

INTERNATIONAL CLIMATE NEGOTIATION AND SCIENTIFIC GUIDANCE (Inter-Governmental Panel on Climate Change, IPCC)

IN 00.41: Climate Change Challenges and Responses

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January 2022

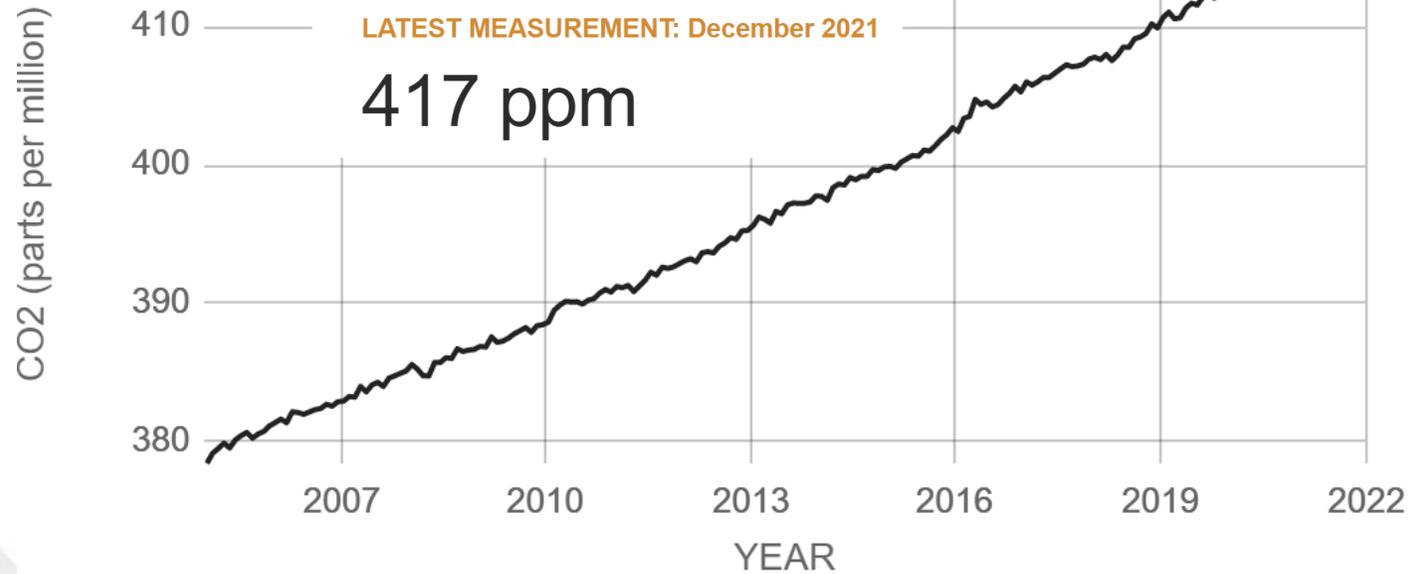


CO2 concentration in atmosphere

Carbon Dioxide

LATEST MEASUREMENT: December 2021

417 ppm



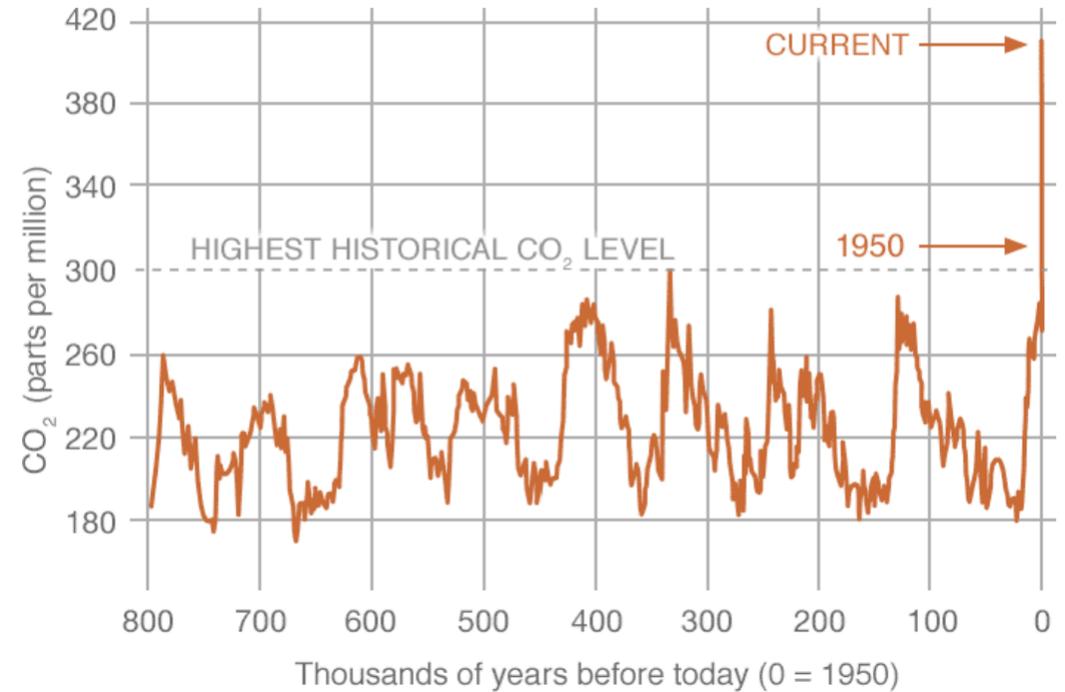
Source: climate.nasa.gov

<https://climate.nasa.gov/vital-signs/carbon-dioxide/>

PROXY (INDIRECT) MEASUREMENTS

Data source: Reconstruction from ice cores.

Credit: NOAA



Key Questions

1. What are/has been the historic trends of global emissions? Who are the top GHG emitters? Which sectors emit most and why?
2. What has been the history of climate negotiations? How it has evolved?
3. How science (IPCC) is driving policy making process? What are some of its key findings and messages from science?

This lecture focuses on the understating of the past trends of global emissions and emitters and their sources and sectors. It discusses the history of climate negotiations and its evolution to the present day. Lastly it highlights IPCC's work, research and its reports that guide policymakers around the world.

IPCC Working Group I Report - 9 August 2021

- Where are we now?

- The average global temperature is now about 1.1°C warmer from pre-industrial times (1850-1900)
- Temperature increased faster since 1970 and recent rate of warming is unprecedented in at least 2000 years

- Climate change is already affecting every regions on earth

- Recent changes in the climate are **widespread**, **rapid**, and **intensifying**, and **unprecedented** in thousands of years

- When might we cross 1.5°C?

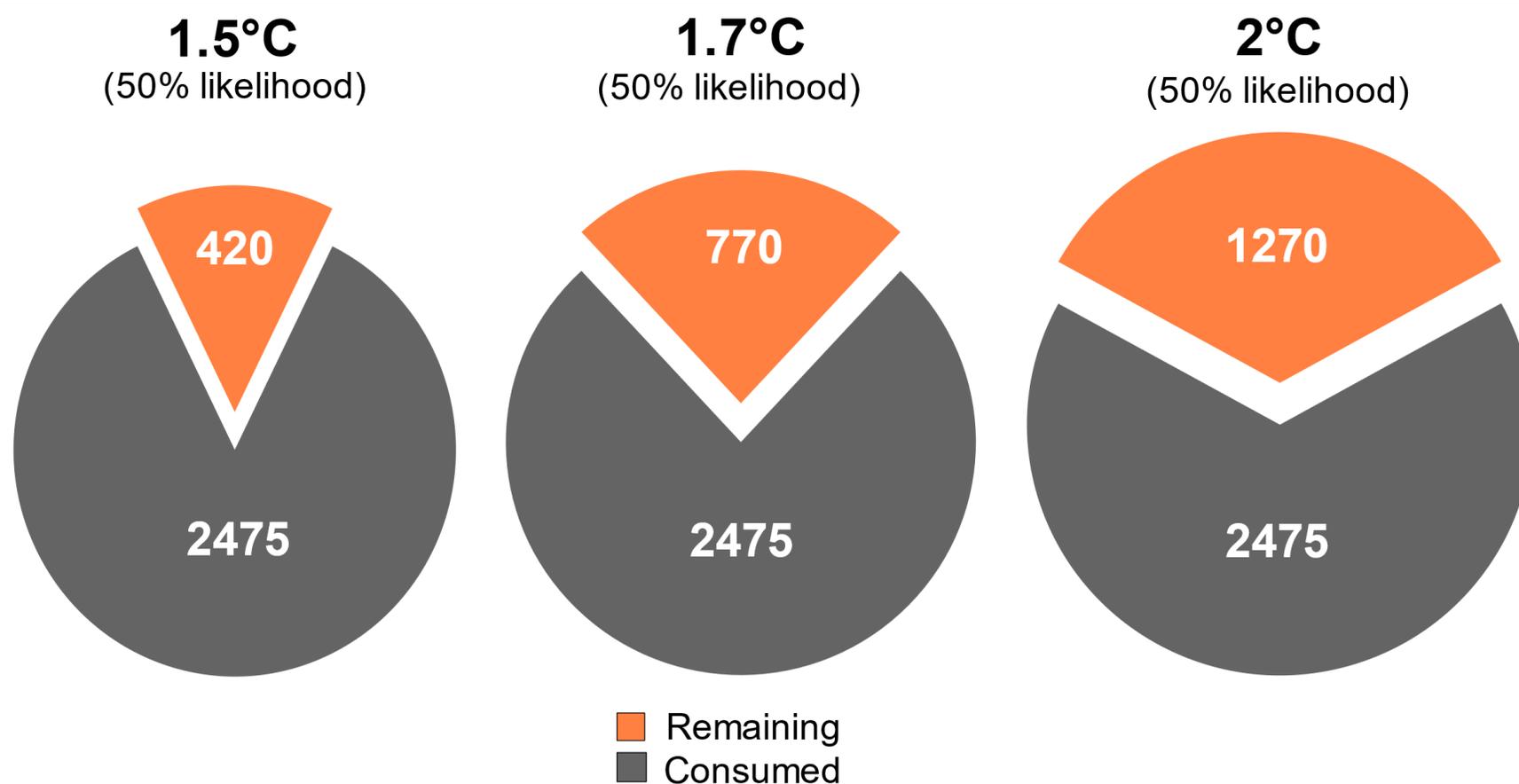
- 1850-2019 @2390 GtCO₂e emissions; remaining quota 400-500GtCO₂e for 1.5°C, 1150-1350 GtCO₂e for 2°C
- This report calculates that there is a greater than 50% chance that 1.5°C of warming will be crossed in the early 2030s

- Unless three are **immediate**, **rapid** and **large –scale reduction** in GHG emissions, limiting warming to 1.5°C will be beyond reach

- **Carbon Dioxide Removal (CDR)** can remove emissions through technology and natural means and balance little but mitigation must happen

