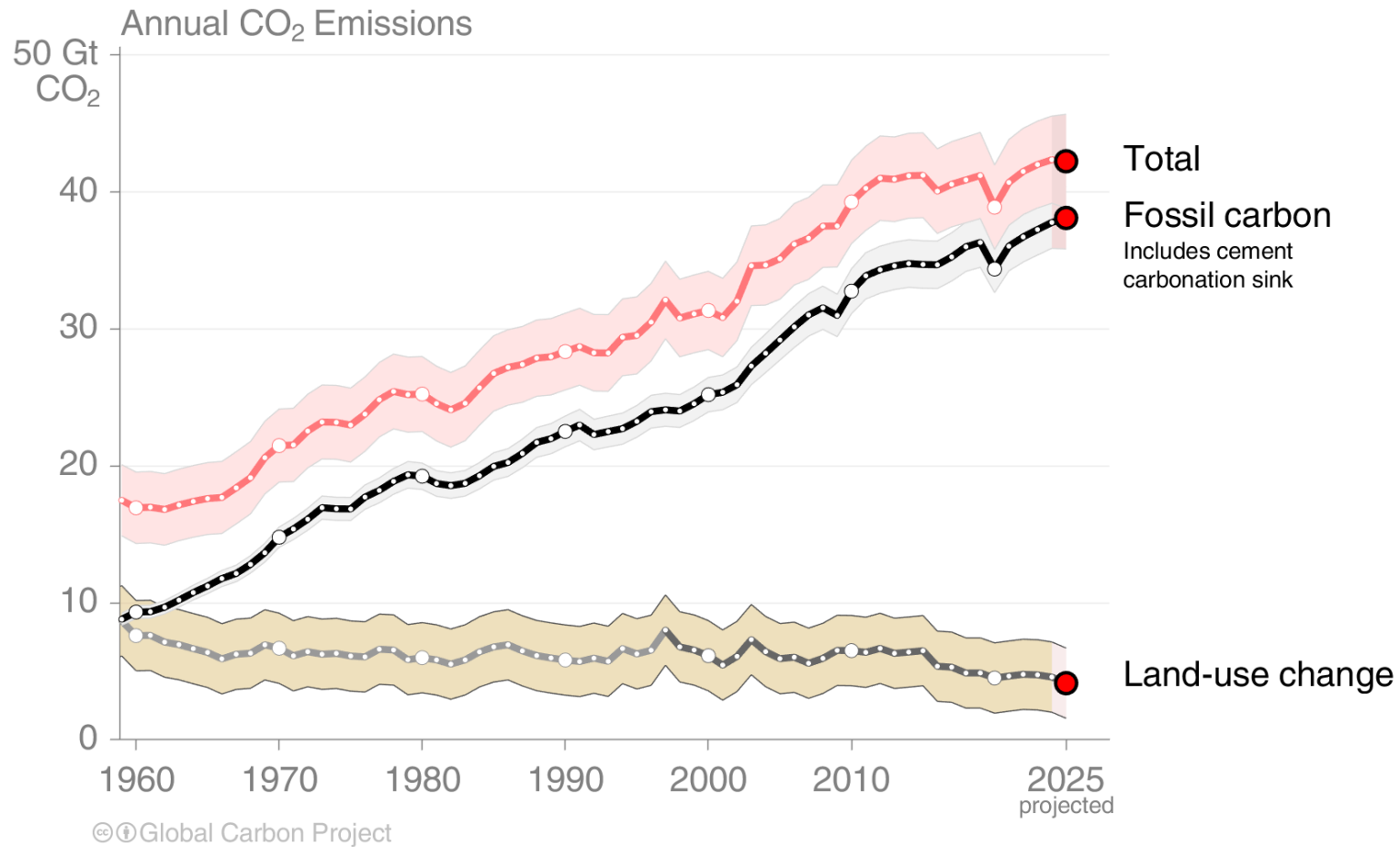


Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Figure from [Grassi et al., ESSD 2023](#)

Total global emissions

Total global emissions, projected to reach 42.2 ± 3.2 GtCO₂ in 2025, 49% over 1990
 Percentage land-use change: 45% in 1960, 12% averaged 2015–2024



Land-use change estimates from four bookkeeping models, using fire-based variability from 1997
 Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Carbon Dioxide Removal

Equivalent to ~5% of annual Fossil CO₂ emissions



2.2 GtCO₂ per year

Equivalent to ~1 millionth of annual Fossil CO₂ emissions



0.001 MtCO₂ per year

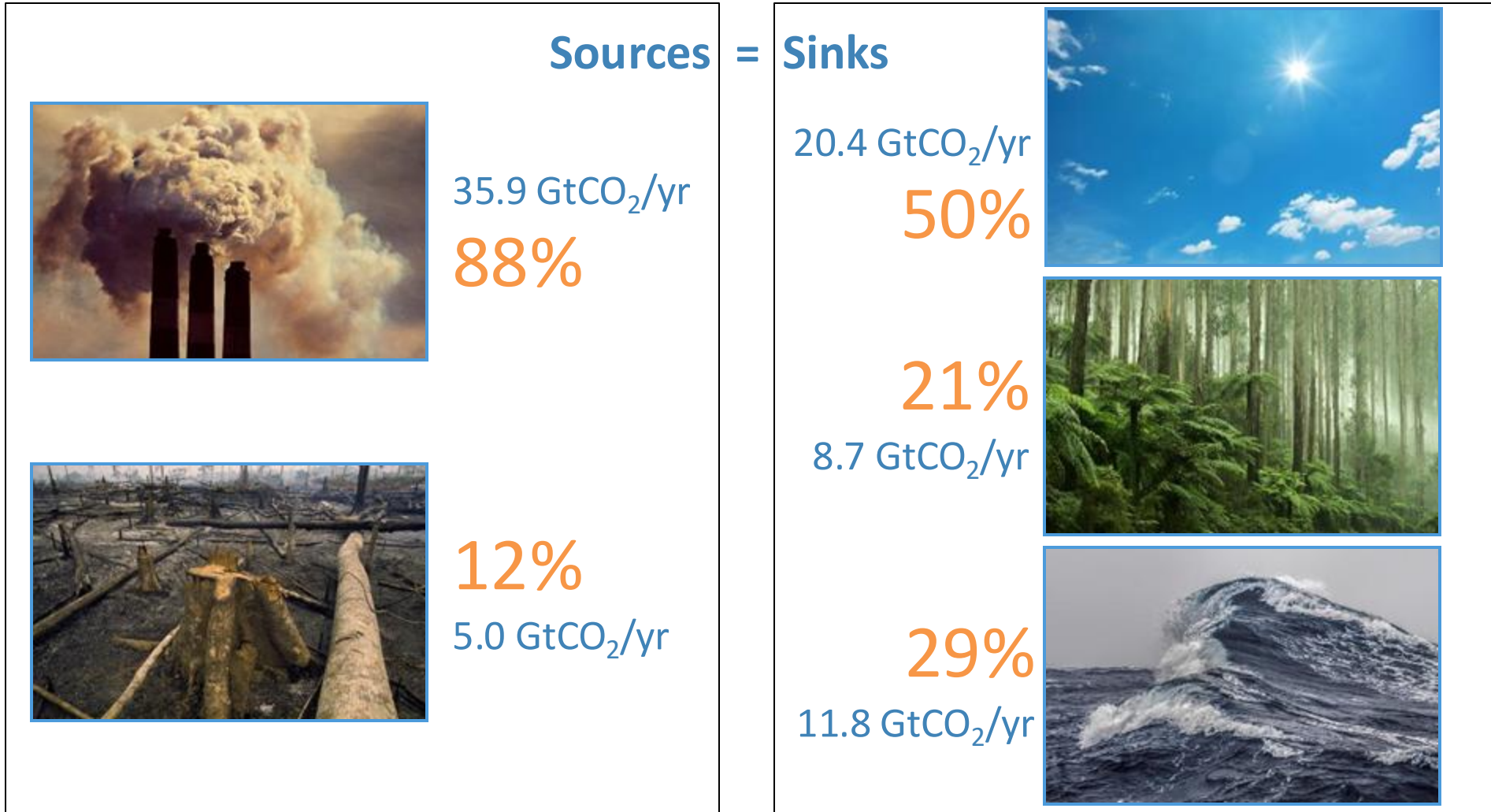


0.007 MtCO₂ per year

Vegetation-based CDR estimates from GCB2025
CDR not based on vegetation from the State of CDR report (2024)

Closing the Global Carbon Budget

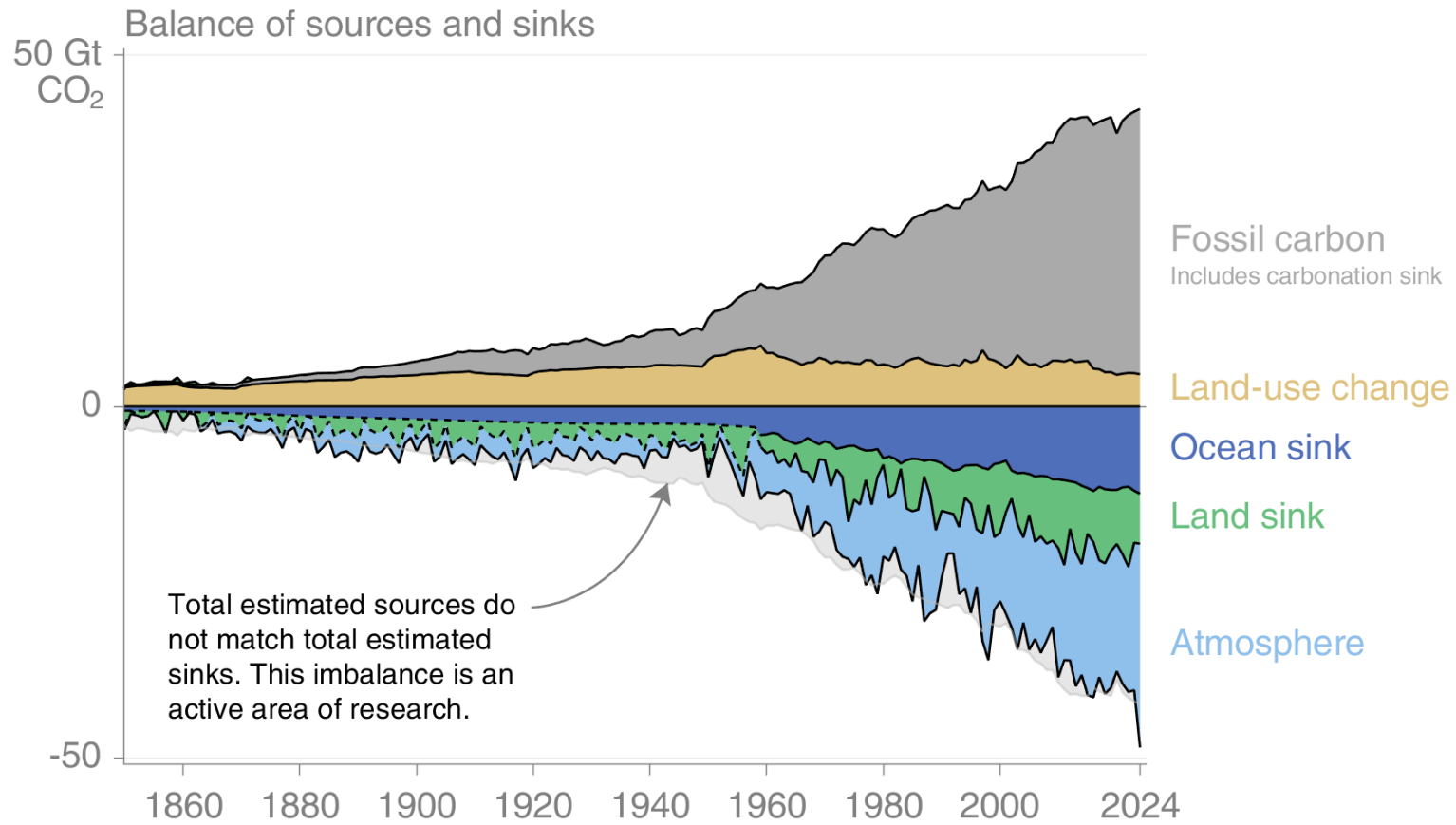
Fate of anthropogenic CO₂ emissions (2015–2024)



Budget Imbalance: <1%
(the difference between estimated sources & sinks) 0.1 GtCO₂/yr

Global carbon budget

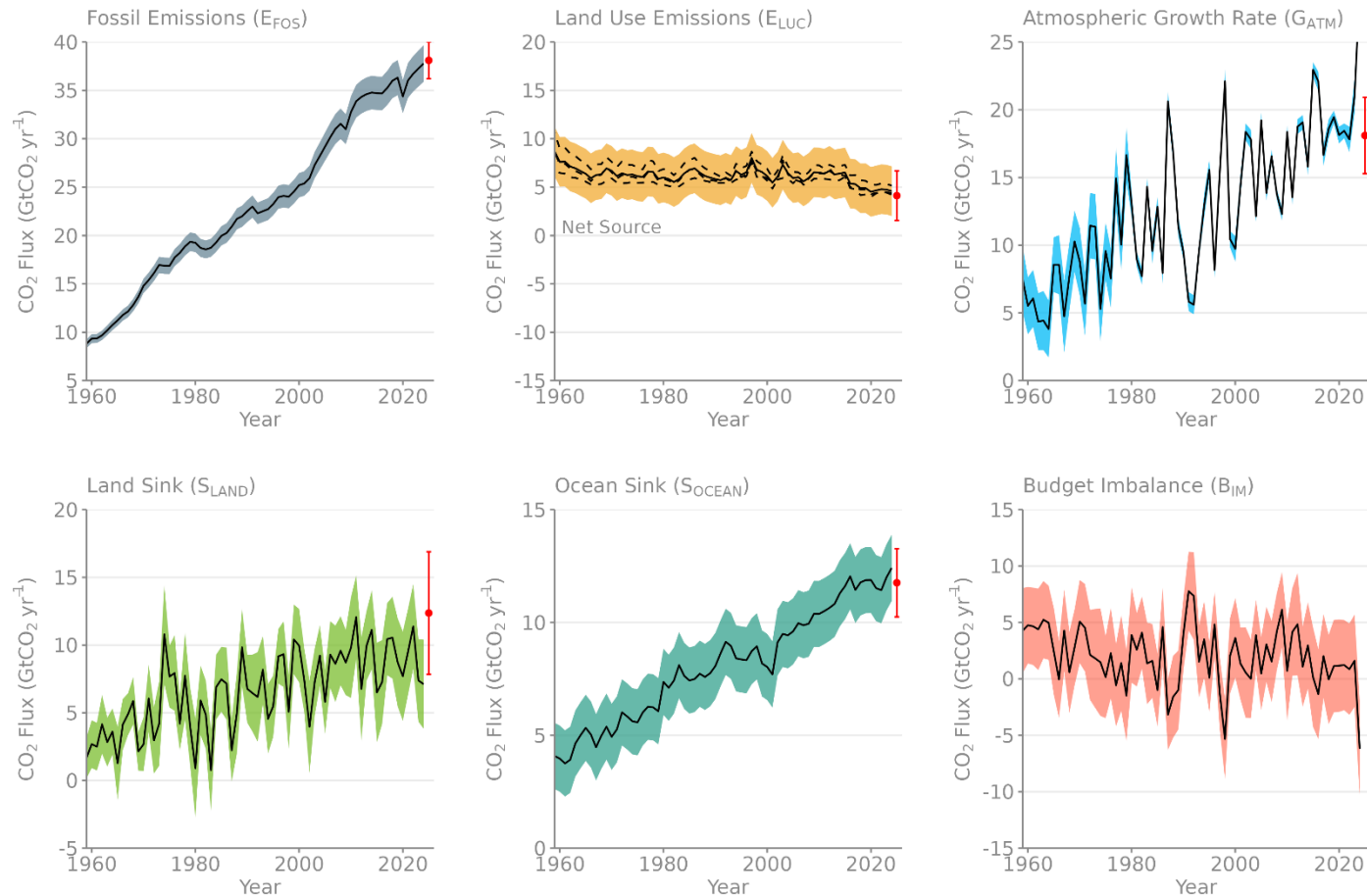
Carbon emissions are partitioned among the atmosphere and carbon sinks on land and in the ocean
 The “imbalance” between total emissions and total sinks is an active area of research



© Global Carbon Project

Changes in the budget over time

The sinks have continued to grow with increasing emissions, but climate change affects carbon cycle processes in a way that will exacerbate the increase of CO₂ in the atmosphere

