

Supplementary Table 1: Future CO₂ emissions scenarios, budgets, and gaps to the Paris Agreement temperature goals.

Metric and time frame or case	Values based on current NDCs	Annual Emissions Reduction Rate (2031 – 2100)				3% annual emissions reduction from 2021 onwards
		0% (constant)	1%	3%	5%	
<u>Annual CO₂ Emissions Rate^a [Gt(CO₂)/yr]</u>						
2030	47 ± 4					31 ± 0.8
2100		47 ± 4	23 ± 2	5.5 ± 0.4	1.3 ± 0.1	3.7 ± 0.1
<u>Cumulative CO₂ emissions [Gt(CO₂)]</u>						
2015 – 2030	700 ± 37					600 ± 13
2031 – 2100		3270 ± 260	2330 ± 180	1330 ± 100	860 ± 68	890 ± 23
2015 – 2100		3970 ± 290	3030 ± 220	2030 ± 140	1560 ± 100	1490 ± 36
<u>Gap to the Remaining Budgets^b in 2100 [Gt(CO₂)]</u>						
For $\Delta\bar{T}_s$ likely ≤ 1.5°C		3320 ± 420	2380 ± 350	1380 ± 270	910 ± 230	840 ± 170
For $\Delta\bar{T}_s$ likely ≤ 2°C		2670 ± 420	1730 ± 350	730 ± 270	260 ± 230	190 ± 170
<u>Implied Negative Radiative Forcing Gap^c to Temperature Limits in 2100 [W/m²]</u>						
For $\Delta\bar{T}_s$ likely ≤ 1.5°C		3.2 ± 0.4	2.3 ± 0.3	1.3 ± 0.3	0.87 ± 0.23	0.81 ± 0.16
For $\Delta\bar{T}_s$ likely ≤ 2°C		2.6 ± 0.4	1.7 ± 0.3	0.7 ± 0.3	0.25 ± 0.23	0.18 ± 0.16
See Methods for assumptions, computations and conversions.						
All values are given as the mean of the lower and upper bound values computed for each individual metric, ± half of the difference between the upper and lower bound values.						
The reference starting year for the remaining budgets is 2015, for comparability to several other relevant recent studies ^{1,2} .						
^a Values for 2030 from Ref. 3 (using the lower and upper bounds given in that study).						
^b Remaining budgets are computed applying values for the remaining CO ₂ budgets derived based on data from an IPCC analysis of model ensemble output ⁴ (see Methods): 650 ± 130 Gt(CO ₂) to 1.5°C and 1300 ± 130 Gt(CO ₂) to 2°C.						
^c Values given are for negative radiative forcing, i.e., cooling. The conversion used between CO ₂ budget gap values and the radiative forcing gaps is 9.6 x 10 ⁻⁴ (W/m ²)/(Gt(CO ₂)) (see Methods).						

Supplementary References

- 1 Rogelj, J. *et al.* Differences between carbon budget estimates unravelled. *Nature Climate Change* **6**, 245, doi:10.1038/nclimate2868 (2016).
- 2 Millar, R. J. *et al.* Emission budgets and pathways consistent with limiting warming to 1.5 °C. *Nature Geoscience* **10**, 741, doi:10.1038/ngeo3031 (2017).
- 3 Benveniste, H., Boucher, O., Guivarch, C., Le Treut, H. & Criqui, P. Impacts of nationally determined contributions on 2030 global greenhouse gas emissions: uncertainty analysis and distribution of emissions. *Environmental Research Letters*, **13**, 014022, doi:10.1088/1748-9326/aaa0b9 (2018).
- 4 IPCC. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. *Cambridge University Press*, 151 pp., (2014).