Negative emissions technologies, including carbon dioxide removal (CDR)

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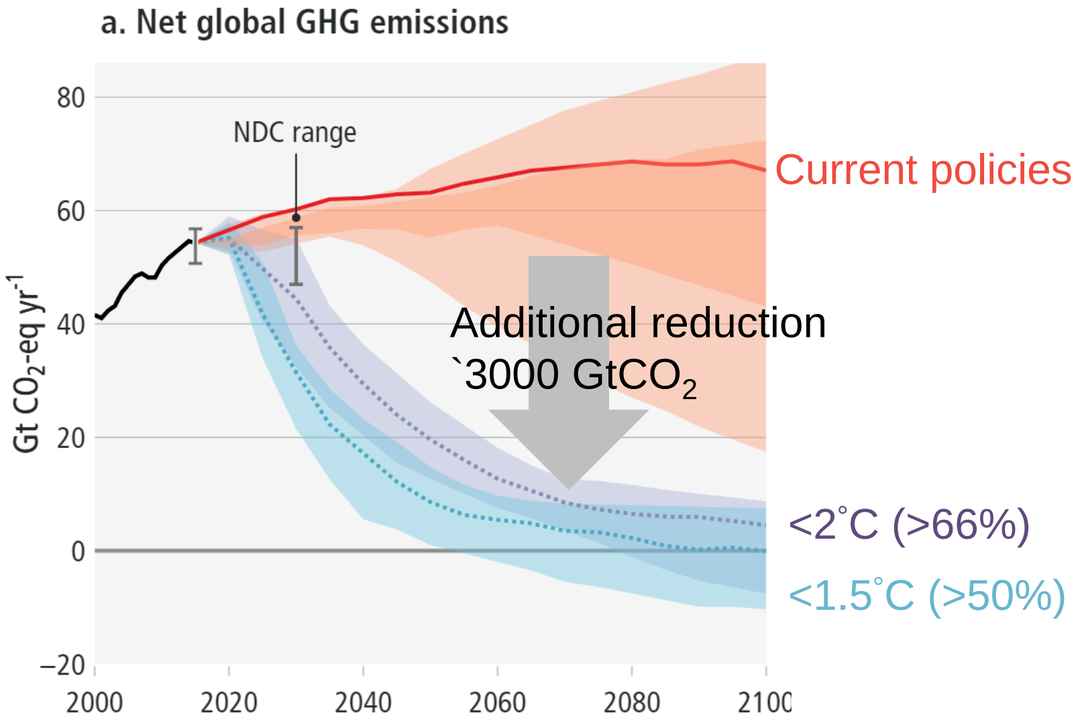
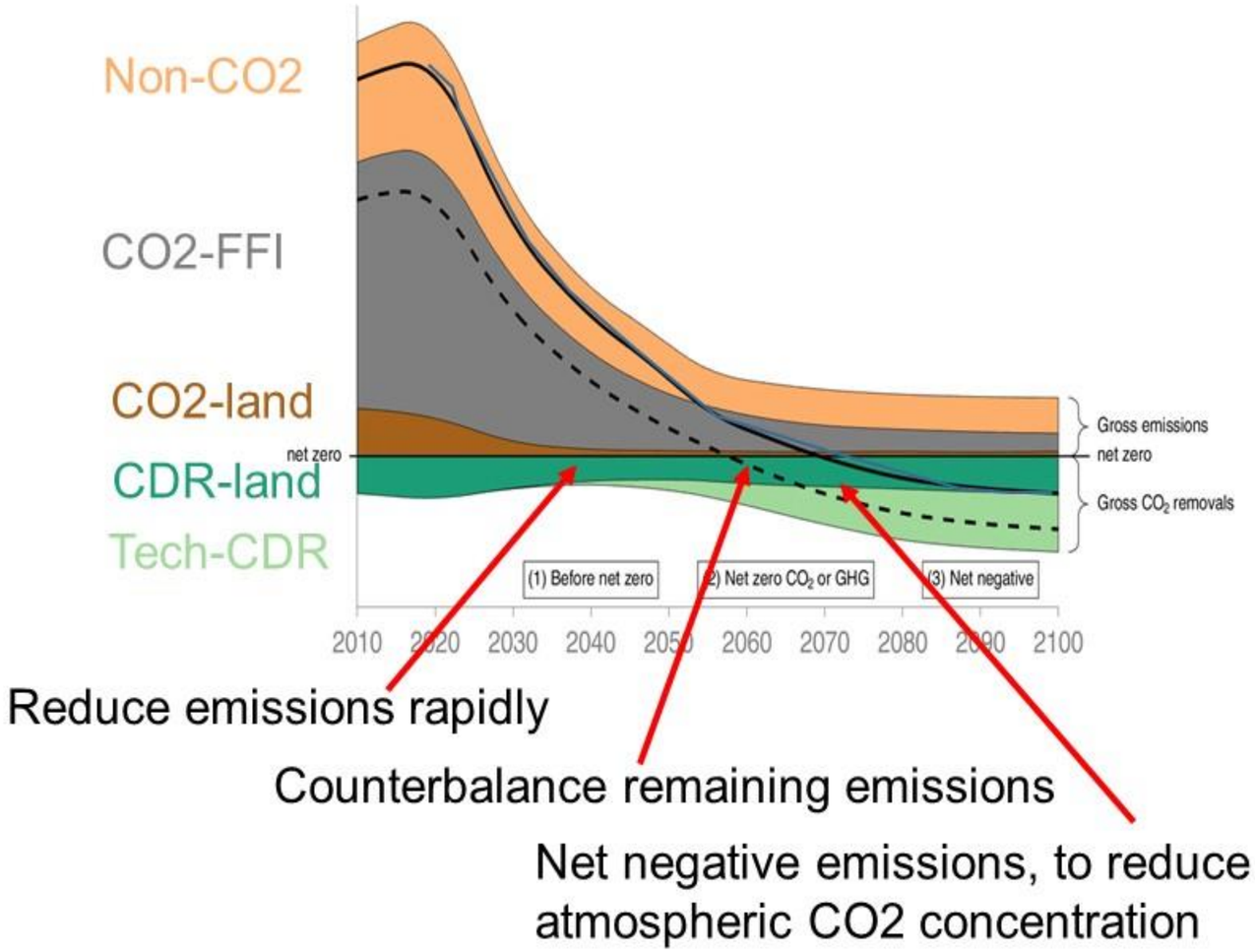
Definition of “Carbon Dioxide Removal”