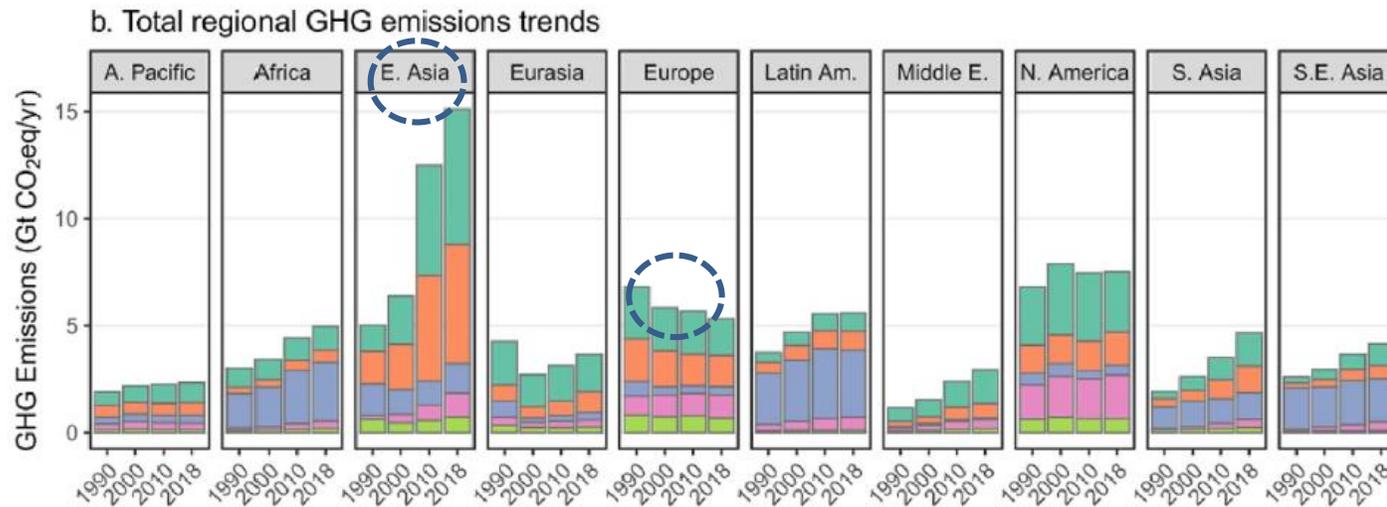
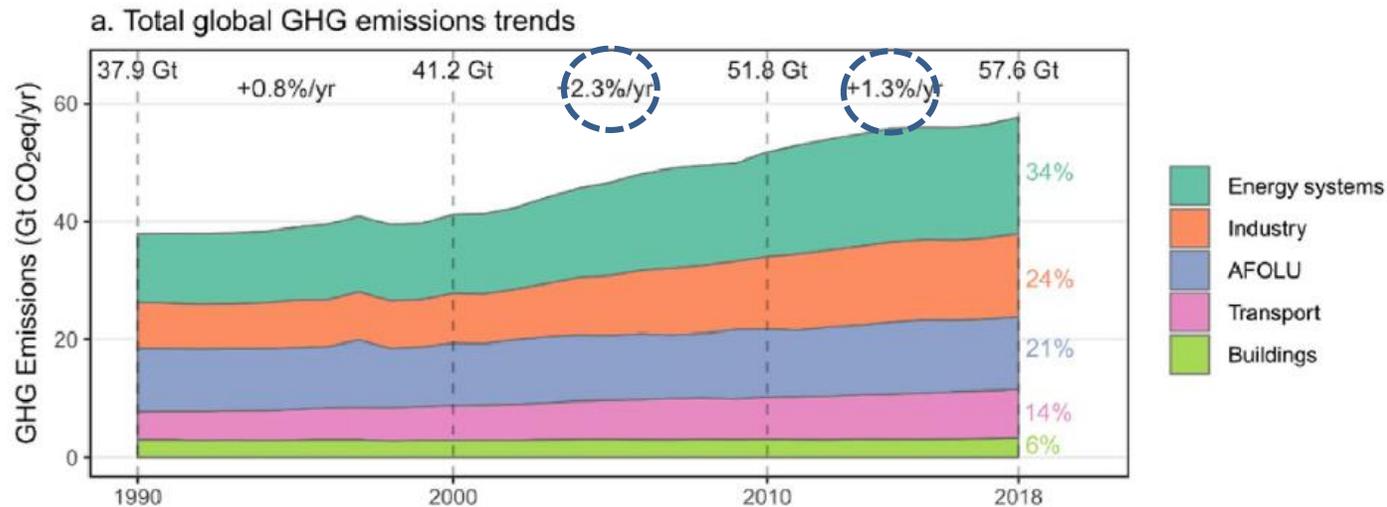
Remaining carbon budget

The remaining carbon budget to limit global warming to 1.5°C, 1.7°C and 2°C is 420 GtCO₂, 770 GtCO₂, and 1270 GtCO₂ respectively, equivalent to 11, 20 and 32 years from 2022. 2475 GtCO₂ have been emitted since 1750



Quantities are subject to [additional] uncertainties e.g., future mitigation choices of non-CO₂ emissions
 Source: IPCC AR6 WG1; [Friedlingstein et al 2021](#); [Global Carbon Budget 2021](#)

Global and regional GHG emissions trends

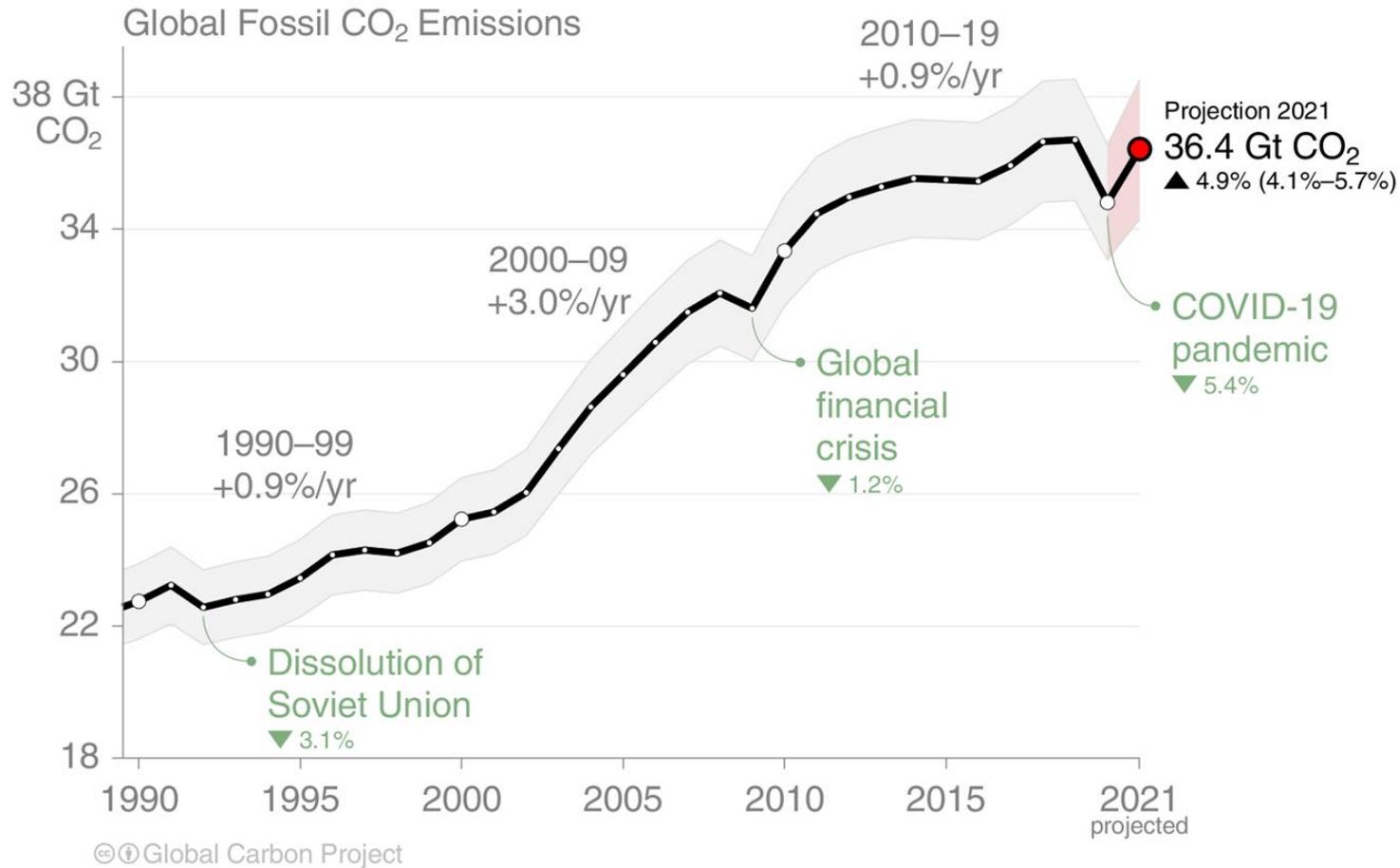


- 2018 GHG emissions: 58 GtCO₂eq → GHG emissions in 2010- 2018
- Energy sector contribute the largest, 34% share (20 GtCO₂eq)
- The only region with a decline in emissions is Europe (-0.3 GtCO₂eq, -0.8%/yr) in 2010-18

