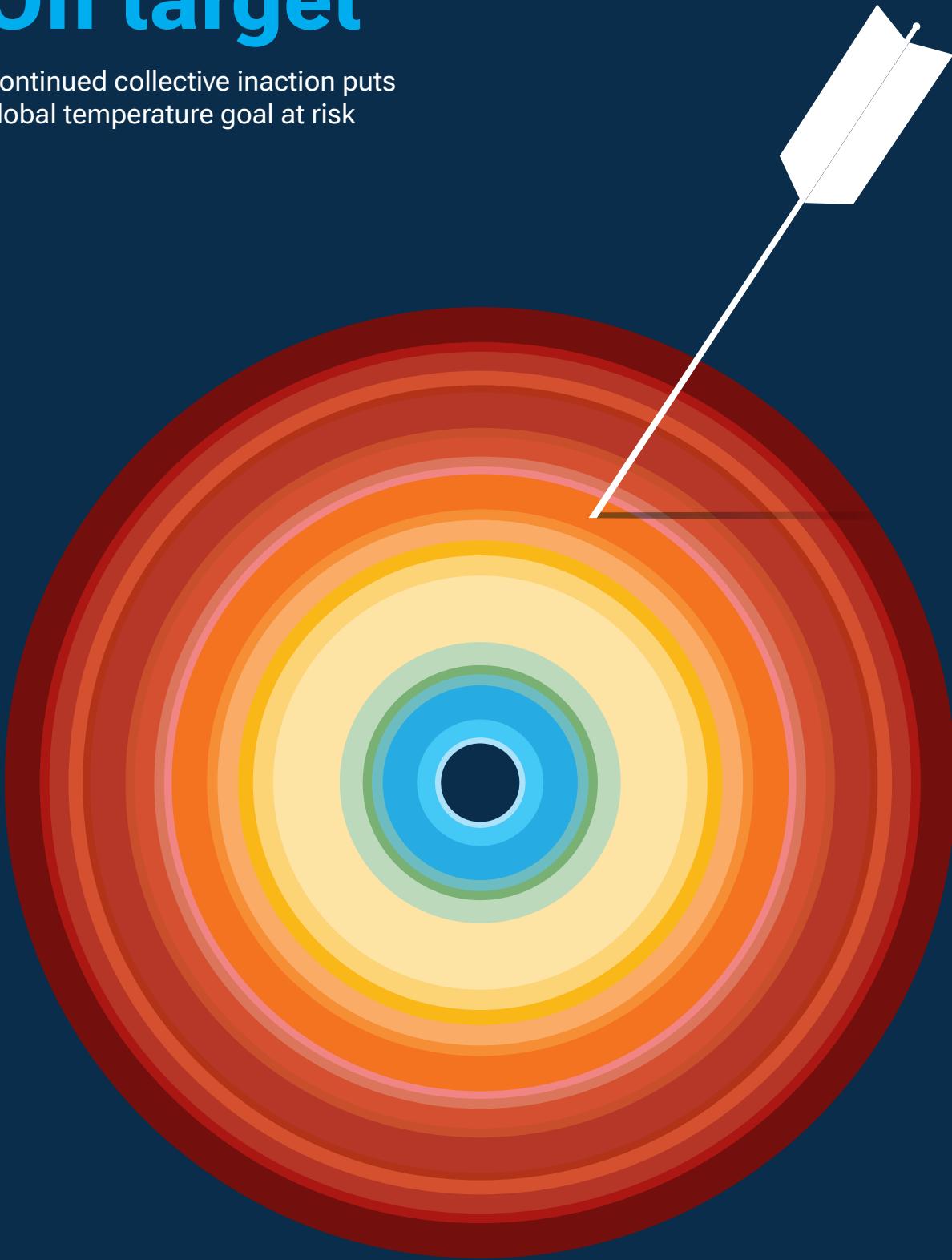


Off target

Continued collective inaction puts
global temperature goal at risk



ISBN: 978-92-807-4239-8
Job number: CLI/2721/NA
DOI: <https://doi.org/10.59117/20.500.11822/48854>

This publication may be reproduced in whole or in part and in any form for educational or non-profit services without special permission from the copyright holder, provided acknowledgement of the source is made. The United Nations Environment Programme would appreciate receiving a copy of any publication that uses this publication as a source.

No use of this publication may be made for resale or any other commercial purpose whatsoever without prior permission in writing from the United Nations Environment Programme. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to unep-communication-director@un.org.

Disclaimers

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries.

Mention of firm names and commercial products in this document does not imply endorsement by the United Nations Environment Programme or the authors. The use of information from this document for publicity or advertising is not permitted. Trademark names and symbols are used in an editorial fashion with no intention of infringement of trademark or copyright laws.

The views expressed in this publication are those of the authors and do not necessarily reflect the views of the United Nations Environment Programme. We regret any errors or omissions that may have been unwittingly made.

© Maps, photos and illustrations as specified

Suggested citation

United Nations Environment Programme (2025). *Emissions Gap Report 2025: Off target – Continued collective inaction puts global temperature goal at risk* [Olhoff, A., chief editor; Lamb, W.; Kuramochi, T.; Rogelj, J.; den Elzen, M.; Christensen, J.; Fransen, T.; Pathak, M.; Tong, D. (eds)]. Nairobi. <https://doi.org/10.59117/20.500.11822/48854>.

Production: Nairobi
URL: <https://www.unep.org/resources/emissions-gap-report-2025>
Cover credit: Beverly McDonald

Co-produced with:



Supported by:



Government of the Netherlands



INTERNATIONAL
CLIMATE
INITIATIVE



Off target

Continued collective inaction puts
global temperature goal at risk

Emissions Gap Report 2025

Acknowledgements

The United Nations Environment Programme (UNEP) extends its gratitude to the members of the steering committee, the chief scientific editor, the lead and contributing authors, the reviewers, and the secretariat for their contributions to the preparation of this report. Authors and reviewers have contributed to the report in their individual capacities. Their affiliations are only mentioned for identification purposes.

Contributing authors: Monica Crippa (European Commission, Joint Research Centre [JRC], Italy), Diego Guizzardi (European Commission, JRC, Italy), Giacomo Grassi (European Commission, JRC, Italy), Renata Libonati (Universidade Federal do Rio de Janeiro, Brazil), Glen P. Peters (CICERO Center for International Climate Research, Norway), Julia Pongratz (Ludwig-Maximilians University Munich, Germany; Max Planck Institute for Meteorology, Germany)

Steering committee

Ruta Bubniene (Secretariat of the United Nations Framework Convention on Climate Change [UNFCCC]), John Christensen (CONCITO – Denmark's green think tank), Navroz K. Dubash (Princeton University), Simon Evans (Carbon Brief)(steering committee observer), Niklas Höhne (NewClimate Institute), Martin Krause (UNEP), Osvaldo Luiz Leal de Moraes (Ministry of Science, Technology and Innovation, Brazil), Maria Netto (Instituto Clima e Sociedade), Shonali Pachauri (International Institute for Applied Systems Analysis [IIASA]), Katia Simeonova (independent researcher), Oksana Tarasova (World Meteorological Organization [WMO])

Chapter 3

Lead authors: Takeshi Kuramochi (NewClimate Institute, Germany), Taryn Fransen (World Resources Institute, United States of America), Michel den Elzen (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands)

Contributing authors: Caroline Alberti (Climate Policy Initiative, United Kingdom), Dan Tong (Tsinghua University, China), Clea Schumer (World Resources Institute, United States of America)

Data contributors: Sarah Heck (Climate Analytics, Germany); Alister Self (Climate Resource, Australia); Florian Fosse and Kimon Keramidas (European Commission, JRC, Spain); Frederic Hans, Pablo Blasco Ladrero, Ana Missirliu and Jan-Luka Scheewel (NewClimate Institute, Germany); Ioannis Dafnomilis, Elena Hooijsscher (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands); Malte Meinshausen (University of Melbourne, Australia); Helen Tatlow (University of Oxford, United Kingdom); Natalia Alayza, Mengpin Ge and Christopher Henderson (World Resources Institute, United States of America)

Chapter 4

Lead authors: Joeri Rogelj (Imperial College London, United Kingdom; IIASA, Austria), Michel den Elzen (PBL Netherlands Environmental Assessment Agency, the Netherlands), Dan Tong (Tsinghua University)

Contributing authors: Matt Gidden (Center for Global Sustainability, University of Maryland, United States of America), Lena Höglund Isaksson (IIASA, Austria/Sweden), Robin Lamboll (Imperial College London, United Kingdom)

Authors

Chapter 1

Lead authors: Anne Olhoff (UNEP-Copenhagen Climate Centre [UNEP-CCC], Denmark), John Christensen (CONCITO– Denmark's green think tank)

Contributing authors: Jesse Burton (University of Cape Town, South Africa), Michel den Elzen (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands), William F. Lamb (Potsdam Institute for Climate Impact Research, Germany; University of Leeds, United Kingdom), Minal Pathak (Ahmedabad University, India), Joeri Rogelj (Imperial College London, United Kingdom; IIASA, Austria)

Chapter 2

Lead authors: William F. Lamb (Potsdam Institute for Climate Impact Research, Germany; University of Leeds, United Kingdom), Minal Pathak (Ahmedabad University, India)

Data contributors: Sarah Heck (Climate Analytics, Germany); Alister Self (Climate Resource, Australia); Florian Fosse and Kimon Keramidas (European Commission, JRC, Spain); Ana Missirliu (NewClimate Institute, Germany); Ioannis Dafnomilis and Elena Hooijsscher (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands); Malte Meinshausen (University of Melbourne, Australia; Climate Resource, Australia); Taryn Fransen, Mengpin Ge, Christopher Henderson and Ashna Siddhi (World Resources Institute, United States of America)

Reviewers

Simon Black (International Monetary Fund [IMF]), Raymond Brandes (UNEP), Ruta Bubniene (UNFCCC), John Christensen (CONCITO – Denmark's green think tank), Daniel Crow (International Energy Agency), Paul Dowling (European Commission, JRC), Navroz K. Dubash (Princeton University), Simon Evans (Carbon Brief), Pierre Friedlingstein (University of Exeter), Oliver Geden (German Institute for International and Security Affairs), Bernd Hackmann (UNFCCC), Thomas Hale (Oxford University), Ryo Hamaguchi (UNFCCC), Andrea Hinwood (UNEP), Niklas Höhne (NewClimate Institute), Yasuko Kameyama (University of Tokyo), Johan Kieft (UNEP), Şiir Kilkış (Scientific and Technological Research Council of Türkiye), Kenichi Kitamura (UNFCCC), Alban Kitous (European Commission, Directorate-General for Climate Action [DG CLIMA]), Hannah Kulus (Rhodium Group), Martin Krause (UNEP), Luca Lo Re (International Energy Agency), Bavelyne Mibe (UNEP), Osvaldo Luiz Leal de Moraes (Ministry of Science, Technology and Innovation, Brazil), Maria Netto (Instituto Clima e Sociedade), Shonali Pachauri (IIASA), Ploy Pattanun Achakulwisut (United Nations), Joana Portugal Pereira (Federal University of Rio de Janeiro), Zoltán Rakonczay (European Commission, Directorate-General for Research and Innovation [DG RTD]), Alexandra Rudiak (European Commission, DG CLIMA), Carl Schleussner (IIASA), Johannes Schuler (European Commission, DG CLIMA), Yuli Shan (University of Birmingham), Sushant Shrestha (UNEP), Katia Simeonova (independent researcher), Kentaro Tamura (Institute for Global Environmental Strategies), Oksana Tarasova (WMO), Davor Vesligaj (UNFCCC), Matthias Weitzel (European Commission, JRC), Zhao Xiusheng (Tsinghua University)

Scientific editors

Anne Olhoff (Chief Scientific Editor, UNEP-CCC), Simon Evans (Carbon Brief), Mark Radka (independent consultant), John Christensen (CONCITO – Denmark's green think tank)

Secretariat, production and coordination

Anne Olhoff (UNEP-CCC), Nicolien de Lange (UNEP), Maarten Kappelle (UNEP), Mirey Atallah (UNEP), Thaddeus Idi Kiplimo (UNEP), Almasi Musa (UNEP)

Media and launch support

UNEP Communication Division and UNEP-CCC communication team

Design and layout

Weeks.de Werbeagentur GmbH (figures), Strategic Agenda (design and layout) and Beverley McDonald (UNEP) (cover design)

Translation of the executive summary and language editing

Strategic Agenda

Thanks also to:

Bernd Hackmann (UNFCCC), Niklas Hagelberg (UNEP), Andrea Hinwood (UNEP), Mohamed Walid Jomni (UNEP-CCC), Alejandro Regatero Labadia (UNEP-CCC), Thomas Laursen (UNEP-CCC), Pia Riis Kofoed-Hansen (UNEP-CCC), Jarl Krausing (CONCITO – Denmark's green think tank), Christian Ibsen (CONCITO – Denmark's green think tank), Paz Lopez- Rey (UNEP), Ploy Pattanun Achakulwisut (United Nations), Pinya Sarasas (UNEP), Anastasia Vergiris (UNEP), Ying Wang (UNEP), and staff in the Early Warning and Assessment Division and Climate Change Division of UNEP.

The 2025 edition of the Emissions Gap Report is supported by the Environment Fund, UNEP's core financial fund. UNEP would like to thank the Danish Ministry of Foreign Affairs, German Federal Foreign Office, and the Dutch Ministry of Economic Affairs and Climate Policy for their support in producing the Emissions Gap Report 2025.

Glossary

This glossary is compiled drawing on glossaries and other resources available on the websites of the following organizations, networks and projects: the Intergovernmental Panel on Climate Change, United Nations Environment Programme and United Nations Framework Convention on Climate Change (UNFCCC).

Anthropogenic emissions: Emissions derived from human activities.

Baseline/reference: The state against which change is measured. In the context of climate change transformation pathways, the term “baseline scenarios” refers to scenarios based on the assumption that no mitigation policies or measures will be implemented beyond those already in force and/or legislated or planned to be adopted. Baseline scenarios are not intended to be predictions of the future, but rather counterfactual constructions that can serve to highlight the level of emissions that would occur without further policy efforts. Typically, baseline scenarios are compared to mitigation scenarios that are constructed to meet different goals for greenhouse gas (GHG) emissions, atmospheric concentrations or temperature change. The term “baseline scenario” is used interchangeably with “reference scenario” and “no-policy scenario”.

Carbon dioxide emission budget (or carbon budget): For a given temperature rise limit, for example a 1.5°C or 2°C long-term limit, the corresponding carbon budget reflects the total amount of carbon emissions that can be emitted for temperatures to stay below that limit. Stated differently, a carbon budget is an area under a carbon dioxide (CO₂) emission trajectory that satisfies assumptions about limits on cumulative emissions estimated to avoid a certain level of global mean surface temperature rise.

Carbon dioxide equivalent (CO₂e): A way to place emissions of various radiative forcing agents on a common footing by accounting for their effect on the climate. It describes, for a given mixture and amount of GHGs, the amount of CO₂ that would have the same global warming ability, when measured over a specified time period. For the purpose of this report, unless otherwise specified, GHG emissions are the sum of the basket of GHGs listed in Annex A to the Kyoto Protocol, expressed as carbon dioxide equivalent (CO₂e), assuming a 100-year global warming potential.

Carbon dioxide removal (CDR): Refers to anthropogenic activities removing CO₂ from the atmosphere and durably storing it in geological, terrestrial or ocean reservoirs, or in products. It includes existing and potential anthropogenic enhancement of biological or geochemical sinks and direct air capture and storage, but excludes natural CO₂ uptake not directly caused by human activities.

Conditional nationally determined contribution: A nationally determined contribution (see below) proposed by some countries that is contingent on a range of possible conditions, such as the ability of national legislatures to enact the necessary laws, ambitious action from other countries, realization of finance and technical support, and other factors.

Conference of the Parties to the United Nations Framework Convention on Climate Change (COP): The supreme body of the UNFCCC. It currently meets once a year to review the UNFCCC’s progress.

Emissions pathway: The trajectory of annual GHG emissions over time.

Global stocktake: The global stocktake was established under article 14 of the Paris Agreement. It is a process for Member States and stakeholders to assess whether they are collectively making progress towards meeting the goals of the Paris Climate Change Agreement. The global stocktake assesses everything related to where the world stands on climate action and support, identifying the gaps, and working together to agree on solutions pathways, to 2030 and beyond. The first global stocktake was completed during COP 28 in 2023, with the second scheduled for COP 33 in 2028.

Global warming potential (GWP): An index representing the combined effect of the differing times GHGs remain in the atmosphere, and their relative effectiveness in absorbing outgoing infrared radiation.

Greenhouse gases (GHGs): The atmospheric gases responsible for causing global warming and climatic change. The major GHGs are CO₂, methane (CH₄) and nitrous oxide (N₂O). Less prevalent but very powerful GHGs include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆).

Integrated assessment models: Models that seek to combine knowledge from multiple disciplines in the form of equations and/or algorithms, in order to explore complex environmental problems. As such, they describe the full chain of climate change, from the production of GHGs to atmospheric responses. This necessarily includes relevant links and feedback between socioeconomic and biophysical processes.

Land use, land-use change and forestry (LULUCF): A GHG inventory sector that covers emissions and removals of GHGs resulting from direct human-induced LULUCF activities.

Least-cost pathway: Least-cost pathway scenarios identify the least expensive combination of mitigation options to fulfil a specific climate target. A least-cost scenario is based on the premise that, if an overarching climate objective is set, society wants to achieve this at the lowest possible cost over time. It also assumes that global actions start at the base year of model simulations (usually close to the current year), and are implemented following a cost-optimal (cost-efficient) sharing of the mitigation burden between current and future generations, depending on the social discount rate.

Likely chance: A likelihood greater than 66 per cent chance. Used in this assessment to convey the probabilities of meeting temperature limits.

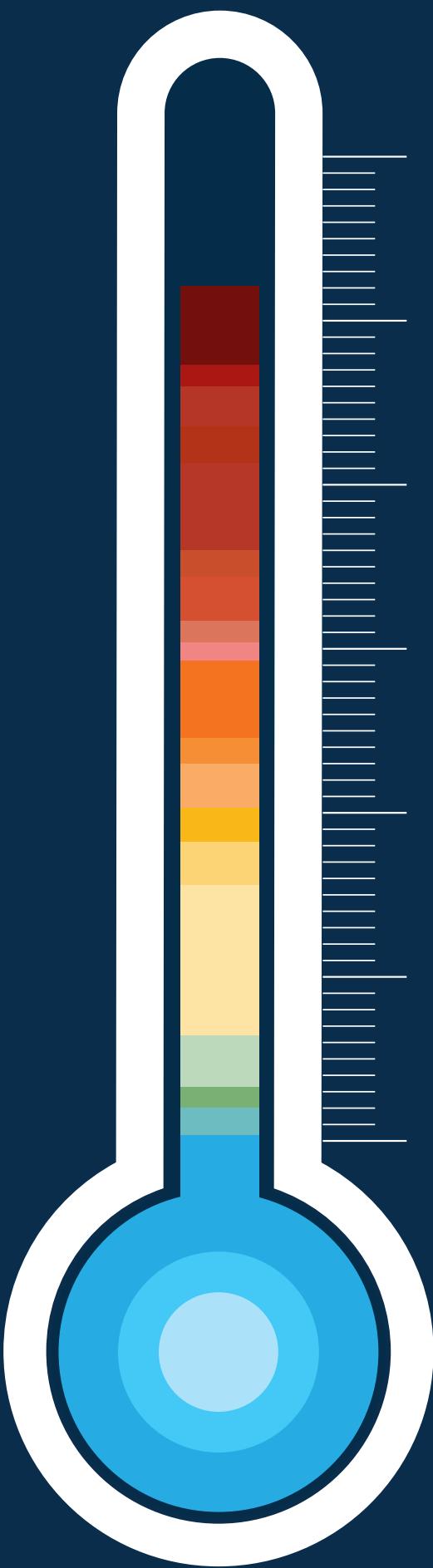
Mitigation: In the context of climate change, mitigation relates to a human intervention to reduce the sources or enhance the sinks of GHGs. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other “sinks” to remove greater amounts of CO₂ from the atmosphere.

Mitigation potential: Mitigation potentials are the quantity of GHG emission reductions or removals that can be achieved by a given mitigation option in a specific period relative to specified emission baselines.

Nationally determined contribution (NDC): Submissions by countries that have ratified the Paris Agreement which present their national efforts to reach the Paris Agreement’s long-term temperature goal of limiting warming to well below 2°C. New or updated NDCs are to be submitted in 2020 and every five years thereafter. NDCs thus represent a country’s current ambition or target for reducing emissions nationally.

Scenario: A description of how the future may unfold, based on “if-then” propositions. Scenarios typically include an initial socioeconomic situation and a description of the key driving forces and future changes in emissions, temperatures or other climate change-related variables.

Source: Any process, activity or mechanism that releases a GHG, an aerosol or a precursor of a GHG or aerosol into the atmosphere.



Contents

Acknowledgements	iv
Glossary	vi
Foreword	xi
Executive summary	xii
Chapter 1 Introduction – A year of new nationally determined contributions and the ten-year anniversary of the Paris Agreement	2
1.1 The focus of this year's report	2
1.2 Significant progress during the first ten years of the Paris Agreement – but still far from the level and speed needed	2
Chapter 2 Global emissions trends	4
2.1 Introduction	4
2.2 Global greenhouse gas emissions continued to increase in 2024	5
2.3 Emissions continued to increase across major sectors	8
2.4 Emissions increased for all but one of the largest GHG emitters	9
Chapter 3 Nationally determined contributions and long-term pledges: The global landscape and G20 member progress	14
3.1 Introduction	14
3.2 Global overview of new nationally determined contributions	15
3.3 G20 emissions pathways towards 2035: A deep dive	17
Chapter 4 The emissions gap in 2030 and 2035	30
4.1 Introduction	30
4.2 Scenarios for assessing the 2030 and 2035 emissions gap	30
4.3 The emissions gaps in 2030, 2035 and 2050 remain large	34
4.4 Temperature implications of the emissions gap stress the urgency of immediate action	37
4.5 Delayed action has implications for 1.5°C pathways	39
References	44



Foreword

This year, a decade on from the adoption of the Paris Agreement, nations were due to submit new climate pledges ahead of COP 30 in Belém, Brazil – pledges that many hoped would demonstrate a step change in ambition and action to lower greenhouse gas emissions and avoid an intensification of the climate crisis that is hammering people and economies. This ambition and action did not materialize.

UNEP's *Emissions Gap Report 2025: Off target* finds that only about a third of parties to the Paris Agreement submitted new nationally determined contributions (NDCs) by 30 September 2025. Yes, global warming projections over this century, based on full implementation of all NDCs, are now 2.3–2.5°C, compared to 2.6–2.8°C in last year's report. However, methodological updates account for 0.1°C of the improvement, and the upcoming withdrawal of the United States of America from the Paris Agreement will cancel another 0.1°C of the progress, which means the new pledges have barely moved the needle. Meanwhile, nations are not even on track to meet their 2030 targets; based on policies currently in place, the world is heading for up to 2.8°C of warming.

The bottom line is that nations have had three attempts to hit the mark with their Paris Agreement pledges, and each time they have landed off target. We still need unprecedented cuts to greenhouse gas emissions, in an ever-compressing timeframe, amid a challenging geopolitical context. As a result, the multi-decadal average of global temperature will now exceed 1.5°C, very likely within the next decade. The task, and it is a big one, is to strive to make this overshoot temporary and minimal.

The report looks at what it would take to limit overshoot to about 0.3°C, with a 66 per cent chance, and return to 1.5°C by 2100. This scenario would require cutting 2030 emissions by 26 per cent and 2035 emissions by 46 per cent, compared with 2019 levels. Every fraction of a degree avoided is crucial, for three reasons. One, to reduce an escalation of the climate impacts that are harming all nations, while hitting the poorest and most vulnerable the hardest. Two, to limit the risks of climate tipping points, such as West Antarctic Ice Sheet collapse, and other impacts that could not be reversed even in a cooler world. Three, to reduce reliance on uncertain, risky and costly carbon dioxide removal methods – which would need to remove and store about five years of current global annual CO₂ emissions for every 0.1°C drop in temperatures.



Progress since the adoption of the Paris Agreement, including rapid growth in cheap renewable energy and tackling short-lived climate pollutants like methane, means that the international community has the opportunity to deliver the necessary cuts to emissions. I call on nations, particularly G20 members, to recalibrate their sights, aim true, and remember the rewards for setting and hitting stronger climate targets: faster economic growth, better human health, more jobs, energy security and the fulfillment of many other development needs. Climate action is not philanthropy – it is national self-interest.

Inger Andersen
Executive Director
United Nations Environment Programme

Executive summary

Ten years of the Paris Agreement has spurred climate action, but ambition and implementation still fall short of what is needed

The Paris Agreement has been pivotal in lowering projected global greenhouse gas (GHG) emissions, helping to drive the accelerated adoption of renewable energy technologies, policies and targets while catalysing net-zero emission pledges from state and non-state actors. Global warming projections based on current policies have declined from just below 4°C at the time of adoption of the Paris Agreement, to just below 3°C today. Similarly, temperature projections based on the conditional and unconditional nationally determined contributions (NDCs) have fallen from 3–3.5°C to 2.3–2.5°C in this year’s report. Although direct comparisons of the warming projections are challenged by changes in the methodological approach over the past 10 years, there has been a significant lowering of projected warming. The proportion of global emissions covered by net-zero emission pledges by around the middle of the century has increased from zero in 2015 to about 70 per cent today. At the same time, climate governance frameworks, policies and legislation have advanced substantially, while low-carbon technology costs have plummeted. These developments position the international community far more favourably to accelerate climate ambition and action than a decade ago – and such acceleration is critically urgent.

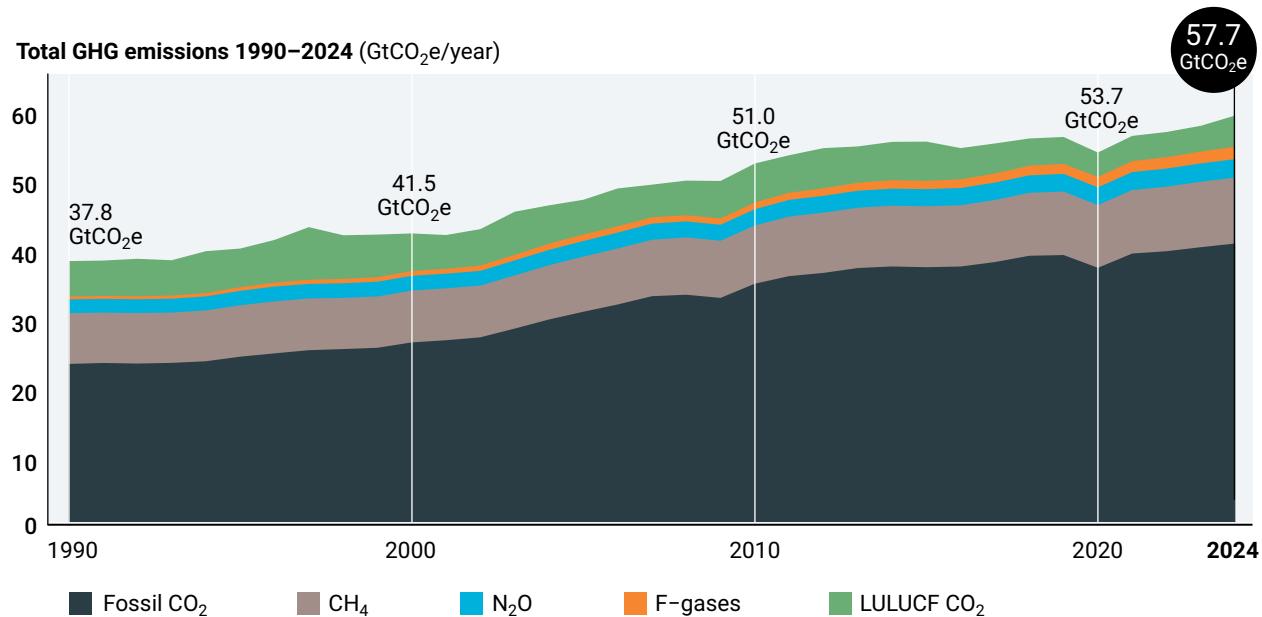
As this sixteenth Emissions Gap Report shows, the new NDCs have limited effect on narrowing the emissions gap by 2030 and 2035, leaving global warming projections well above the Paris Agreement’s temperature goal. New scenarios show that limiting warming to 1.5°C by 2100 remains technically possible. However, due to the continued delay in deep emission cuts, 1.5°C pathways now imply higher temporary exceedance of this temperature target. The magnitude and duration of this overshoot must be limited as much as possible. Each year of delayed action

locks in carbon-intensive infrastructure. It results in greater losses for people and ecosystems, higher adaptation costs and a heavier reliance on costly and uncertain carbon dioxide (CO₂) removal. Each year of inaction makes the path to net zero by 2050 and net-negative emissions thereafter steeper, more expensive and more disruptive.

On the tenth anniversary of the Paris Agreement, the message is clear: only decisive, accelerated GHG emission reductions can align the world with the goals of the Paris Agreement and limit the escalation of climate risks and damages that, already today, are severe, and hit the poorest and most vulnerable the hardest.

1. Another year of broken records – global GHG emissions reached 57.7 GtCO₂e in 2024, a 2.3 per cent increase from 2023 levels

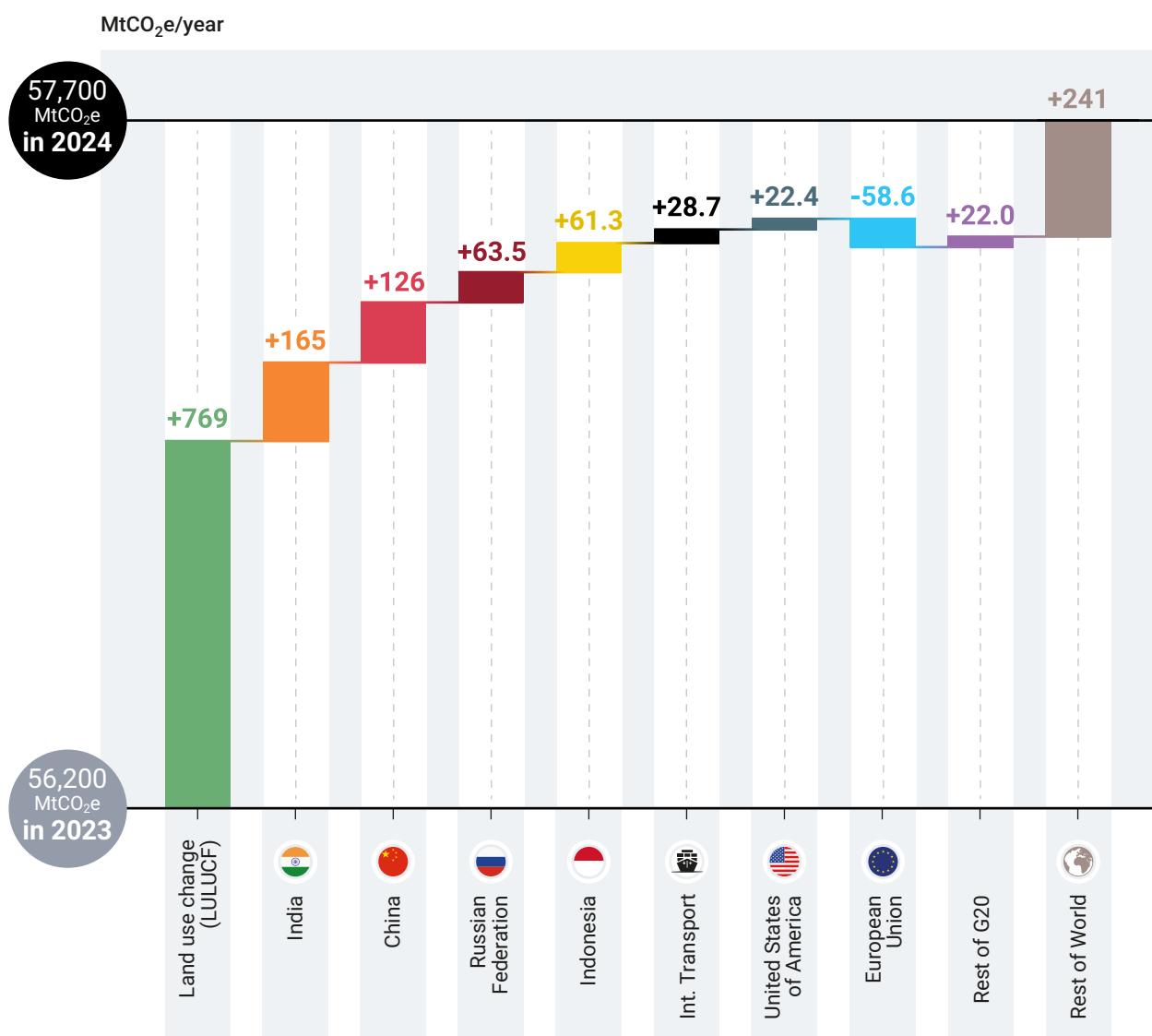
- ▶ The 2.3 per cent increase in total GHG emissions from 2023 levels is high compared with the 2022–2023 increase of 1.6 per cent. It is more than four times higher than the annual average growth rate in the 2010s (0.6 per cent per year), and comparable to the emissions growth in the 2000s (on average 2.2 per cent per year).
- ▶ The increase is occurring in all major sectors, and all categories of GHGs (figure ES.1). However, despite the key role of fossil fuels in driving total emissions, deforestation and land-use change was decisive for the rapid increase in 2024 emissions (figure ES.2). Global net land use, land-use change and forestry (LULUCF) CO₂ emissions increased by 21 per cent in 2024, and were responsible for 53 per cent of the overall increase in global GHG emissions. There are significant uncertainties in estimates of net LULUCF CO₂ emissions, and the large increase in 2024 was likely exacerbated by climatic conditions. Fossil CO₂ increased by 1.1 per cent and was responsible for 36 per cent of the increase in global GHG emissions.