Anthropogenic activities removing carbon dioxide (CO_2) from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products.

It includes existing and potential anthropogenic enhancement of biological or geochemical CO_2 sinks and direct air carbon dioxide capture and storage (DACCS), but excludes natural CO_2 uptake not directly caused by human activities.

Carbon capture and storage (CCS), which alone does not remove CO_2 from the atmosphere, can help reduce atmospheric CO_2 from industrial and energy-related sources if it is combined with bioenergy production (BECCS), or if CO_2 is captured from the air directly and stored (DACCS).



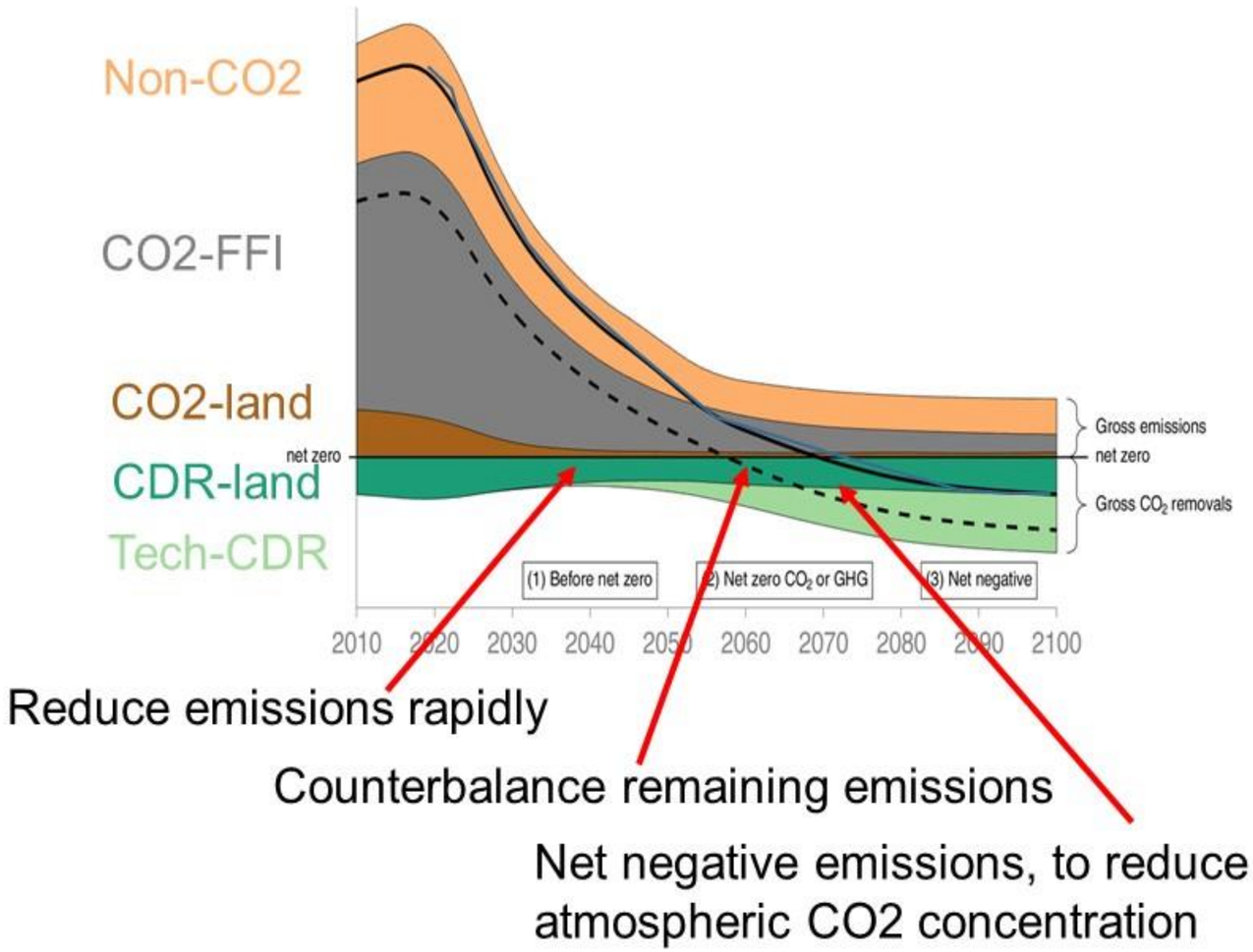


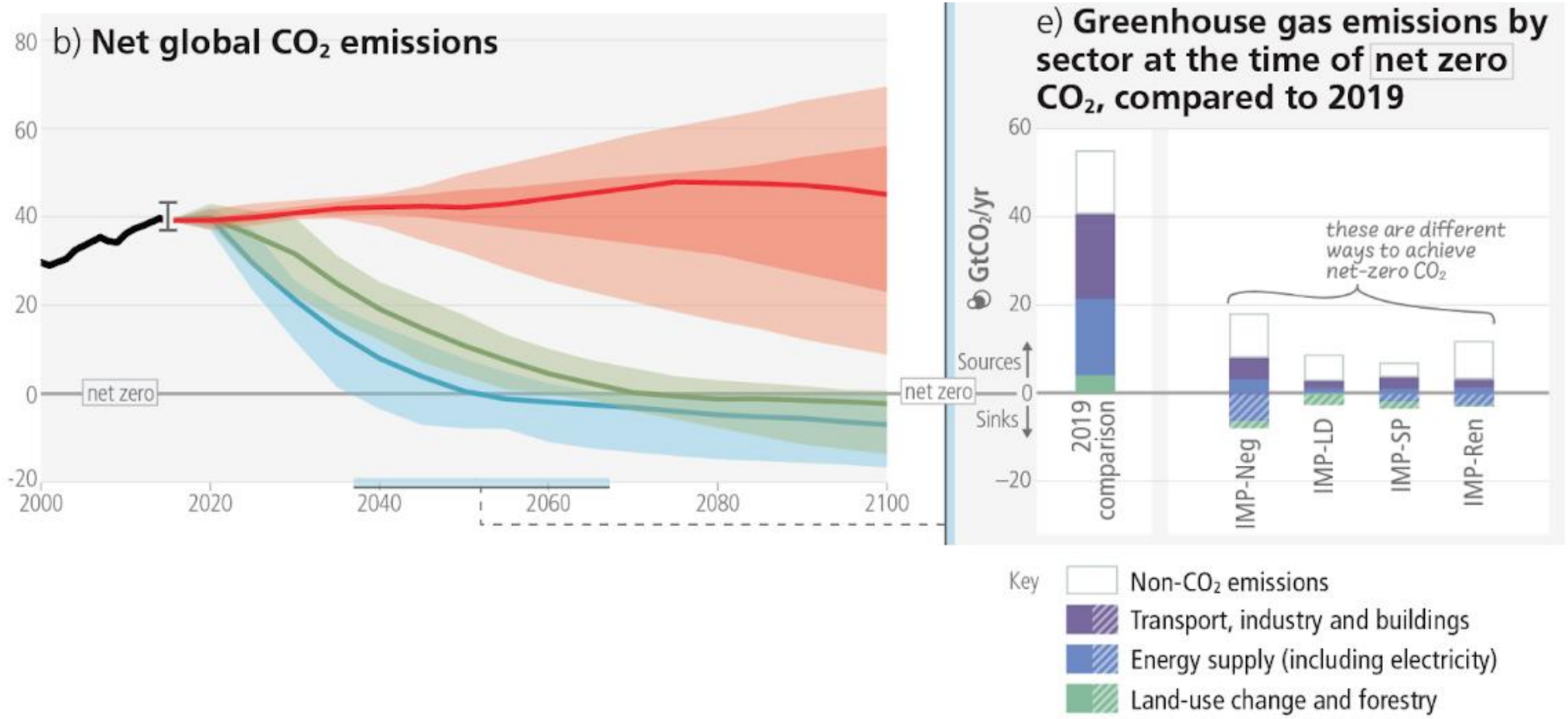
Why CDR:

