POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH

tCDR – A Climate Policy Wager?
Terrestrial CO_2 Removal: Potentials and tradeoffs in the SDG context

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Leibniz Gemeinschaft

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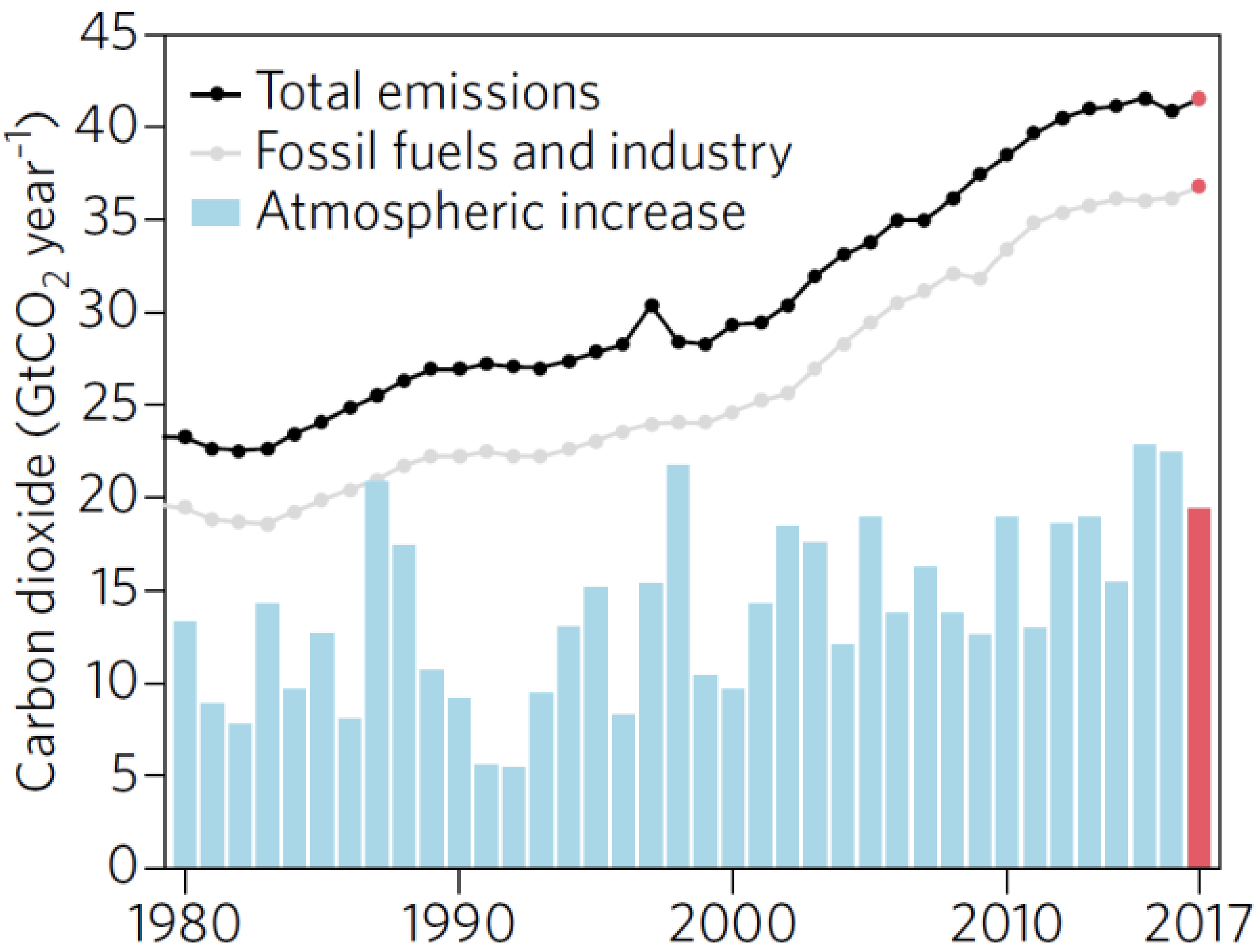
Overview

- The Challenge
- The role of negative emissions in mitigation pathways
- The Coal Question
- Moral Hazard, Hedging and CDR
- Policy Options

Emissions are rising.



Source: Peters et al. (2017)

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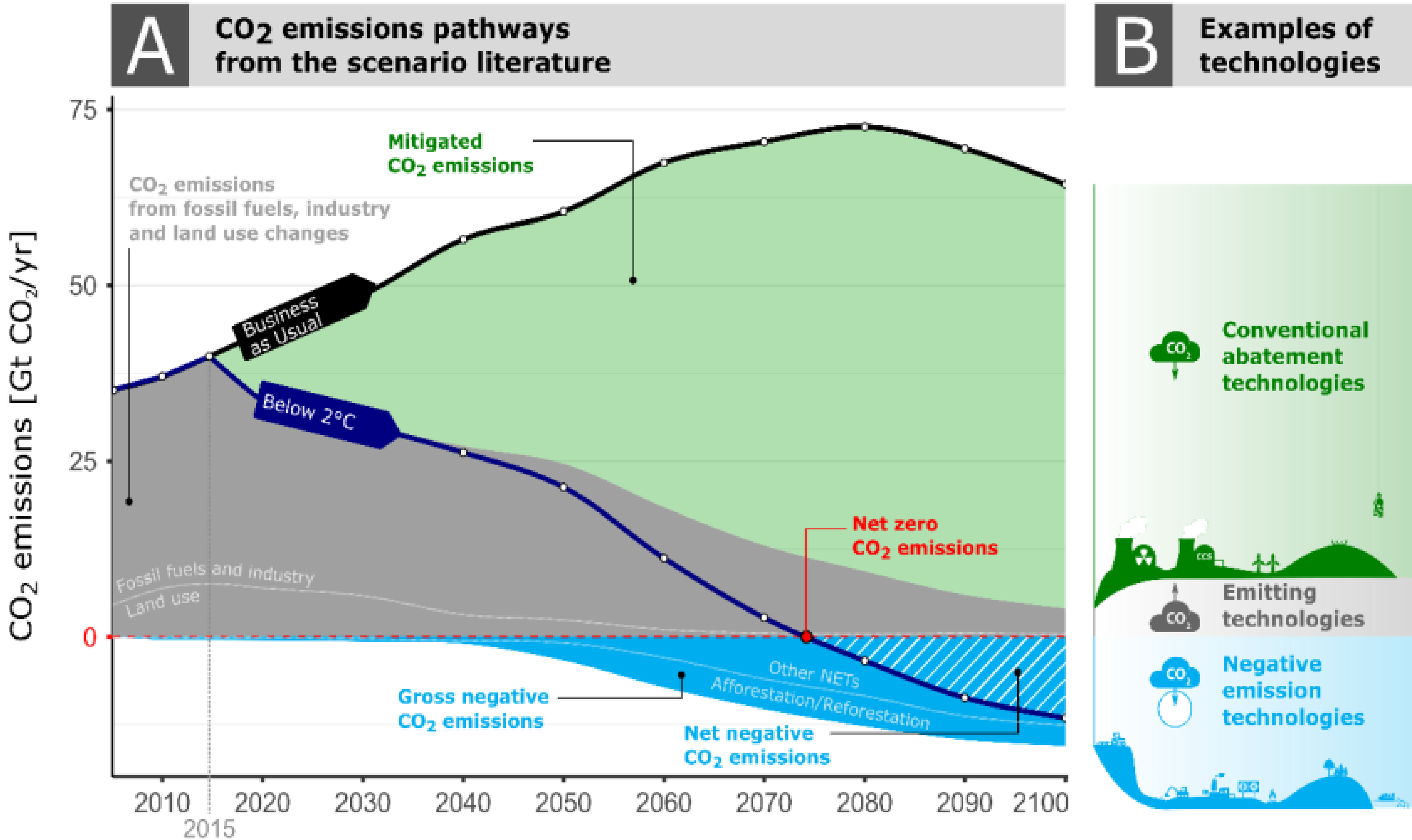
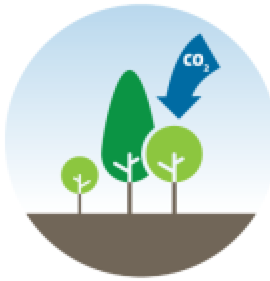
NETs used to compensate for atmospheric overshoot and residual emissions