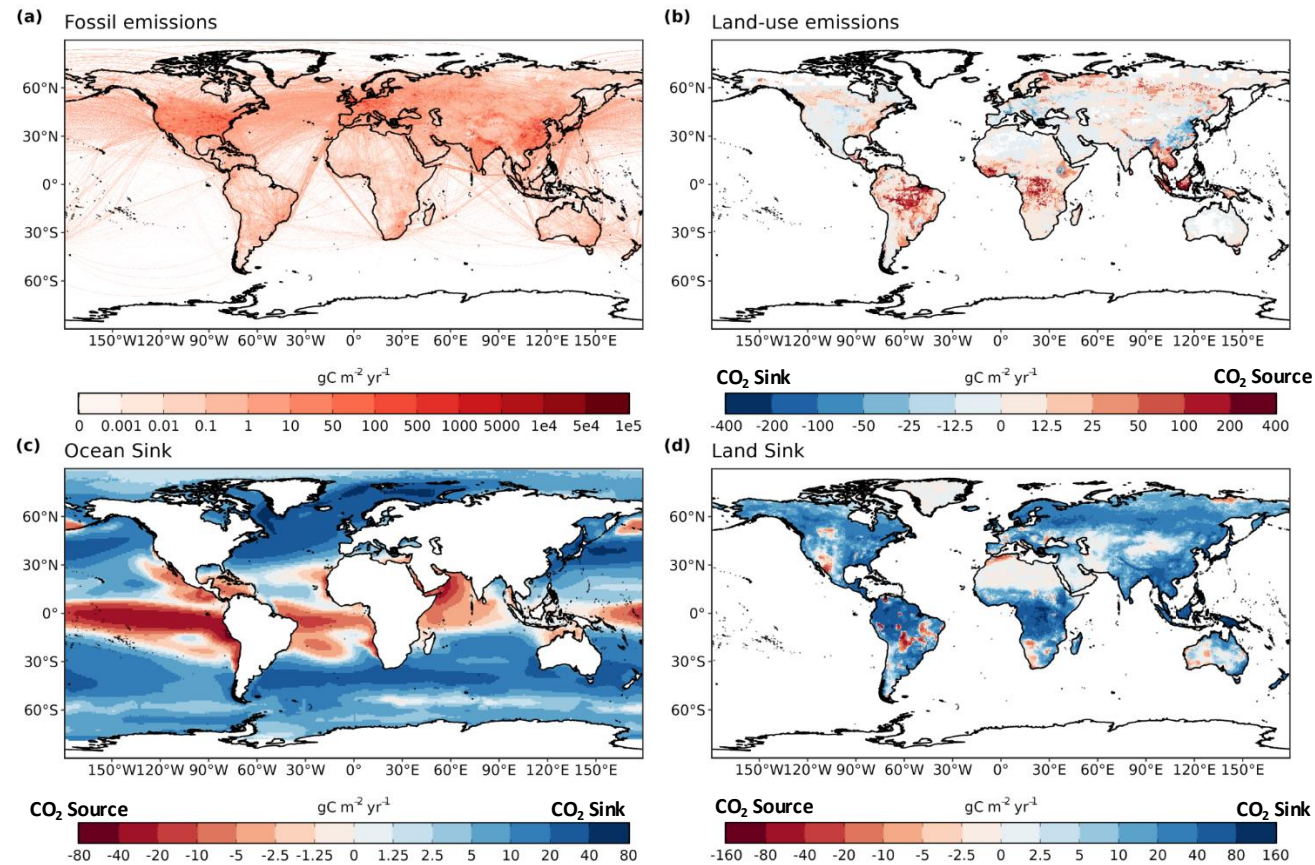


The budget imbalance is the total emissions minus the estimated growth in the atmosphere, land and ocean. It reflects the limits of our understanding of the carbon cycle.

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

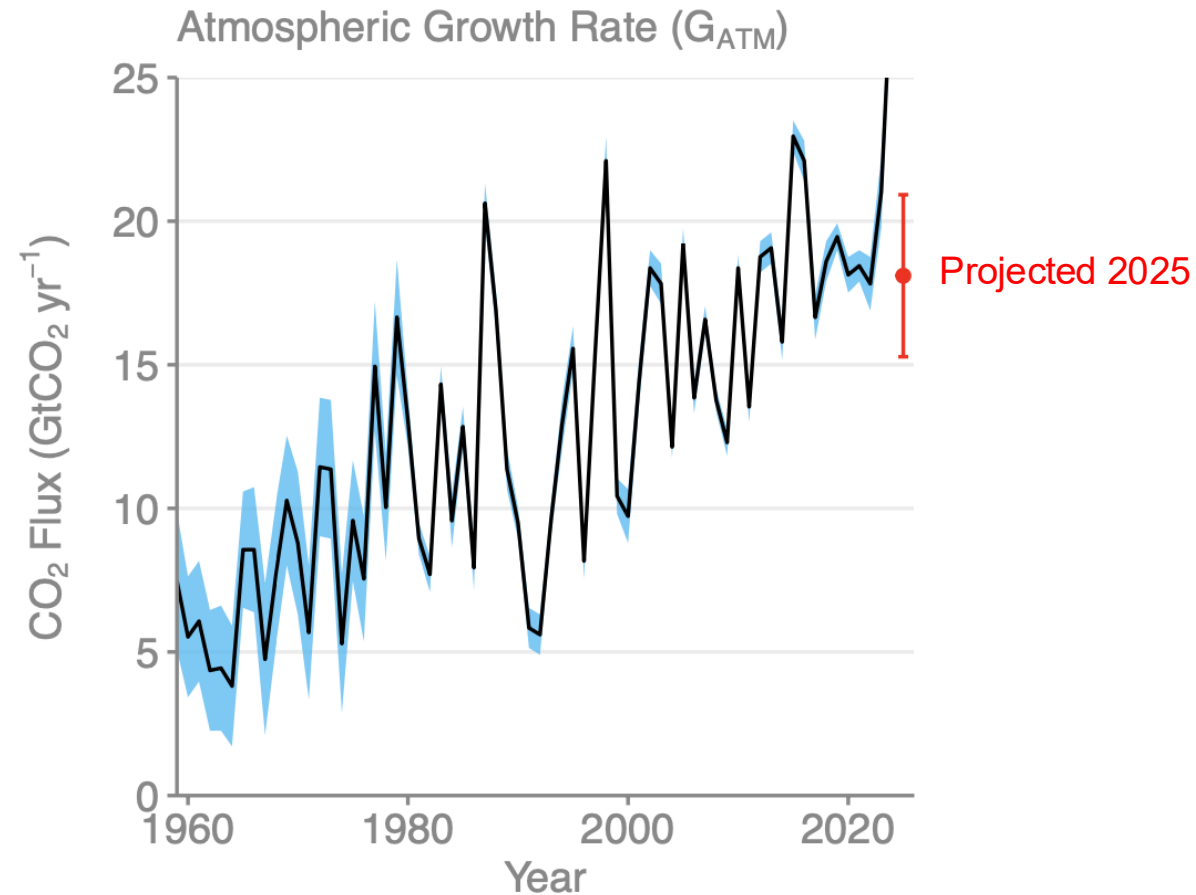
Global carbon budget

Fossil emissions dominate in the Northern Hemisphere, while land-use emissions are important in the tropics. The North Atlantic and Southern Ocean are carbon sinks while the tropical ocean is a source of CO₂. Tropical, temperate and boreal forest are the main terrestrial carbon sinks



Atmospheric concentration

The atmospheric concentration growth rate has increased steadily.
 The high growth in 1997-98, 2015-16 and 2023-24 reflect a strong El Niño, which weakens the land sink.
 The 2025 growth rate is expected to return to pre-El Niño level

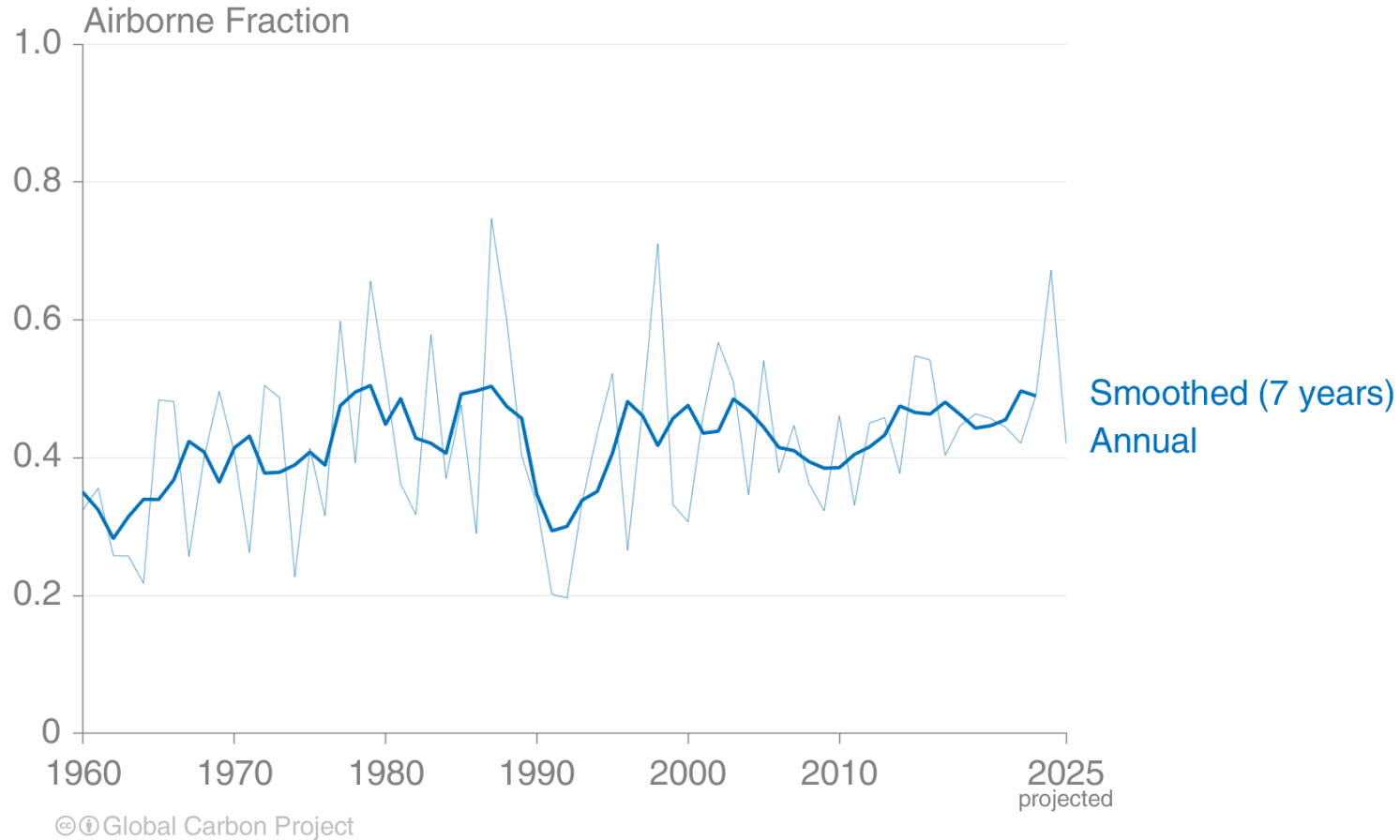


Airborne Fraction

The airborne fraction is the proportion of the total annual CO₂ emissions that remains in the atmosphere.

The rest of the CO₂ emissions are removed by the land and ocean sinks.

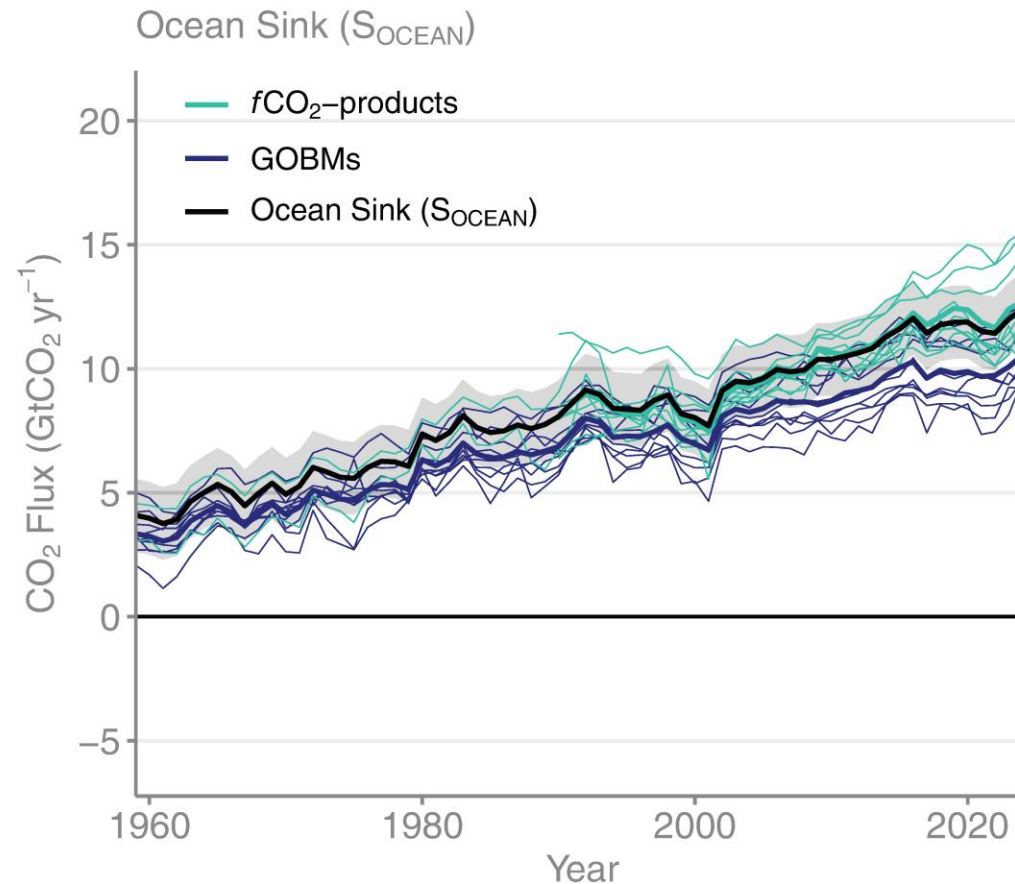
Around 45% of CO₂ emissions remain in the atmosphere despite sustained growth in CO₂ emissions.



Ocean sink

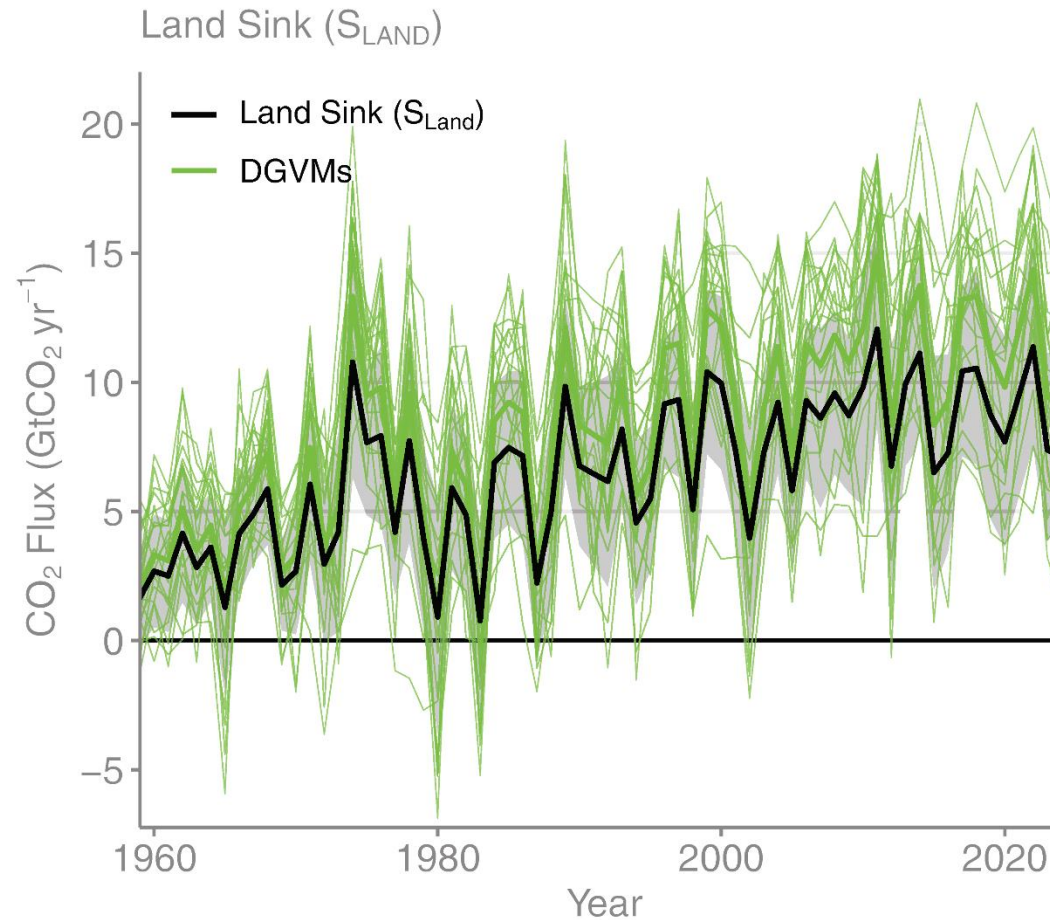
The ocean carbon sink, estimated by Global Ocean Biogeochemical Models and observation-based data products, amounts to 11.8 ± 1.5 GtCO₂/yr for 2015–2024 and 12.4 ± 1.5 GtCO₂/yr in 2024.

