Overshoot: from implicit assumption to political plan for going net-negative?

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Delayed mitigation results in higher peak temperature

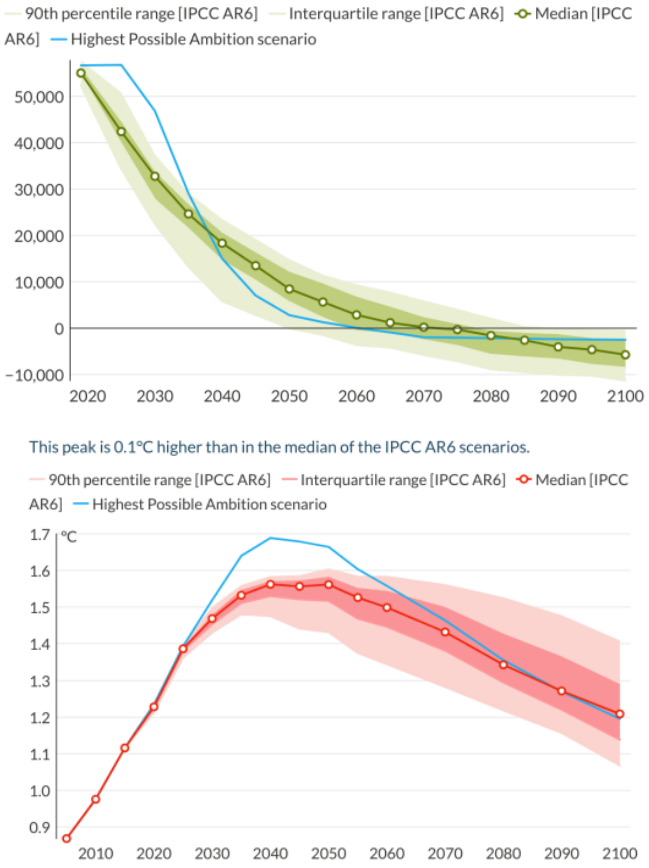
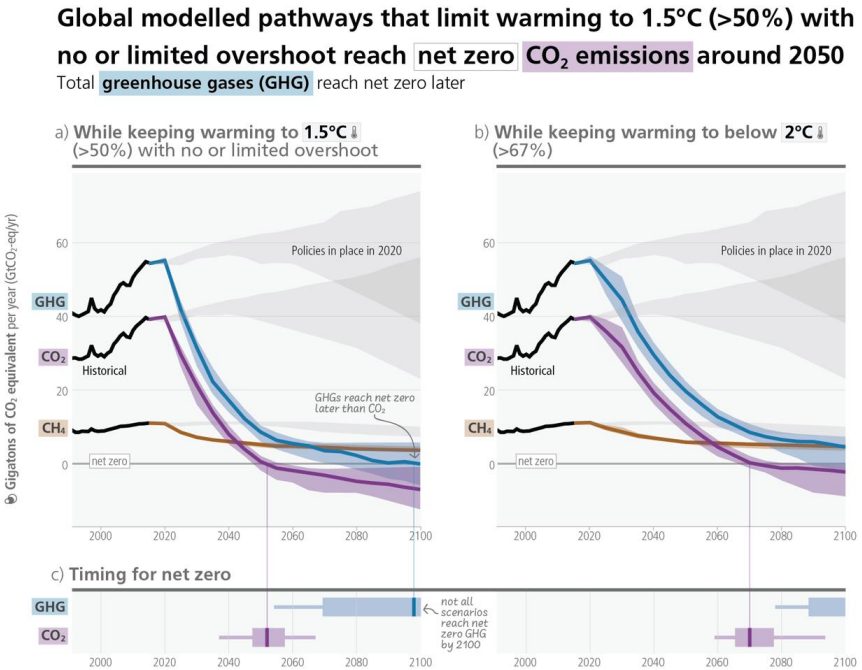


Figure 3 compares the global average temperatures out to 2100 in the Highest Possible Ambition scenario with the IPCC AR6 scenarios.

- Emissions have been not been falling since 2019 (IPCC AR6 base year for mitigation benchmarks)
- Together with methodological changes in calculating remaining carbon budgets since AR6, this leaves only 3-4 years for 1.5°C carbon budget
- **Exceedance** of 1.5°C, **peak** at 1.7°C (and **return** to 1.5° before 2100) increasingly seen as “Highest Possible Ambition”
- But “1.5°C overshoot” is not a new design feature, it was already part of IPCC Special Report on 1.5°C and IPCC AR6

