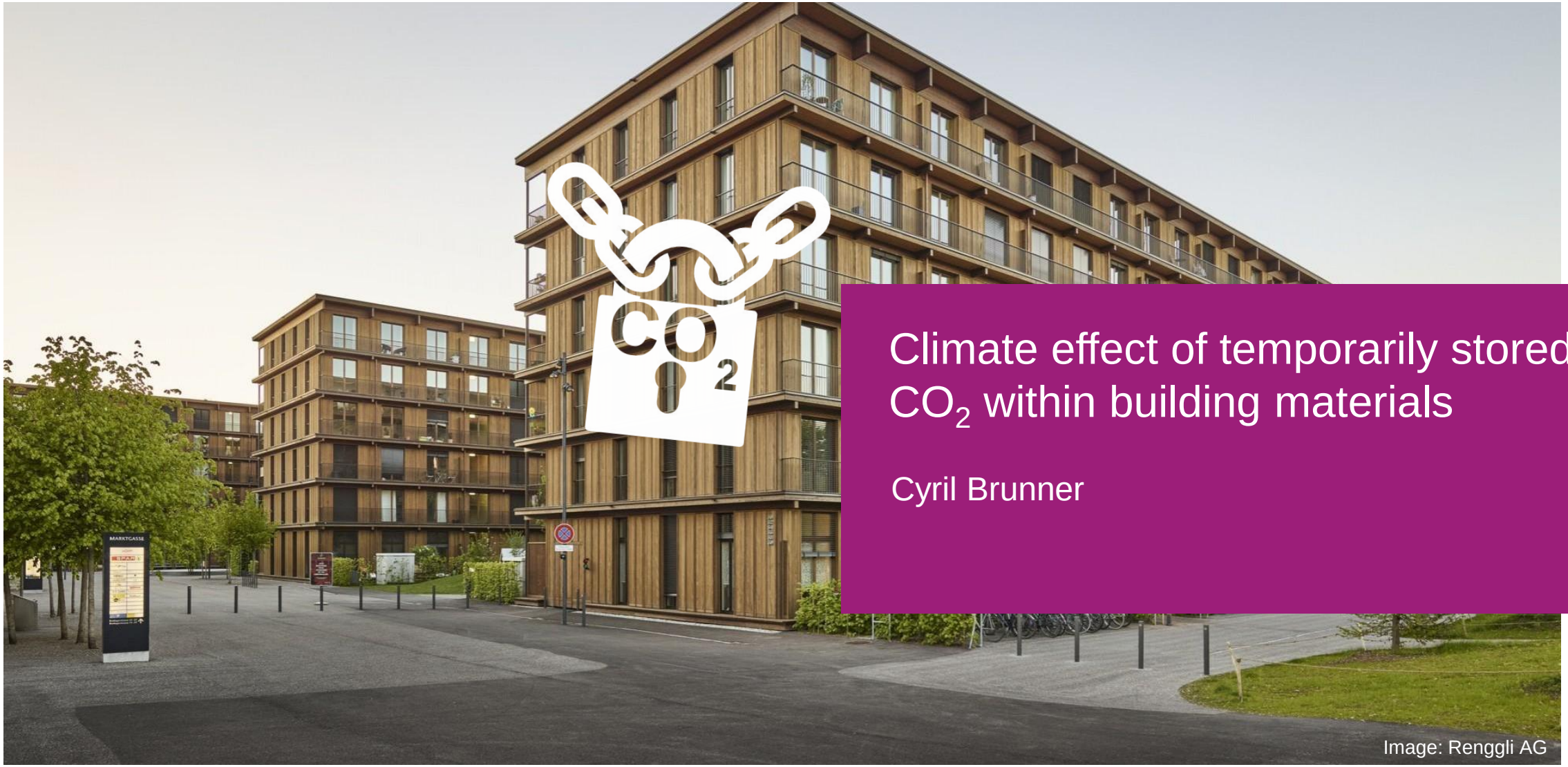
ETH zürich

Institute for Atmospheric and Climate Science



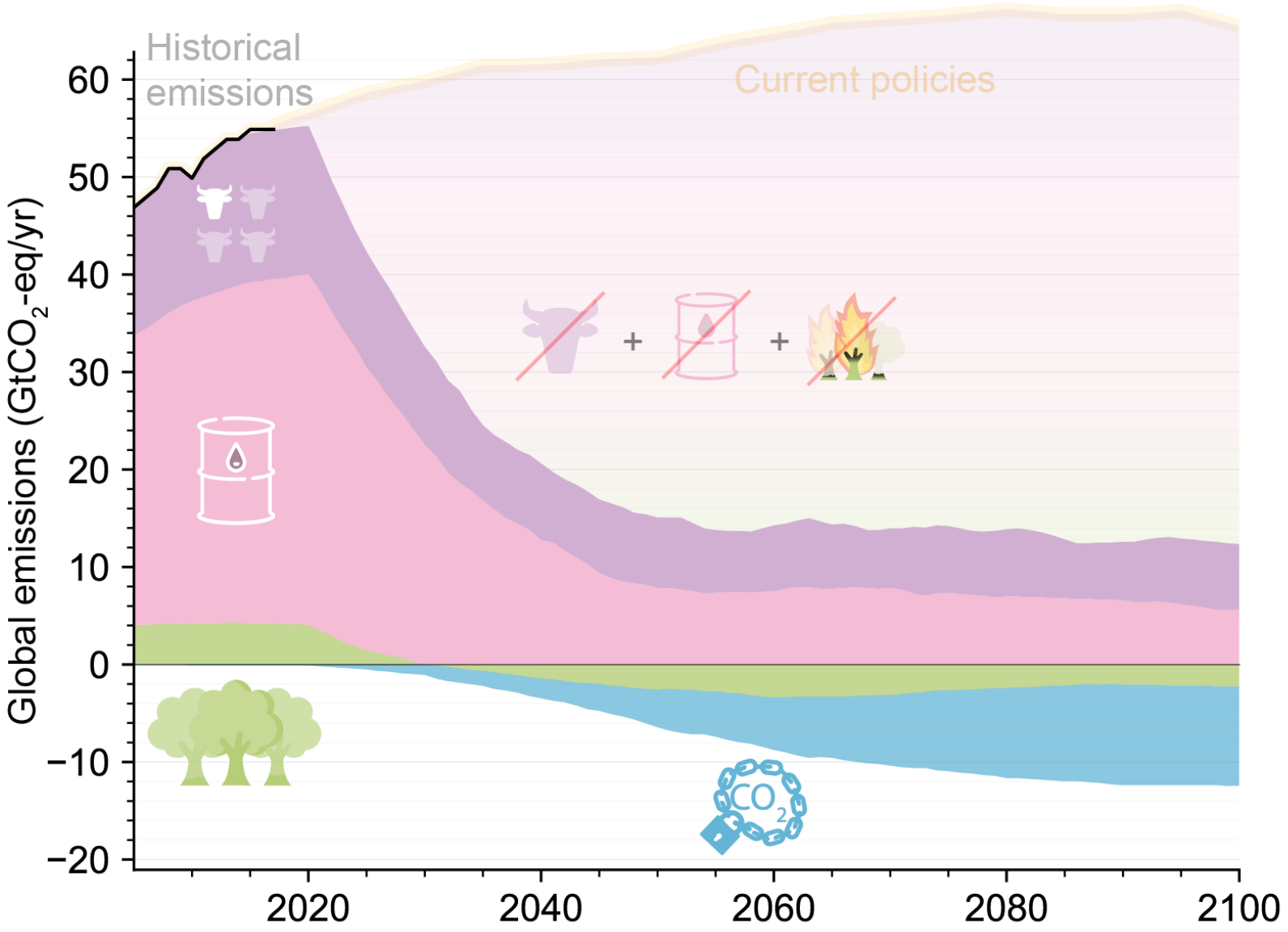
Climate effect of temporarily stored CO_2 within building materials