Figure ES.1 Total net anthropogenic GHG emissions, 1990–2024

Note: The time series data sets used for the Emissions Gap Report are updated on an annual basis using the latest available statistical information on activities and emissions factors. These updates imply changes compared to prior reporting in the Emissions Gap Report. Accordingly, global GHG emissions in 2023 were adjusted to 56.2 GtCO₂e from the 57.1 GtCO₂e reported in the 2024 edition of the report.

- ▶ GHG emissions of the G20 members, excluding the African Union, account for 77 per cent of global emissions and increased by 0.7 per cent in 2024. Many countries outside of G20 also showed significant increases in emissions in 2024 (figure ES.2). Of the six largest emitters of GHGs, the European Union was the only one to decrease emissions in 2024. The highest absolute increase in total GHG emissions, excluding LULUCF, was observed in India and China, while Indonesia recorded the fastest relative growth in emissions. It should be noted that current, per capita and historic emissions differ across G20 members and world regions, and should be considered along with contributions to global emissions.
- 2.** Only 60 parties, covering 63 per cent of global GHG emissions, submitted or announced new NDCs containing mitigation targets for 2035 by 30 September 2025
- ▶ Despite the Paris Agreement requirement to submit new NDCs by February 2025, only 64 parties covering 63 per cent of global GHG emissions had submitted or announced new NDCs by the cut-off date for this report of 30 September. Sixty of these contain mitigation targets for 2035. Only 13 parties covering less than 1 per cent of global GHG emissions have updated their 2030 targets as part of their new NDCs. Overall, NDCs have become modestly more robust over time, but at nowhere near the pace needed, and the new NDCs have done little to accelerate progress.

Figure ES.2 Contributions to the increase in GHG emissions in 2024 from 2023 levels of the six largest emitters, the rest of the G20 members, the rest of the world, international transport and LULUCF



- ▶ Countries' NDC targets have become incrementally more robust over the past decade, with enhanced sector and gas coverage and a greater number of countries adopting absolute targets. Most of this progress, however, occurred prior to the new NDCs, which have done little to increase ambition and coverage.
- ▶ The NDCs reflect uneven progress towards the sectoral efforts identified in the outcome of the global stocktake. While 73 per cent of the new NDCs include renewable energy targets, it is unclear whether these will be sufficient to achieve the goal of tripling renewable energy by 2030, with market trends currently suggesting a 2.7-times increase. NDCs commitments also fall short of the goal to double the rate of energy efficiency improvements by 2030, the actual rate of improvement has stalled in the last two years, and fewer than half of new NDCs contain such targets.
- ▶ The NDC response to the fossil fuel-related outcomes of the global stocktake remains low. Just 62 per cent of new NDCs set a target to reduce fossil fuel use in the electricity mix, while 29 per cent set a coal phase-down target. To date, no NDCs have set targets to reduce oil and gas production or phase out inefficient fossil fuel subsidies.
- ▶ Investment signals in new NDCs remain limited. While some parties have improved the scope or detail of finance needs, most NDCs still lack clarity on capital requirements, sectoral pathways and implementation plans.

3. The new NDCs and policy updates of the G20 members lower expected GHG emissions in 2035, but reductions are relatively small and surrounded by significant uncertainty

- ▶ Seven G20 members have submitted new NDCs with mitigation targets for 2035 (Australia, Brazil, Canada, Japan, the Russian Federation, the United Kingdom and the United States of America), while three members have announced such targets (China, the European Union and Türkiye). None of the G20 members have strengthened their 2030 targets.
- ▶ All the new NDC mitigation targets of the G20 members imply progress in terms of reducing emissions in 2035 beyond the NDC mitigation targets for 2030. If fully implemented, they are estimated to bring GHG emissions in 2035 to 3.6 gigatons of CO₂ equivalent (GtCO₂e) (range: 3.3–3.6 GtCO₂e) below the 2030 emission level. For the G20 members collectively, this estimate increases to around 4 GtCO₂e (figure ES.3). These estimates include the NDC of the United States of America, which will only remain active until the United States of America leaves the Paris Agreement in January 2026. As shown in figure ES.3, the withdrawal of the United States of America NDC will have significant implications for the estimates.
- ▶ To assess whether the new G20 NDCs represent increased mitigation ambition beyond what would result from policies already in place, 2035 emissions under the new G20 NDCs are compared with those expected under current policies. In aggregate, the new NDC targets for 2035 by G20 members are estimated to result in 2035 emissions that are about 2.8 GtCO₂e/year (range: 1.8–5.9) lower than current policy projections. The new NDC targets of Brazil and the United States of America make up the largest contribution to the estimated total, while the new NDC targets of several G20 members are close to or even less ambitious than expected emissions based on policies currently in place (figure ES.4).

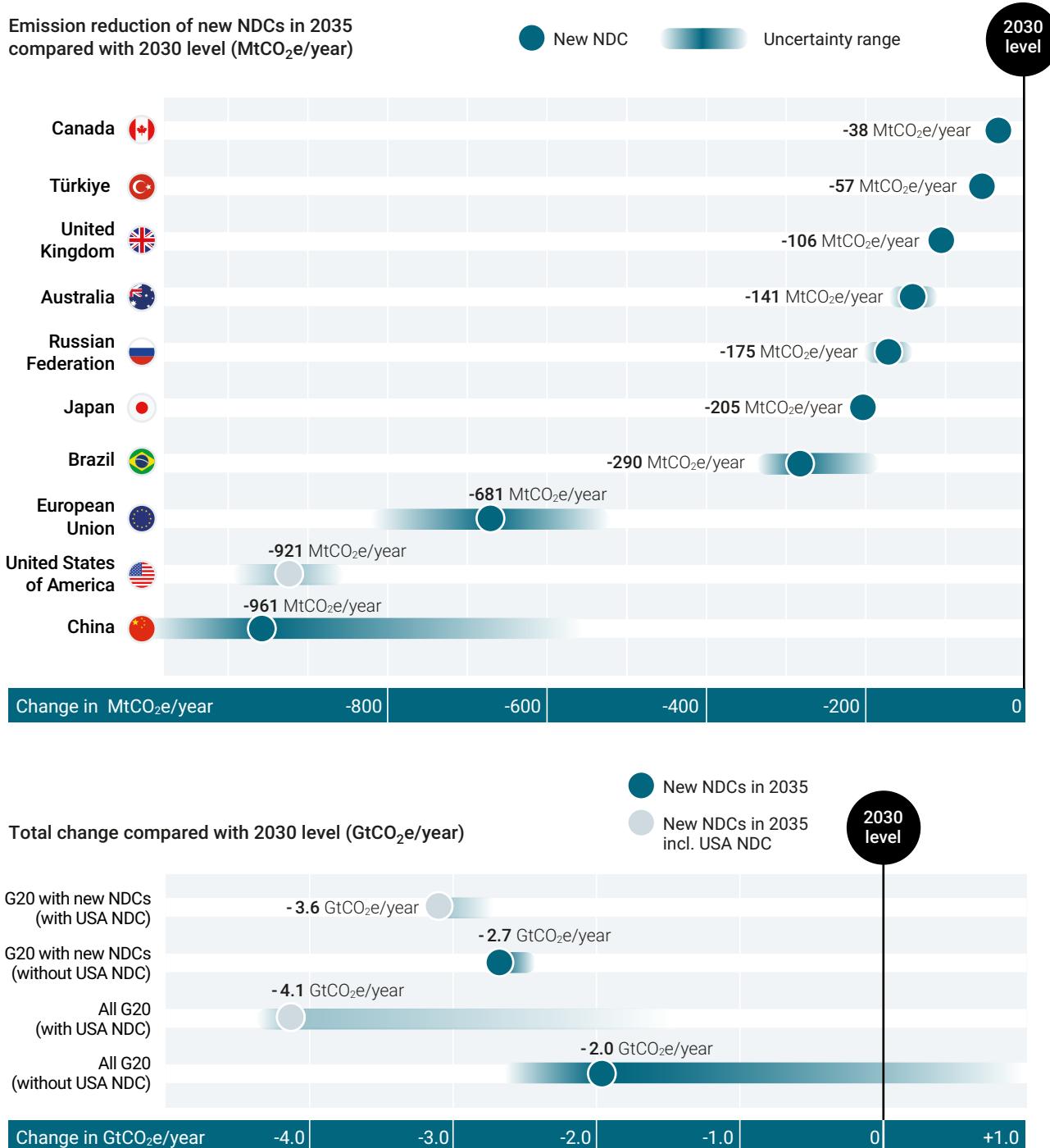
▶ Current policy updates do not noticeably change expected emissions in 2030 by the G20 as a group. However, there are significant changes for individual G20 members, particularly for China and the United States of America. Updated current policy projections for China indicate a peaking of emissions around 2025, followed by a reduction of 0.3–1.4 GtCO₂e by 2030. Previously, projections pointed to continued emission growth until 2030. The new trend is mainly explained by the growth of renewable electricity generation in China outpacing overall growth in power demand. In contrast, the 2030 emission projections for the United States of America increase by 1 GtCO₂e, largely due to recent policy reversals.

▶ In 2035, the G20 aggregate emissions under current policies are projected to drop by 2 GtCO₂e compared with 2030 levels. The largest contributor to the reduction is China (1 GtCO₂e), followed by the European Union (0.6 GtCO₂e) and the United States of America (0.2 GtCO₂e).

4. Seven G20 members are on track to achieving their NDC targets, but few are on a clear trajectory towards their net-zero emission pledges

- ▶ Collectively, the G20 members are not on track to achieving their unconditional and conditional NDC targets for 2030. This implementation gap between emissions under NDC pledges and current policies is estimated at 2 GtCO₂e for the unconditional NDC scenario, increasing to 3–4 GtCO₂e if adjusted for overachievement. For the conditional NDC scenario, it is 0.5 GtCO₂e higher.
- ▶ Seven G20 members are likely to achieve their 2030 unconditional NDC targets with existing policies, while nine G20 members are assessed to be off track or uncertain to achieve their targets with existing policies. It is worth noting that a few countries have narrowed the implementation gap significantly and now have their target within reach, based on existing policies and measures.

Figure ES.3 Emissions in 2035 implied by the new unconditional NDCs of G20 members compared with 2030 NDC targets, individually (upper figure) and collectively (lower figure)

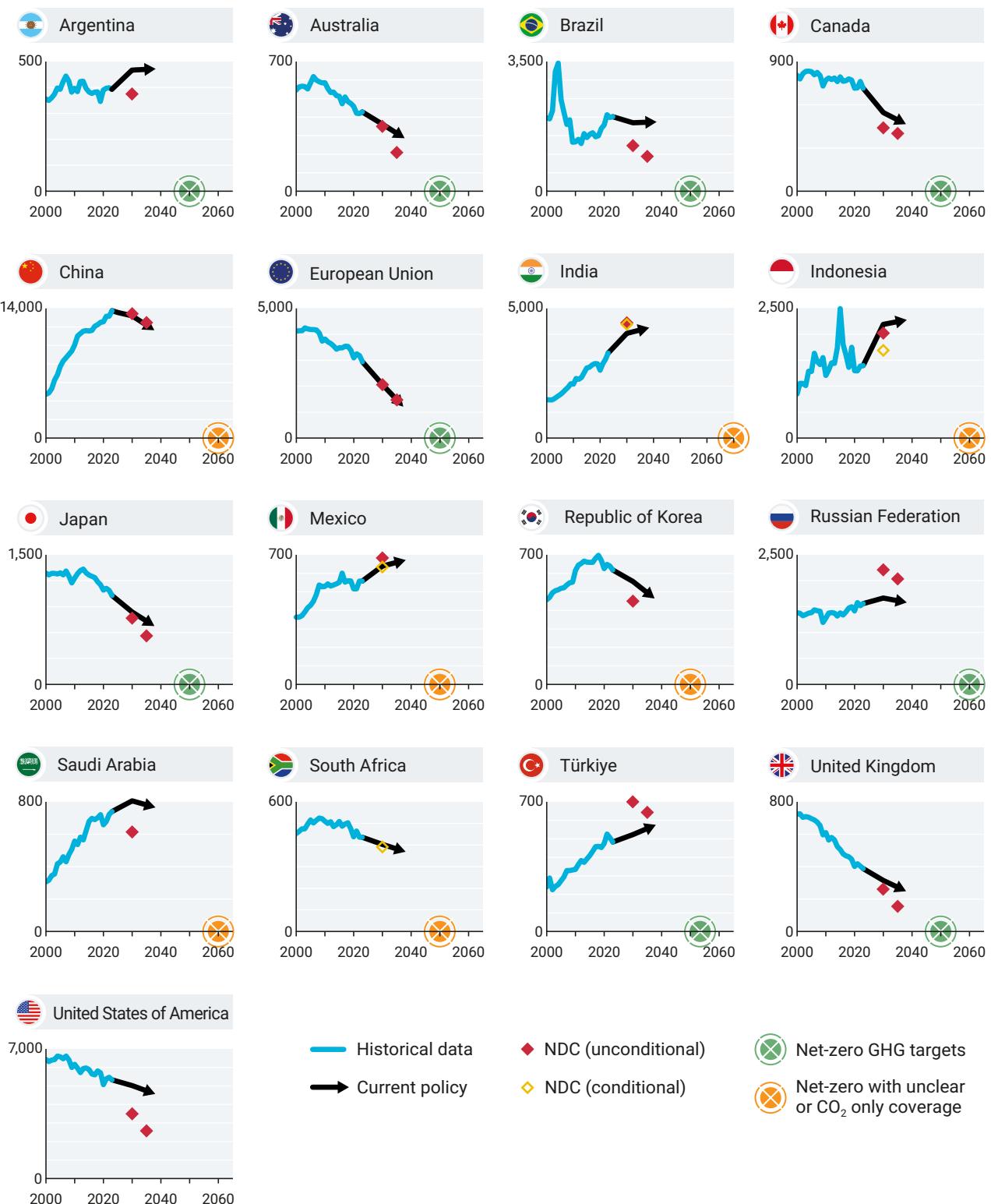


- ▶ Figure ES.4 shows the direction required for G20 members to move from their current emission trajectories to their NDC targets for 2030 and 2035, as applicable, and the extent to which further acceleration of decarbonization rates would be required to achieve the net-zero targets for each G20 member (noting that France, Germany and Italy are only assessed as part of the European Union). Few G20 members are on a clear trajectory towards their net-zero emission pledges based on current policies and NDC targets.

For G20 members whose emissions have not yet peaked, the NDC and net-zero targets that countries have set themselves suggest a very short time frame for peaking emissions and reaching net zero. It should be noted that this illustration does not consider the relative merits in terms of equity or fairness of the choices countries make regarding their NDCs or their nationally determined pathways to net zero.

Figure ES.4 G20 members' emissions trajectories implied by historical emissions, current policies, NDC targets and net-zero targets

National emissions in MtCO₂e/year over time



5. The new NDCs narrow the emissions gap in 2035, but the gap remains large

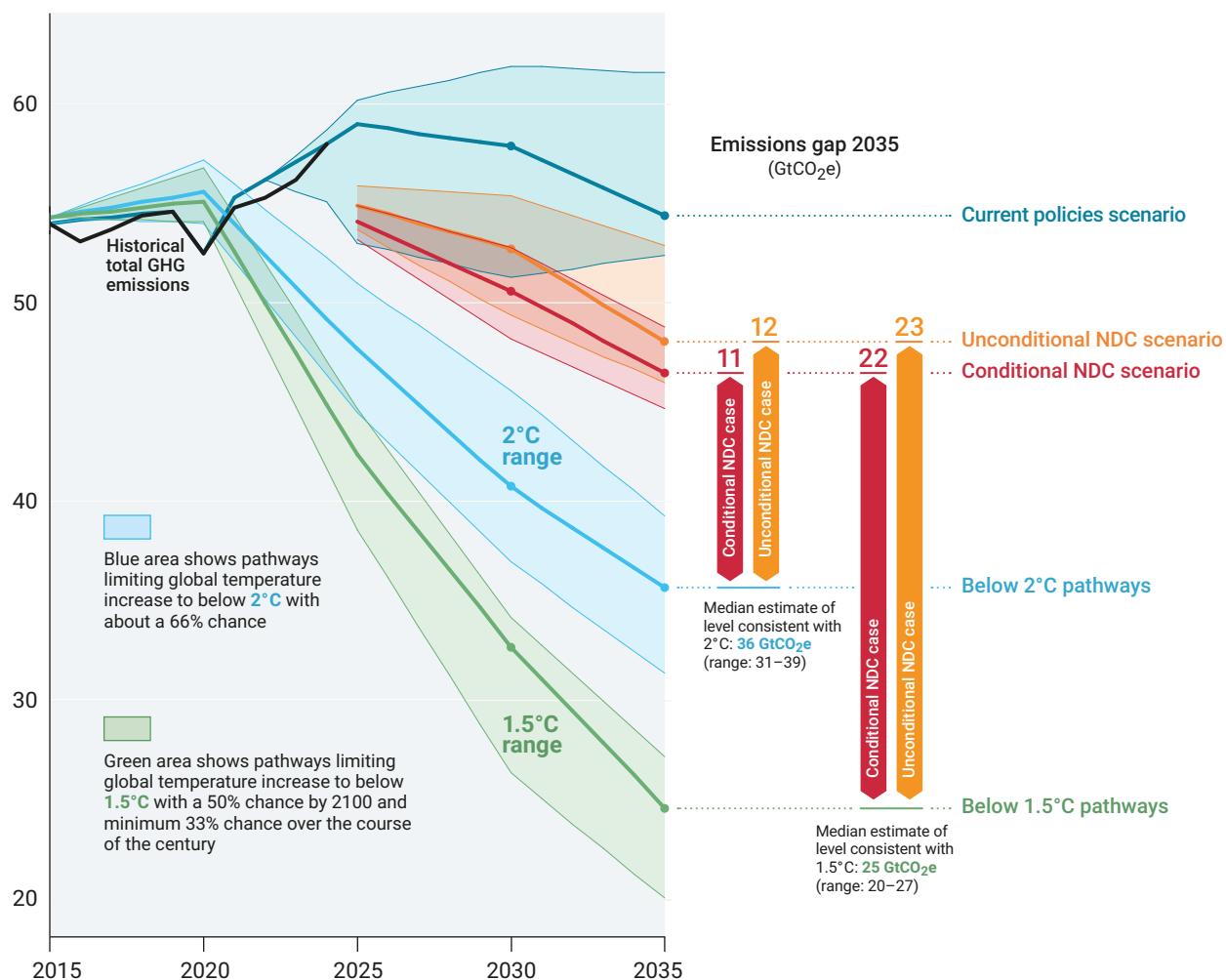
- ▶ Despite the new NDCs, the emissions gap in 2030 and 2035 between global GHG emissions resulting from the full implementation of the NDCs and the levels aligned with 2°C and 1.5°C pathways remain large (figure ES.5 and table ES.1).
- ▶ For 2030, full implementation of unconditional NDCs is estimated to result in an emissions gap with below 2°C pathways of about 12 GtCO₂e annually (range: 9–15 GtCO₂e), and 20 GtCO₂e (range: 17–23 GtCO₂e) with 1.5°C pathways. If, in addition, conditional NDCs are fully implemented, these gaps are reduced by approximately 2 GtCO₂e (see table ES.1 and figure ES.5). These gaps are slightly lower than last year's assessment (about 2 GtCO₂e for unconditional NDCs, and 1 GtCO₂e for conditional NDCs). However, this does not stem from strengthened 2030 NDC targets, but rather results from updated emission trends by modelling groups and methodological updates that decrease the gaps. As indicated in table ES.1, the numbers would increase by 2 GtCO₂e once the United States of America exits the Paris Agreement and its NDC becomes void, cancelling out the effect of the updates.
- ▶ It should be noted that countries are not even on track to achieving the globally insufficient NDCs for 2030. There is also an implementation gap between global emissions projected under current policies and those expected with full NDC implementation (table ES.1). This implementation gap amounts to about 5 GtCO₂e (range: 3–8 GtCO₂e) for unconditional NDCs, and 7 GtCO₂e (range: 5–9 GtCO₂e) for conditional NDCs by 2030 (table ES.1). These totals are around 2 GtCO₂e higher than last year's assessment, due to the increasing divergence between the United States of America's NDC and its current policies. If the United States of America's NDC is excluded, the median estimates of the implementation gap are similar to last year's.
- ▶ The new NDCs narrow the emissions gap in 2035 compared with last year's assessment. The unconditional and conditional NDC gaps with respect to 2°C and 1.5°C pathways are 6 and 4 GtCO₂e lower than last year respectively. The new NDC targets and updated policy projections contribute around 4 and 3 GtCO₂e to these reductions respectively, while updates to methodologies and emissions trends reduce the gaps by another 1–2 GtCO₂e.
- ▶ Full implementation of all unconditional NDCs is estimated to result in a gap with below 2°C pathways of about 12 GtCO₂e annually (range: 10–16 GtCO₂e), and 23 GtCO₂e annually (range: 21–27 GtCO₂e) with 1.5°C pathways. If conditional NDCs are also fully implemented, these gaps are reduced by approximately 1 GtCO₂e for both temperature limits. The small difference between unconditional and conditional NDC scenarios reflects that no new NDCs with conditional elements for 2035 had been submitted by major emitters by the cut-off date for inclusion in this report.

Table ES.1 Global total GHG emissions in 2030, 2035 and 2050, and estimation of associated emissions gaps under different scenarios

Scenario	Projected GHG emissions (GtCO ₂ e)	Estimated emissions gaps (GtCO ₂ e)		
		Median and range	Below 2.0°C	Below 1.8°C
2030				
Current policies	58 (51–62)	17 (11–21)	23 (16–27)	25 (19–29)
Unconditional NDCs	53 (49–55)*	12 (9–15)*	18 (15–21)*	20 (17–23)*
Conditional NDCs	51 (48–53)*	10 (7–12)*	16 (13–18)*	18 (15–20)*
2035				
Current policies	54 (52–62)	19 (17–26)	28 (26–35)	30 (28–37)
Unconditional NDCs	48 (46–52)*	12 (10–16)*	21 (19–25)*	23 (21–27)*
Conditional NDCs	46 (45–49)*	11 (9–13)*	20 (18–22)*	22 (20–24)*
2050				
Current policies continued	51 (33–71)	30 (13–51)	38 (20–59)	42 (24–63)
Conditional NDCs and all net-zero pledges**	19 (8–29)	-1 (-12–9)	7 (-4–17)	11 (0–21)

Note: * All estimates would increase by 2 GtCO₂e without the NDC of the United States of America.

** Extensions of conditional NDCs with net-zero pledges, including long-term low emission development strategies, exclude the United States of America's net-zero target as it has been withdrawn.

Figure ES.5 Global GHG emissions under different scenarios and the emissions gap in 2030 and 2035GtCO₂e**Table ES.2** Global total GHG emissions in 2030, 2035 and 2050, and global warming characteristics of different scenarios, consistent with limiting global warming to specific temperature limits

Scenario	# scenarios	Global total GHG emissions (GtCO ₂ e)	Estimated temperature outcome							Nearest IPCC scenario class
			In 2030	In 2035	In 2050	50% chance	66% chance	90% chance		
Below 2.0°C (66% chance)	195	41 (37–46)	36 (31–39)	20 (16–24)	Peak: 1.7–1.8°C In 2100: 1.4–1.7°C	Peak: 1.8–1.9°C In 2100: 1.6–1.9°C	Peak: 2.2–2.4°C In 2100: 2.0–2.4°C	C3a		
Below 1.8°C (66% chance)	139	35 (28–41)	27 (21–31)	12 (8–16)	Peak: 1.5–1.7°C In 2100: 1.3–1.6°C	Peak: 1.6–1.8°C In 2100: 1.4–1.7°C	Peak: 1.9–2.2°C In 2100: 1.8–2.2°C	N/A		
Around 1.5°C (50% in 2100 with no or limited overshoot)	50	33 (26–34)	25 (20–27)	8 (5–13)	Peak: 1.5–1.6°C In 2100: 1.1–1.3°C	Peak: 1.6–1.7°C In 2100: 1.2–1.5°C	Peak: 1.9–2.1°C In 2100: 1.6–1.9°C	C1a		

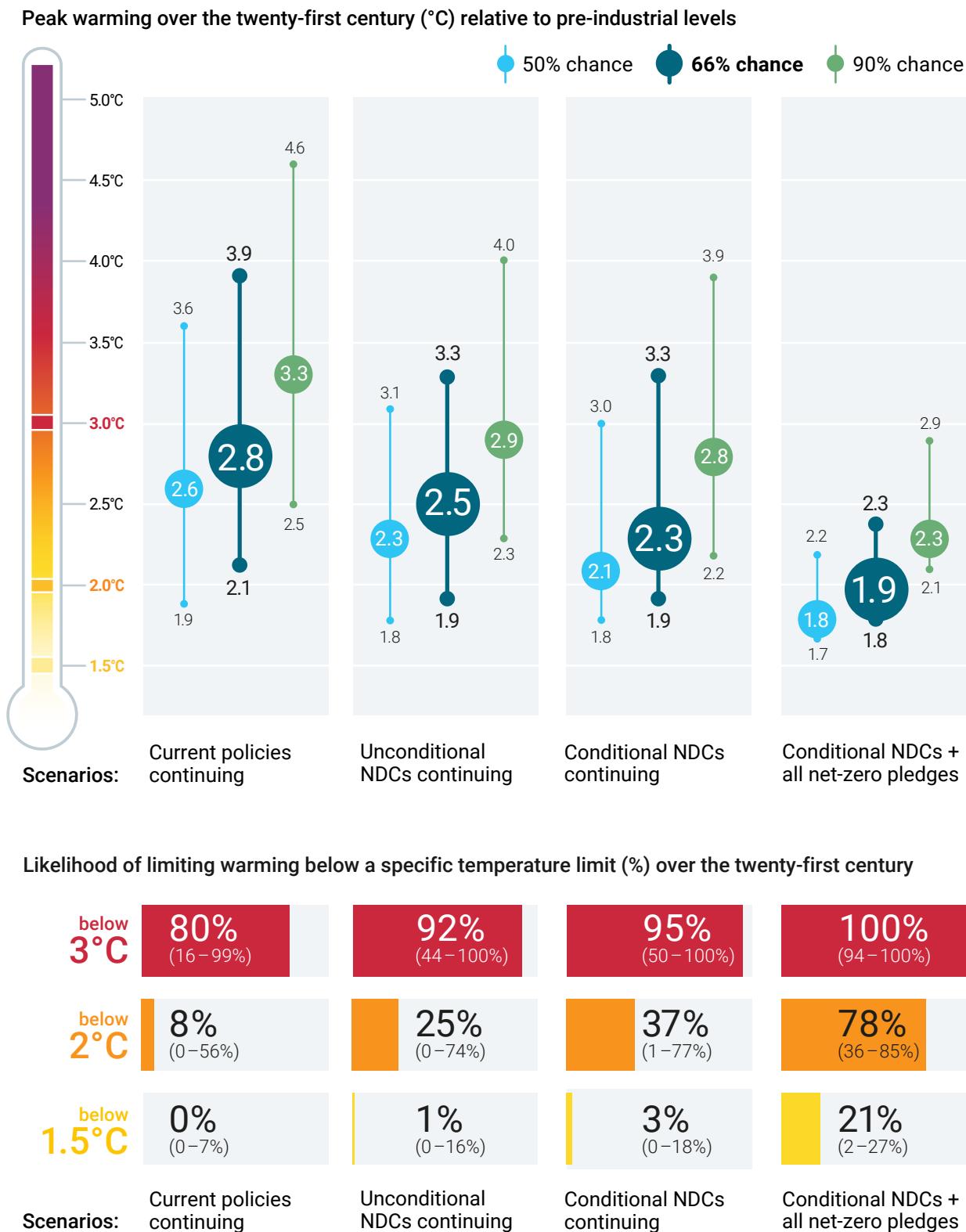
- ▶ The full implementation of unconditional and conditional NDCs would reduce expected emissions in 2035 by about 12 (range: 6–16) and 15 per cent (range: 11–18) respectively, compared with 2019 levels. These percentages change to 9 (range: 0–13) and 11 (range: 6–15) per cent if the NDC of the United States of America is excluded. While this indicates a peak and decline in global emissions, the large ranges around the estimates signals continued uncertainty around firm conclusions about peaking. Furthermore, the reductions are far smaller than the 35 and 55 per cent reductions needed to align with 2°C and 1.5°C pathways, respectively.