Global Fossil CO₂ Emissions

Global fossil CO₂ emissions: 34.8 ± 2 GtCO₂ in 2020, 53% over 1990

- Projection for 2021: 36.4 ± 2 GtCO₂, 4.9% [4.1%–5.7%] higher than 2020

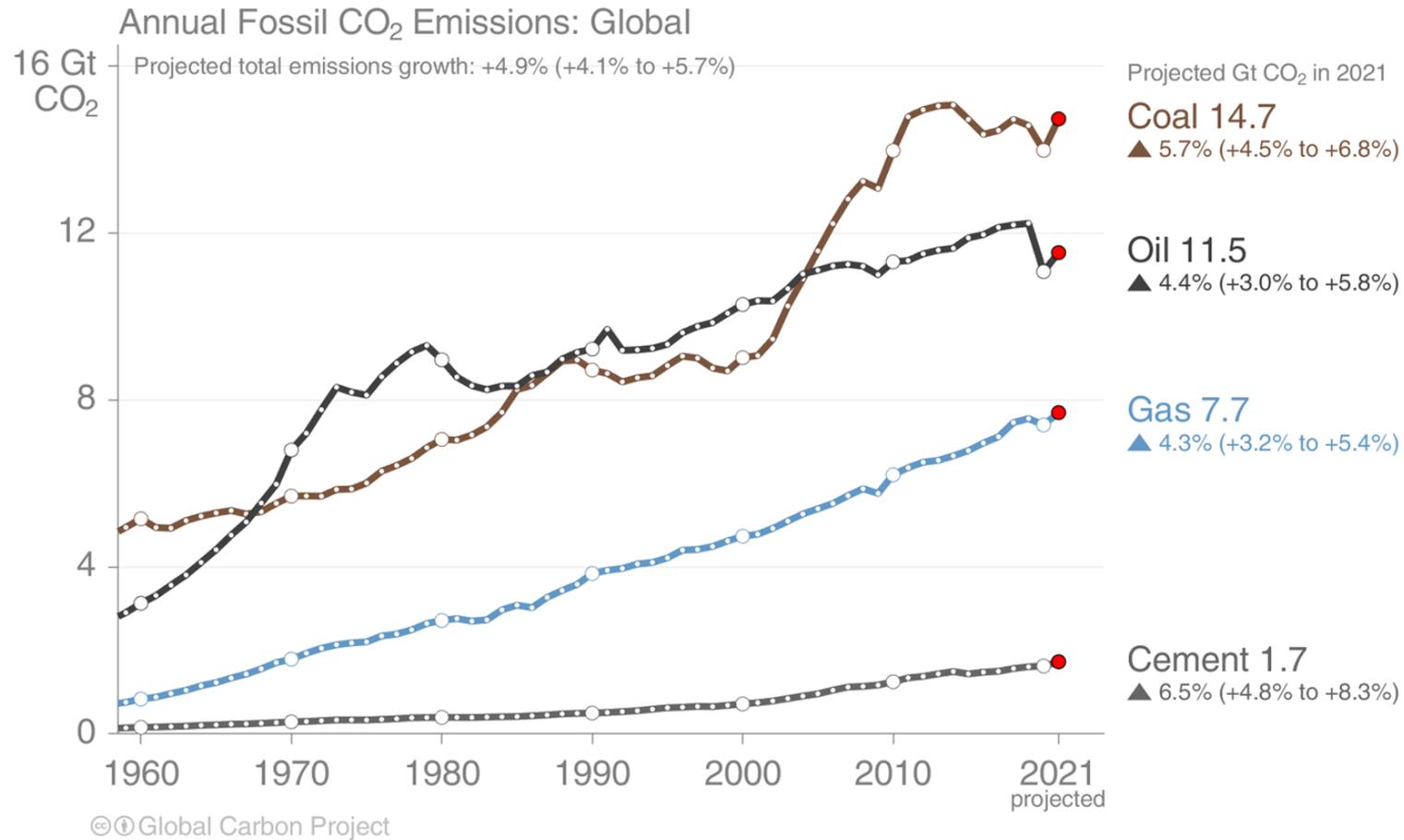


Uncertainty is ±5% for one standard deviation (IPCC “likely” range)

The 2021 projection is based on preliminary data and modelling.
 Source: [Friedlingstein et al 2021](#); [Global Carbon Project 2021](#)

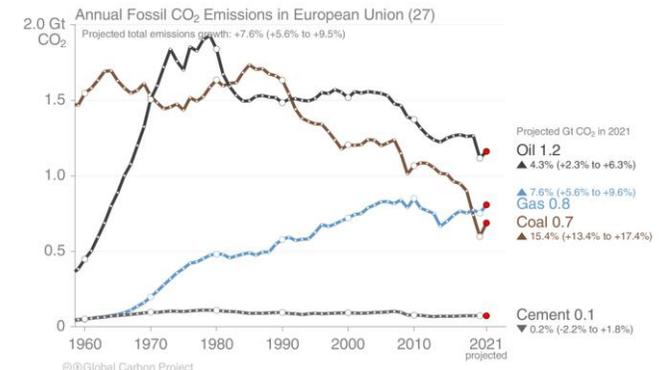
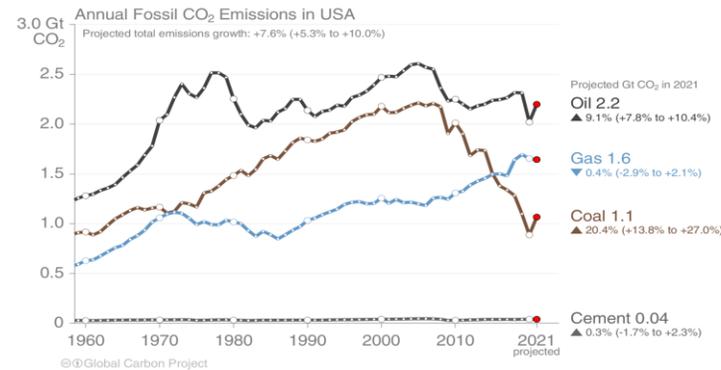
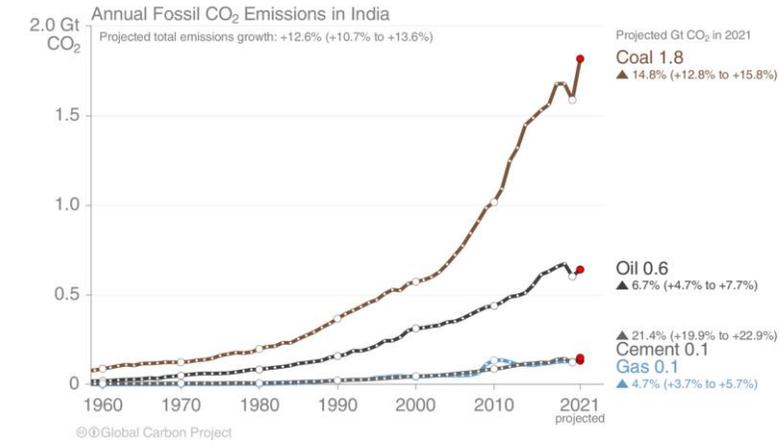
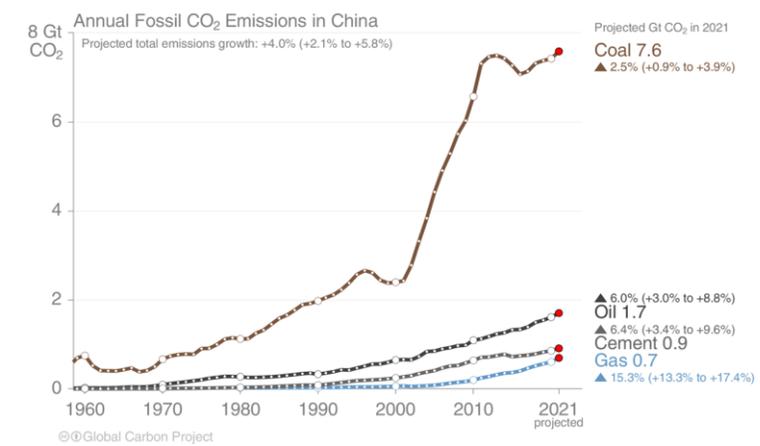
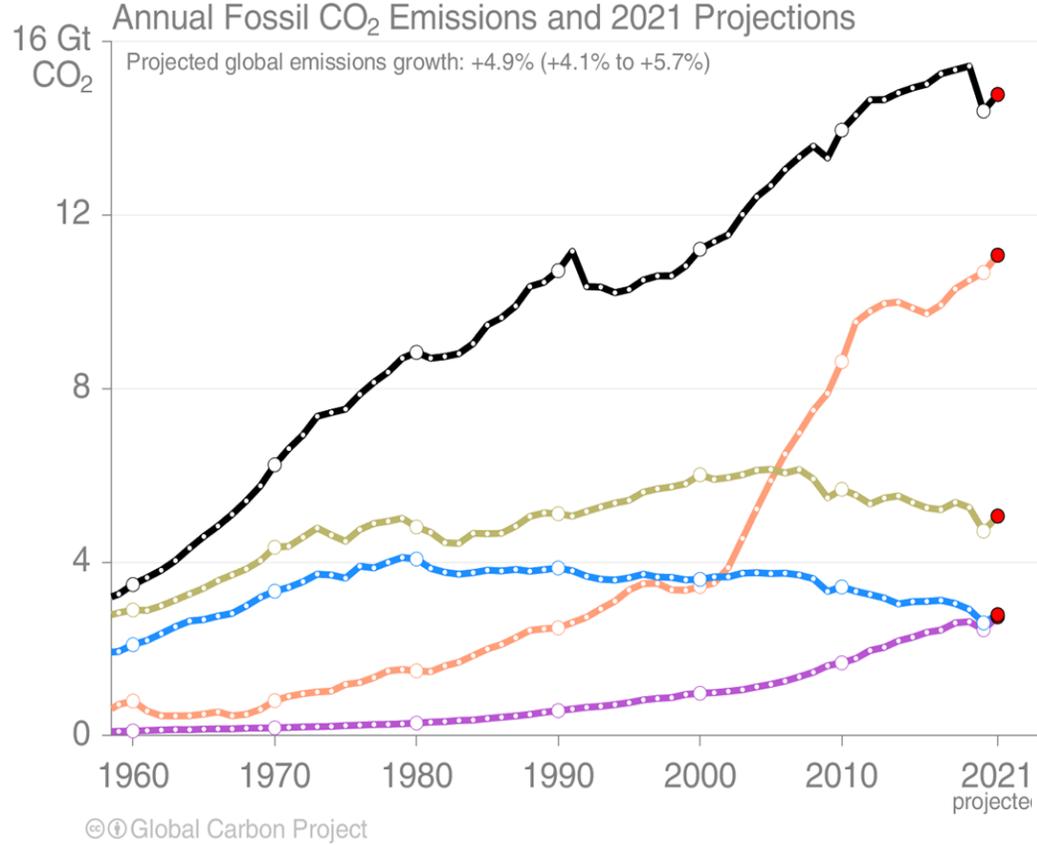
Fossil CO₂ Emissions by source

Share of global fossil CO₂ emissions in 2020: coal (40%), oil (32%), gas (21%), cement (5%), flaring and others (2%, not shown)
 Projection by fuel type is based on monthly data (GCP analysis)



Emissions Projections for 2021

Global fossil CO₂ emissions are projected to increase by 4.9% [4.1%–5.7%] in 2021