Cyril Brunner

Image: Renggli AG

D USYS

How to tackle climate change



To tackle climate change, we need to:

1. Stop buring fossil fuels

2. Use biomass sustainably

3. Reduce our non-CO_2 emissions

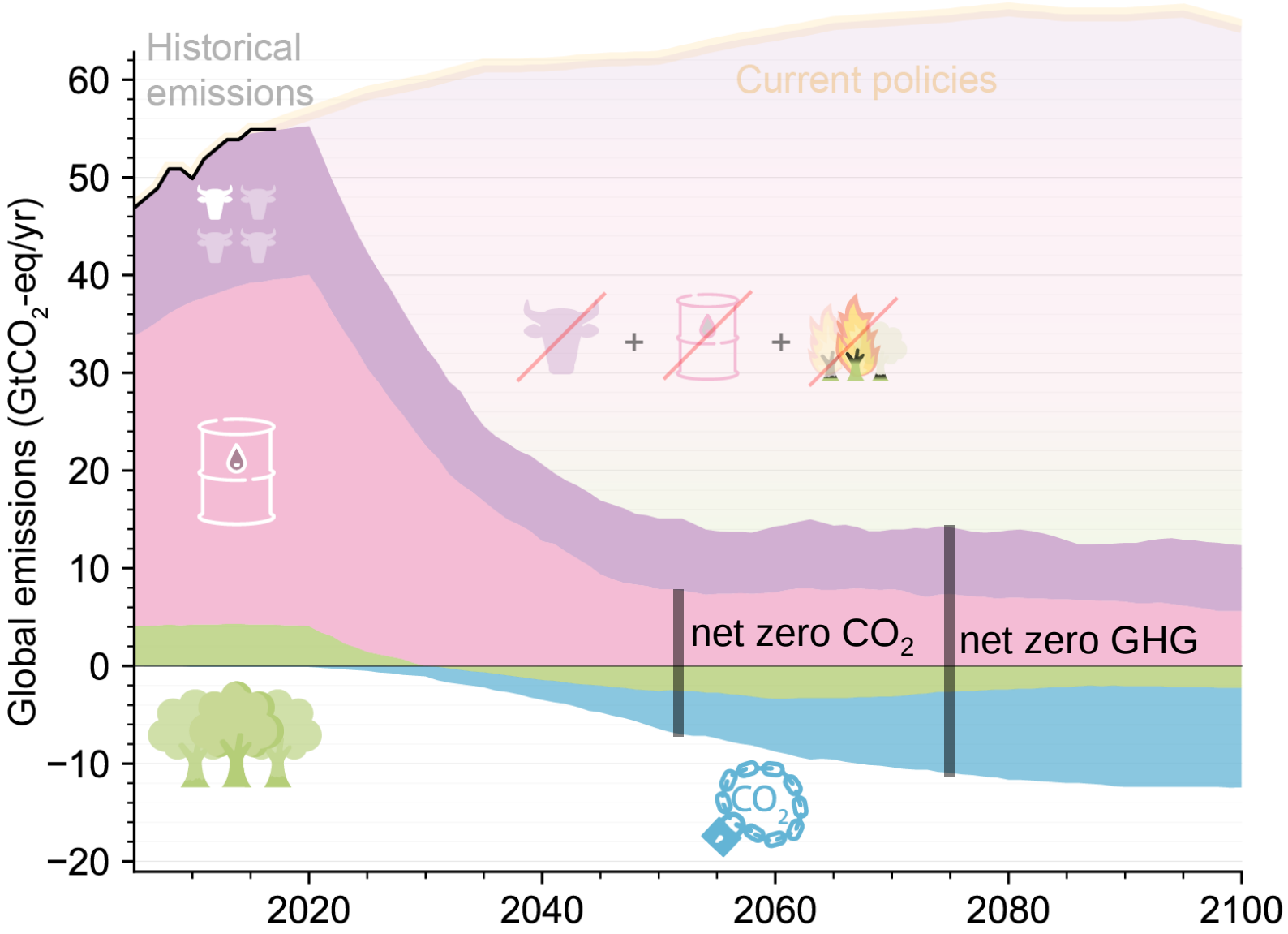
4. Carbon dioxide removal to achieve a net emissions balance of zero

Sources:
IPCC AR6 WGIII (2022)
AR6 Scenarios Database hosted by IIASA; Byers et al. (2022).

“The deployment of Carbon Dioxide Removal to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO_2 or GHG emissions are to be achieved.”

Source: IPCC AR6 WGIII SPM C.11

Without carbon dioxide removal no net zero



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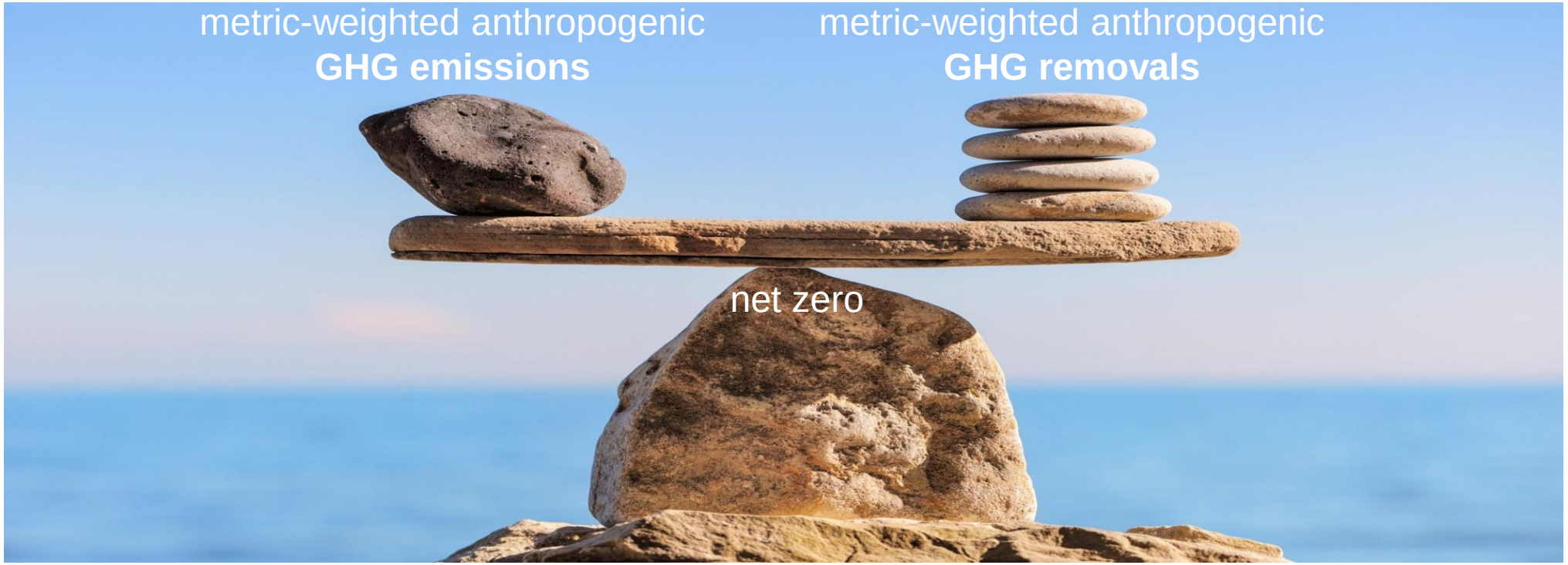
What is net zero?