Grant et al. 2025, Rescuing 1.5°C, Climate Analytics & PIK

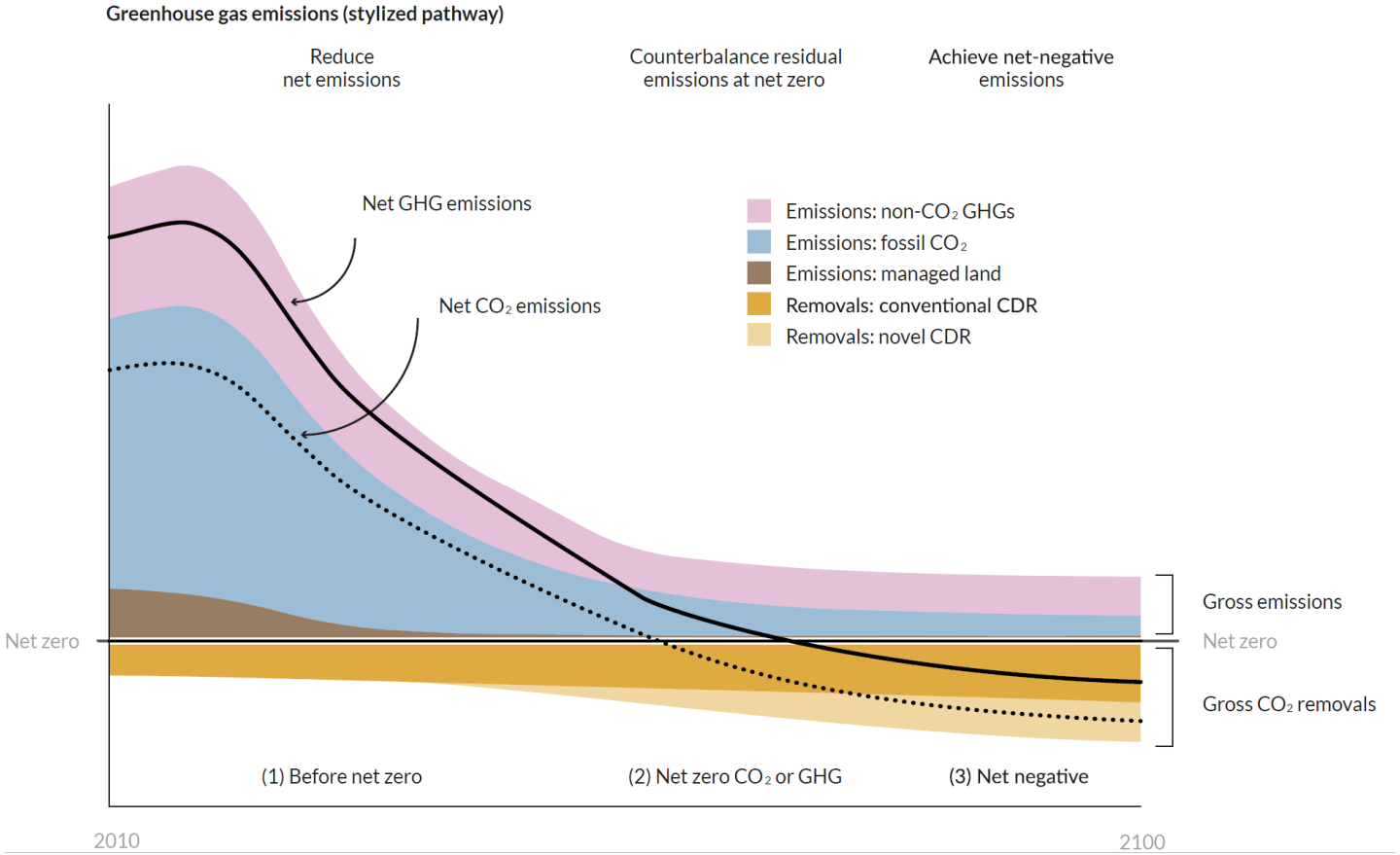
IPCC AR6 1.5°C pathways already about overshoot



- **Overshoot** in IPCC AR6 1.5°C mitigation scenarios (C1 – *1.5°C with no or **limited overshoot***: 97 scenarios, 6 no vs. **91 limited overshoot**)
- 1.5 limited overshoot (+ 0.1°C) implicit in UNFCCC decisions referring to 2030/2035 benchmarks in AR6 pathways: -48/-65% CO_2 vs. 2019 for 1.5°C
- 1.5°C reached by 2030-35 (AR6 SYR) = net-zero (-100%) CO_2 by 2030-35 to avoid exceedance
- Net-zero CO_2 in 2050 (for 1.5°C by 2100) = **exceedance** of 1.5°C before 2050 **& return** to 1.5°C after 2050, via net-negative CO_2 emissions
- Reducing global warming by 0.1°C = cumulative net-negative CO_2 emissions of **~220 Gigatons** (residual CO_2 emissions minus CO_2 removal)