The ocean sink increased in 2024, in line with the expected sink response to the 2023-24 El Niño conditions.



Terrestrial sink

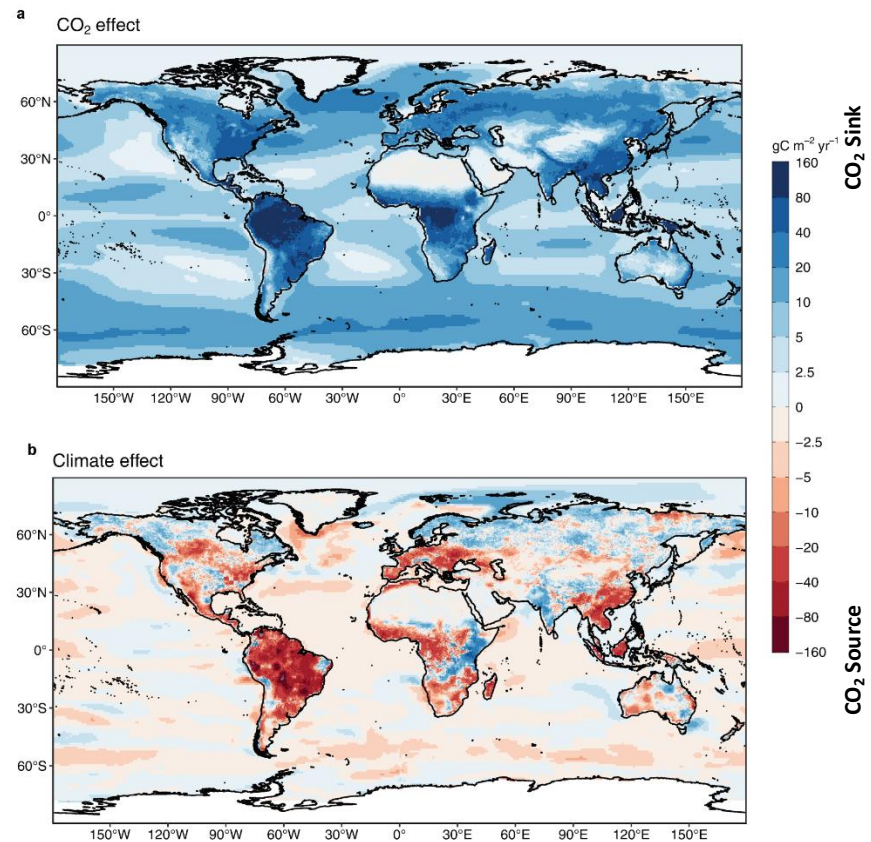
The land carbon sink, estimated by Dynamic Global Vegetation Models, was 8.7 ± 3.2 GtCO₂/yr during 2015–2024. The effects of 2023-24 El Niño reduced the land CO₂ sink to 7.1 GtCO₂ in 2024, 18% below its decadal mean.



Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Land and ocean sinks — Effects of CO₂ vs climate change

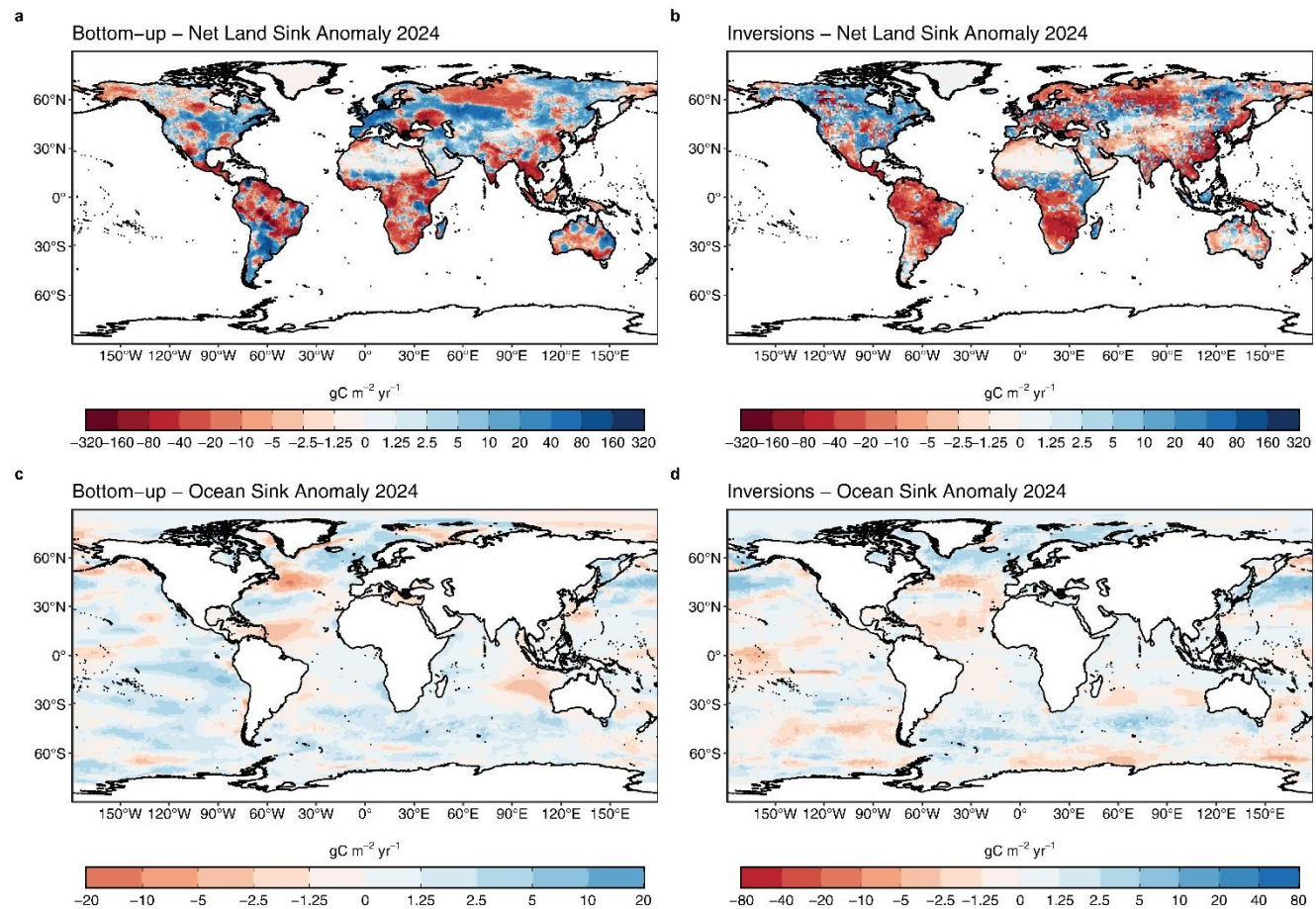
Process models suggest that increasing atmospheric CO₂ drives the land and ocean sinks while climate change reduces the carbon sinks. On average for the 2015-2024 period, the land and ocean CO₂ sink are respectively 25% and 7% smaller than what they would have been without the effects of climate change and variability



Land and ocean sinks — The 2023–2024 El Niño

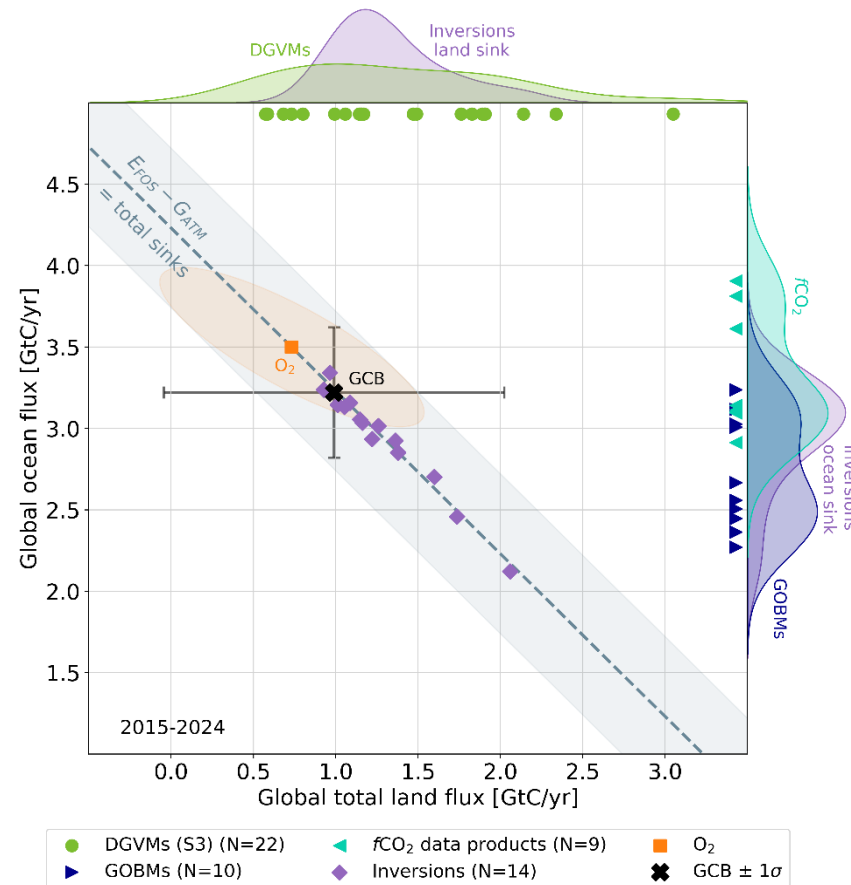
The 2023–2024 El Niño conditions led to a large reduction of the land carbon sink, particularly in the tropics with a 66% reduction relative to the pre-El Niño (2022) land sink.

The ocean sink was slightly larger in 2024 than in 2023, primarily due to the high atmospheric CO₂ growth rate in 2024.



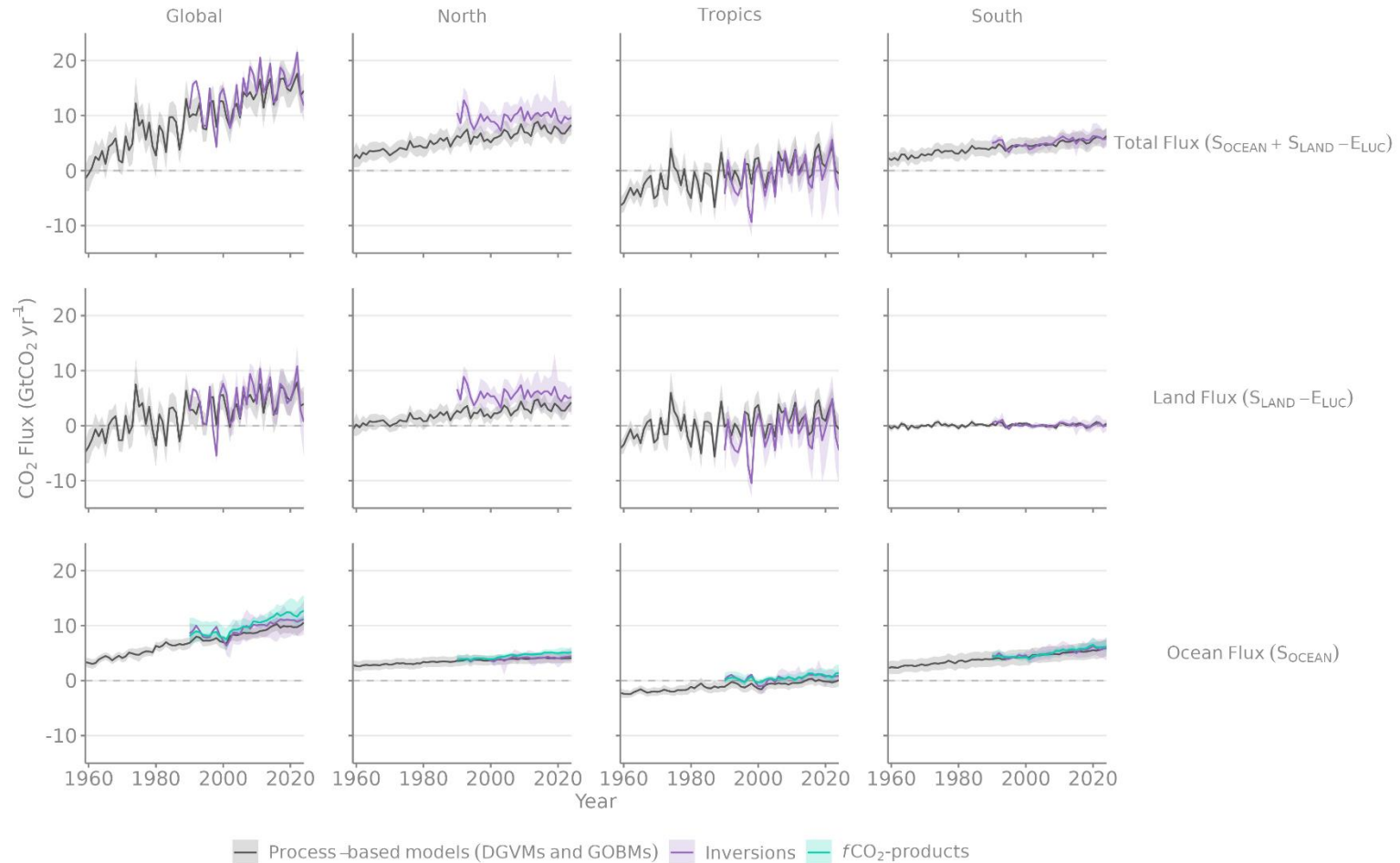
Land and ocean sinks — Estimates from atmospheric inversions

Both atmospheric CO₂ inversions and atmospheric oxygen allow to estimate the land and ocean carbon fluxes, independently from the land and ocean process-based models, confirming the global carbon budget estimates of the land and ocean partitioning of anthropogenic CO₂



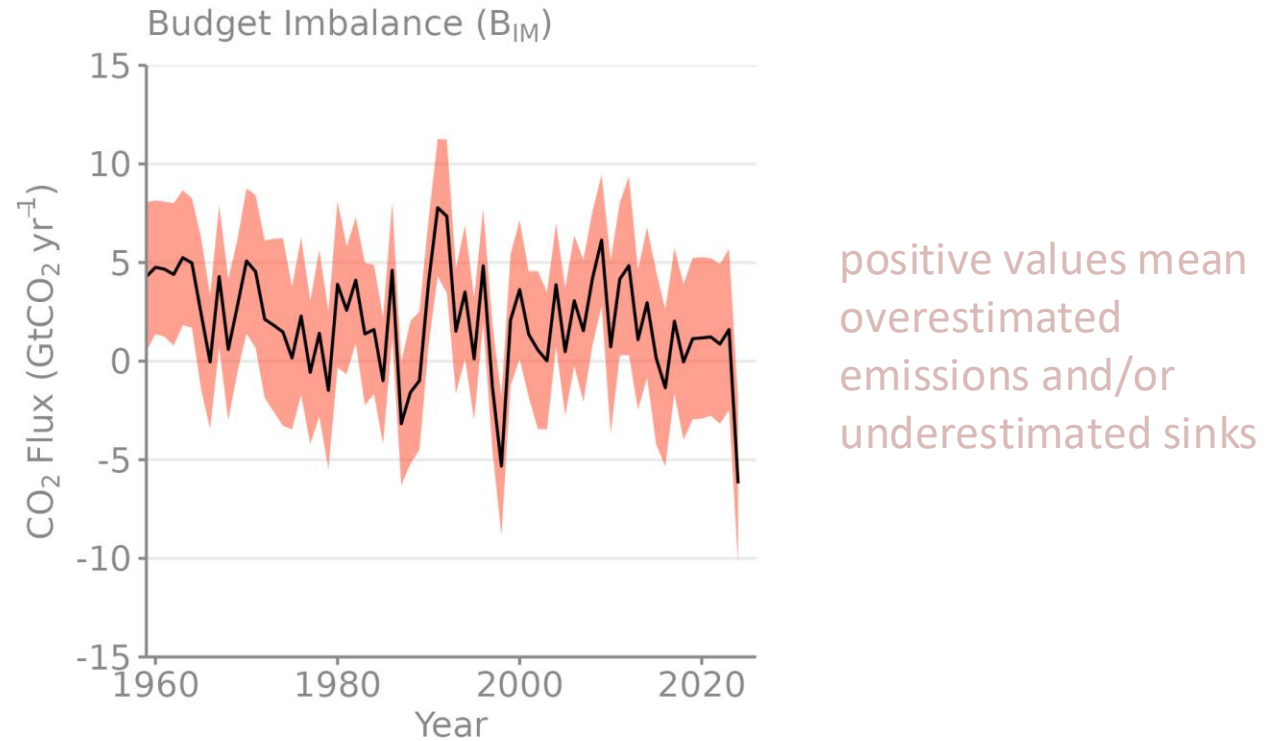
Total land and ocean fluxes

Bottom-up estimates and top-down atmospheric inversions broadly agree on the land and ocean sinks at large regional scales. The interannual variability in the global total CO₂ flux is largely due to the variability of the land sink in the tropics.