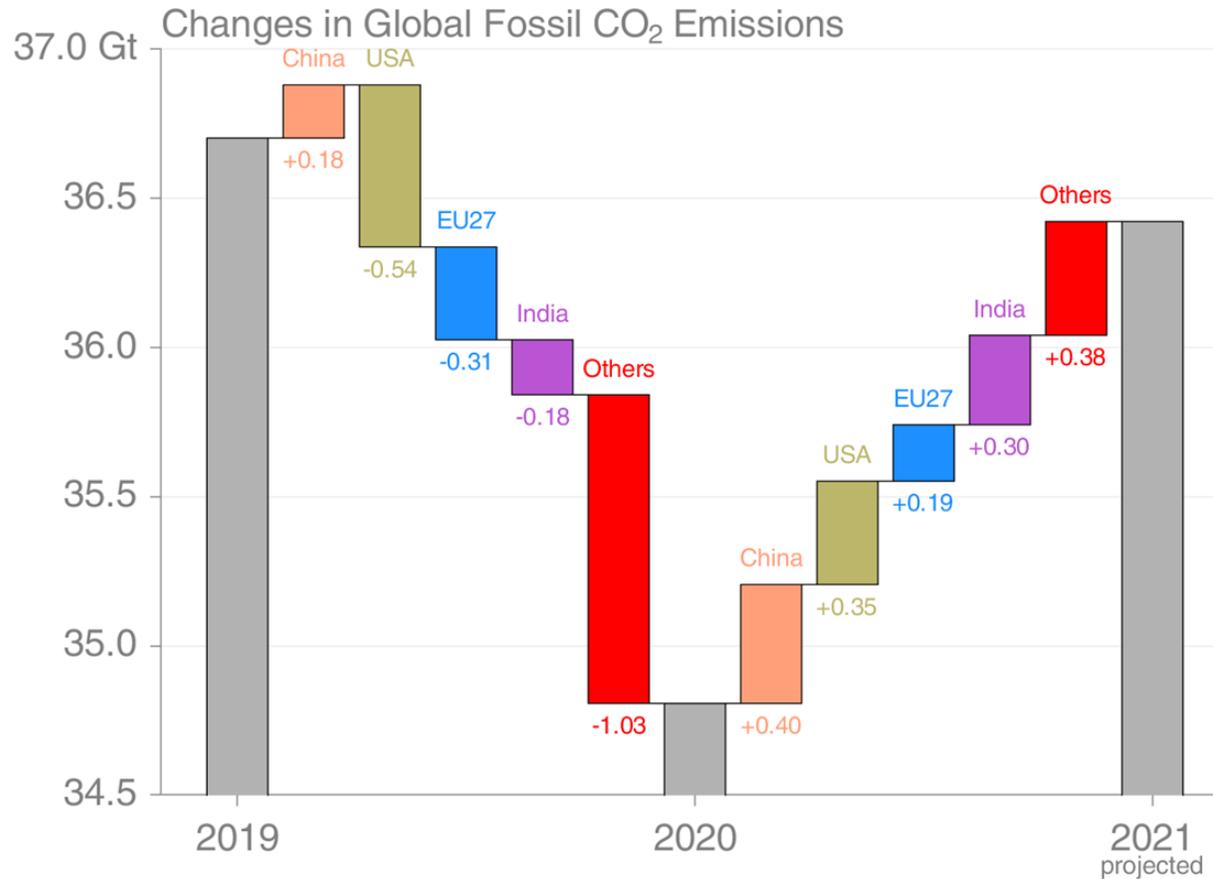


The 2021 projections are based on preliminary data and modelling.

Source: [Friedlingstein et al 2021](#); [Global Carbon Project 2021](#)

Fossil CO₂ emissions growth: 2019–2021

Emissions are expected to increase in most countries in 2021, with the largest increase in China, USA, and India



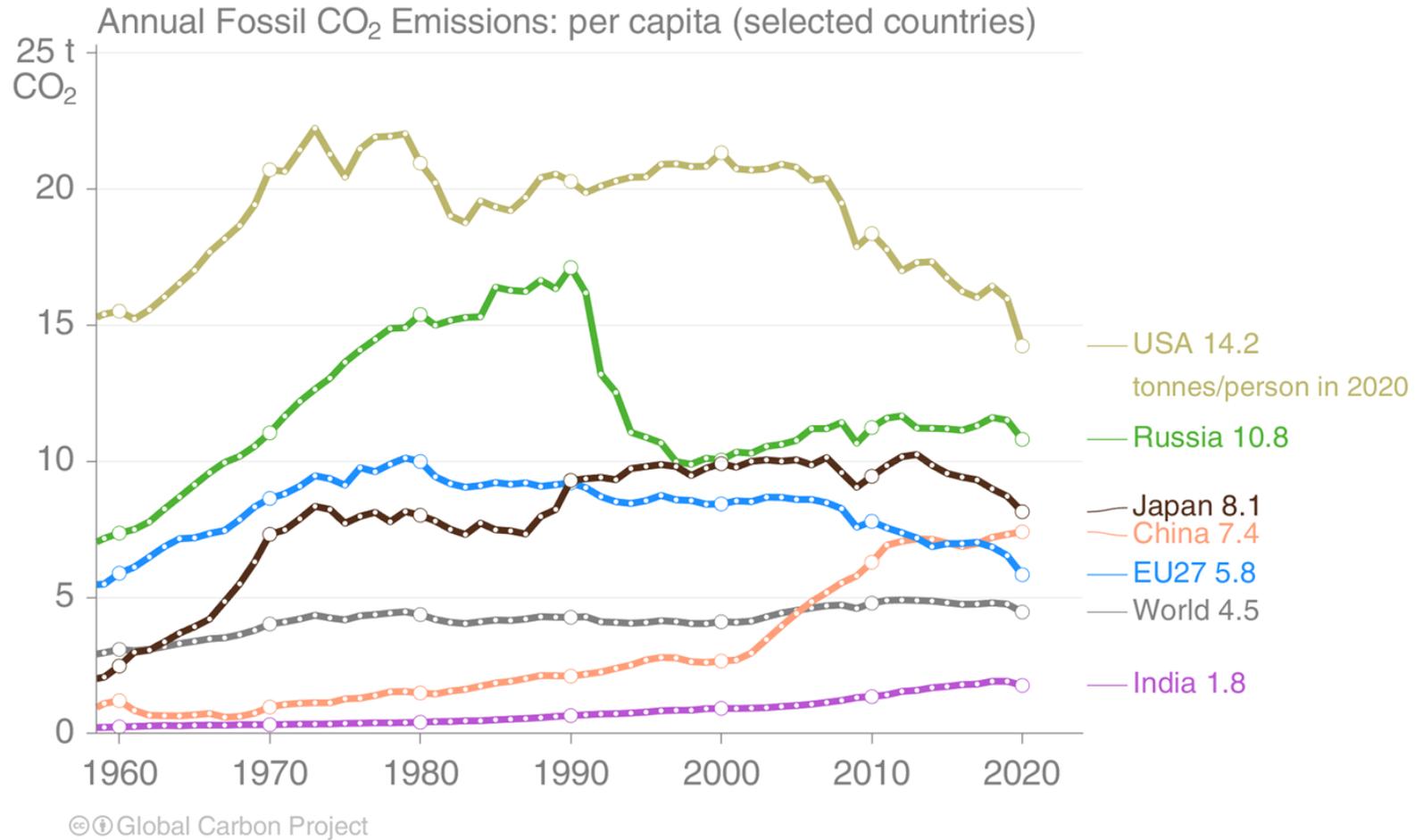
© Global Carbon Project

Figure shows the top four countries contributing to emissions changes

Source: [Friedlingstein et al 2021](#); [Global Carbon Project 2021](#)

Top emitters: Fossil CO₂ Emissions per capita to 2020

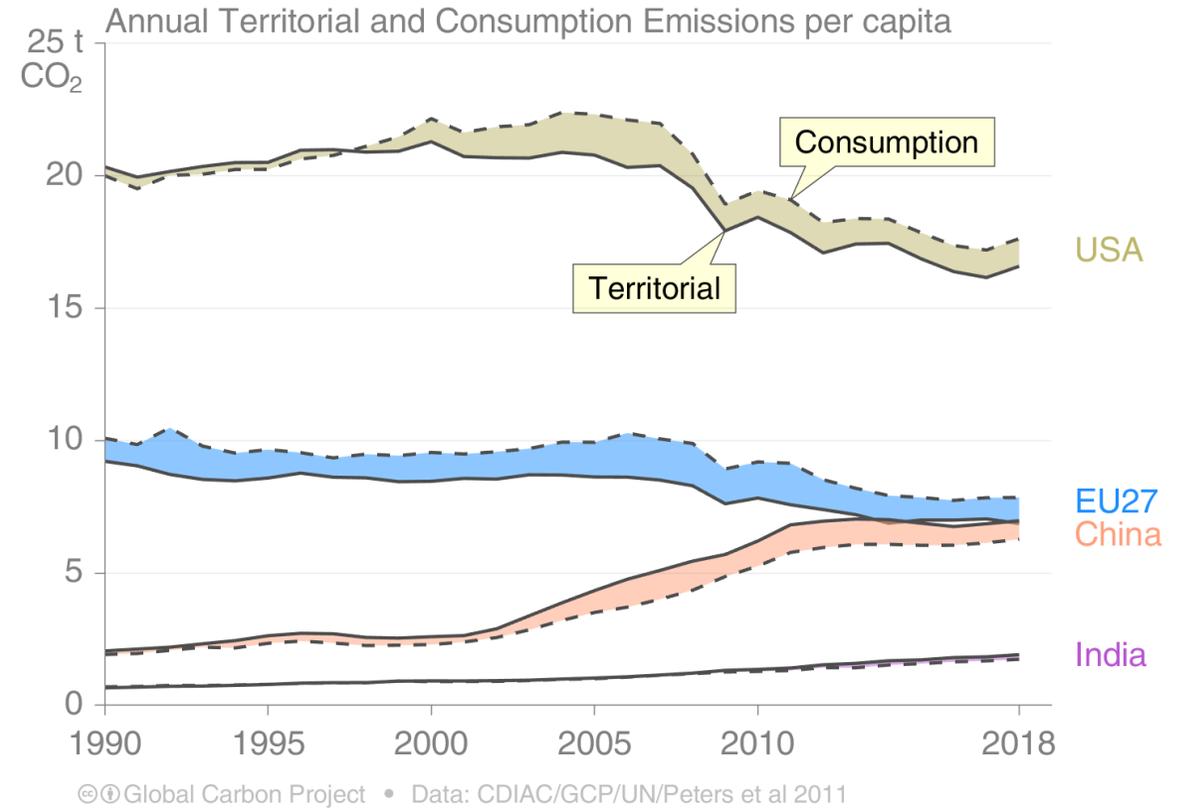
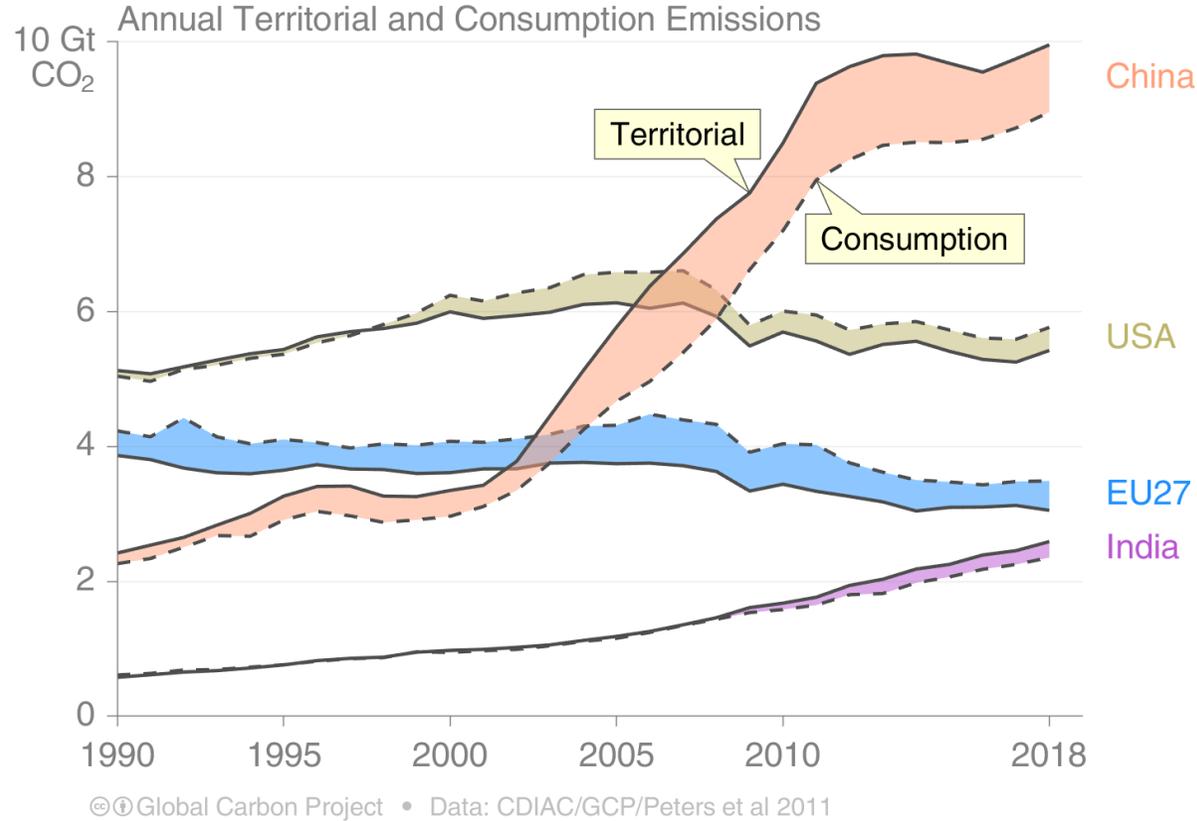
Countries have a broad range of per capita emissions reflecting their national circumstances