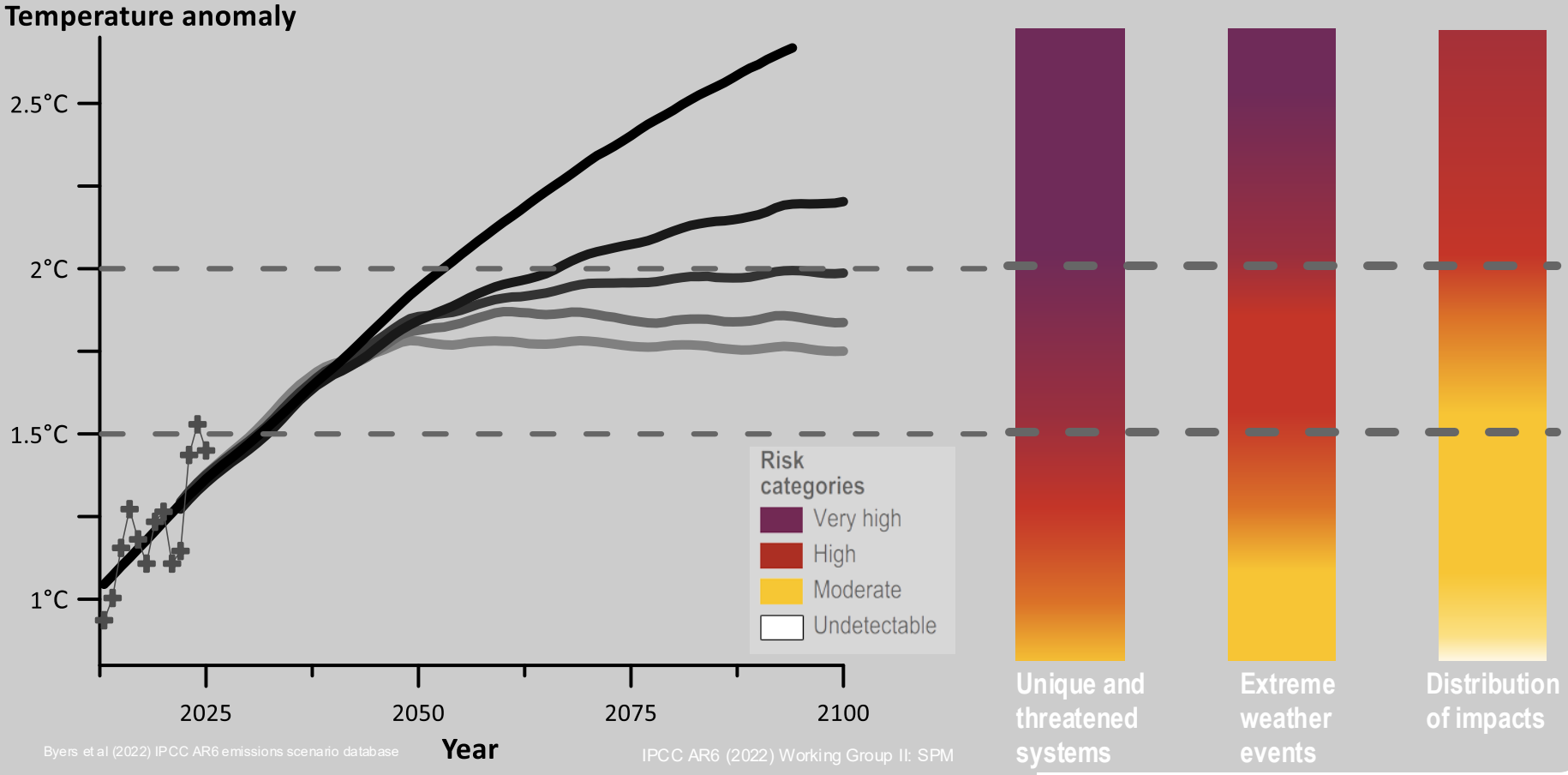
IPCC AR6 Synthesis Report, 2023, Fig 3.6

CO_2 removal unavoidable to reach *net-zero* and *net-negative*



State of CDR, 3rd Edition 2026
(based on IPCC AR6 WGIII, chapter 12)

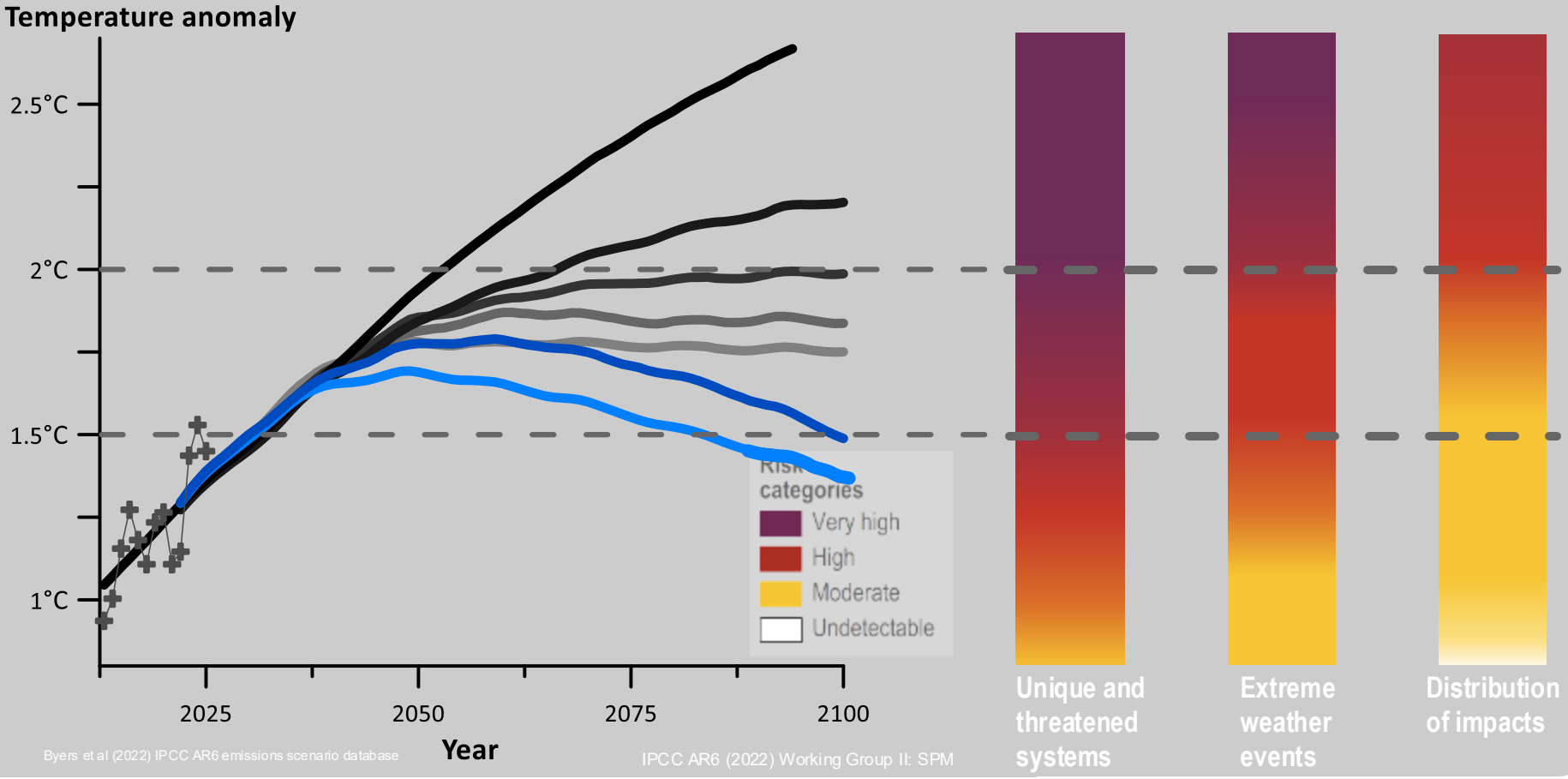
The next exit above 1.5C°: Every year, every tonne matters