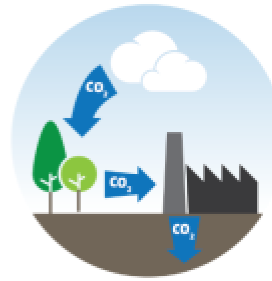


Fuss et al (under review)

NETs comprise a wealth of different methods



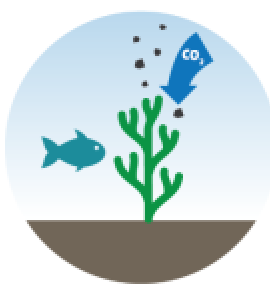
Afforestation and reforestation
Additional trees are planted, capturing CO_2 from the atmosphere as they grow. The CO_2 is then stored in living biomass.



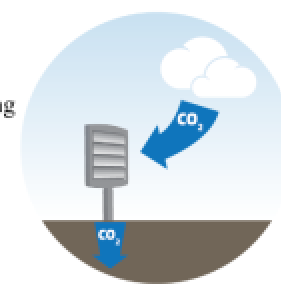
Bioenergy with carbon capture and sequestration (BECCS)
Plants turn CO_2 into biomass, which is then combusted in power plants, a process that is ideally CO_2 neutral. If CCS is applied in addition, CO_2 is removed from the atmosphere.

Biochar and soil carbon sequestration (SCS)
Biochar is created via the pyrolysis of biomass, making it resistant to decomposition; it is then added to soil to store the embedded CO_2. SCS enhances soil carbon by increasing inputs or reducing losses.

Enhanced weathering
Minerals that naturally absorb CO_2 are crushed and spread on fields or the ocean; this increases their surface area so that CO_2 is absorbed more rapidly.



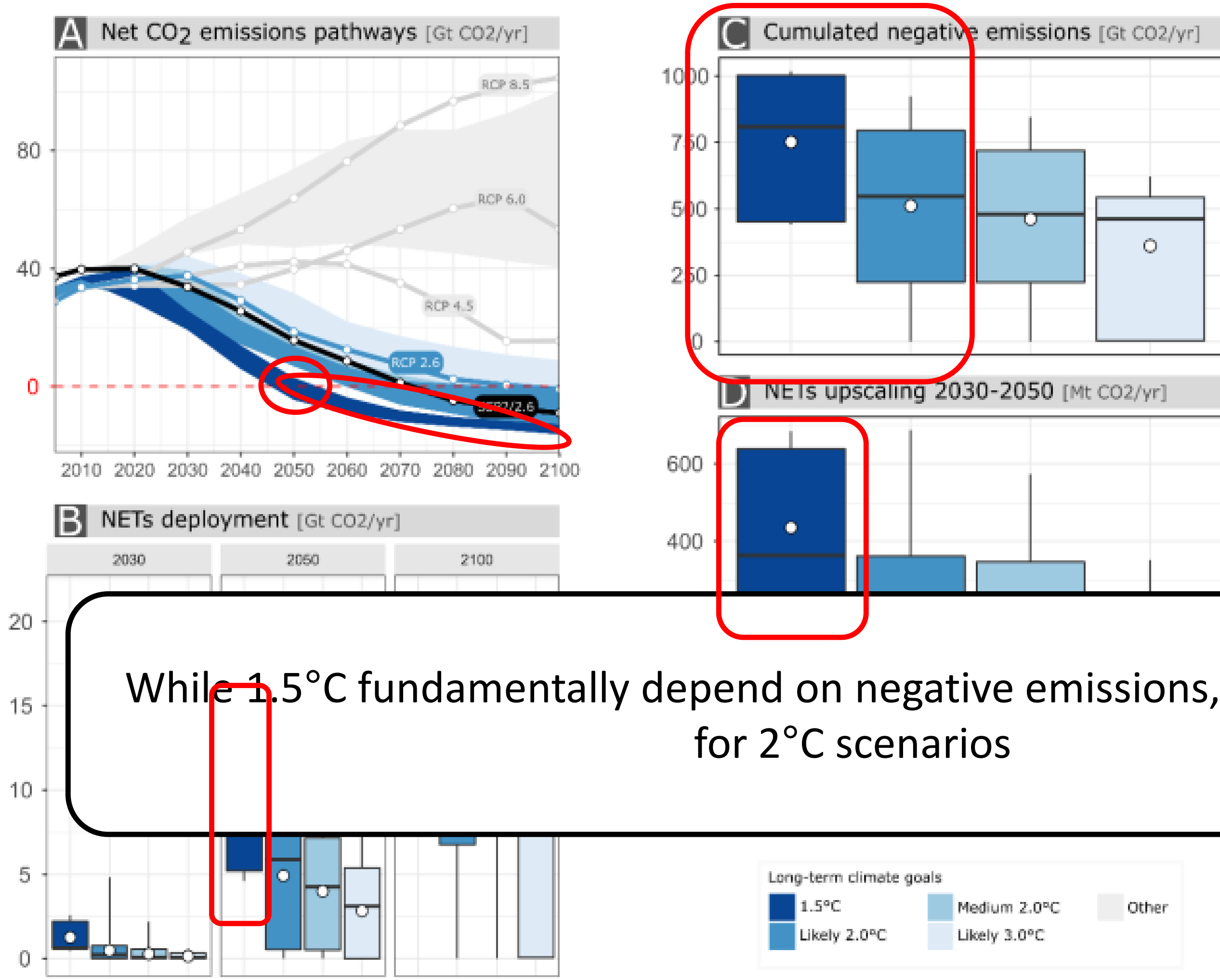
Ocean fertilization
Iron or other nutrients are applied to the ocean, stimulating phytoplanton growth and increasing CO_2 absorbtion. When the plankton die, they sink to the deep ocean and permanently sequester carbon.



