Mercator Research Institute on
Global Commons and Climate Change

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Options for Carbon Dioxide Removal

Jan C. Minx

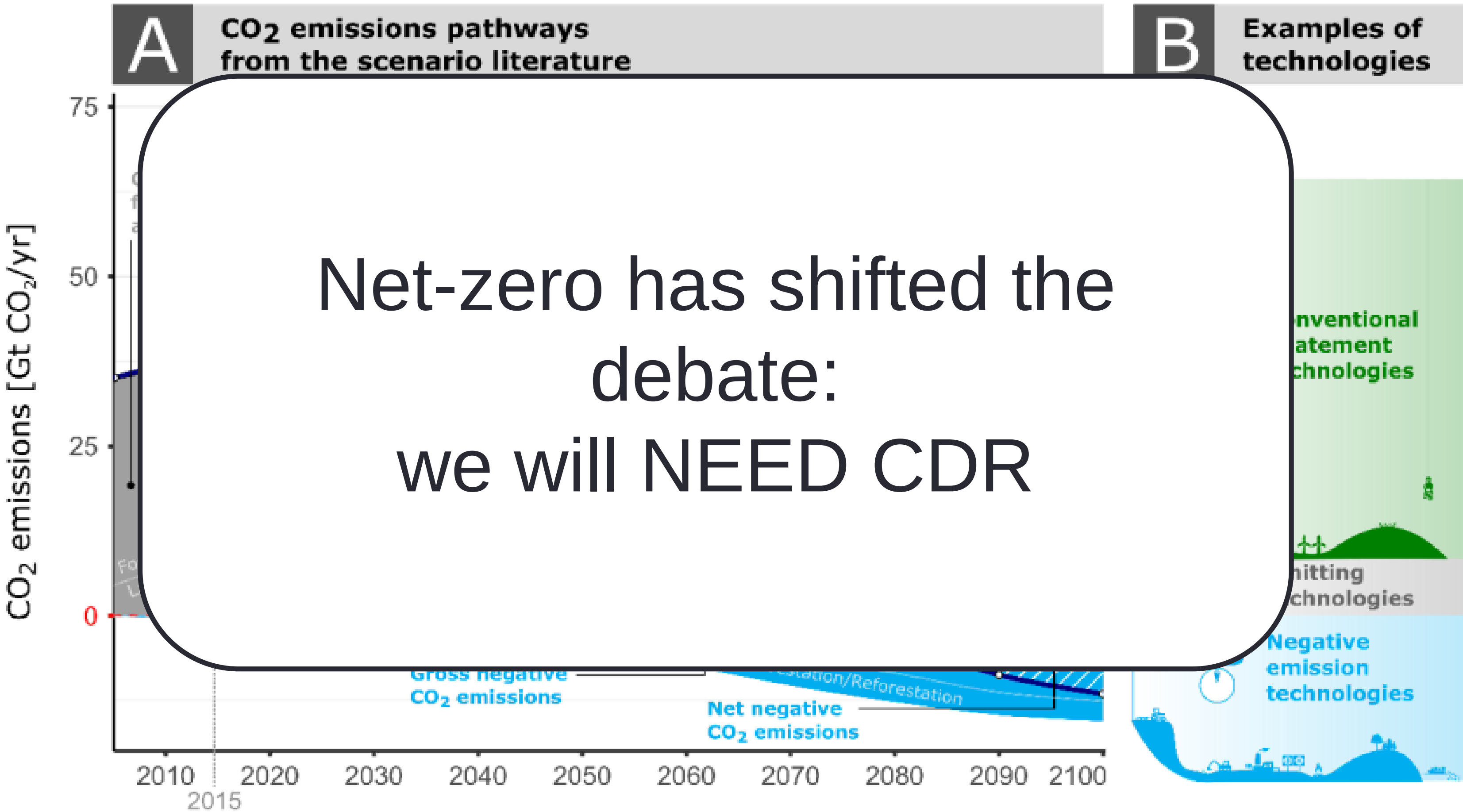
Final Symposium – BMBF-PEP1.5

PIK Potsdam

03.09.2019

CO2removal.org
ASSESSING THE TECHNOLOGIES

Net-zero emissions & carbon dioxide removal



Net-zero has shifted the debate:
we will NEED CDR

Fuss et al. (2018), Negative Emissions – Part 2: Costs, potential and side-effects, *Environ Res Lett.*

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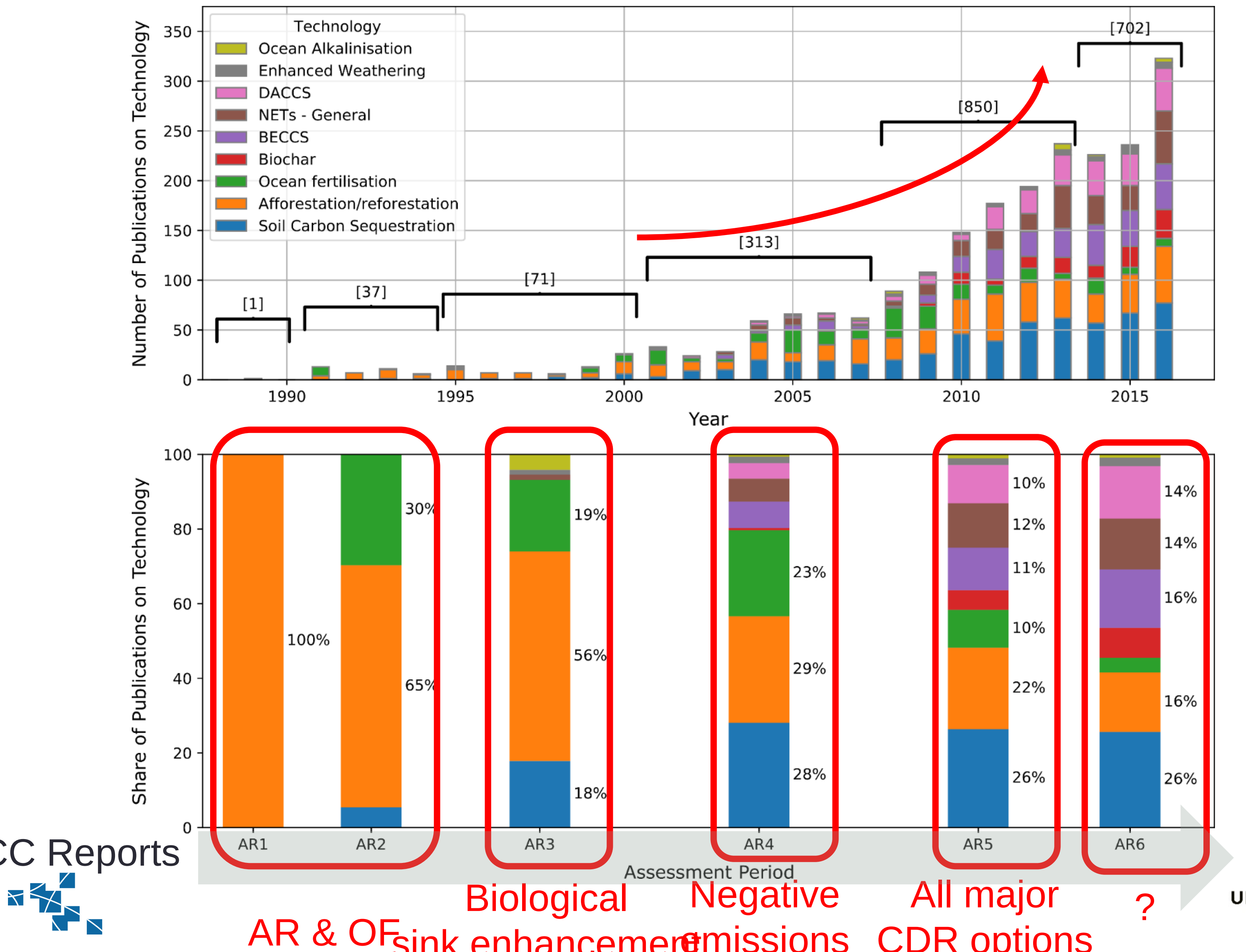
From discussions of individual CDR options towards portfolios