- Carbon budget 400-500 GtCO2 for 1.5°C
- Hard-to-abate CO_2 emissions
- Non-CO_2 emissions are not expected to go to zero

All scenarios have some CDR

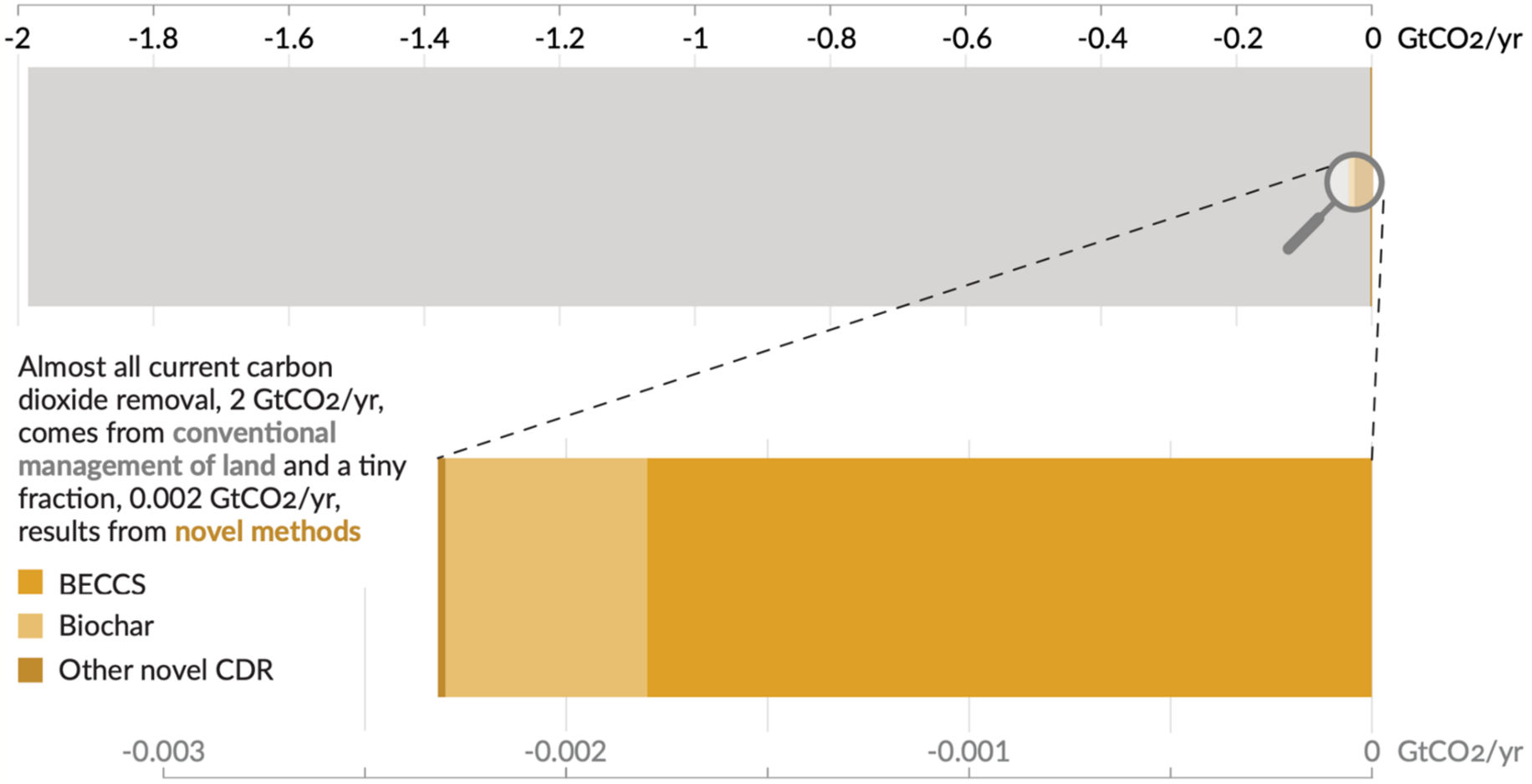
- Use in 1.5°C scenarios on the order of several 100s $GtCO_2$
- Uncertainty in upscaling and serious sustainability risks with most CDR options, depending on volumes and placement
- Overshoot involves climate risks
- In other words: CDR will not be unlimited