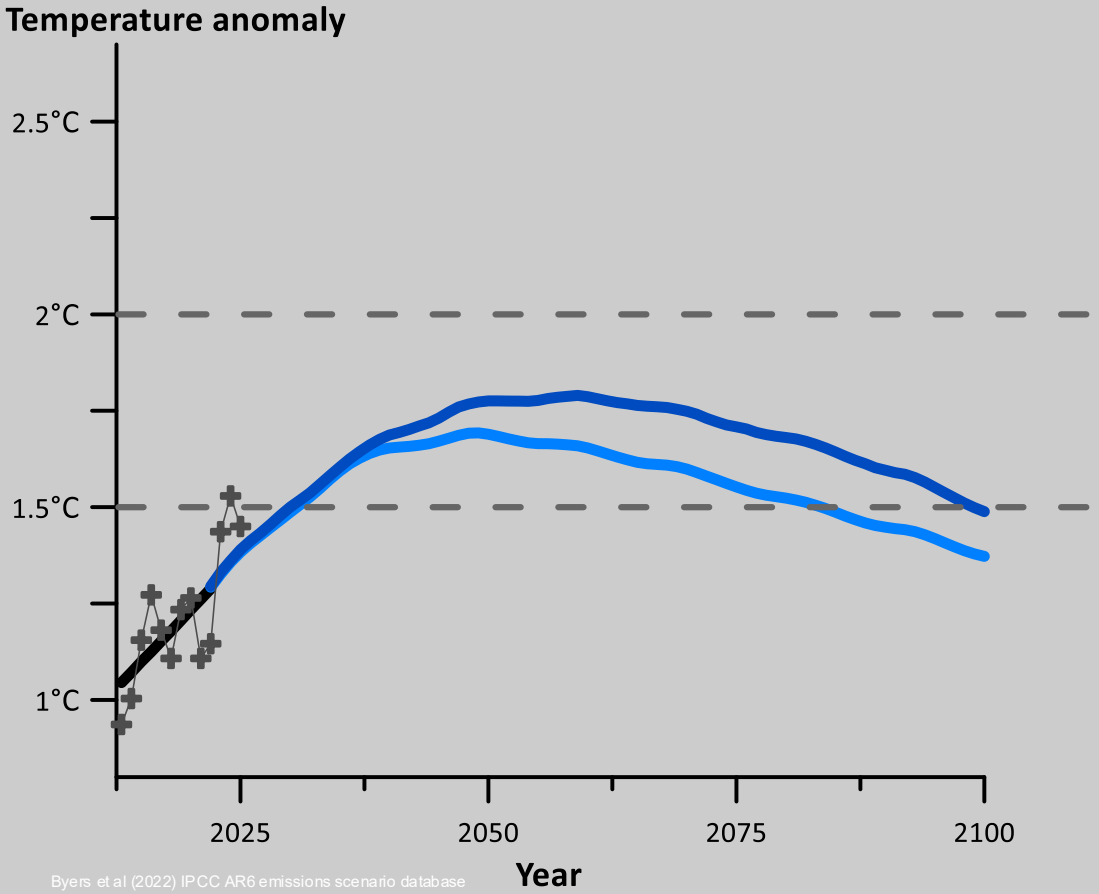
Byers et al (2022) IPCC AR6 emissions scenario database

