

## What does the IPCC say about the remaining CO<sub>2</sub> budgets?

The goal of the [Paris Agreement](#) is to hold “the increase in the global average temperature to **well below 2°C** above pre-industrial levels” and pursue efforts “to limit the temperature increase to **1.5°C** above pre-industrial levels”.

The UN Intergovernmental Panel on Climate Change (IPCC) published the following figures in its Sixth Assessment Report (AR6) Working Group I 2021 (IPCC, 2021, cf. Tables SPM.2 and 5.8):

Table 1: Remaining budgets from 2020 onwards according to the IPCC (AR6)

Warming	Estimated remaining carbon budgets			Scenario variation	Geophysical uncertainties			
				Non-CO <sub>2</sub> scenario variation	Non-CO <sub>2</sub> forcing and response uncertainty	Historical temperature uncertainty	ZEC uncertainty	Recent emissions uncertainty
Probabilities:	50%	67%	83%					
[°C]	[GtCO <sub>2</sub> from 2020 on]				[GtCO <sub>2</sub> ]			
1.5	500	400	300	±220	±220	±550	±420	±20
1.6	650	550	400					
1.7	850	700	550					
1.8	1000	850	650					
1.9	1200	1000	800					
2.0	1350	1150	900					

A remaining CO<sub>2</sub> budget is currently being used up with **annual emissions** of around **40 Gt**.<sup>1</sup>

Here is a web app for calculating linear global emission paths that comply with a given CO<sub>2</sub> budget (temporary overshooting can be taken into account): <http://global-paths.climate-calculator.info>.

The IPCC writes about the CO<sub>2</sub> budget (IPCC, 2021, p. 28 f., emphasis and [...] not in the original):

«D.1.1 [...] there is a **near-linear relationship between cumulative anthropogenic CO<sub>2</sub> emissions and the global warming they cause**. Each 1000 GtCO<sub>2</sub> of cumulative CO<sub>2</sub> emissions is assessed to likely cause a 0.27°C to 0.63°C increase in global surface temperature with a best estimate of 0.45°C. [...] This quantity is referred to as the transient climate response to cumulative CO<sub>2</sub> emissions (TCRE). This relationship implies that reaching net zero anthropogenic CO<sub>2</sub> emissions is a requirement to stabilize human-induced global temperature increase at any level, but that **limiting global temperature increase to a specific level would imply limiting cumulative CO<sub>2</sub> emissions to within a carbon budget**.»

«D.1.2 [...] **Remaining carbon budgets have been estimated for several global temperature limits and various levels of probability**, based on the estimated value of TCRE and its uncertainty, estimates of historical warming [±550 GtCO<sub>2</sub>], variations in projected warming from non-CO<sub>2</sub> emissions [±220 GtCO<sub>2</sub>], climate system feedbacks such as emissions from thawing permafrost [±220 GtCO<sub>2</sub>], and the global surface temperature change after global anthropogenic CO<sub>2</sub> emissions reach net zero [ZEC].»

Regarding **probabilities**, the IPCC notes (IPCC, 2021, p. 29, emphasis not in the original):

«This likelihood is based on the uncertainty in transient climate response to cumulative CO<sub>2</sub> emissions (TCRE) and additional Earth system feedbacks and provides the probability that global warming will not exceed the temperature levels [...]. Uncertainties related to historical warming (±550 GtCO<sub>2</sub>) and non-CO<sub>2</sub> forcing and response (±220 GtCO<sub>2</sub>) are **partially addressed** by the **assessed uncertainty in TCRE**, but uncertainties in recent emissions since 2015 (±20 GtCO<sub>2</sub>) and the climate response after net zero CO<sub>2</sub> emissions are reached (±420 GtCO<sub>2</sub>) **are separate**.»

<sup>1</sup> Actual CO<sub>2</sub> emissions in 2024 were estimated (projection) at 41.6 Gt (GCP, 2024). 37.4 Gt result from the use of fossil fuels and cement production and 4.2 Gt from land use change (LUC). See also footnote 2.

## Updated budgets

Since 2023, the Indicators of Global Climate Change ([IGCC](#)) initiative has published an annual update on remaining CO<sub>2</sub> budgets, which also takes into account the latest scientific findings. IGCC publishes the remaining budgets (see Table 2), taking also into account known actual emissions from 2020 onwards (cf. Forster, P.M. et al., 2025).

Table 3 shows the results converted to budgets from 2020 onwards. Data from the Global Carbon Project was used for this purpose. These emissions amounted to 200 GtCO<sub>2</sub> between 2020 and 2024 (cf. GCP, 2024; Wolfsteiner & Wittmann, 2025).<sup>2</sup>

Table 2: Updated budgets from 2025 onwards

Warming	Estimated remaining carbon budgets		
Probabilities:	50%	67%	83%
[°C]	[GtCO <sub>2</sub> from 2025 on]		
1.5	130	80	30
1.6	310	240	160
1.7	490	390	290
1.8	680	550	430
1.9	860	710	560
2.0	1,050	870	690

Table 3: Recalculated updated budgets from 2020 onwards

Warming	Estimated remaining carbon budgets		
Probabilities:	50%	67%	83%
[°C]	[GtCO <sub>2</sub> from 2020 on]		
1.5	330	280	230
1.6	510	440	360
1.7	690	590	490
1.8	880	750	630
1.9	1.060	910	760
2.0	1,250	1,070	890

<sup>2</sup> The figures from GCP include land-use change (LUC) and ‘cement carbonation sink’. Forster et al. estimates 206 GtCO<sub>2</sub> for 2020 – 2024 (cf. Forster, P.M. et al., 2025, p. 6):

GtCO <sub>2</sub>	GCP			IGCC		
	fossil	LUC	total	fossil	LULUCF	total
2020	34.4	3.4	37.8	36.0	4.4	40.4
2021	36.2	3.6	39.8	36.5	4.3	40.8
2022	36.5	3.5	40.0	37.1	4.1	41.2
2023	37.0	3.6	40.6	37.8	3.6	41.4
2024	37.4	4.2	41.6	38.2	4.2	42.4
total			199.8			206.2

## References

Forster, P.M. et al.. 2025. *Indicators of Global Climate Change 2024: annual update of key indicators of the state of the climate system and human influence*. [Online]

Available at: <https://essd.copernicus.org/articles/17/2641/2025/>

GCP. 2024. [Online]

Available at: <https://globalcarbonbudget.org>

[Accessed 13 11 2024].

IPCC. 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*. [Online]

Available at: <https://www.ipcc.ch/report/ar6/wg1/>

Wolfsteiner, A. & Wittmann, G.. 2025. *Tool: Implicit and explicit weighting of the population in the allocation of a global CO<sub>2</sub> budget*. [Online]

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