Minx et al. (2018), Negative Emissions – Part 1: Research landscape and synthesis, *Environ Res Lett.*

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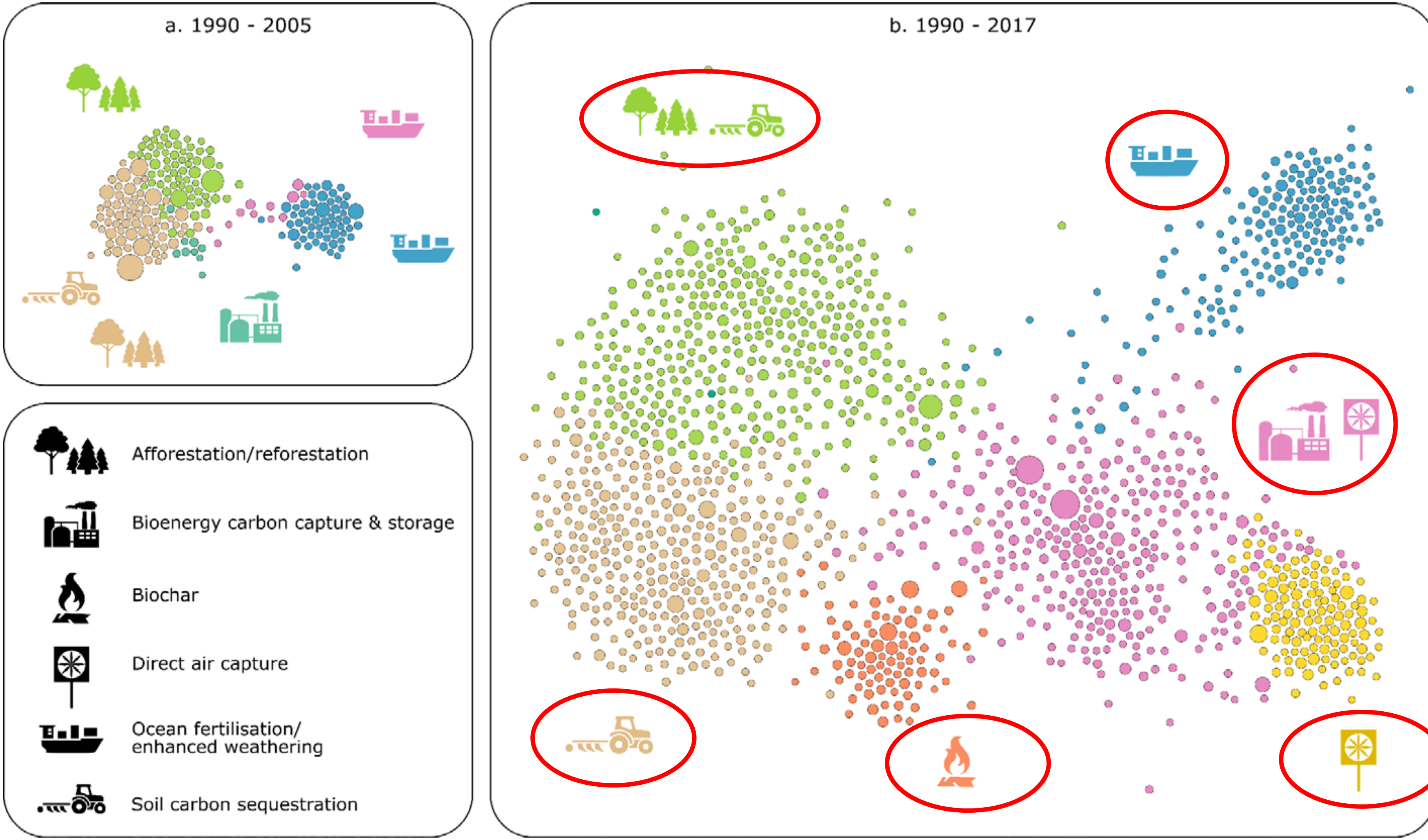
Matured clusters of scientific research around the various CDR options



Minx et al. (2018), Negative Emissions – Part 1: Research landscape and synthesis, *Environ Res Lett.*