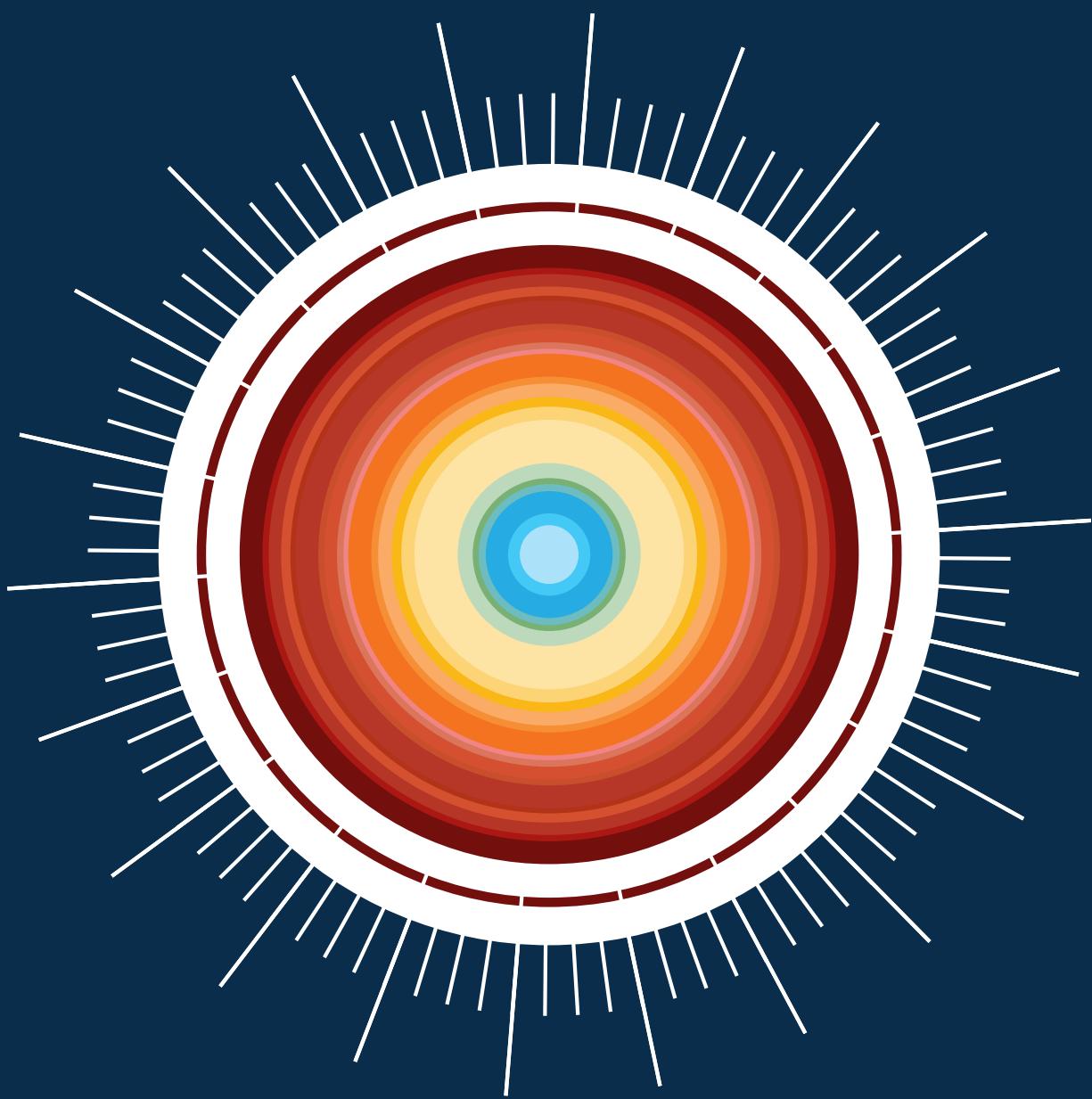
6. Temperature projections are only slightly lower than last year and reiterate that immediate mitigation matters

- ▶ Immediate action matters: a move from the current policies scenario to the conditional NDC scenario through stronger immediate mitigation action shaves 0.5°C off global temperature projections. If, in addition, all net-zero pledges are fully achieved, projections drop by another 0.4°C (figure ES.6).
- ▶ A continuation of the mitigation effort implied by current policies only limits warming below 2.8°C (range: 2.1–3.9) over the century, with a 66 per cent chance. This level of warming would be reduced to 2.5°C (range: 1.9–3.3) if unconditional NDCs are fully implemented by 2035 and similar efforts continue. Even with efforts sufficient to meet the conditional NDCs in full, warming would only be kept below 2.3°C (range 1.9–3.3) with at least a 66 per cent chance. By 2050, the central warming projections for these scenarios see global warming surpassing 1.5°C by several tenths of a degree, leaving the world with a 21–33 per cent chance that warming will already exceed 2°C by then.
- ▶ The updated policy projections and new NDC targets for 2035, along with methodological updates, have lowered these warming projections by about 0.3°C, compared with last year's assessment. The updated policy projections and new NDCs account for roughly two thirds of this improvement, with around one-third due to methodological updates. However, about 0.1°C of this limited progress would be cancelled out, once the forthcoming official withdrawal of the United States of America's NDC is accounted for.
- ▶ The most optimistic pledge-based scenario included in this report, which combines the full implementation of conditional NDCs and all net-zero pledges, would limit warming over the course of the century to 1.9°C (range: 1.8–2.3°C) with a 66 per cent chance. This has remained unchanged since last year.
- ▶ These projections highlight the potential to reduce warming significantly through immediate mitigation action. However, they also underline the uncomfortable truth that surpassing 1.5°C is increasingly near, and that the risk of even higher levels of warming is rising fast.

7. Despite the increasing likelihood of higher and longer temperature overshoot, pursuing efforts to limit global warming to 1.5°C remains as critical and relevant as ever

- ▶ While global warming is now close to 1.5°C and is likely to exceed this temperature limit soon, the long-term temperature goal of the Paris Agreement to limit global warming to well below 2°C, while pursuing efforts to stay below 1.5°C, remains central. The Paris Agreement does not set a target date or expiration for its temperature goal. It is widely understood as a legal, moral and political obligation, as affirmed by the recent advisory opinion of the International Court of Justice affirming that 1.5°C remains the "primary" target of the Paris Agreement.
- ▶ New scenarios show that limiting warming to 1.5°C by 2100 remains technically possible. However, due to the continued delay in deep emission cuts, 1.5°C pathways now imply temporary exceedance of this temperature limit. This merely stresses the imperative of immediate and unprecedented levels of mitigation to limit the magnitude and duration of overshoot to the lowest possible level, thereby also minimizing the increased reliance on uncertain, risky and costly CO₂ removal methods.
- ▶ Every fraction of a degree of global warming matters. Each additional 0.1°C of global warming is associated with an escalation of the damages, losses and adverse health impacts that are already being experienced at current levels of global warming, and which hit the poorest and most vulnerable the hardest. Furthermore, the risks of irrevocable impacts and of triggering climate tipping points that would lead to abrupt and irreversible climate changes, increase with every increment of global warming.
- ▶ Accelerated mitigation action provides benefits and opportunities. In many cases, mitigation aligns with economic growth, job creation, energy security and achievement of other pressing development needs and the Sustainable Development Goals. The required technologies are available, and wind and solar energy development continue to exceed expectations, lowering deployment costs and driving market expansion. Yet deployment remains insufficient, and accelerated emission reductions require overcoming policy, governance, institutional and technical barriers; unparalleled increase in support to developing countries; and redesigning the international financial architecture.
- ▶ The new NDCs and current geopolitical situation do not provide promising signs that this will happen, but that is what countries and the multilateral processes must resolve to affirm collective commitment and confidence in achieving the temperature goal of the Paris Agreement.

Figure ES.6 Projections of global warming under the pledge-based scenarios assessed



1

Introduction – A year of new nationally determined contributions and the ten-year anniversary of the Paris Agreement

Lead authors:

Anne Olhoff (United Nations Environment Programme [UNEP] Copenhagen Climate Centre, Denmark), John Christensen (CONCITO - Denmark's green think tank)

Contributing authors:

Jesse Burton (University of Cape Town, South Africa), Michel den Elzen (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands), William F. Lamb (Potsdam Institute for Climate Impact Research, Germany; University of Leeds, United Kingdom), Minal Pathak (Ahmedabad University, India), Joeri Rogelj (Imperial College London, United Kingdom; IIASA, Austria)

1.1 The focus of this year's report

This sixteenth Emissions Gap Report coincides with two major milestones: the ten-year anniversary of the adoption of the Paris Agreement, and the submission of new nationally determined contributions (NDCs) with mitigation targets and measures for 2035 to the United Nations Framework Convention on Climate Change (UNFCCC), as specified in the Paris Agreement and as part of its five-year ambition-raising cycle (United Nations 2015).

It is therefore timely to reflect on progress made over the past decade, and to examine what needs to happen in the coming decade, considering the findings of this Emissions Gap Report of:

- ▶ A continued increase in global greenhouse gas emissions in 2024 ([chapter 2](#))
- ▶ Few and late submissions of new NDCs, in which responses to the outcomes of the first global stocktake are minor ([chapter 3](#))
- ▶ Globally insufficient mitigation ambition and action that does not significantly narrow the emissions gap ([chapter 4](#))
- ▶ All of which results in projected global warming far above the temperature goal of the Paris Agreement, with the lack of stringent mitigation action to date implying that 1.5°C pathways are now associated with higher overshoot ([chapter 4](#))

The submitted and announced new NDCs as at 30 September 2025, included in this report, are in glaring contrast to the recent advisory opinion by the International Court of Justice (2025) that characterizes the obligations of states with respect to climate change. It clearly states that climate obligations are not aspirational – they are legal, substantive and enforceable.

1.2 Significant progress during the first ten years of the Paris Agreement – but still far from the level and speed needed

While the new NDCs signify the continued collective inadequacy of countries' response to the climate change crisis and the Conference of the Parties to the UNFCCC (COP) decisions, it would be wrong to interpret this as a failure of the Paris Agreement or multilateralism. On the contrary, it is important to acknowledge and appreciate the significant progress that has been made since the adoption of the Paris Agreement, which is often hidden underneath the sombre global headlines. While all progress cannot be directly attributed to the Paris Agreement, it is indisputable that the agreement has been a pivotal driving force for global climate ambition and action in key areas over the past decade. A few of these areas are highlighted below, based on the past decade of Emissions Gap Reports.

First, the past decade has witnessed a significant lowering of projected warming global warming over this century, as a result of progress on climate policies and country

mitigation pledges. Projections based on current policies have declined from just below 4°C at the time of adoption of the Paris Agreement, to just below 3°C today. Similarly, temperature projections based on the conditional and unconditional NDCs have fallen from 3–3.5°C (range: 3–4) to 2.3–2.5°C (range 1.9–3.3) in this year’s report (chapter 4). Although direct comparisons of the warming projections are challenged by changes in the methodological approach over the past ten years, the decline is clear.

Second, the world has moved from zero commitment on net-zero emissions to near-universal understanding of the need for global emissions to reach net zero around the middle of this century. The proportion of global emissions covered by net-zero emission pledges by around the middle of this century has increased from zero in 2015 to about 70 per cent today.

Third, climate governance and accountability frameworks, policies and legislation have advanced substantially, as highlighted in the past ten Emissions Gap Reports and as indicated by the first biennial transparency reports that offer a first step towards a harmonized, transparent and timely global approach to emissions reporting, which is

instrumental for informing national pledges and tracking progress towards them (chapter 2).

Fourth, in the ten years since the Paris Agreement was adopted, renewable energy technologies have undergone a transformation. As noted by the recent United Nations report on the opportunities of energy transition, with cost declines and manufacturing capacity growth, the global deployment of solar and wind energy, and electric vehicles, has exceeded even the most optimistic projections, and continues to advance exponentially (United Nations 2025). Last year’s Emissions Gap Report (UNEP 2024) highlighted that all the solutions needed to get on track to achieving the temperature goal of the Paris Agreement in the next decade are available at low cost, and are associated with significant economic, job creation and health benefits.

These developments position the international community far more favourably to accelerate climate ambition and action than a decade ago – and as this report emphasizes, such acceleration is critically urgent. In the current challenging geopolitical context, multilateralism will likely be even more important to sustain and accelerate climate action in an equitable and geopolitically balanced manner.

The process behind the Emissions Gap Report

As in previous years, this report has been prepared by an international team of leading experts. This year, 39 leading scientists from 21 expert institutions across 16 countries have been engaged in producing the report, with consideration of geographical diversity, gender balance and renowned expertise. The assessment process has been overseen by an international steering committee, and

it has been transparent and participatory. Geographical diversity and gender balance have been considered to the extent possible. All chapters have undergone external review, and the assessment methodology and preliminary findings were made available to the governments of the countries specifically mentioned in the report, to provide them with the opportunity to comment on the findings.¹

¹ In view of the announced withdrawal from the Paris Agreement of the United States of America, the following statement is included at the request of the State Department of the United States of America: “The United States does not support the Emissions Gap Report. It is the policy of the United States that international environmental agreements must not unduly or unfairly burden the United States. Accordingly, the U.S. Department of State notified the UN Secretary-General of the U.S. withdrawal from the Paris Agreement on January 27.” The U.S. Government furthermore informed UNEP that they would not provide comments to this report.

2 Global emissions trends

Lead authors:

William F. Lamb (Potsdam Institute for Climate Impact Research, Germany; Priestley Centre for Climate Futures, University of Leeds, United Kingdom) and Minal Pathak (Climate Institute, Ahmedabad University, India)

Contributing authors:

Monica Crippa (European Commission, Joint Research Centre, Italy), Giacomo Grassi (European Commission, Joint Research Centre, Italy), Diego Guizzardi (European Commission, Joint Research Centre, Italy), Renata Libonati (Departamento de Meteorologia, Universidade Federal do Rio de Janeiro, Brazil), Glen P. Peters (CICERO Center for International Climate Research, Norway) and Julia Pongratz (Ludwig-Maximilians-Universität Munich, Germany; Max Planck Institute for Meteorology, Germany)

2.1 Introduction

This chapter assesses greenhouse gas (GHG) emissions trends up to and including 2024. It aims to describe emissions trends from multiple perspectives, including total emissions across gases and sources (section 2.2), emissions by major sectors (section 2.3), and the emissions of major emitters,

including their per capita and historic contributions (section 2.4). These different perspectives offer insight into drivers of emissions, as well as inequalities in contributions to climate change. The past year also saw improvements to emissions data reporting under the Paris Agreement with the release of the biennial transparency reports (BTRs). These are assessed in box 2.3.

Box 2.1 Methodological approach to greenhouse gas accounting and warming potentials of the report

As in previous years, the Emissions Gap Report focuses on total net GHG emissions across all major groups of anthropogenic sources and sinks reported under the United Nations Framework Convention on Climate Change (UNFCCC). This includes carbon dioxide (CO_2) emissions from fossil fuels and industry (fossil CO_2); CO_2 emissions and removals from land use, land-use change and forestry (LULUCF CO_2); methane emissions (CH_4); nitrous oxide emissions (N_2O); and fluorinated gas (F-gas) emissions covered under UNFCCC reporting. This set of sources is consistent with global integrated assessment modelling benchmarks reported in chapter 4, as well as other major assessments (Skea et al. 2022; Forster et al. 2024). It excludes ozone-depleting substances regulated under the Montreal Protocol, as well as the cement carbonation sink, neither of which are currently covered in UNFCCC reporting. It also excludes fire emissions not covered by inventory or bookkeeping model reporting. Including these various sources

would increase global emissions by approximately 1.8 Gt CO_2e per year (Lamb et al. 2025). Global totals include all countries and international aviation and shipping emissions. Where national estimates are reported, emissions are attributed to the country in which they are produced (territorial accounting).

The reporting of net LULUCF CO_2 emissions is consistent with previous Emissions Gap Reports. Bookkeeping models are used to estimate global net LULUCF CO_2 emissions, and estimates consistent with national inventories are used to report national net LULUCF CO_2 emissions. This ensures that global estimates are consistent with chapter 4, as well as the carbon cycle and climate science literature, while national estimates are consistent with those reported by countries to the UNFCCC. Total net LULUCF CO_2 emissions differed by 7.9 Gt CO_2 between the two approaches during the period 2014–2023 (Melo et al. 2025) (see [appendix A](#), figure A.2). This is due to

known differences in system boundaries between each approach, in particular the fact that bookkeeping models consider only 'direct' human-induced fluxes as anthropogenic (e.g. deforestation, afforestation and other land-use-related vegetation changes), whereas national inventories typically also include most of the 'indirect' human-induced fluxes (e.g. enhanced vegetation growth due to increased atmospheric CO₂) that occur on a larger area defined as 'managed land' (Grassi et al. 2021). As a result, national inventories globally sum up to a small net LULUCF CO₂ removal, but include a large portion of removals that are not the result of direct management and will not be sustained if atmospheric CO₂ levels stabilize (Gidden et al. 2023). This has significant implications for tracking national

and global emissions, and for evaluating collective progress towards the Paris Agreement goals (Grassi et al. 2025; see [appendix A](#)). A translation between global emissions based on bookkeeping models and the national GHG inventories reported by countries is available and is updated annually (Friedlingstein et al. 2025; Melo et al. 2025; Schwingshakl et al. 2022).

Throughout this report, 100-year global warming potentials from the latest IPCC Working Group I Sixth Assessment Report (IPCC WGI AR6) (Forster et al. 2021) are used, where GHG emissions are aggregated to CO₂ equivalents. Alternative metrics can be used to highlight the differing impacts of short-lived gases, but are not explored here.

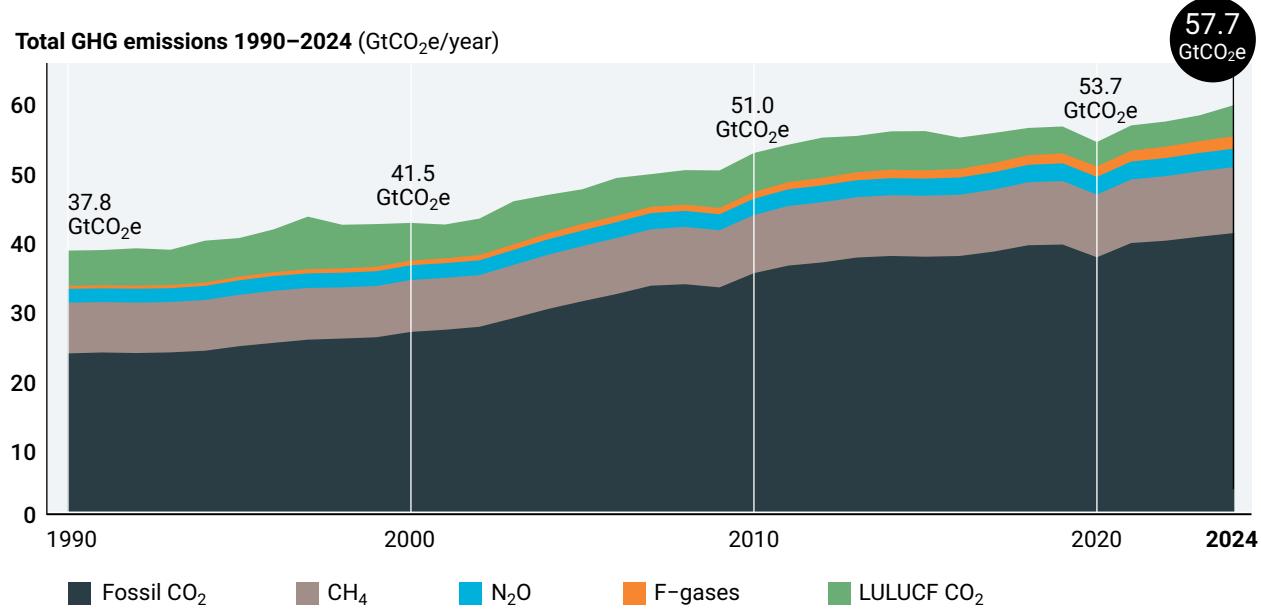
The principal data sources in this chapter include the Emissions Database for Global Atmospheric Research (EDGAR) dataset for fossil CO₂, CH₄, N₂O and F-gas emissions (Crippa et al. 2025); the Global Carbon Budget for global LULUCF CO₂ estimates, taking the average of four bookkeeping models (Friedlingstein et al. 2025); and Melo et al. (2025) for national inventory-based LULUCF CO₂. Further methodological and data choices are detailed in [appendix A](#), which is available online.

2.2 Global greenhouse gas emissions continued to increase in 2024

Ten years on from the adoption of the Paris Agreement, global GHG emissions continue to increase. In 2024, they

reached a record of 57.7 GtCO₂e, representing a 2.3 per cent (1.4 GtCO₂e) increase from the previous year (figure 2.1, table 2.1) (Crippa et al. 2025). This rate is high compared with the 2023 growth rate (1.6 per cent). It is more than four times higher than the annual average growth rate in the 2010s (0.6 per cent per year) and comparable to that of the 2000s (on average 2.2 per cent per year). At the same time, atmospheric CO₂ concentrations rose to 423.9 parts per million in 2024, while CH₄ and N₂O concentrations also continued to increase (World Meteorological Organization [WMO] 2025a). Since atmospheric GHG concentrations drive global warming, these are ultimately the metrics that matter for meeting the temperature goal of the Paris Agreement.

Figure 2.1 Total net anthropogenic GHG emissions by gas, 1990–2024



Sources: Crippa et al. (2025) for non-LULUCF emissions, Friedlingstein et al. (2025) for LULUCF emissions

Table 2.1 Total global emissions by source

GtCO ₂ e	2010–2019 (average)	2022	2023	2024
GHG	53.3±5.4	55.3±5.1	56.2±5.2	57.7±5.5
Fossil CO ₂	36.3±2.9	38.5±3.1	39.1±3.1	39.6±3.2
LULUCF CO ₂ (global bookkeeping)	4.9±3.4	3.5±2.5	3.6±2.5	4.4±3.1
LULUCF CO ₂ (national inventory*)	-3.6±-2.5	-4.2±-2.9	-4.2±-3	-
CH ₄	8.6±2.6	9.1±2.7	9.2±2.8	9.3±2.8
N ₂ O	2.4±1.4	2.5±1.5	2.6±1.5	2.6±1.6
F-gases	1.2±0.35	1.6±0.48	1.7±0.5	1.7±0.52

Note: Non-CO₂ GHGs are converted to CO₂ equivalents using global warming potentials with a 100-year time-horizon from the IPCC WGI AR6 (Forster *et al.* 2021). Annual updates entail revisions to previously published data, which implies small changes compared to prior reporting in the Emissions Gap Report (see [appendix A](#) for details).

* Inventory-based LULUCF CO₂ is excluded from total GHG emissions, but all other sources are included. Uncertainties are based on a 90 per cent confidence interval, consistent with the IPCC WGI AR6 assessment (see [appendix A](#)).

Sources: Crippa *et al.* (2025), Friedlingstein *et al.* (2025), Melo *et al.* (2025)

Fossil CO₂ emissions account for approximately 69 per cent of current GHG emissions. These emissions are driven by the combustion of coal, oil and gas in the energy sector, as well as industrial processes associated with the manufacture of metals, cement and other materials (figure 2.2). Multiple datasets agree that fossil CO₂ emissions grew in 2024: EDGAR (used here) estimates an increase of 1.1 per cent (Crippa *et al.* 2025), compared to +0.5 per cent reported by the International Energy Agency (IEA 2025a), +1.1 per cent reported by the Energy Institute (2025) (energy sector only) and +0.7 per cent forecast by the Global Carbon Budget (Friedlingstein *et al.* 2025). Overall, the change in Fossil CO₂ emissions was substantive at +0.55 GtCO₂, but not as fast as last year when the increase was +0.88 GtCO₂.

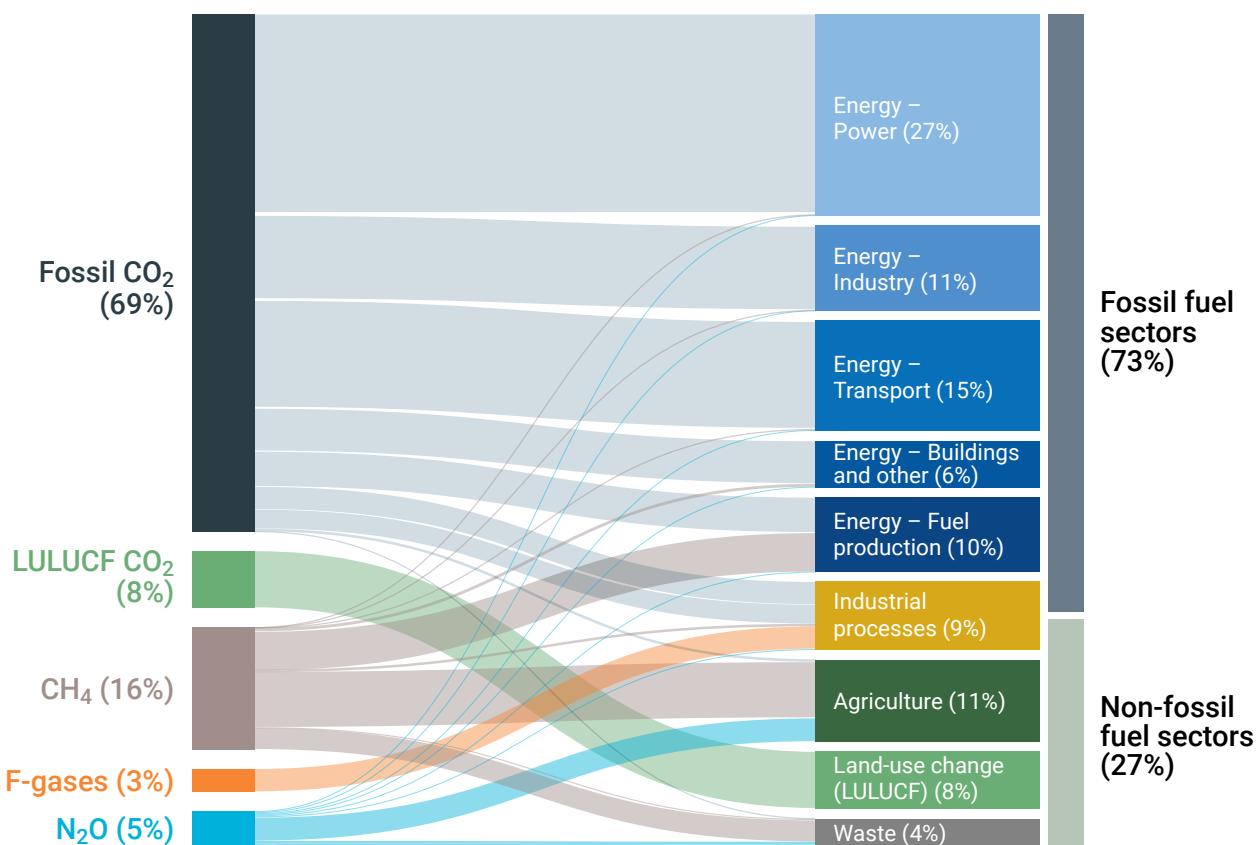
Together, CH₄, N₂O and F-gas emissions account for about 24 per cent of total GHG emissions. All these gases continued to grow in 2024, with F-gas emissions the fastest at 3.8 per cent, followed by N₂O at 0.59 per cent and CH₄ at 0.39 per cent (figure 2.1). Anthropogenic CH₄ emissions are currently the second largest source of GHG emissions, and are mainly attributable to agricultural sources including enteric fermentation from ruminant livestock, manure management and rice cultivation. Oil and gas operations, coal mine methane leaks, and waste management are also significant sources (figure 2.2). As methane has significant short-term climate impacts, it has been the focus of recent commitments (see box 4.1 "Global methane mitigation and the progress of the Global Methane Pledge"). F-gases are man-made substances used as insulators and substitutes to ozone-depleting substances such as refrigerants, and are closely tied to industrial production.

Total emissions across all gases that are associated with fossil fuel extraction, production and combustion sectors were 42 GtCO₂e in 2024, accounting for ~73 per cent of the total (figure 2.2). Most absolute and relative growth in emissions over the past few decades was also associated with fossil fuels (see [appendix A](#), figure A.1).

Despite the key role of fossil fuels in driving total emissions, deforestation and land-use change were decisive factors in the rapid increase in 2024 emissions. Global net LULUCF CO₂ emissions were projected to increase by 21 per cent (0.77 GtCO₂) in 2024 and were thereby responsible for the largest share of the overall change in last year's emissions (53 per cent compared to 36 per cent for fossil CO₂). However, this category of emissions is generally considered to have the largest uncertainties of all gases considered here, both in terms of absolute levels and year-to-year trends (see [appendix A](#), figure A.3). Averaged over the last decade, global net LULUCF CO₂ emissions have trended downward. The bookkeeping approach underlying the Global Carbon Budget estimates used here calculates emissions and removals based on land-use activity data and carbon response curves; but it extrapolates the most recent year (here 2024) based on the inter-annual variability of the emission estimates from tropical deforestation and degradation fires, and south-east Asian peat fires (Friedlingstein *et al.* 2025).

Figure 2.2 Total net GHG emissions by gas, sector, and fossil or non-fossil category in 2024

Net greenhouse gas emissions by gas and sector – 2024 (%)



Sources: Crippa et al. (2025) for non-LULUCF emissions, Friedlingstein et al. (2025) for LULUCF emissions

Emissions from tropical deforestation and degradation fires in South America were among the highest ever recorded since 1997 at 1.2 GtCO₂ in 2024 (van der Werf et al. 2017; Friedlingstein et al. 2025). They were likely exacerbated by El Niño conditions that started in mid-2023 and ended in mid-2024, which drive increased temperatures and drought risk, and are known to increase the odds that anthropogenic fires used for agricultural management or forest clearing

activities ‘escape’, and have larger-than-anticipated effects (Friedlingstein et al. 2025; Lamb et al. 2025). In contrast to South America, land-use emissions from south-east Asia have dropped in 2024, as the El Niño conditions ceased (Friedlingstein et al. 2025). The interactions between deforestation, fires and emissions are becoming increasingly important due to their implications for climate, mitigation and biodiversity (see box 2.2).

Box 2.2 Deforestation, emissions and impacts on nature and health

Despite over 100 countries pledging to halt or reverse deforestation at the twenty-sixth Conference of the Parties to the UNFCCC (COP 26) (UNFCCC 2021), global primary forest loss remains high and deforestation continues to drive emissions and impact biodiversity. In 2024, 6.7 million hectares (Mha) of primary forest were lost – an 80 per cent increase from 2023. Total global tree cover loss reached a record 30 Mha, driven by human activity alongside natural factors, with major impacts on emissions, biodiversity, nature and human health (World Resources Institute 2025).

Forest fires are one of the key drivers of forest and tree cover loss (World Resources Institute 2025). South America was particularly affected in 2024, with dry conditions and extensive fires in Chile, Bolivia and Brazil (WMO 2025b). Temperate and boreal forests were also anomalously affected by wildfires in 2024, most notably in Canada, where the extreme wildfire season of 2023 persisted into 2024.

In fire-prone regions, fires often occur as part of natural fire regimes. Further, fire conditions respond to inter-annual variability from the El Niño Southern Oscillation cycle. However, an increase in frequency and intensity of droughts and heatwaves associated with human-induced climate change has contributed to an increase in the likelihood of large-scale wildfires in some parts of the world (Copernicus 2024). Moreover, wildfires slow down forest regrowth by 56–82 per cent, disrupting the carbon cycle (Drücke et al. 2023).

Non-fire-related primary forest loss rose by 14 per cent from 2023 to 2024, mostly due to land clearing for agriculture, especially soy, cattle and oil palm. These commodities are widely traded internationally,

with major economies consuming products linked to deforestation abroad (West et al. 2025). Roughly one quarter of total land-use emissions are tied to trade, with notable contributions linked to, for example, the export of soybean from Brazil or palm oil from Indonesia to Europe and China (Hong et al. 2022). In turn, post-deforestation peatlands and exposed organic soils are vulnerable to drought conditions and ignition, further exacerbating fire frequency and intensity (Greifswald Mire Centre 2024; Page et al. 2002).

Despite these trends, emissions from deforestation have declined compared to 2000–2010 (see [appendix A](#), figure A.2). About 2.2 GtCO₂ per year was also removed from the atmosphere between 2013 and 2022 and stored through afforestation, reforestation and long-lived wood products globally (Pongratz et al. 2024). Nonetheless, gross emissions from permanent deforestation still far exceed CO₂ removals and summed to 3.7 GtCO₂ per year over 2014–2023 (Friedlingstein et al. 2025).

The impacts of deforestation and wildfires on local populations including loss of lives, public health, impacts on property and infrastructure, and other economic impacts underscores the need to look at these events beyond emissions. Wildfire smoke can travel long distances causing air pollution and harming regional health, while black carbon speeds up glacier melt (Kolden et al. 2025; Magalhães et al. 2019; Prist et al. 2023). Wildfires and deforestation are accelerating habitat fragmentation, pushing thousands of species closer to extinction (Driscoll et al. 2021). The disruption of ecological networks and loss of keystone species also undermines ecosystem resilience, with cascading effects on food security, water regulation and disease control (Wiebe and Wilcove 2025).