IPCC AR6 WGI glossary:

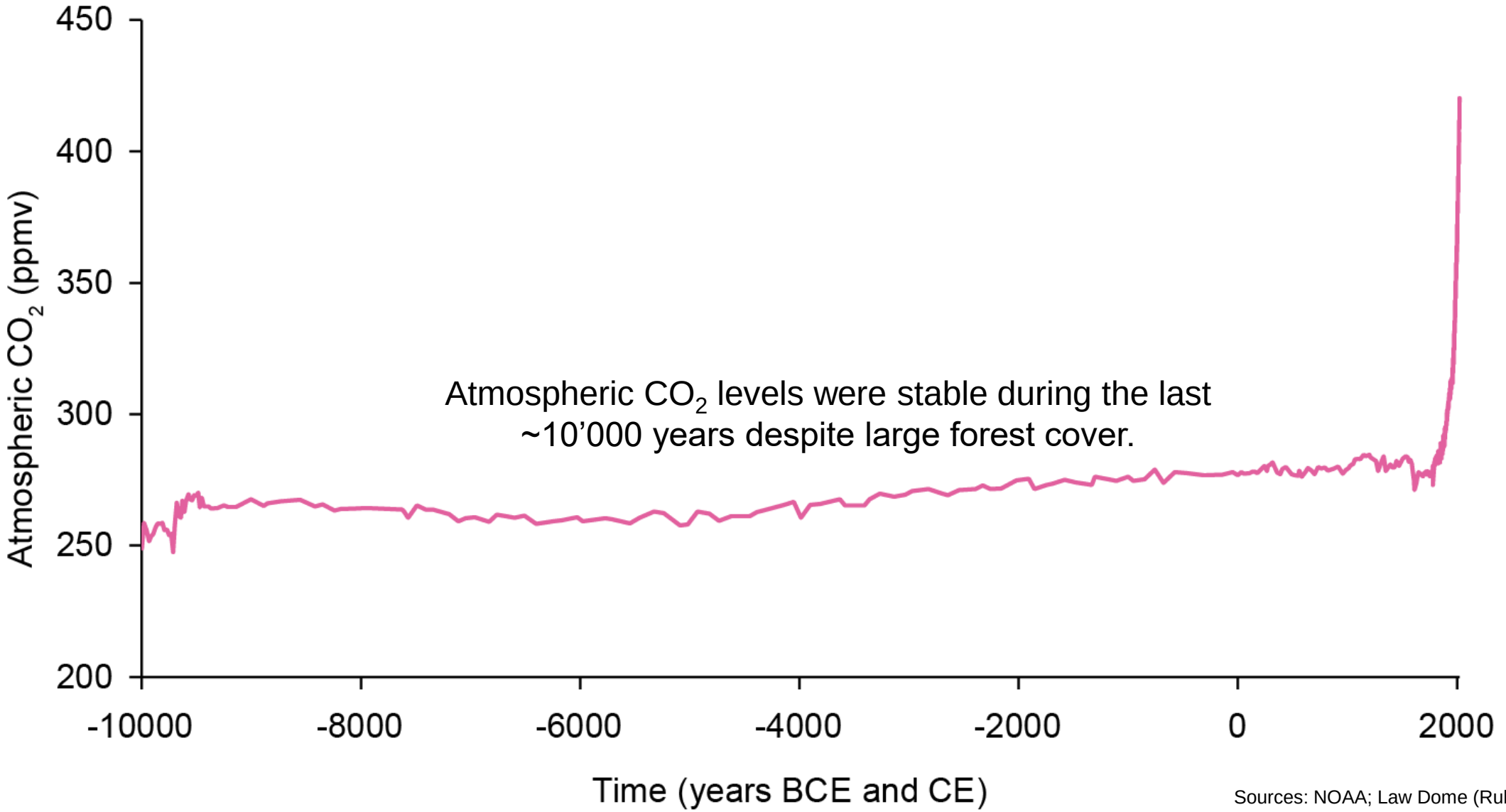
Net zero greenhouse gas emissions:

Condition in which metric-weighted anthropogenic greenhouse gas (GHG) emissions are balanced by metric-weighted anthropogenic GHG removals over a specified period. […]



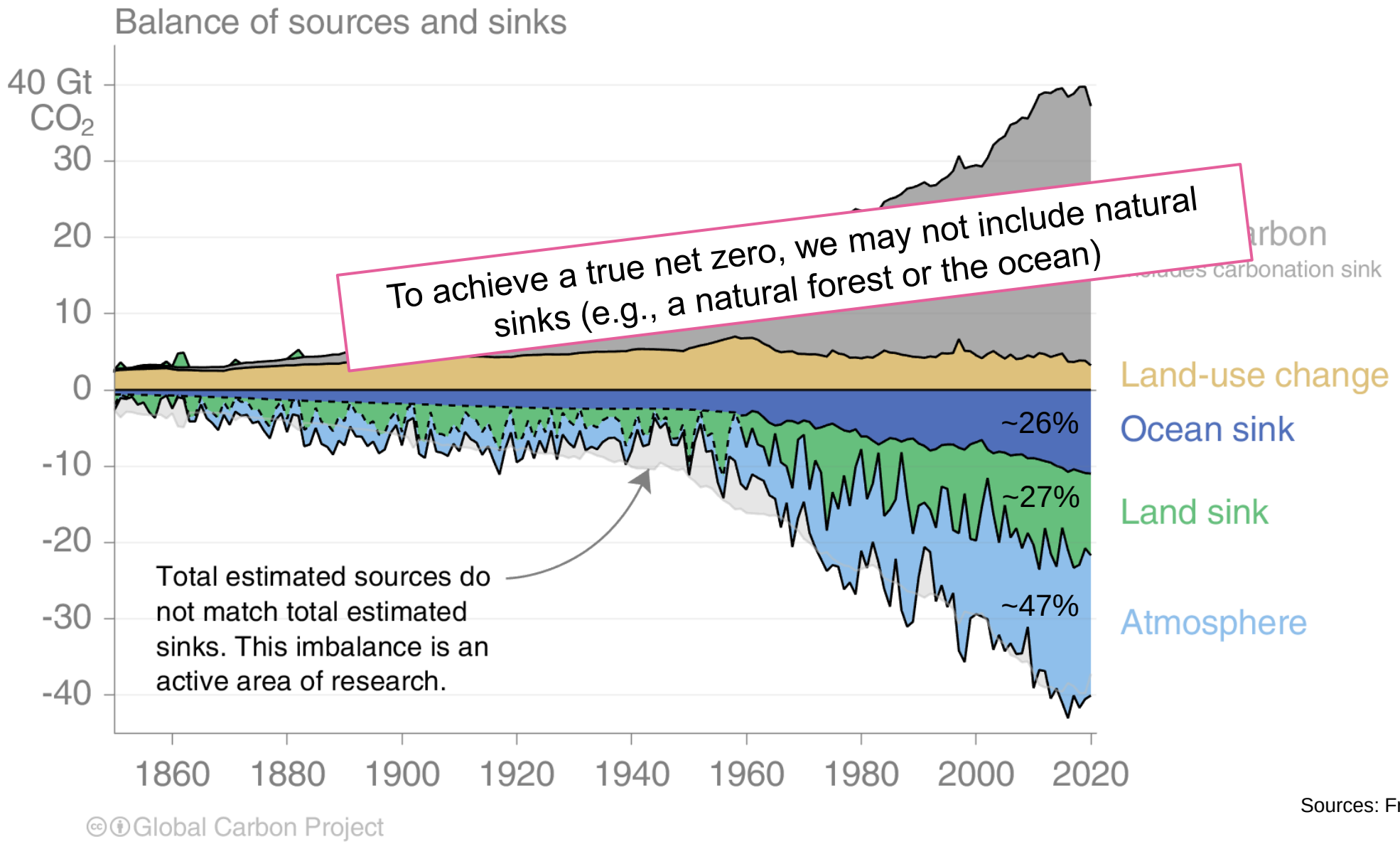
Sources:
Getty Images

Natural greenhouse gas removals are part of an ecosystem



Sources: NOAA; Law Dome (Rubino et al., 2013);
Law Dome (MacFarling Meure et al., 2006);
Dome C (Monnin et al., 2001 + 2004)

Land and Ocean sink are no anthropogenic CO_2 removals!



