



POTSDAM-INSTITUT FÜR
KLIMAFOLGENFORSCHUNG

An Update on the State of the Planet

Japan Climate Action Summit 2026
October 2026

Prof. Dr. Johan Rockström

Director, Potsdam Institute for Climate Impact Research

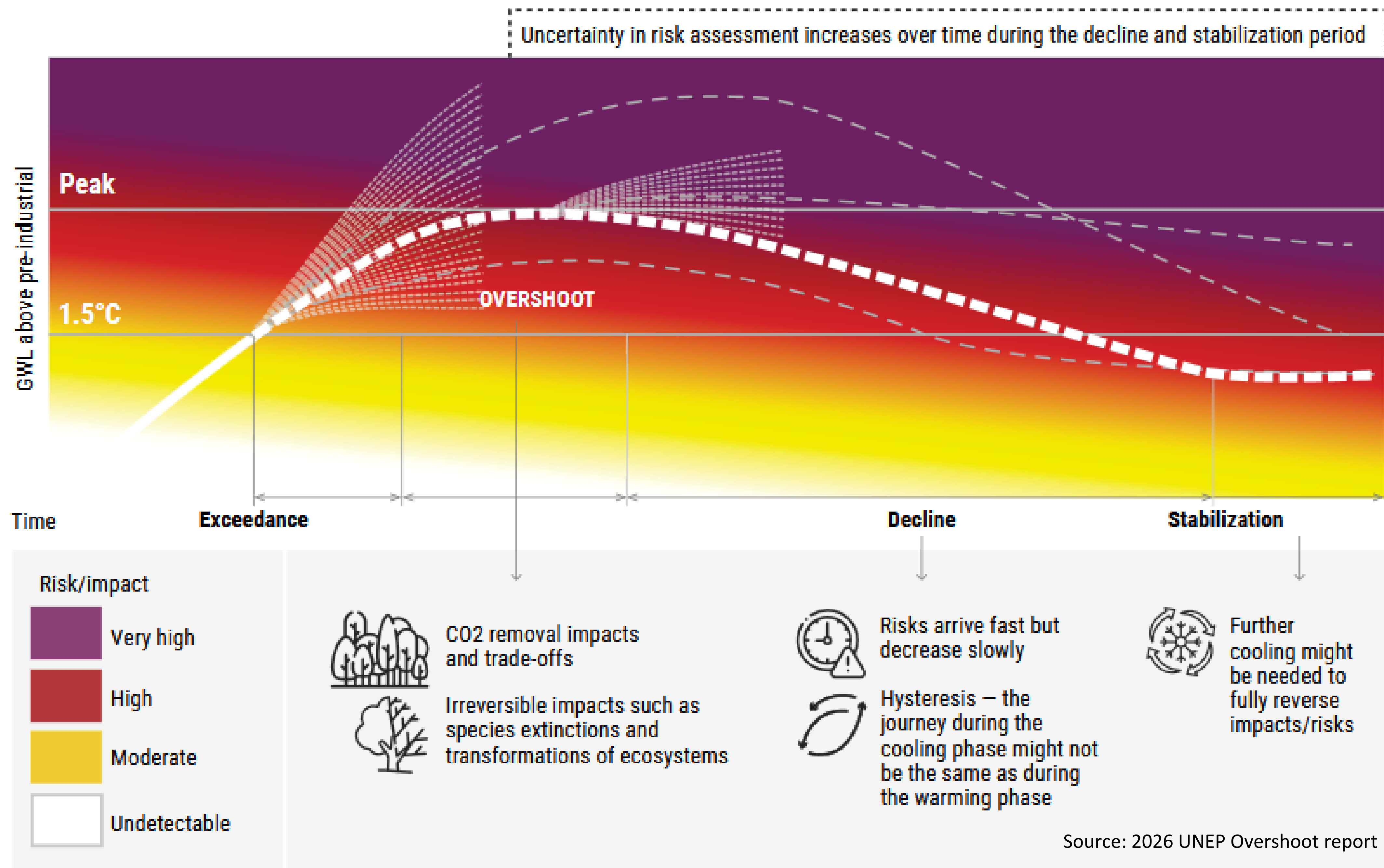
Professor in Earth System Science, University of Potsdam

The background of the slide is a composite image of Earth from space. The planet's surface is visible, showing continents and oceans. Overlaid on this are numerous glowing lines in shades of blue and yellow, representing global connectivity, such as flight paths, satellite orbits, or data transmission routes. These lines are most concentrated over the Eastern Hemisphere, particularly around Asia and Australia. The overall effect is a sense of a highly interconnected, global network.

Anthropocene

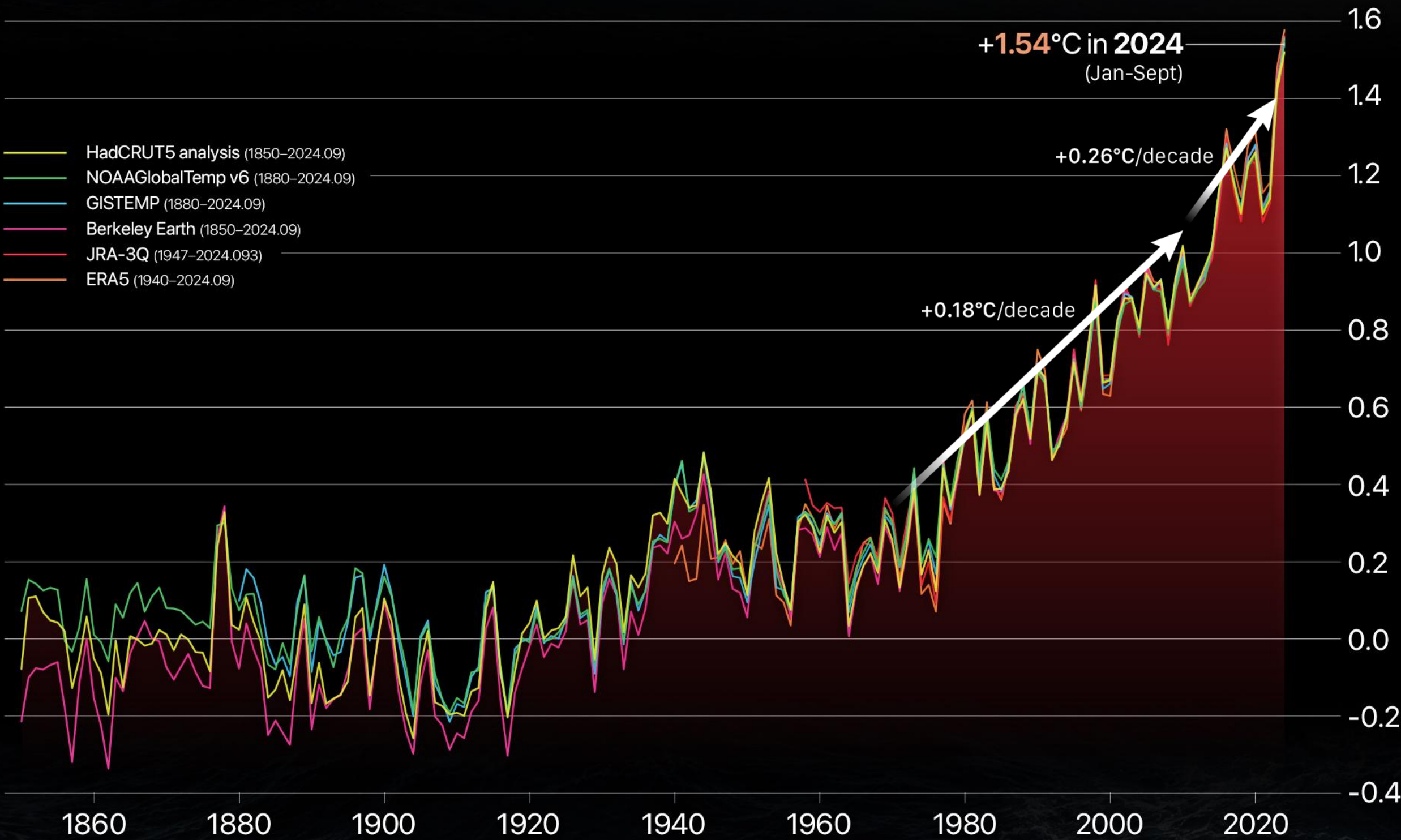
Scale - Speed - Connectivity

People and planet intertwined



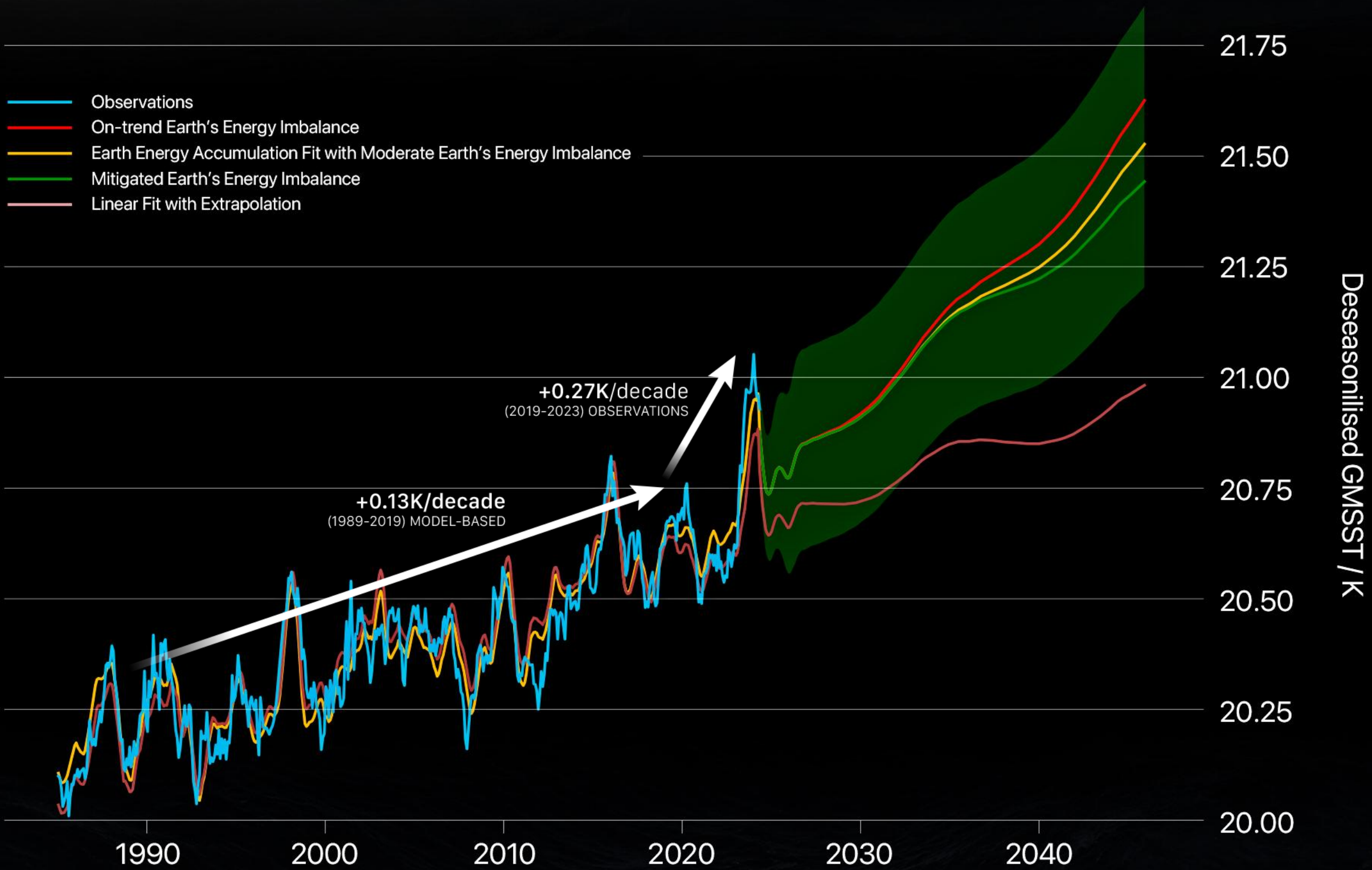
Signs of Accelerated Warming

Annual global mean temperature anomalies (°C)
relative to 1850-1900 average



World Meteorological Organization. (2024). *State of the Global Climate 2023* (WMO-No. 1347). Geneva: World Meteorological Organization. ISBN 978-92-63-11347-4. <https://library.wmo.int/idurl/4/68576>

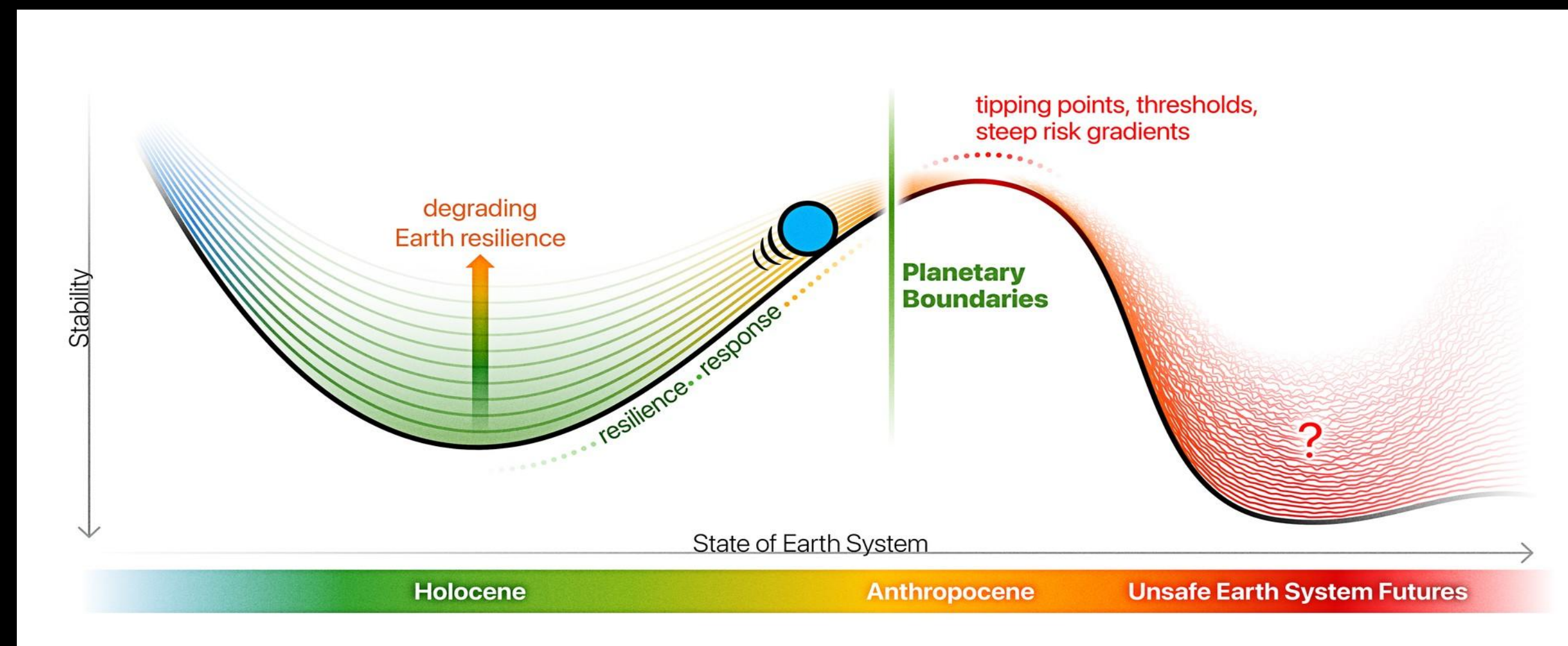
Scenarios for Future Global Mean Sea Surface Temperature