Direct air capture (DAC)
Chemicals are used to absorb CO_2 directly from the atmosphere, which is then stored in geological reservoirs.

Minx et al. (2017)

NETs play a distinct role in 1.5°C scenarios: on geophysical requirements and economic attractiveness



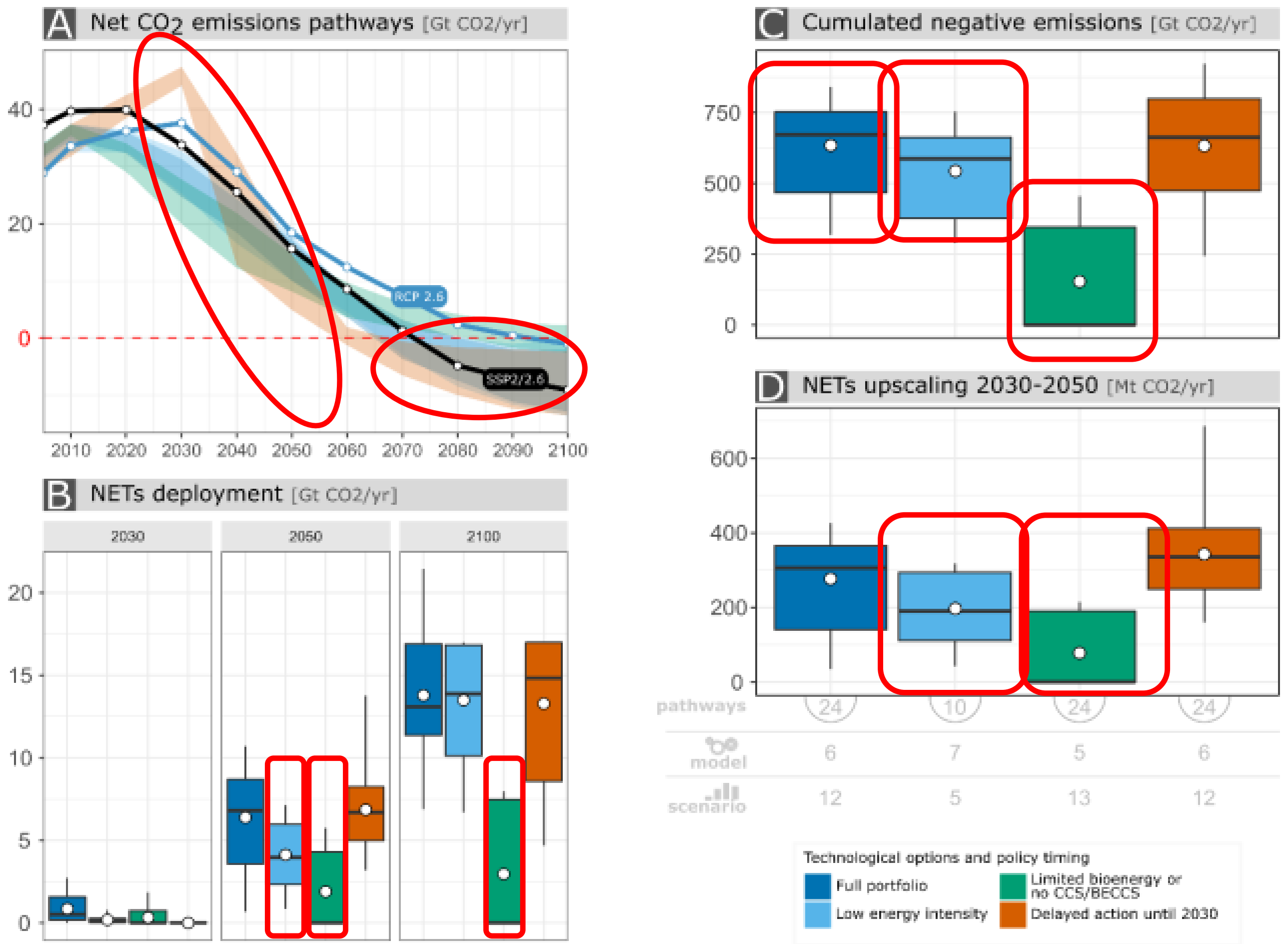
Charateristics of 1.5°C scenarios

- Fully decarbonized world economy by 2050 (sharp emissions reductions)
- Sustained period of deep negative emissions thereafter

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

Fuss et al. (under review)