Remaining carbon budget imbalance

Large and unexplained variability in the global carbon balance caused by uncertainty and understanding hinder independent verification of reported CO₂ emissions

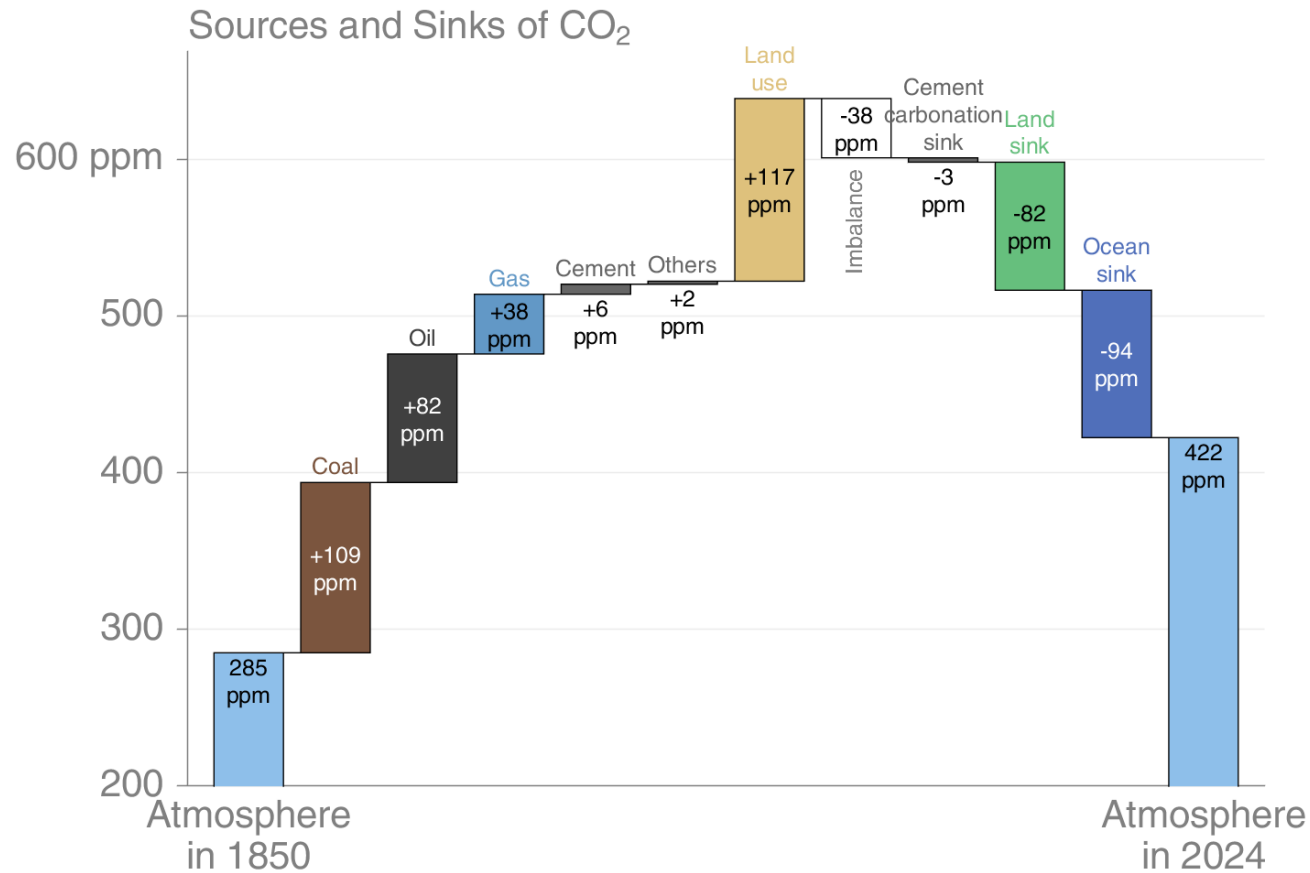


The budget imbalance is the carbon left after adding independent estimates for total emissions, minus the atmospheric growth rate and estimates for the land and ocean carbon sinks using models constrained by observations

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Global carbon budget

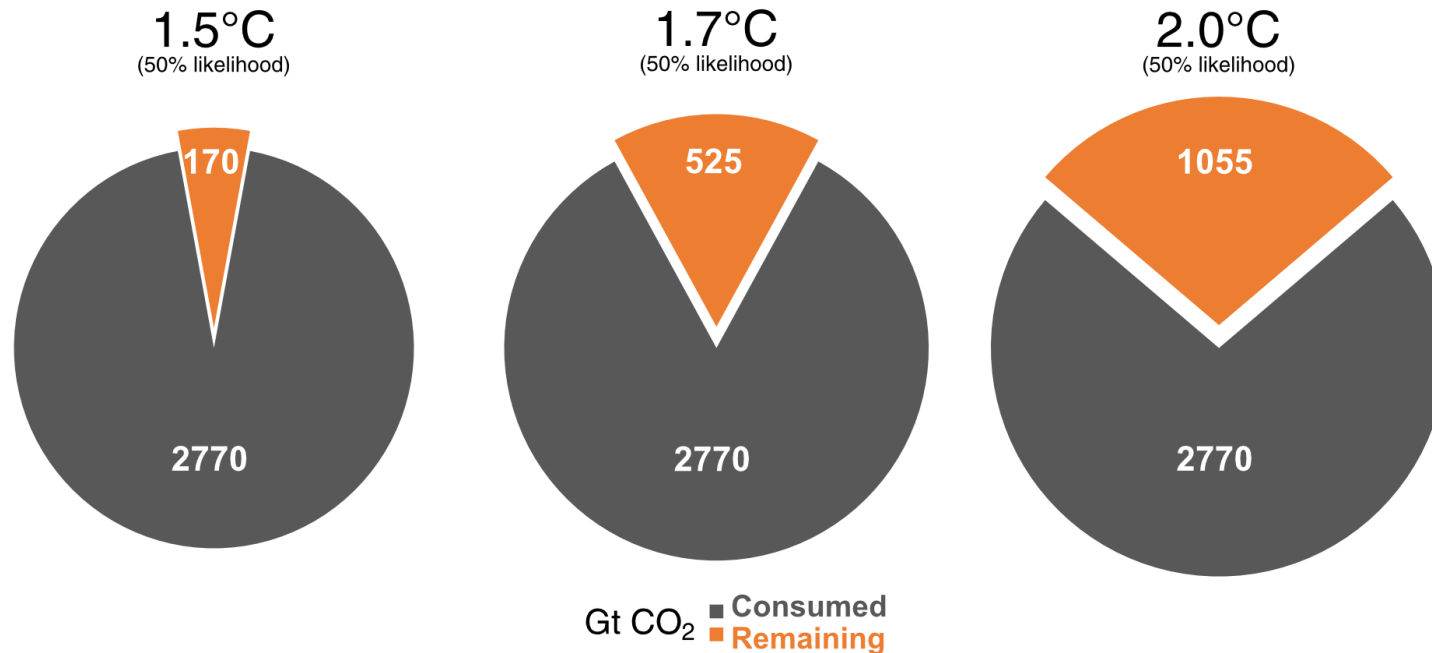
The cumulative contributions to the global carbon budget from 1850
 The carbon imbalance represents the gap in our current understanding of sources & sinks



© Global Carbon Project

Remaining carbon budget

The remaining carbon budget to limit global warming to 1.5°C, 1.7°C and 2°C is 170 GtCO₂, 525 GtCO₂, and 1055 GtCO₂ respectively, equivalent to 4, 12 and 25 years from 2026. A total of 2770 GtCO₂ has been emitted since 1850.

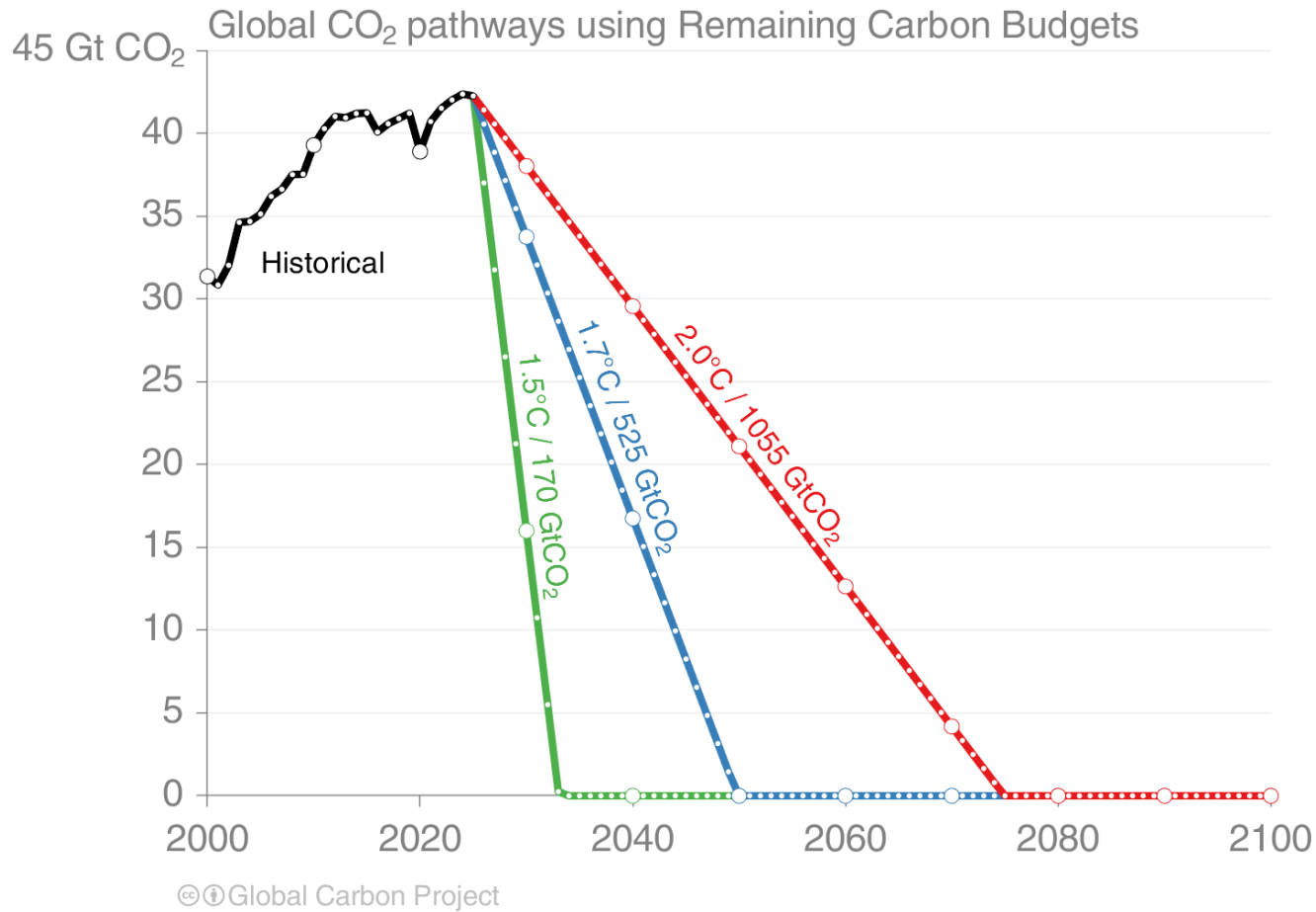


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The remaining carbon budgets are the average of two estimates (IPCC AR6 and Forster et al., 2025), both updated by removing the most recent emissions. Quantities are subject to additional uncertainties e.g., future mitigation choices of non-CO₂ emissions
 Source: IPCC AR6 WG1; [Forster et al., 2023](#); [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Remaining carbon budget

Global CO₂ emissions must reach zero to limit global warming.
All-else-equal, the later the net zero year, the higher the warming level.



Acknowledgements

The work presented in the **Global Carbon Budget 2025** has been possible thanks to the contributions of **hundreds of people** involved in observational networks, modelling, and synthesis efforts.

We thank the institutions and agencies that provide support for individuals and funding that enable the collaborative effort of bringing all components together in the carbon budget effort.

We thank the sponsors of the GCP and GCP support and liaison offices.

We also want to thank the many funding agencies that supported this coordinated effort and the individual components of this release. A full list is provided in Friedlingstein et al. 2025, (available on November 13th):

<https://doi.org/10.18160/GCP-2025>

We also thank the Fondation BNP Paribas for supporting the Global Carbon Atlas and the Integrated Carbon Observation System (ICOS) for hosting our data.

This presentation was created by Robbie Andrew, Pierre Friedlingstein, Glen Peters, Julia Pongratz, and Corinne Le Quéré in support of the international carbon research community.