Consumption-based emissions (carbon footprint)

Allocating fossil CO₂ emissions to consumption provides an alternative perspective. USA and EU28 are net importers of embodied emissions, China and India are net exporters.

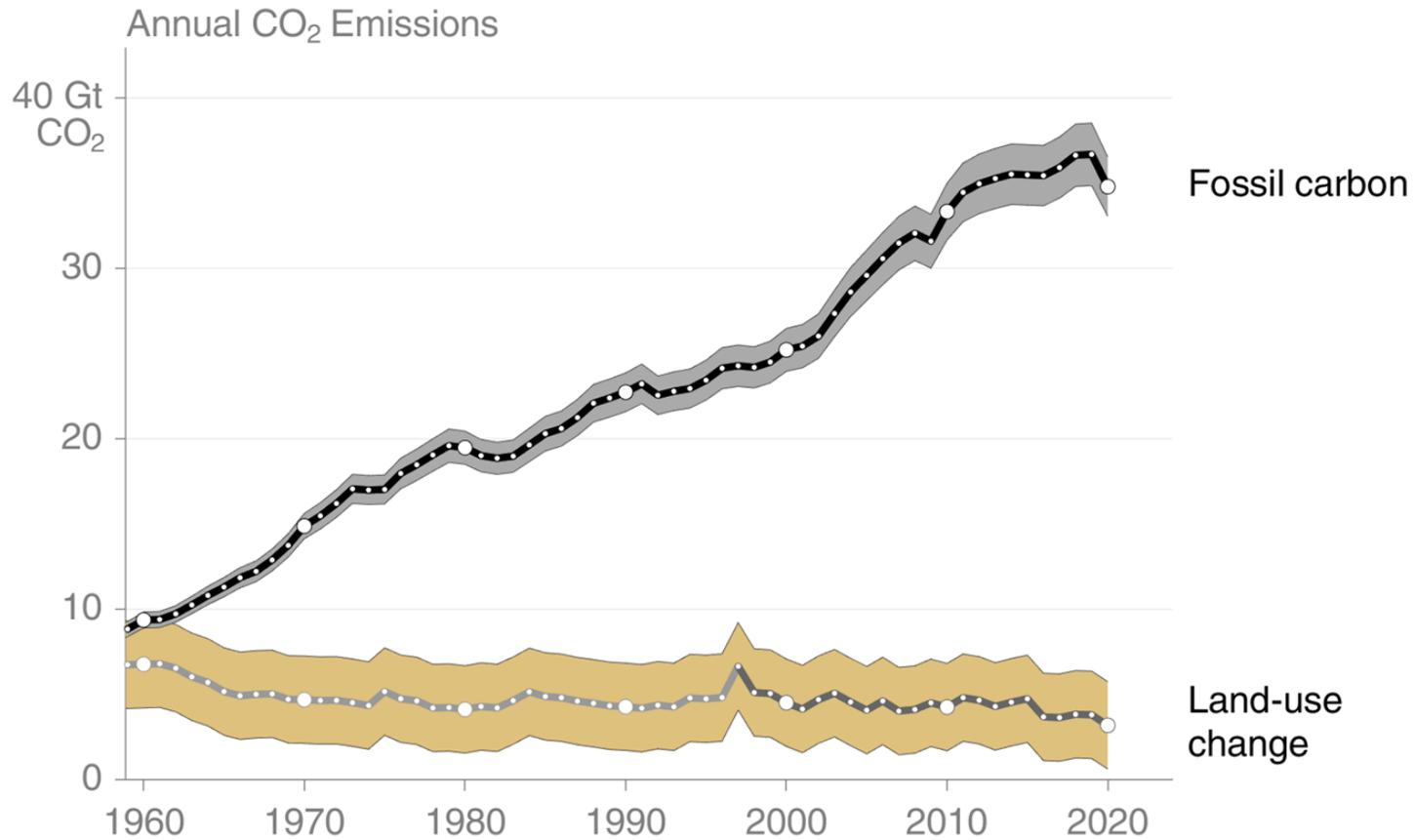
The differences between fossil CO₂ emissions per capita is larger than the differences between consumption and territorial emissions.



Consumption-based emissions are calculated by adjusting the standard production-based emissions to account for international trade
 Source: [Peters et al 2011](#); [Friedlingstein et al 2020](#); [Global Carbon Project 2019](#)

Total global emissions

Total global emissions: 38.0 ± 3.1 GtCO₂ in 2020, 40% over 1990
 Percentage land-use change: 42% in 1960, 10% averaged 2011–2020



© Global Carbon Project



Fossil carbon

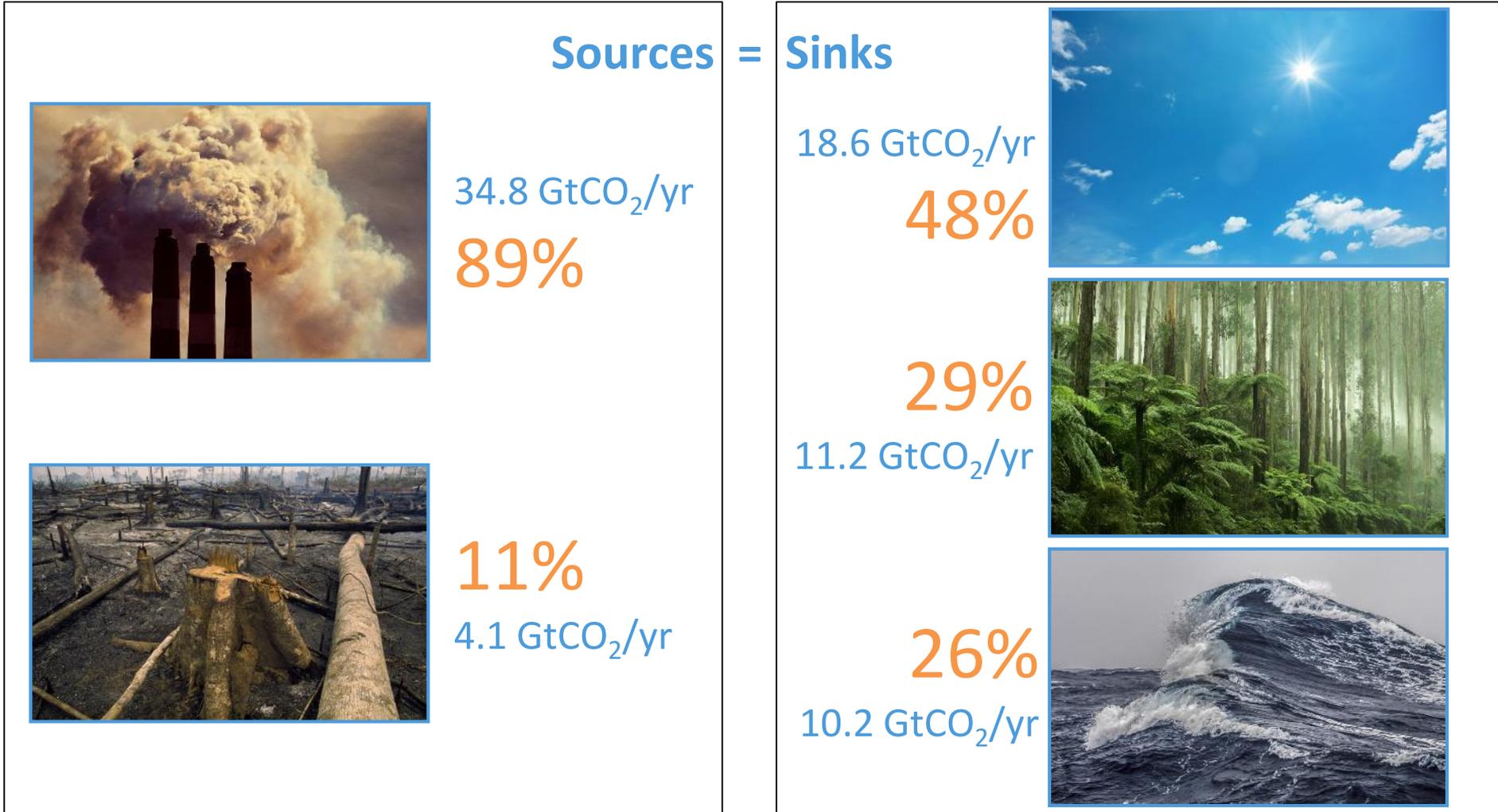


Land-use change

Land-use change estimates from three bookkeeping models, using fire-based variability from 1997

Source: [Friedlingstein et al 2021](#); [Global Carbon Project 2021](#)

Fate of anthropogenic CO₂ emissions (2011–2020)



Budget Imbalance:
 (the difference between estimated sources & sinks) **3%**
 -1.0 GtCO₂/yr

Summary of key trends

- ✓ Rising emission
- ✓ Rising coal emissions
- ✓ Top few nations/regions contributing a majority of emissions
- ✓ Historical contributions
- ✓ Structural change in developing-developed countries contributions
- ✓ Few developing countries driving most of 'new' emissions
- ✓ Rapid emissions reduction is needed and thus early peaking
- ✓ Lower emissions in 2020 due to the COVID-19 pandemic have had little effect on the atmospheric CO2 concentration
- ✓ COVID-19 effect could be only transitory and could catch up → structural change ????