Role of NETs varies in 2°C scenarios – NETs can still be limited in many cases

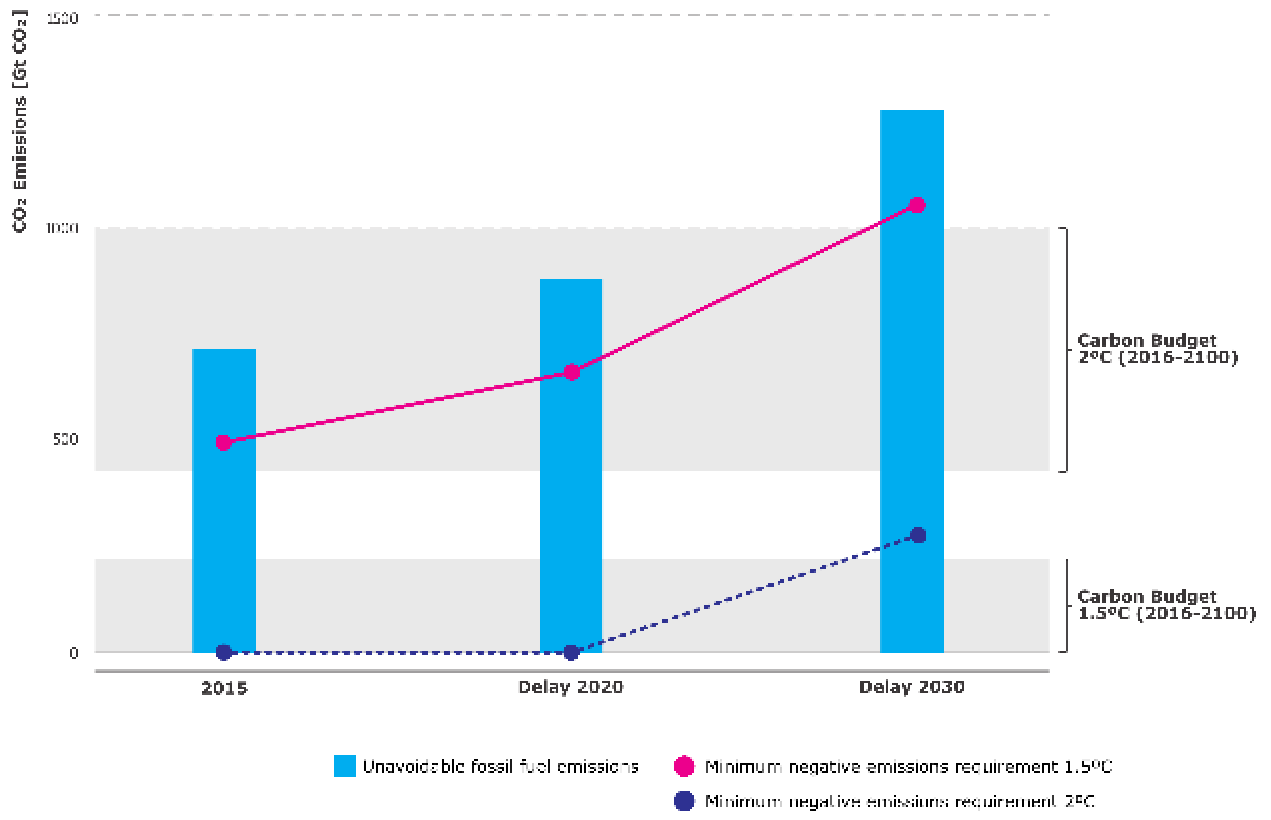


Important distinctions for 2°C scenarios:

- 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
- NDC trajectory poses similar challenges in 2030 like 1.5°C world today

Fuss et al. (under review)

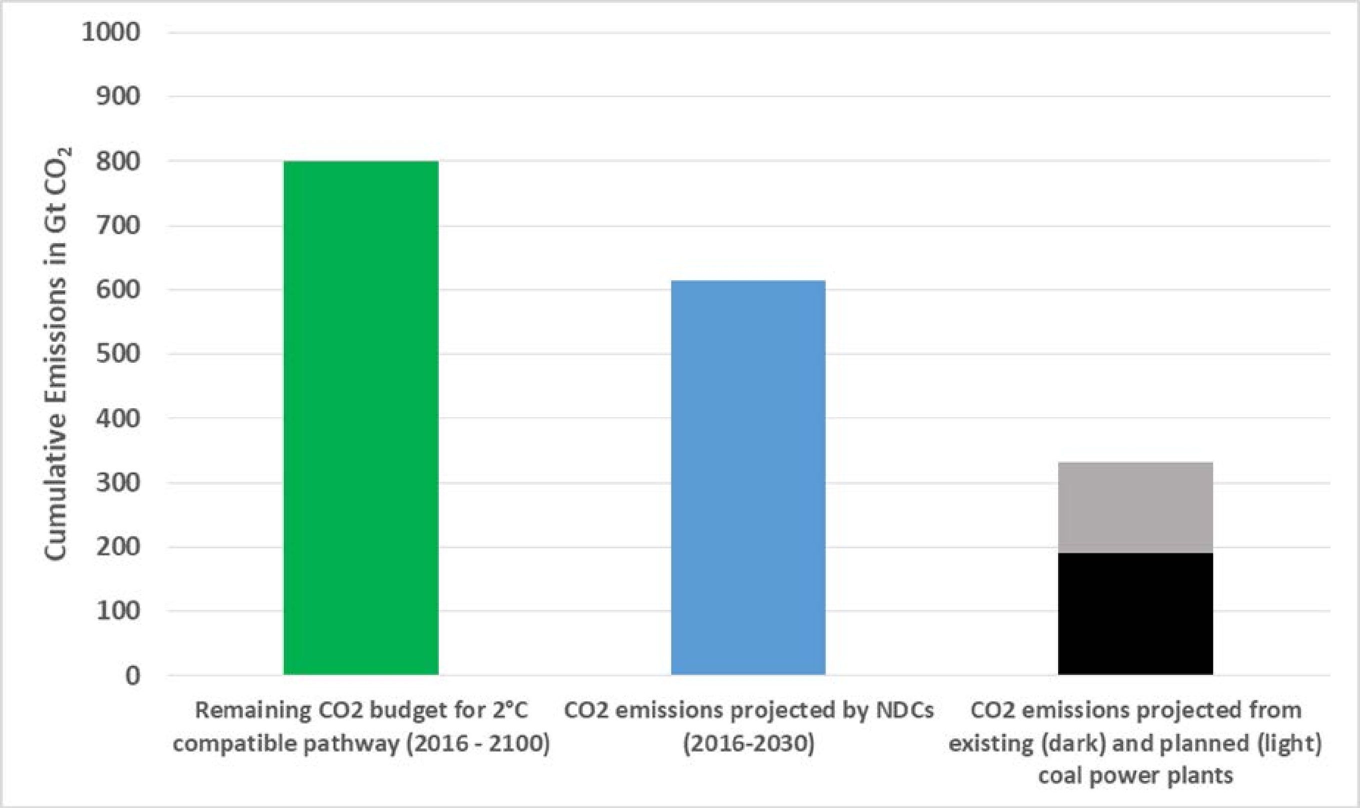
How much NETs do we really need to meet the climate goals?



Minx et al. (under review)

The 2°C budget does not leave any leeway.