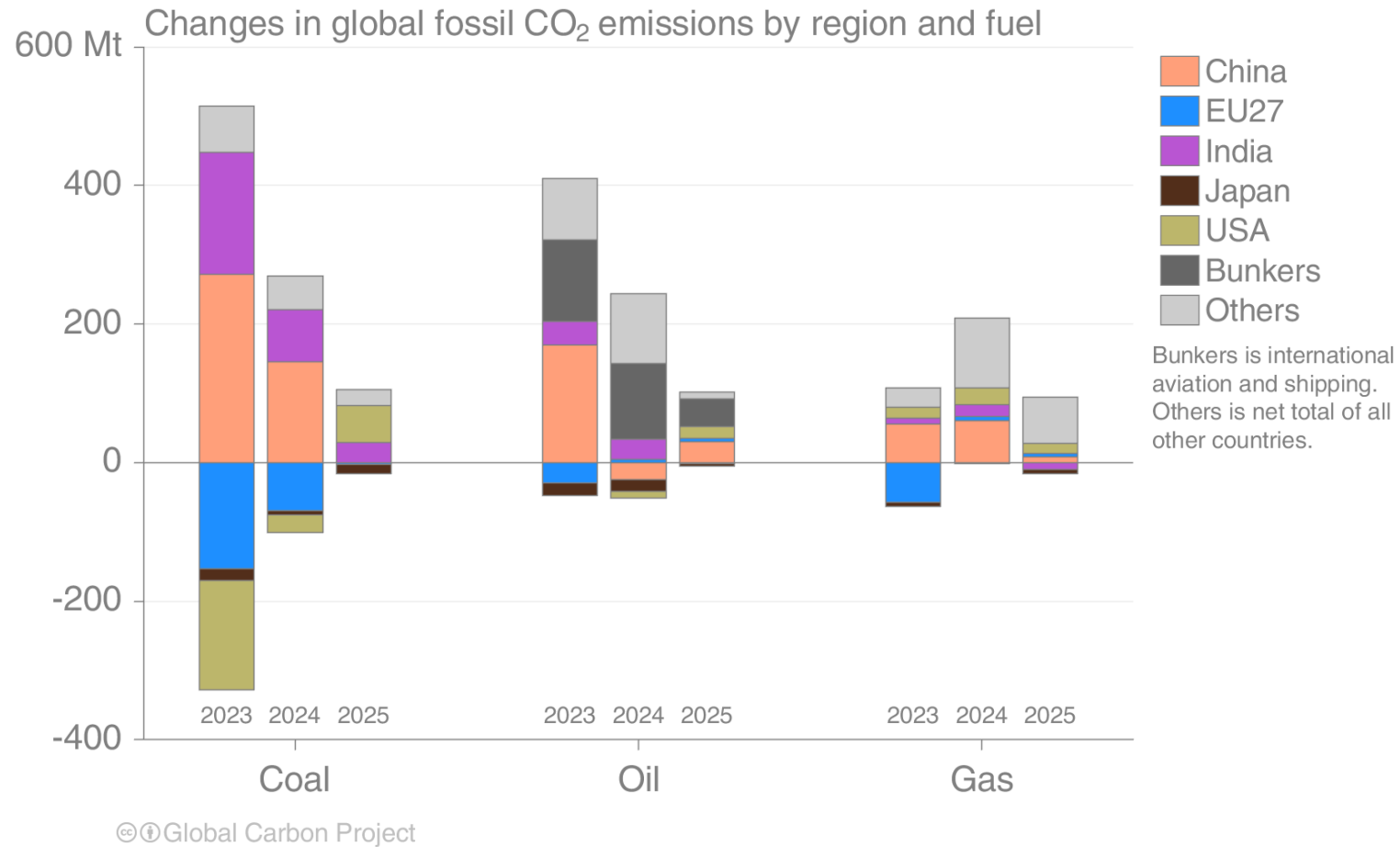
Additional Figures

Additional Figures

Fossil CO₂

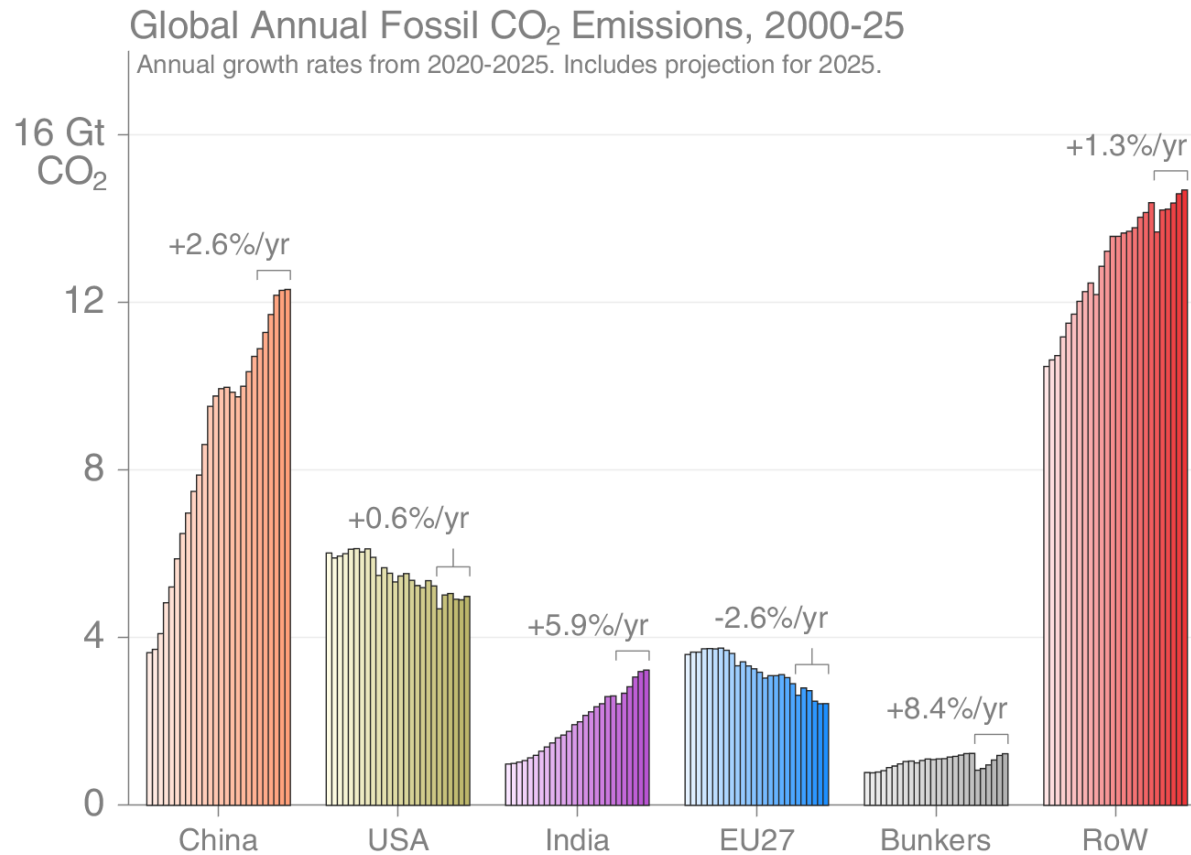
Emissions changes 2023–2025

Emissions from coal in China and India have been a core reason for global growth, but in 2025 this growth is low. Both 2023 and 2024 were marked by post-pandemic recovery in international aviation (bunkers).



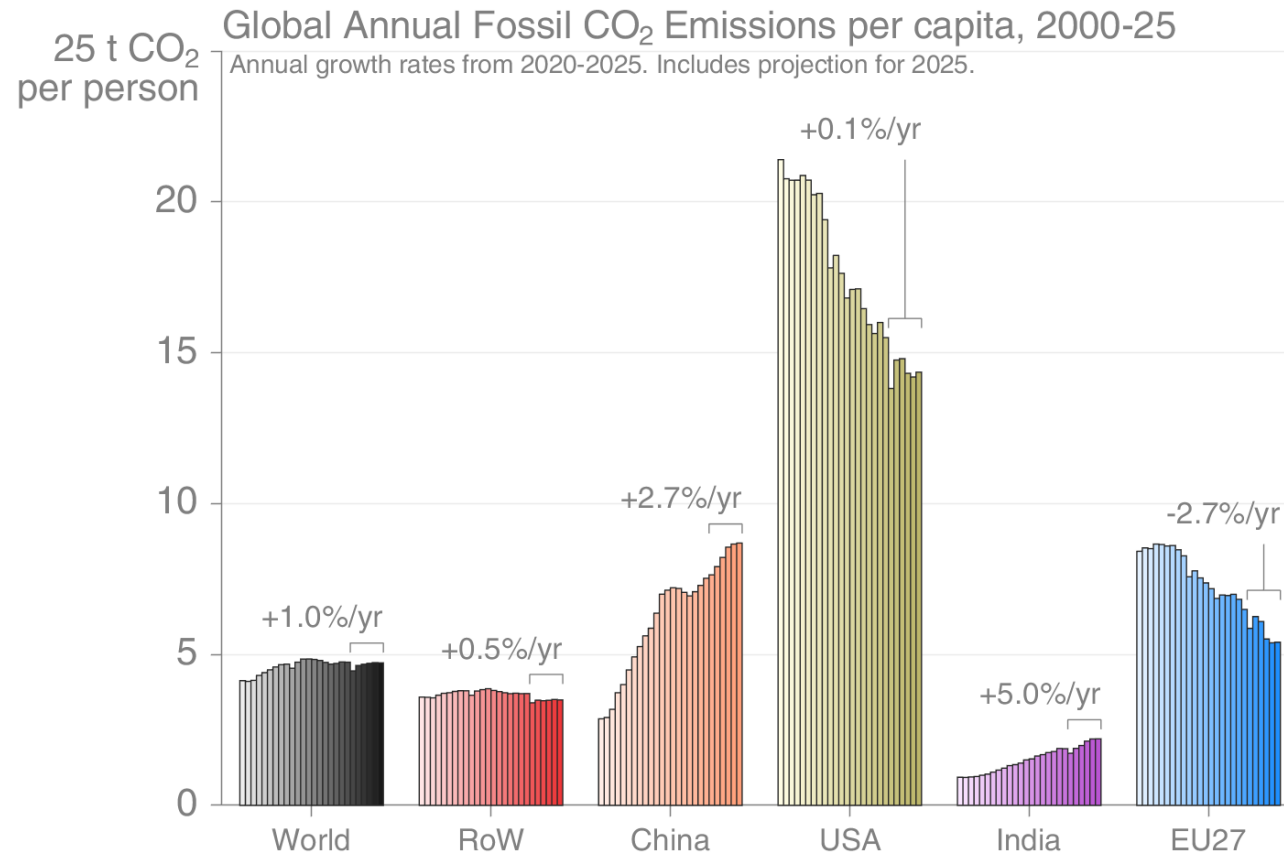
Top emitters: Fossil CO₂ Emissions

Emissions by country from 2000 to 2025, with the growth rates indicated for the more recent period of 2020 to 2025



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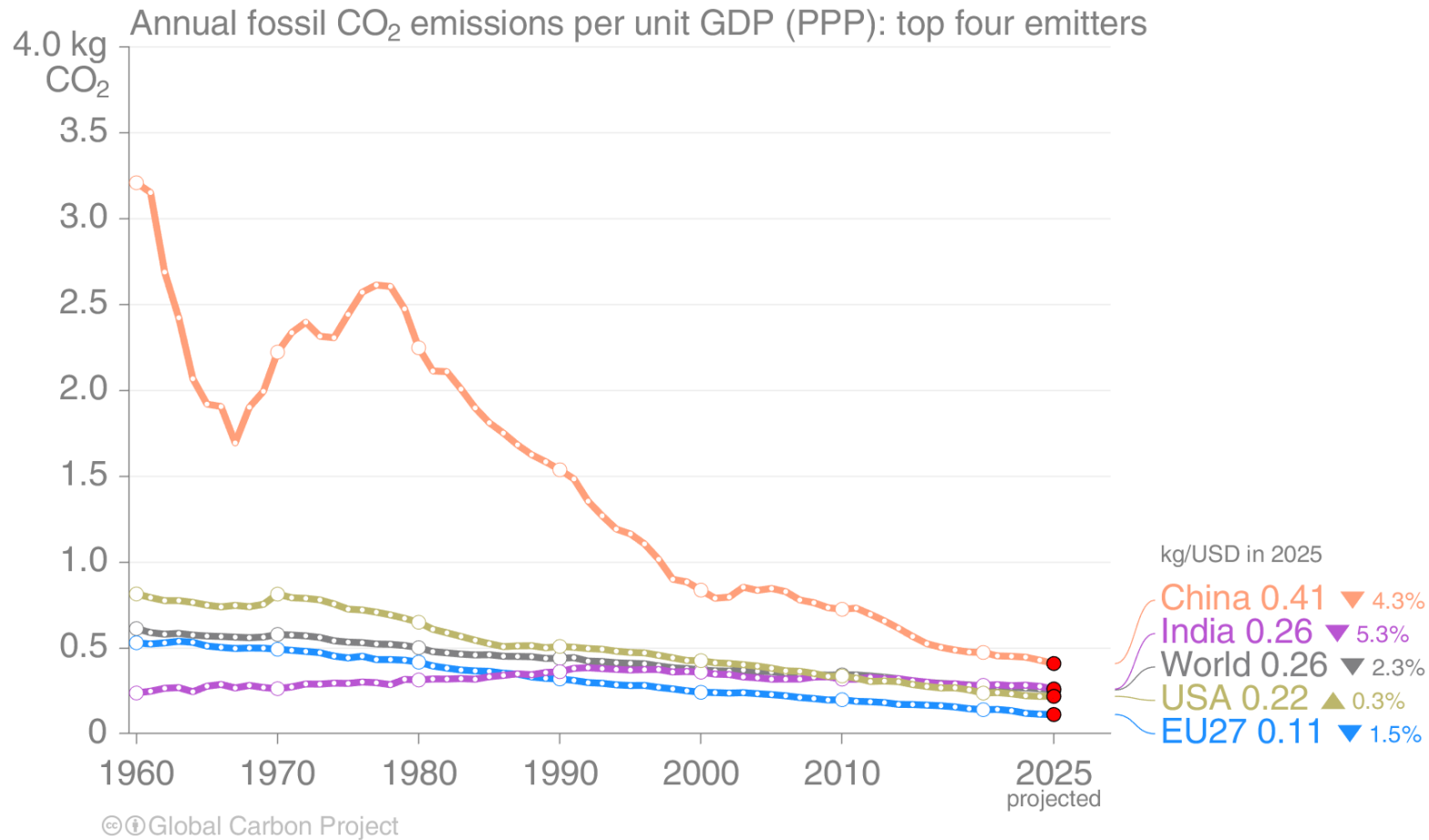
Per capita CO₂ emissions



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Top emitters: Fossil CO₂ Emission Intensity

Emission intensity (emission per unit economic output) generally declines over time. In many countries, these declines are insufficient to overcome economic growth.

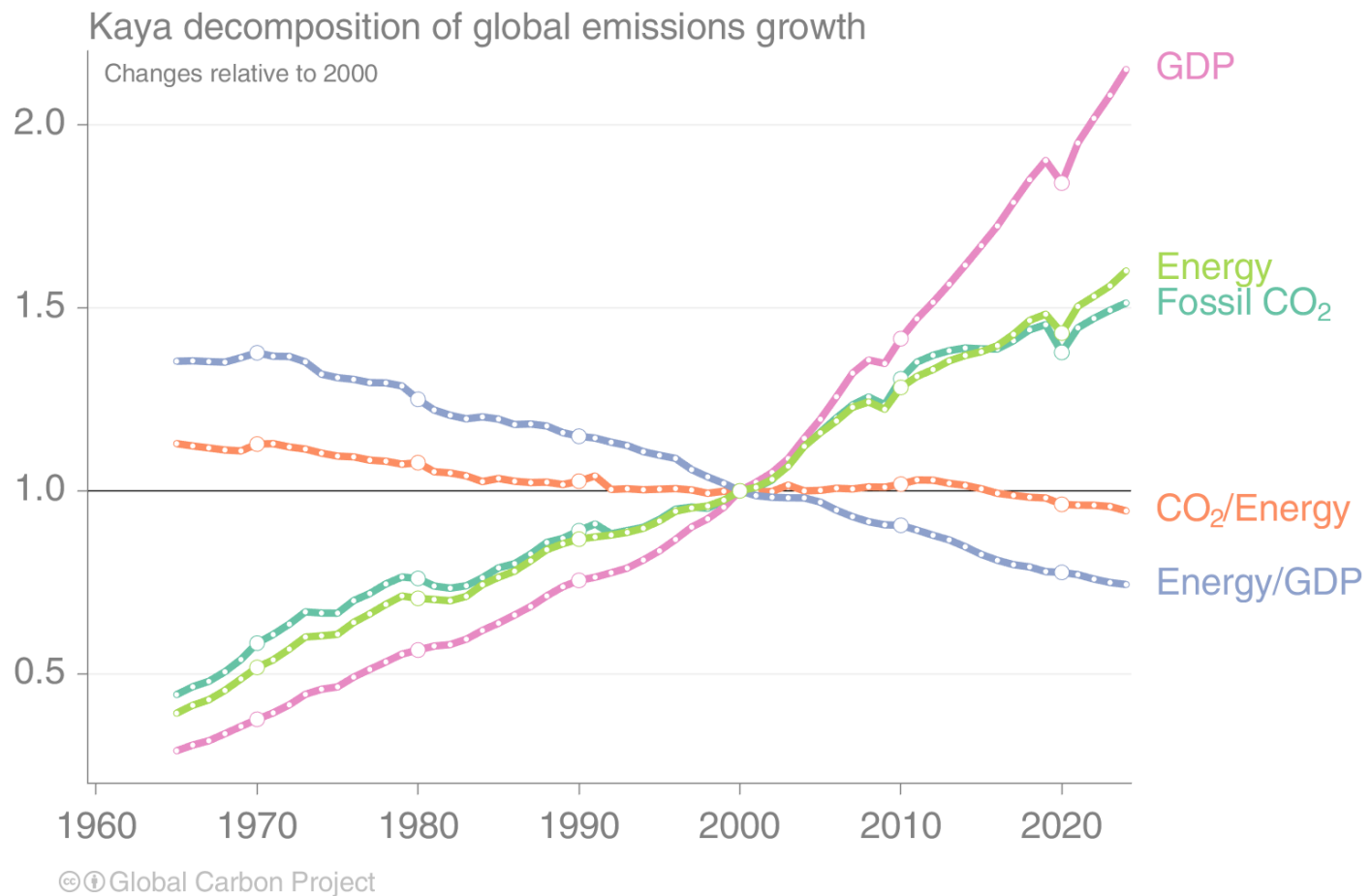


GDP is measured in purchasing power parity (PPP) terms in 2017 US dollars.