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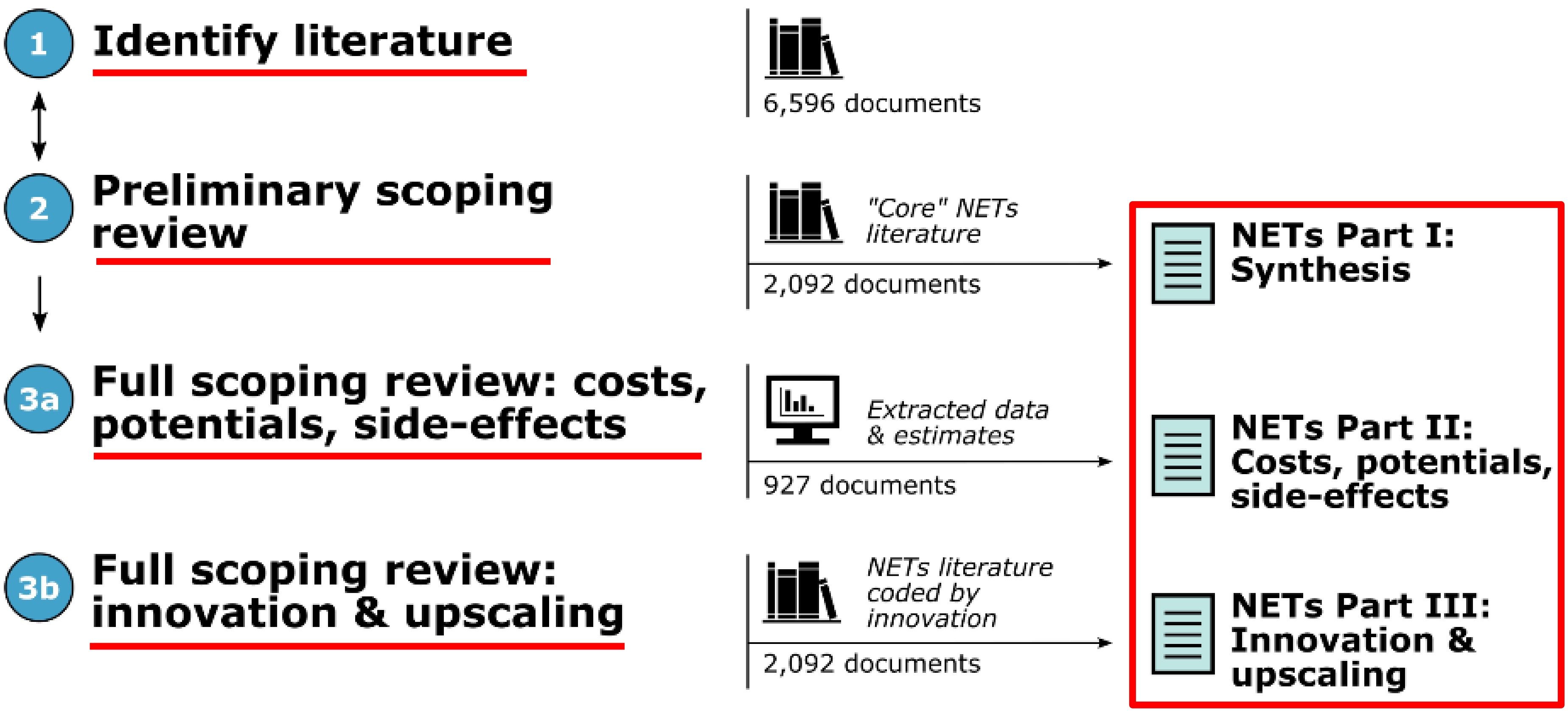
Assessing the CDR space – linking bottom-up and top-down



Minx et al. (2018), Negative Emissions – Part 1: Research landscape and synthesis, *Environ Res Lett.*

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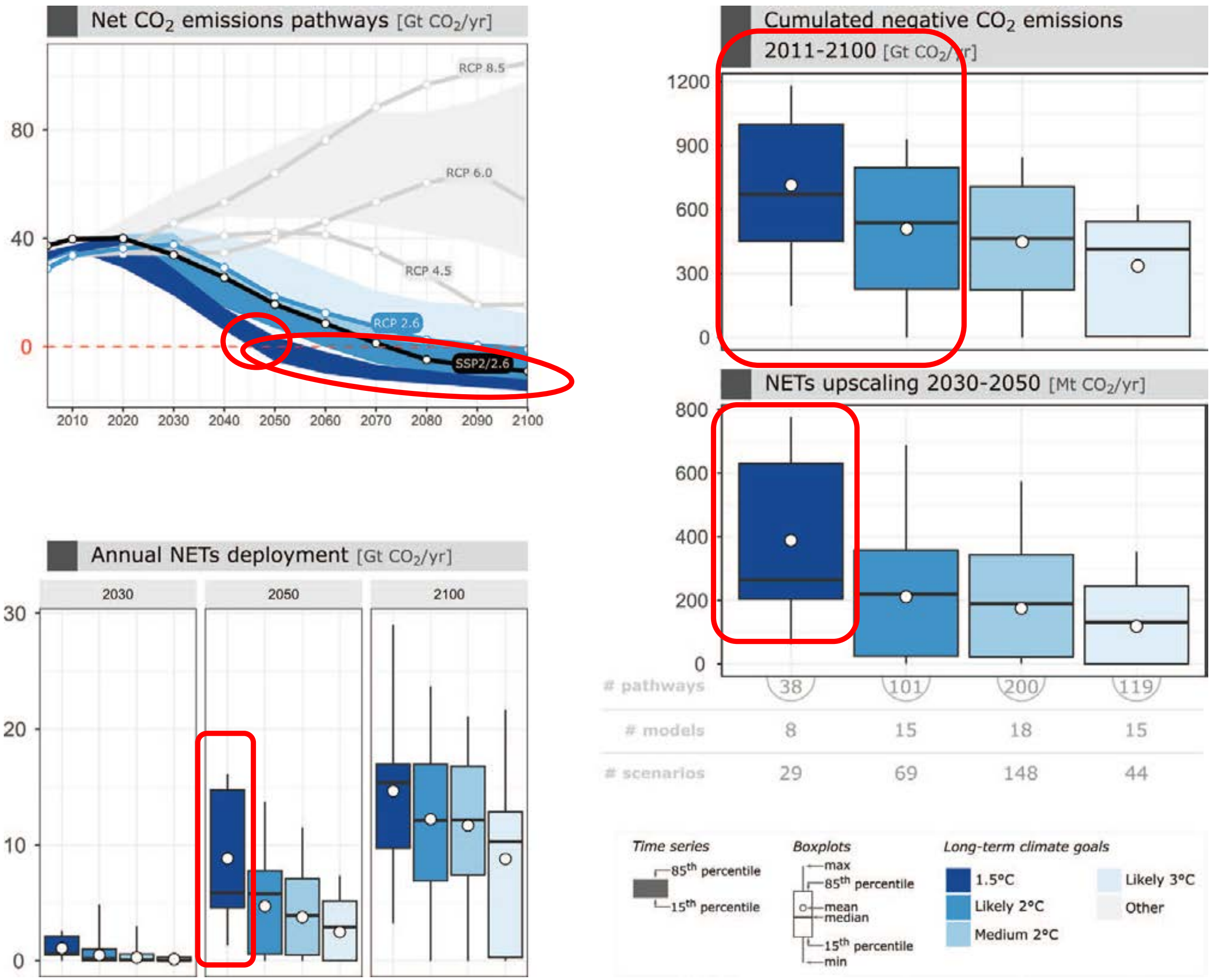
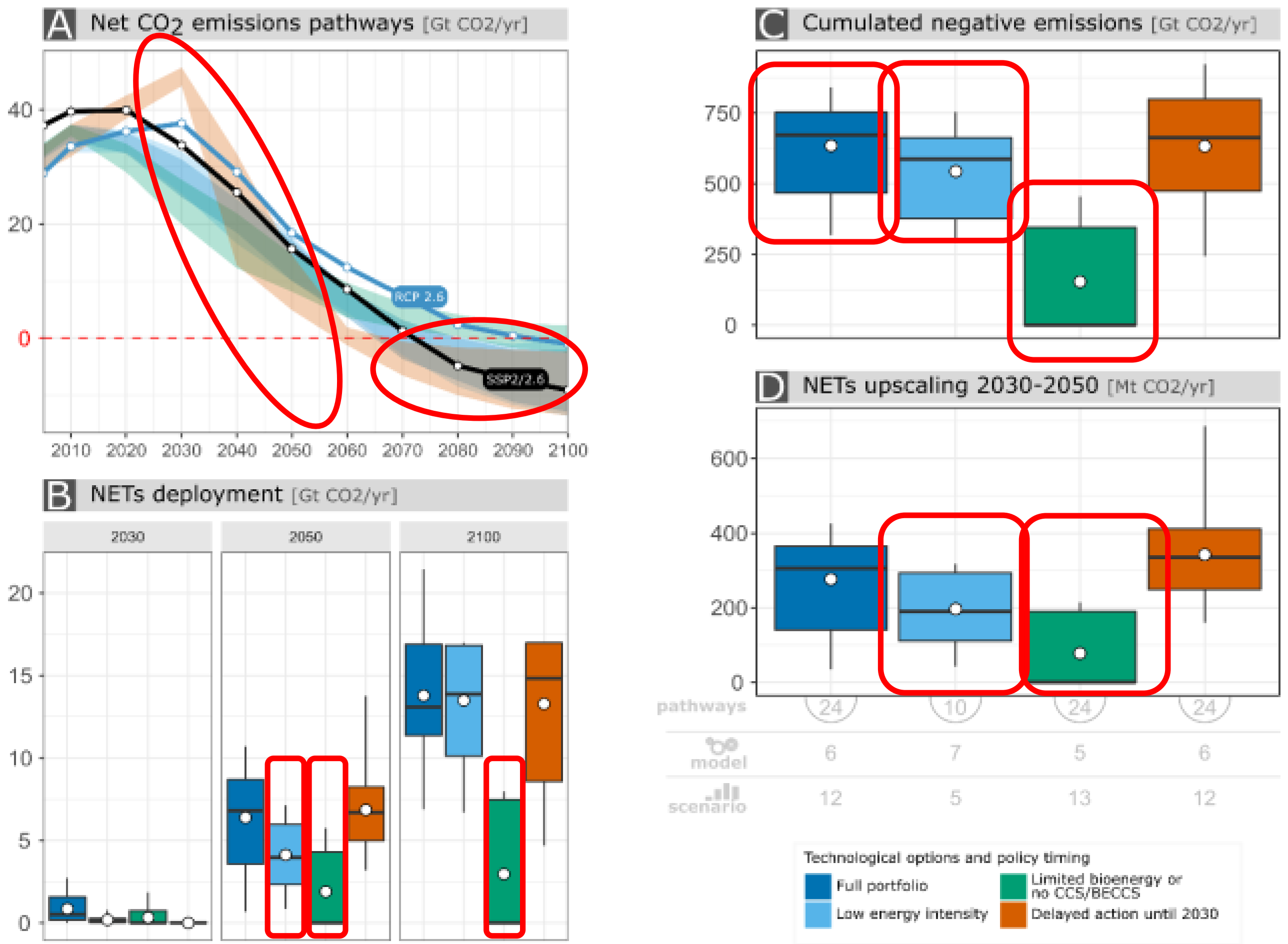
While 1.5°C fundamentally depend on CO_2 removal, this is not the case for 2°C scenarios