Cheap and abundant coal is the driver of a „re-carbonisation“ of the energy system in some parts of the world



*All budgets are are subject to considerable uncertainty, see Edenhofer et al. (2017)

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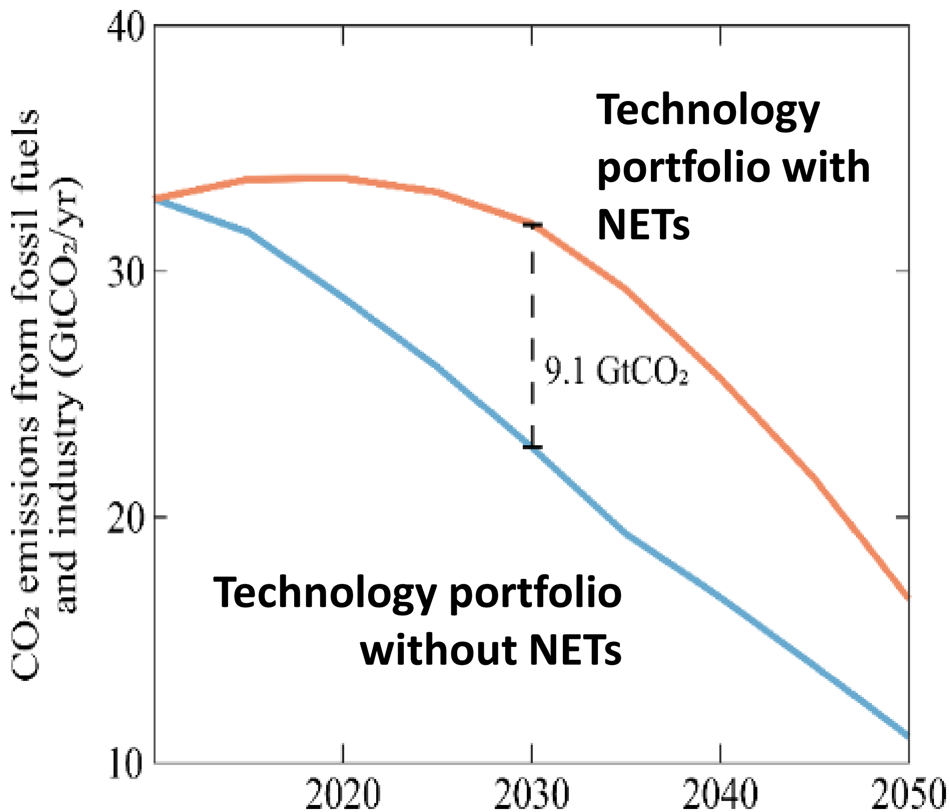
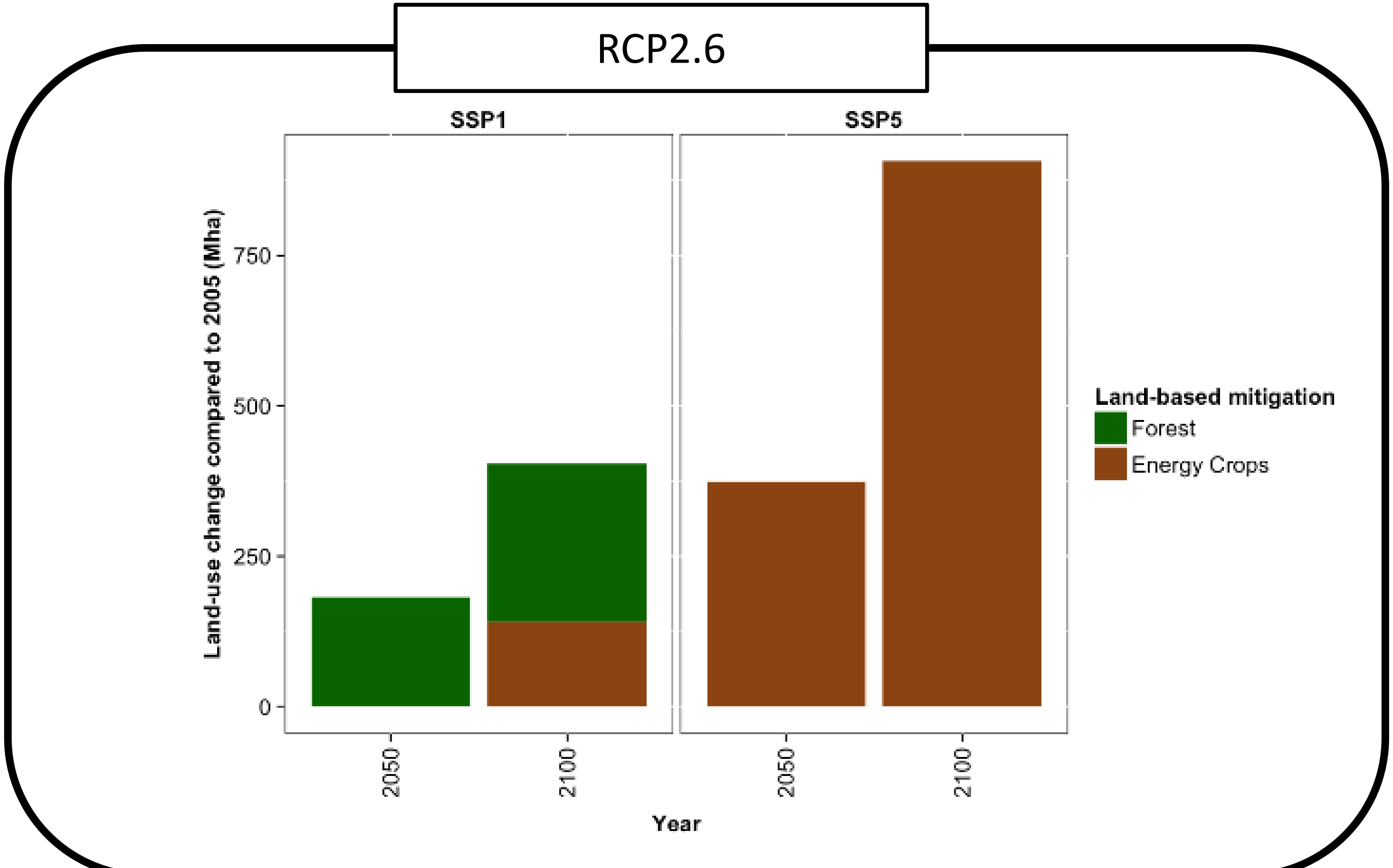
A self-fulfilling prophecy?
Introducing NETs in mitigation scenarios obstructs immediate emission reductions.



Minx et al. (under review)

Need for land...