2.3 Emissions continued to increase across major sectors

When emissions are allocated to major economic sectors, power generation was the largest contributor in 2024 at 15.6 GtCO₂e, followed by transport (8.4 GtCO₂e) and industry (6.5 GtCO₂e) (figure 2.2; [appendix A](#), figure A.4 available online). Emissions grew across most sectors in 2024, but growth was particularly pronounced in international aviation (+6.3 per cent), continuing the rebound of the sector since the COVID-19 pandemic. Robust emissions growth also occurred in specific segments of the energy sector (e.g. from solid – i.e. coal – fuel production at +2.2 per cent, and industry at +1.8 per cent); as well as from industrial processes (e.g. from metals at +1.5 per cent and chemicals

at +1.4 per cent). There was a significant decrease in process emissions from cement (-3.7 per cent), primarily occurring in China (Andrew 2025).

Focusing on the energy sector, overall energy demand increased by 2.2 per cent in 2024, which was higher than the average rate of demand increase observed between 2013 and 2023 (IEA 2025a). Combined with a recovery of hydropower generation, much of the increase in energy demand in 2024 was met by non-fossil sources (IEA 2025a). On the supply side, the demand for coal-based power generation increased by 1 per cent in 2024; however, there has been a progressive decline in the growth rate, as well as its share in the total energy mix (IEA 2025a). The year 2024 was another record year for renewable electricity generation

(Graham et al. 2025). Compared to a counterfactual scenario where the global roll-out of solar, wind, hydro and nuclear power did not take place, significant emissions have been avoided (Deng et al. 2025). The increased adoption of renewable energy, combined with the declining share of thermal power and with energy efficiency improvements, have resulted in a steady decline in the global CO₂ intensity of electricity since 2007 (Peng et al. 2025).

Despite positive trends on the supply side, 2024 was also a year of extreme heat waves around the globe (Jha et al. 2025), which pushed up electricity demand for cooling (Graham et al. 2025; IEA 2025a). Temperature and heatwave records were shattered across many parts of the globe, including across central, western and southern Africa; vast regions across South America, which endured more than 150 heatwave days; south-east Asia, where temperatures exceeded 43°C in April; southern parts of the United States of America and Mexico, where extreme heat reached up to 48°C; and the Eastern Mediterranean, where temperatures climbed above 45°C (Jha et al. 2025). Without these events, fossil fuel electricity generation may have remained flat in 2024 – instead, it increased (Graham et al. 2025; IEA 2025a).

Other emerging sources of demand included electric vehicles, heat pumps and data centres, which collectively contributed to an additional 200 TWh or 0.7 per cent of global demand growth (Graham et al. 2025; IEA 2025a).

While data centres are the fastest growing sources of emissions, their overall contribution to emissions remained relatively minor. In 2024, data centres took up 1.5 per cent of the total electricity demand and less than 1.5 per cent of energy sector emissions (IEA 2025b). There are concerns that the pace and scale of artificial intelligence (AI) adoption and associated infrastructure needs is undermining progress on renewable energy (Lee 2025). From a macroeconomic perspective, the future growth of AI and

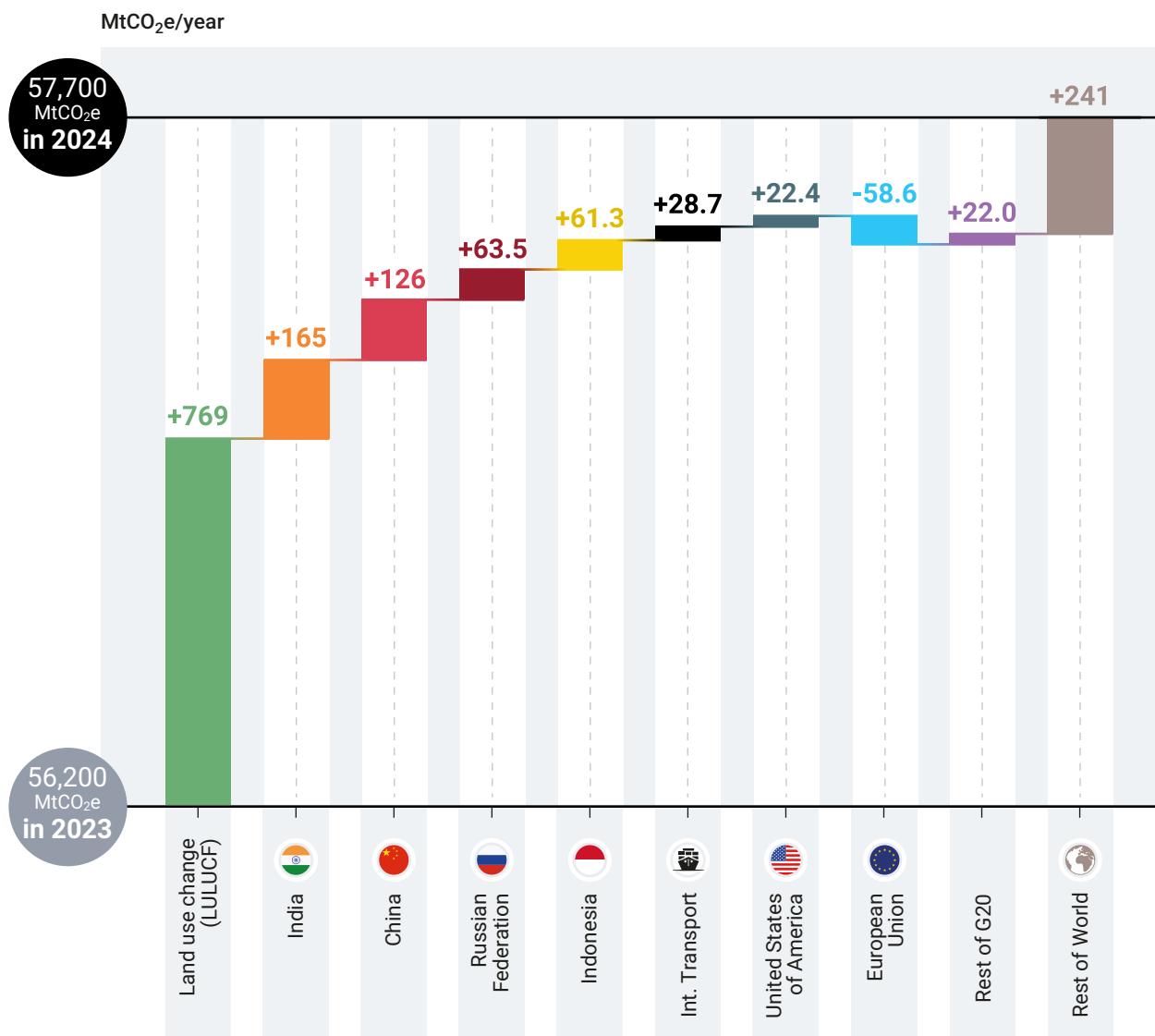
associated emissions or their contribution to emission reductions is uncertain and depends significantly on gains in efficiency or future technology changes, such as shifting to less-resource intensive models; it is also likely to be small relative to the overall energy sector emissions (Chen 2025; IEA 2025b; UNESCO 2025). There is a need to further understand the full range of impacts associated with near-term digitalization trends, including local impacts.

2.4 Emissions increased for all but one of the largest GHG emitters

Currently, the six largest emitters in terms of total GHG emissions are China, the United States of America, India, the European Union, the Russian Federation and Indonesia. Preliminary estimates for 2024 (which exclude national-level LULUCF CO₂, for which data is only available up to 2023) show an increase in GHG emissions compared with 2023 in all of these except the European Union (figure 2.3; figure 2.4).

The G20 group accounted for 77 per cent of global GHG emissions in 2024, excluding the African Union (see [appendix A](#), figure A.7). Least developed countries (LDCs) – which include many African Union countries – remain a minor contributor to global emissions, at 3 per cent of the total. Most of the G20 countries recorded an increase in emissions in 2024. The highest absolute growth in emissions occurred in India, followed by China and Indonesia, which are also among the highest populated countries globally. In terms of growth rate, Indonesia showed the highest increase (4.6 per cent) followed by India (3.6 per cent). Emissions growth in China (0.5 per cent in 2024) was lower than the previous year. However, many countries outside of G20 also showed significant increases in emissions in 2024 (figure 2.3; figure 2.4). Emissions in the European Union decreased by 2.1 per cent.

Figure 2.3 Contributions to the increase in GHG emissions in 2024 from 2023 levels of the six largest emitters, the rest of the G20 members, the rest of the world, international transport and LULUCF



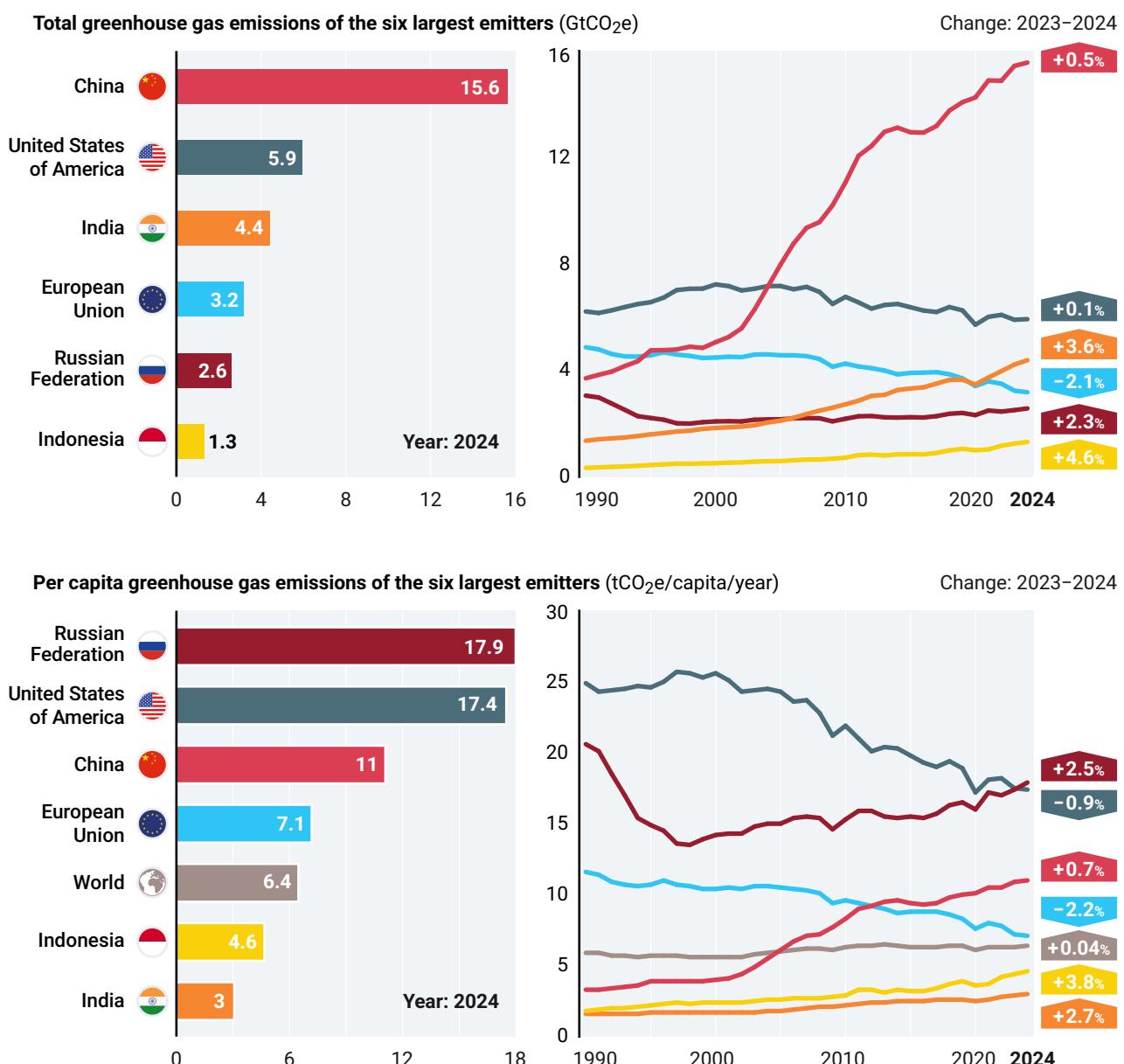
Sources: Crippa et al. (2025), Friedlingstein et al. (2025)

Note: The hatched LULUCF estimate refers to the global change.

Contributions by current, per capita and historic emissions differ across the high emitters and world regions. Per capita GHG emissions are above the world average of 6.4 tons of CO₂ equivalent (tCO₂e) in the United States of America, the Russian Federation, China and the European Union, and remain significantly below it in Indonesia and India. The per capita emissions of LDCs is 1.5 tCO₂e. In terms of historic cumulative CO₂ emissions (including LULUCF), the United States of America has produced the most global CO₂ emissions to date, followed by China and the European Union

(see [appendix A](#), figure A.9). The LDCs and the African Union have only produced a minor share of historic cumulative emissions, despite being highly populous countries and regions. Several countries with high per capita and historic emitters have still to peak in their emissions. As discussed in previous reports, emissions inequality continues to exist within countries, with the richest individuals driving emissions with their consumption and investments, and few policies addressing this globally (Pathak et al. 2025; Schöngart et al. 2025).

Figure 2.4 Total and per capita GHG emissions of the six largest GHG emitters



Sources: Crippa et al. (2025), World Bank (2025)

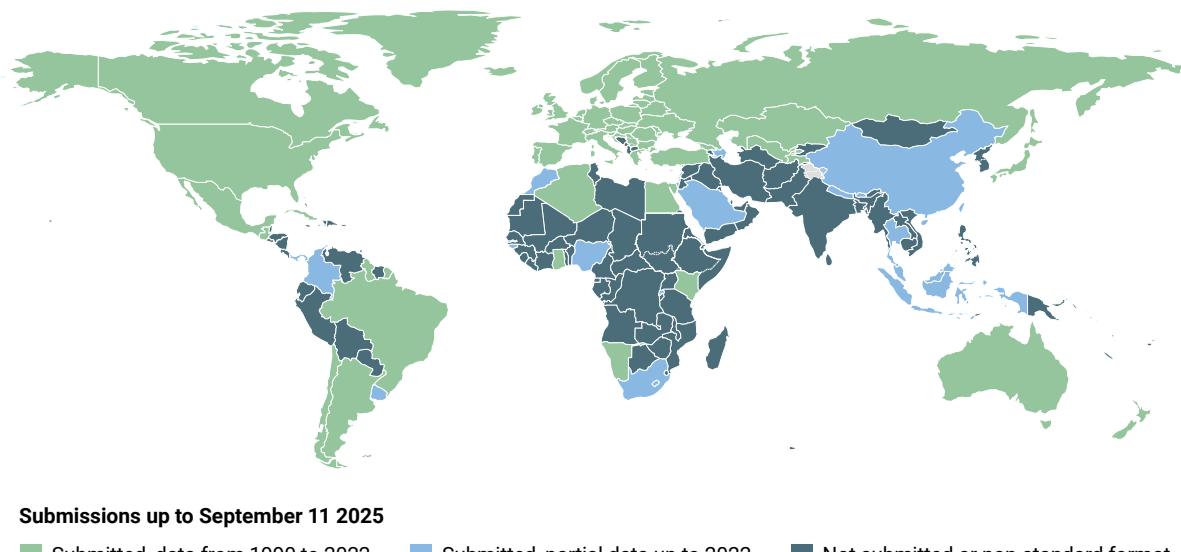
Note: Emissions from LULUCF are excluded.

Box 2.3 Transparency in national greenhouse gas emissions reporting

At COP 24 in Katowice, countries agreed to submit BTRs under the new Enhanced Transparency Framework (ETF) by 31 December 2024. These were to contain, among other documents, a set of common reporting tables (CRTs) with the national

GHG inventory of each country. Developed country parties have been submitting national inventories in a similar format for many years, but for many other countries the BTRs have led to substantially improved emissions data-gathering under the agreement.

Figure 2.5 Submissions of CRTs in the first BTRs



As of 11 September 2025, 85 of 195 parties in the Paris Agreement have submitted a CRT with their BTR (figure 2.5). Of these, 61 CRTs cover the period 1990–2021 across the full scope of gases and sectors under the Agreement. Many developing country Parties do not include a full-time series, which is in accordance with flexibility provisions provided under the ETF. LDCs and small island developing States may choose to submit BTRs at their discretion, and eight have done so (Cuba, Guinea-Bissau, Guyana, Maldives, Mauritius, Nepal, Rwanda and Singapore).

By contrast, many countries have yet to provide CRTs. Among the high emitters, these include India. A further six countries have submitted CRTs, but did so with inconsistent, missing or incorrectly formatted data (Lamb 2025). It should also be noted that the United States of America failed to submit a National

Inventory Report in 2025, which is an obligation for Annex I Parties countries under the Convention, which the United States of America continues to be.

The BTRs offer a first step towards a harmonized, transparent and timely global approach to emissions reporting, which is instrumental for informing national pledges and tracking progress towards them. In the absence of a strong compliance regime, this transparency is a core accountability mechanism in the Paris Agreement to ensure that countries deliver on their pledges. Nonetheless, further improvements in reporting – taking into account differing technical and institutional capacities – are required before a complete assessment of global emissions based on the inventories can be made.



3 Nationally determined contributions and long-term pledges: The global landscape and G20 member progress

Lead authors:

Takeshi Kuramochi (NewClimate Institute, Germany), Michel den Elzen (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands) and Taryn Fransen (World Resources Institute, United States of America)

Contributing authors:

Caroline Alberti (Climate Policy Initiative, United Kingdom), Clea Schumer (World Resources Institute, United States of America) and Dan Tong (Tsinghua University, China)

Data contributors:

Sarah Heck (Climate Analytics, Germany), Alister Self (Climate Resource, Australia), Florian Fosse and Kimon Keramidas (Joint Research Centre, European Commission, Spain), Frederic Hans, Pablo Blasco Ladrero, Ana Missirliu and Jan-Luka Scheewel (NewClimate Institute, Germany), Ioannis Dafnomilis and Elena Hooijer (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands), Malte Meinshausen (University of Melbourne, Australia), Helen Tatlow (University of Oxford, United Kingdom), Natalia Alayza, Mengpin Ge and Christopher Henderson (World Resources Institute, United States of America)

3.1 Introduction

The Paris Agreement builds on a five-year ambition-raising cycle, whereby parties are requested to ratchet up the ambition of their mitigation efforts over time to align with the temperature goal and other goals of the agreement. The new nationally determined contributions (NDCs) that countries are required to submit this year are therefore a critical test of the ambition-raising mechanism. The extent to which parties respond with enhanced ambition and implementation – grounded in the principle of equity, including gender equity, and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances – influences the credibility of the Paris Agreement and the world's ability to close the emissions gap.

As at 30 September 2025 (the cut-off date for NDCs, data and literature assessed in this report, unless otherwise

noted), only 60 parties, accounting for 63 per cent of global emissions, had either submitted (57 parties) or announced (three parties) new NDCs containing greenhouse gas (GHG) mitigation targets for 2035. In addition, four parties had submitted new NDCs that did not contain GHG mitigation targets for 2035.

This chapter takes stock of the current state of play of NDCs and progress towards their achievement, with a focus on the new NDCs. Section 3.2 examines the new NDCs at the global level and the general evolution of emission reduction targets since the adoption of the Paris Agreement, in terms of the form and coverage of targets, the sector-specific efforts called for in the global stocktake, conditionality and stated needs for financial support. Section 3.3 then takes a deeper look at the emission trajectories of G20 members under their current policies, new NDCs, net-zero targets and the implications for peaking for each G20 member.¹

¹ G20 members include the African Union and the European Union. As the African Union has neither a collective NDC nor a net-zero target, the assessment does not include commitments by the African Union as a whole. Conversely, the European Union has both a collective NDC and a net-zero target, so these are included in the assessment, as are the commitments of G20 members South Africa, France, Germany and Italy.

Box 3.1 Terminology and data sources

In this report, 'new NDCs' refers to NDCs included in the United Nations Framework Convention on Climate Change (UNFCCC) NDC 3.0 list and, unless otherwise noted, high-level announcements of new NDC targets that have not yet been submitted (United Nations 2025; United Nations Framework Convention on Climate Change [UNFCCC] 2025a; UNFCCC 2025b). The term 'most recent NDCs' refers to the active NDCs in the UNFCCC registry of every party to the Paris Agreement, regardless of whether the party has submitted or announced a 'new' NDC. Currently there are 168 active NDCs (the European Union and its member states are counted as one party because they submit a common NDC). The cut-off date for the literature and data

assessed in the report is 30 September 2025 unless otherwise noted. Country-level emissions include territorial emissions unless otherwise stated.

In contrast to chapter 2, this chapter uses historical energy and industry emissions from the latest national GHG inventories, as compiled by the PRIMAP-hist project (Gütschow, Busch and Pflüger 2025). Historical CO₂ emissions from land use, land-use change and forestry (LULUCF) are also taken from the national GHG inventories (EU Observatory on Deforestation and Forest Degradation 2025). These methodological choices cause minor variations in country-level emission estimates between chapters 2 and 3.

The United States of America Government has given notice of its withdrawal from the Paris Agreement (United States of America, White House 2025). This withdrawal will come into effect one year after the formal notification, so the new NDC submitted by the United States of America is still active. However, given the volume of the country's emissions, this report also examines the expected effects of its NDC becoming inactive when it exits the Paris Agreement.

formulations, but have not noticeably broadened the scope of sectors and gases covered by the targets.

Forty-four NDCs (including those of all developed countries) now contain absolute targets relative to a base year, while another nine have fixed-level targets that specify the emissions level in the target year. This is up from 35 and 5, respectively, at the time of the adoption of the Paris Agreement. While baseline scenario targets still appear in a majority of NDCs, in their new NDCs six parties switched from baseline scenario targets to base-year targets, a welcome move because base-year and fixed-level targets are generally considered to be more robust than other types from an accounting and transparency perspective. Parties are also increasingly considering gender in their NDCs to promote inclusive and effective climate action

3.2 Global overview of new nationally determined contributions

3.2.1 NDCs have become slightly more robust over time but this evolution has been slow, and the new NDCs have done little to accelerate progress

This section assesses the new NDCs against language in the Paris Agreement and the first global stocktake.² First, it examines the stipulation in the Paris Agreement that developed countries' NDCs should contain economy-wide, absolute emission reduction targets, while developing countries are encouraged to move over time towards economy-wide targets. Second, it considers the call in the global stocktake for parties to submit "ambitious, economy-wide emission reduction targets, covering all GHGs, sectors and categories" (UNFCCC 2023).

Parties have not materially improved the sector and gas coverage of targets in their most recent NDCs. Ninety NDCs now cover all sectors, including LULUCF. While this is a marked improvement from the time of the Paris Agreement, when only 53 NDCs did so, most of this increase took place in earlier updates and progress appears to have stalled in the new NDCs. Only 25 NDCs cover all seven Paris Agreement GHGs, while 108 cover at least the three major gases (CO₂, methane and nitrous oxide), up from 20 and 80 respectively in 2015. Again, the new NDCs do not significantly improve on this metric. Moreover, while several decisions since the twenty-sixth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 26) have requested countries to revisit and strengthen their 2030 targets, only 91 NDCs (accounting for 79 per cent of global emissions) have ever done so, and only 13 countries (responsible for only 1 per cent of global emissions) have strengthened their 2030 targets in the new submissions.

² This section does not consider the new NDCs announced recently by three parties.

The overall conclusion is that NDCs have become slightly more robust over time, but this evolution has been very slow, and the new NDCs have done little to accelerate progress.

3.2.2 Alignment with sectoral elements of the global stocktake outcome is still lacking

The outcome of the first global stocktake clarified sector-specific global mitigation effort areas and goals. Paragraph 28 “calls on Parties to contribute ... in a nationally determined manner” to a range of sector-specific efforts, mainly in the energy and industry sectors (UNFCCC 2023). This section examines how NDCs fare against these efforts and goals.

The global stocktake set targets to triple renewable energy capacity and double the annual rate of energy efficiency improvement by 2030. The latest available assessments, based on active NDCs in 2024, indicate that renewable energy capacity would increase by 2.0–2.2 times (International Renewable Energy Agency [IRENA] 2024; Altieri and Jones 2025; International Energy Agency [IEA] 2025), falling well short of the tripling target. These commitments appear conservative, however, in light of prevailing policies and market dynamics, which look to increase capacity by 2.7 times (IEA 2025), much closer to (though still short of) the tripling goal. While it is not yet clear to what extent the new NDCs will increase progress on this point, it is encouraging that 70 per cent of them now contain a renewable capacity target (Marshall, Gompertz and Senlen 2025).

Regarding energy efficiency, active NDCs in 2024 would increase the global efficiency improvement rate by an average of 2.8 per cent per year through to 2030 (IEA 2024), falling short of the global stocktake goal of doubling the improvement rate. Moreover, actual improvements have declined in recent years, falling to 1 per cent per year in 2023 and 2024 (IEA 2024). Again, the effect that the new NDCs will have on this metric is not yet clear. To date, most (91 per cent) new NDCs mention energy efficiency, although just under half (49 per cent) set an improvement target (Marshall, Gompertz and Senlen 2025).

In addition to these specific targets, the global stocktake outlines a range of global efforts to reduce reliance on fossil fuels. While these are not quantified, the International Energy Agency (IEA’s) net-zero scenario provides benchmarks against which NDCs might be measured. Regarding their

fossil fuel aspirations, NDCs active in 2024 do not fare particularly well. For instance, they would, by 2030, leave the world with 1.4 times as much unabated coal power generation capacity, 1.3 times as much energy-related CO₂ emissions, and 1.2 times as much primary energy supply from oil and gas as required in the IEA net-zero scenario (IEA 2024). Likewise, under those NDCs only 41 per cent of global energy supply would be from zero-carbon sources (IEA 2024). With regard to the new NDCs, more than half (62 per cent) set a target to reduce fossil fuel use in the electricity mix, while 29 per cent set a coal-phasedown target. To date, however, no NDCs set targets to reduce oil and gas production or trim inefficient fossil fuel subsidies (Marshall, Gompertz and Senlen 2025).

3.2.3 There is scope for increased clarity on conditionality and finance

The Paris Agreement requires that mitigation efforts in developing country parties be supported with finance, technology and capacity-building, and many parties have proposed NDCs that are fully or partially conditional on receiving such support. The Emissions Gap Report 2024 proposed that new NDCs should be “explicit about conditional and unconditional elements, with emerging market and developing economies providing details on the means of implementation they need, including institutional and policy change, as well as international support and finance required to achieve ambitious NDC targets for 2035.” This section briefly examines how NDC conditionality has evolved since 2015, as well as the finance needs identified in NDCs.

Since the adoption of the Paris Agreement, the share of NDCs that include one or more unconditional elements has increased over time, from 90 to 111 NDCs. As at 30 September 2025, NDCs identified US\$5.3 trillion in needs, of which US\$1.9 trillion was for conditional actions. Of the total finance needed for conditional actions, mitigation accounted for a total of US\$1.2 trillion (Climate Watch 2025a). It is important that NDCs be conducive to investment, particularly in countries that require conditional finance or seek private investment. Many NDCs still need to be clearer regarding finance needs and require credible implementation plans (box 3.2). Gender-responsive finance planning can enhance the effectiveness and equity of NDC implementation.

Box 3.2 Do the new NDCs provide clearer signals for investors?

NDCs can send investment signals by identifying specific investment opportunities that are well aligned with near- and long-term national climate priorities (Institutional Investors Group on Climate Change 2024). Clearly articulated financial indicators such as scope, granularity, policy alignment and other information needed for investment decisions can make NDCs particularly useful to investors (see [appendix B.1](#)) (Alberti, Alanah and Sawant 2025).

A preliminary assessment of the new NDCs submitted by 18 developing country parties (as at 31 May 2025) (Alberti, Alanah and Sawant 2025) showed that seven of these had enhanced either the scope or the granularity of their needs, but that improvement is needed across most indicators.

Key findings

- ▶ **Scope and granularity of needs:** Eight of the 18 updated NDCs quantified climate finance needs for both mitigation and adaptation; three costed mitigation only. Five of the NDCs provided granular detail on needs such as disaggregated sector- or project-level investment requirements. Critically, five parties did not quantify climate finance needs at all.
- ▶ **Private sector mobilization strategies:** While a majority of the NDCs referenced the private sector, eight of these references were high-level or unspecific. Strategies were improved in six of the updated NDCs, while four were weaker or less specific, making them less useful to investors.
- ▶ **Conditionality:** Most (15 out of 18) countries indicated that international support was needed to implement their NDCs, but specificity decreased for four countries compared to their previous NDCs, making it difficult to know which commitments depend on international resources.

▶ **Implementability:** All (18) NDCs included a general implementation plan for delivering climate objectives; only two, however, addressed details such as implementation responsibility, legal frameworks, timelines, budgets, and expected outcomes of specific measures. Many NDCs still lack a clear, actionable delivery roadmap, which is needed for coordinating implementation and building investor trust.

▶ **Alignment with national and sectoral plans:** Sixteen of the 18 mentioned alignment with other national or sectoral plans, but most provided only vague descriptions of how this was to be accomplished. Investors seek this alignment as it helps to reduce duplication and streamline coordination. It also signals policy coherence, reducing the likelihood of risks arising from fragmentation and weak integration with broader development priorities.

The findings highlight the need for stronger investment and implementation planning in future NDCs. More international cooperation and support in preparing NDCs would help, particularly for emerging market and developing economies. Development finance institutions and private advisory groups can provide technical expertise and data infrastructure, and offer capacity-building programmes aimed at improving national investment planning capabilities. In sum, better investment 'signaling' in NDCs – linked to sound policies, enabling frameworks, and price incentives – will help attract climate finance that is aligned with development priorities. However, it should be noted that investment signals in NDCs in isolation are not enough to attract climate finance. Strong policies, enabling frameworks and price incentives remain key to enabling investment in NDCs and climate objectives.

3.3 G20 emissions pathways towards 2035: A deep dive

This section provides an overview of the new NDCs submitted or announced by G20 members (section 3.3.1) followed by an updated assessment of G20 members' collective and individual progress with respect to current policies in 2030 and 2035 (section 3.3.2) and progress

towards achievement of 2030 NDC targets (section 3.3.3). It also provides a preliminary assessment of the new NDCs and the extent to which they represent strengthened mitigation ambition (section 3.3.4), per capita emissions (section 3.3.5) and peaking of emissions and net-zero emission pledges (section 3.3.6).³⁴ See [appendix B.2](#) for data sources and assumptions used throughout this section.

³ The literature cut-off date for this analysis is 30 September 2025. This ensures that the most recent historical GHG emissions and recently adopted policies are considered. A list of the studies used, criteria for their inclusion, and other assumptions made in the assessment are available in [appendix B.4](#).

⁴ The assessment is based on a synthesis of emission scenarios presented in independent studies, most published in 2024 or later.

Throughout this section reference is made to figure 3.1, which shows for each G20 member historical emissions between 2000 and 2023 based on national GHG inventories; emission trajectories based on current policies; and target emission levels from 2030 and 2035 NDCs, as well as net-zero targets. Although it is a G20 member, the African Union is not assessed as it does not have a union-wide NDC.

3.3.1 Ten G20 members have submitted or announced new NDCs with mitigation targets for 2035

Seven G20 members submitted a new NDC by 30 September 2025 (Australia, Brazil, Canada, Japan, the Russian Federation, the United Kingdom and the United States of America), and three announced GHG mitigation targets for 2035 during the United Nations Climate Summit in September 2025 (China, the European Union and Türkiye), while Mexico outlined the stronger mitigation actions it intends to take (table 3.1). No G20 member has formally updated its 2030 NDC target since COP 29 (Climate Watch 2025a).