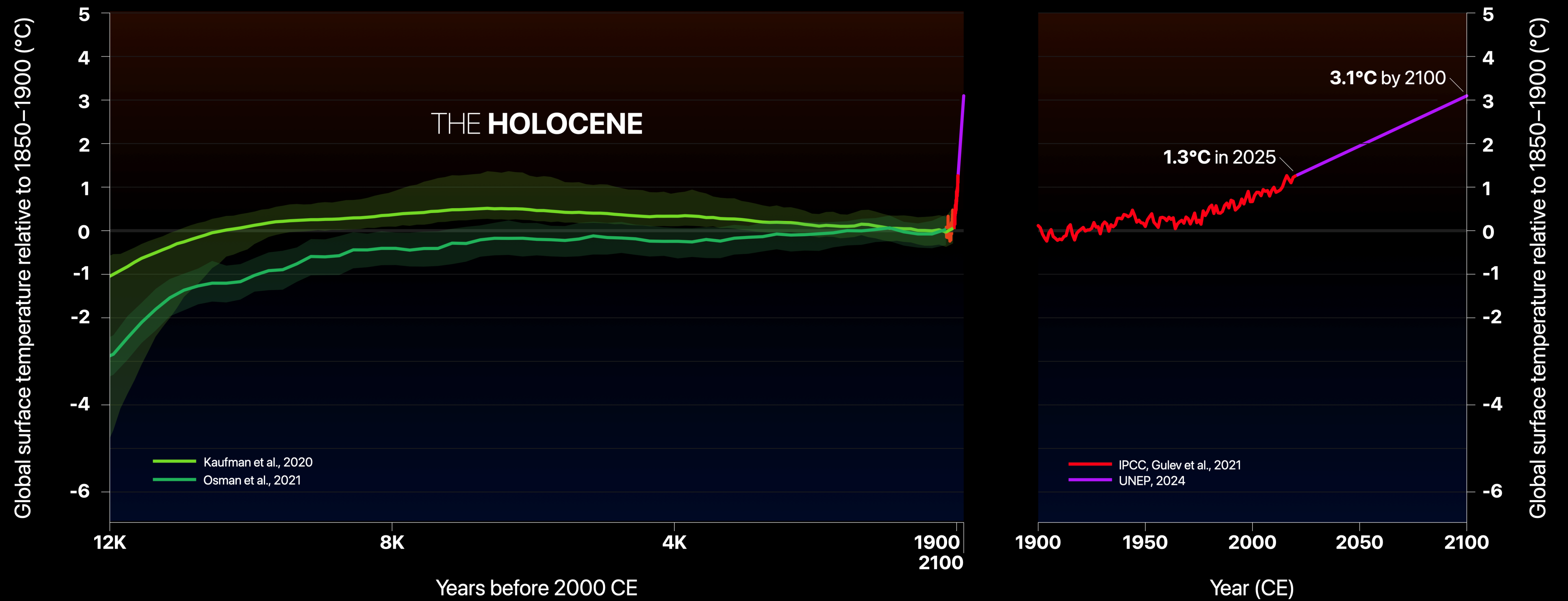
Merchant, C. J., Allan, R. P., & Embury, O. (2025). Quantifying the acceleration of multidecadal global sea surface warming driven by Earth's energy imbalance. *Environmental Research Letters*, 20(2), 024037. <https://doi.org/10.1088/1748-9326/adaa8a>

Earth resilience...

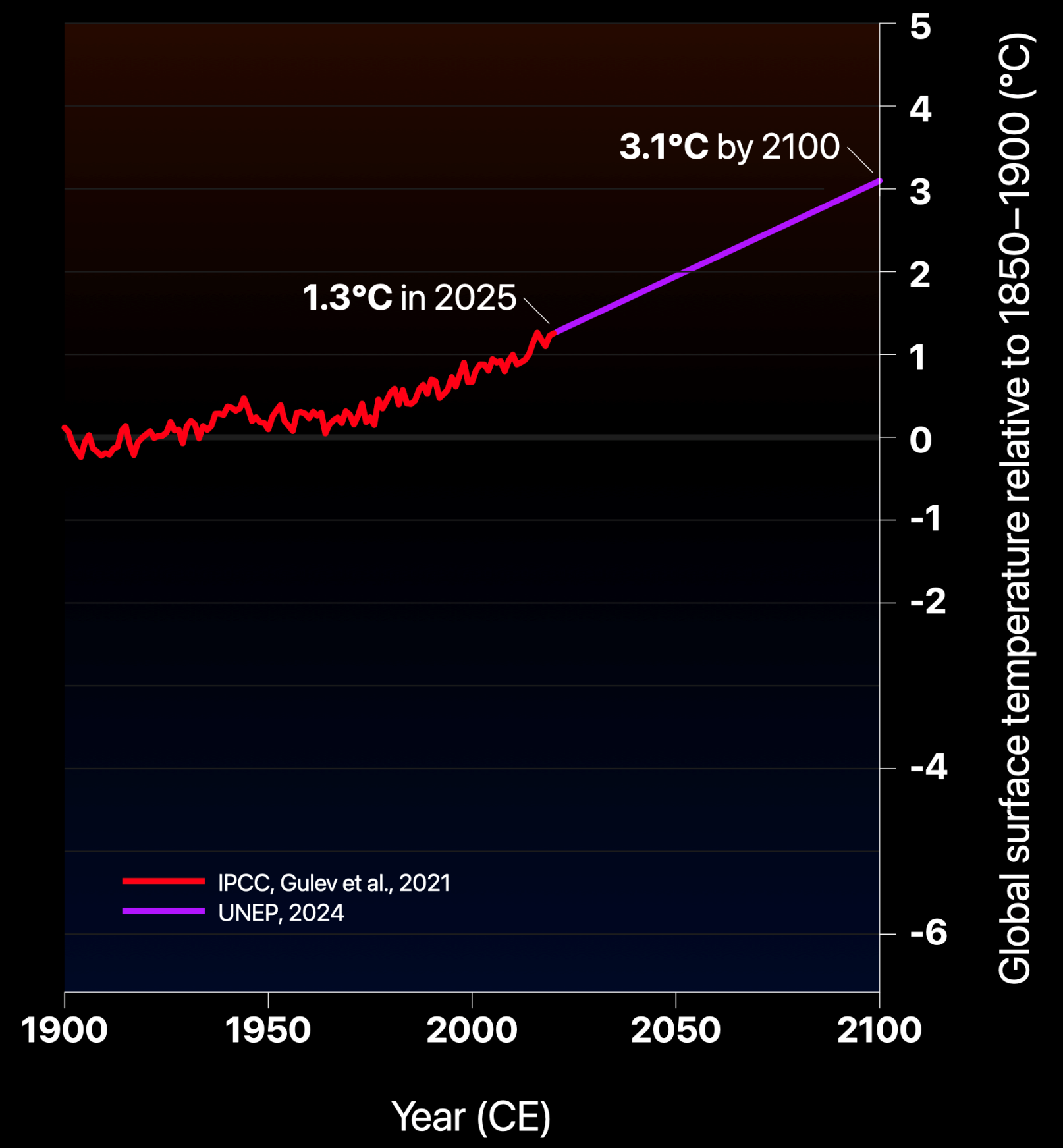
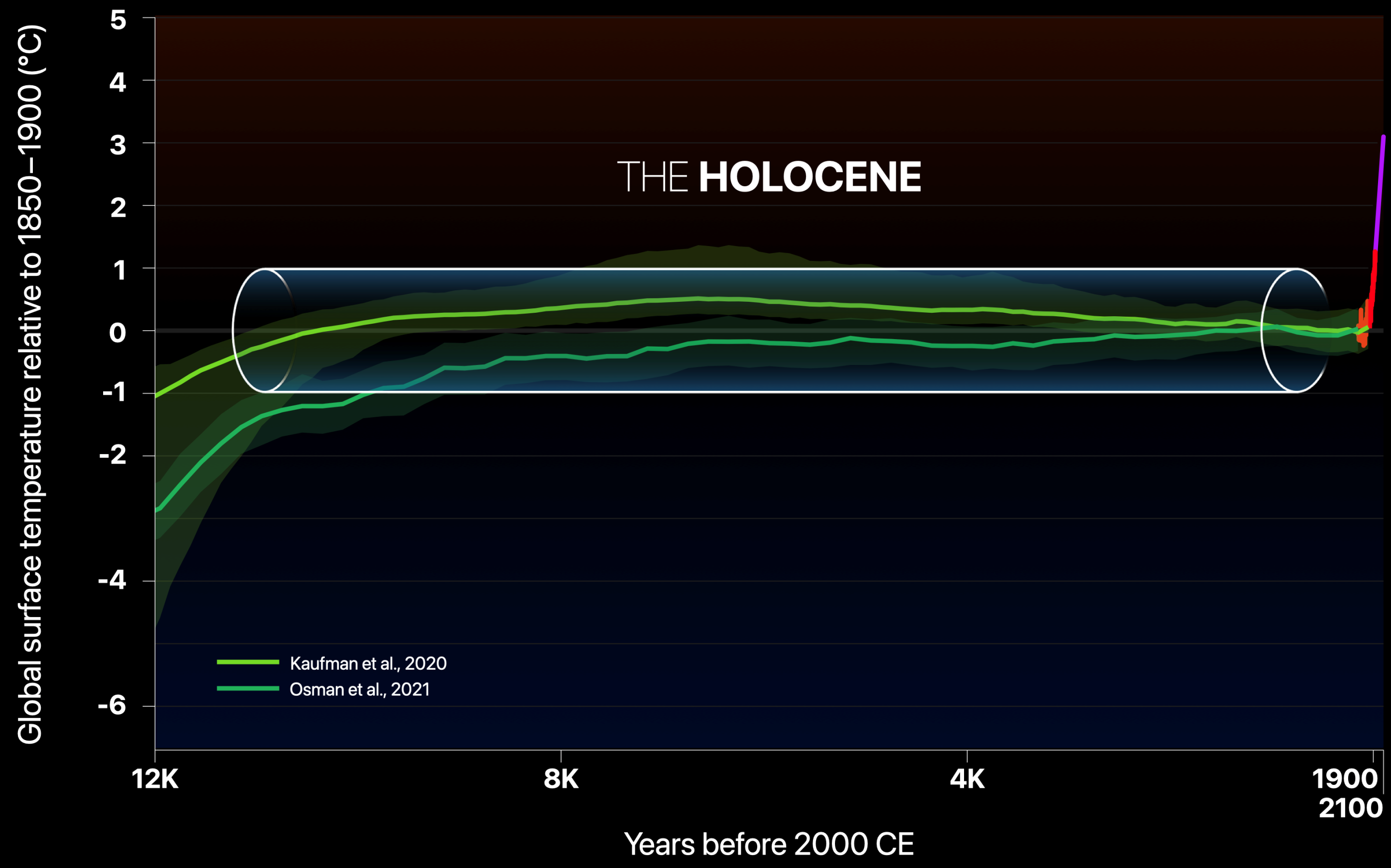
...requires that on aggregate the Earth system remains dominated by negative *feedbacks*, and that *forcing* does not (on the long term) exceed Earth system feedbacks. Tipping the Earth system from a net-negative to a net-positive feedback regime would push Earth away its the Holocene Inter-glacial quasi-equilibrium.



Holocene our Corridor of Life



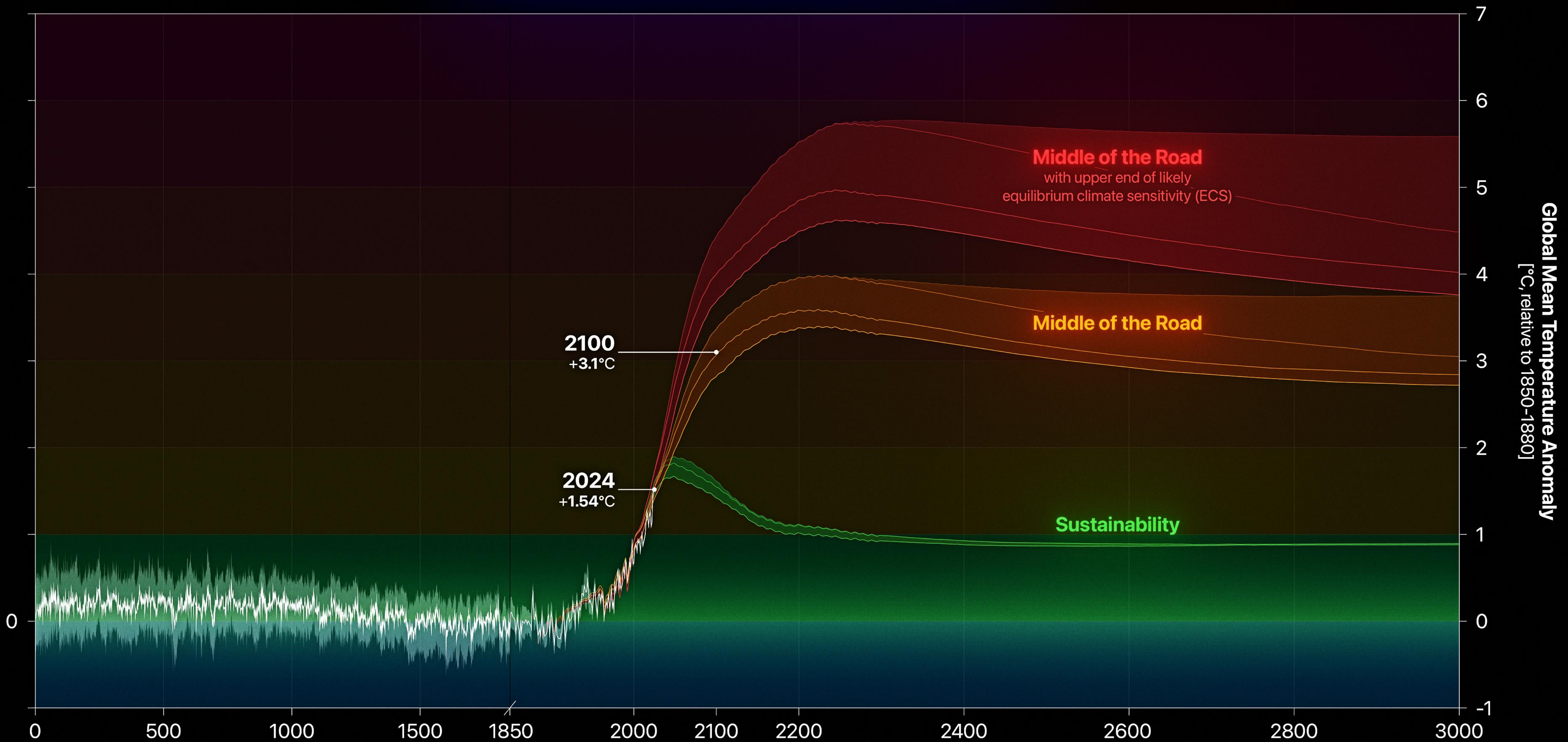
Adapted from Kaufman & McKay, 2022, and Ripple et al. 2025 · PIK Potsdam / GLOBIAA