- 5 billion hectares (approximately 40% of the land surface) is under agricultural use (potentially increasing in the future).
- Additional land-use pressure to be expected from land based CDR options.



based on Popp et al. 2016; GEC

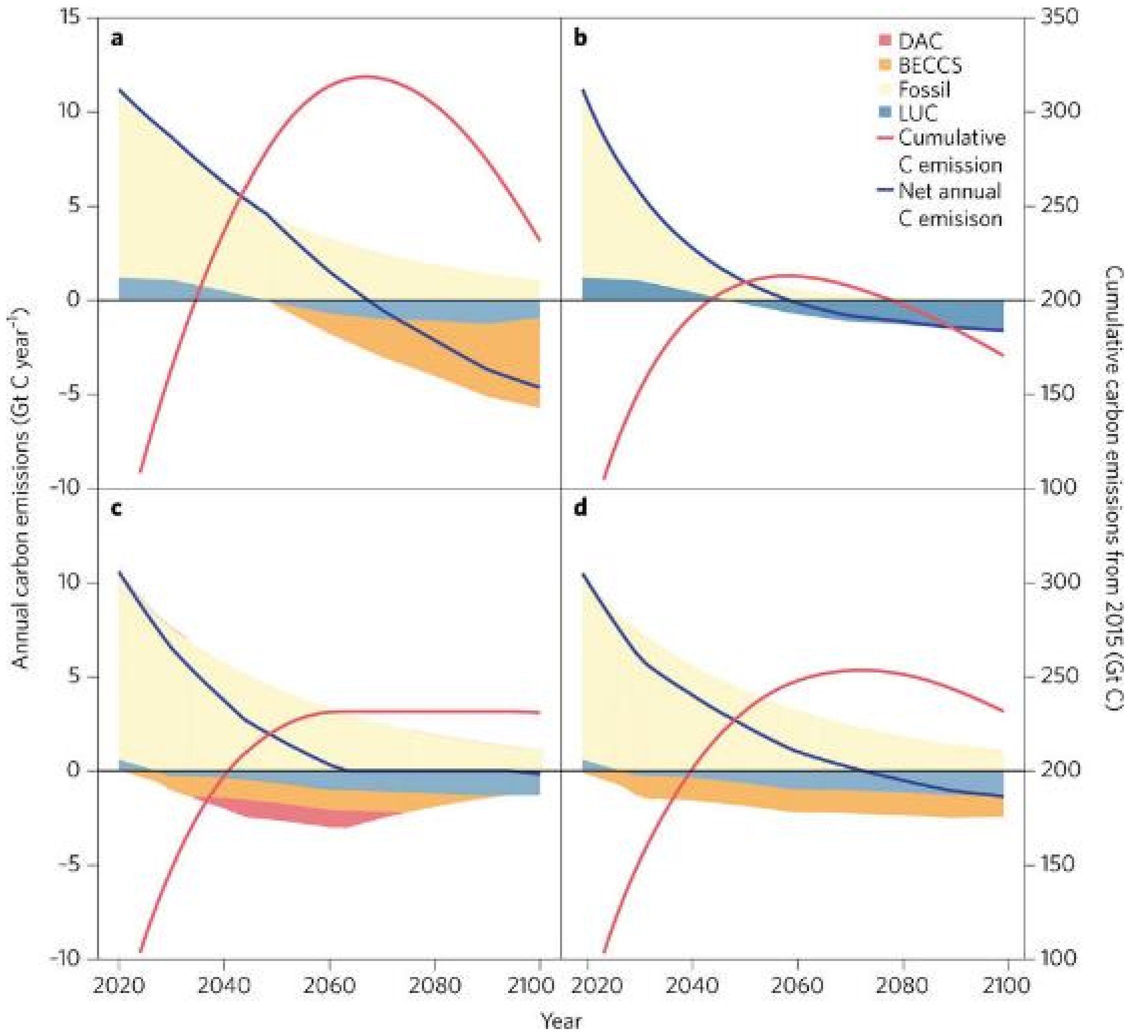
There are different ways how NETs can be used, but not all are equally well understood