Table 3.1 Summary of the NDC mitigation targets of G20 members

G20 member ^a	2030 NDC	2035 NDC or mitigation pledge
Argentina	<ul style="list-style-type: none"> Cap 2030 net emissions at 349 MtCO₂e (unconditional) 	<ul style="list-style-type: none"> No new NDC submitted or mitigation pledge announced by 30 September 2025
Australia	<ul style="list-style-type: none"> Reduce GHG emissions by 43 per cent from 2005 levels by 2030 	<ul style="list-style-type: none"> Reduce GHG emissions by 62–70 per cent from 2005 levels by 2035
Brazil	<ul style="list-style-type: none"> Reduce net GHG emissions by 53 per cent from 2005 levels by 2030 	<ul style="list-style-type: none"> Reduction in the net range of 59–67 per cent compared to 2005 emissions
Canada	<ul style="list-style-type: none"> Reduce GHG emissions by 40–45 per cent from 2005 levels by 2030 	<ul style="list-style-type: none"> Reduce GHG emissions by 45–50 per cent from 2005 levels by 2035
China	<ul style="list-style-type: none"> Peak CO₂ emissions before 2030 Reduce CO₂/gross domestic product (GDP) by 65 per cent from 2005 levels by 2030 Increase share of non-fossil fuels in primary energy consumption to around 25 per cent in 2030 Increase forest stock volume by around 6 billion cubic metres by 2030 Increase the installed capacity of wind and solar power to 1,200 GW by 2030 	<ul style="list-style-type: none"> Announced mitigation pledge for 2035: By 2035, reduce economy-wide net GHG emissions by 7–10 per cent from peak levels, striving to do better Increase the share of non-fossil fuels in total energy consumption to over 30 per cent Expand the installed capacity of wind and solar power to over six times the 2020 levels, striving to bring the total to 3,600 GW Scale up the total forest stock volume to over 24 billion cubic metres
European Union	<ul style="list-style-type: none"> Reduce net GHG emissions by at least 55 per cent from 1990 levels by 2030 	<ul style="list-style-type: none"> Announced mitigation pledge for 2035: Reduce net GHG emissions by 66–72 per cent from 1990 levels by 2035
India	<ul style="list-style-type: none"> Reduce GHG per unit of GDP by 45 per cent from 2005 levels by 2030 Increase the share of non-fossil energy in total power capacity to around 40 per cent by 2030 (conditional, depending on finance) Increase the carbon sink volume by an additional 2.5–3 GtCO₂e 	<ul style="list-style-type: none"> No new NDC submitted or mitigation pledge announced by 30 September 2025
Indonesia	<ul style="list-style-type: none"> Reduce GHG emissions by 29 per cent (unconditional) and 41 per cent (conditional) relative to the business-as-usual (BAU) scenario by 2030 	<ul style="list-style-type: none"> No new NDC submitted or mitigation pledge announced by 30 September 2025
Japan ^b	<ul style="list-style-type: none"> Reduce GHG emissions by 46 per cent from 2013 levels by 2030 	<ul style="list-style-type: none"> Reduce GHG emissions by 60 per cent from 2013 levels by 2035
Mexico ^c	<ul style="list-style-type: none"> Reduce GHG emissions by 35 per cent (unconditional) and 40 per cent (conditional) from BAU by 2030 	<ul style="list-style-type: none"> No new NDC submitted by 30 September 2025; mitigation plans presented at the United Nations Climate Summit

G20 member ^a	2030 NDC	2035 NDC or mitigation pledge
Republic of Korea	<ul style="list-style-type: none"> Reduce GHG emissions by 40 per cent from 2018 levels by 2030 	<ul style="list-style-type: none"> No new NDC submitted or mitigation pledge announced by 30 September 2025
Russian Federation	<ul style="list-style-type: none"> Reduce GHG emissions to up to 70 per cent of the 1990 level by 2030 	<ul style="list-style-type: none"> Reduce GHG emissions to 65–67 per cent of the 1990 level by 2035
South Africa	<ul style="list-style-type: none"> Limit 2030 emissions to 350–420 MtCO₂e 	<ul style="list-style-type: none"> No new NDC submitted or mitigation pledge announced by 30 September 2025
Saudi Arabia	<ul style="list-style-type: none"> Reduce emissions by 278 MtCO₂e annually by 2030, with 2019 as the base year 	<ul style="list-style-type: none"> No new NDC submitted or mitigation pledge announced by 30 September 2025
Türkiye	<ul style="list-style-type: none"> Reduce GHG emissions by 41 per cent from the BAU level by 2030 	<ul style="list-style-type: none"> Announced mitigation pledge for 2035: Reduce GHG emissions to 643 MtCO₂e by 2035
United Kingdom	<ul style="list-style-type: none"> Reduce GHG emissions by at least 68 per cent from 1990 levels by 2030 	<ul style="list-style-type: none"> Reduce GHG emissions by at least 81 per cent from 1990 levels by 2035
United States of America ^d	<ul style="list-style-type: none"> Reduce GHG emissions by 50–52 per cent from 2005 levels by 2030 	<ul style="list-style-type: none"> Reduce GHG emissions by 61–66 per cent from 2005 levels by 2035

Note: ‘Net GHG emissions’ refers to total GHG emissions minus the quantity of GHGs removed or offset.

- The African Union is not listed as it does not have a collective mitigation target.
- Japan also communicated a 2040 target to reduce its emissions by 73 per cent from 2013 levels.
- Mexico referred to stronger mitigation commitments at the United Nations Climate Summit, but stopped short of making this a pledge.
- As the United States of America is withdrawing from the Paris Agreement, its NDC will no longer be in effect as of 27 January 2026.

3.3.2 G20 members’ emission projections under current policies in 2030 and 2035

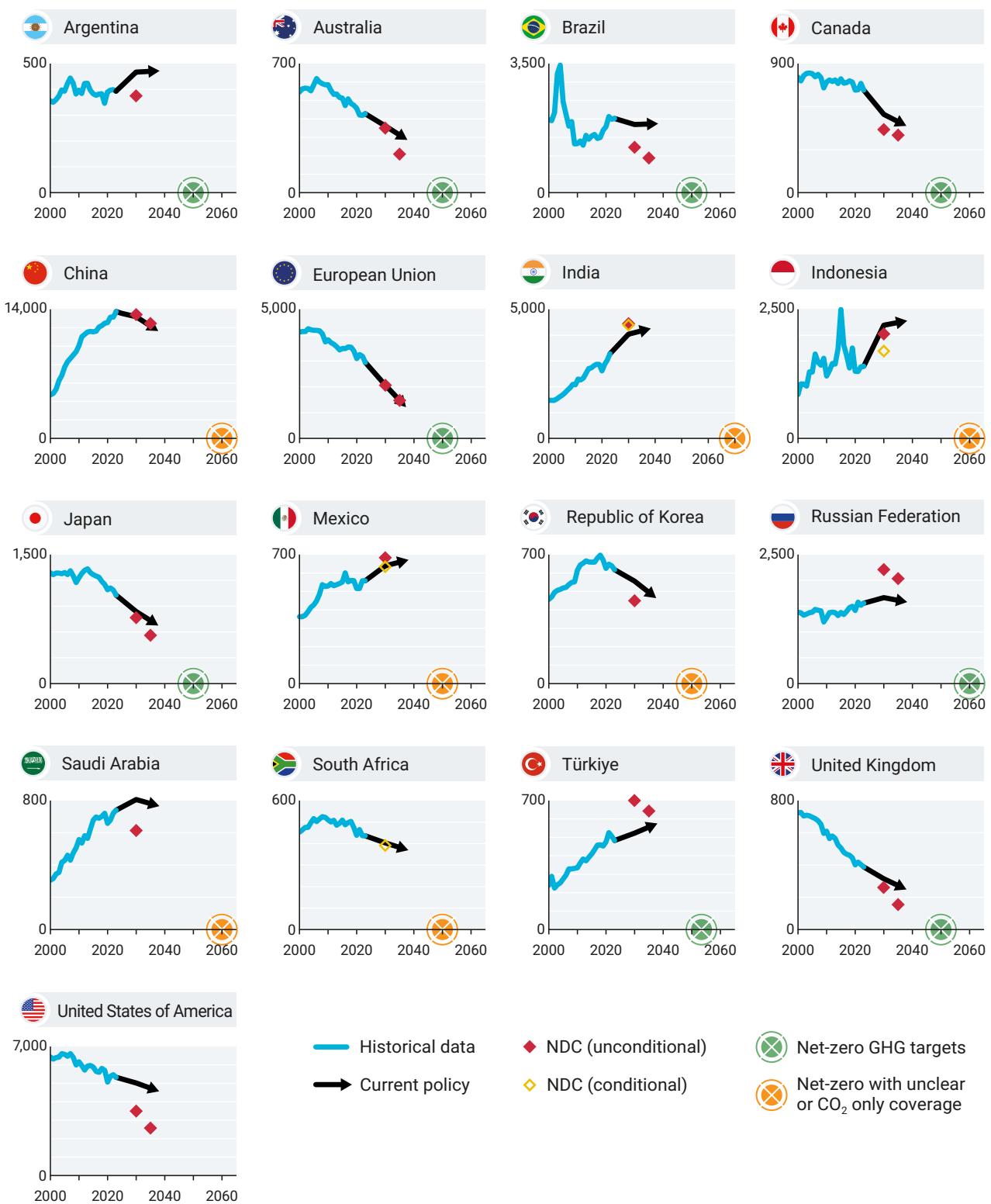
Current policies scenarios project GHG emissions based on policies already adopted and/or implemented. For 2030, the G20 aggregate emissions under current policies are projected to be 35 GtCO₂e (sum of central estimates).⁵ While the results are largely similar to last year’s at the aggregate level, there are significant changes for individual G20 members, particularly the United States of America and China. Lower projections for China and several other countries are cancelled out by higher projections for the United States of America (figure 3.1). The latest projections for China in three annually updated studies from the Climate Action Tracker (2025b), the Joint Research Centre of the European Commission (Keramidas *et al.* 2025) and PBL (Nascimento *et al.* 2024; den Elzen *et al.* 2025a; den Elzen *et al.* 2025b) show peaking occurring around 2025 followed by a reduction in emissions of 0.3–1.4 GtCO₂e by 2030, whereas these same studies previously saw continued emission

growth until 2030. This new trend is largely explained by the growth of renewable electricity generation in China outpacing overall growth in power demand. In contrast, the 2030 emission projections for the United States of America have increased by 1 GtCO₂e (range of two studies: 0.8–1.1 GtCO₂e) from last year’s assessment, largely due to policy reversals.

For 2035, the G20 aggregate emissions under current policies are projected to drop to 33 GtCO₂e, i.e. 2 GtCO₂e lower than 2030’s figure (sum of central estimates). China is the largest contributor to this projected reduction (1 GtCO₂e), followed by the European Union (0.6 GtCO₂e) and the United States of America (0.2 GtCO₂e). Other G20 members are on clear downward emission trends and several more might peak or plateau between 2030 and 2035 under current policies, while others are projected to continue increasing their emissions up to 2035 (figure 3.1). Section 3.3.6 explores peaking in greater detail.

⁵ For 2030 and 2035 projections, only the central estimates are presented (median values when five or more studies were available, otherwise they are average values, following the approach in den Elzen *et al.* [2019]); see [appendix B.2](#) for data sources and assumptions.

Figure 3.1 G20 members' emissions trajectories implied by historical emissions, current policies, NDC targets and net-zero targets



Note: All figures include emissions from LULUCF.

3.3.3 Collectively, G20 members are not estimated to achieve their 2030 NDC targets

Figure 3.1 presents central estimates of emissions for G20 members based on current policies and unconditional NDC target projections. Further detail is provided in table 3.2.⁶ Seven G20 members are likely to achieve their unconditional NDC targets with existing policies, while nine are projected to fall short. Estimates for Indonesia remain highly uncertain due to large fluctuations in land-use emissions during the past several years (EU Observatory on Deforestation and Forest Degradation 2025). South Africa is a new addition to the list of countries projected to achieve their NDC target, while some of the nine countries projected to fall short – Australia and Japan for example – are making progress and are very close to achieving their 2030 NDC targets with existing policies and measures. The projected emissions for the Russian Federation and Türkiye under current policies are considerably below their unconditional NDC target levels

(25 per cent based on central estimates). Three countries communicated both unconditional and conditional NDC targets; of these, India is projected to achieve its conditional target while Indonesia and Mexico are projected to fall short of their conditional NDC targets under current policies.

On an aggregate level, G20 members' emissions under the 2030 unconditional NDCs, including the NDC of the United States of America and not taking into account the expected overachievement by China, India, the Russian Federation and Türkiye, are projected to be 33 GtCO₂e. The G20's implementation gap, which is defined as the difference between projected emissions under NDC scenarios and those expected based on current policies (den Elzen *et al.* 2019; Fransen *et al.* 2023), is therefore around 2 GtCO₂e for the unconditional NDCs, increasing to 3–4 GtCO₂e if adjusted for expected overachievement. If the analysis is based on conditional NDCs, the implementation gap widens slightly, by about 0.5 GtCO₂e.

Table 3.2 Assessment of progress towards achieving the unconditional 2030 NDC targets ([x/y] denotes how many studies [x] out of the total number considered [y] project that the target will be achieved)

Likely to meet the target with existing policies (Bold font indicates the country overachieved by more than 15 per cent)	Less likely to meet the target with existing policies	Uncertain
China [6/7] European Union [2/3] ^a	Argentina [0/3] Australia [1/3] ^a	Indonesia [2/3]
India [4/5]	Brazil [0/3]	
Türkiye [3/3]	Canada [0/4] ^a	
Russian Federation [3/3]^a	Japan [1/4]	
South Africa [conditional: 2/4]^b Mexico [3/3]	Republic of Korea [0/4] Saudi Arabia [0/3] United Kingdom [0/2] ^a United States of America [0/2] ^a	

Note: All NDCs considered in this assessment are unconditional NDCs unless otherwise stated. The assessment is based on independent studies mainly published in 2021 or later. The number of independent studies that project a country will meet its current NDC target is compared to the total number of studies. This ratio is indicated in brackets.

- a. Current policies scenario projections available in official publications were also examined. The official publications for three G20 members (Canada, the European Union and the United Kingdom) show that these countries do not expect to meet their 'point in time' NDC target under their current policies scenarios (European Environment Agency [EEA] 2024; United Kingdom, Department for Energy Security and Net Zero 2024; Canada 2025). Australia projected that it is very close to achieving the target (Australia, Department of Climate Change, Energy, the Environment and Water 2024). For the European Union, the official projections by the EEA (under the existing measures scenario) do not fully account for the member state-level implementation of European Union-wide policies (EEA 2024).
- b. One study suggests that South Africa is "within reach", meaning that the lower bound estimate of a current policy scenario projection is within the NDC target range.

⁶ As in the 2024 edition of this report, South Africa's 2030 NDC is considered conditional, based on the World Resources Institute's categorization (Climate Watch 2025a).

3.3.4 The new NDCs indicate limited progress on collective mitigation ambition

This section examines the impact of the new NDCs submitted or announced by G20 members on projected emissions and assesses the extent to which they move beyond the prior NDCs and current policies of these members collectively and individually.

New NDC targets for 2035 are lower than 2030 NDC targets

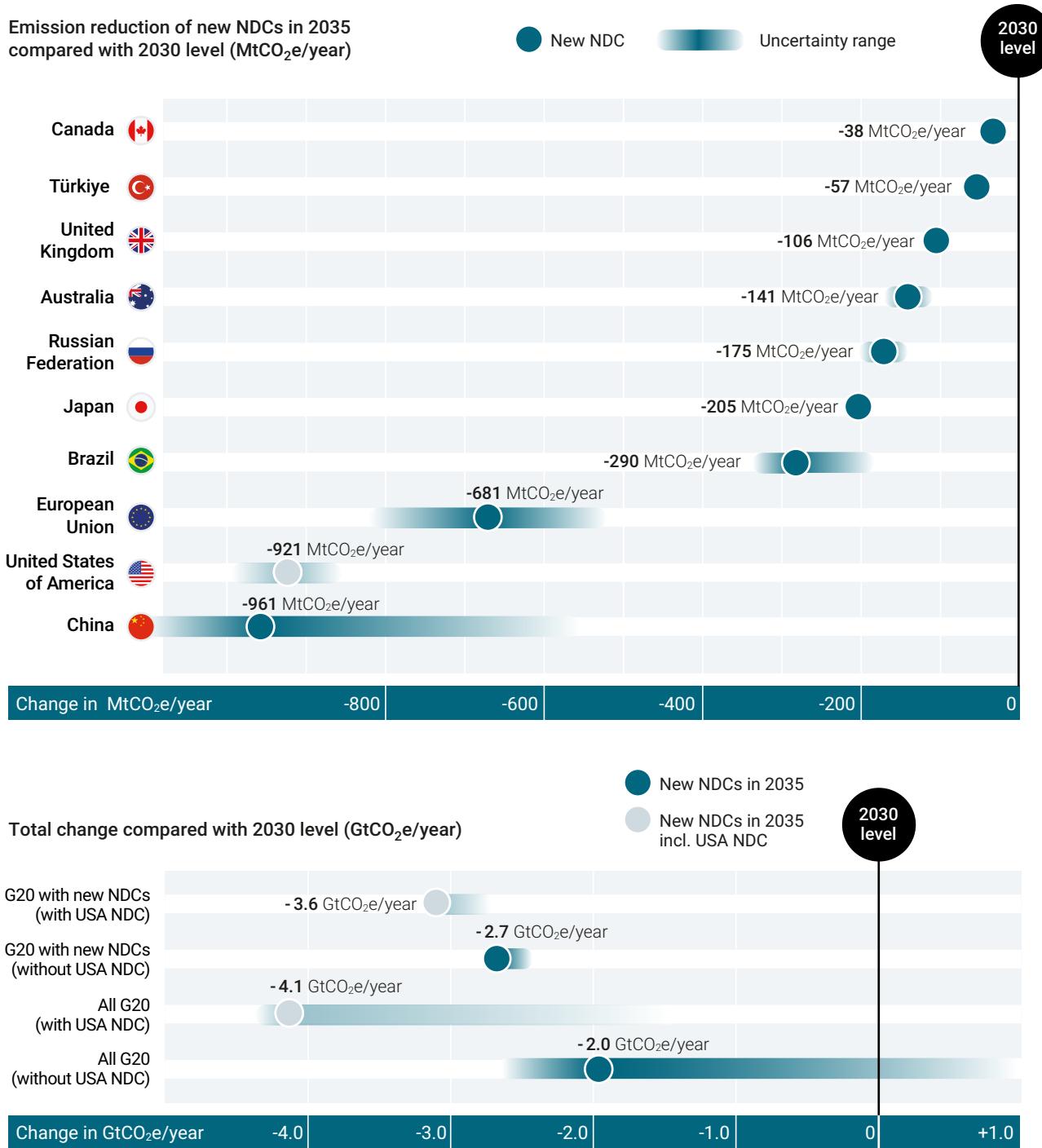
Figure 3.2 shows the estimated impact on GHG emissions in 2035 of the new unconditional NDC targets announced or submitted by ten G20 members, compared with the estimated 2030 levels based on the previous NDCs. This gives a weak indication of the extent to which ambition in the new NDCs has been strengthened, by showing whether 2035 target emissions are lower than 2030 target emissions.

If fully implemented, these 10 members' total GHG emissions in 2035 will be reduced by 3.6 GtCO₂e (range: 3.3–3.6) compared with emissions in 2030 based on the NDC emission targets (upper part of figure 3.2). This estimate drops to 2.7 GtCO₂e (range: 2.5–2.7) once the United States of America withdraws from the Paris Agreement and its NDC becomes void, thereby cancelling 25 per cent of the projected emission reductions compared with 2030 levels.

If all the G20 members are considered collectively, total G20 emissions in 2035 are estimated to be about 4 GtCO₂e (range: 1–4 GtCO₂e) below 2030 levels (lower part of figure 3.2). Here, current-policy scenarios are used as a substitute for new NDC targets for the G20 members yet to submit these targets (see chapter 4, table 4.1 for details on the methodology). Excluding the United States of America's NDC would halve this estimate to 2 GtCO₂e, because the reversal of the country's domestic climate regulations and laws is estimated to increase the country's projected emissions by 1.2 GtCO₂e in 2035 instead of reducing these by 0.9 GtCO₂e.



Figure 3.2 Emissions in 2035 implied by the new unconditional NDCs of G20 members compared with 2030 NDC targets, individually (upper figure) and collectively (lower figure)



Note: Estimates are shown both including and excluding the NDC of the United States of America.

Ranges indicate that G20 members have submitted ranges for their 2035 mitigation targets in their new NDCs.

Collectively, the new NDCs show limited mitigation ambition beyond existing policies for 2035

A comparison of 2035 emissions under the new NDCs with those expected under current policies indicates whether the new NDCs represent increased mitigation ambition beyond what would result from policies already in place. This metric is key to assessing the ambition-raising mechanism of the Paris Agreement (Nascimento et al. 2024).

Figure 3.3 shows that the total estimated emissions in 2035 resulting from the new unconditional NDCs of the ten G20 members are about 2.8 GtCO₂e/yr (range: 1.8–5.9) lower than emissions based on current policy projections (upper part of figure 3.3). Considering the G20 collectively changes this estimate to 3.6 GtCO₂e/yr (range: 2.7–3.0) (lower part of figure 3.3). Again, these totals are based on the inclusion of the NDC of the United States of America. Once the country exits the Paris Agreement and its NDC becomes void, the estimates drop to about 0.7 GtCO₂e/yr and 1.5 GtCO₂e/yr respectively, indicating the limited global ambition of the remaining new NDCs relative to current policies.

As figure 3.3 illustrates, the new NDC targets of Brazil and the United States of America make up the largest absolute contributions to the estimated total, followed by those of Japan, the United Kingdom, Australia, Canada and the European Union (although it should be noted that there is a large uncertainty range around the median estimate). The new NDC targets of Türkiye and the Russian Federation are less ambitious than emission levels resulting from current policies projections. China's new NDC target is also assessed to be less ambitious than the current policies scenario. However, this assessment is subject to considerable uncertainty, as indicated by the large uncertainty range around the median estimate for China.

3.3.5 Per capita emissions of G20 members continue to differ widely

Per capita GHG emissions in 2019 and projections under NDC targets and current policies scenarios are presented in figure 3.4, grouped by the per capita income levels of G20 members. High-income members (as defined by the World Bank [2025]) are all expected to steadily reduce their per capita emissions in the years to 2035. Fully achieving 2035 pledges would reduce the per capita emissions levels of several high-income G20 members (e.g. the European Union, Japan and the United Kingdom) to levels similar to those of lower-middle-income members. Several high-income G20 members, however, are still on course to emit more than 10 tCO₂e per capita in 2035 – this is a higher level than that of almost all middle-income G20 members today.

The declining emissions trend observed for high-income G20 members is less apparent for middle-income G20 members. It is a positive sign, however, that many of these countries are projected not to increase their per capita emissions much beyond current levels despite their need for further economic development.

3.3.6 Mixed progress among the G20 members in terms of peaking of emissions and net-zero emission pledges

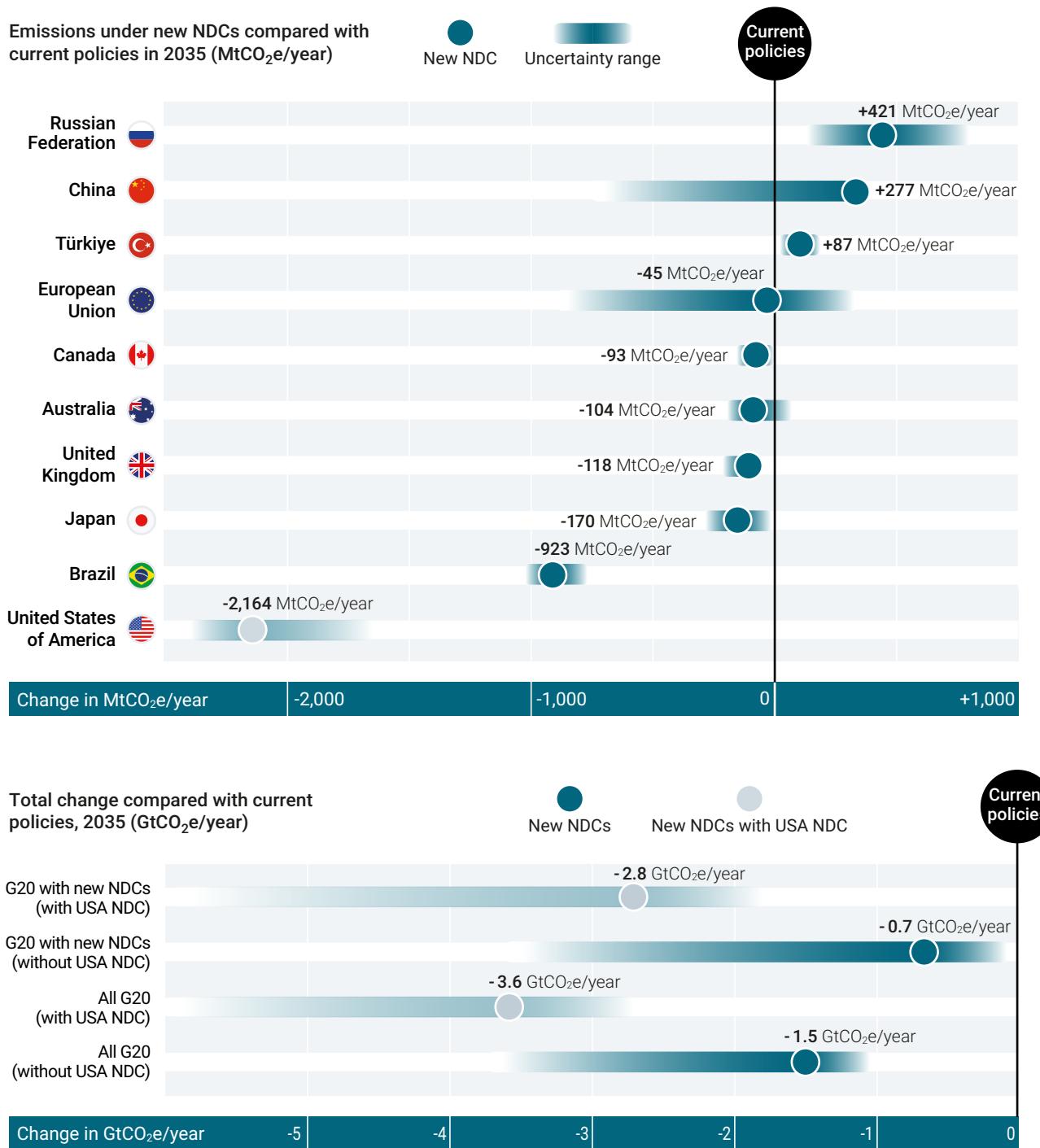
The outcome of the first global stocktake encourages parties to align their NDCs with 1.5°C, "as informed by the latest science, in the light of different national circumstances" (UNFCCC 2023). It also notes the importance of aligning NDCs with long-term, low emissions development strategies, which in turn are to be "towards just transitions to net-zero emissions." The global stocktake recognizes that in scenarios limiting warming to 1.5°C (>50 per cent), global emissions reach their peak between 2020 and 2025, noting that "this does not imply peaking in all countries within this time frame, and that time frames for peaking may be shaped by sustainable development, poverty eradication needs and equity and be in line with different national circumstances" (UNFCCC 2023).

This section contains an assessment of G20 members' NDCs with regard to their implications for peaking emissions and for achieving countries' self-defined net-zero targets (figure 3.1). The analysis uses data from Gütschow, Busch and Pflüger (2025) and from the EU Observatory on Deforestation and Forest Degradation (2025) to identify countries that have already peaked emissions, countries that have not done so, and countries for which this status varies according to the assessment methodology chosen. For countries that have not yet peaked, the analysis notes whether they commit to peak timing in their NDCs and/or long-term low emissions development strategies. It then assesses implementation progress towards stated net-zero targets.

A country's emissions are considered to have peaked if an established minimum time has passed since its year of maximum emissions (5 years and 10 years are the two time periods established, and calculations are done including and excluding LULUCF), and if its current policy trajectory indicates that future emissions will continue to decline in the years to 2035.

Emissions Gap Report 2025: Off target

Figure 3.3 Emissions in 2035 implied by the new unconditional NDCs of G20 members compared with current policy projections, individually (upper figure) and collectively (lower figure)



Note: Estimates are shown both including and excluding the NDC of the United States of America.

The ranges represent the reduction relative to the minimum and maximum level of the current policies scenario.

For 11 of the 17 G20 members (this total of 17 excludes the African Union, as it does not have a union-wide target, and counts the European Union, France, Germany and Italy as one member), this status is insensitive to the time period, while for six it is sensitive. Canada, the European Union, Japan, South Africa, the United Kingdom and the United States of America have peaked in emissions according to all four tests (5 years, 10 years, including and excluding LULUCF). China, India, Saudi Arabia and Türkiye have not yet peaked according to all of the four tests. Argentina, Australia and Brazil are sensitive to the inclusion of LULUCF: Argentina and Brazil peaked more than 10 years ago when LULUCF is included, but have not yet definitively peaked when it is excluded, while Australia has peaked by all measures except the 10-year period excluding LULUCF (Australia's non-LULUCF emissions peaked in 2018). The Republic of Korea has peaked when the five-year criteria is applied but not the 10-year period, while Indonesia and Mexico show localized peaks in 2015 and 2016, respectively, but current policies suggest emissions will continue to rise through to 2035. The Russian Federation peaked before 1990, preceding the economic crash that accompanied the collapse of the Soviet Union, but its emissions have been steadily rising throughout the twenty-first century.

For countries that have not yet peaked, or have peaked less than five years ago including LULUCF, stated or implied commitments to peaking in NDCs and long-term low emissions development strategies can also be assessed. Of these countries, Indonesia commits to peaking GHG emissions by 2030, while China commits to peaking CO₂ emissions before 2030. Türkiye commits to peaking emissions in 2038. India and Saudi Arabia would not peak by 2030 according to their NDCs and do not specify post-2030

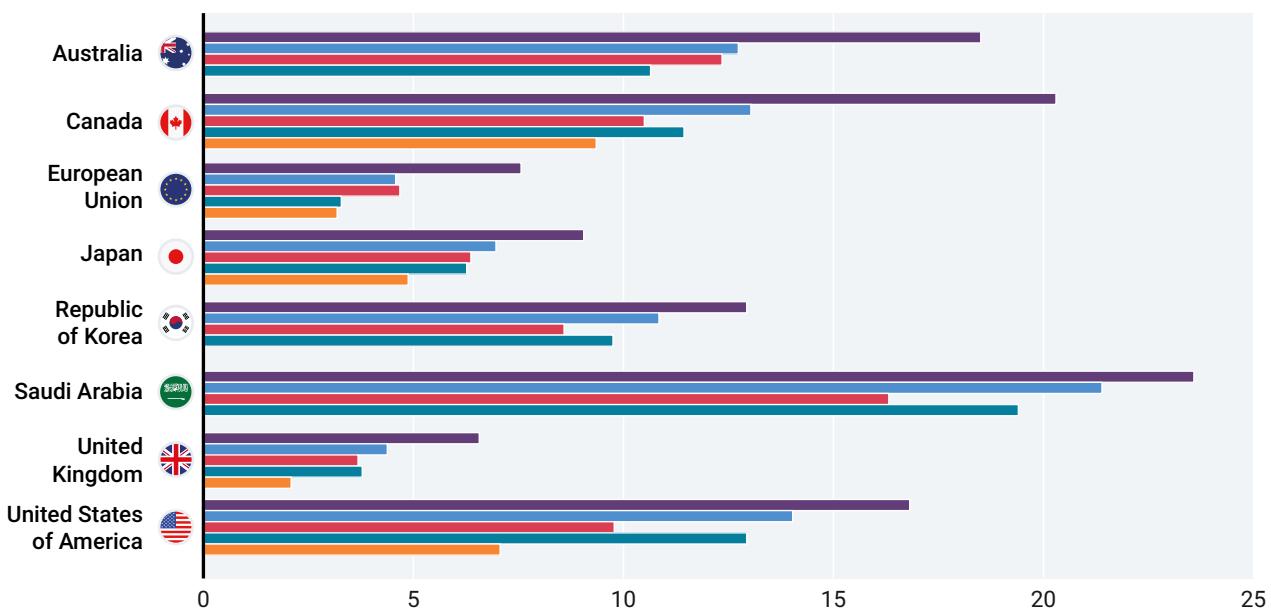
emission trajectories other than their net-zero commitments. To achieve their net-zero goals, the countries in this group would need to transition from peak to net-zero emissions in much less time than the countries that have already peaked.