Adapted from Kaufman & McKay, 2022, and Ripple et al. 2025 · PIK Potsdam / GLOBAlA

Humanity's Journey on Earth

Global Temperature Anomalies Under Different Emission Pathways and Climate Sensitivities



Tipping Points are hard-wired into the Earth system

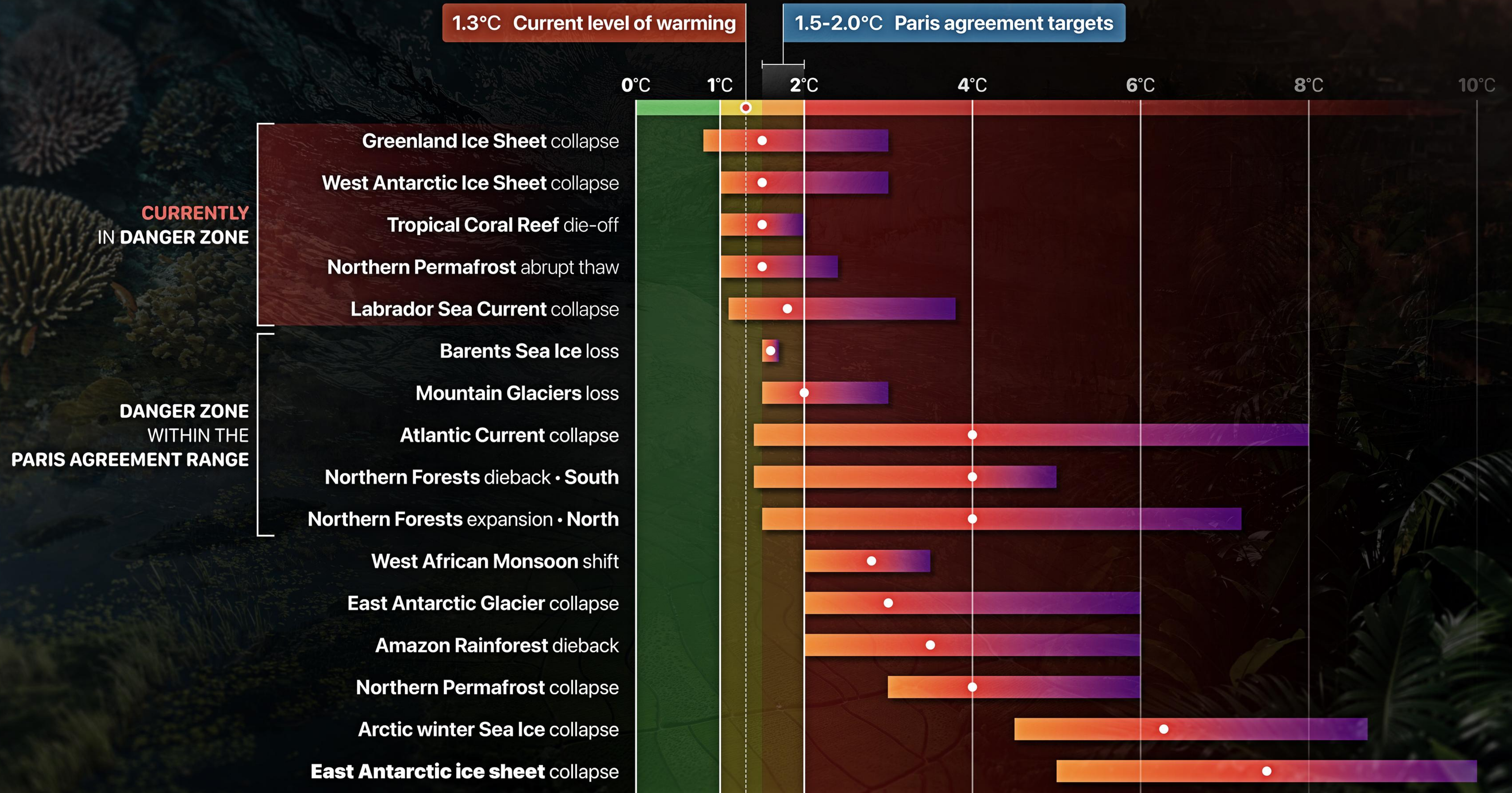


**Atlantic Meridional
Overturning Circulation**
COLLAPSE

Amazon Rainforest
DIEBACK

**Extrapolar
Mountain Glaciers**
LOSS

The risk of **climate tipping points** is rising rapidly as the world heats up

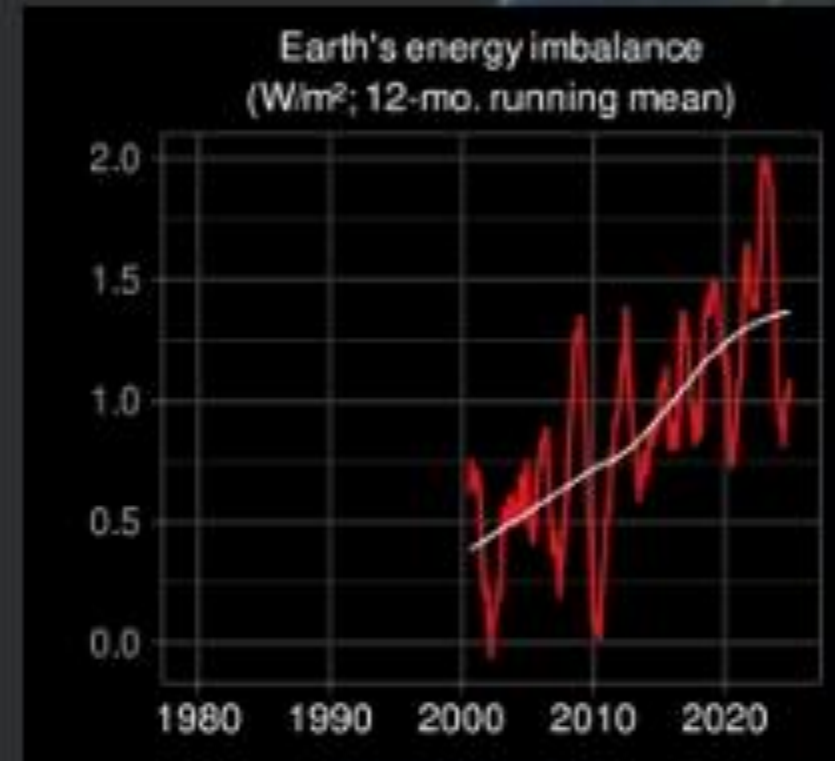


Source: Armstrong McKay et al, **Science**, 2022.

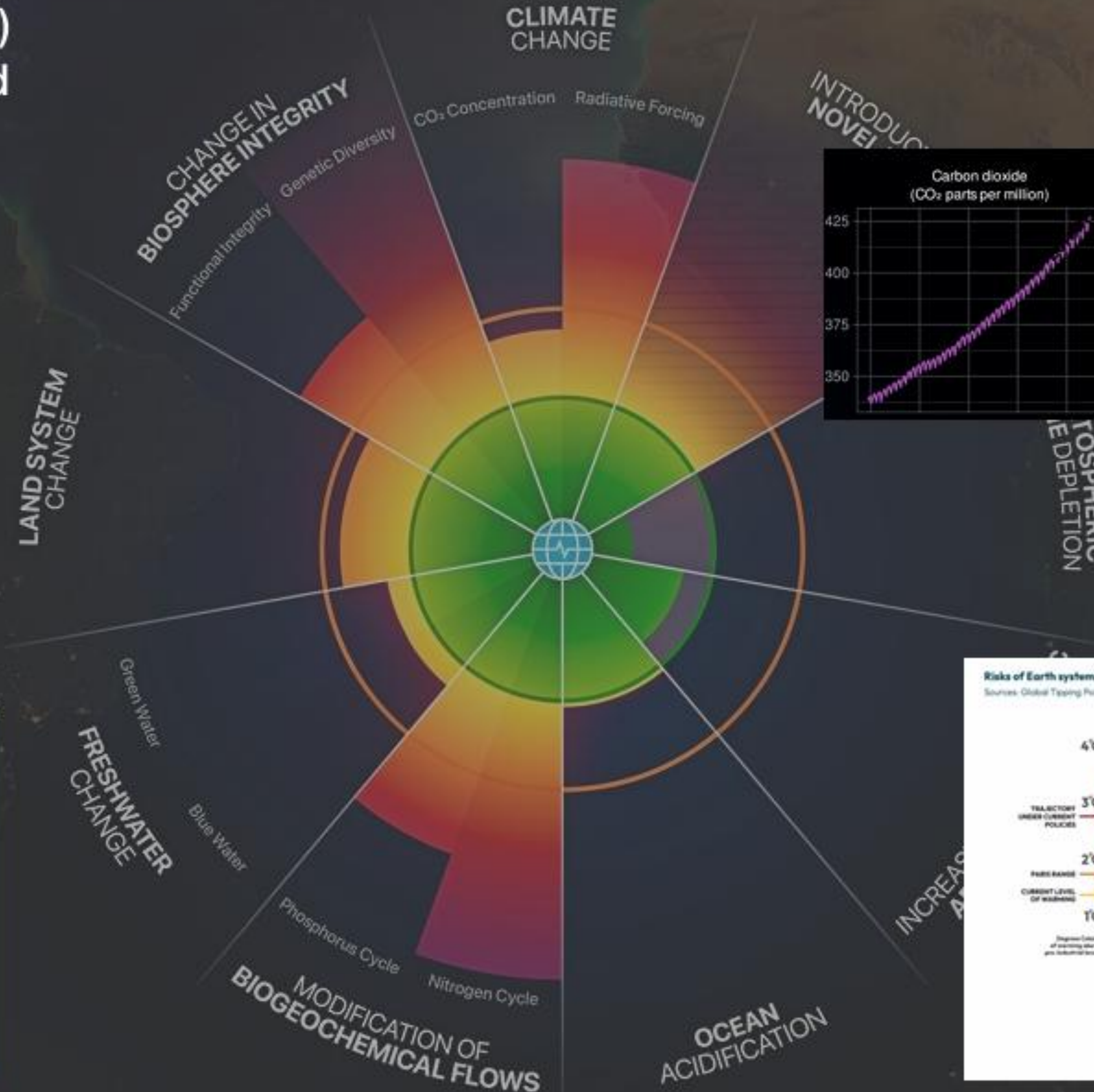
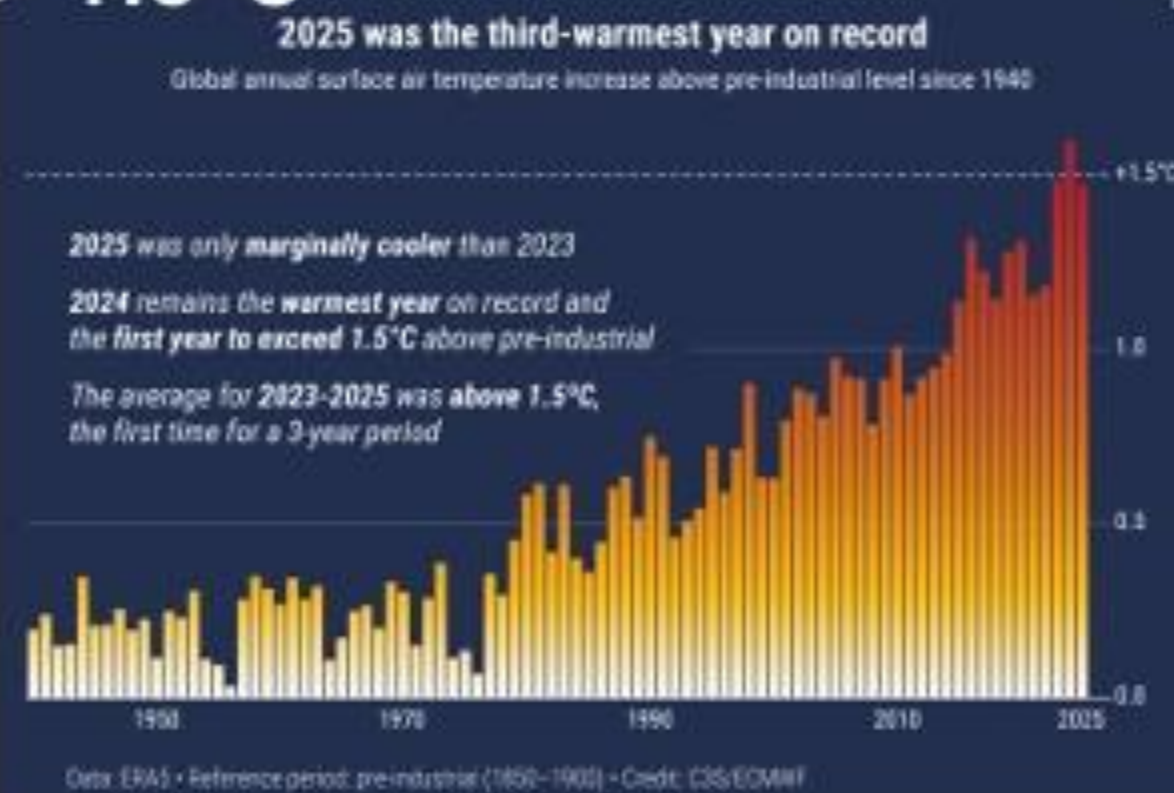
Planetary Health Check 2025