Late century NETs

Rapid decarbonization

No overshoot

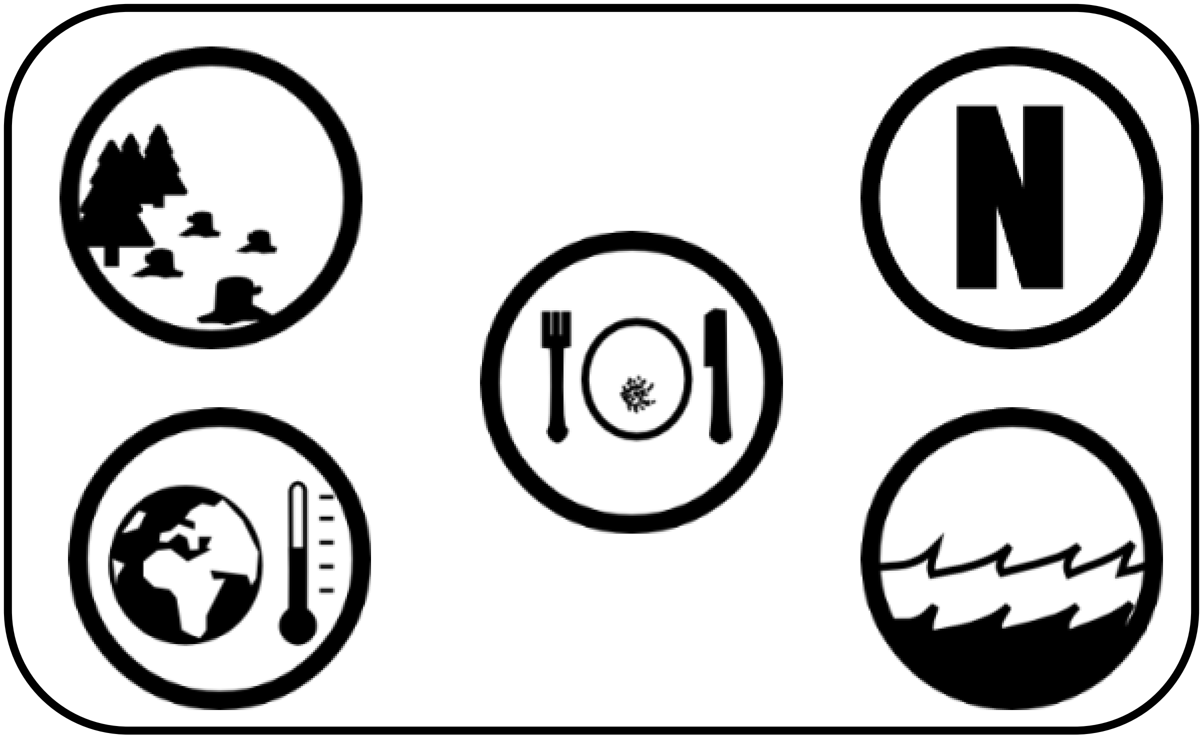
Minimize NETs



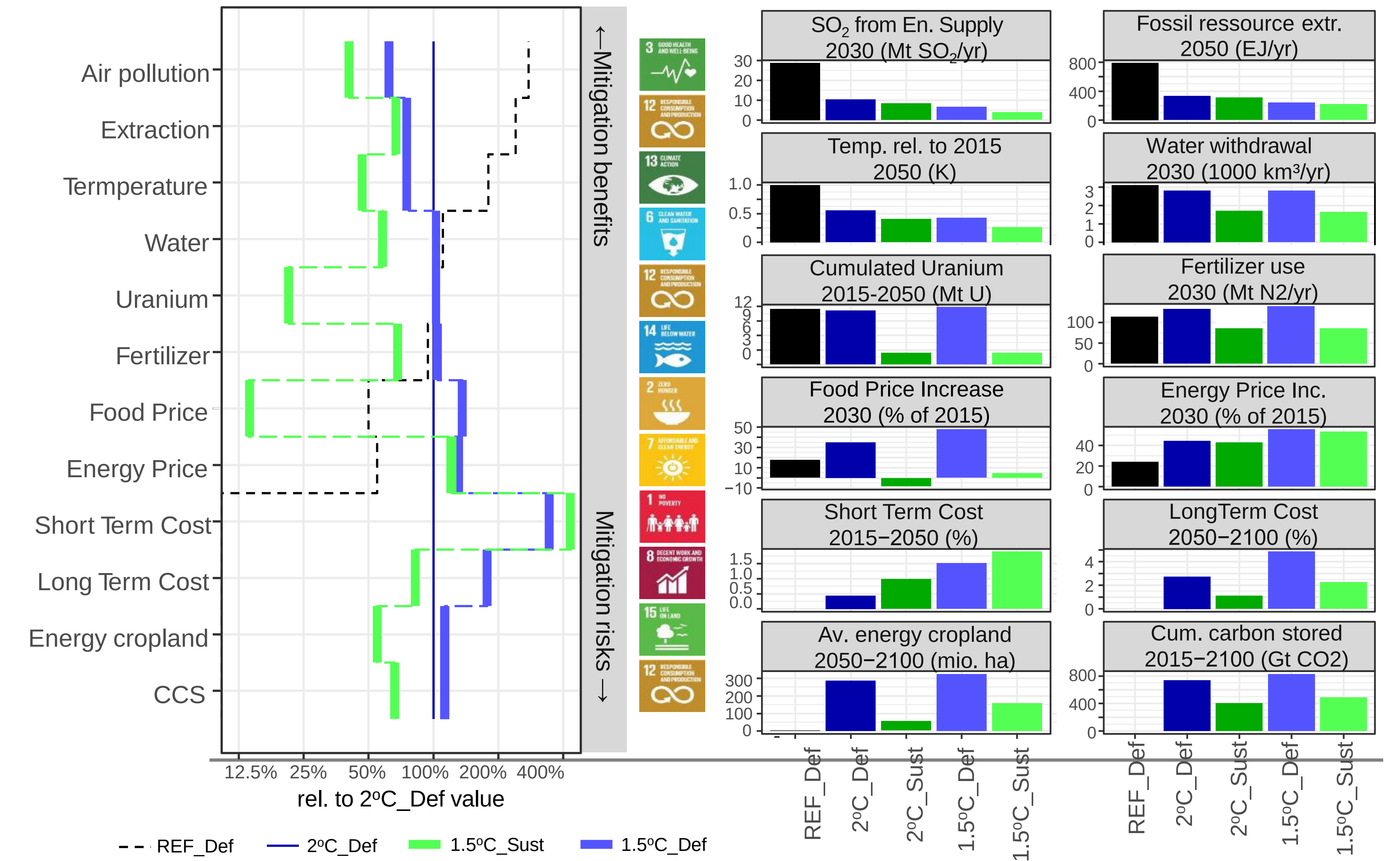
Obersteiner et al. (2018)

Potential externalities of land-based CDR:

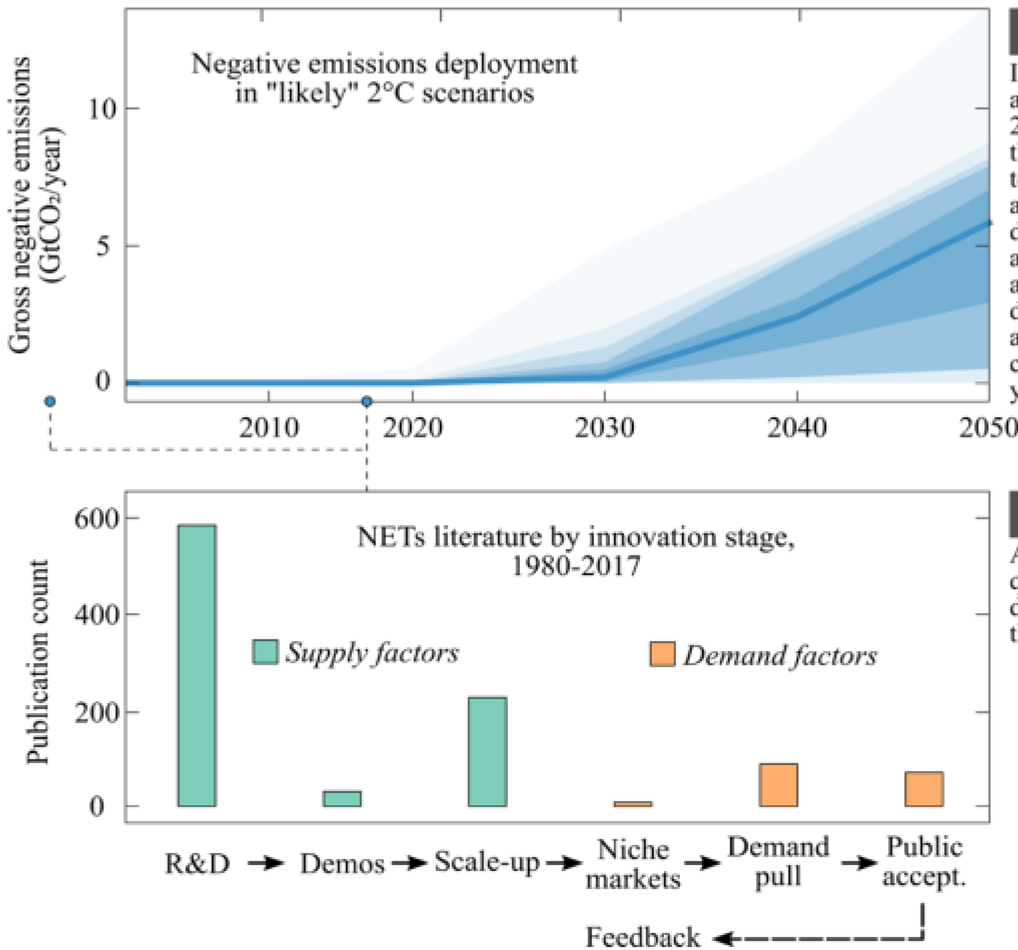
- Loss of natural land - affecting e.g. biodiversity,
- greenhouse gas emissions from land use and agricultural production,
- nitrogen pollution,
- water withdrawals for irrigation - affecting e.g. sweet water ecosystems,
- food security