Because they account for 77 per cent of current global emissions, G20 members will largely determine when global emissions reach net zero. Following Mexico's November 2024 commitment to reach net-zero emissions by 2050, all G20 parties to the Paris Agreement briefly had net-zero targets in place – until the United States of America began rolling back its climate policies in January 2025. Also over the past year, Indonesia has signalled that it could achieve its net-zero target 10 years early, in 2050 rather than 2060 (Climate Watch 2025b), and Brazil has made progress in clarifying the parameters of its net-zero target and moved forward with implementation planning (table 3.4). Additional information about the methods used to assess these targets can be found in [appendix B.4](#).

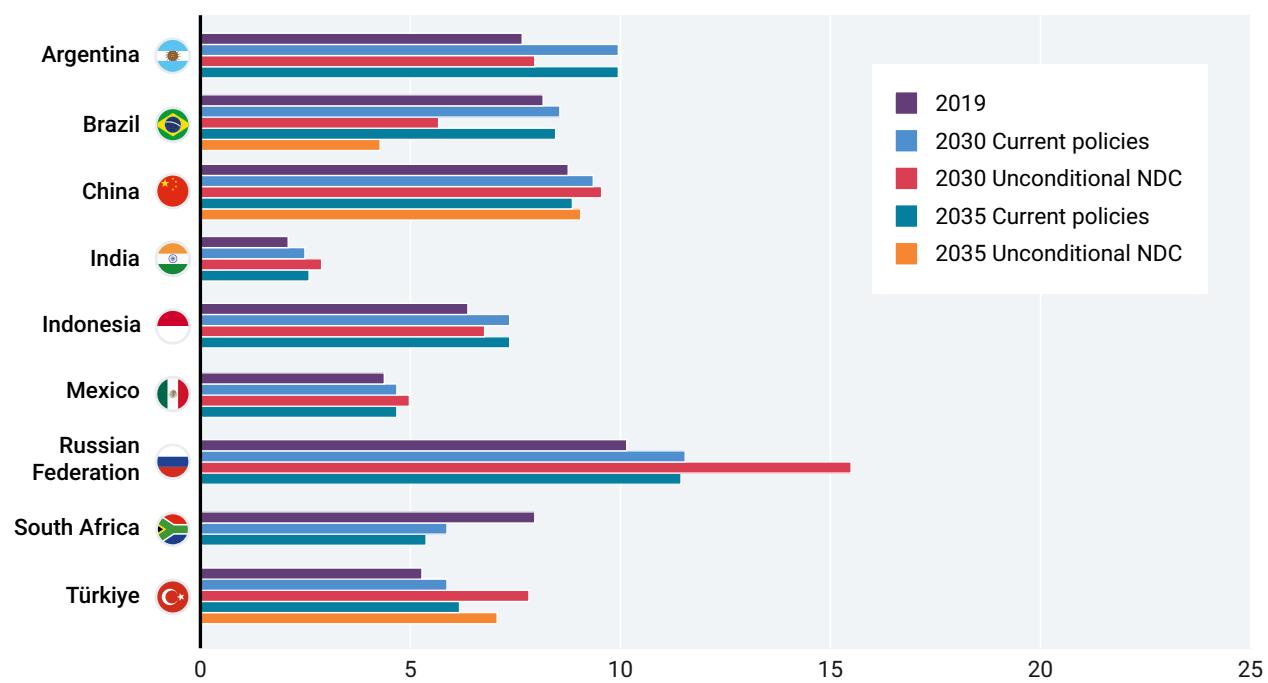
Nevertheless, indicators of actual net-zero implementation activity consistent with the projections in figure 3.1 remain generally weak in G20 members (Rogelj *et al.* 2023). Examples of such activity include legislation and regulations, high quality implementation plans, and alignment of near-term emission trajectories with net-zero targets. Table 3.4 presents a meta-analysis of the key characteristics of G20 members' net-zero targets based on three independent trackers (Climate Action Tracker 2025a; Climate Watch 2025b; Net Zero Tracker 2025). The criterion for inclusion in this analysis is that a tracker must track the net-zero targets of a majority of G20 members (see [appendix B.4](#) for the detailed methodology).

Figure 3.4 2030 and 2035 per capita emissions of G20 members implied by current policies and NDCs, by income group (including LULUCF emissions)

High-income G20 members (tCO₂e/capita)



Upper- and lower-middle-income G20 members (tCO₂e/capita)



Note: Country income group classification is based on World Bank (2025).

For South Africa, the conditional NDC target is presented for 2030.

For 2030 and 2035 projections, only the central estimates are presented (median values when five or more studies were available, otherwise they are average values, following the approach in den Elzen et al. [2019]); see [appendix B.2](#) for data sources and assumptions.

Data on historical and projected (medium fertility variant) population per country are taken from the United Nations World Population Prospects 2024 (United Nations, Department of Economic and Social Affairs 2024).

Historical emissions data for 2019 were compiled from the latest national GHG inventories (EU Observatory on Deforestation and Forest Degradation 2025; Gütschow, Busch and Pflüger 2025).

Table 3.4 G20 net-zero targets: Status and details

Countries	Source	Target year	Covers all sectors and gases	Transparent information on carbon removal	Comprehensive published plan	Review process	Annual reporting
High-income G20 members							
Australia	in law	2050	✓	✗	[inconclusive]	✓	✓
Canada	in law	2050	✓	✓	✓	✓	✓
European Union	in law	2050	✓	✓	✓	✓	✓
France	in law	2050	✓	[not evaluated]	✓	[not evaluated]	✓
Germany	in law	2045	✓	✓	✓	✓	✓
Italy	in policy document	2050	✓	[not evaluated]	✓	[not evaluated]	✓
Japan	in law	2050	✓	✗	✓	✓	✓
Republic of Korea	in law	2050	✓	✓	✓	✓	✓
Saudi Arabia	government announcement	2060	?	✗	✗	?	✗
United Kingdom	in law	2050	✓	✓	✓	✓	✓
United States of America	not in force	N/A	N/A	N/A	N/A	N/A	N/A
Upper- and lower-middle-income G20 members							
Argentina	in policy document	2050	✓	✗	[inconclusive]	?	✗
Brazil	in policy document	2050	✓	[not evaluated]	✓	[not evaluated]	✗
China	in policy document	2060	?	✗	✓	✓	✗
India	in policy document	2070	?	✗	[inconclusive]	?	✗
Indonesia	in policy document	2060 in policy; pledged to achieve by 2050	✓	✗	[inconclusive]	?	✗
Mexico	government announcement	2050	?	[not evaluated]	✓	[not evaluated]	✗
Russian Federation	in law	2060	✓	✗	✓	✓	✗
South Africa	in policy document	2050	✓	✗	[inconclusive]	?	✓
Türkiye	in law	2053	✓	✗	✓	?	✗
Other G20 members							
African Union	no union-wide net-zero target; not party to the Paris Agreement	N/A	N/A	N/A	N/A	N/A	N/A

✓ Fulfilled

○ Partially fulfilled

✗ Not fulfilled

? No information



4 The emissions gap in 2030 and 2035

Lead authors:

Joeri Rogelj (Imperial College London, United Kingdom/Belgium; International Institute for Applied Systems Analysis [IIASA], Austria), Michel den Elzen (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands) and Dan Tong (Tsinghua University, China)

Contributing authors:

Matt Gidden (Center for Global Sustainability, University of Maryland, United States of America), Lena Höglund Isaksson (IIASA, Austria/Sweden) and Robin Lamboll (Imperial College London, United Kingdom)

Data contributors:

Ioannis Dafnomilis (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands), Florian Fosse (European Commission, Joint Research Centre [JRC], Spain), Taryn Fransen (World Resources Institute, United States of America), Mengpin Ge (World Resources Institute, United States of America), Sarah Heck (Climate Analytics, Germany), Christopher Henderson (World Resources Institute, United States of America), Elena Hooijsscher (PBL Netherlands Environmental Assessment Agency, Kingdom of the Netherlands), Kimon Keramidas (European Commission, JRC, Spain), Malte Meinshausen (University of Melbourne, Australia; Climate Resource, Australia), Ana Missirliu (NewClimate Institute, Germany), Alister Self (Climate Resource, Australia) and Ashna Siddhi (World Resources Institute, United States of America)

4.1 Introduction

This chapter updates the emissions gap, which is defined as the difference between the estimated global greenhouse gas (GHG) emissions resulting from the full implementation of the latest nationally determined contributions (NDCs), and the levels of emissions consistent with least-cost pathways that limit warming to levels associated with the long-term temperature goal of the Paris Agreement.

This year the key focus is to assess the implications for the emissions gap, and for global warming projections, of the submitted and announced new NDC mitigation targets for 2035 (sections 4.2, 4.3 and 4.4). By the cut-off date for inclusion in this report of 30 September 2025, 60 Parties covering 63 per cent of global GHG emissions had announced or submitted such targets, and another four parties had submitted new NDCs that did not contain 2035 mitigation targets. The chapter also examines whether NDC targets will be achieved by existing policies, or whether there is an implementation gap between policies and pledges. In addition, it considers the effects of the withdrawal of the United States of America from the Paris Agreement, which will take effect in late January 2026 and which will void the country's new NDC.

Finally, the failure to date to implement the stringent emissions cuts from 2020 assumed by least-cost pathways consistent with the Paris Agreement's long-term temperature goal, means that the 1.5°C pathways of the Intergovernmental Panel on Climate Change (IPCC) with no or limited overshoot are slipping out of reach. The final section explores new emerging 1.5°C pathways that take the lack of global action from 2020 into account, and their implications in terms of increased challenges, risks and uncertainty (section 4.5).

4.2 Scenarios for assessing the 2030 and 2035 emissions gap

The emissions gap assessment is based on four categories of scenarios: a current policies reference scenario; NDC scenarios; scenarios extending to the end of the century; and least-cost mitigation scenarios aligned with specific temperature limits (table 4.1). These scenarios provide the foundation for estimating the emissions gaps and the global temperature outcomes discussed in sections 4.3 and 4.4 respectively.

Table 4.1 Summary of scenarios for emissions gap assessment and global warming projections¹

Category	Scenario cases	Scenario description
Reference scenario	Current policies	This scenario projects global GHG emissions based only on policies adopted and implemented as of November 2024, as well as policy rollbacks in the United States of America as of September 2025.
NDC scenarios	Unconditional NDCs	This scenario projects GHG emissions assuming full implementation of the most recent NDCs and announced 2035 pledges that do not depend on explicit external support (cut-off date: 30 September 2025). For the G20 economies and major emitting countries that do not yet have a new NDC or announced pledge, it assumes a current policies scenario. For others, it assumes a continuation of efforts at a similar level of ambition to their 2030 pledge. Default projections include the NDC of the United States of America.
	Conditional NDCs	In addition to the unconditional NDCs and announced 2035 pledges, this scenario encompasses the most recent NDC targets for which implementation is contingent on receiving international support, such as finance, technology transfer and/or capacity-building (cut-off date: 30 September 2025). For the G20 economies and major emitting countries that do not have a new NDC or announced pledge, it assumes a current policies scenario, as described in chapter 3. For others, it assumes a continuation of efforts at a similar level of ambition to their 2030 pledge. Default projections include the United States of America's NDC.
Scenario extensions	Current policies continuing	This scenario follows current policies to 2035 and assumes a continuation of similar efforts thereafter.
	Conditional NDCs plus all net-zero pledges	This is the most optimistic scenario included. It assumes the achievement of the conditional NDC scenario until 2035 and all net-zero or other long-term low emissions development strategies (LT-LEDS) pledges (cut-off date: 30 September 2025) thereafter. The United States of America's former net-zero target is excluded.
Mitigation scenarios consistent with limiting global warming to specific levels	Below 2°C	A least-cost pathway starting from 2020 and consistent with keeping global warming below 2°C throughout the twenty-first century with at least a 66 per cent chance.
	Below 1.8°C	A least-cost pathway starting from 2020 and consistent with holding global warming below 1.8°C throughout the twenty-first century with at least a 66 per cent chance.
	1.5°C (with no or limited overshoot) ²	A least-cost pathway starting from 2020 and ensuring that global warming is kept below 1.5°C with at least a 33 per cent chance throughout the entire century and is brought back below 1.5°C with at least a 50 per cent chance by 2100. This pathway reaches net-zero GHG emissions in the second half of the century.

¹ Definitions used in emission projections for policy-related scenario cases (reference scenario, NDC scenarios, scenario extensions) have been aligned to ensure differences between estimates based on national GHG inventories and estimates based on global integrated assessment models are comparable, drawing on Gidden *et al.* (2023).

² 1.5°C scenarios have a lower probability of keeping warming below 1.5°C throughout the century than the 66 per cent probability of Below 1.8°C or Below 2°C scenarios, which is why they are qualified as having "no or limited overshoot". The no or limited overshoot characteristic is captured by ensuring that the probability of warming being limited to 1.5°C throughout the entire twenty-first century is never less than 33 per cent, identical to the C1a category definition used by the IPCC AR6 WG III report. Aligned with the definitions used in the IPCC Special Report on Global Warming of 1.5°C and IPCC AR6, the probability of returning warming to 1.5°C is set to 50 per cent, noting that because of the limit to peak warming, a strengthening of this to higher probabilities (such as 66 per cent in line with the definitions of the other mitigation scenarios) would have limited effect on the emissions milestones in 2030, 2035 and through to mid-century. It would affect assumed emissions and removals levels in the second half of the century, where a higher probability of returning warming to 1.5°C with at least 66 per cent probability would imply a larger deployment of net negative emissions through CO₂ removal.

All the scenarios follow methodologies similar to previous editions of the Emissions Gap Report. Further details are provided in [appendix C](#) of this year's report and in [appendix D](#) of last year's (United Nations Environment Programme [UNEP] 2024). Scenario estimates are summarized in tables 4.2–4.4).

The current policies scenario is based on updates from the same five modelling groups as last year, with projections extending to 2035 instead of 2030: Climate Action Tracker (2024), Planbureau voor de Leefomgeving (PBL) (Dafnomilis, den Elzen and van Vuuren 2024; den Elzen et al. 2023; Nascimento et al. 2024), JRC Global Energy and Climate Outlook (JRC-GECO) (Keramidas et al. 2025), ELEVATE (Hooijsscher et al. 2025)³ and the International Energy Agency (IEA) World Energy Outlook (IEA 2023; IEA 2024).⁴ The projections have been adjusted to reflect the recent changes to domestic climate regulations and laws in the United States of America, as calculated by three model teams (Climate Action Tracker, JRC and PBL) and based on the calculations of chapter 3.⁵ The current policies scenario results in global GHG emissions in 2030 and 2035 of 58 gigatons of carbon dioxide equivalent (GtCO₂e) (range: 51–62) and 54 GtCO₂e (range: 52–62), respectively

(tables 4.2–4.4). The 2030 estimate is slightly higher than last year's assessment (about 1 GtCO₂e), mainly due to policy rollbacks in the United States of America (see chapter 3). For 2035, the estimate is about 3 GtCO₂e lower, due to the impact of improved 2035 policy estimates (-2 GtCO₂e), methodological updates and harmonization (-2.5 GtCO₂e), offset by policy changes in the United States of America (+1.5 GtCO₂e).

The new pledges for 2035 are reflected in the updated NDC scenarios, based on findings from five modelling exercises conducted by Climate Action Tracker (2024), PBL (den Elzen et al. 2022; den Elzen et al. 2025a; den Elzen et al. 2025b), JRC-GECO (Keramidas et al. 2025), Climate Resource (Meinshausen et al. 2022; Climate Resource 2025) and the World Resource Institute (2025). All modelling teams have provided new GHG emission projections based on the new NDCs and announced pledges as part of a common model analysis, specifically for the Emissions Gap Report. The impact of the new pledges is summarized in table 4.2, alongside changes since last year's assessment resulting from updated emissions trends, policies and methodological improvements.⁶

Table 4.2 How GHG emission projections have changed since 2024 (median estimates) and the contributing factors

Scenario	Emissions Gap Report 2025	Emissions Gap Report 2024	Difference EGR 2025–EGR 2024**	Factors explaining differences between EGR 2025–EGR 2024 reports			
	New pledges or updated policy projections	Updated emissions trends (harmonization)	Methodological updates	Policy changes in the United States of America			
2030							
Current policies	58	57	1	0	0	0	+1
Unconditional NDCs*	53	55	-2	0	-0.5	-1.5	
Conditional NDCs*	51	52	-1	0	-0.5	-1	

³ REMIND model results were missing in the ELEVATE database, and included from the Network for Greening the Financial System (NGFS) study (NGFS Workstream on Scenario Design and Analysis 2024) instead.

⁴ Note that last year's analysis started future extensions of current policies and NDCs from 2030 onwards. This year's analysis builds on additional data, which also includes 2035. This change in the source of estimates for 2035 results in a lowering of the 2035 estimate of about 4 GtCO₂e compared to last year.

⁵ The adjustment is based on the difference between the emission projection of the current policies scenario for the United States of America accounting for the policy rollbacks, as calculated in chapter 3, and the emission projection of the current policies scenario without the policy rollbacks from the five individual model studies. PBL includes its own calculations of the impact of the policy rollbacks.

⁶ The most significant methodological improvement is that all underlying studies now account for the fact that certain countries are expected to overachieve their NDCs, which lowers the global emission projections, in particular for the unconditional NDC scenario.

	Emissions Gap Report 2025	Emissions Gap Report 2024	Difference EGR 2025– EGR 2024**	Factors explaining differences between EGR 2025–EGR 2024 reports			
Scenario				New pledges or updated policy projections	Updated emissions trends (harmonization)	Methodological updates	Policy changes in the United States of America
2035							
Current policies	54	57	-3	-1.5	-1	-1.5	+1.5
Unconditional NDCs*	48	54	-6	-4	-1	-1	
Conditional NDCs*	46.5	50.5	-4	-3	-1	-0.5	

Notes:

* Figures for NDC scenarios would increase by around 2 GtCO₂e without the NDC of the United States of America. This is a combination of the direct effect of about 0.9 GtCO₂e resulting from the emission reduction target by the United States of America becoming void, and the effect of around 1.2 GtCO₂e resulting from replacing its NDC with its current policy projections, aligned with the methodological approach of the report (table 4.1).

** Note that the sum of factors may not match the totals, due to rounding.

Scenario extensions are used to explore the post-2035 implications of current policies, NDCs and net-zero pledges including LT-LEDS. Because GHG projections further into the century are subject to much larger policy uncertainty than projections to 2035, two cases are presented to reflect

the full range of potential futures based on mitigation pledges currently put forward. A conservative case simply assumes the continuation of the current policies scenario. The optimistic case assumes the full implementation of all NDCs, net-zero targets and other LT-LEDS.

Box 4.1 Global methane mitigation and the progress of the Global Methane Pledge

The Global Methane Pledge (GMP) was launched in November 2021 at the twenty-sixth session of the Conference of the Parties to the UNFCCC (COP 26) with the aim of cutting anthropogenic methane (CH₄) emissions globally to at least 30 per cent below 2020 levels by 2030. By July 2025, 160 Parties had signed the GMP, covering 56 per cent of current global CH₄ emissions. Many countries have submitted methane action plans (MAPs) to the UNEP-convened Climate and Clean Air Coalition (CCAC), while a larger group have included measures targeting CH₄ emissions in their NDCs. China submitted a MAP to the CCAC even though it has not signed the pledge. Despite these plans, new analysis using the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model (International Institute for Applied Systems Analysis 2025) estimates that global anthropogenic

CH₄ emissions stand a few per cent above 2020 levels in 2025, and will rise to 5 per cent above this baseline by 2030 (Höglund-Isaksson *et al.* 2020; UNEP and CCAC forthcoming). If countries fully implement their published methane action plans MAPs and NDCs, global CH₄ emissions could fall to 8 per cent below 2020 levels by 2030. This suggests that current policies and pledges fall well short of meeting the GMP target for 2030. However, countries still have room for significantly higher ambition. Global CH₄ emissions would drop to 33 per cent below 2020 levels by 2030 if governments fully applied existing control technologies worldwide. By 2050, CH₄ emissions could be further cut to half of 2020 levels through additional technical controls, combined with demand-side measures such as switching to more healthy diets and cutting food waste.

The gap analysis compares emissions under current policies and pledges with three sets of least-cost pathways consistent with limiting global warming to specific levels that are relevant to the Paris Agreement: 2°C, 1.8°C and 1.5°C. These pathways are drawn from the IPCC Working Group III Assessment Report 6 (WG III AR6) database (Byers *et al.* 2022; Riahi *et al.* 2022), and are grouped according to characteristics as described in table 4.1. Their corresponding temperature projections are based on the IPCC WGI AR6 physical science assessment (Kikstra *et al.* 2022; Nicholls *et al.* 2021), and are consistent with recent updates to the remaining carbon budget (Forster *et al.* 2025).

Below 2°C and Below 1.8°C scenarios limit global warming to these levels with at least a 66 per cent chance throughout the century. In line with definitions applied by the IPCC

Special Report on Global Warming of 1.5 °C (Rogelj *et al.* 2018) and the IPCC AR6 WGIII assessment (Riahi *et al.* 2022), 1.5°C scenarios have up to a 67 per cent chance of exceeding 1.5°C over the course of the century, but a 50 per cent chance of returning below this level by 2100. To do this, they achieve net-zero GHG emissions in the second half of the century, which implies that global CO₂ emissions would need to become net-negative (Rogelj *et al.* 2021).

The least-cost scenarios are based on stringent mitigation action starting in 2020, which has not happened. The implications of this delay are explored in section 4.5, which considers the emerging literature on updated least-cost scenarios, where deep emissions reductions begin from 2025 (Kikstra *et al.* 2022; Riahi *et al.* 2022; Hooijsscher *et al.* 2025).

Table 4.3 Global total GHG emissions in 2030, 2035 and 2050, and global warming characteristics of different scenarios, consistent with limiting global warming to specific temperature limits

Scenario	# scenarios	Global total GHG emissions (GtCO ₂ e)	Estimated temperature outcome						
			In 2030	In 2035	In 2050	50% chance	66% chance	90% chance	Nearest IPCC scenario class
Below 2.0°C (66% chance)	195	41 (37–46)	36 (31–39)	20 (16–24)	Peak: 1.7–1.8°C In 2100: 1.4–1.7°C	Peak: 1.8–1.9°C In 2100: 1.6–1.9°C	Peak: 2.2–2.4°C In 2100: 2.0–2.4°C		C3a
Below 1.8°C (66% chance)	139	35 (28–41)	27 (21–31)	12 (8–16)	Peak: 1.5–1.7°C In 2100: 1.3–1.6°C	Peak: 1.6–1.8°C In 2100: 1.4–1.7°C	Peak: 1.9–2.2°C In 2100: 1.8–2.2°C		N/A
Around 1.5°C (50% in 2100 with no or limited overshoot)	50	33 (26–34)	25 (20–27)	8 (5–13)	Peak: 1.5–1.6°C In 2100: 1.1–1.3°C	Peak: 1.6–1.7°C In 2100: 1.2–1.5°C	Peak: 1.9–2.1°C In 2100: 1.6–1.9°C		C1a

Note:

* Values represent the median and twentieth to eightieth percentile range across scenarios. Probabilities refer to peak warming at any time during the twenty-first century for the Below 1.8°C and Below 2.0°C scenarios. When achieving net-negative CO₂ emissions in the second half of the century, global warming can be further reduced from these peak warming characteristics, as illustrated by the estimated temperature outcome columns. For the around 1.5°C scenarios, the probability applies to the global warming in the year 2100, while the “no or limited overshoot” characteristic is captured by ensuring projections do not exceed 1.5°C with more than 67 per cent probability over the course of the twenty-first century or, in other words, that the lowest probability of warming being limited to 1.5°C throughout the entire twenty-first century is never less than 33 per cent. This definition is identical to the C1a category definition used by the IPCC AR6 WG III report. The UNEP Emissions Gap Report analysis uses scenarios that assume immediate action from 2020 onwards.

GHG emissions in this table have been aggregated with 100-year global warming potential (GWP) values of the IPCC AR6.

4.3 The emissions gaps in 2030, 2035 and 2050 remain large

The emissions gap shows the shortfall in the collective mitigation ambition of countries to get on track to achieving the temperature goal of the Paris Agreement. It is defined as

the difference between the estimated global GHG emissions resulting from the full implementation of the latest NDCs and emissions under least-cost pathways aligned with limiting warming to specific levels. The following sections estimate the emissions gap in 2030 (section 4.3.1), 2035 (section 4.3.2) and 2050 (section 4.3.3).

4.3.1 New NDCs have no effect on the 2030 emissions gap

Full implementation of unconditional NDCs is estimated to result in an emissions gap in 2030 with below 2°C pathways of about 12 GtCO₂e annually (range: 9–15 GtCO₂e), and 20 GtCO₂e (range: 17–23 GtCO₂e) with 1.5°C pathways. If, in addition, conditional NDCs are fully implemented, these gaps are reduced by approximately 2 GtCO₂e (see figure 4.1 and table 4.4). These gaps are slightly lower than last year's assessment (about 2 GtCO₂e for unconditional NDCs, and 1 GtCO₂e for conditional NDCs). However, this does not reflect strengthening of 2030 NDC targets; rather it results from updated emission trends by modelling groups and methodological updates. Furthermore, as indicated in table 4.4, the numbers would increase by 2 GtCO₂e once the United States of America exits the Paris Agreement and its NDC becomes void, cancelling out the effect of these updates.

The full implementation of unconditional and conditional NDCs reduces expected emissions in 2030 by 4 per cent (range: -1–10) and 7 per cent (range: 3–13), respectively,

compared with 2019 levels, or by 0 per cent (range: -4–6) and 5 per cent (range: 0–9) without the NDC of the United States of America. In contrast, a 25 per cent reduction (range: 17–32) is needed for 2030 emissions to be aligned with 2°C pathways and a 40 per cent reduction (range: 37–52) for 1.5°C pathways. These figures are similar to those in the 2023 and 2024 assessments, yet the time available to course-correct has shrunk.

Moreover, countries are still not on track to meet their 2030 NDCs, let alone their new submitted or announced 2035 targets. There is an implementation gap between emissions projected under current policies and those expected with full NDC implementation. For 2030, this implementation gap amounts to about 5 GtCO₂e (range: 3–8 GtCO₂e) for unconditional NDCs, and 7 GtCO₂e (range: 5–9 GtCO₂e) for conditional NDCs. These totals are around 2 GtCO₂e higher than last year's assessment, due to the increasing divergence between the United States of America's NDC and its current policies. If the United States of America's NDC is excluded, the median estimates of the implementation gap are similar to last year's.

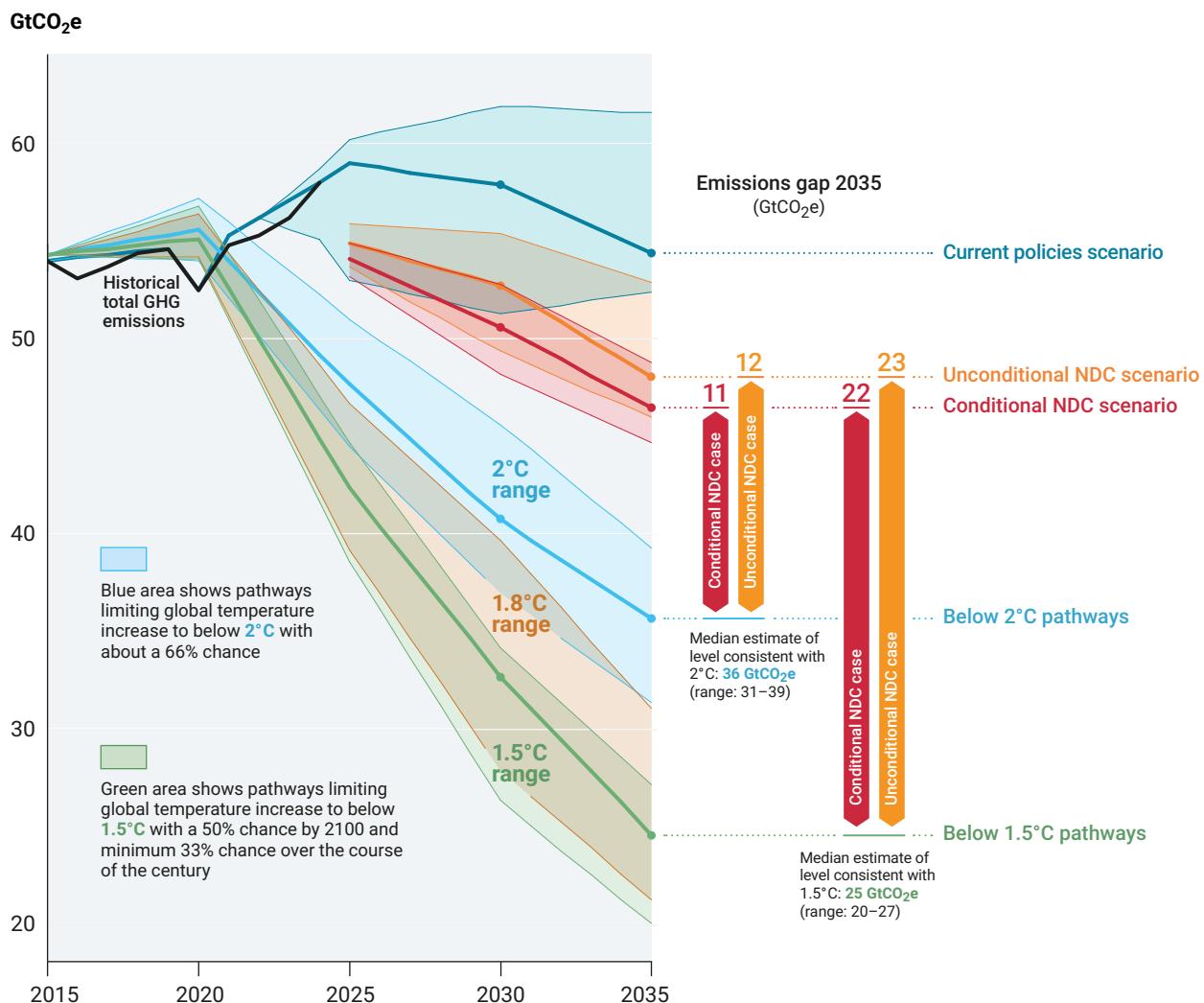
Table 4.4 Global total GHG emissions in 2030, 2035 and 2050, and estimation of associated emissions gaps under different scenarios

Scenario	Projected GHG emissions (GtCO ₂ e)	Estimated emissions gaps (GtCO ₂ e)		
		Below 2.0°C	Below 1.8°C	Around 1.5°C
2030				
Current policies	58 (51–62)	17 (11–21)	23 (16–27)	25 (19–29)
Unconditional NDCs	53 (49–55)*	12 (9–15)*	18 (15–21)*	20 (17–23)*
Conditional NDCs	51 (48–53)*	10 (7–12)*	16 (13–18)*	18 (15–20)*
2035				
Current policies	54 (52–62)	19 (17–26)	28 (26–35)	30 (28–37)
Unconditional NDCs	48 (46–52)*	12 (10–16)*	21 (19–25)*	23 (21–27)*
Conditional NDCs	46 (45–49)*	11 (9–13)*	20 (18–22)*	22 (20–24)*
2050				
Current policies continued	51 (33–71)	30 (13–51)	38 (20–59)	42 (24–63)
Conditional NDCs and all net-zero pledges**	19 (8–29)	-1 (-12–9)	7 (-4–17)	11 (0–21)

Notes:

* All estimates would increase by 2 GtCO₂e without the NDC of the United States of America.