IPCC AR6 (2022) Working Group II: SPM

The long way home to 1.5°C



The long way home to 1.5°C



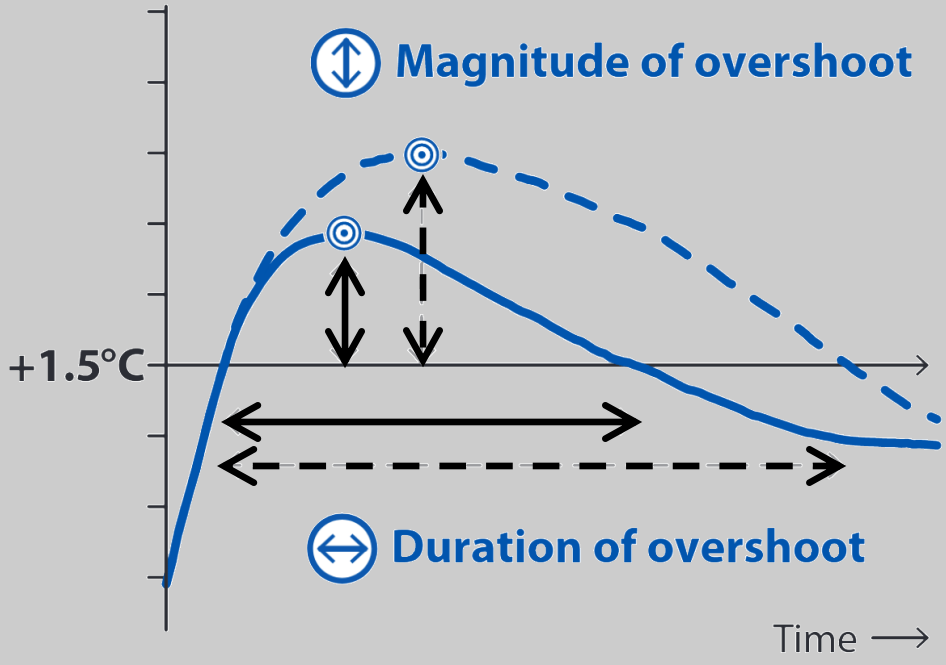
Byers et al (2022) IPCC AR6 emissions scenario database

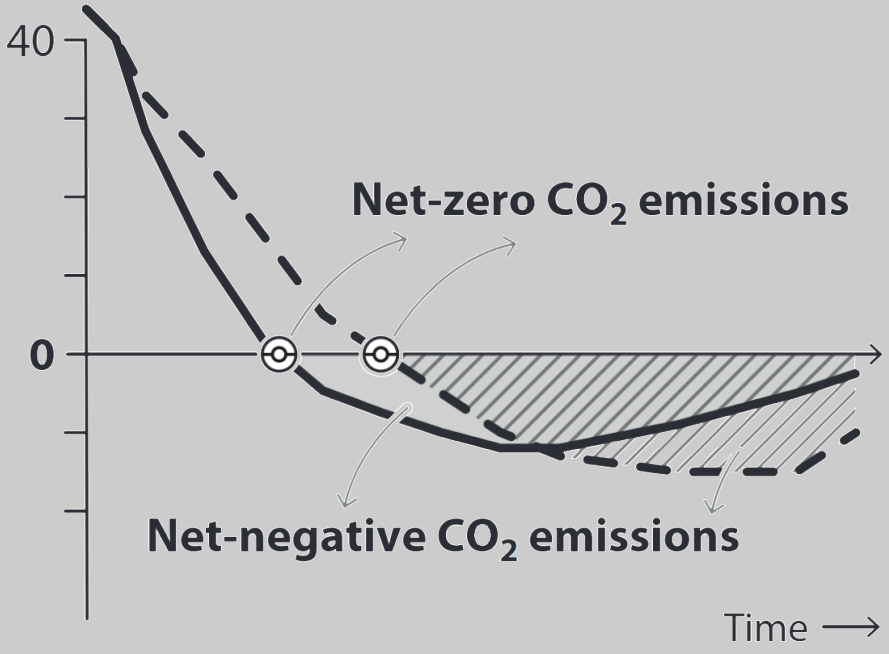
“Overshoot”
=
exceed and return

(to a specified warming level)
(within a specified time frame)

COP30 on overshoot: stating the *what*, leaving out the *how*

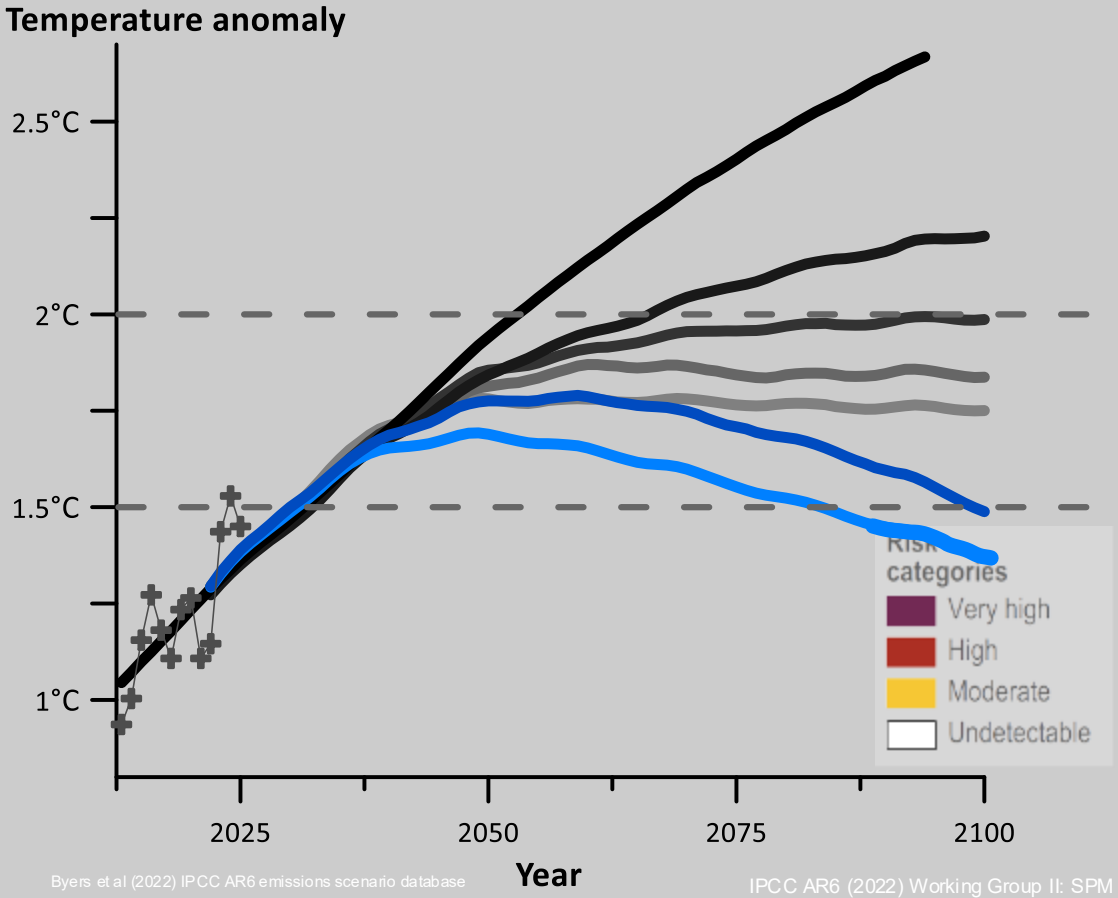
„*reiterates* its resolve […] to limit both the magnitude and the duration of any temperature overshoot"