History of climate negotiation

- ✓ 1979 — The first World Climate Conference (WCC)
- ✓ 1988 — The Intergovernmental Panel on Climate Change is set up
- ✓ 1990 — IPCC publishes first assessment report. IPCC and second World Climate Conference call for a global treaty on climate change. United Nations General Assembly negotiations on a framework convention begin
- ✓ 1991 — First meeting of the Intergovernmental Negotiating Committee (INC)
- ✓ 1992 — The INC adopts UNFCCC text. At the Earth Summit in Rio, the UNFCCC is opened for signature along with UNCBD and UNCCD
- ✓ 1994 — UNFCCC enters into force
- ✓ 1995 — The first Conference of the Parties (COP 1) in Berlin
- ✓ 1996 — The UNFCCC Secretariat is set up to support the Convention
- ✓ 1997 — Kyoto Protocol adopted at COP-3

UNFCCC Article 2 (Objectives)

- “The ultimate objective of the Convention is to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system.....”
-“such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner.....”

UNFCCC Article 3 (Principles)

- **Inter-generational equity**

- “... The Parties should protect the climate system for the benefit of present and future generations of humankind.... ”

- **Common but differentiated responsibility**

- “... on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof....”

- **Needs of developing countries**

- “.....The specific needs and special circumstances of developing country Parties... should be given full consideration.....”

International Climate Regime

Kyoto Targets

- **Kyoto Protocol at COP-3** (1997 Dec 11)
Protocol “operationalizes” the Convention through specific commitments; apply to only the group that sign-up particular protocol
 - Legally binding targets for 37 industrialized countries and the European community to cut average 5.2% over 2008-12 from 1990 levels
 - **Initiation of flexible mechanisms- Clean Development Mechanism**, Emission Trading, and Joint Implementation giving rise to *carbon market*

Countries	Target (1990** - 2008/2012)
EU-15*, Bulgaria, Czech Republic, Estonia, Liechtenstein, Lithuania, Monaco, Romania, Slovakia, Slovenia, Switzerland	-8%
US***	-7%
Canada, Hungary, Japan	-6%
Croatia	-5%
New Zealand, Russian Federation, Ukraine	0
Norway	1%
Australia	8%
Iceland	10%

Flexible Mechanisms – CDM, Joint Implementation, Emission Trading

- **Clean development Mechanism**

- Projects in developing countries can earn **certified emission reduction (CER) credits**. Each CER credits are equivalent to **one tonne of CO2**
- CERs can be traded and sold and be used by developed-countries with emission-reduction-commitments to contribute (a part) of their Kyoto Protocol targets
- CDM projects must reduce GHG emissions, support sustainable development.
- An **Adaptation Fund** is financed by a 2% levy on CERs issued by CDM

- **Joint Implementation**

- Joint Implementation allows **Annex B country** (with emission reduction commitment in Kyoto Protocol) to earn emission reduction units (ERUs) from emission-reduction/removal project in **another Annex B country 1 ERU = One tonne of CO2**

- **Emission Trading**

- Annex B parties accepted targets are expressed as levels of allowed emissions over the commitment period (2008-12 first period); the allowed emissions are divided into "assigned amount units" (**AAUs**)
- Allows countries with surplus emission units but not "used" - to sell such surplus to countries that are over their targets
- Emission Trading thus creates a new 'commodity' in the form of emission reductions or removals. Carbon and other GHGs are now tracked and traded like any other commodity creating "carbon market"

The Copenhagen (COP15) failure

- No new global agreements on emission cut targets
 - Voluntary emission cut **pledged** by few countries (too little)
 - A new and additional resource, including forestry and investments through international institutions, approaching **USD 30 billion for 2010-2012**
- Mobilizing **100 Billion US\$ a year (new and additional) by 2020** to support climate change actions in developing countries
- **Forestry** deal (Norway and few countries)
- “Copenhagen Accord” recognized **need to stay below 2°C** despite no commitments



US president Barack Obama along with European leaders including German chancellor Angela Merkel attend negotiations on the final night of the Copenhagen UN Climate Change summit on 18 December 2009.

Photograph: Pool/Getty Images

The era of “pledges” after Copenhagen

- As a part of Copenhagen Accord, countries pledged to reduce GHG emissions for **the year 2020**
- 42 industrialized countries and 44 developing countries submitted pledges by Cancun meeting in Dec 2010 (conditional-unconditional)
- **Was it enough for emission in 2020 needed for 2°C (>66% likelihood)? No; how big is gap? huge**
- **Can we reduce the gaps: Yes** but needs massive energy efficiency and accelerating introduction of renewables
- GAP Reports

Mitigation Pledges of Top Emitters

Top 5 emitters

Country, % of global GHG emissions, 2012	GHG emissions reduction target	Target year	Reference year	Period for implementation
USA 12.1%	26-28%	2025	2005	2020-2025
China 23.75%	30-45% per unit of GDP	2030	2007	- 2030 <ul style="list-style-type: none"> • 60% to 65% by 2030 below 2005 levels • Increase the share of non-fossil primary energy to 20% • Emission peak by 2030 or earlier
EU 8.97%	≥40%	2030	1990	2021-2030
India 5.73%	33-35% per unit of GDP	2030	2005	2021-2030 Non-fossil power generation capacity to 40% of installed capacity by 2030
Russia 5.35%	25-30%	2030	1990	2020-30
Japan 2.82%	26%	2030	2013	2020-30 18% below 1990 levels
South Korea 1.28%	37%	2030	BAU	2020-30

See all INDCs here: <http://climateobserver.org/open-and-shut/indc/>

COP 21 Paris Agreement, 2015



Executive Secretary of the United Nations Framework Convention on Climate Change Christiana Figueres, Secretary General of the United Nations Ban Ki Moon, Foreign Affairs Minister and President-designate of COP21 Laurent Fabius, and France's President Francois Hollande raise hands together after adoption of a historic global warming pact at the COP21 Climate Conference in Le Bourget, north of Paris, on Dec. 12, 2015. Anadolu Agency—Getty Images

- 197 parties to Paris Agreement; 160 Parties ratified as of August 2017
- The Paris Agreement entered into force on 4 November 2016 — “thirty days after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55 % of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession with the Depository.”



Guardian Opinion cartoon, Ben Jennings on the Paris climate talks, Friday 11 December 2015

UNFCCC COP 21 – Paris Agreement

- **Universal nature of mitigation agreement:** For the first time, all nations irrespective of developed and developing, have agreed to the mitigation commitments
- **A hybrid structure of global climate governance:** Composed of a mix of bottom-up pledge-based agreement structure coupled with top-down oversights, A shorter NDC review cycle, namely five years.
- **Successfully raising the mitigation aim to the higher bar of dangerous-climate-change threshold:** The agreement aimed at ambitious climate stabilization goals, namely aimed to keep climate stabilization below 2°C and aimed 1.5°C.
- **A clear signal to broader stakeholders for early peaking of emissions and envisioning the world after 2050 as a GHG-neutral one:** Especially to policy makers, investors and business communities for peaking of emissions as soon as possible and for **decarbonizing the energy sector**, that involve less/no fossil energy mix, **ramping-up renewable energy** deployments, carbon capture and storage, and reforestation.
- **The commitment of 100 billion US\$ by 2020 by developed countries:** The idea of 100 bn US\$ as a financing ‘floor’ has opened up avenues to mobilize more support for developing countries.

Challenges: “Implementation of commitments” and “progressively moving to higher level of commitments”

Reflecting on COP26: what were the key outcomes?

<https://www.lawsociety.org.uk/topics/climate-change/reflecting-on-cop26-what-were-the-key-outcomes>

Successes

- Green finance for the net zero economy
 - Glasgow Financial Alliance for Net Zero of \$130 trillion of private capital to accelerate the transition to a net-zero economy
 - New International Sustainability Standards Board (ISSB) to develop a global baseline for disclosure standards on climate and other environmental, social and governance (ESG) matters.
- Disclosure and transparency for the private sector
- Increasing the pace of implementing the Paris Agreement
 - Paris Agreement 'rulebook' for Article 6 approved which concerns carbon markets and accounting
 - Agreement "to revisit and strengthen the 2030 targets in their nationally determined contributions...by the end of 2022"

Shortcomings

- Failure to meet 1.5°C target
- Not securing \$100 billion climate finance (delaying to 2023)

Other key announcements at COP26

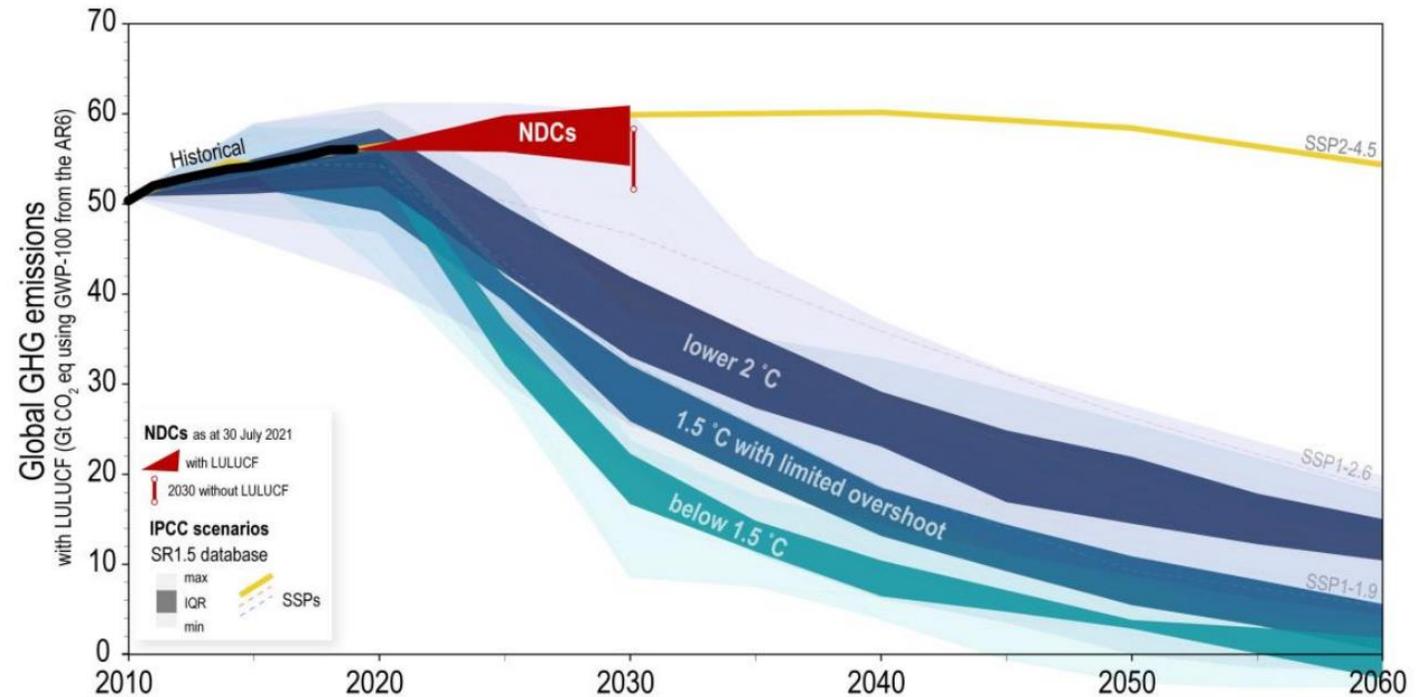
<https://www.lawsociety.org.uk/topics/climate-change/reflecting-on-cop26-what-were-the-key-outcomes>