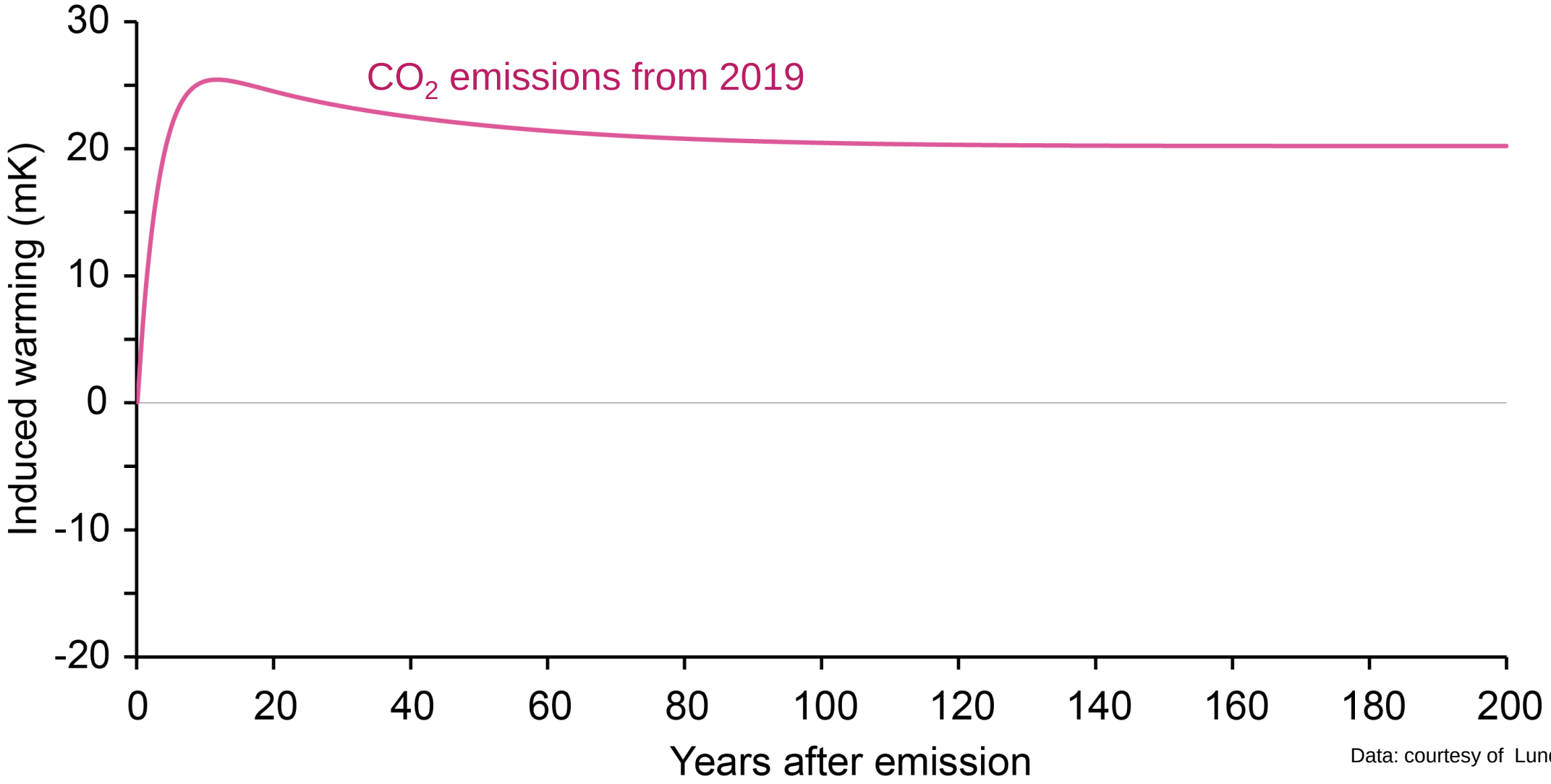
Sources: Friedlingstein et al., 2022

How can we remove greenhouse gases?