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Kaya decomposition

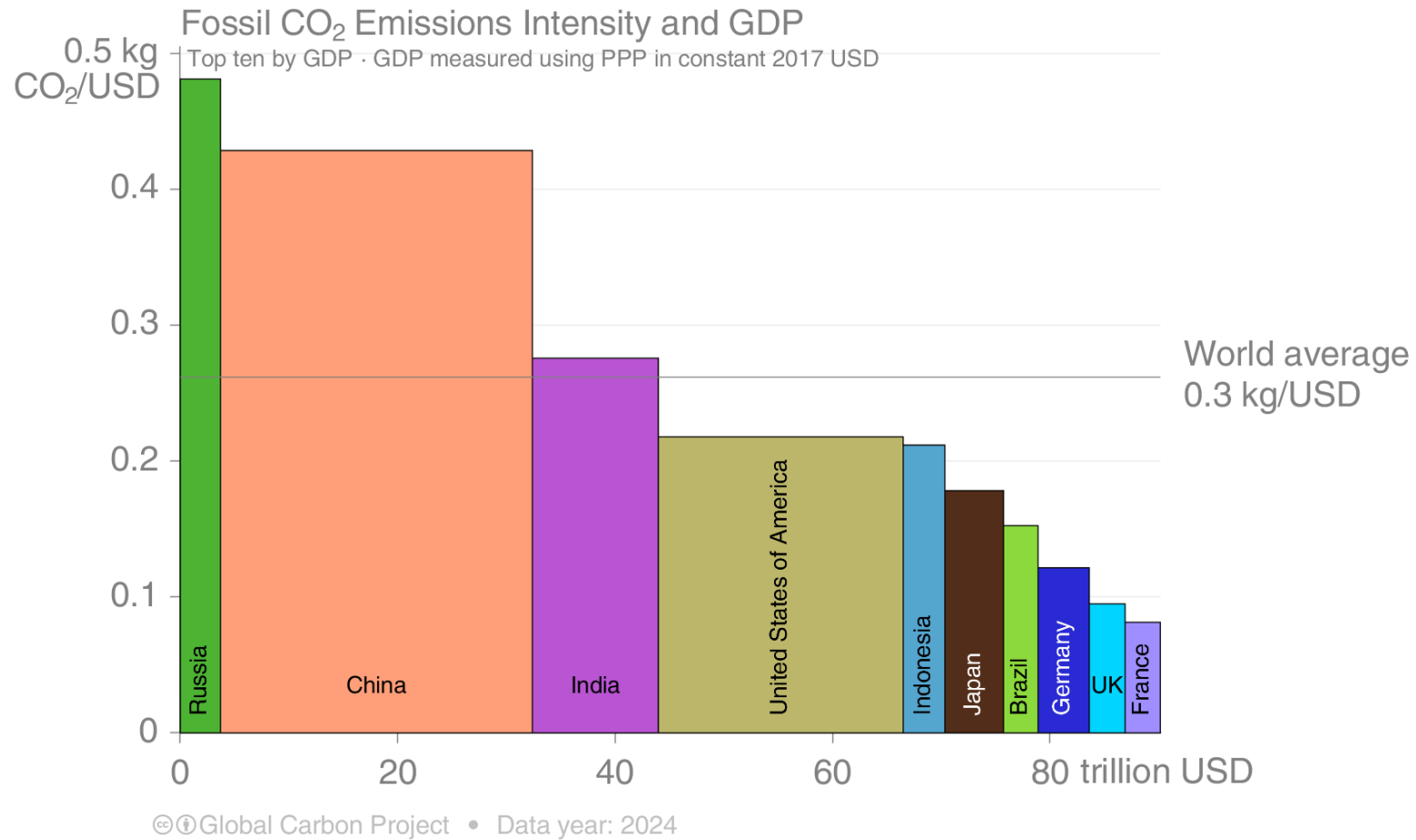
The Kaya decomposition illustrates that relative decoupling of economic growth from CO₂ emissions is driven by improved energy intensity (Energy/GDP) and, recently, carbon intensity of energy (CO₂/Energy)



GDP: Gross Domestic Product (economic activity)
Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Fossil CO₂ emission intensity

The 10 largest economies have a wide range of emission intensity of economic activity

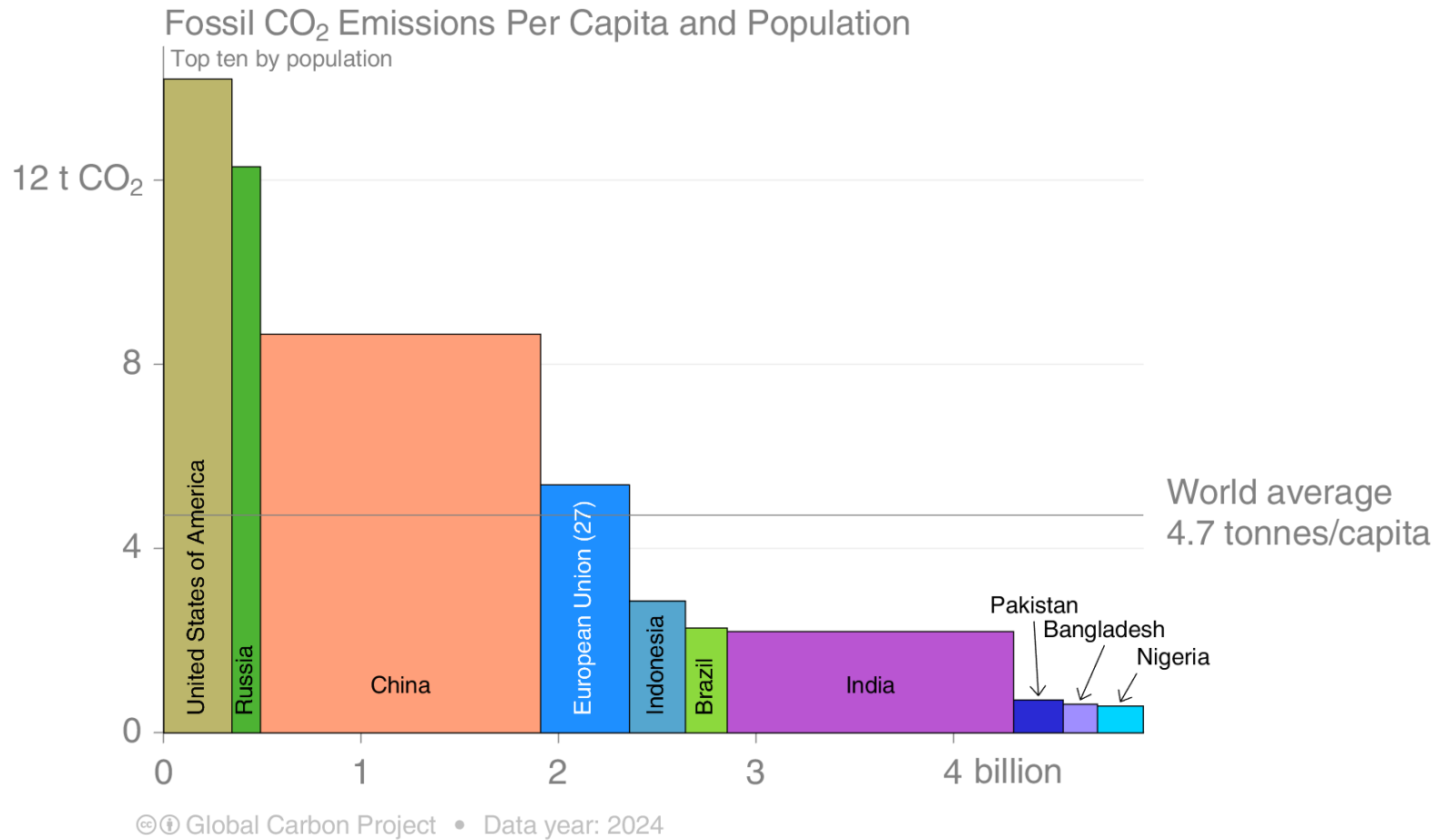


Emission intensity: Fossil CO₂ emissions divided by Gross Domestic Product (GDP)

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Fossil CO₂ Emissions per capita

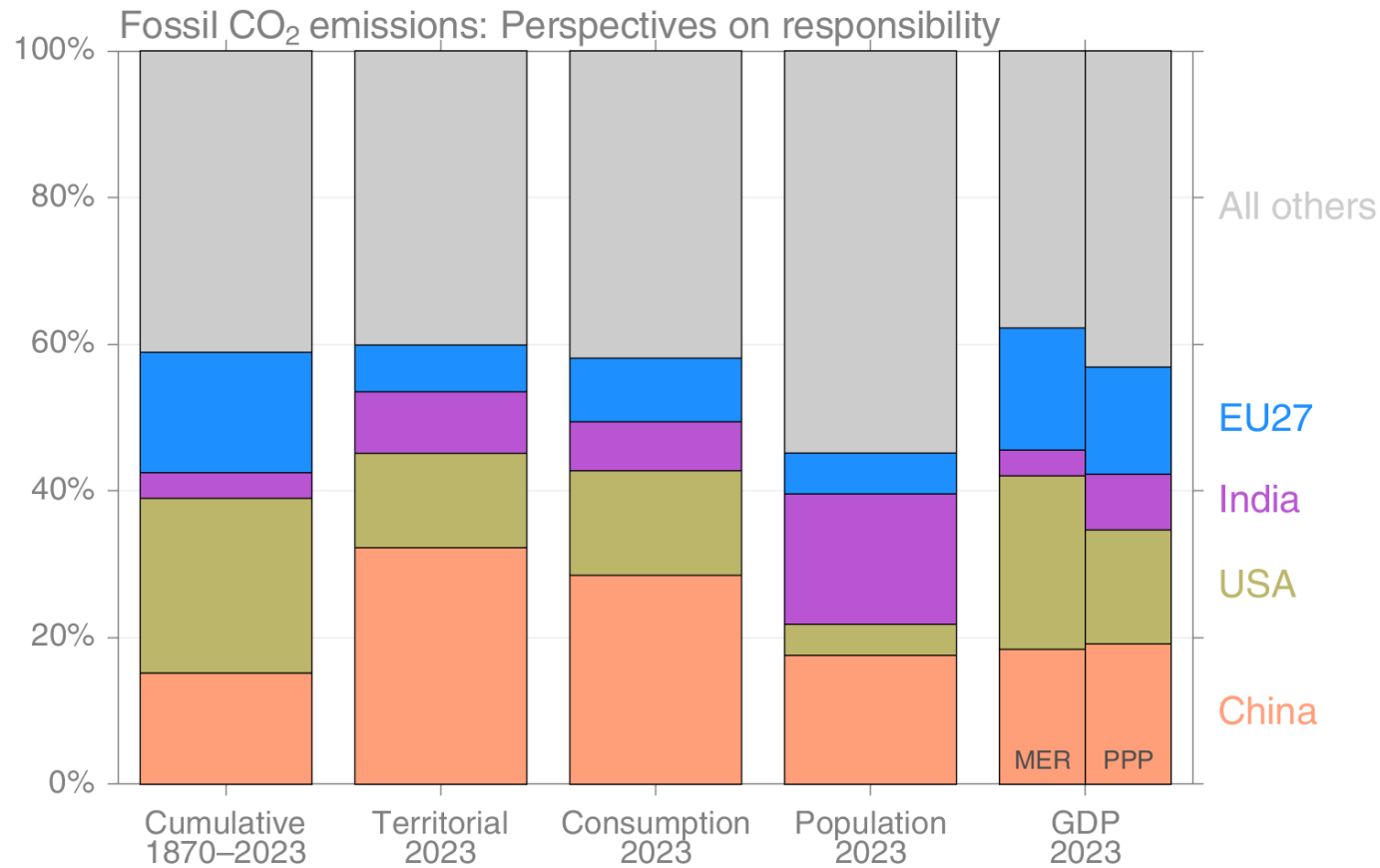
The 10 most populous countries span a wide range of development and emissions per capita



Emission per capita: Fossil CO₂ emissions divided by population
Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Alternative rankings of countries

The responsibility of individual countries depends on perspective.
 Bars indicate fossil CO₂ emissions, population, and GDP.

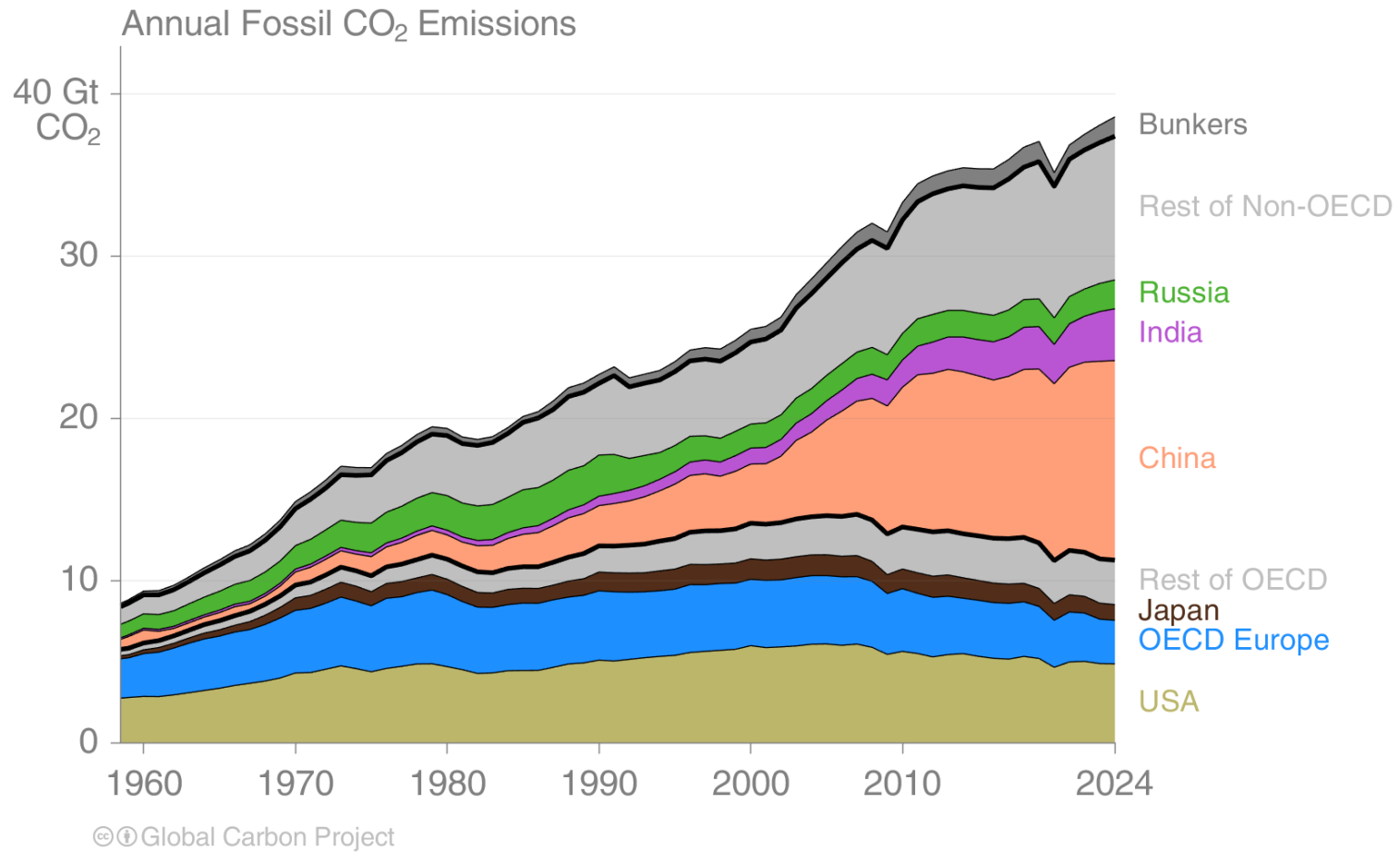


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GDP: Gross Domestic Product in Market Exchange Rates (MER) and Purchasing Power Parity (PPP)

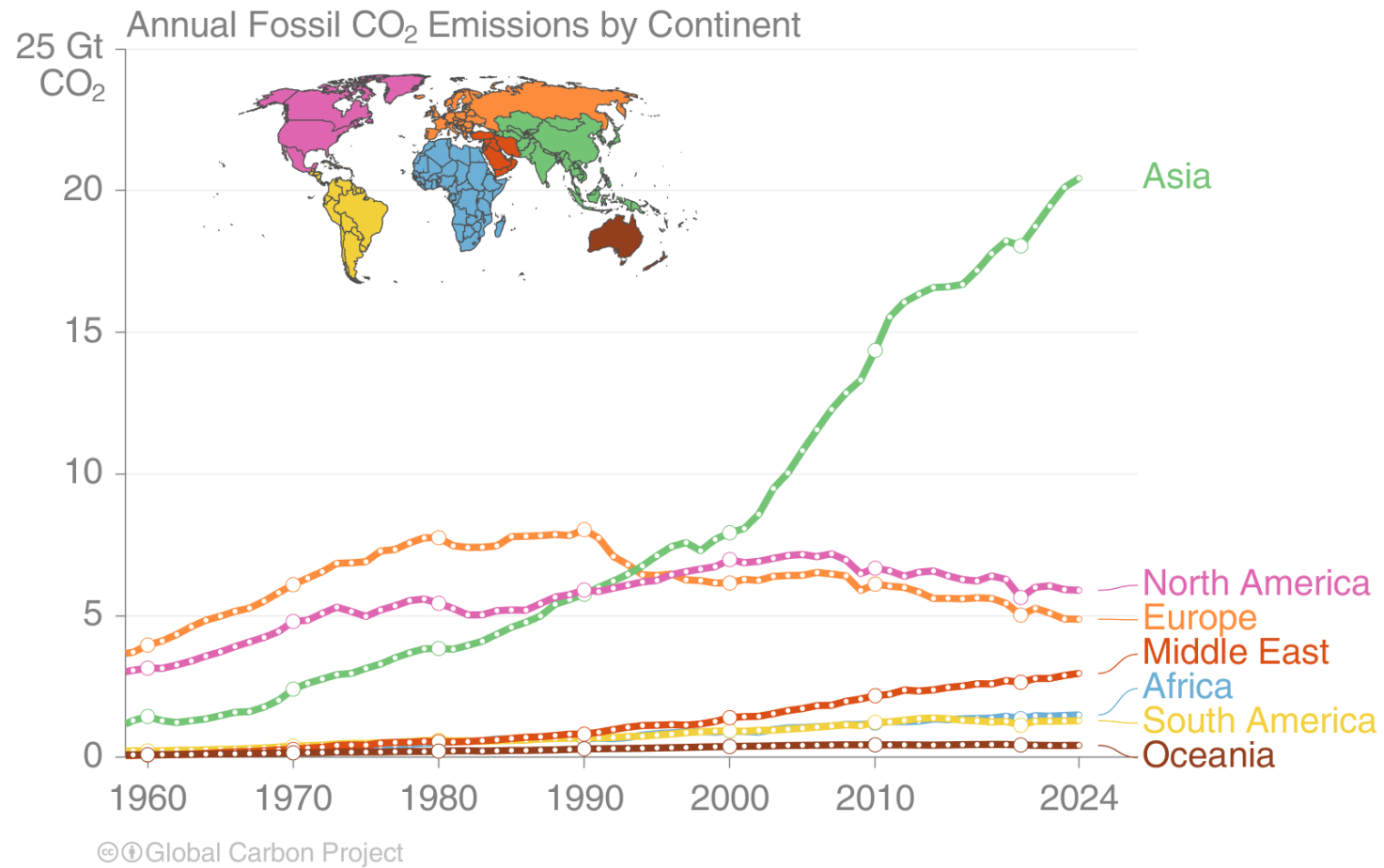
Source: [United Nations](#); [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Breakdown of global fossil CO₂ emissions by country