- Carbon budget for 1.5°C is small and finite
- Fully decarbonized world economy by 2050 (sharp emissions reductions)
- Sustained period of deep net negative emissions thereafter
- Up to 15Gt of NETs deployment in 2050
- Near-term upscaling substantially faster in 1.5°C scenarios
- All 1.5°C scenario require NETs – not the case for 2°C

Fuss et al. (2018), Negative Emissions – Part 2: Costs, potential and side-effects, *Environ Res Lett.*

NDC trajectory leads to similar dependence on CO_2 removal in 2030 like for 1.5°C limit today



Role of NETs varies in 2°C scenarios, but can still be limited:

- Full tech, immediate action scenarios feature large-scale NETs deployment
- There are scenarios without or limited NETs deployment
- Low energy demand pathway provide additional flexibility for NETs deployment

Fuss et al. (2018), Negative Emissions – Part 2: Costs, potential and side-effects, *Environ Res Lett.*

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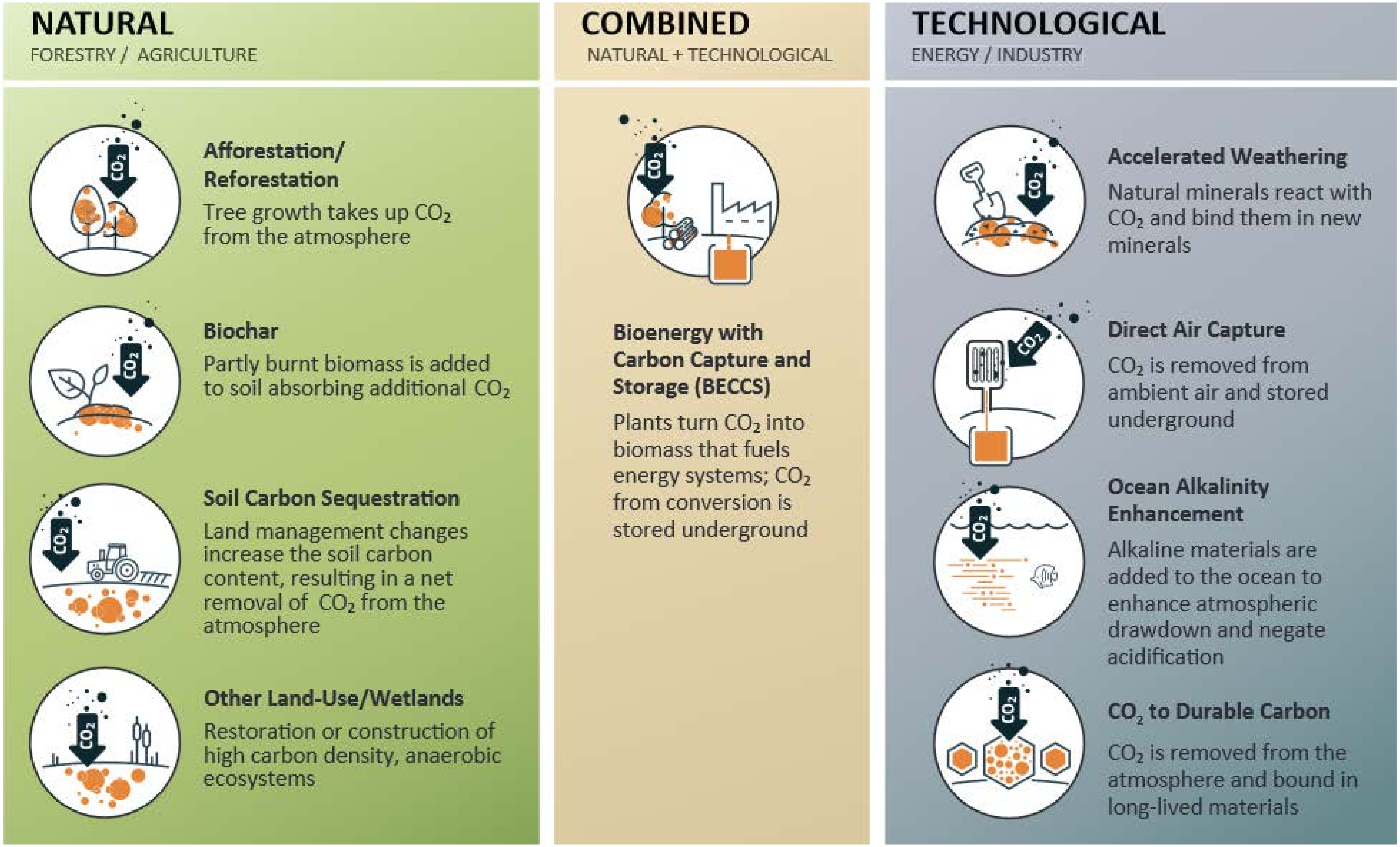
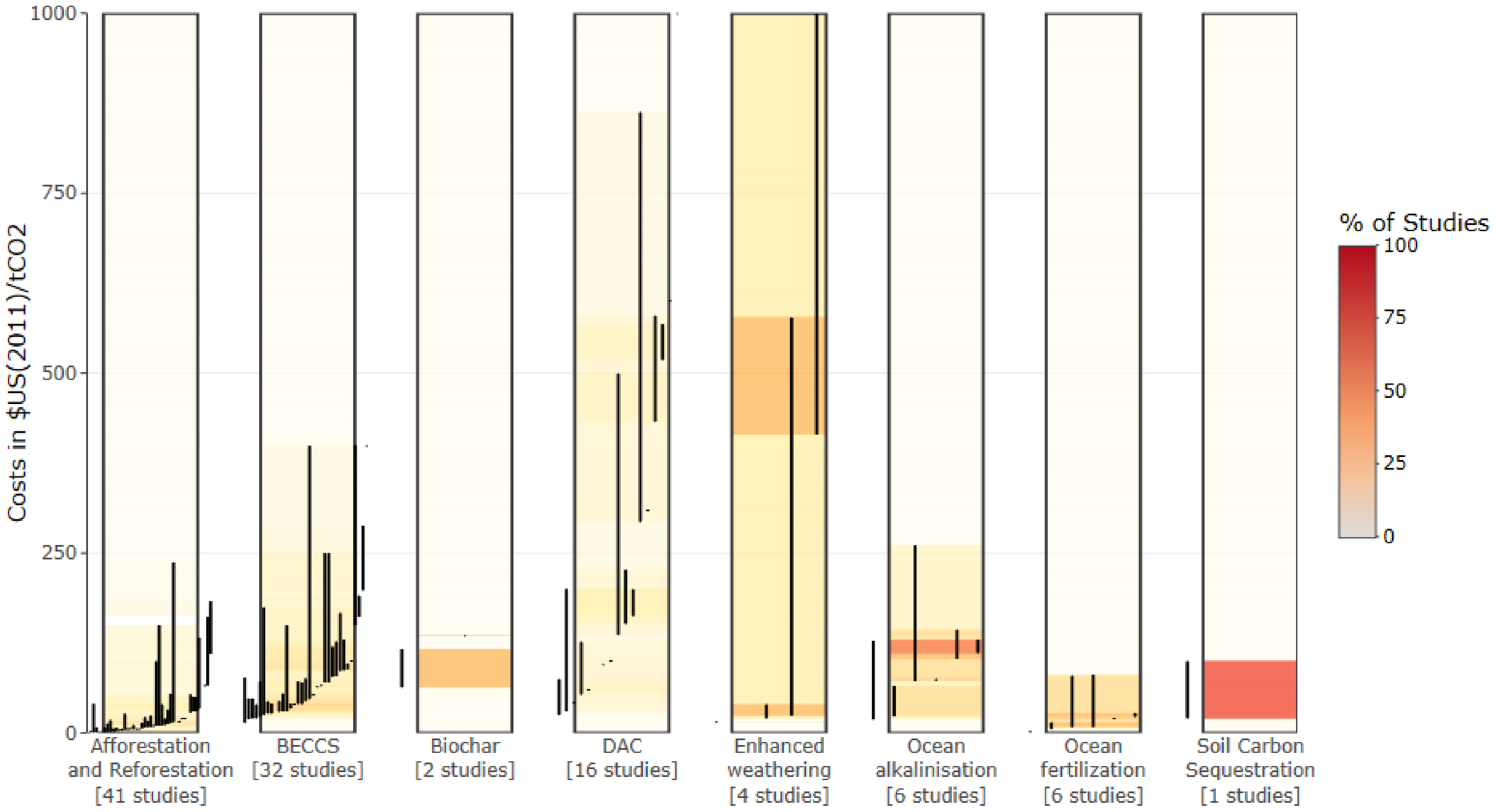
While the recent discussions have mainly focussed on BECCS, the spectrum of options is large



UN Environment (2017), The Emissions Gap Report 2017

Costs (US$/ton CO2 in 2050)



Fuss et al. (2018), Negative Emissions – Part 2: Costs, potential and side-effects, *Environ Res Lett.*

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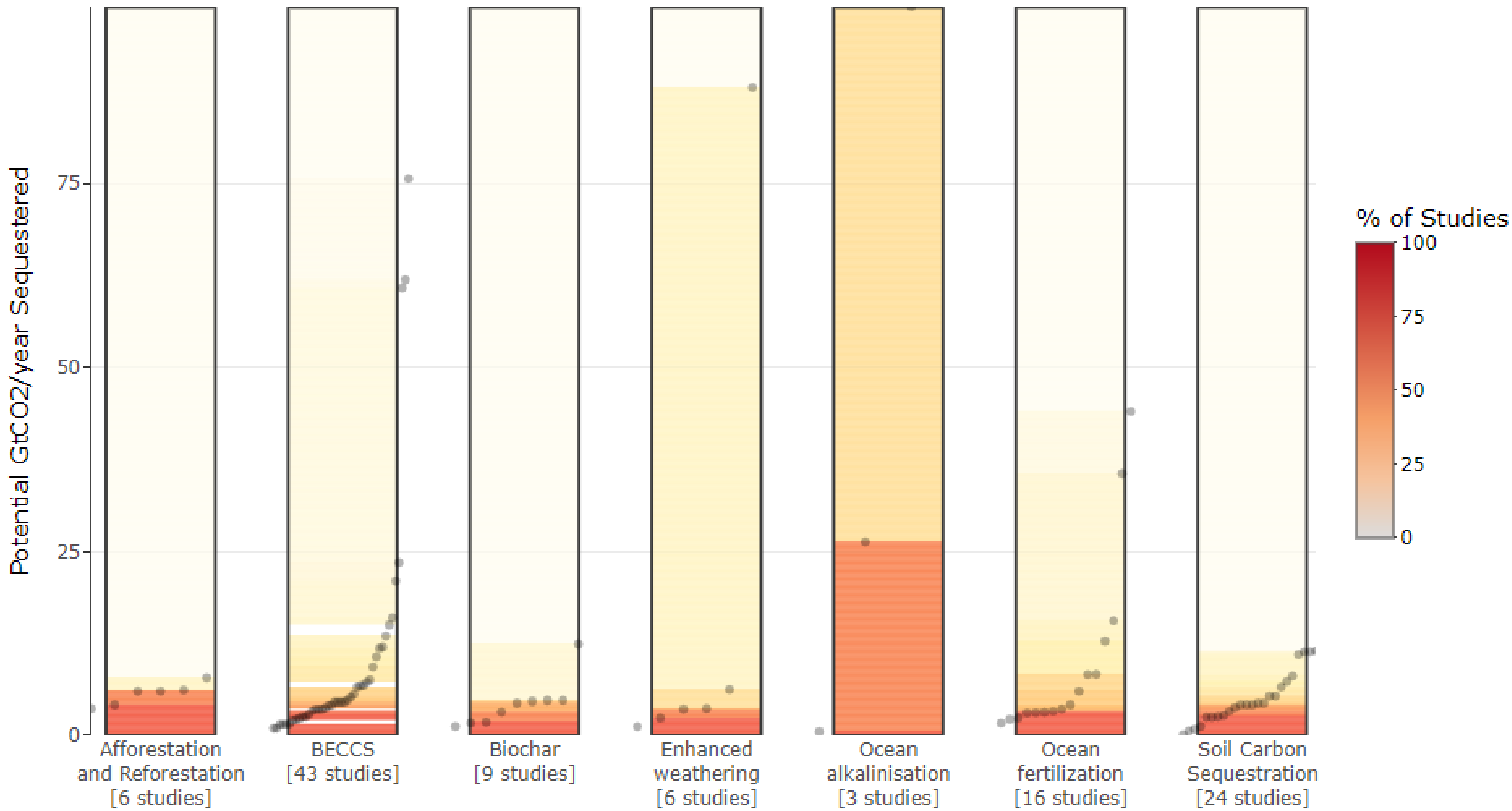
Non-additive potentials (Gt CO2/year in 2050)