Improved sustainable forest management + construction with wood

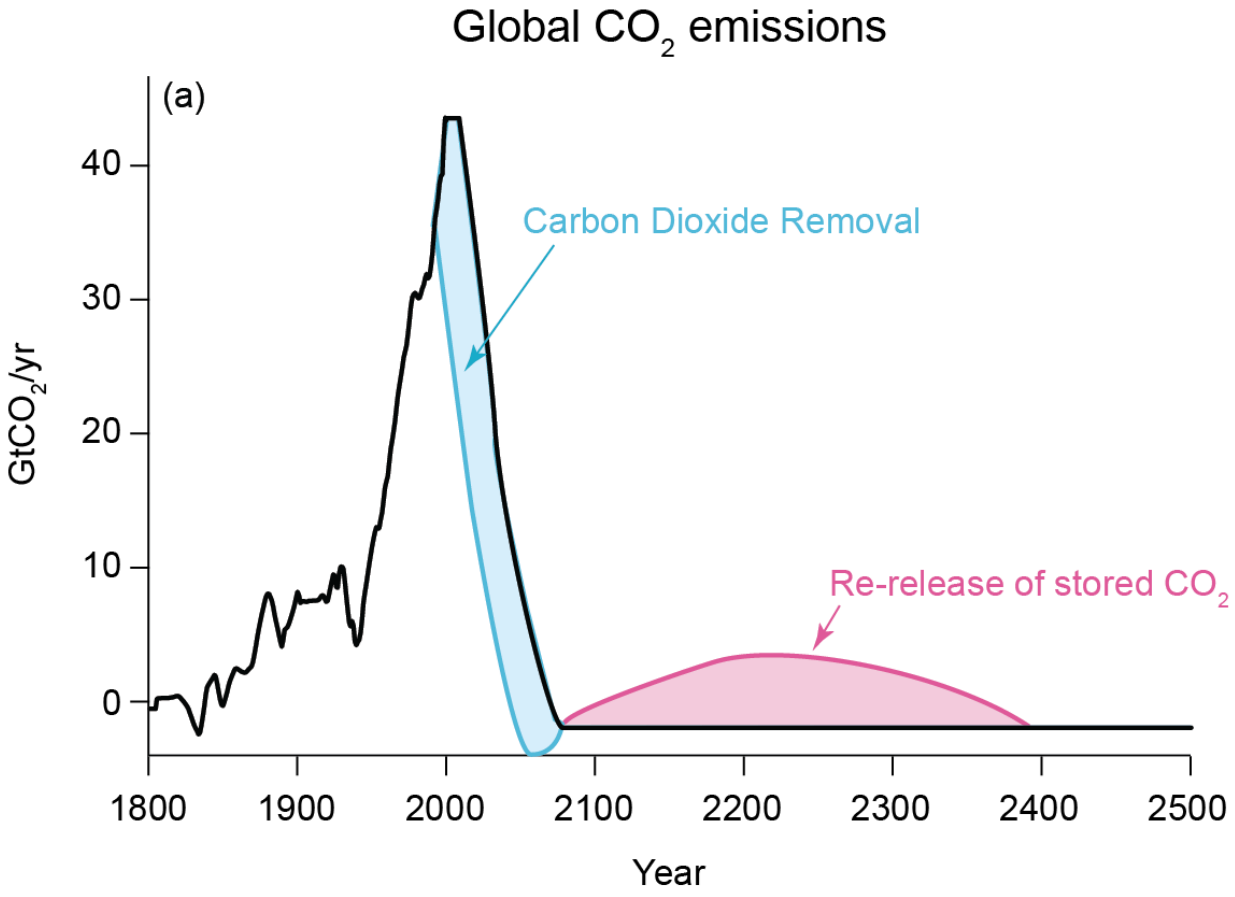
Sources: Gothe-Institut

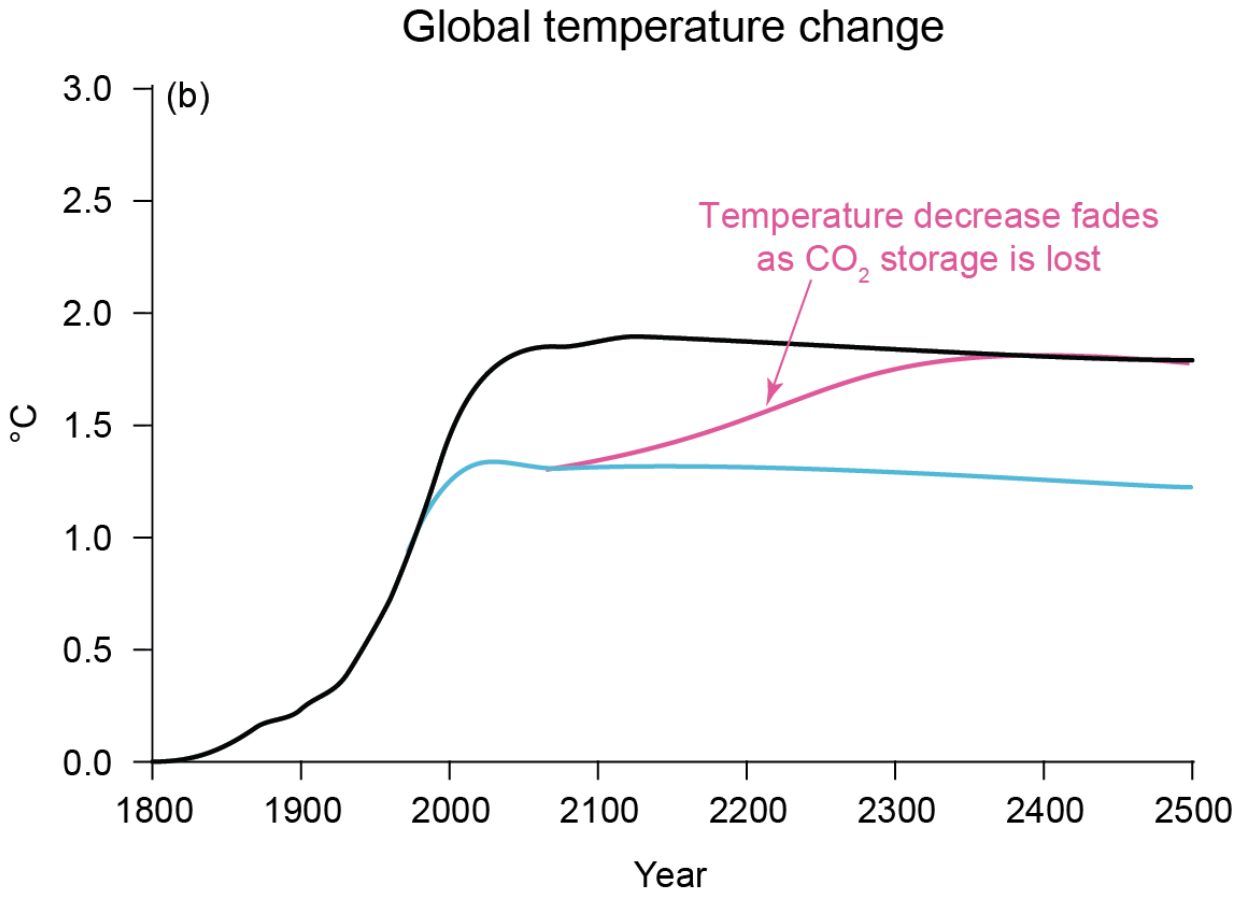
Most of the CO_2-induced warming remains past the typical lifespan of human infrastructure.



Data: courtesy of Lund et al., 2020

Non-permanent CO_2 storage has only an temporary benefit





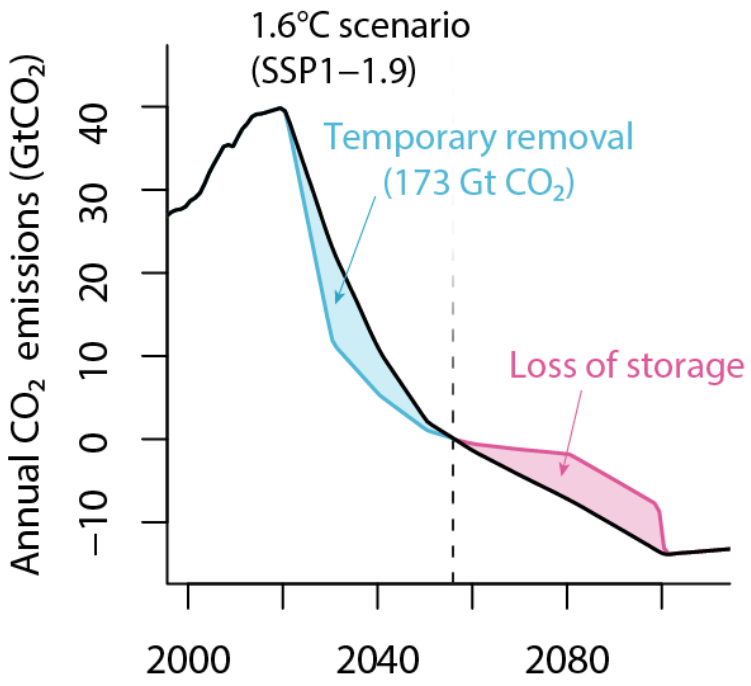
If the permanence of the stored CO_2 is not sufficient, the global temperature will return as if no Carbon Dioxide Removal (CDR) had taken place.