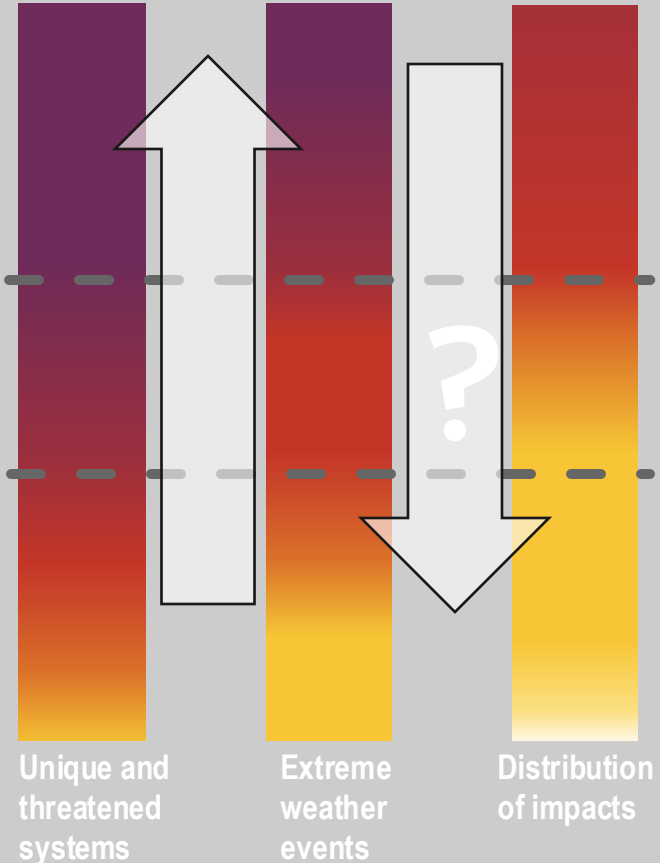




Reisinger et al (2025) doi: 10.1146/annurev-environ-111523-102029

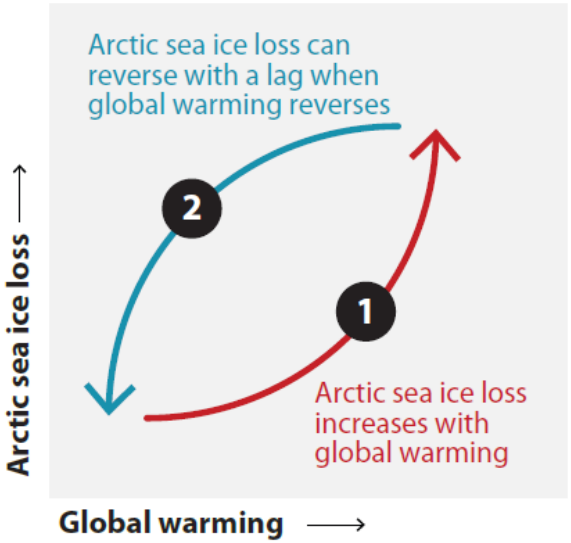
return ≠ recovery

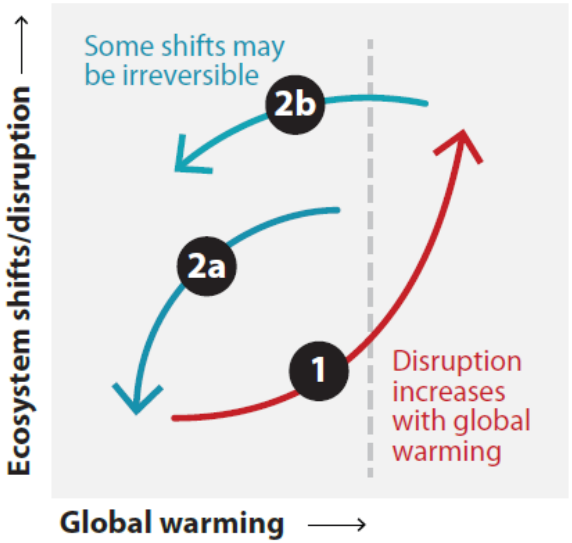


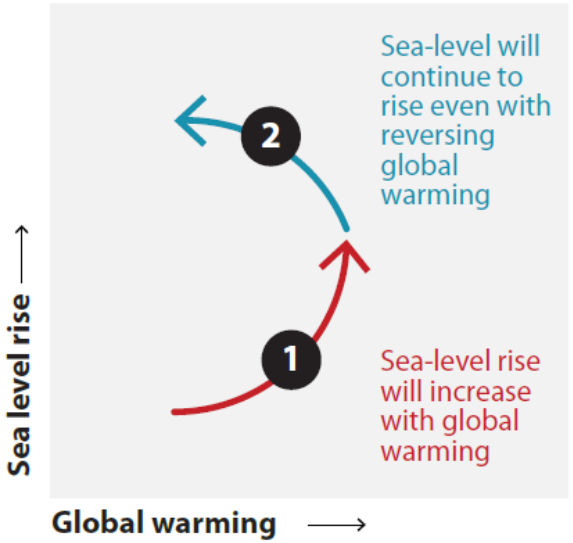


return ≠ recovery

A reversal of global temperature would not reverse all bio-geo-physical Earth system changes