A Scientific Assessment of the State of the Planet

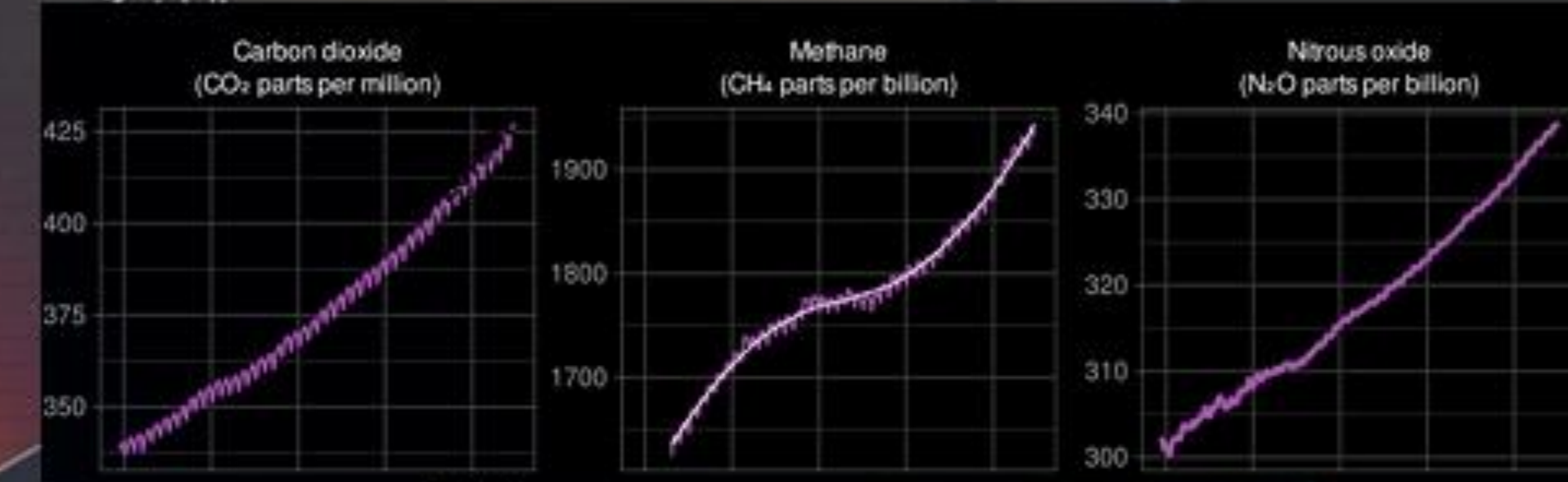
Earth Energy Imbalance (EEI) is rising faster than expected



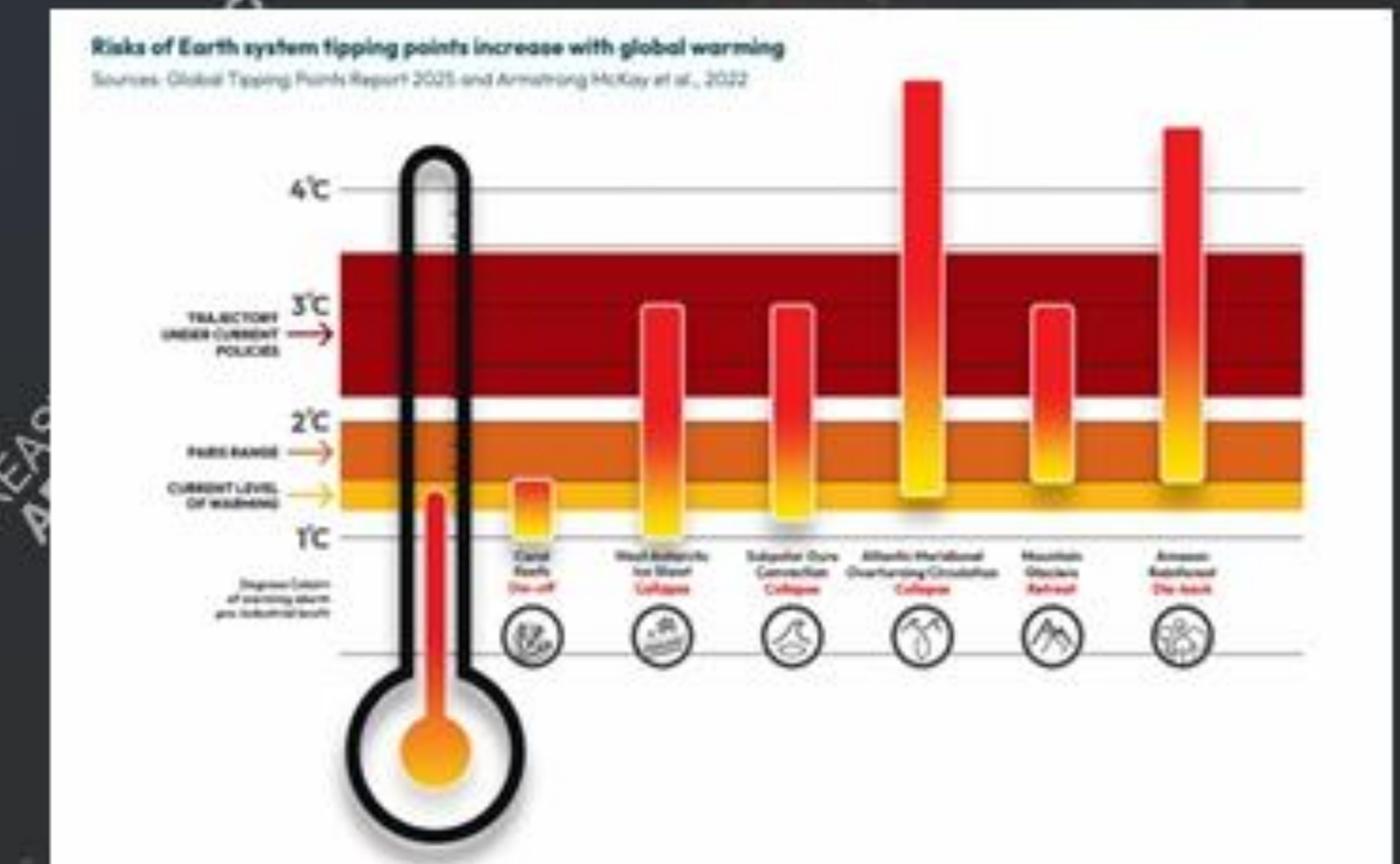
Global Warming Accelerating, 2023-2025 > 1.5°C