Fuss et al. (2018), Negative Emissions – Part 2: Costs, potential and side-effects, *Environ Res Lett.*

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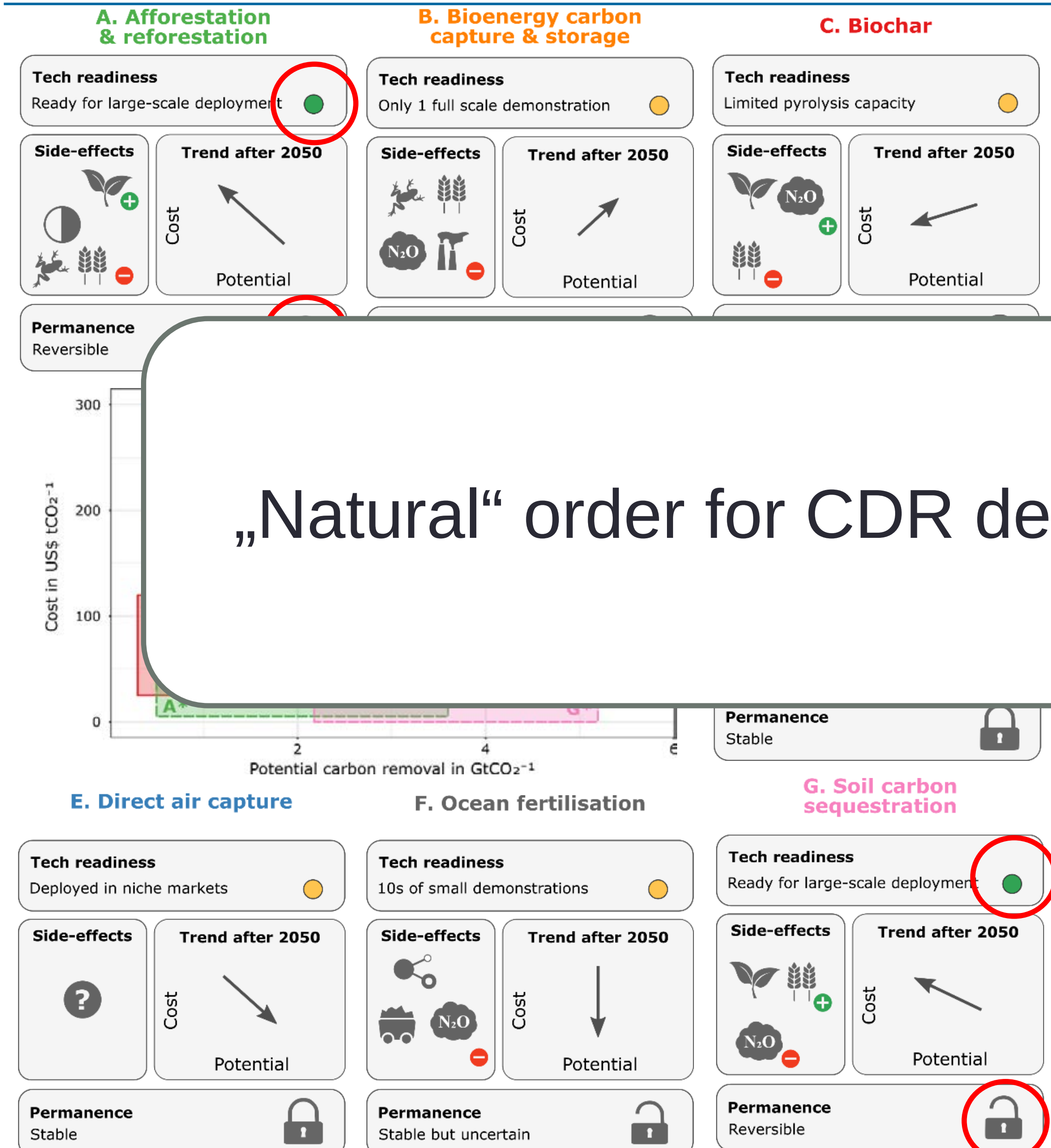
Most CDR options show relevant potentials, but all have limits



„Natural" order for CDR deployment?

- Relevant potentials for all CDR options, except ocean fertilization
- Potentials are all constrained by bio- … omic … t additive … n unlikely … tentials … y … nably … tiple CDR otpions, each deployed at modest scales can hedge risks and seem more realistic
- Important differences in development status and secure CO_2 storage

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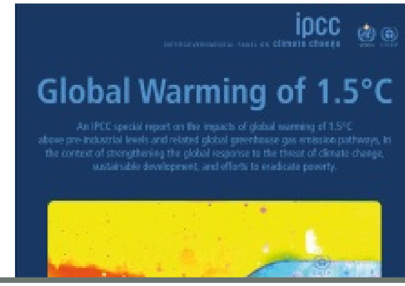
Evidence synthesis is a lot of work - but it is worth it!

- Prominently picked up by recent climate change assessments
- A serie
  publi
- Large
  reque
  Gove
  Commons, Royal Society,
  German NGOs, etc.
- Wide media-coverage
- Triggered German Roundtable on Negative Emissions



Need to organise synthesis process for AR6!