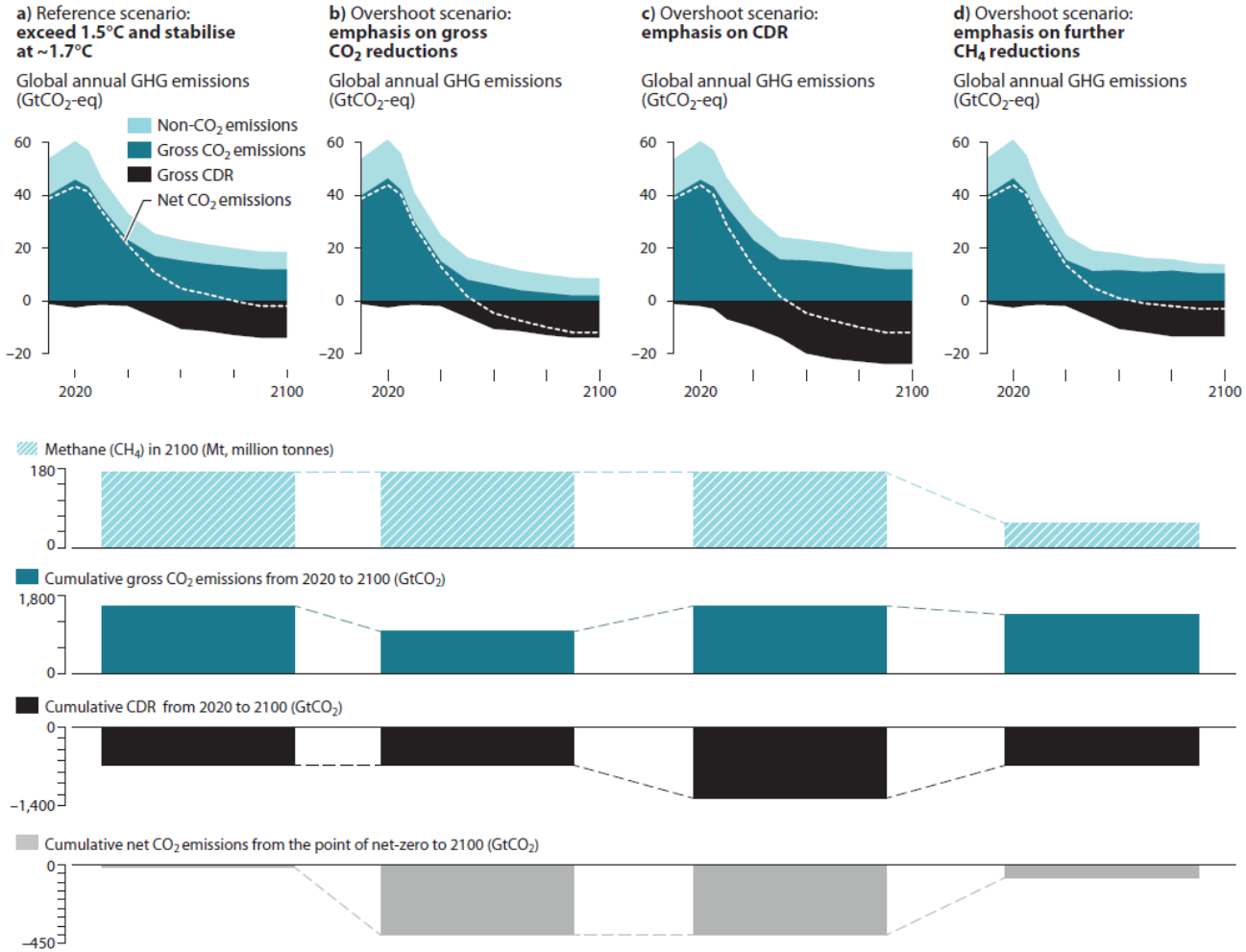






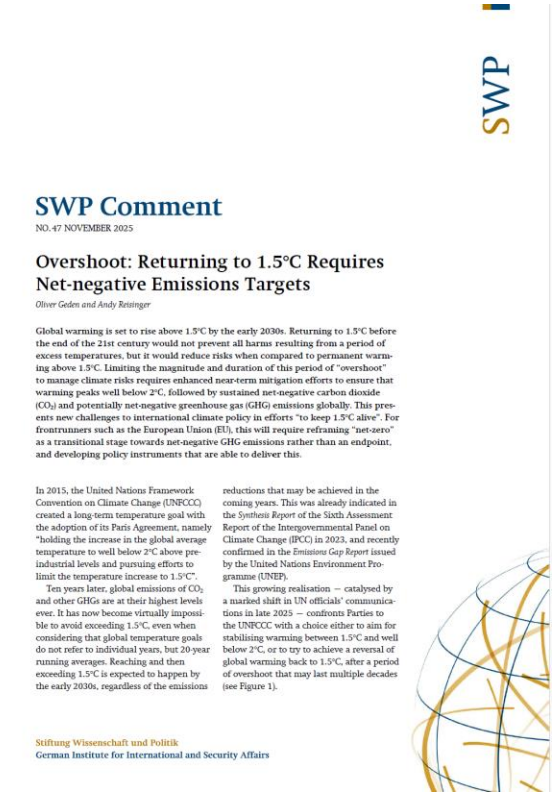
Reisinger et al. 2025, *Annual Reviews of Environment and Resources* 50

Return is not only about CO_2 removal, it's also about residual CO_2 & non-CO_2 emissions



Reisinger et al. 2025,
Annual Reviews of Environment and Resources 50

Enabling conditions for (credible) overshoot pathways



SWP

SWP Comment

NO.47 NOVEMBER 2025

Overshoot: Returning to 1.5°C Requires Net-negative Emissions Targets

Oliver Geden and Andy Reisinger

Global warming is set to rise above 1.5°C by the early 2030s. Returning to 1.5°C before the end of the 21st century would not prevent all harms resulting from a period of excess temperatures, but it would reduce risks when compared to permanent warming above 1.5°C. Limiting the magnitude and duration of this period of "overshoot" to manage climate risks requires enhanced near-term mitigation efforts to ensure that warming peaks well below 2°C, followed by sustained net-negative carbon dioxide (CO_2) and potentially net-negative greenhouse gas (GHG) emissions globally. This presents new challenges to international climate policy in efforts "to keep 1.5°C alive". For frontrunners such as the European Union (EU), this will require reframing "net-zero" as a transitional stage towards net-negative GHG emissions rather than an endpoint, and developing policy instruments that are able to deliver this.

In 2015, the United Nations Framework Convention on Climate Change (UNFCCC) created a long-term temperature goal with the adoption of its Paris Agreement, namely "holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C".