- Major international banks have committed to ending all international public financing of new unabated coal power by the end of 2021.
- Multilateral Development Banks' joint statement created a commitment to align their portfolios with the Paris Agreement goals and as well as nature
- About 100 countries agreed to decrease their methane emissions by 30% by 2030, compared with 2020 levels. Methane accounts for about 0.5°C of the 1.1°C–1.2°C warming the world has seen to date
- World leaders representing 110 nations have signed a declaration to halt and reverse deforestation and land degradation by 2030
- At least 23 countries, including five of the world's top 20 coal power-using countries, have agreed to phase out coal power in the 2030s for leading nations, and the 2040s for the rest of the world

Role of NDCs towards mitigating warming

Synthesis report 17 Sept 2021 by UNFCCC

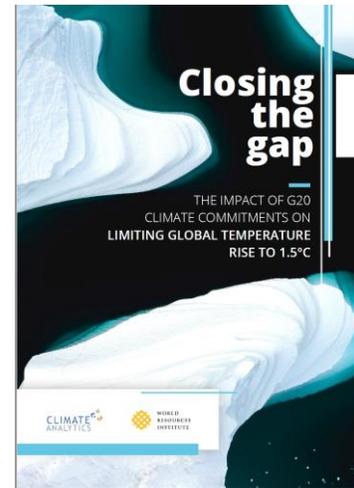
- Synthesizes 164 available NDCs, representing all 191 Parties to the Paris Agreement, including the 86 new or updated NDCs communicated by 113 Parties, recorded in the interim NDC registry as at 30 July 2021
- Cover 93.1 per cent of the total global emissions in 2019



The illustrative SSP scenarios are indicated by SSP2-4.5 by a yellow solid line - end-of-century temperature of **2.7 (2.1–3.5) °C**

Closing the gap

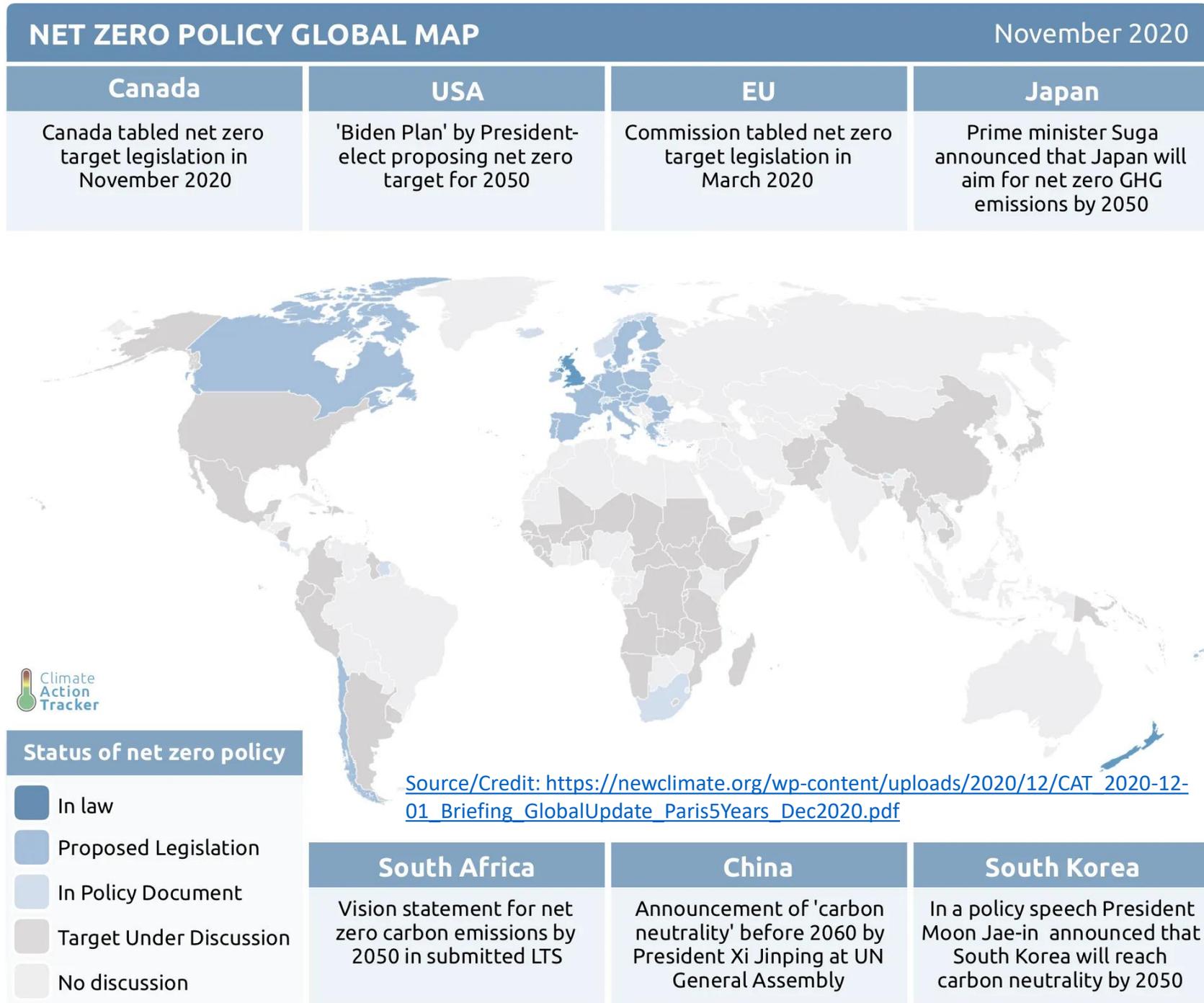
- Current submitted NDCs, together with legally binding net zero commitments, lead to 2.4°C of warming by the end of the century (*note: Only NDCs will lead to 2.7°C according to UNFCCC Synthesis of 17 Sept 2021*)
- G20 countries announced additional 2030 and net zero pledges but not yet formalized in the NDCs or binding net zero targets → that has potentials to lower temperature rise in 2100 to 2.1°C, “if fully implemented” → *The G20 collectively account for around 75% of GHGs*



Wave of Net Zero emission targets for middle of this century ...

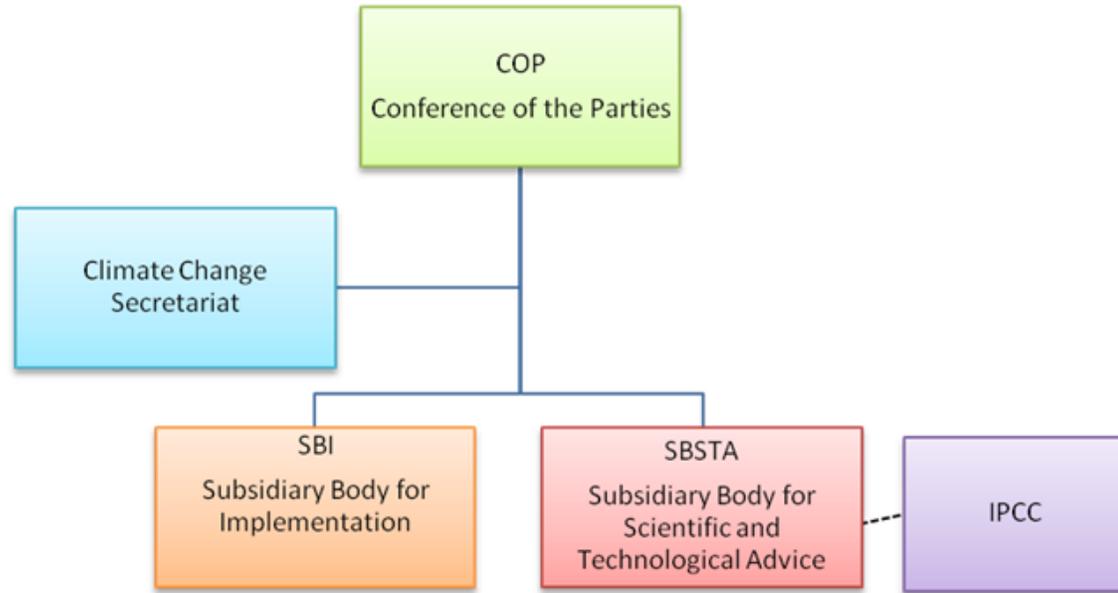
.... still not enough

... but what about stronger near-term 2030 targets?



Inter-governmental Panel on Climate Change (IPCC)

UNFCCC organizational chart indicating SBSTA as a link between the IPCC and the COP.¹⁴



Publications

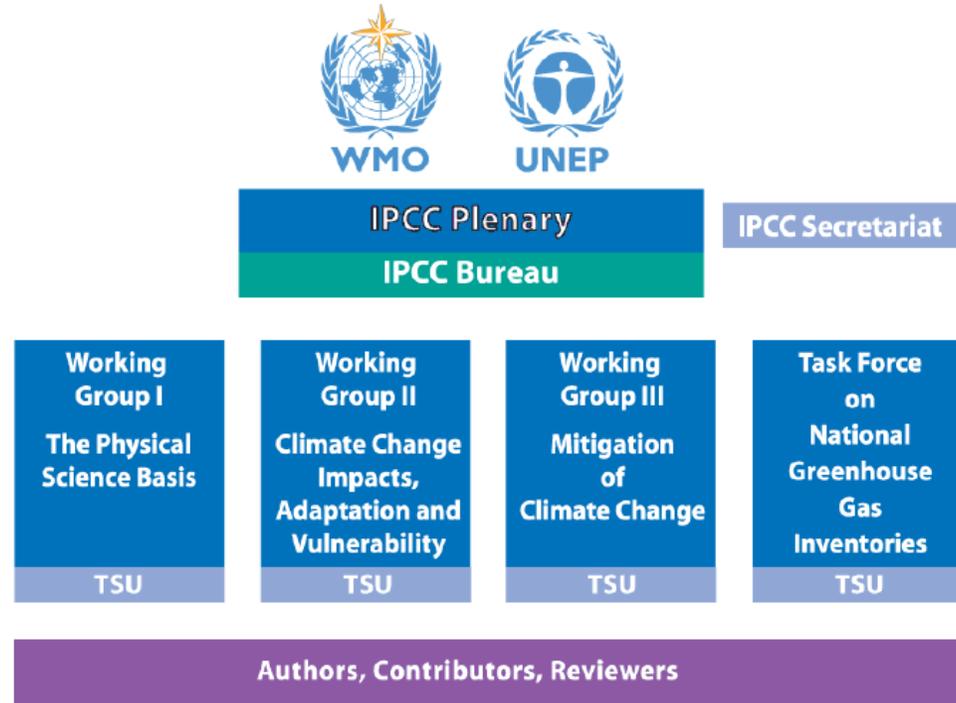
- First Assessment Report 1990
- Second Assessment Report 1995
- Third Assessment Report 2001
- Fourth Assessment Report 2007
- Fifth Assessment Report 2014
- *Sixth Assessment Report 2022 (ongoing)*