** Extensions with all net-zero pledges, including long-term low emission development strategies, now exclude the United States of America's net-zero target, which has been withdrawn. The GHG emission ranges for 2050 show the minimum–maximum range across different projection-model assumptions, including 2030 and 2035 current policy/NDC assessment uncertainty (see UNEP 2023, chapter 4, [appendix C](#)). That means that the uncertainty in knowing precisely what emissions levels will result from current policies or NDCs in 2030/2035, as well as the ambiguity in how this can be extended into the future, is captured by this range. The gap numbers and ranges are calculated based on the original numbers (without rounding), and these may differ from the rounded numbers in the table, which are rounded to the nearest GtCO₂e. The gap numbers and ranges are calculated as the difference between the median and minimum and maximum estimates for GHG emissions of the current policies and NDC scenarios, and the median estimate for GHG emissions of the least-costs scenarios in line with specific temperature limits. GHG emissions have been aggregated with 100-year GWP values of the IPCC AR6.

Figure 4.1 GHG emissions under different scenarios and the emissions gap in 2035

Note: For the current policies and NDC scenarios, median estimates and minimum–maximum ranges are shown. The scenarios consistent with limiting global warming to 2°C, 1.8°C and 1.5°C show medians and twentieth–eightieth percentile range.

4.3.2 The emissions gap in 2035 is narrowed by the new NDCs, but remains large

The new NDCs narrow the emissions gap in 2035 compared with last year's assessment. The unconditional and conditional NDC gap with respect to 2°C and 1.5°C pathways is 6 and 4 GtCO₂e lower than last year, respectively. The new NDC targets and updated policy projections contribute around 4 and 3 GtCO₂e to reducing these gaps, respectively, while updates to methodologies and emissions trends reduce the gaps by another 1–2 GtCO₂e. Full implementation of all unconditional NDCs is estimated to result in a gap with below 2°C pathways of about 12 GtCO₂e (range: 10–16 GtCO₂e), and 23 GtCO₂e (range: 21–27 GtCO₂e) with 1.5°C pathways. If conditional NDCs are also fully implemented, these gaps are reduced by approximately 1 GtCO₂e for both temperature limits. The small difference between

unconditional and conditional NDC scenarios reflects that no new NDCs with conditional elements for 2035 had been submitted by the cut-off date for inclusion in this report. Again, a significant part of these gains will be cancelled out by the withdrawal of the NDC of the United States of America, which will increase the gaps by 2 GtCO₂e.

The full implementation of unconditional and conditional NDCs would reduce expected emissions in 2035 by about 12 per cent (range: 6–16%) and 15 per cent (range: 11–18%) respectively, compared with 2019 levels (9 per cent [range: 0–13] and 11 per cent [range: 6–15] without the NDC of the United States of America). These pledged reductions are far smaller than the 35 per cent (range: 28–43) and 55 per cent (range: 50–63) reductions needed to align with 2°C and 1.5°C pathways, respectively.

4.3.3 The 2050 emissions gaps

As for previous years, the emissions gap grows further from 2035 to mid-century. In the conservative case of a continuation of current policies, the emissions gap reaches 30–42 GtCO₂e in 2050, relative to least-cost pathways that limit warming to 2°C and 1.5°C, respectively.

The most optimistic case of this report, where all conditional NDCs and long-term net-zero targets are achieved, provides an alternative extreme. In this case, both the gap and surrounding uncertainties shrink to -1, 7 and 11 GtCO₂e, compared with least-cost pathways limiting warming to 2°C, 1.8°C and 1.5°C, respectively (see table 4.4). However, this most optimistic case should be interpreted cautiously because most countries do not have NDCs, implementation plans or finance that are aligned with achieving their long-term net-zero targets. This highlights both the challenge of steering economies from past trends towards sustainable, low-carbon futures and the necessity of meeting – and preferably overachieving – new NDCs for 2035, as they are the near-term steps that will determine the likelihood and credibility of long-term pledges being implemented and achieved.

4.4 Temperature implications of the emissions gap stress the urgency of immediate action

As in previous years, the temperature implications of the emissions gap are estimated by projecting emissions over the twenty-first century and assessing their global warming implications with a reduced-complexity climate model, the Finite-amplitude Impulse Response (FaIR) model, that is calibrated to the IPCC AR6 (Nicholls *et al.* 2021; Kikstra *et al.* 2022; Smith 2023). Projections until the end of the century are subject to scenario assumptions, such as the level at which climate action continues or how technology costs develop. These uncertainties are reflected in the ranges around the central warming projections indicated in figure 4.2. Despite the ranges, the trends are clear.

A continuation of the mitigation effort implied by current policies is only enough to keep warming below 2.8°C (range: 2.1–3.9) over the century with a 66 per cent chance.⁷ This level of warming would be reduced to 2.5°C (range: 1.9–3.3) if unconditional NDCs are fully implemented by 2035 and

similar efforts continue. Even with efforts sufficient to meet the conditional NDCs in full, warming would only be kept below 2.3°C (range: 1.9–3.3) with at least a 66 per cent chance. By 2050, the central warming projections for these scenarios see global warming surpassing 1.5°C by several tenths of a degree, leaving the world with a 21–33 per cent likelihood that warming already exceeds 2°C by then.

The updated policy projections and new NDC targets for 2035, along with the methodological updates described in section 4.3, have lowered these warming projections by about 0.3°C, compared with last year's assessment. The updated policy projections and new NDCs account for roughly two thirds of this improvement, with around one third due to methodological updates. However, about 0.1°C of this limited progress would be cancelled out once the forthcoming official withdrawal of the United States of America's NDC is accounted for.

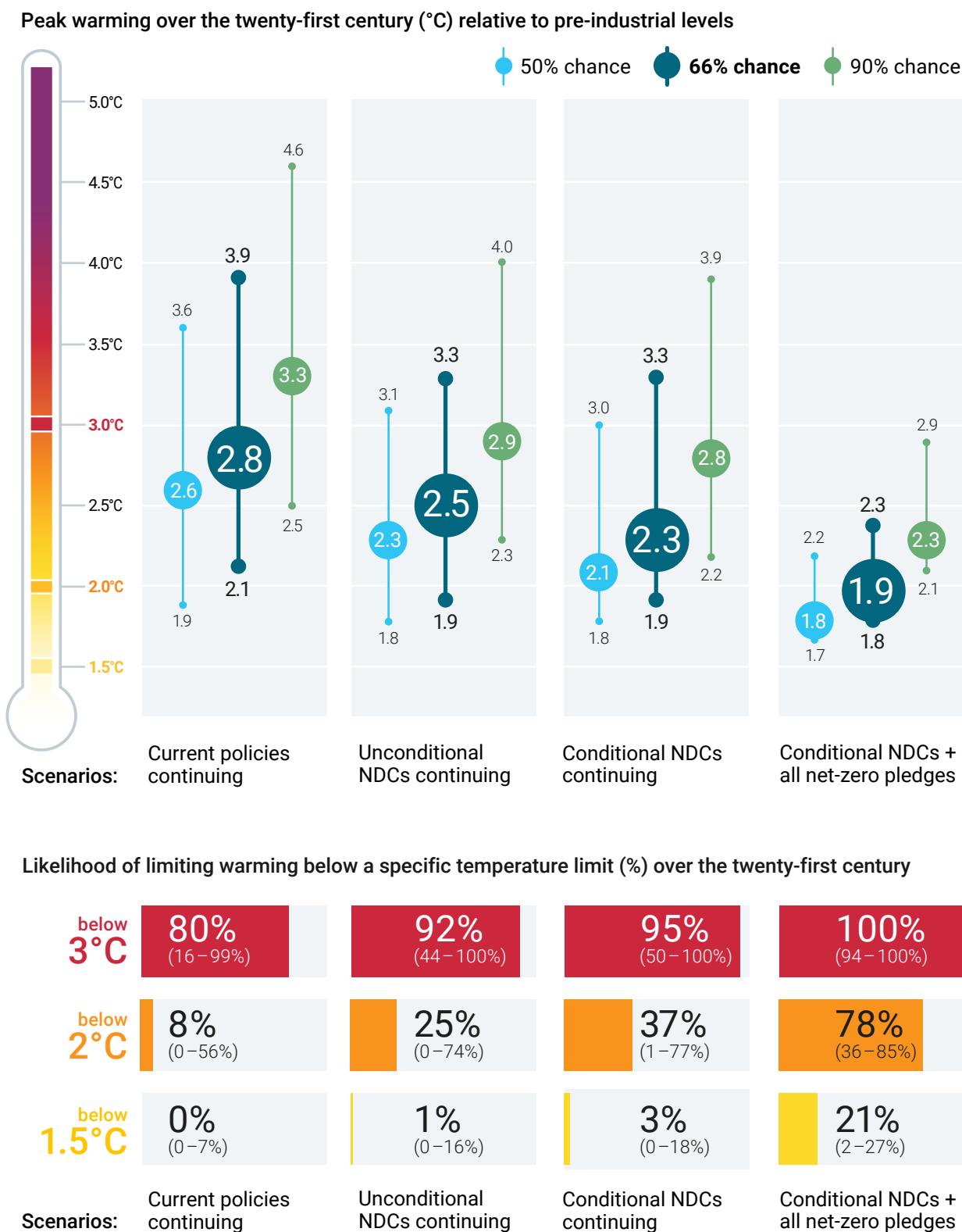
The most optimistic pledge-based scenario, which combines the full implementation of conditional NDCs and all net-zero pledges – which now exclude the former net-zero target of the United States of America – would limit peak warming over the course of the century to 1.9°C (range: 1.8–2.3°C) with a 66 per cent chance. This implies about 0.4°C of exceedance of 1.5°C, with a 21 per cent (range: 2–27 per cent) likelihood of limiting warming below 1.5°C (figure 4.2). This 1.9°C projection is unchanged, beyond rounding precision, compared with last year's assessment.⁸

The most optimistic pledge-based scenario is the only scenario under which the best-estimate global warming is halted over the course of this century. In the other scenarios, warming has not yet stabilized by 2100, and temperature would continue to rise into the twenty-second century. In all but the scenarios where net-zero pledges are effectively achieved, the likelihood of limiting global warming to 1.5°C over the course of this century is close to zero.

The scenarios above highlight the potential to reduce warming by up to 0.5°C, through immediate action that effectively implements the NDCs that have been put forward. However, they also underline that, collectively, the pledges currently put on the table by countries are insufficient to get the world on track towards the temperature goal of the Paris Agreement. Furthermore, they stress the uncomfortable truth that surpassing 1.5°C is increasingly near, and that the risk of even higher levels of warming is rising fast.

⁷ Ranges capture the uncertainty due to emissions quantifications of current policies in 2030 and 2035, and ambiguities regarding their extension until the end of the century. Uncertainties in the temperature response are captured by the probabilities with which warming is held to a specific level.

⁸ Even in absence of the net-zero target, the United States of America's emissions are still projected to decline, albeit less rapidly.

Figure 4.2 Projections of global warming under the pledge-based scenarios assessed

4.5 Delayed action has implications for 1.5°C pathways

4.5.1 Global warming is approaching 1.5°C, and pathways to 1.5°C now entail larger overshoot

The pathways in the preceding sections that limit global warming to below 2°C, 1.8°C and 1.5°C are based on the IPCC AR6 scenario database (Byers *et al.* 2022; Riahi *et al.* 2022). These pathways assume that ambitious emissions reductions start from 2020 and result in strong reductions in global GHG emissions already during 2020–2030 (see

also table 4.1). In stark contrast, and as shown in chapter 2, global GHG emissions have continued to rise. Continued construction of carbon-intensive infrastructure since 2020 is also locking in continued high emissions unless its lifetime is curtailed (Stockholm Environment Institute, Climate Analytics and the International Institute for Sustainable Development 2025). Given global inaction and continued lock-in since 2020, the cumulative emission reductions over the 2020s assumed under the 1.5°C scenarios by the IPCC are no longer fully achievable and exceedance of this temperature limit is getting closer (box 4.2).

Box 4.2 The world has not surpassed 1.5°C of global warming yet – but it is getting close

Although 2024 was the hottest year on record, at 1.55°C above pre-industrial levels (World Meteorological Organization 2025), this does not imply the world has exceeded the 1.5°C temperature goal as specified in the Paris Agreement, which refers to global warming levels based on multidecadal averages. Still, it signals that exceedance is getting closer. Global temperatures are currently rising at about 0.27°C per decade from human-induced warming (Forster *et al.* 2025). At this rate, 1.5°C above pre-industrial levels will be reached

within the next decade. While very stringent near-term emissions reductions could delay this exceedance, they cannot prevent it entirely.

The remaining carbon budget for limiting warming to 1.5°C without overshoot is now 130 GtCO₂ at 50 per cent probability, and only 80 GtCO₂ at 66 per cent probability (Forster *et al.* 2025). At current CO₂ emissions levels of about 40 GtCO₂/year (chapter 2), this budget will be exhausted before 2030.

Previous editions of the Emissions Gap Report have highlighted these and other implications of delayed and insufficient action, including for the possibility of limiting global warming to 1.5°C with no or limited overshoot, in accordance with scenarios assessed by the IPCC AR6 and used in the preceding sections. Most of these no or limited overshoot scenarios (91 out of 97) already imply a period of several decades of limited overshoot (<0.1°C), in which the median temperature projection would peak at no more than 1.6°C before returning to 1.5°C by 2100 (see tables 4.1 and 4.2). As such, limited overshoot of 1.5°C is not a new issue in the context of the temperature goal of the Paris Agreement.

However, given the lack of stringent emissions cuts since 2020, even the limited overshoot pathways are slipping out of reach, making higher and potentially longer overshoot of 1.5°C increasingly likely. As the following sections highlight this move from limited to higher overshoot pathways has significant implications in terms of challenges, risks and uncertainty.

4.5.2 Returning to 1.5°C by 2100 is still possible, but has become more uncertain and challenging

To provide a benchmark that accounts for delayed action, this year's report explores emerging scenarios that take delayed rapid mitigation into account. Specifically, a "rapid mitigation action from 2025" scenario is considered, which assumes current policies until 2025, followed by deep emissions reductions from 2025 and a return of global warming to 1.5°C by 2100.⁹

The scenario is designed to limit the overshoot to about 0.2°C, with a 50 per cent chance of temperatures peaking at no more than 1.6–1.8°C above pre-industrial levels and returning to 1.5°C by 2100 (Hooijsschuur *et al.* 2025, table 4.4). The overshoot increases to about 0.3°C with temperatures peaking at 1.7–1.9°C for a 66 per cent chance (table 4.5). The rapid mitigation action from 2025 scenario still implies significant reductions of global GHG emissions compared with the levels associated with current

⁹ Scenarios provided by the ELEVATE project (Hooijsschuur *et al.* 2025). Specifically, scenarios keep cumulative CO₂ emissions from 2020 onwards to no more than 650 GtCO₂ from 2020 to the time of net-zero emissions, and to 400 GtCO₂ from 2020 to 2100, in line with the remaining carbon budget estimates for 1.5°C (67 per cent, 400 GtCO₂) and 1.5°C (33 per cent, 650 GtCO₂).

policies and NDC scenarios for 2030 and 2035, provided in table 4.4. It would entail cutting global GHG emissions in 2035 to 32 GtCO₂e, i.e. 22 GtCO₂e lower than implied by

current policies and 14 GtCO₂e below the most ambitious conditional NDC scenario.

Table 4.5 Global total GHG emissions in 2030, 2035 and 2050 and global warming characteristics of the rapid mitigation action from 2025 scenario

Scenario	# scenarios	Global total GHG emissions [GtCO ₂ e]			Estimated temperature outcome		
		In 2030	In 2035	In 2050	50% chance	66% chance	90% chance
Rapid mitigation action from 2025	6 (4)	44 (32–51)	32 (23–40)	10 (9–29)	Peak: 1.6–1.8°C In 2100: 1.2–1.6°C	Peak: 1.7–1.9°C In 2100: 1.3–1.7°C	Peak: 2.1–2.3°C In 2100: 1.7–2.2°C

Note: Ranges show the minimum–maximum values across the number of scenarios available. Only four scenarios provided temperature projections to 2100.

Reversing global temperature overshoot requires countries to reduce and remove emissions to such a degree that global emissions become net negative. This implies that more CO₂ needs to be removed from the atmosphere each year through human activity, than the amount of residual CO₂ and other GHGs that are being emitted (box 4.3). Achieving this requires deep reductions in emissions and the widespread deployment of CO₂ removal methods (Arias *et al.* 2021; UNEP 2023; Schleussner *et al.* 2024; Reisinger *et al.* 2025).

The amount of CO₂ that causes 0.1°C of global warming is equivalent to the net amount of permanent CO₂ removal required to reverse 0.1°C of global warming (MacDougall *et al.* 2020; Arias *et al.* 2021; Palazzo Corner *et al.* 2023). As a central estimate, around 220 GtCO₂ would need to be removed and permanently stored to reverse each 0.1°C of overshoot (Canadell *et al.* 2021),¹⁰ which is roughly equivalent to five years of current global annual CO₂ emissions. Under the rapid mitigation action from 2025 scenario, 260–610 GtCO₂ will need to be removed from the atmosphere through net-negative emissions to return to 1.5°C by 2100.

4.5.3 Increased reliance on carbon dioxide removal is uncertain, risky and costly

The level of carbon dioxide removal (CDR) needed to first achieve net-zero CO₂ emissions and then reverse global warming to 1.5°C after a period of overshoot, set out in section 4.5.2, is subject to large uncertainties and risks. Most studies assume central estimates of climate sensitivity and other Earth system characteristics (box 4.4), but given uncertainties in the Earth system response and the challenge of eliminating all anthropogenic CO₂ emissions, markedly larger amounts of CDR could be required to stabilize global warming after overshoot (Schleussner *et al.* 2024). Each

additional year without deep global emission reductions increases the CDR required to return global warming to 1.5°C. Geologic carbon storage, a key enabler of CDR, could also be limited (Gidden *et al.* 2025), and sustainability considerations limit feasible annual CDR rates this century (Deprez *et al.* 2024).

The risks and uncertainties related to the achievement of the gigaton levels of CDR that would be required later in this century were also stipulated in the 2023 edition of the Emissions Gap Report (UNEP 2023, chapter 7). Methods that deliver CDR are associated with major technological, economic and sustainability challenges, including high energy and water demands, land-use competition, significant costs and technological uncertainties (Fuhrman *et al.* 2021; Lane *et al.* 2021; Meckling and Biber 2021; Rosa *et al.* 2020; Smith *et al.* 2016; Wei *et al.* 2021). Increased reliance on conventional land-based CDR is risky due to issues of land competition, protection of Indigenous and traditional communities' land tenure and rights, and sustainability, biodiversity and permanence risks of forest-based CO₂ removal, including from forest fires and other disturbances. Scaling and expanding novel CDR methods with geological storage requires time and significant policy effort (Nemet *et al.* 2023; UNEP 2023). Novel CDR methods are generally at an early stage of development and are associated with different types of risks, including that the technical, economic and political requirements for large-scale deployment may not materialize in time. Furthermore, public acceptance is still uncertain, particularly for approaches involving carbon capture and storage, or the open ocean. These risks can negatively affect the prospects for scale-up, despite technical potential. Furthermore, overreliance on CDR risks delaying the broader energy transition and decarbonization (Ampah *et al.* 2024).

¹⁰ This value is based on the central estimate of the transient climate response to cumulative emissions of CO₂ (TCRE). The IPCC AR6 WGI reports a 0.27–0.63°C per 1000 GtCO₂ likely (>66 per cent) range for the TCRE with a best estimate of 0.45°C. Under the simplifying assumption of reversibility of TCRE, this results in a range of 159–370 GtCO₂ of CO₂ removal required to reverse 0.1°C of warming, with a best estimate of 220 GtCO₂.

Box 4.3 Overshoot and net-negative emissions

The IPCC defines overshoot as a temporary exceedance of a specified global warming level, followed by a decline to or below that level within a specified time period (for example, before 2100). The duration of overshoot can vary from at least one decade and up to several decades (Matthews et al. 2022).

To return to or below a specified global warming level following overshoot, requires achieving the following globally:

- ▶ Net-zero CO₂ emissions. Global warming is expected to stabilize once global CO₂ emissions reach net zero, i.e. when residual CO₂ emissions are balanced by an equal amount of CO₂ removal.
- ▶ Net-zero GHG emissions. Needed for a peak and subsequent decline in global warming. Net-zero GHG emissions are achieved when residual CO₂ and other GHG emissions are balanced by an equivalent amount of CO₂ removal (Fuglestvedt et al. 2018; Forster et al. 2021; Allan et al. 2021; Rogelj et al. 2021).
- ▶ Net-negative GHG emissions. After net-zero GHG emissions are achieved, GHG emissions become net-negative. This implies that the amount of CO₂

emissions removed from the atmosphere is greater than the amount of residual CO₂ and other GHGs being emitted.

With the Paris Agreement's mitigation goal of reaching net-zero GHG emissions in the second half of the century,¹¹ which implies net-negative CO₂ emissions, some reversal of global warming is already part of the Paris Agreement's ambition. Indeed, achieving net-zero GHG emissions would gradually reverse global warming (Arias et al. 2021).

None of the available mitigation scenarios fully eliminate all CO₂ or other GHG emissions (Rogelj et al. 2018; Smith et al. 2014; Riahi et al. 2022). To reach net-zero emissions, residual emissions are thus balanced by removals from the atmosphere: hence the inclusion of 'net' in net-zero targets. The most scalable forms of GHG removal are CO₂ removal measures (Babiker et al. 2022; Lomax et al. 2025). This means that net-zero CO₂ emissions are achieved before net-zero GHG emissions. Reaching net-zero GHG emissions and net-negative GHG emissions therefore involves at least two, and in most cases three, interlinked strategies: deep reductions in CO₂ emissions, the upscaling of CO₂ removal, and deep reductions in other GHG emissions.

Two imperatives that have also been continuously stressed in previous Emissions Gap Reports thus emerge: immediately implementing aggressive mitigation to minimize overshoot, while deploying CDR to achieve net-zero emissions and subsequently reverse global warming.

4.5.4 Pursuing efforts to limit global warming to 1.5°C remains critical and relevant

Questions have been raised about the Paris Agreement's long-term temperature goal to limit global warming to well below 2°C, while pursuing efforts to stay below 1.5°C, since global warming is approaching 1.5°C and will likely exceed it soon. However, the Paris Agreement establishes no target date or expiration for this goal (Rogelj and Rajamani 2025). It represents a legal, moral and political obligation, as affirmed

by the recent advisory opinion of the International Court of Justice (2025) linking climate change to human rights. The International Court of Justice not only affirmed the temperature goal, it also concluded that 1.5°C remains the "primary" goal of the Paris Agreement.

Every fraction of a degree of global warming matters. Each additional 0.1°C of global warming escalates damages, losses and adverse health impacts already experienced at current warming levels, disproportionately affecting the poorest and most vulnerable, including women, children and Indigenous communities (Hoegh-Guldberg et al. 2018; Skea et al. 2022). With the carbon budget nearly depleted, almost every ton of CO₂ emitted from today on needs to be removed from the atmosphere in the future to bring warming back to 1.5°C, entailing substantial costs and high

¹¹ Paris Agreement, article 4.1: "In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty."

risks. Each increment of global warming also increases the probability of triggering climate tipping points such as a West Antarctic Ice Sheet collapse, leading to abrupt and irreversible changes (Armstrong McKay *et al.* 2022), and it is highly unlikely that all risks and hazards will reverse proportionately if global warming is returned to 1.5°C after a period of overshoot (Schleussner *et al.* 2024).

The fundamental ingredient for progress towards the temperature goal of the Paris Agreement remains unchanged: immediate and stringent emission reductions. Unprecedented mitigation action will be essential to minimize the level and duration of overshoot and reliance on uncertain removal technologies. Considerable knowledge exists regarding the options, benefits and opportunities of accelerated mitigation action. In many cases, mitigation aligns with economic growth, job creation, energy security

and achievement of other pressing development needs and Sustainable Development Goals. Required technologies are available, and wind and solar energy development, continue to exceed expectations, lowering deployment costs and driving market expansion (UNEP 2024; United Nations 2025). Yet deployment remains insufficient. Accelerated emission reductions require overcoming policy, governance, institutional and technical barriers; unparalleled increase in support to developing countries; and redesigning the international financial architecture.

The new NDCs and current geopolitical situation do not provide promising signs that this will happen, but that is what countries, and the multilateral processes, must resolve to affirm collective commitment and confidence in achieving the temperature goal of the Paris Agreement.

Box 4.4 Earth system feedbacks and overshoot

Earth system feedbacks affect and are affected by the exceedance of critical temperature limits such as the 1.5°C limit. First, uncertainty in the Earth system response means that the level of global warming consistent with a given path of global GHG emissions cannot be estimated with exact precision. For example, even an emission pathway that results in a central estimate of global warming of about 1.5°C also simultaneously has a possibility of about 5–10 per cent that global warming ends up much higher around 2°C (Skea *et al.* 2022). The magnitude by which 1.5°C of global warming would be exceeded therefore not only depends on the amount of past and future GHG

emissions, but also on the strength of reinforcing feedbacks.

On the other hand, because many Earth system feedbacks scale with either CO₂ concentrations or global warming, exceeding 1.5°C can also result in stronger amplifying feedbacks being triggered. For global warming between 1.5°C and 2°C, one such feedback would be the accelerated thawing of permafrost that would amplify global warming as a result of the CH₄ and CO₂ emissions that are being released in the process.



References

Chapter 1

- I International Court of Justice (2025). Obligations of States in respect of climate change: Advisory opinion. 23 July. <https://www.icj-cij.org/sites/default/files/case-related/187/187-20250723-adv-01-00-en.pdf>.
- U United Nations (2015). Paris Agreement. 4 November 2016. https://unfccc.int/sites/default/files/english_paris_agreement.pdf.
- United Nations (2025). *Seizing the Moment of Opportunity: Supercharging the New Energy Era of Renewables, Efficiency, and Electrification*. New York: United Nations. https://www.un.org/sites/un2.un.org/files/un-energy-transition-report_2025.pdf.
- United Nations Environment Programme (2015). *The Emissions Gap Report 2015: A UNEP Synthesis Report*. Nairobi: United Nations Environment Programme. <https://wedocs.unep.org/bitstream/handle/20.500.11822/32070/EGR15.pdf>.

Chapter 2

- A Andrew, R.M. (2025). Global CO₂ emissions from cement production. Earth System Science Data. <https://doi.org/10.5281/zenodo.14931651>. Accessed 8 October 2025.
- C Chen, S. (2025). How much energy will AI really consume? The good, the bad and the unknown, 5 March. <https://doi.org/10.1038/d41586-025-00616-z>.
- Crippa, M., Guizzardi, D., Pagani, F., Banja, M., Muntean, M., Schaaf, E. et al. (2025). *GHG emissions of all world countries – 2025 Report*. Luxembourg: Publications Office of the European Union <https://data.europa.eu/doi/10.2760/9816914>.
- D Deng, Z., Zhu, B., Davis, S.J., Ciais, P., Guan, D., Gong, P. et al. (2025). Global carbon emissions and decarbonization in 2024. *Nature Reviews Earth & Environment* 6, 231–233. <https://doi.org/10.1038/s43017-025-00658-x>.
- Driscoll, D.A., Armenteras, D., Bennett, A.F., Brotons, L., Clarke, M.F., Doherty, T.S. et al. (2021). How fire interacts with habitat loss and fragmentation. *Biological Reviews* 96(3), 976–998. <https://doi.org/10.1111/brv.12687>.
- Drücke, M., Sakschewski, B., Von Bloh, W., Billing, M., Lucht, W. and Thonicke, K. (2023). Fire may prevent future Amazon forest recovery after large-scale deforestation. *Communications Earth & Environment* 4, 248. <https://doi.org/10.1038/s43247-023-00911-5>.
- E Energy Institute (2025). *Statistical Review of World Energy*. London: Energy Institute. <https://www.energiinst.org/statistical-review>.
- F Forster, P., Storelvmo, T., Armour, K., Collins, W., Dufresne, J.-L., Frame, D. et al. (2021). Chapter 7: The Earth's Energy Budget, Climate Feedbacks and Climate Sensitivity. In *Climate Change 2021: The Physical Science Basis. Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Chen, Y. et al. (eds). Cambridge and New York: Cambridge University Press. Chapter 7. 923–1054. <https://doi.org/10.1017/9781009157896.009>.
- Forster, P.M., Smith, C., Walsh, T., Lamb, W.F., Lamboll, R., Hall, B. et al. (2024). Indicators of Global Climate Change 2023: annual update of key indicators of the state of the climate system and human influence. *Earth System Science Data* 16(6), 2625–2658. <https://doi.org/10.5194/essd-16-2625-2024>.

- Friedlingstein, P., O'Sullivan, M., Jones, M.W., Andrew, R.M., Hauck, J., Landschützer, P. et al. (2025). Global Carbon Budget 2024. *Earth System Science Data* 17(3), 965–1039. <https://doi.org/10.5194/essd-17-965-2025>.
- G** Gidden, M.J., Gasser, T., Grassi, G., Forsell, N., Janssens, I., Lamb, W.F. et al. (2023). Aligning climate scenarios to emissions inventories shifts global benchmarks. *Nature* 624, 102–108. <https://doi.org/10.1038/s41586-023-06724-y>.
- Graham, E., Fulghum, N. and Altieri, K. (2025). *Global Electricity Review 2025*. Ember. <https://ember-energy.org/latest-insights/global-electricity-review-2025>.
- Grassi, G., House, J., Kurz, W.A., Cescatti, A., Houghton, R.A., Peters, G.P. et al. (2018). Reconciling global-model estimates and country reporting of anthropogenic forest CO₂ sinks. *Nature Climate Change* 8, 914–920. <https://doi.org/10.1038/s41558-018-0283-x>.
- Grassi, G., Peters, G.P., Canadell, J.G., Cescatti, A., Federici, S., Gidden, M.J. et al. (2025). Improving land-use emission estimates under the Paris Agreement. *Nature Sustainability* 8, 579–581. <https://doi.org/10.1038/s41893-025-01565-1>.
- Grassi, G., Stehfest, E., Rogelj, J., van Vuuren, D., Cescatti, A., House, J. et al. (2021). Critical adjustment of land mitigation pathways for assessing countries' climate progress. *Nature Climate Change* 11, 425–434. <https://doi.org/10.1038/s41558-021-01033-6>.
- H** Hong, C., Zhao, H., Qin, Y., Burney, J.A., Pongratz, J., Hartung, K. et al. (2022). Land-use emissions embodied in international trade. *Science* 376(6593), 597–603. <https://doi.org/10.1126/science.abj1572>.
- I** International Energy Agency (2025a). *Global Energy Review 2025*. Paris: International Energy Agency. <https://www.iea.org/reports/global-energy-review-2025>.
- (2025b). *Energy and AI: World Energy Outlook Special Report*. Paris: International Energy Agency. <https://iea.blob.core.windows.net/assets/601eaec9-ba91-4623-819b-4ded331ec9e8/EnergyandAI.pdf>.
- Skea, J., Shukla, P.R., Reisinger, A., Slade, R., Pathak, M., Al Khourdajie, A. et al. (2022). Summary for Policymakers. In *Climate Change 2022: Mitigation of Climate Change. Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Shukla, P.R., Skea, J., Slade, R., Al Khourdajie, A., van Diemen, R., McCollum, D. et al. (eds.). Cambridge and New York: Cambridge University Press. <https://doi.org/10.1017/9781009157926.001>.
- J** Jha, R., Perkins-Kirkpatrick, S.E., Singh, D., Kimutai, J., Libonati, R. and Mondal, A. (2025). Extreme terrestrial heat in 2024. *Nature Reviews Earth & Environment* 6, 234–236. <https://doi.org/10.1038/s43017-025-00661-2>.
- K** Kolden, C.A., Abatzoglou, J.T., Jones, M.W. and Jain, P. (2025). Wildfires in 2024. *Nature Reviews Earth & Environment* 6, 237–239. <https://doi.org/10.1038/s43017-025-00663-0>.
- L** Lamb, W. (2025). Tidy GHG Inventories. Potsdam Institute for Climate Impact Research. <https://doi.org/10.5281/zenodo.14637347>. Accessed 8 October 2025.
- Lamb, W., Andrew, R., Jones, M., Nicholls, Z., Peters, G., Smith, C. et al. (2025). Differences in anthropogenic greenhouse gas emissions estimates explained. *Earth System Science Data*. <https://doi.org/10.5194/essd-2025-188>.
- Lee, D. (2025). Meeting the energy challenge posed by data centres is central to a green future. *Nature* 639, S33. <https://doi.org/10.1038/d41586-025-00747-3>.
- M** Magalhães, N.D., Evangelista, H., Condom, T., Rabatel, A. and Ginot, P. (2019). Amazonian Biomass Burning Enhances Tropical Andean Glaciers Melting. *Scientific Reports* 9, 16914. <https://doi.org/10.1038/s41598-019-53284-1>.