GHG emission continue rising



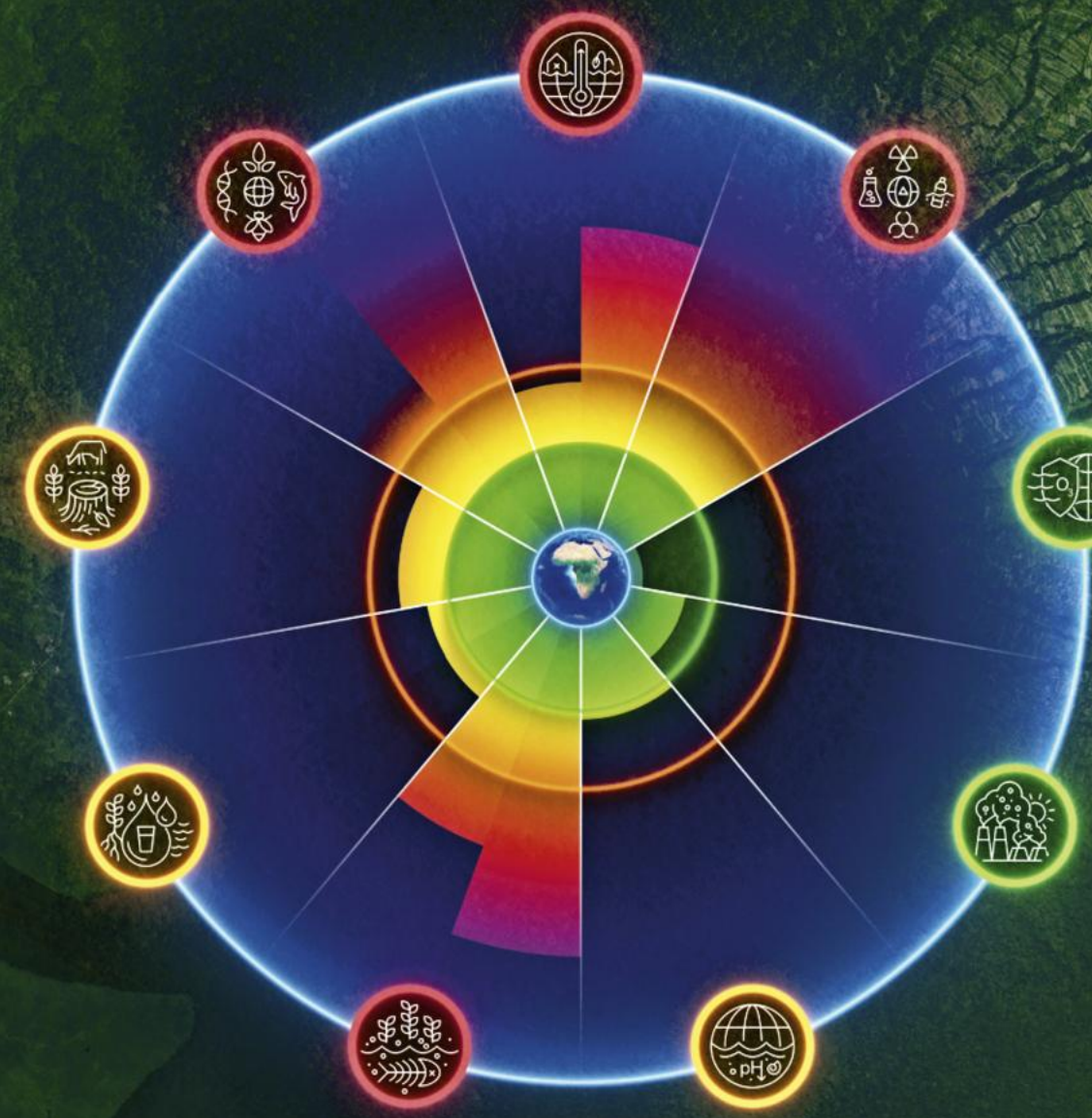
Tipping Points coming closer



PLANETARY HEALTH CHECK 2026

A Scientific Assessment of the State of Our Planet

SUMMARY

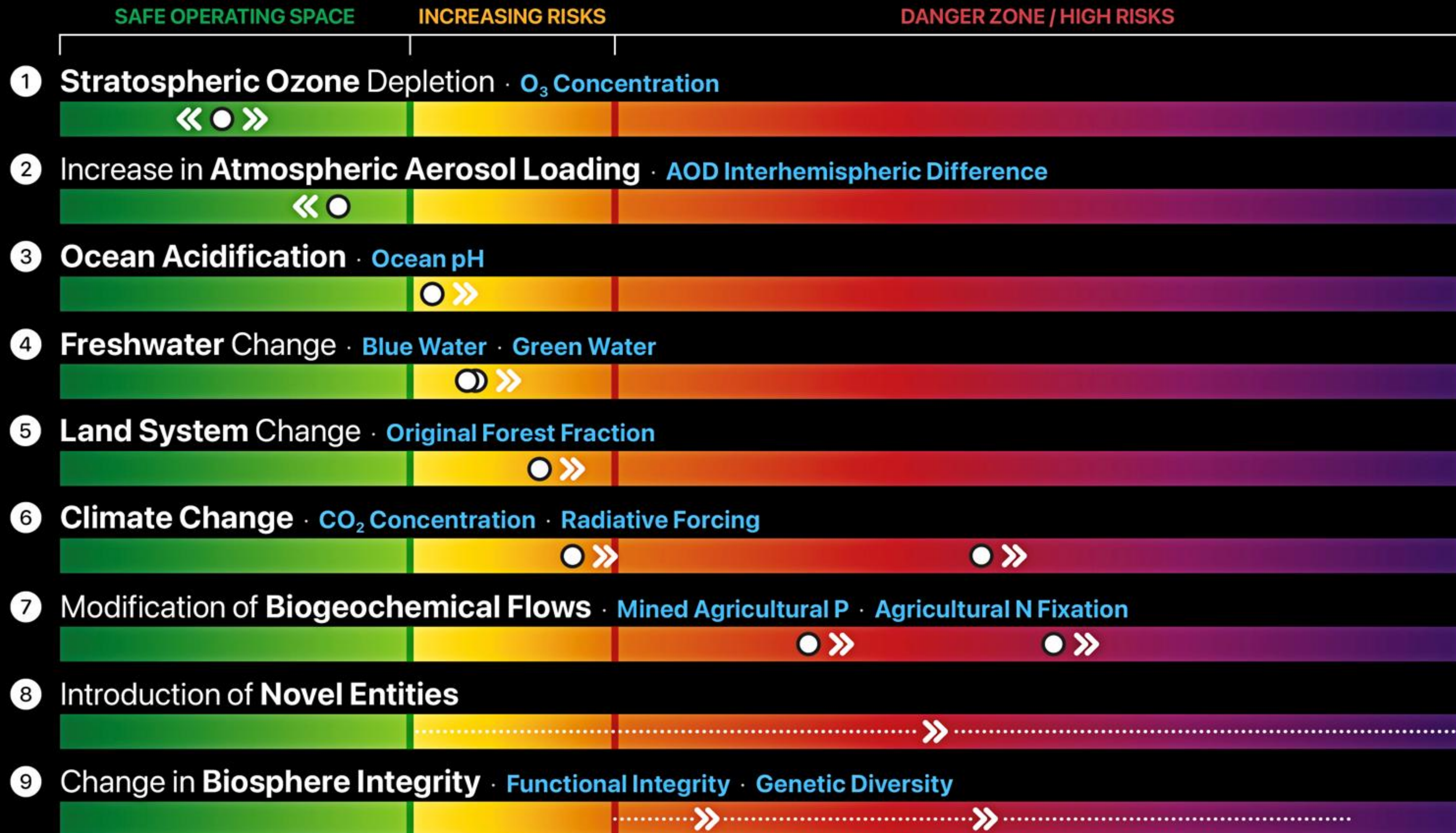


Planetary Boundaries
SCIENCE LAB



THE PLANETARY BOUNDARIES

Nine pillars of Earth's stability, resilience, and habitability





Planetary Health Check 2026



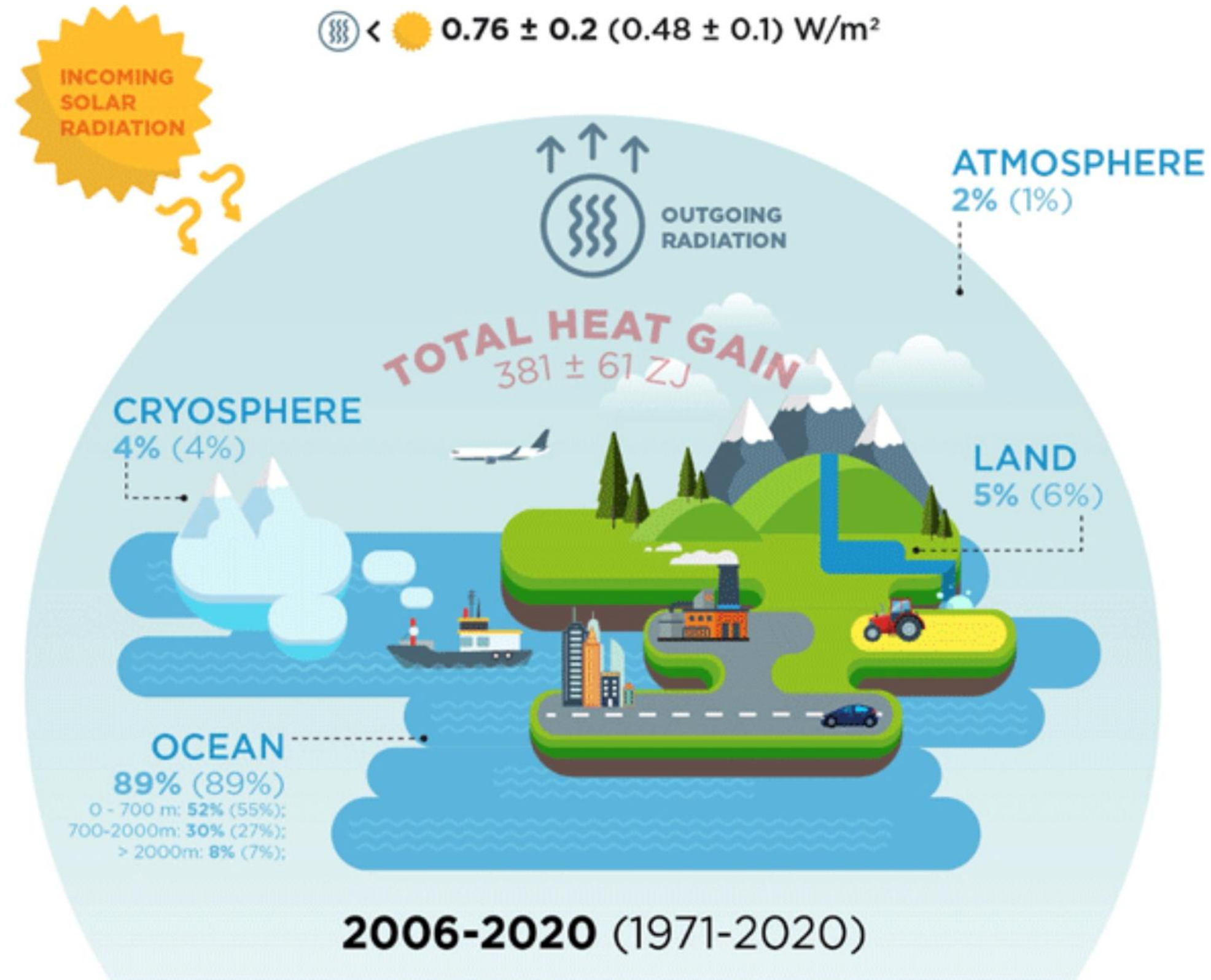
Is Earth showing first signs of losing resilience?

[Shifts in human forcing and potential changes
in Earth feedbacks]

Anthropocene pressures threaten Earth Resilience

EARTH HEAT INVENTORY :

0.76 ± 0.2 (0.48 ± 0.1) W/m²

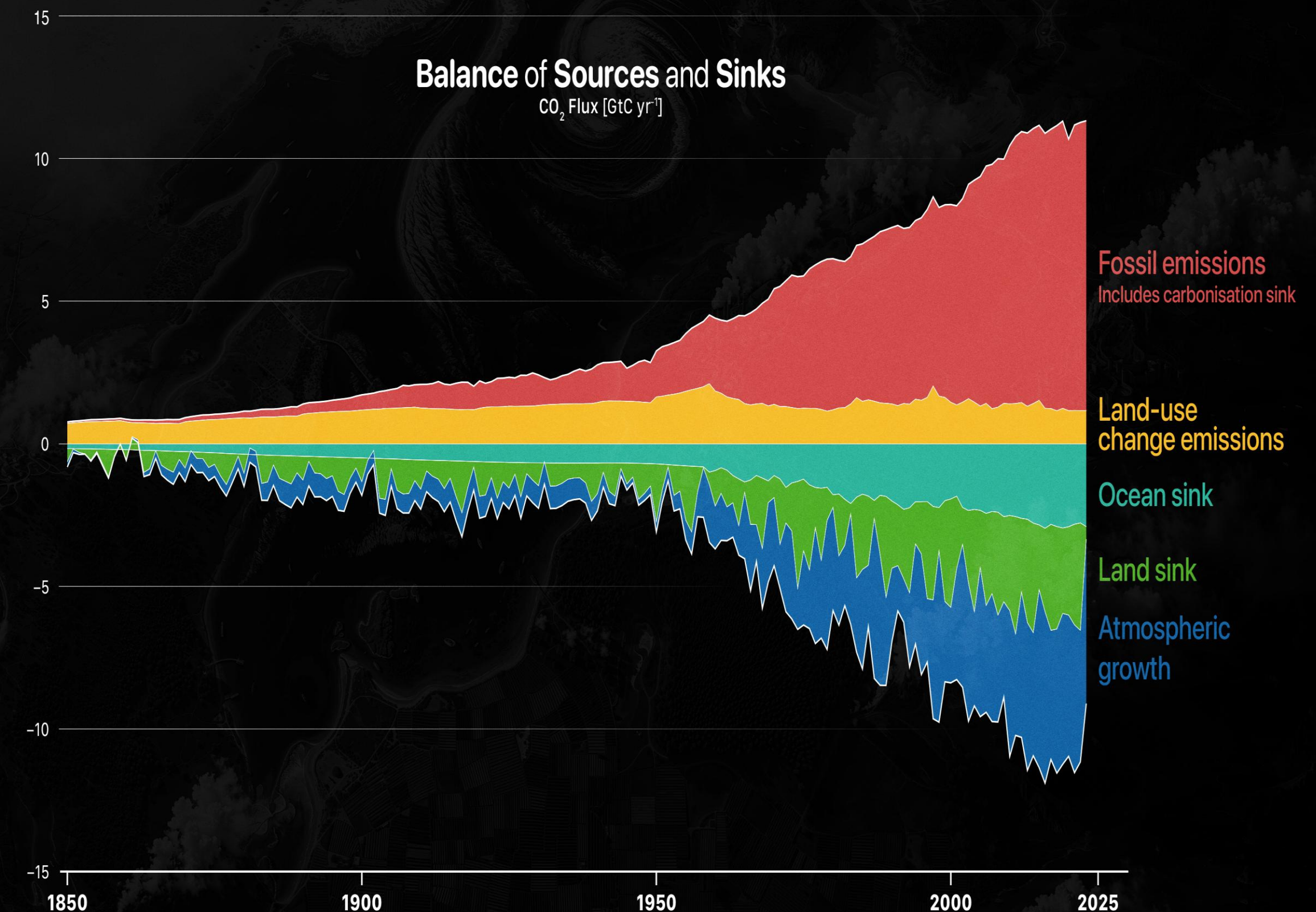


2006-2020 (1971-2020)

(von Schukmann et al., 2024)

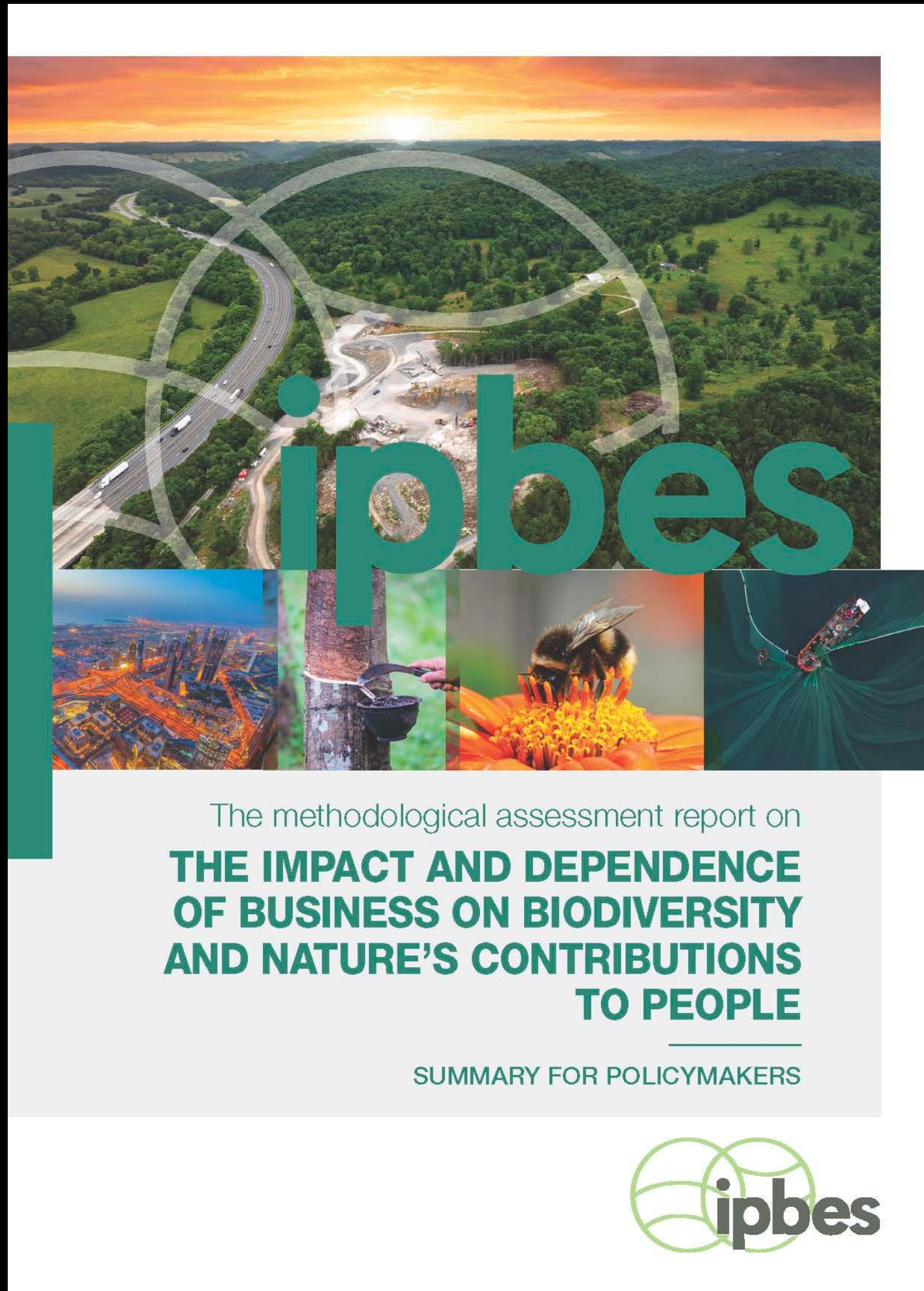
Balance of Sources and Sinks

CO₂ Flux [GtC yr⁻¹]



- Friedlingstein, P., O'Sullivan, M., Jones, M. W., Andrew, R. M., Bakker, D. C. E., Hauck, J., Landschützer, P., Le Quéré, C., Luijckx, I. T., Peters, G. P., Peters, W., Pongratz, J., Schwingshackl, C., Sitch, S., Canadell, J. G., Ciais, P., Jackson, R. B., Alin, S. R., Anthoni, P., ... Zheng, B. (2023). **Global Carbon Budget 2023**. Earth System Science Data, 15(12), 5301–5369.
- Ke, P., Ciais, P., Sitch, S., Li, W., Bastos, A., Liu, Z., Xu, Y., Gui, X., Bian, J., Goll, D. S., Xi, Y., Li, W., O'Sullivan, M., de Souza, J. G., Friedlingstein, P., & Chevallier, F. (2024). **Low latency carbon budget analysis reveals a large decline of the land carbon sink in 2023**. National Science Review.

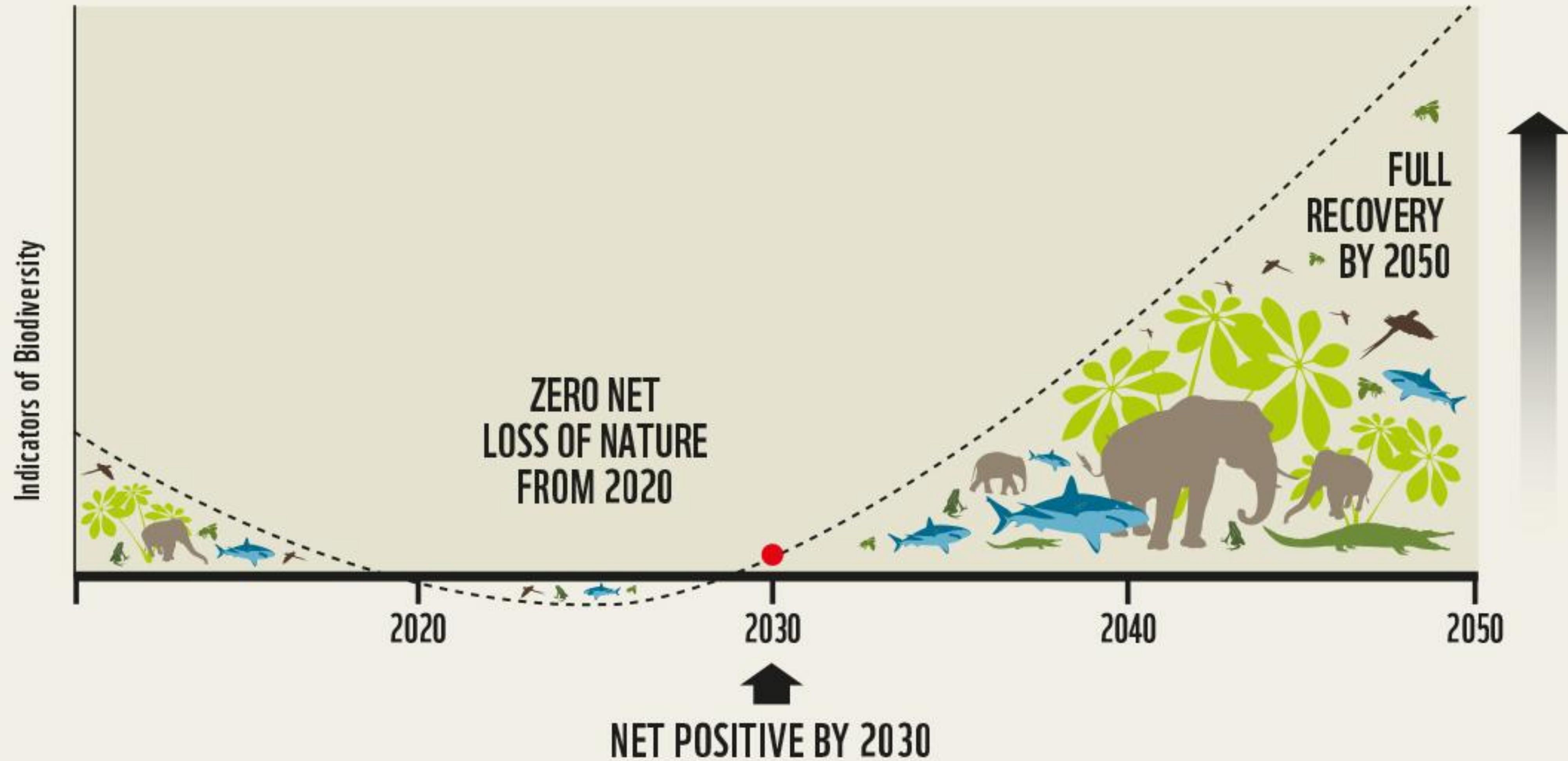
IPBES: Four key takeaways on how nature loss threatens the global economy