MMENT

Weigh the ethics of plans to mop up carbon dioxide

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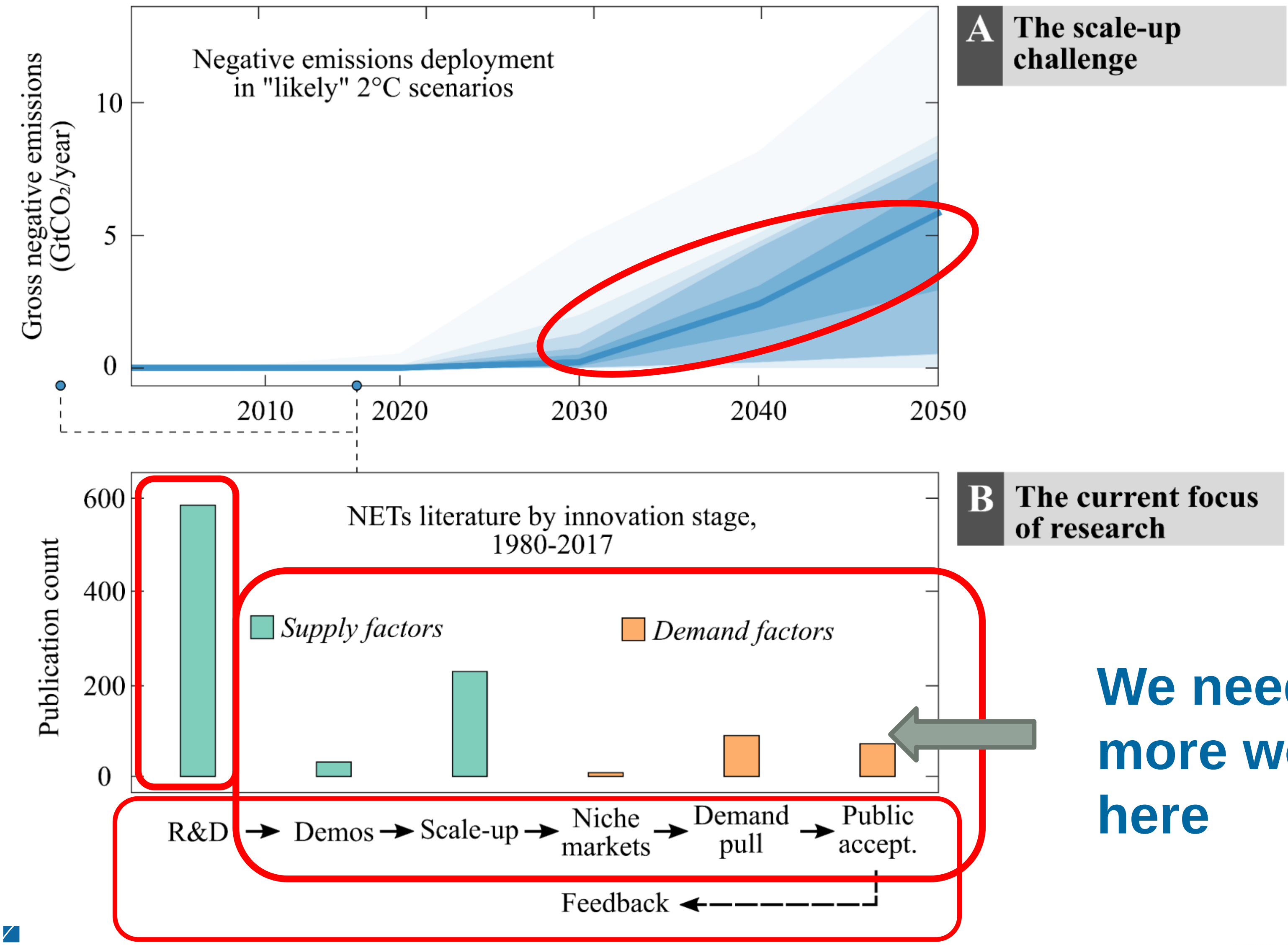
Technological transitions often take time! Urgency in developing CDR portfolios



We need more work here

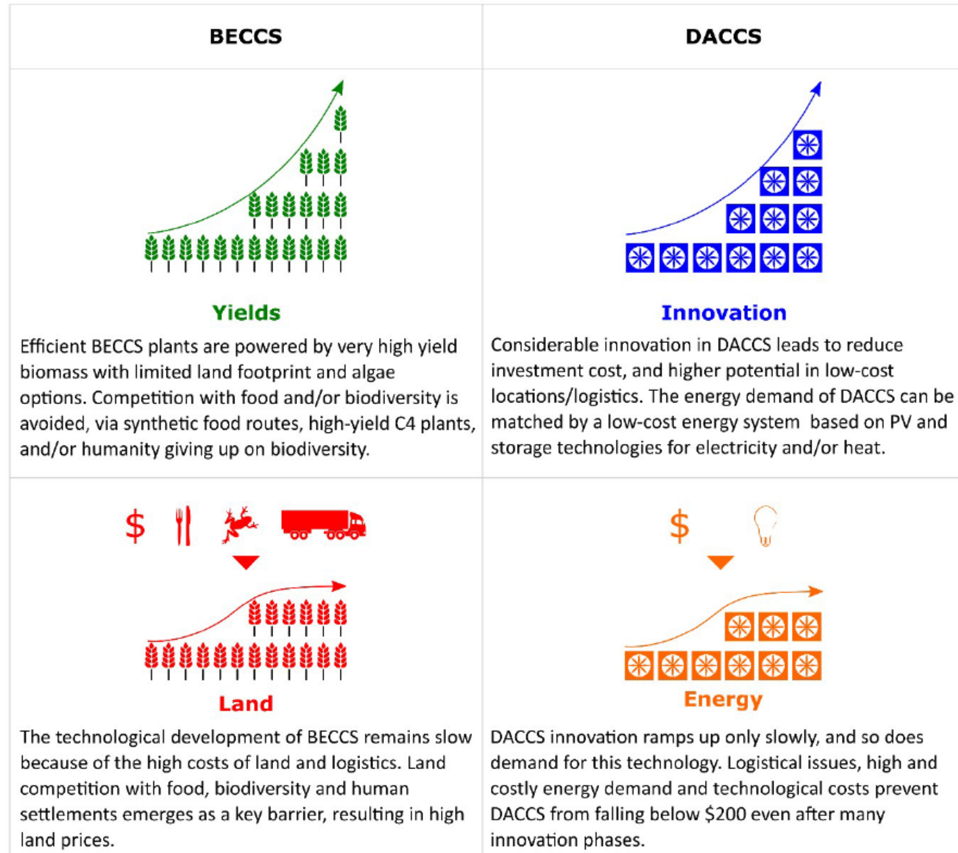
Nemet et al. (2018), Negative Emissions – Part 3: Innovation and upscaling, *Environ Res Lett.*