- Melo, J., Rossi, S., Achard, F., Alkama, R., Canadell, J.G., Friedlingstein, P. et al. (2025). The LULUCF data hub: translating global land use emissions estimates into the national GHG inventory framework (Version 3.0, 2025 NGHGI release). LULUCF Data Hub. <https://doi.org/10.5281/zenodo.17153438>. Accessed 8 October 2025.
- P** Pathak, M., Creutzig, F. and Gupta, D. (2025). What Has Been Done to Reduce Luxury Consumption? A Global Review. *Annual Review of Environment and Resources* 50, 133–157. <https://doi.org/10.1146/annurev-environ-111523-102010>.
- Peng, X., Liang, J., Chen, H., Chen, J., Zhang, J., Sun, Q. et al. (2025). Heterogeneous drivers of decarbonization in the global power sector. *Environmental Research Letters* 20, 064044. <https://doi.org/10.1088/1748-9326/add9b1>.
- Pongratz, J., Smith, S.M., Schwingshackl, C., Dayathilake, L., Gasser, T., Grassi, G. et al. (2024). Current levels of CDR. In *The State of Carbon Dioxide Removal - 2nd Edition*. Smith, S.M., Geden, O., Gidden, M., Lamb, W.F., Nemet, G.F., Minx, J. et al. (eds.). Charlottesville: Center for Open Science. <https://doi.org/10.17605/OSF.IO/ZXSKB>.
- Prist, P.R., Sangermano, F., Bailey, A., Bugni, V., Villalobos-Segura, M.D.C., Pimiento-Quiroga, N. et al. (2023). Protecting Brazilian Amazon Indigenous territories reduces atmospheric particulates and avoids associated health impacts and costs. *Communications Earth & Environment* 4, 34. <https://doi.org/10.1038/s43247-023-00704-w>.
- R** Reining, S., Wussow, M., Zanocco, C. and Neumann, D. (2025). Roof renewal disparities widen the equity gap in residential wildfire protection. *Nature Communications* 16, 463. <https://doi.org/10.1038/s41467-024-55705-w>.
- S** Schöngart, S., Nicholls, Z., Hoffmann, R., Pelz, S. and Schleussner, C.-F. (2025). High-income groups disproportionately contribute to climate extremes worldwide. *Nature Climate Change* 15, 627–633. <https://doi.org/10.1038/s41558-025-02325-x>.
- Schwingshackl, C., Obermeier, W.A., Bultan, S., Grassi, G., Canadell, J.G., Friedlingstein, P. et al. (2022). Differences in land-based mitigation estimates reconciled by separating natural and land-use CO₂ fluxes at the country level. *One Earth* 5(12), 1367–1376. <https://doi.org/10.1016/j.oneear.2022.11.009>.
- United Nations Educational, Scientific and Cultural Organization (2025). *Smarter, Smaller, Stronger: Resource-Efficient Generative AI & the Future of Digital Transformation*. Paris: UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf0000394521>.
- U** United Nations Framework Convention on Climate Change (2021). COP26: Pivotal Progress Made on Sustainable Forest Management and Conservation, 10 November. <https://unfccc.int/news/cop26-pivotal-progress-made-on-sustainable-forest-management-and-conservation>. Accessed 7 April 2025.
- W** West, C., Rabeschini, G., Singh, C., Kastner, T., Bastos Lima, M., Dermawan, A. et al. (2025). The global deforestation footprint of agriculture and forestry. *Nature Reviews Earth & Environment* 6, 325–341. <https://doi.org/10.1038/s43017-025-00660-3>.
- Wiebe, R.A. and Wilcove, D.S., 2025. Global biodiversity loss from outsourced deforestation. *Nature* 639, 389–394. <https://doi.org/10.1038/s41586-024-08569-5>.
- World Bank (2025). World Bank Open Data. <http://data.worldbank.org>. Accessed 7 July 2025.
- World Meteorological Organization (2025a). Greenhouse Gas Bulletin (No. 21). Geneva.
- (2025b). *State of the Climate in Latin America and the Caribbean 2024*. Geneva. <https://wmo.int/publication-series/state-of-climate-latin-america-and-caribbean-2024>.
- World Resources Institute (2025). Global Forest Watch. <https://www.wri.org/initiatives/global-forest-watch>. Accessed 21 October 2025.

Chapter 3

A

Alberti, C., Alanah, I. and Sawant, O. (2025). From commitments to capital—are the NDCs 3.0 built to mobilize climate investment? 24 July. <https://www.climatepolicyinitiative.org/publication/from-commitments-to-capital-are-new-ndcs-built-to-mobilize-climate-investment/>. Accessed 24 October 2025.

Altieri, K. and Jones, D. (2025). *What's New with National Renewable Targets? Not Much!* London: Ember. https://ember-energy.org/app/uploads/2025/07/Ember-Whats-new-with-national-renewables-targets_Nothing-much-1.pdf.

Australia, Department of Climate Change, Energy, the Environment and Water (2024). *Australia's Emissions Projections 2024*. Canberra: Department of Climate Change, Energy, the Environment and Water. <https://www.dcceew.gov.au/climate-change/publications/australias-emissions-projections-2024>.

C

Canada (2025). Greenhouse gas emissions projections (update February 2025). Environment and Climate Change Canada. <https://data-donnees.az.ec.gc.ca/data/substances/monitor/canada-s-greenhouse-gas-emissions-projections/?lang=en/>. Accessed 29 April 2025.

Climate Action Tracker (2025a). CAT Net Zero Target Evaluations. Climate Analytics, NewClimate Institute. [https://climateactiontracker.org/global/cat-netzero-target-evaluations/](https://climateactiontracker.org/global/cat-net-zero-target-evaluations/). Accessed 30 June 2025.

Climate Action Tracker (2025b). Country Assessments. Latest available as of 30 September 2025. Climate Analytics, NewClimate Institute. <https://climateactiontracker.org/countries/>. Accessed 30 September 2025.

Climate Watch (2025a). NDC Enhancement Tracker. World Resources Institute. <https://www.climatewatchdata.org/ndc-tracker>. Accessed 30 September 2025.

Climate Watch (2025b). Net-Zero Tracker. World Resources Institute. <https://www.climatewatchdata.org/net-zero-tracker>. Accessed 30 June 2025.

D

den Elzen, M., Kuramochi, T., Höhne, N., Cantzler, J., Esmeijer, K., Fekete, H. et al. (2019). Are the G20 economies making enough progress to meet their NDC targets? *Energy Policy* 126, 238–250. <https://doi.org/10.1016/j.enpol.2018.11.027>.

den Elzen, M., Beusen, A., Dafnomilis, I., Forsell, N., Fragkos, P., Fragkiadakis, K. et al. (2025a). Infographics PBL NDC tool 2025. <https://themasites.pbl.nl/o/climate-ndc-policies-tool/>. Accessed 30 September 2025.

den Elzen, M.G.J., Dafnomilis, I., Nascimento, L., Beusen, A., Forsell, N., Gubbels, J. et al. (2025b). Uncertainties around net-zero climate targets have major impact on greenhouse gas emissions projections. *Annals of the New York Academy of Sciences* 1544(1), 209–222. <https://doi.org/10.1111/nyas.15285>.

E

EU Observatory on Deforestation and Forest Degradation (2025). Global land use carbon fluxes. V3.0 (NGHGI 2025). Joint Research Centre, European Commission. <https://forest-observatory.ec.europa.eu/carbon-fluxes>. Accessed 30 September 2025.

European Environment Agency (2024). Progress towards achieving climate targets in the EU-27, 25 October (modified 7 November 2024). <https://www.eea.europa.eu/en/analysis/indicators/total-greenhouse-gas-emission-trends/progress-towards-achieving-climate>. Accessed 8 May 2025.

F

Fransen, T., Meckling, J., Stünzi, A., Schmidt, T.S., Egli, F., Schmid, N. et al. (2023). Taking stock of the implementation gap in climate policy. *Nature Climate Change* 13(8), 752–755. <https://doi.org/10.1038/s41558-023-01755-9>.

G

Gütschow, J., Busch, D. and Pflüger, M. (2025). The PRIMAP-hist National Historical Emissions Time Series (1750–2023) v2.6.1. Zenodo. <https://doi.org/10.5281/zenodo.15016289>. Accessed 24 October 2025.

I

International Energy Agency (2024). Energy Efficiency Progress Tracker. <https://www.iea.org/data-and-statistics/data-tools/energy-efficiency-progress-tracker>. Accessed 24 October 2025.

International Energy Agency (2025). Renewable Energy Progress Tracker. <https://www.iea.org/data-and-statistics/data-tools/renewable-energy-progress-tracker>. Accessed 30 September 2025.

Institutional Investors Group on Climate Change (2024). Making NDCs investable - the investor perspective. London: Institutional Investors Group on Climate Change. <https://www.iigcc.org/resources/making-ndcs-investable-the-investor-perspective>.

International Renewable Energy Agency (IRENA) (2024). *World Energy Transitions Outlook 2024: 1.5°C Pathway*. Abu Dhabi: IRENA. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2024/Nov/IRENA_World_energy_transitions_outlook_2024.pdf.

K Keramidas, K., Fosse, F., Aycart Lazo, F.J., Dowling, P., Garaffa, R., Ordóñez, J. et al. (2025). *Global Energy and Climate Outlook 2024: Updating NDCs and Closing the Ambition Gap – Indicators for 1.5° Alignment*. Luxembourg: Publications Office of the European Union. <https://doi.org/10.2760/9028706>.

M Marshall, S., Gompertz, D. and Senlen, O. (2025). NDC energy commitments tracker: Tracking global stocktake energy commitments in newly submitted NDCs, 3 October. <https://www.e3g.org/publications/ndc-3-0-energy-commitments-tracker/>. Accessed 4 October 2025.

N Nascimento, L., den Elzen, M., Kuramochi, T., Woollards, S., Dafnomilis, I., Moisio, M. et al. (2024). Comparing the sequence of climate change mitigation targets and policies in major emitting economies. *Journal of Comparative Policy Analysis: Research and Practice* 26(3–4), 233–250. <https://doi.org/10.1080/13876988.2023.2255151>.

Nascimento, L., Scheewel, J.-L., Kuramochi, T., Missirliu, A., Woollards, S., Zhang, et al. (2024). *Progress of Major Emitters Towards Climate Targets: 2024 Update*. Cologne: NewClimate Institute. <https://newclimate.org/resources/publications/progress-of-major-emitters-towards-climate-targets-2024-update>.

Net Zero Tracker (2025). Data Explorer. www.zerotracker.net. Accessed 30 June 2025.

R Rogelj, J., Fransen, T., den Elzen, M.G.J., Lamboll, R.D., Schumer, C., Kuramochi, T. et al. (2023). Credibility gap in net-zero climate targets leaves world at high risk. *Science* 380(6649), 1014-1016. <https://doi.org/10.1126/science.adg6248>.

U United States of America, White House (2025). Putting America first in international environmental agreements, 20 January. <https://www.whitehouse.gov/presidential-actions/2025/01/putting-america-first-in-international-environmental-agreements/>. Accessed 13 May 2025.

United Kingdom, Department for Energy Security and Net Zero (2024). Annex A: National communication categories: Greenhouse gas emissions by source. In *Energy and Emissions Projections: 2023 to 2040*. London: Department for Energy Security and Net Zero. <https://www.gov.uk/government/publications/energy-and-emissions-projections-2023-to-2050>. Accessed 29 April 2025.

United Nations, Department of Economic and Social Affairs (2024). World Population Prospects 2024. <https://population.un.org/wpp/>. Accessed 24 October 2025.

United Nations (2025). *Climate Summit 2025* [online video]. 24 September. https://webtv.un.org/en/asset/k12_k12ebey0bu.

United Nations Environment Programme (2024). *Emissions Gap Report 2024: No More Hot Air ... Please!* Nairobi: UNEP. <https://www.unep.org/emissions-gap-report-2024>.

United Nations Framework Convention on Climate Change (2023). Outcome of the first global stocktake. Draft decision -/CMA.5. Proposal by the President. 13 December. FCCC/PA/CMA/2023/L.17. <https://unfccc.int/documents/636608>.

----- (2025a). NDC 3.0. <https://unfccc.int/ndc-3.0>. Accessed 30 September 2025.

----- (2025b). NDC registry. <https://unfccc.int/NDCREG>. Accessed 30 September 2025.

W

World Bank (2025). Country Classification. Updated 1 July 2025. <https://ddh-openapi.worldbank.org/resources/DR0095333/download>. Accessed 7 October 2025.

Chapter 4

A

Allan, R.P., Arias, P.A., Berger, S., Canadell, J.G., Cassou, C., Chen, D. et al. (2021). Summary for policymakers. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. 3–32. <https://www.ipcc.ch/report/ar6/wg1/chapter/summary-for-policymakers/>.

Ampah, J.D., Jin, C., Liu, H., Yao, M., Afrane, S., Adun, H. et al. (2024). Deployment expectations of multi-gigatonne scale carbon removal could have adverse impacts on Asia's energy-water-land nexus. *Nature Communications* 15, 6342. <https://www.sciencedirect.com/science/article/pii/S254243512300449X>.

Arias, P.A., Bellouin, N., Coppola, E., Jones, R.G., Krinner, G., Marotzke, J. et al. (2021). Technical summary. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S. et al. (eds.). 33–144. Cambridge, UK and New York: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_TS.pdf.

Armstrong McKay, D.I., Staal, A., Abrams, J.F., Winkelmann, R., Sakschewski, B., Loriani, S. et al. (2022). Exceeding 1.5°C global warming could trigger multiple climate tipping points. *Science* 377(6611). <https://doi.org/10.1126/science.abn7950>.

B

Babiker, M., Blok, K., Cohen, B., Cowie, A., Geden, O., Ginzburg, V. et al. (2022). Cross-sectoral perspectives. In: *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Shukla, P.R., Skea, J., Slade, R., Al Khourdajie, A., Belkacemi, R., van Diemen, A. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. Chapter 12. 1245–1354. https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_Chapter12.pdf.

Bevacqua E., Schleussner C.-F. and Zscheischler J. (2025). A year above 1.5 °C signals that Earth is most probably within the 20-year period that will reach the Paris Agreement limit. *Nature Climate Change* 15, 262–265. <https://www.nature.com/articles/s41558-025-02246-9>.

Byers, E., Krey, V., Kriegler, E., Riahi, K., Schaeffer, R., Kikstra, J. et al. (2022). AR6 Scenarios Database (Version 1.0). Zenodo. <https://doi.org/10.5281/zenodo.5886912>. Accessed 7 October 2024.

C

Canadell, J.G., Monteiro, P.M.S., Costa, M.H., Cotrim da Cunha, L., Cox, P.M., Eliseev, A.V. et al. (2021). Global carbon and other biogeochemical cycles and feedbacks. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. Chapter 5. 673–816. <https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-5/>.

Climate Action Tracker (2024). As the climate crisis worsens, the warming outlook stagnates, 14 November. <https://climateactiontracker.org/publications/the-climate-crisis-worsens-the-warming-outlook-stagnates/>. Accessed 1 May 2025.

Climate Resource (2025). NDC Factsheets. <https://www.climate-resource.com/tools/ndcs>. Accessed 10 October 2025.

D

Dafnomilis, I., den Elzen, M. and van Vuuren, D. (2024). Paris targets within reach by aligning, broadening and strengthening net-zero pledges. *Communications Earth & Environment* 5, 48. <https://doi.org/10.1038/s43247-023-01184-8>.

den Elzen, M.G.J., Dafnomilis, I., Forsell, N., Fragkos P., Fragkiadakis, K., Höhne, N. et al. (2022). Updated nationally determined contributions collectively raise ambition levels but need strengthening further to keep Paris goals within reach. *Mitigation and Adaptation Strategies for Global Change* 27, 33. <https://doi.org/10.1007/s11027-022-10008-7>.

den Elzen, M.G.J., Dafnomilis I., Hof, A.F., Olsson M., Beusen, A., Botzen, W.J.W. et al. (2023). The impact of policy and model uncertainties on emissions projections of the Paris Agreement pledges. *Environmental Research Letters* 18, 054026. <https://doi.org/10.1088/1748-9326/acceb7>.

den Elzen, M.G.J., Dafnomilis, I., Nascimento, L., Beusen, A., Forsell, N., Gubbels, J. et al. (2025a). Uncertainties around net-zero climate targets have major impact on greenhouse gas emissions projections. *Annals of the New York Academy of Sciences* 1544(1), 209–222. <https://doi.org/10.1111/nyas.15285>.

den Elzen, M.G.J., Dafnomilis, I., Nascimento, L., Beusen, A., Forsell, N., Gubbels, J. et al. (2025b). Infographics PBL NDC Tool 2025. <https://themasites.pbl.nl/o/climate-ndc-policies-tool/>. Accessed 7 October 2025.

Deprez, A., Leadley, P., Dooley, K., Williamson, P., Cramer, W., Gattuso, J.-P. et al. (2024). Sustainability limits needed for CO₂ removal. *Science* 383(6682), 484–486. <https://doi.org/10.1126/science.adj6171>.

F

Forster, P.M., Smith, C., Walsh, T., Lamb, W.F., Lamboll, R., Cassou, C. et al. (2025). Indicators of global climate change 2024: Annual update of key indicators of the state of the climate system and human influence. *Earth System Science Data* 17(6), 2641–2680. <https://doi.org/10.5194/essd-17-2641-2025>.

Forster, P., Storelvmo, T., Armour, K., Collins, W., Dufresne, J.-L., Frame, D. et al. (2021). The Earth's energy budget, climate feedbacks and climate sensitivity. In *Climate Change 2021: The Physical Science Basis: Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Berger, S. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. Chapter 7. 923–1054. <https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-7/>.

Fuglestvedt, J., Rogelj, J., Millar, R.J., Allen, M., Boucher, O., Cain, M. et al. (2018). Implications of possible interpretations of 'greenhouse gas balance' in the Paris Agreement. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 376(2119). <https://doi.org/10.1098/rsta.2016.0445>.

Fuhrman, J., Clarens, A.F., McJeon, H., Patel, P., Ou, Y. and Doney, S.C. (2021). The role of negative emissions in meeting China's 2060 carbon neutrality goal. *Oxford Open Climate Change* 1(1). <https://doi.org/10.1093/oxfclm/kgab004>.

G

Gidden, M.J., Gasser, T., Grassi, G., Forsell, N., Janssens, I., Lamb, W.F. et al. (2023). Aligning climate scenarios to emissions inventories shifts global benchmarks. *Nature* 624, 102–108. <https://doi.org/10.1038/s41586-023-06724-y>.

Gidden, M.J., Joshi, S., Armitage, J.J., Christ, A.-B., Boettcher, M., Brutschin, E. et al. (2025). A prudent planetary limit for geologic carbon storage. *Nature* 645, 124–132. <https://www.nature.com/articles/s41586-025-09423-y>.

H

Hoegh-Guldberg, O., Jacob, D., Taylor, M., Bind, M., Brown, S., Camilloni, I. et al. (2018). Impacts of 1.5 °C global warming on natural and human systems. In *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Chapter 3. 175–312. Cambridge, UK and New York: Cambridge University Press. <https://doi.org/10.1017/9781009157940.005>.

Höglund-Isaksson, L., Gómez-Sanabria, A., Klimont, Z., Rafaj, P. and Schöpp, W. (2020). Technical potentials and costs for reducing global anthropogenic methane emissions in the 2050 timeframe – results from the GAINS model. *Environmental Research Communications* 2, 025004. <https://doi.org/10.1088/2515-7620/ab7457>.

Hooijer, E., Vrontisi, Z., Ali Abdallah, R., Angelkorte, G., Baptista, L.B., Daskalaki, V. et al. (2025). Development of global and national climate policy pathways (2.0). Zenodo. <https://doi.org/10.5281/zenodo.15655308>.

Emissions Gap Report 2025: Off target

- I** International Court of Justice (2025). *Obligations of States in respect of climate change. Advisory opinion.* 23 July. <https://www.icj-cij.org/case/187>.
- International Energy Agency (2023). *World Energy Outlook 2023.* Paris. <https://www.iea.org/reports/world-energy-outlook-2023>.
- (2024). *World Energy Outlook 2024.* Paris. <https://www.iea.org/reports/world-energy-outlook-2024>.
- International Institute for Applied Systems Analysis (2025). Greenhouse Gas – Air Pollution Interactions and Synergies (GAINS). http://gains.iiasa.ac.at/models/gains_models4.html. Accessed 7 October 2025.
- K** Keramidas, K., Fosse, F., Aycart, L., Dowling, P., Garaffa, R., Ordonez, J. et al. (2025). *Global Energy and Climate Outlook 2024.* Luxembourg: Publications Office of the European Union. <https://data.europa.eu/doi/10.2760/9028706>.
- Kikstra, J.S., Nicholls, Z.R.J., Smith C.J., Lewis J., Lamboll, R.D., Byers, E. et al. (2022). The IPCC Sixth Assessment Report WGIll climate assessment of mitigation pathways: From emissions to global temperatures. *Geoscientific Model Development* 15(24), 9075–9109. <https://gmd.copernicus.org/articles/15/9075/2022/>.
- L** Lane, J., Greig, C. and Garnett, A. (2021). Uncertain storage prospects create a conundrum for carbon capture and storage ambitions. *Nature Climate Change* 11, 925–936. <https://doi.org/10.1038/s41558-021-01175-7>.
- Lomax, C., Smith, S.M., Bellamy, R. And Wagle, A. (2025). *The UK State of Carbon Dioxide Removal.* Oxford: Smith School of Enterprise and the Environment, University of Oxford. <https://co2re.org/wp-content/uploads/2025/07/UK-State-of-CDR-Report.pdf>.
- M** MacDougall, A.H., Frölicher, T.L., Jones C.D., Rogelj, J., Matthews, H.D., Zickfeld, K. et al. (2020). Is there warming in the pipeline? A multi-model analysis of the Zero Emissions Commitment from CO₂. *Biogeosciences* 17(11), 2987–3016. <https://doi.org/10.5194/bg-17-2987-2020>.
- Matthews, J.B.R., Babiker, M., de Coninck, H., Connors, S., van Diemen, R., Djalante, R. et al. (eds.) (2022). Annex I: Glossary. (ed.). In *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty.* Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P.R. et al. (eds.). 541–562. Cambridge, UK and New York: Cambridge University Press. <https://doi.org/10.1017/9781009157940.008>.
- Meckling, J. and Biber, E. (2021). A policy roadmap for negative emissions using direct air capture. *Nature Communications* 12, 2051. <https://doi.org/10.1038/s41467-021-22347-1>.
- Meinshausen, M., Lewis, J., McGlade, C., Gütschow, J., Nicholls, Z., Burdon, R. et al. (2022). Realization of Paris Agreement pledges may limit warming just below 2°C. *Nature* 604, 304–309. <https://doi.org/10.1038/s41586-022-04553-z>.
- N** Nascimento, L., Scheewel, J.-L., Kuramochi, T., Dafnomilis, I., Hooijer, E., den Elzen M. et al. (2024). *Progress of Major Emitters Towards Climate Targets: 2024 Update.* Cologne: NewClimate Institute. <https://newclimate.org/resources/publications/progress-of-major-emitters-towards-climate-targets-2024-update>.
- Nemet, G.F., Gidden, M.J., Greene, J., Roberts, C., Lamb, W.F., Minx, J. et al. (2023). Near-term deployment of novel carbon removal to facilitate longer-term deployment. *Joule* 7(12), 2653–2659. <https://www.sciencedirect.com/science/article/pii/S254243512300449X>.
- Nicholls, Z., Meinshausen, M., Forster, P., Armour, K., Berntsen, T., Collins, W. et al. (2021). Cross-Chapter Box 7.1: Physical emulation of Earth system models for scenario classification and knowledge integration in AR6. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Masson-Delmotte, V., Zhai, P.,

Pirani, A., Connors, S.L., Péan, C., Berger, S. et al. (eds.). 962–967. Cambridge, UK and New York: Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg1/chapter/chapter-7/>.

NGFS Workstream on Scenario Design and Analysis (2024). *NGFS Climate Scenarios Technical Documentation: V5.0.* Paris: Network for Greening the Financial System. <https://www.ngfs.net/system/files/2025-01/NGFS%20Climate%20Scenarios%20Technical%20Documentation.pdf>.

P Palazzo Corner, S., Siegert, M., Ceppi, P., Fox-Kemper, B., Frölicher, T.L., Gallego-Sala, A. et al. (2023). The zero emissions commitment and climate stabilization. *Frontiers in Science* 1. <https://doi.org/10.3389/fsci.2023.1170744>.

R Reisinger, A., Fuglestvedt, J. S., Pirani, A., Geden, O., Jones, C. D., Maharaj, S. et al. (2025). Overshoot: A conceptual review of exceeding and returning to global warming of 1.5°C. *Annual Review of Environment and Sciences* 50, 185–217. <https://www.annualreviews.org/content/10.1146/annurev-environ-111523-102029>.

Riahi, K., Schaeffer, R., Arango, J., Calvin, K., Guivarch, C., Hasegawa, T. et al. (2022). Mitigation pathways compatible with long-term goals. In *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Shukla, P.R., Skea, J., Slade, R., Al Khourdajie, A., Belkacemi, R., van Diemen, A. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. Chapter 3. 295–408. <https://doi.org/10.1017/9781009157926.005>.

Rogelj, J., Shindell, D., Jiang, K., Fifita, S., Forster, P., Ginzburg, V. et al. (2018). Mitigation pathways compatible with 1.5°C in the context of sustainable development. In *Global warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty*. Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P.R. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. Chapter 2. 93–174. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf.

Rogelj, J., Geden, O., Cowie, A. and Reisinger, A. (2021). Three ways to improve net-zero emissions targets. *Nature* 591, 365–368. <https://doi.org/10.1038/d41586-021-00662-3>.

Rogelj, J. and Rajamani, L. (2025). The pursuit of 1.5°C endures as a legal and ethical imperative in a changing world. *Science* 389(6757), 238–240. <https://doi.org/10.1126/science.ady1186>.

Rosa, L., Reimer, J.A., Went, M.S. and D'Odorico, P. (2020). Hydrological limits to carbon capture and storage. *Nature Sustainability* 3, 658–666. <https://doi.org/10.1038/s41893-020-0532-7>.

S Schleussner, C.-F., Ganti, G., Lejeune, Q., Zhu, B., Pfleiderer, P., Prütz, R. et al. (2024). Overconfidence in climate overshoot. *Nature* 634, 366–373. <https://doi.org/10.1038/s41586-024-08020-9>.

Skea, J., Shukla, P.R., Reisinger, A., Slade, R., Pathak, M., Khourdajie, A.A. et al/ (2022). Summary for policymakers. In *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Shukla, P.R., Skea, J., Slade, R., Al Khourdajie, A., Belkacemi, R., van Diemen, A. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. <https://doi.org/10.1017/9781009157926.001>.

Smith, C. (2023). FaIR Calibration Data (FaIRv2.1.0). Zenodo. <https://doi.org/10.5281/zenodo.7740606>. Accessed 7 October 2025.

Smith, P., Bustamante, M., Ahammad, H., Clark, H., Dong, H., Elsiddig, E.A. et al. (2014). Agriculture, forestry and other land use (AFOLU). In *Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Farahani, E., Kadner, S., Seyboth, K. et al. (eds.). Cambridge, UK and New York: Cambridge University Press. Chapter 11. 811–922. <https://www.ipcc.ch/report/ar6/wg3/chapter/chapter-7/>.

Smith, P., Davis, S.J., Creutzig, F., Fuss, S., Minx, J., Gabrielle, B. et al. (2016). Biophysical and economic limits to negative CO₂ emissions. *Nature Climate Change* 6, 42–50. <https://doi.org/10.1038/nclimate2870>.

Emissions Gap Report 2025: Off target

Stockholm Environment Institute, Climate Analytics and the International Institute for Sustainable Development (2025). *The Production Gap Report 2025*. Stockholm, Berlin and Winnipeg: Stockholm Environment Institute, Climate Analytics and the International Institute for Sustainable Development. <http://productiongap.org/2025report>.

U

United Nations (2025). *Seizing the Moment of Opportunity: Supercharging the New Energy Era of Renewables, Efficiency, and Electrification*. New York: United Nations. https://www.un.org/sites/un2.un.org/files/un-energy-transition-report_2025.pdf.

United Nations Environment Programme (2023). *Emissions Gap Report 2023: Broken Record*. Nairobi: UNEP. <https://www.unep.org/emissions-gap-report-2023>.

United Nations Environment Programme (2024). *Emissions Gap Report 2024: No More Hot Air... Please!* Nairobi: UNEP. <https://www.unep.org/emissions-gap-report-2024>.

United Nations Environment Programme and the Climate and Clean Air Coalition (forthcoming). *Global Methane Status Report*. Nairobi: UNEP.

W

Wei, Y.-M., Kang, J.-N., Liu, L.-C., Li, Q., Wang, P.-T., Hou, J.-J. et al. (2021). A proposed global layout of carbon capture and storage in line with a 2°C climate target. *Nature Climate Change* 11, 112–118. <https://doi.org/10.1038/s41558-020-00960-0>.

World Meteorological Organization (2025). *State of the Global Climate 2024*. Geneva: World Meteorological Organization. <https://library.wmo.int/records/item/69455-state-of-the-global-climate-2024>.

World Resource Institute (2025). Climate Watch NDC Tracker. <https://www.climatewatchdata.org/ndc-tracker>. Accessed 7 October 2025.



Special thanks to UNEP's funding partners. For more than 50 years, UNEP has served as the leading global authority on the environment, mobilizing action through scientific evidence, raising awareness, building capacity and convening stakeholders. UNEP's core programme of work is made possible by flexible contributions from Member States and other partners to the Environment Fund and UNEP Planetary Funds. These funds enable agile, innovative solutions for climate change, nature and biodiversity loss, and pollution and waste.

Support UNEP. Invest in people and planet.
www.unep.org/funding