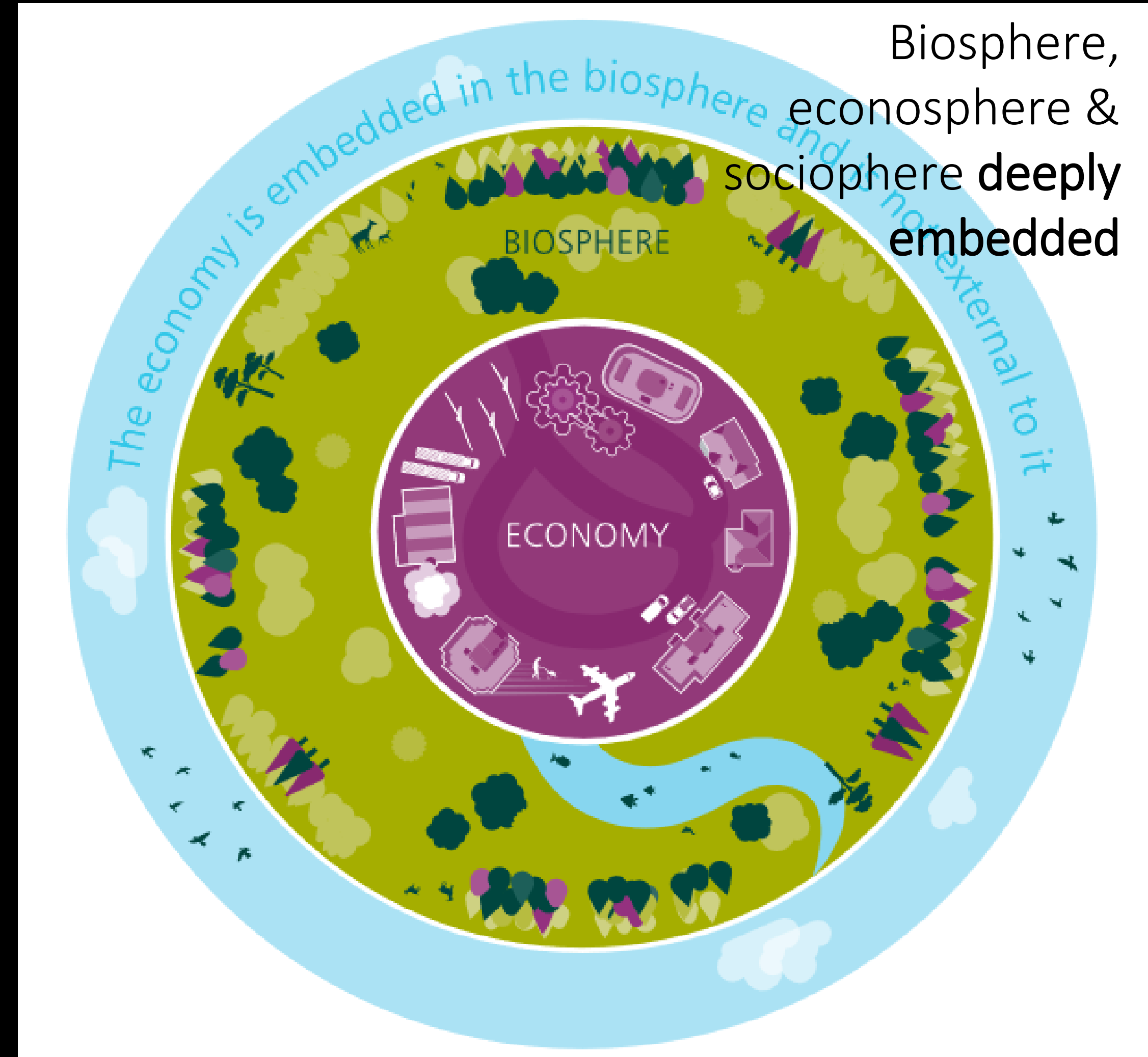
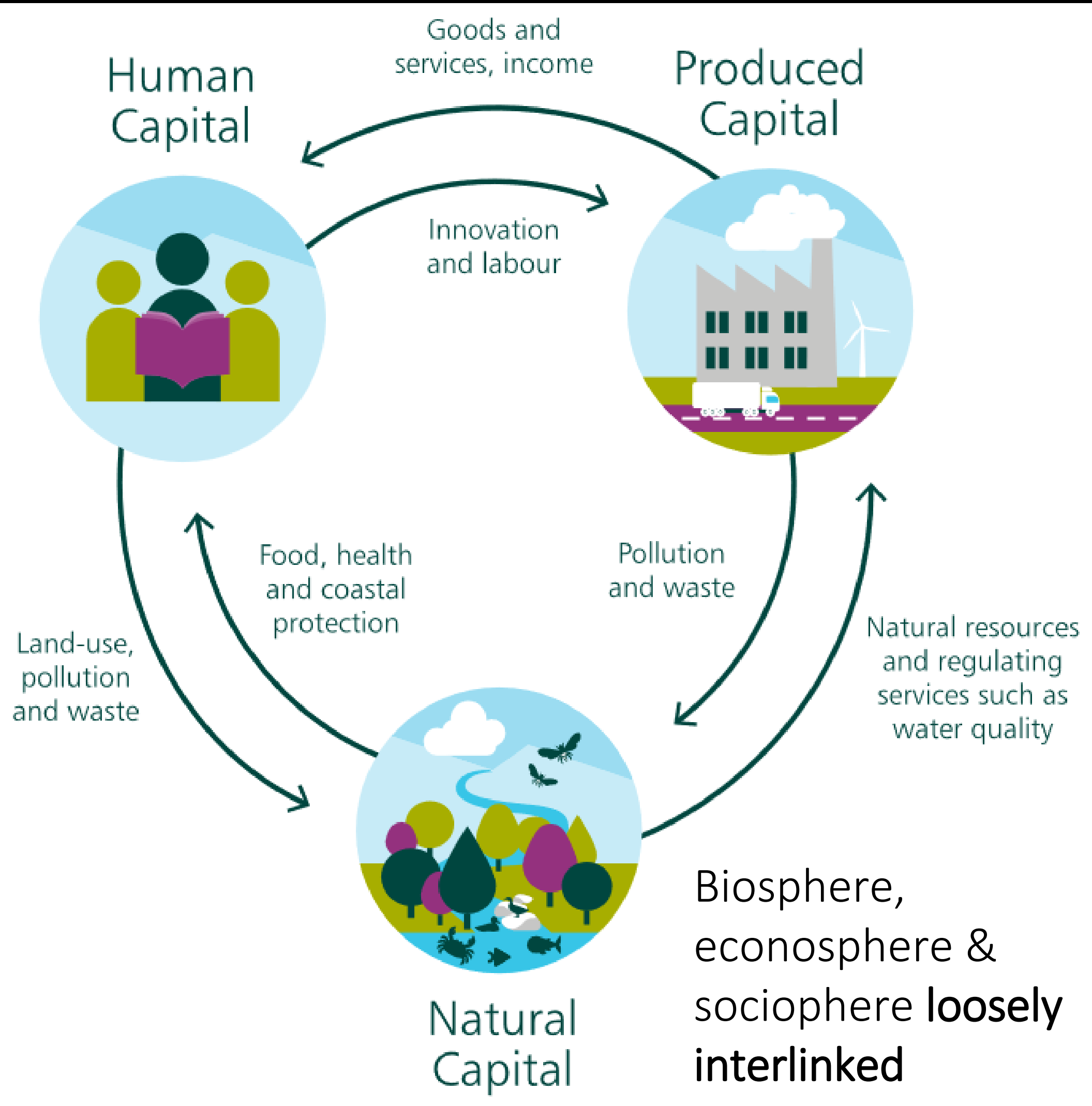
1. Businesses both depend on, and harm, nature
2. Current practices 'do not support' efforts to halt and reverse biodiversity loss
3. Businesses can act now to address their impacts on nature
4. Government policies can drive a 'just and sustainable future' for nature and people

Source: IPBES Business and Biodiversity Report (2026)