The need for acceleration in innovation and diffusion of CDR technologies

Minx and Nemet (2018), The inconvenient truth about carbon capture, *Washington Post;*
Figure by William Lamb (MCC)

Requirement to spell out development paths

Innovation archetype	Technology role model	CDR analogue
High-tech, iterative disruptive	PV	DAC
Low-tech, small, distributed	Green revolution	Soil carbon sequestratio n
Large, system integration intensive	Chemical plants	BECCS



Nemet (2019), How solar energy became cheap, Routledge; Creutzig et al. (2019), The mutual dependence of negative emissions technologies and energy sytsems, *Energ Environ Sci*

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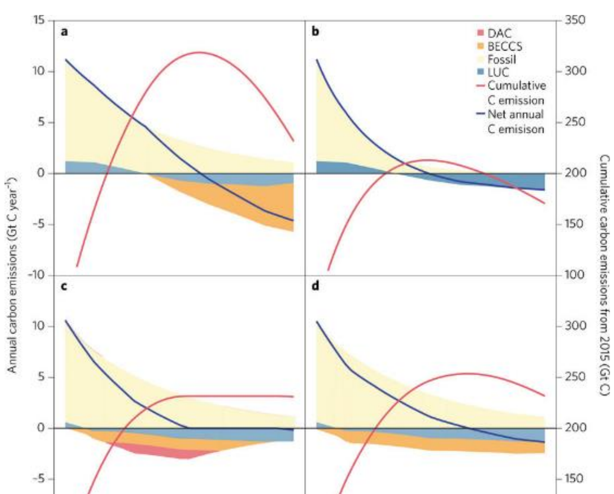
Major avenues for research



- Closing the innovation gap – accelerating development and diffusion
    - Models of innovation for CDR
    - Public perceptions
    - Policy design & instruments
- Learning about the CDR policies & governance
    - Evidence synthesis
    - Ex-post policy assessments
    - Policy design & instruments
    - Governance
- CDR portfolios & pathways and their risks
    - Scenario analysis from differ
    - Political economy & socio-technical transitions
    - Evidence synthesis: co-benefits & risks

Take away messages

- **CDR has arrived in policy - growing understanding that CDR is essential for meeting climate goals – net zero fundamental**
- **There are more technologies available than BECCS with relevant potentials.**
  - Potentials are all constrained by bio-physical or economic limits.
  - Any single CDR option unlikely to provide the potentials observed in many scenarios sustainably: Portfolios of multiple NETs, each deployed at modest scales seem more realistic.
- **There is a large gap between CDR upscaling in scenarios and in reality.**
  - Limiting dependence on CDR through a rapid scale-up of short-term action
- **Concerted, community driven research agenda needed around policy, governance and innovation and linkage to scenarios work**

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Thanks!

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MCC was founded jointly by Stiftung Mercator and the Potsdam Institute for Climate Impact Research

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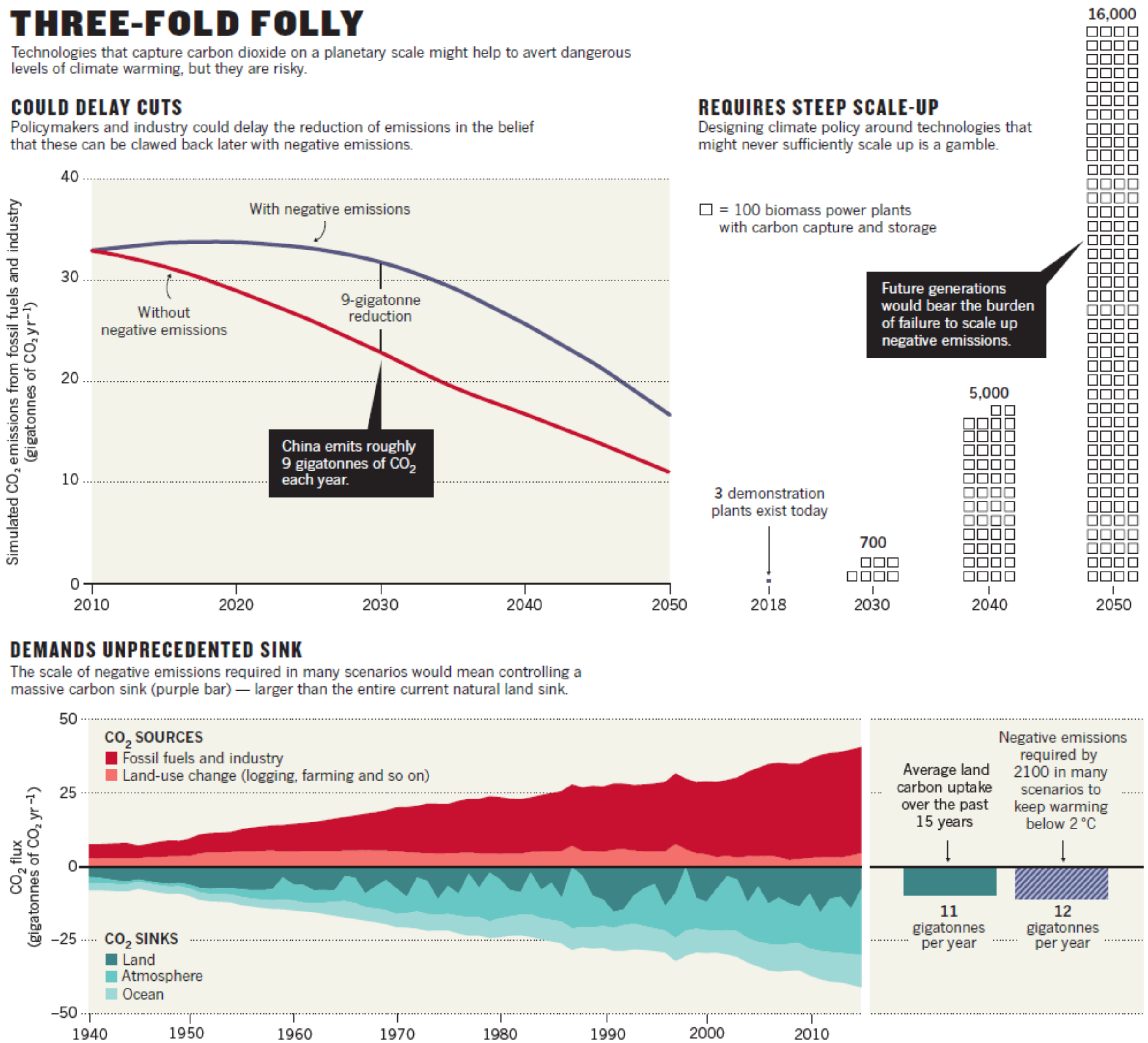
Things to work towards in AR6

- Clear home for CDR synthesis & common approach across chapters (sound top-down/ bottom-up link)
- Clear conceptual framing around net-zero that takes into account related discourses such as committed carbon

Insufficient ethical discussion around CO_2 removal



Lenzi et al. (2018), Weigh the ethics of plans to mop up carbon dioxide, *Nature*

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