Dedicated sustainability can overcompensate additional risks of 1.5°C scenarios



Closing the innovation gap



A The scale-up challenge

Integrated assessment scenarios assume a rapid upscaling of NETs, starting in 2030, and growing to ~5Gt CO_2/year by the mid-century. As with any other niche technology that reaches wide-scale adoption, basic research and demonstration must be in place, as well as a set of mutually re-inforcing political and institutional conditions that generate demand. To align with integrated assessment scenarios for 2°C, these conditions must be in place within 15 years.

B The current focus of research

Although the NETs research to date is quite mature for research and development, there is very little work on the crucial demand factors ...

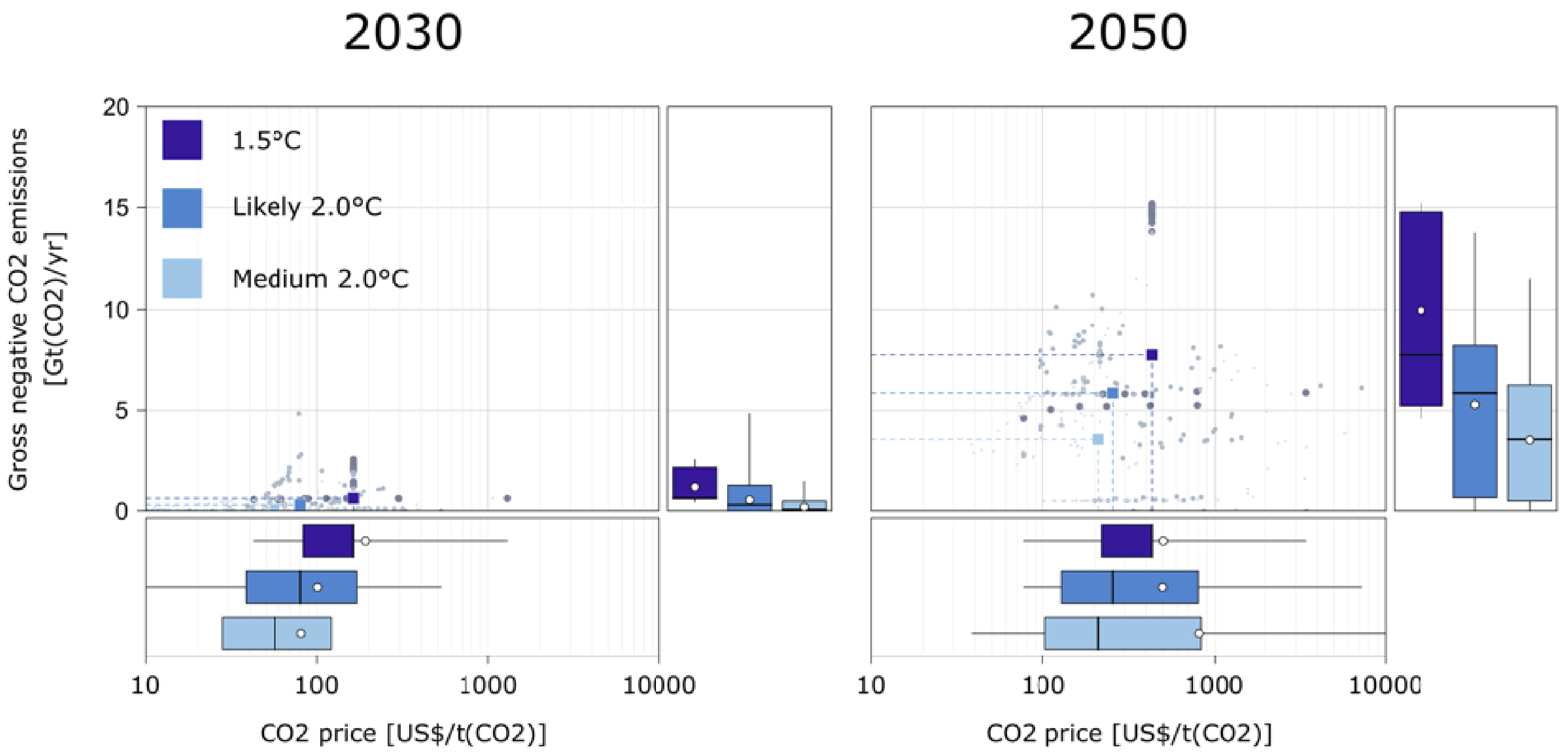
Closing the innovation gap (I)

- Results from integrated assessment models show that while NETs play a key role in the second half of the 21st century for 1.5°C and 2°C scenarios, the major period of new NETs deployment is between 2030 and 2050.
- Given that the broader innovation literature consistently finds long time periods involved in scaling up and deploying novel technologies, there is an urgency to develop NETs that is largely unappreciated.
- This challenge is exacerbated by the thousands to millions of actors that potentially need to adopt these technologies for them to achieve the planetary scale.

Closing the innovation gap (II)

- This urgency is neither reflected in the Paris Agreement NDCs nor in most of the literature we review here.
- If NETs are to be deployed at the levels required to meet 1.5°C and 2°C targets, then important post-R&D issues will need to be addressed in the literature, including incentives for early deployment, niche markets, scale-up, demand, and—particularly if deployment is to be hastened—public acceptance.

A pre-condition for short-term mitigation in order to limit NETs is carbon-pricing



Conclusion

- (t)CDR is an important part of the technology mix for 1.5°C, but not necessarily so for 2°C.
- (t)CDR is only a reasonable hedging strategy for committed policy makers.
- However, there is a risk of moral hazard.
- Short-term entry points and carbon pricing are essential to limit (t)CDR
- If NETs should be available at any larger scale, the innovation gap needs to be bridged.
- Other dedicated policies are needed for sustainable pathways.