Global Goal for Nature: Nature Positive by 2030



Weak and Strong Sustainability

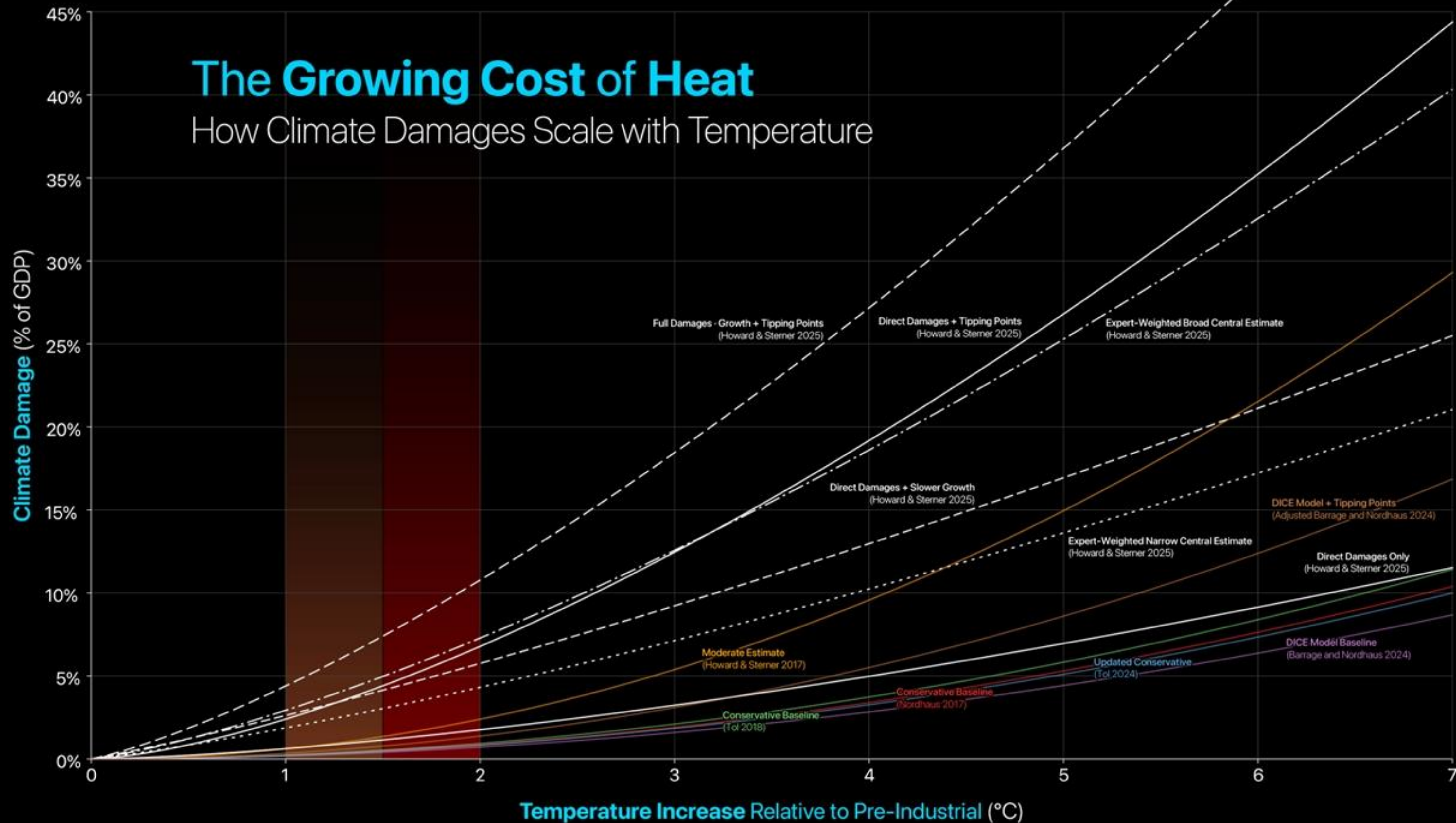


Source: *The Economics of Biodiversity: The Dasgupta Review 2021*

And it is starting to cost the Global Economy

The Growing Cost of Heat

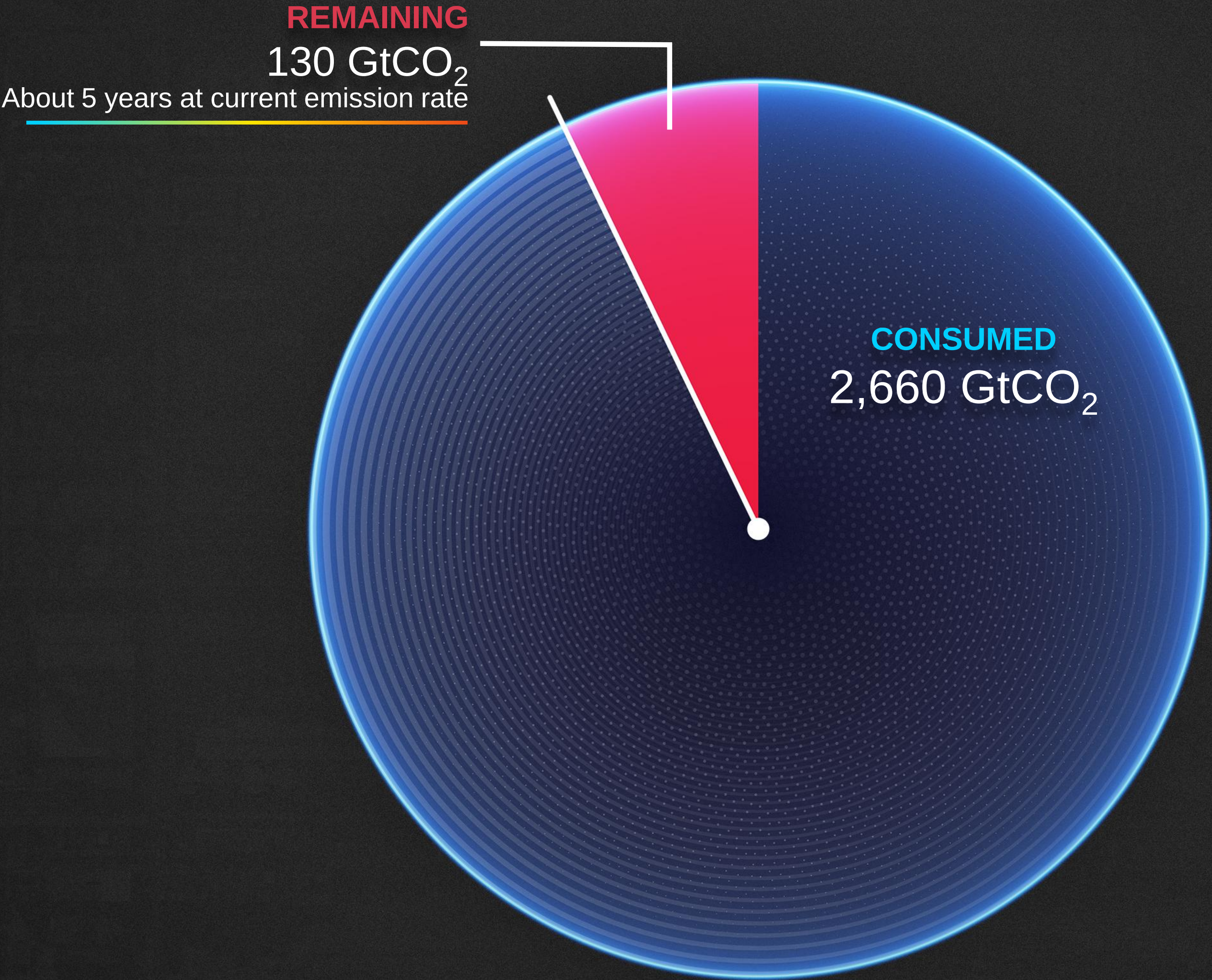
How Climate Damages Scale with Temperature



Transformation Pathways

REMAINING CARBON BUDGET

1.5°C (50% likelihood)



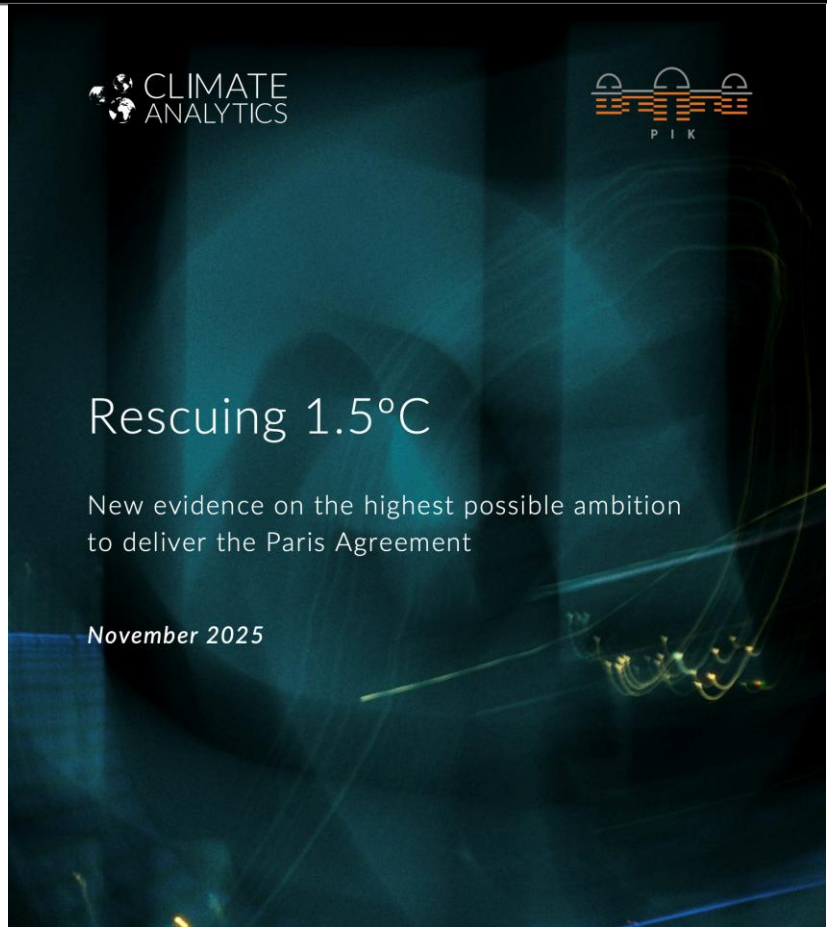
Source: Forster et al. (2025)

We can emit just

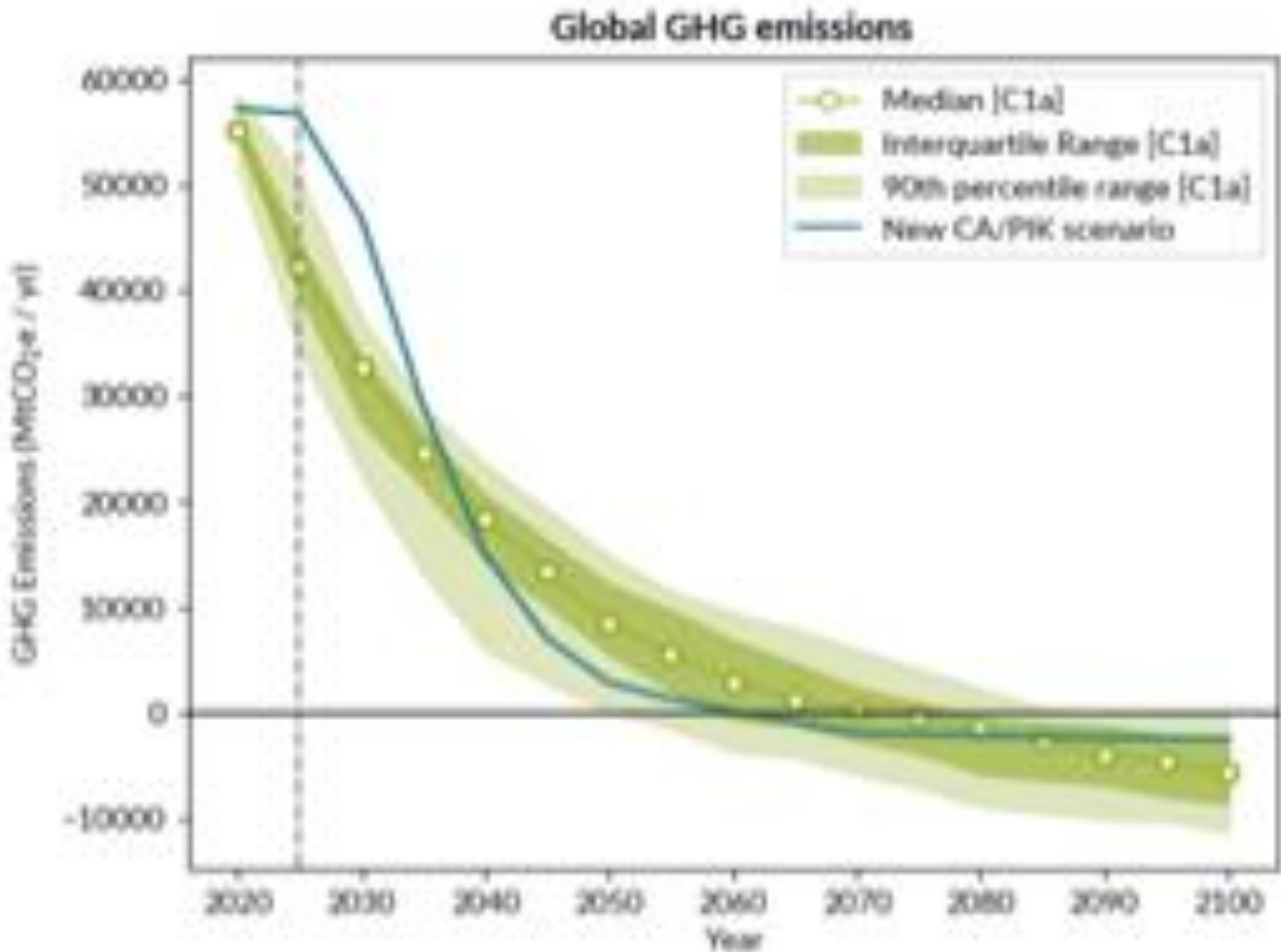
130 Gt CO₂

before exhausting the

Remaining Carbon Budget for 1.5°C



Global emissions start higher, fall faster, catch up with AR6 by the late 2030s, and reach net zero earlier



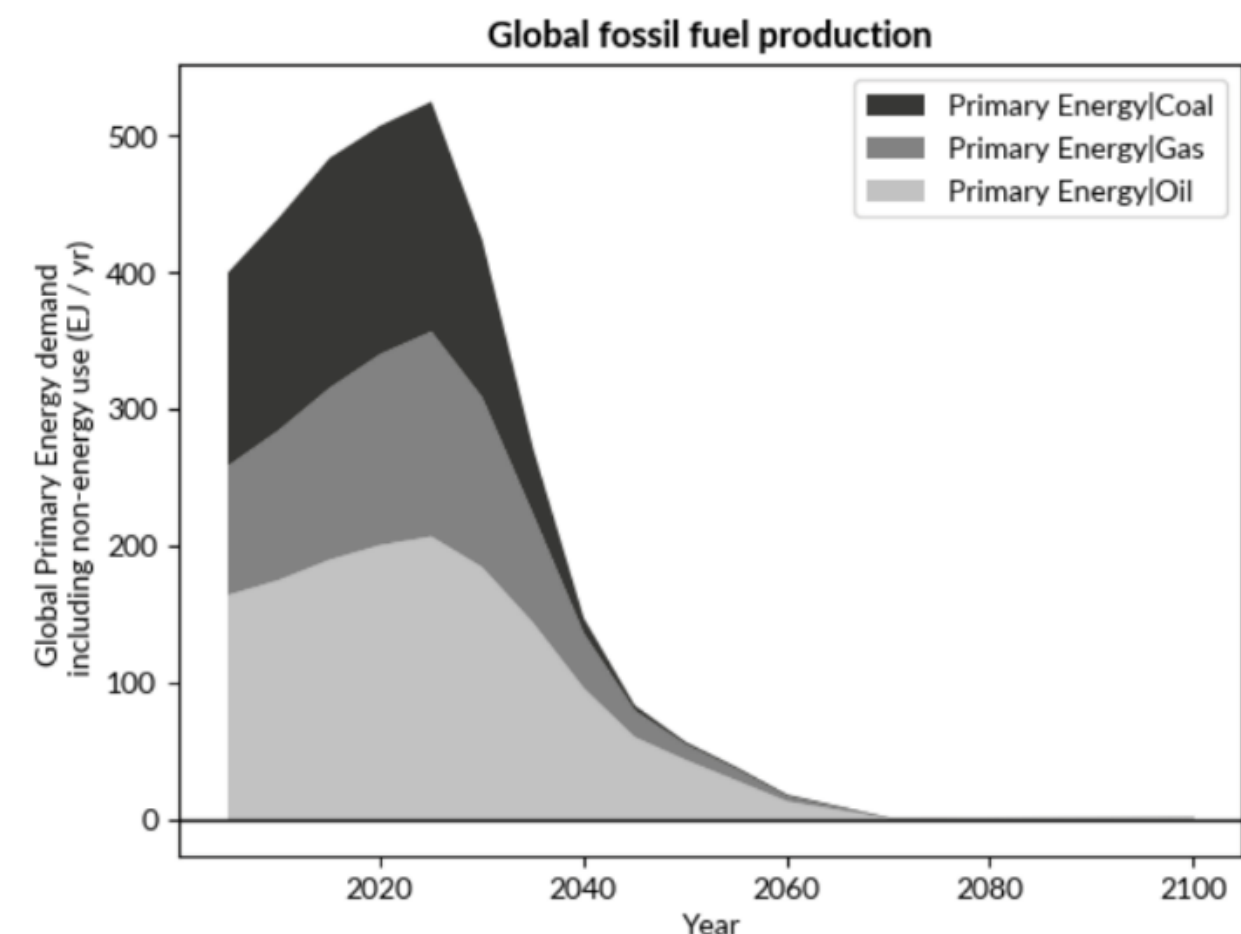
- Presenting new scenario co-developed by Climate Analytics and PIK, with global action starting from 2025
- Global emissions are higher until the late ~2030s than in C1a pathway (due to delayed start)
- Global emissions are reduced more steeply by 2050
- Net zero CO₂ reached in 2045, net zero GHGs reached ~2060, faster than median C1a scenario. This is essential to peak and then drive post-peak temperature decline

Time-period	AR6 scenarios	New scenario
2019–2030	41%	17%
2019–2035	55%	49%
2019–2050	85%	95%