Ten years later, global emissions of CO_2 and other GHGs are at their highest levels ever. It has now become virtually impossible to avoid exceeding 1.5°C, even when considering that global temperature goals do not refer to individual years, but 20-year running averages. Reaching and then exceeding 1.5°C is expected to happen by the early 2030s, regardless of the emissions reductions that may be achieved in the coming years. This was already indicated in the *Synthesis Report* of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2023, and recently confirmed in the *Emissions Gap Report* issued by the United Nations Environment Programme (UNEP).

This growing realisation — catalysed by a marked shift in UN officials' communications in late 2025 — confronts Parties to the UNFCCC with a choice either to aim for stabilising warming between 1.5°C and well below 2°C, or to try to achieve a reversal of global warming back to 1.5°C, after a period of overshoot that may last multiple decades (see Figure 1).

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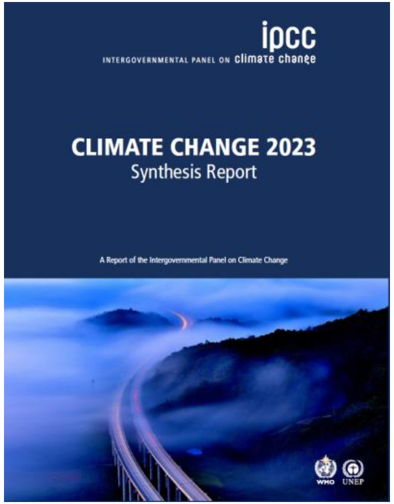
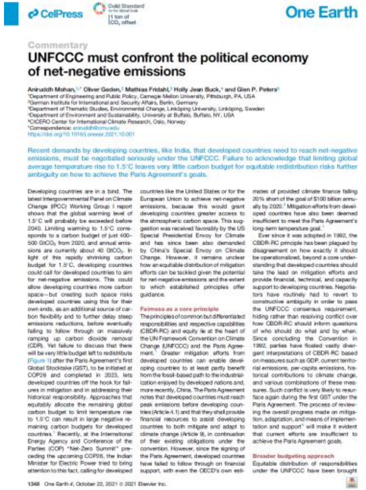
Geden/Reisinger 2025, SWP Comment C47/2025

… that aim to achieve cumulative net-negative CO_2 emissions of **~220 Gt per 0.1°C** exceedance, paying back accumulated carbon debt

- Strong link between 1.5° OS & global/national net-negative pledges/plans (incl. in global scenarios), i.e. developed countries need to set net-negative (GHG) emissions targets
- No prolongation of the end of the overshoot period beyond 2100
- Political demand from developing countries & NGOs for quantified net-negative (CO_2 or GHG) targets in OECD countries soon after net-zero (via LT-LEDS and NDCs), and by extension to sectors or cities
- Viable macroeconomic & political concepts for successfully running net-negative countries, beyond simple *polluter pays* principle & win/win narratives, e.g., what's is a *just transition* into net-negative?
- Shift CO_2 removal from (being seen as) barrier to ambition to an enabler of even higher ambition, but not by betting on ever more CDR





Thanks for your attention