Other Special reports

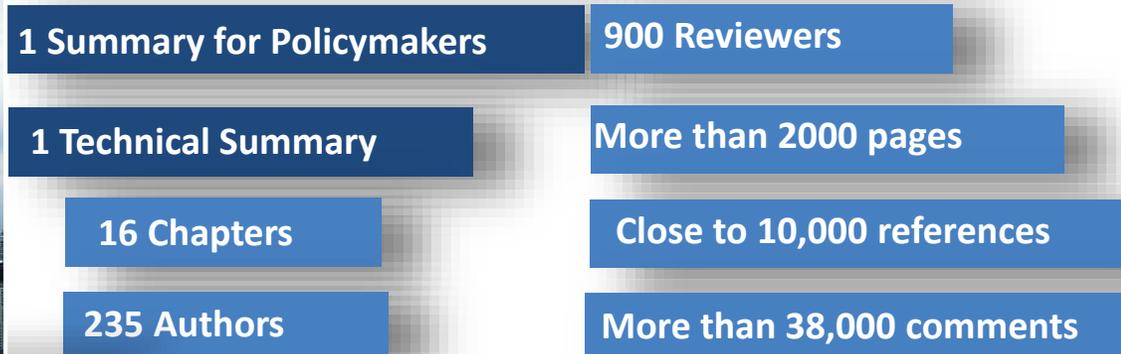
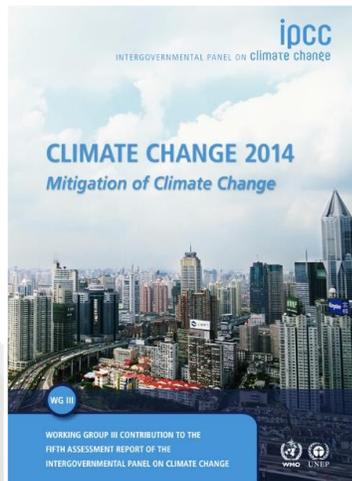
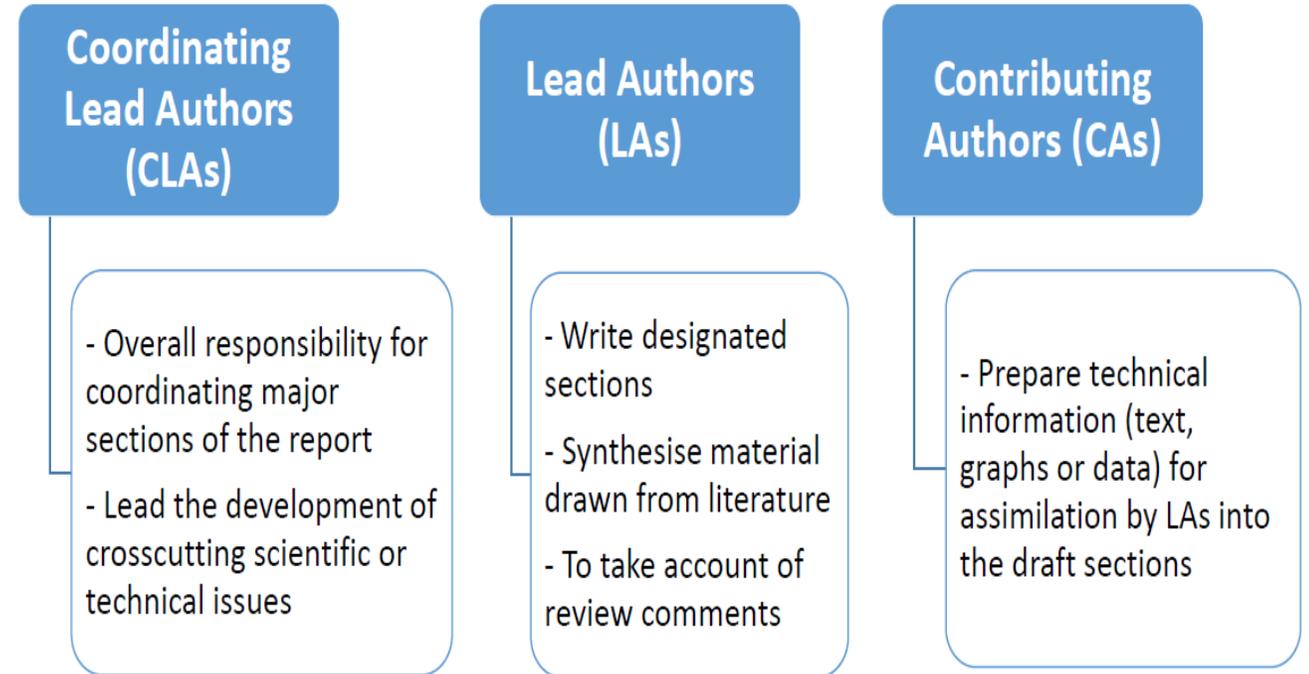
Role of IPCC

- “Policy-relevant” and yet “policy-neutral” but never “policy-prescriptive”
- Honest broker between experts and decision makers in business, politics and civil society
- Exploring opportunities and synergies, making trade-offs explicit
- Provide insights how policy instruments and incentives could be designed
- Identifying knowledge gaps

IPCC Structure



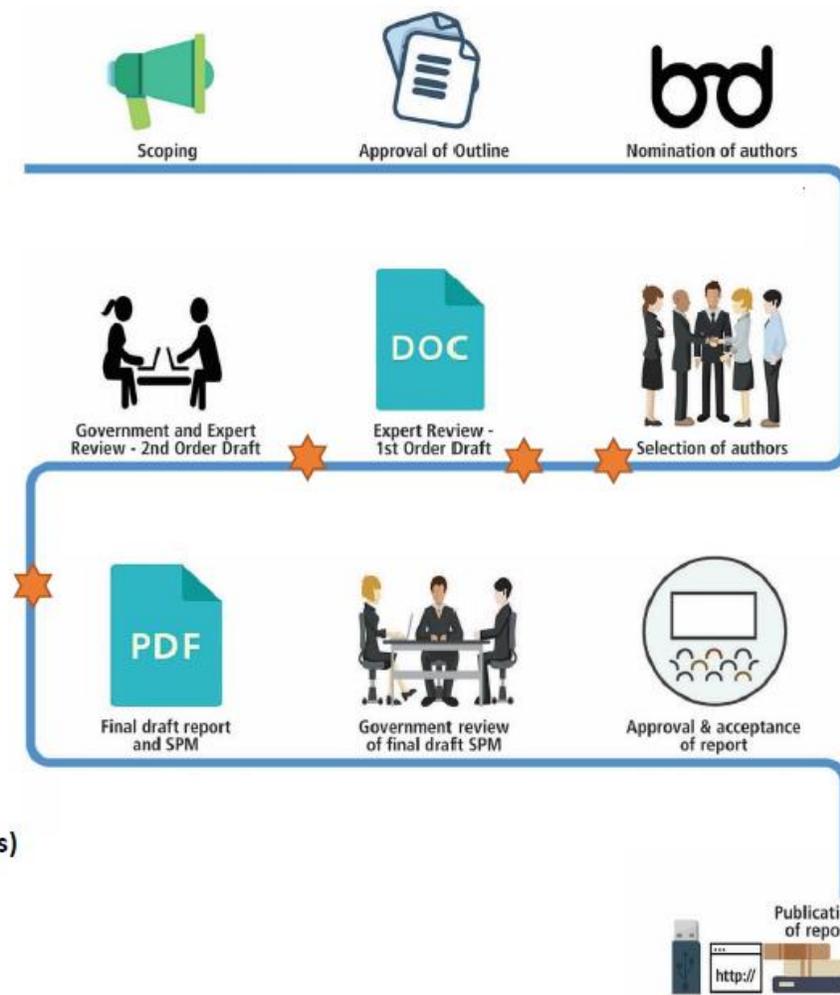
Authors



Essence of Assessment Making

1. Reviewing comprehensively the relevant scientific, technical and socio-economic literature
2. Describing consistent transformation pathways
3. Evaluating costs, risks and opportunities of different pathways in a consistent way within and across Chapters and WGs
4. Specifying underlying value judgments and worldviews
5. Communicating quantitative and qualitative uncertainties
6. Using neutral language along good scientific practice
7. Making text, figures and tables accessible

IPCC Writing and Review Process

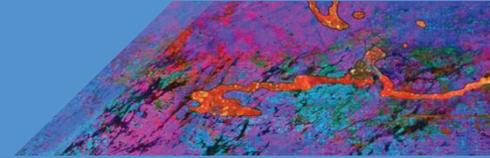


★ Leading author meetings (LAMs)

Source: Adapted from IPCC, 2013

ipcc
INTERGOVERNMENTAL PANEL ON climate change





BY THE NUMBERS

Author Team

234 authors from **65** countries

28% women, **72%** men

30% new to the **IPCC**

Review Process

14,000 scientific publications
assessed

78,000+ review comments

46 countries commented on Final
Government Distribution

References

- Lamb et al. (2021). A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018, Environmental Research Letters 16, 073005
<https://iopscience.iop.org/article/10.1088/1748-9326/abee4e>
- Global Warming of 1.5 °C <https://www.ipcc.ch/sr15/>
- IPCC Reports: <https://www.ipcc.ch/reports/>
- IPCC 6th Assessment: <https://www.ipcc.ch/assessment-report/ar6/>
- Global Carbon project: <https://www.globalcarbonproject.org/carbonbudget/index.htm>
- Figures from the Global Carbon Budget 2021 (Robbie Andrew, CICERO).
<https://robbieandrew.github.io/GCB2021/index.html>
- Global Carbon Atlas: A platform to explore and visualize the most up-to-date data on carbon fluxes resulting from human activities and natural processes
<http://www.globalcarbonatlas.org/en/content/welcome-carbon-atlas>
- Reflecting on COP26: what were the key outcomes? <https://www.lawsociety.org.uk/topics/climate-change/reflecting-on-cop26-what-were-the-key-outcomes>

Thank you

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