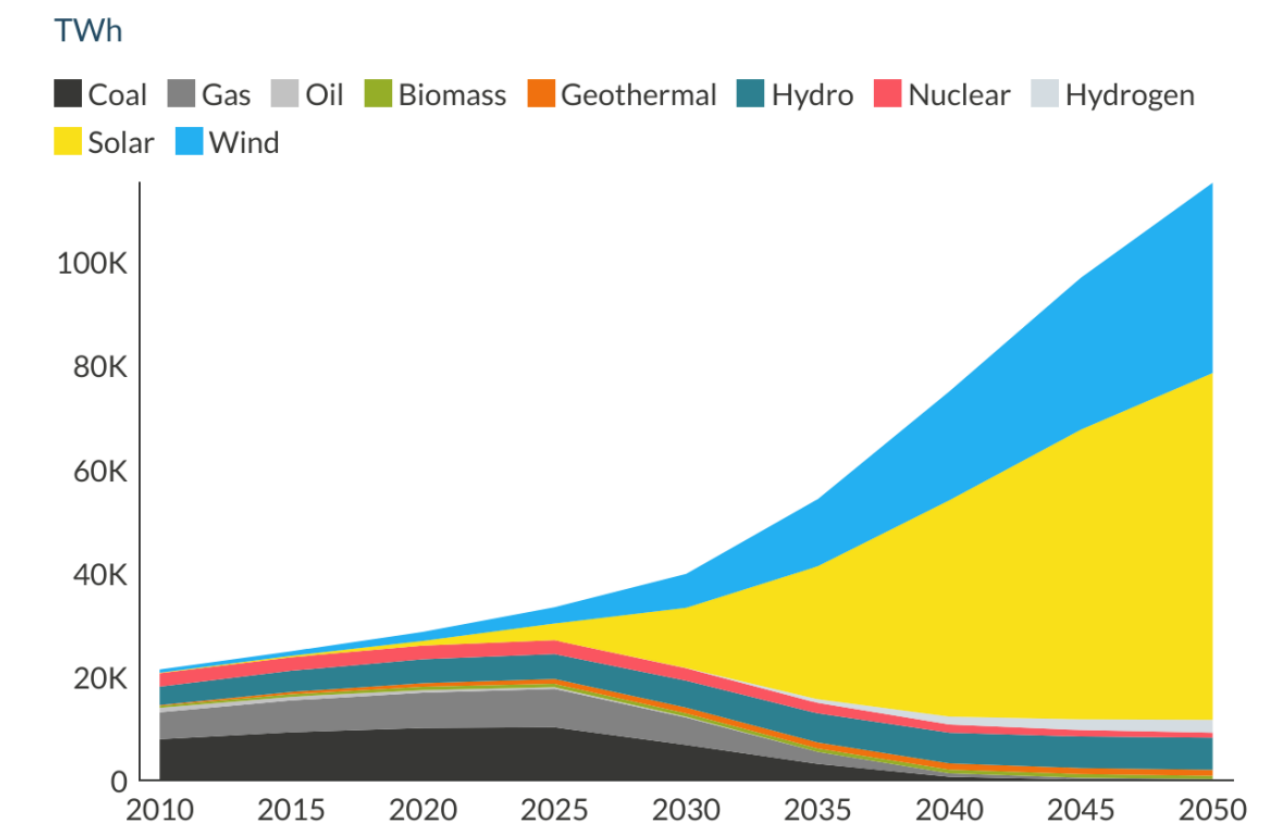
Fossil fuel production must fall rapidly towards zero, and wind and solar dominate the system

- Effective phaseout* of:
 - 2040s for coal
 - 2050s for gas
 - 2060s for oil
- Complete phaseout in the second half of the century
- Without a fossil phaseout, limited CDR deployment will have to be used to offset continued fossil fuel demand
- Electricity demand more than triples by 2050, driving electrification in all sectors
- Total renewable capacity triples by 2030, 6x by 2035, 15x by 2050 (relative to 2022 levels)

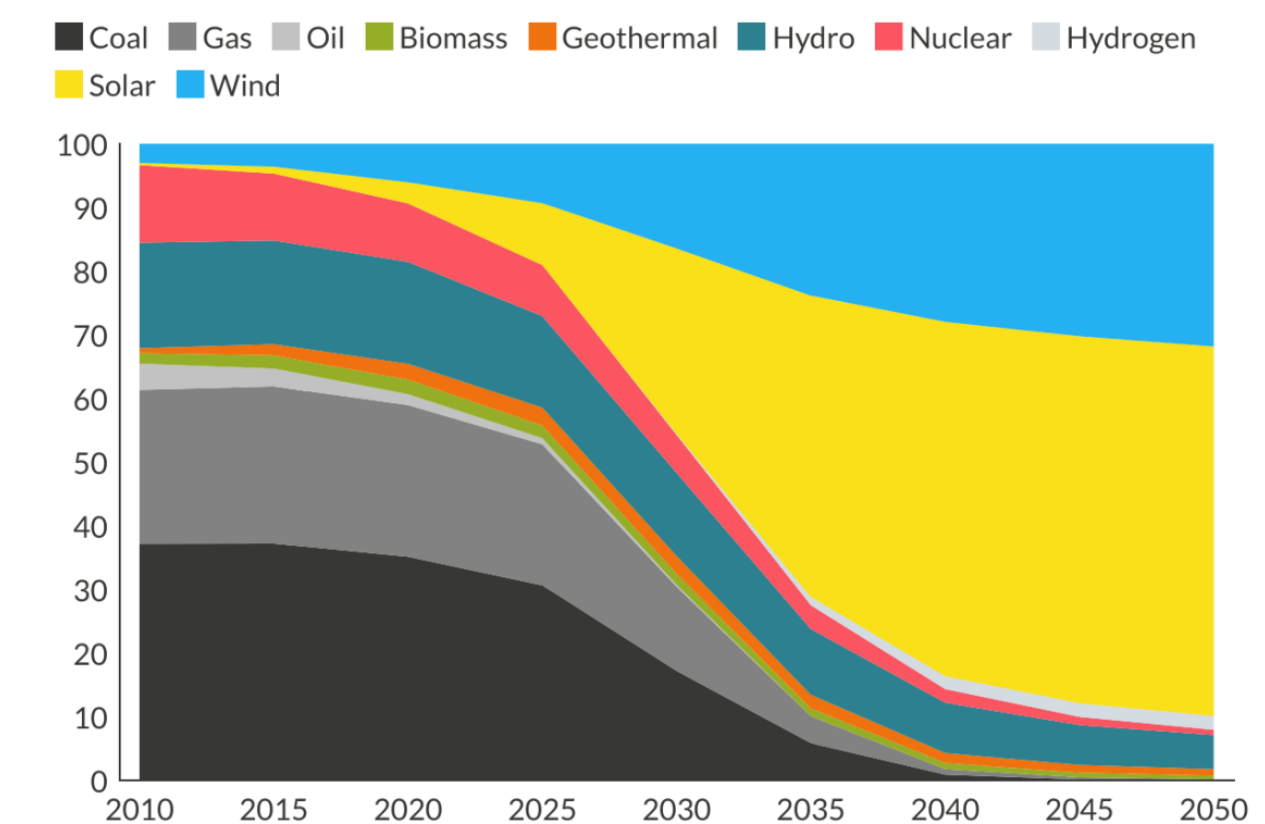
* Defined as >95% reductions from 2020 levels



Global electricity mix



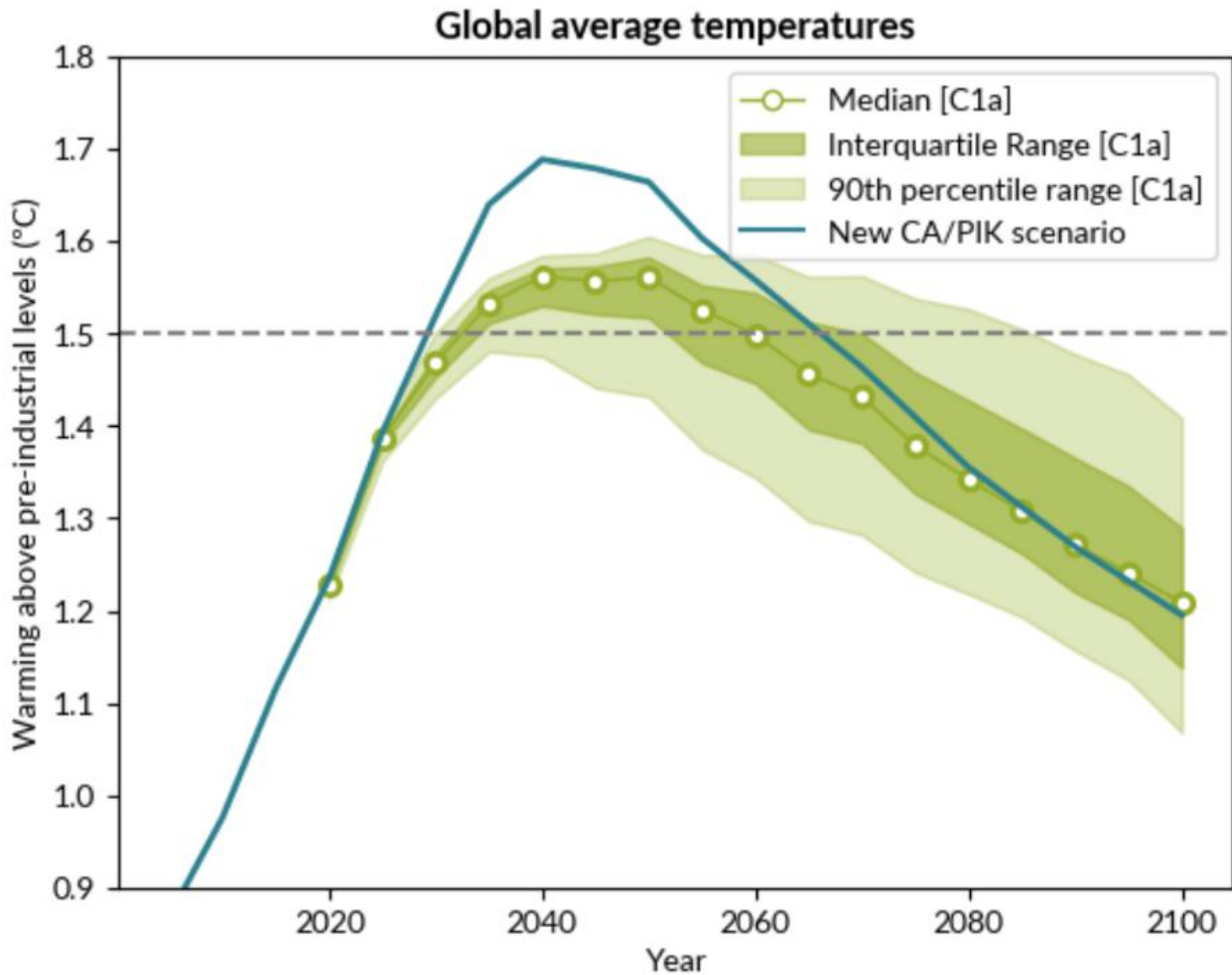
Share of global electricity generation



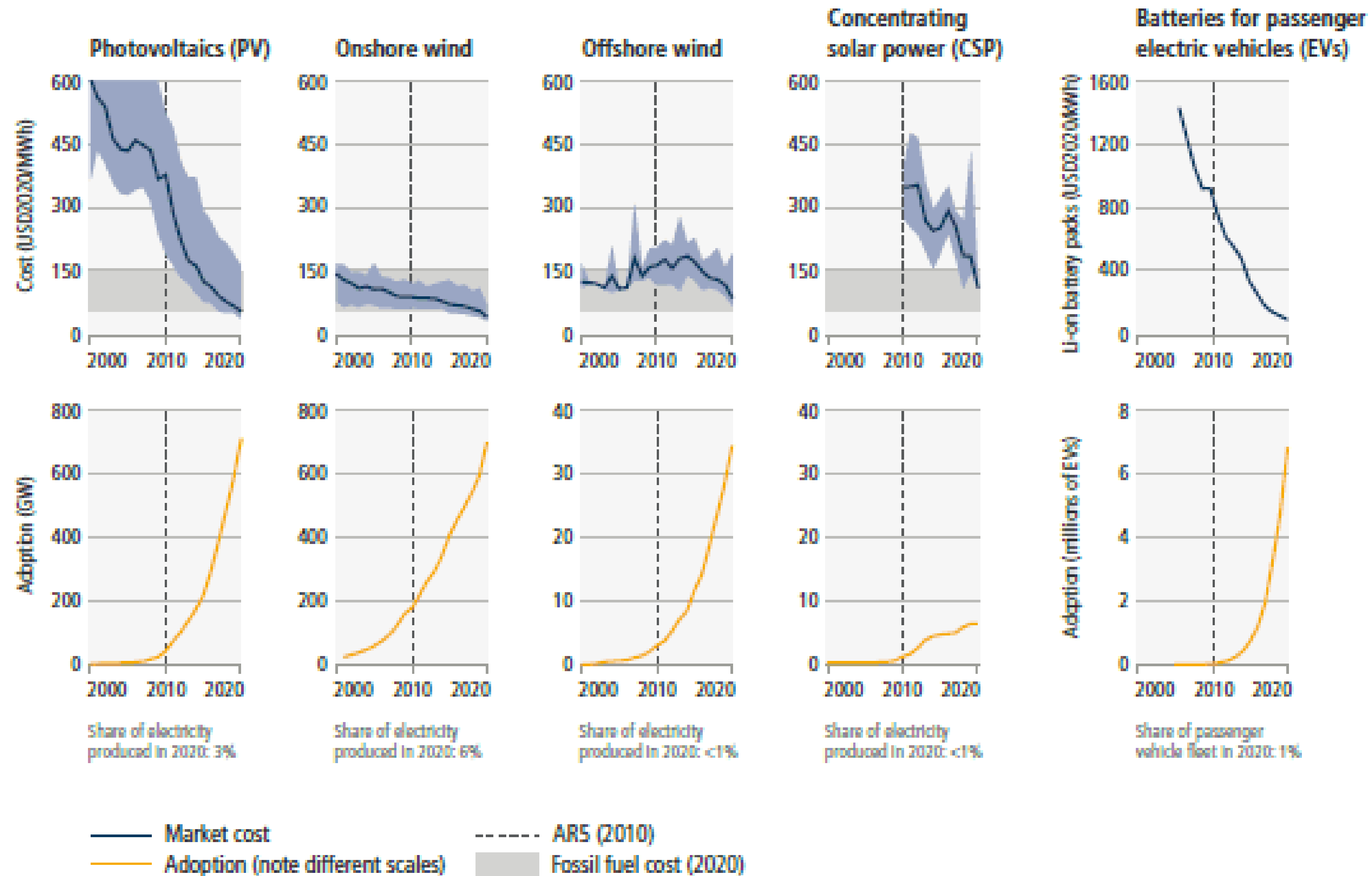
Global temperatures peak at ~1.7°C but fall substantially below 1.5°C pre-2100

- Peak warming limited to 1.7°C, 2100 temperature of 1.2°C.
- This does not account for updates to climate system that could push warming even higher
- Overshooting 1.5°C for ~40 years vs ~30 years in C1a
- Table compares temperature outcomes to the IPCC AR6 C1a scenarios

Variable	AR6 scenarios	New scenario
Peak median temperature	1.58°C	1.69°C
2100 median temperature	1.22°C	1.20°C



The unit costs of some forms of renewable energy and of batteries for passenger EVs have fallen, and their use continues to rise.



Exponential
Change

Positive
Hockeysticks
as we speak

IPCC AR6 WG III

Santa Marta: Key outcomes from first summit on ‘transitioning away’ from fossil fuels

- establishment of a “coordination group to ensure continuity towards the second and subsequent conferences”
- delivering the findings of Santa Marta conference to the COP30 presidency, currently preparing a global fossil-fuel roadmap to present at COP31 in November.
- establishment of **three “workstreams”** on issues to bring forward to the second summit:
 1. develop national and regional roadmaps away from fossil fuels,
 2. change the financial system to better facilitate the transition away from fossil fuels,
 3. address fossil-fuel-intensive trade, with the aim of “advancing progress towards a fossil fuel-free trade system”
- Tuvalu and Ireland will co-host a second transitioning away from fossil fuels conference in 2027.







POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH

THANK YOU!

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