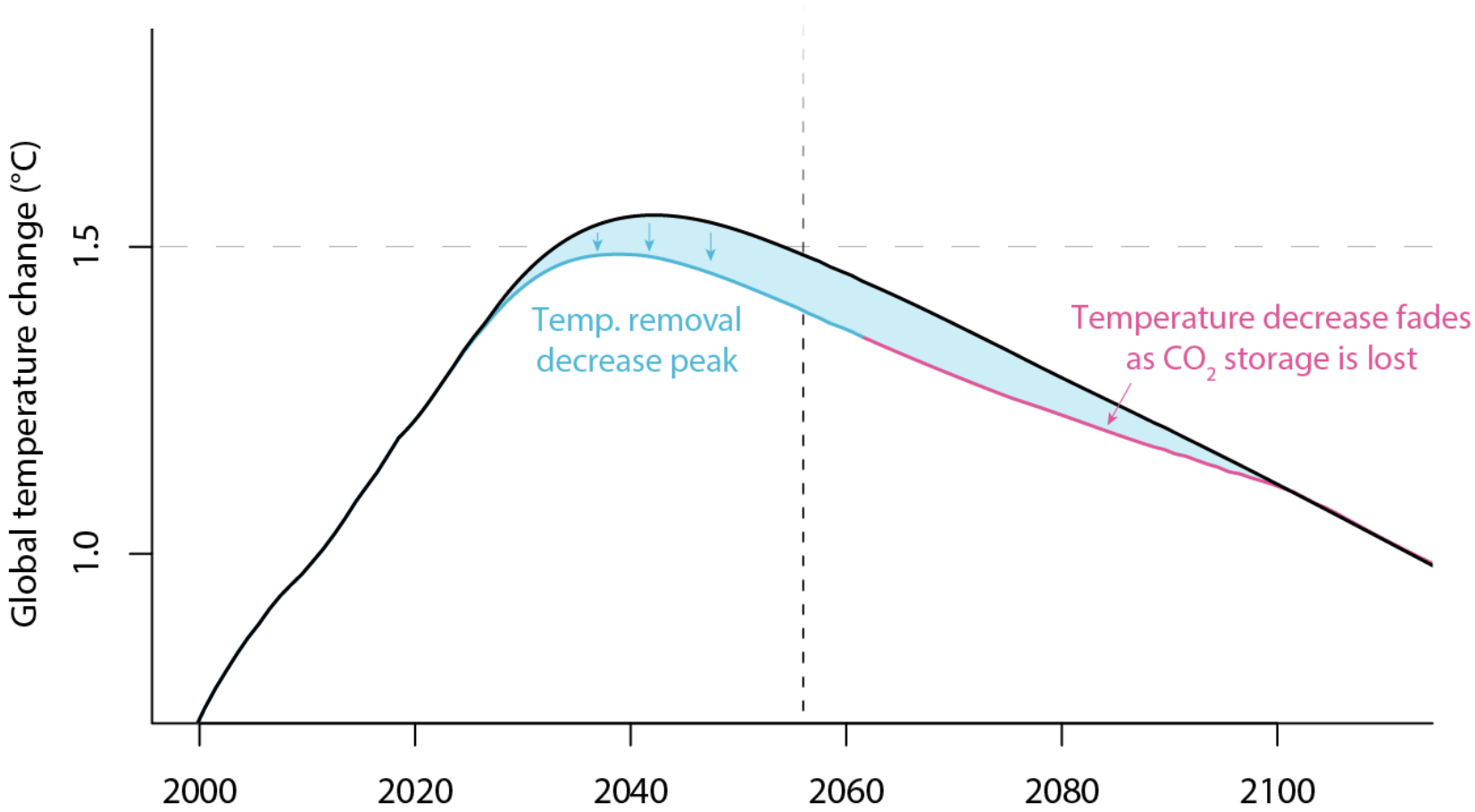
What permanence is required to avoid this?

→ Our best estimate is 3000-8000 years (half-life)

Figures: IPCC AR5, WGI, Fig. 6.39

Temporary removal of CO_2 can dampen global temperature maximum

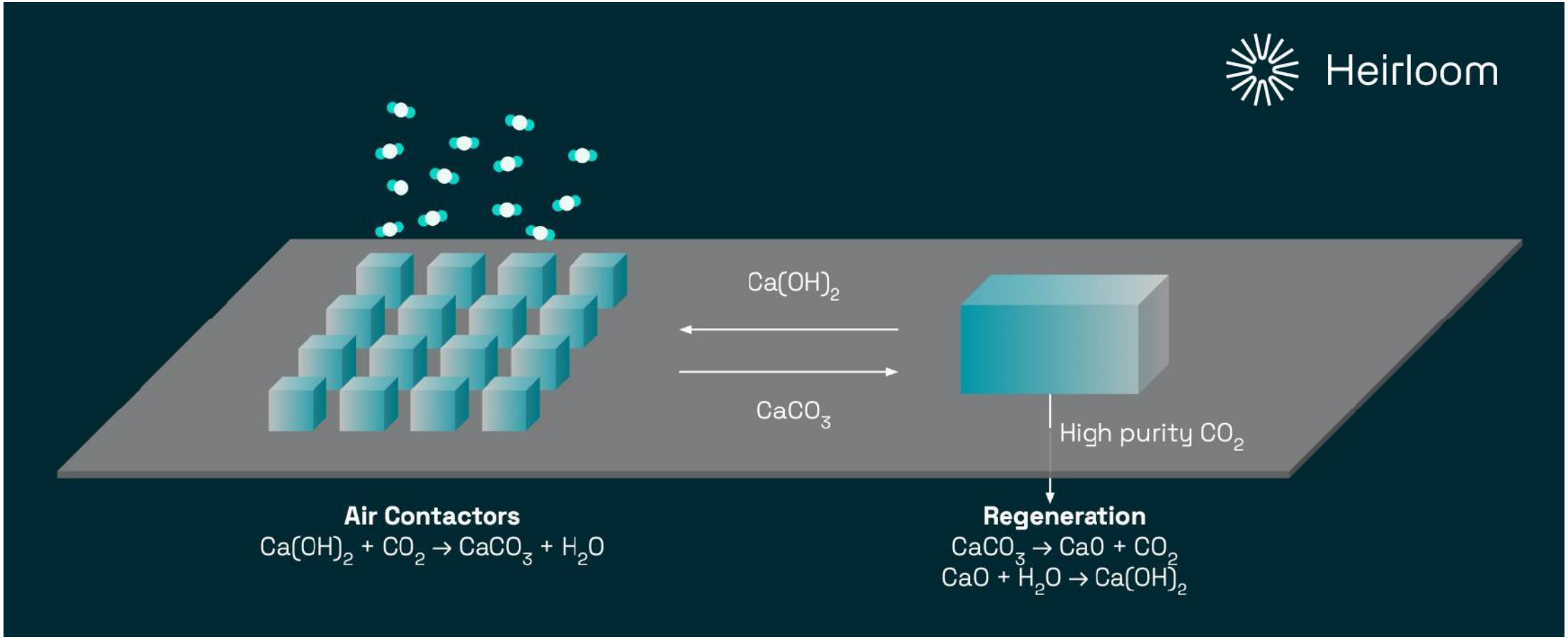




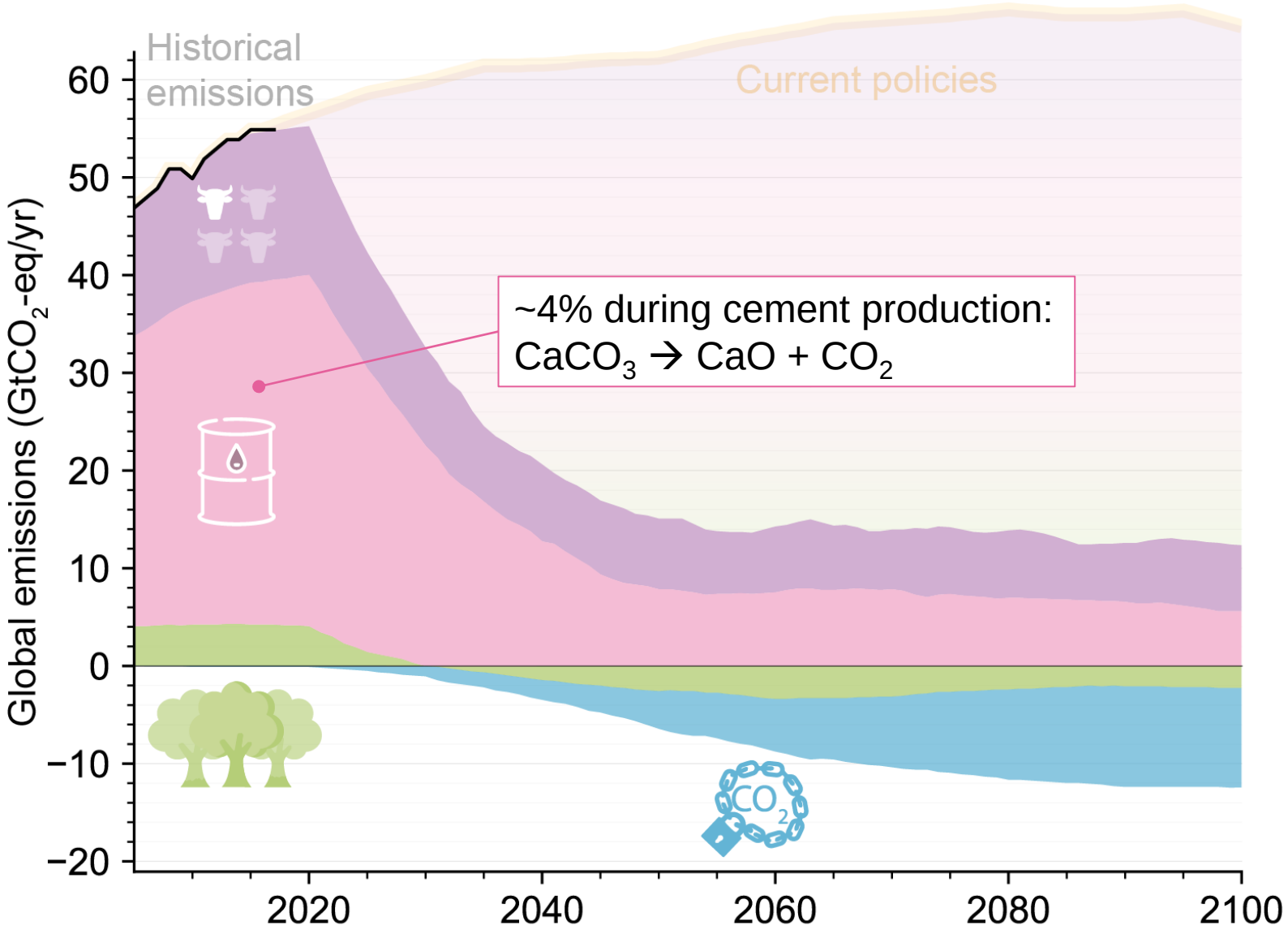
Figures: adopted from Matthews et al., 2022