- Strategies to reduce reliance on CDR available (e.g. lifestyle changes, early steep emission reductions)

Current CDR is around 2 $GtCO_2$/yr – only 0.1% (2 $MtCO_2$/yr) is from novel methods



Knowledge gaps, research needs & emerging action

Fundamentals

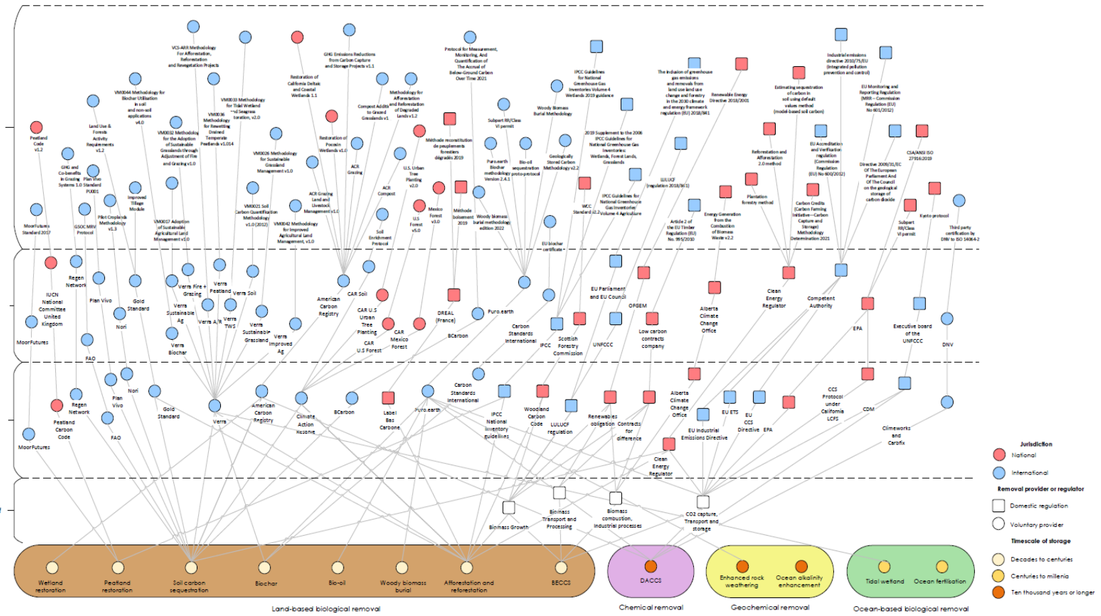
- Definition of *durability*
- Measurement, reporting and verification of carbon flows

Methods & Pathways

- Effectiveness of methods
- Risks & co-benefits
- Demonstration *(UK, US, EU)*
- Residual emissions vs. CDR

Governance/Policy

- Voluntary vs. Compliance Markets
- Certification & accounting *(PA Art. 6.4, EU, US, UK)*
- Int. Cooperation *(Mission Innovation)*
- Targeted incentives *(SWE, US)*
- Residuals vs. removals *(GER)*
- National Net-Negative *(DEN)*



Mercer/Burke (2023): Strengthening MRV standards for greenhouse gas removals to improve climate change governance. Grantham Institute and CCEP/LSE