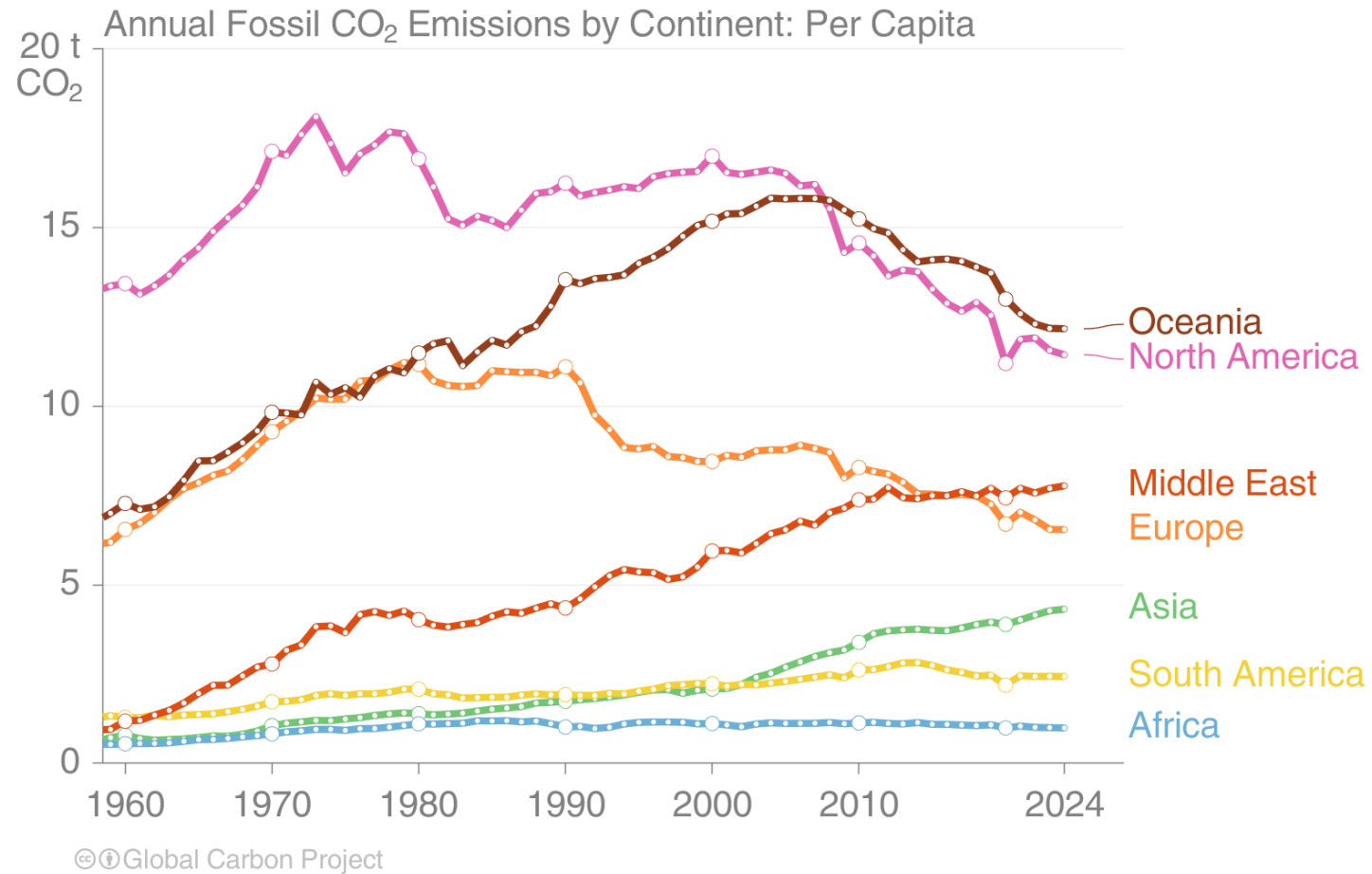
Fossil CO₂ emissions by continent

Asia dominates global fossil CO₂ emissions, while emissions in North America are of similar size to those in Europe, and the Middle East is growing rapidly.



Fossil CO₂ emissions by continent: per capita

Oceania and North America have the highest per capita emissions, while the Middle East has recently overtaken Europe. Africa has by far the lowest emissions per capita.



Additional Figures

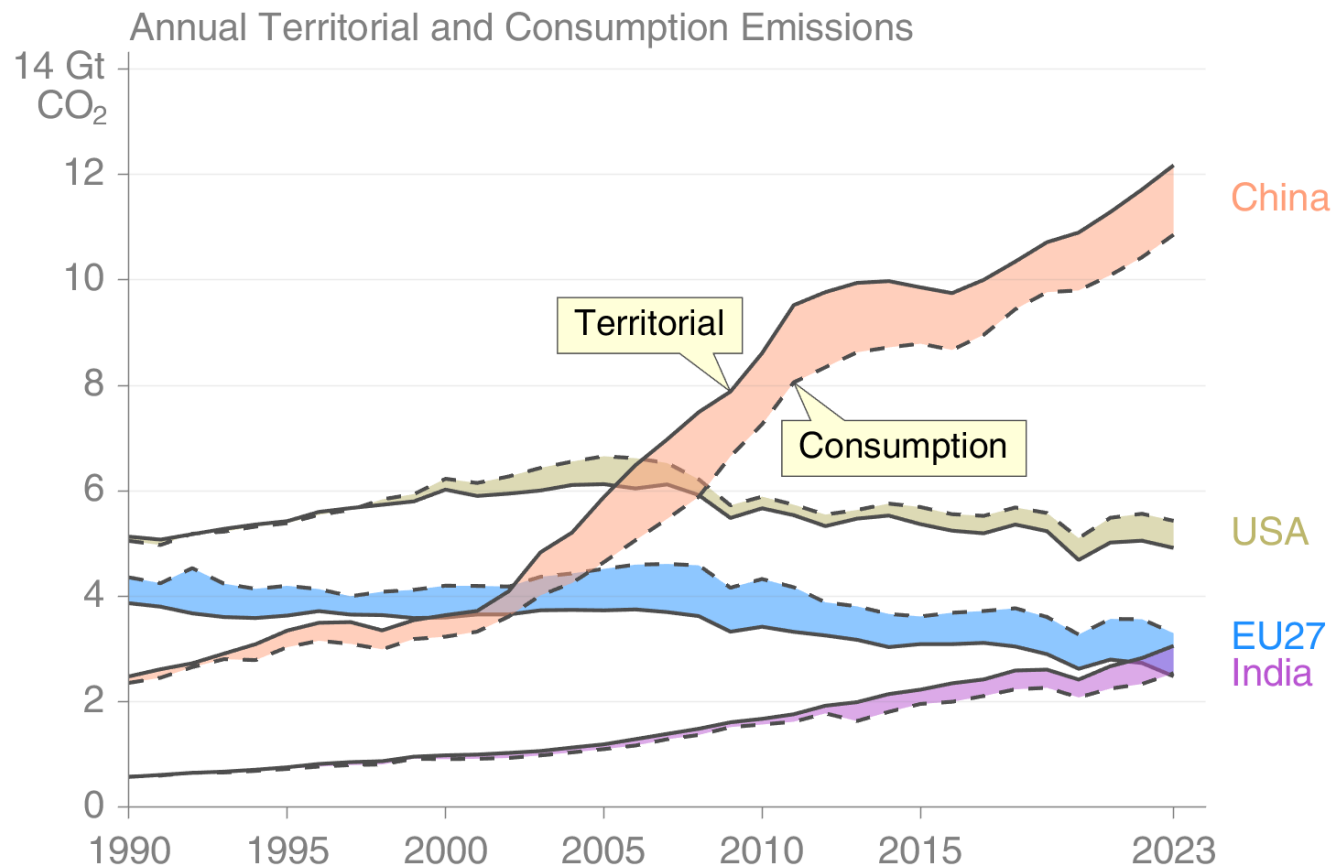
Consumption-based Emissions

Consumption-based emissions allocate emissions to the location that goods and services are consumed

Consumption-based emissions = Production/Territorial-based emissions minus emissions embodied in exports plus the emissions embodied in imports

Consumption-based emissions (carbon footprint)

Allocating fossil CO₂ emissions to consumption provides an alternative perspective. USA and EU are net importers of embodied emissions, China and India are net exporters.



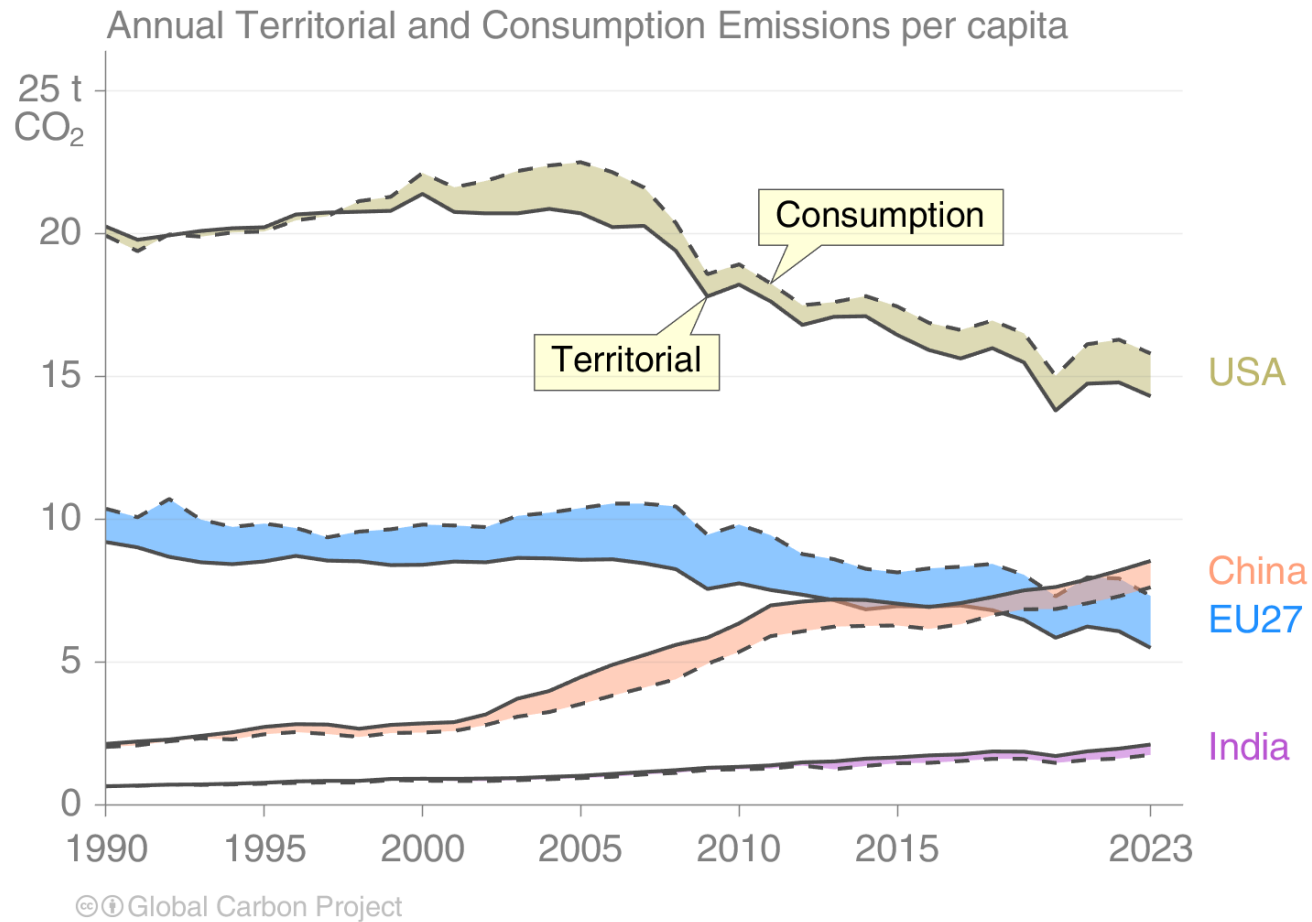
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Consumption-based emissions are calculated by adjusting the standard emissions estimates to account for international trade

Source: [Peters et al 2011](#); [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Consumption-based emissions per person

The differences between fossil CO₂ emissions per capita is larger than the differences between consumption and territorial emissions.

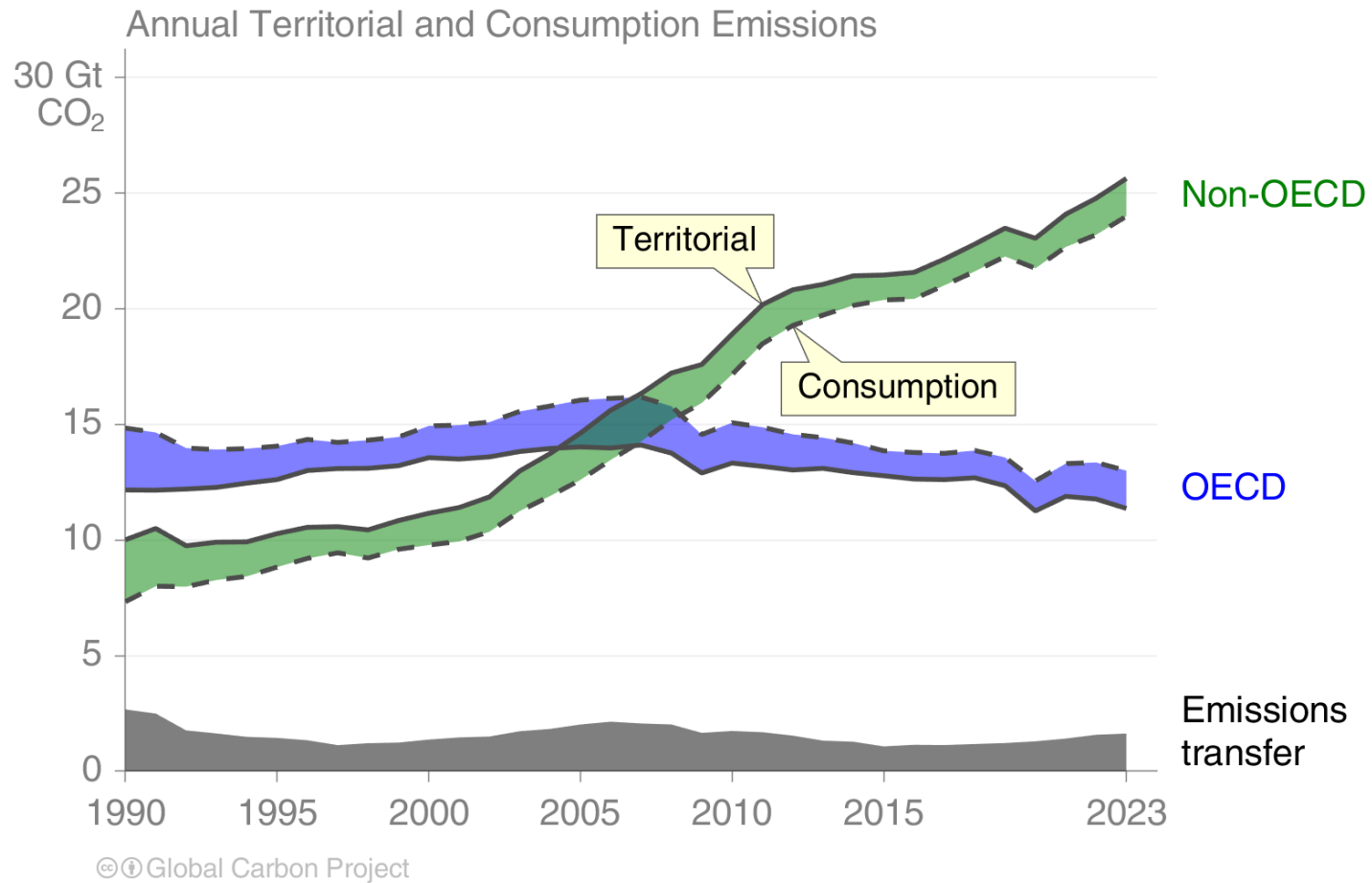


Consumption-based emissions are calculated by adjusting the standard emissions estimates to account for international trade