How can we remove greenhouse gases?

The Direct Air Capture and Storage process of Heirloom



How to tackle climate change



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Sources:
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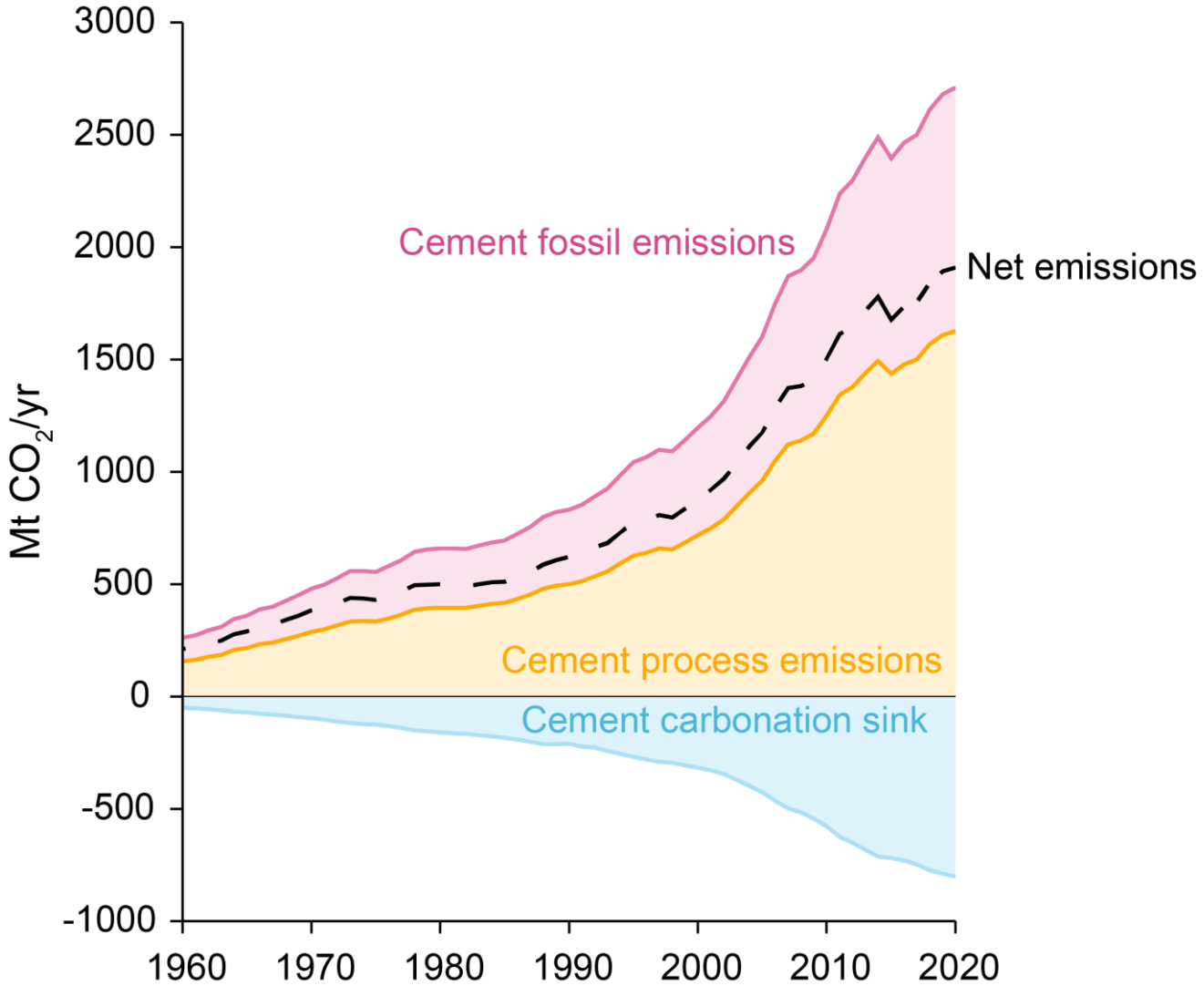
The carbonation of cement in concrete is not negligible

It is estimated that 52 to 55% of all process emissions have been reabsorbed since 1930.

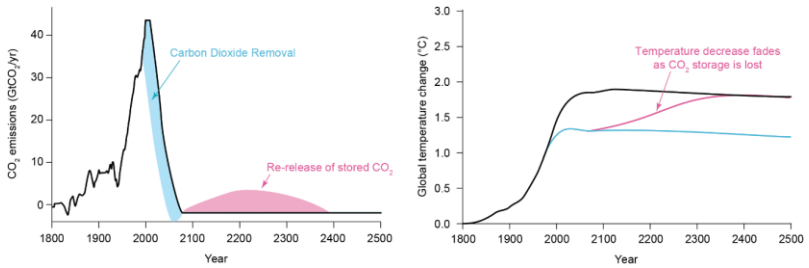


Sources: Friedlingstein et al. 2022

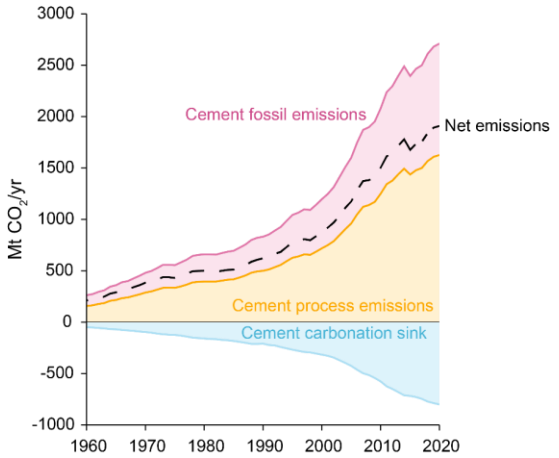
Concluding thoughts

- Net zero:
  anthropogenic GHG emissions + anthropogenic GHG removals = 0

- It matters how permanently the GHG are removed from the atmosphere.