Source: [Peters et al 2011](#); [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Consumption-based emissions (carbon footprint)

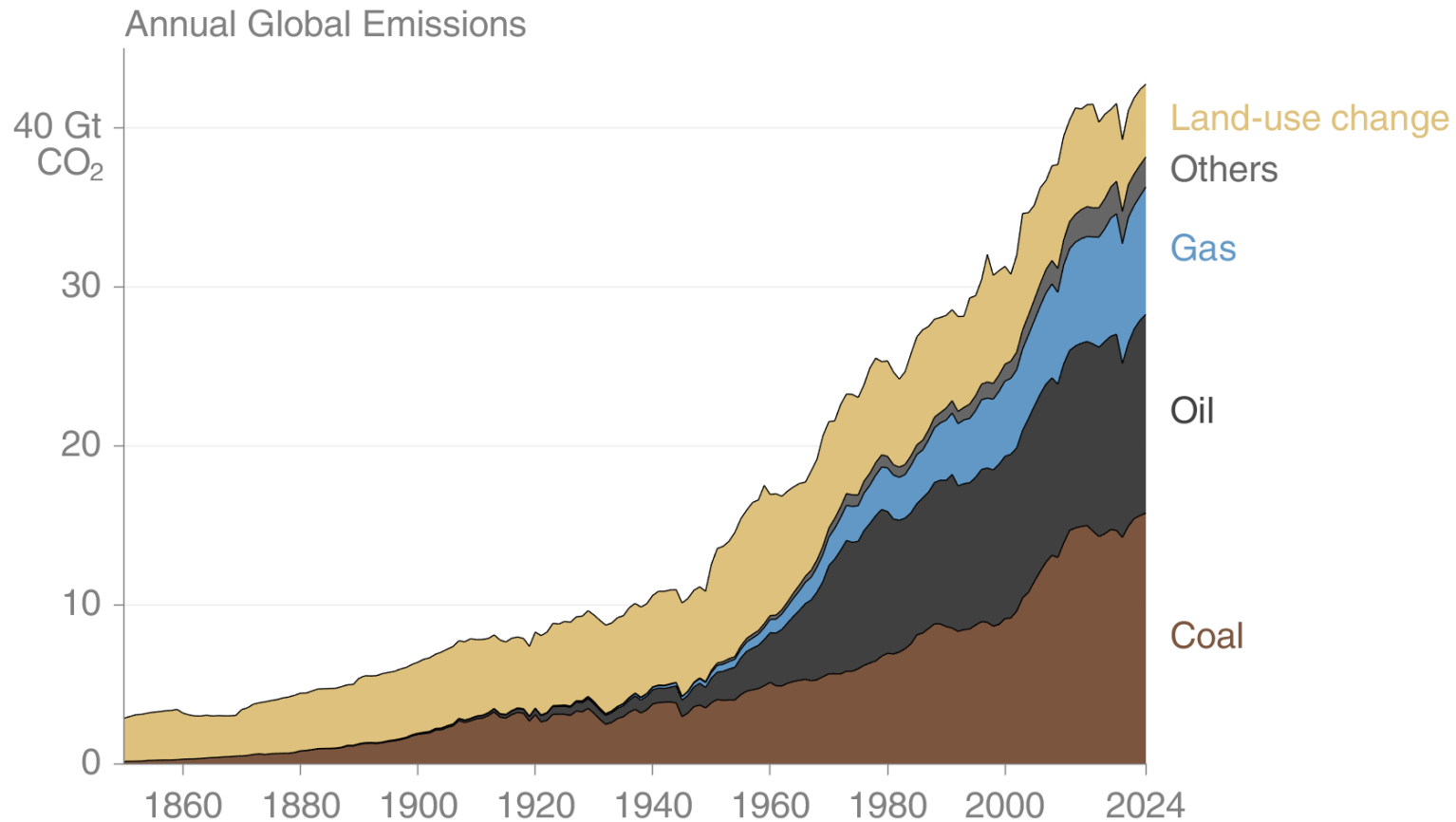
Transfers of emissions embodied in trade between OECD and non-OECD countries grew slowly during the 2000's, declined to 2015 and have been relatively flat since then.



Additional Figures Historical Emissions

Total global emissions by source

Land-use change was the dominant source of annual CO₂ emissions until around 1950. Fossil CO₂ emissions now dominate global changes.

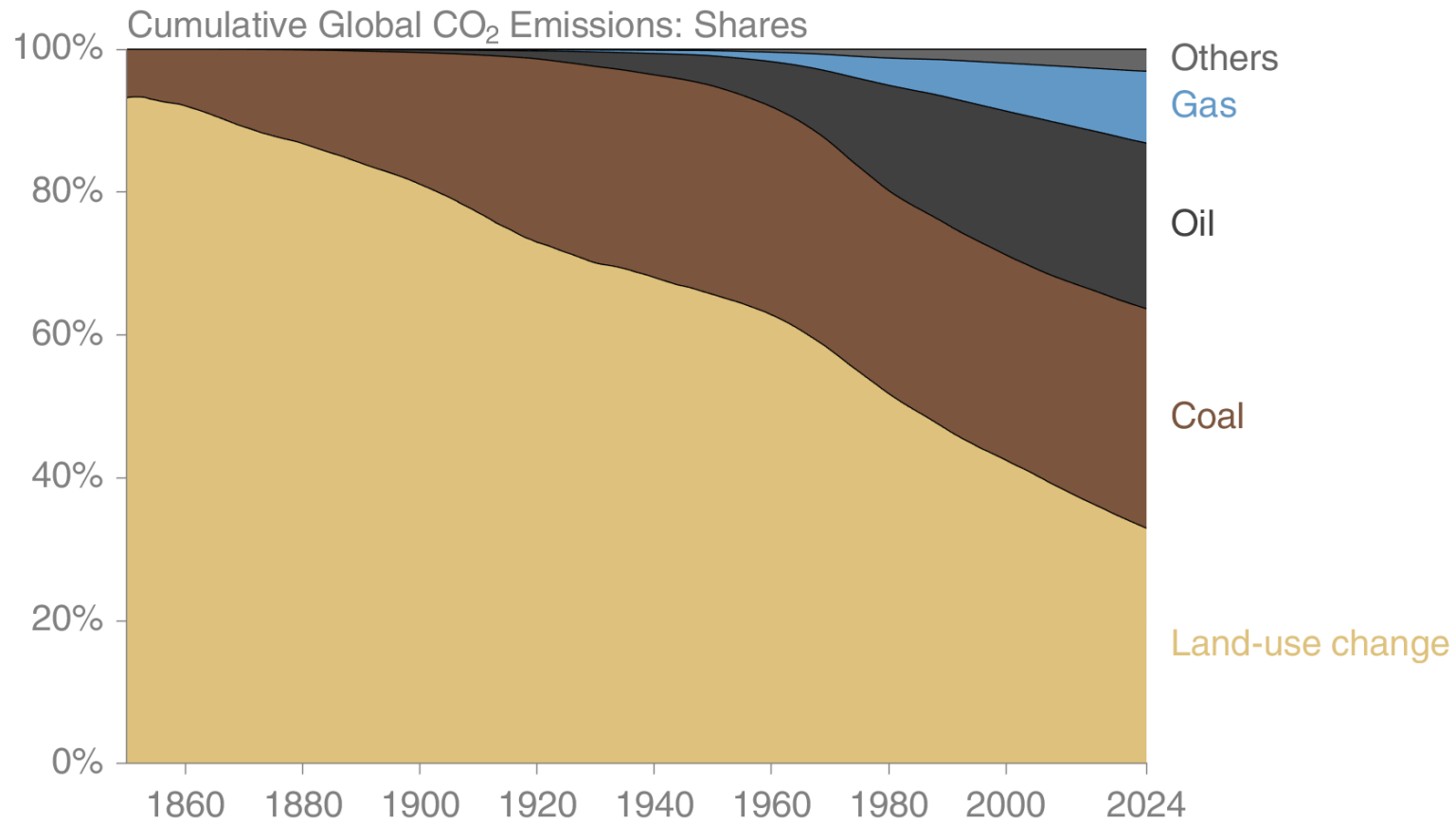


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Others: Emissions from cement production, gas flaring and carbonate decomposition

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Historical cumulative emissions by source

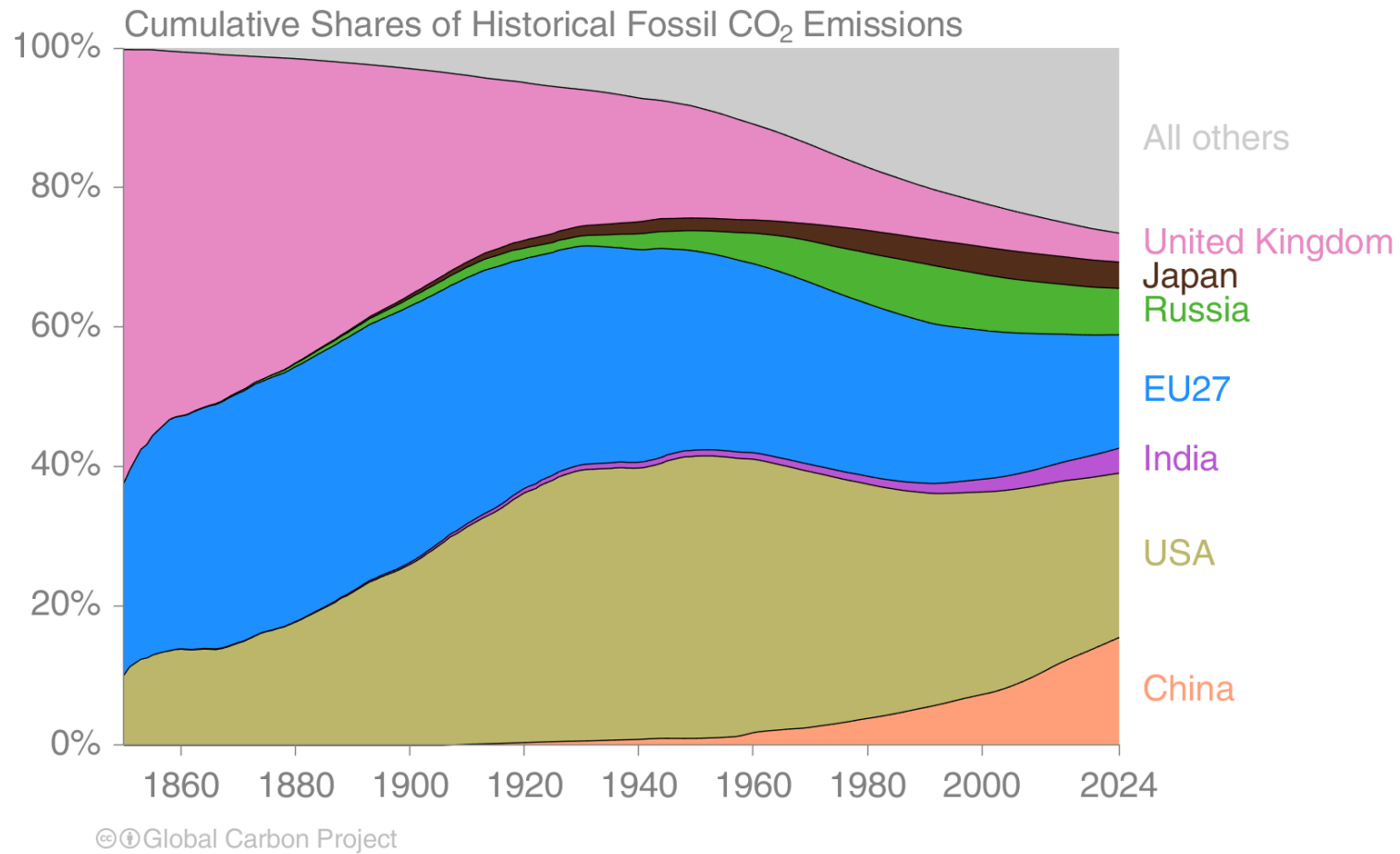


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Others: Emissions from cement production, gas flaring and carbonate decomposition

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Historical cumulative fossil CO₂ emissions by country

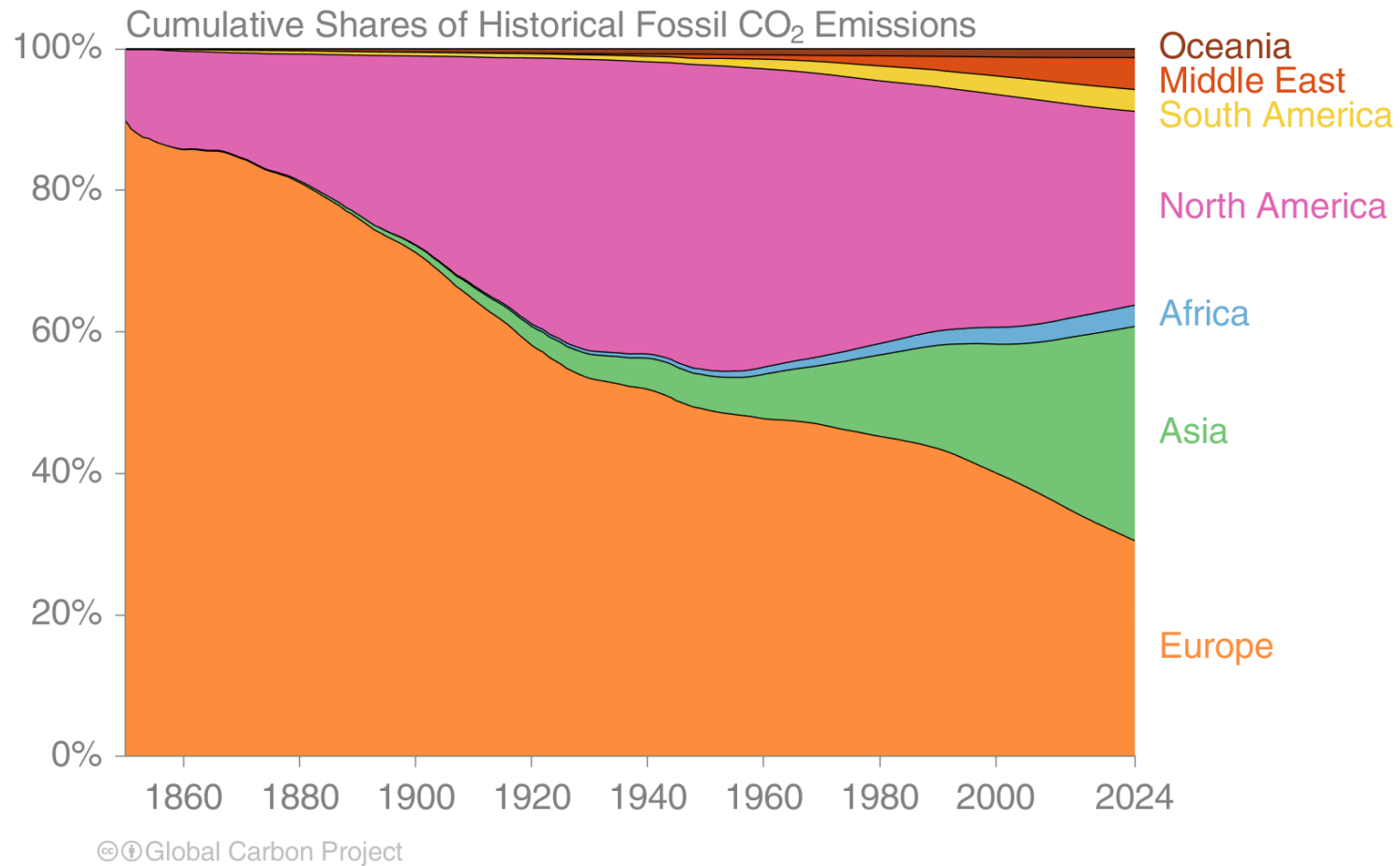


'All others' includes all other countries along with emissions from international aviation and maritime shipping

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)

Historical cumulative emissions by continent

Cumulative fossil CO₂ emissions (1850–2024). North America and Europe have contributed the most cumulative emissions, but Asia is growing fast



The figure excludes emissions from international aviation and maritime shipping

Source: [Friedlingstein et al 2025](#); [Global Carbon Project 2025](#)