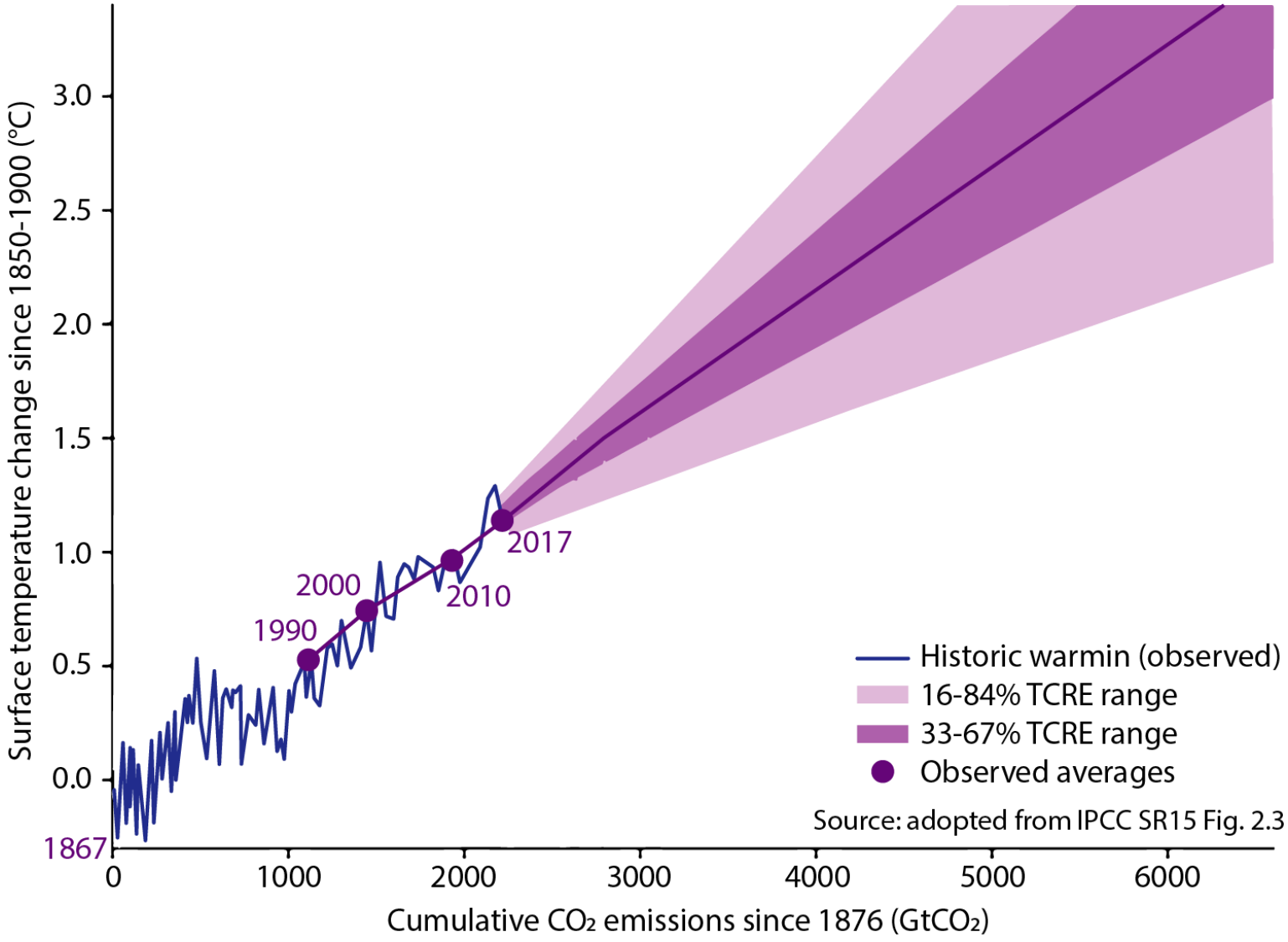


- Resolving GHG sinks in LCA can make the difference between a net positive or net negative good/process.

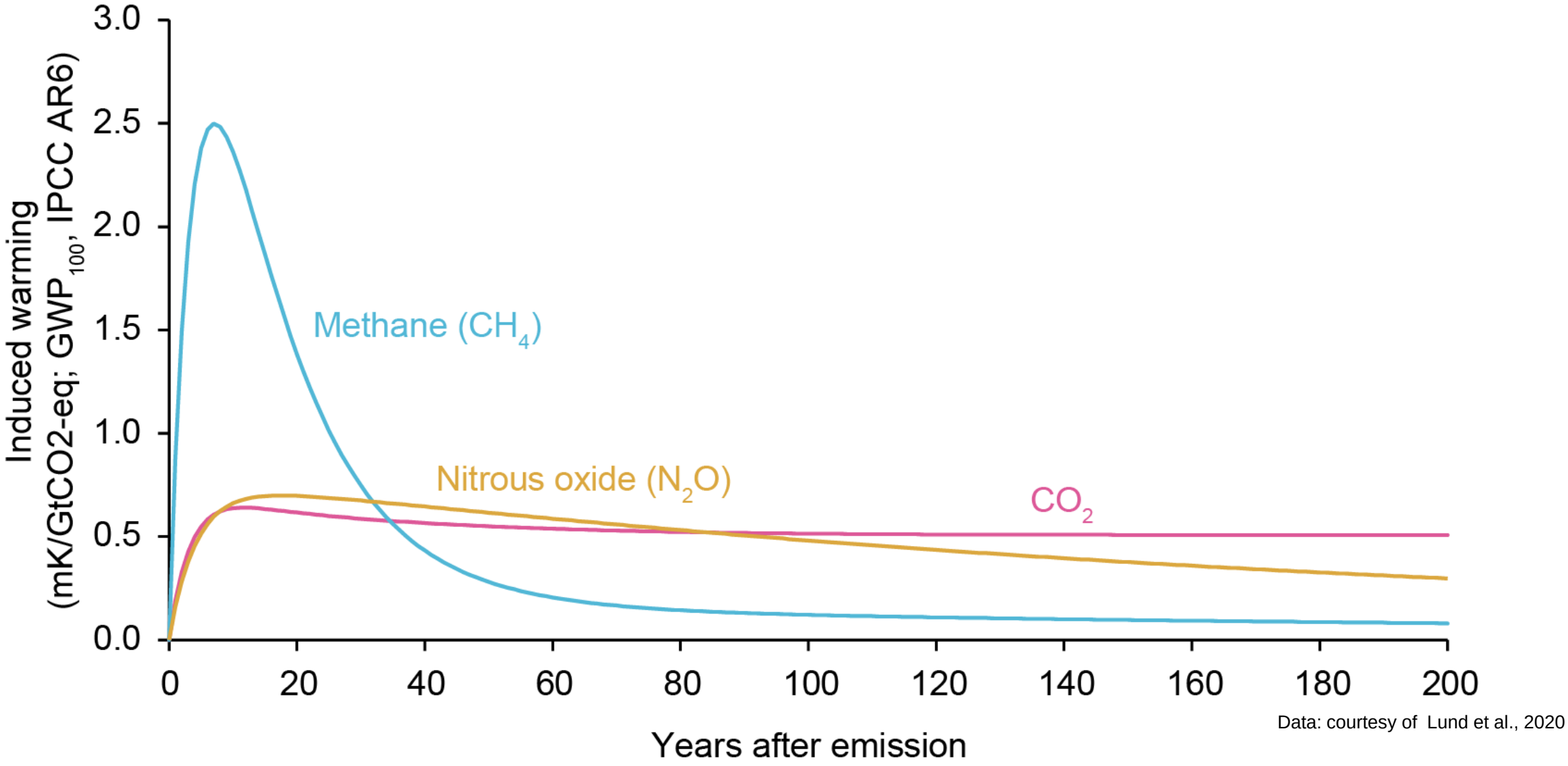


Why do we need net zero?

Temperature increase is nearly proportional to the cumulative CO_2 emissions.



Every conversion to CO_2-eq is a simplification



Data: courtesy of Lund et al., 2020