The role of BECCS and negati emissions in global climate change mitigation scenarios

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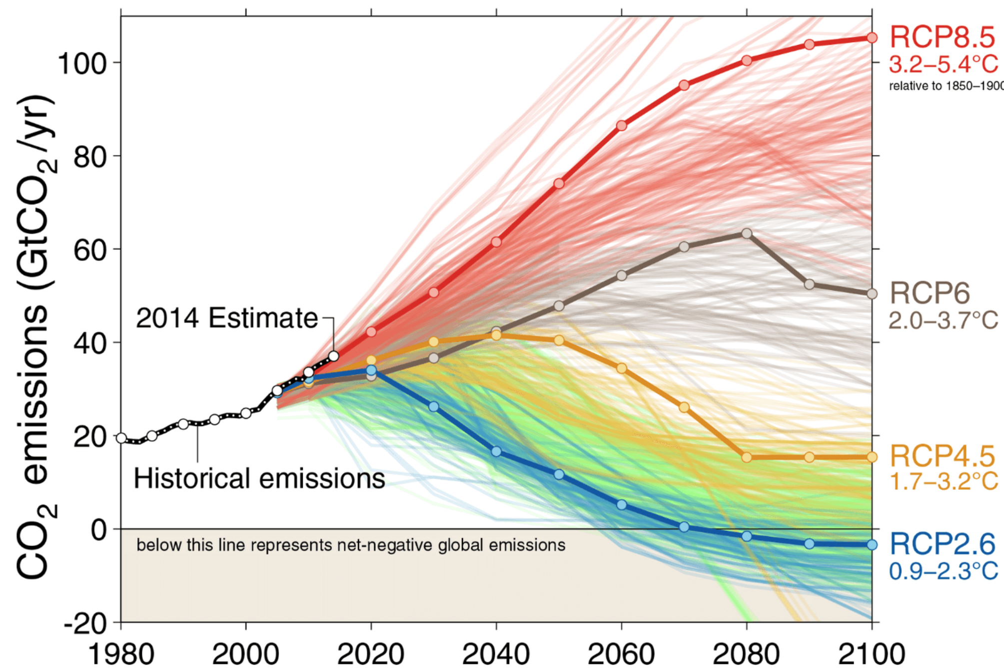
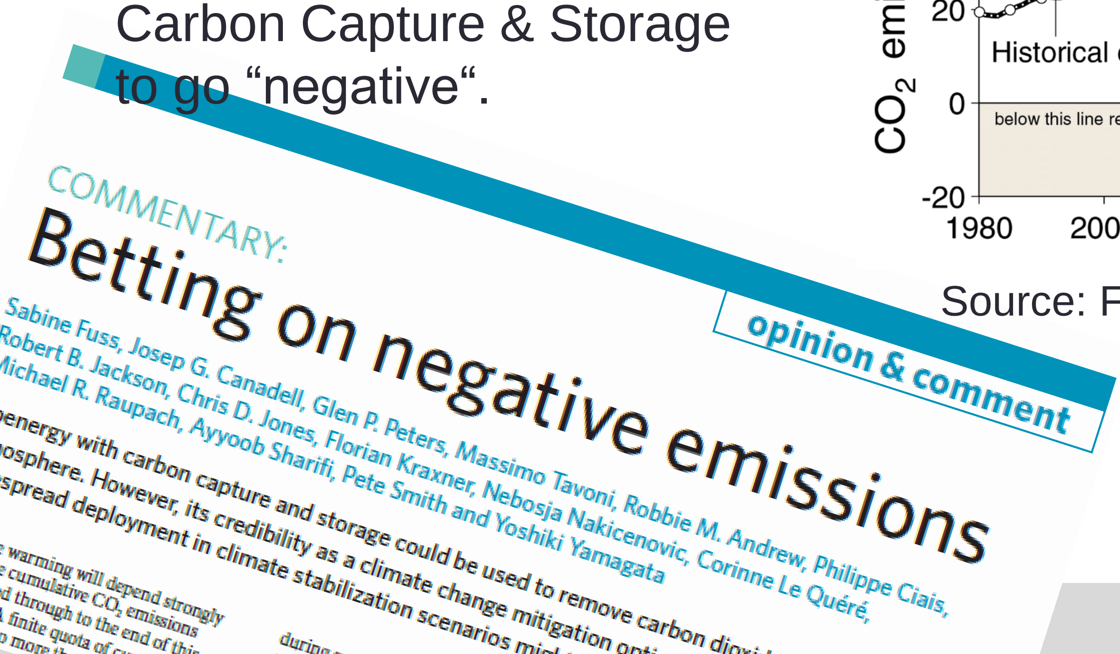
The Climate Change Mitigation Context

IPCC AR5:

Achieving 2°C is still possible, but it entails huge contributions from bioenergy - in most scenarios combined with Carbon Capture & Storage to go “negative“.

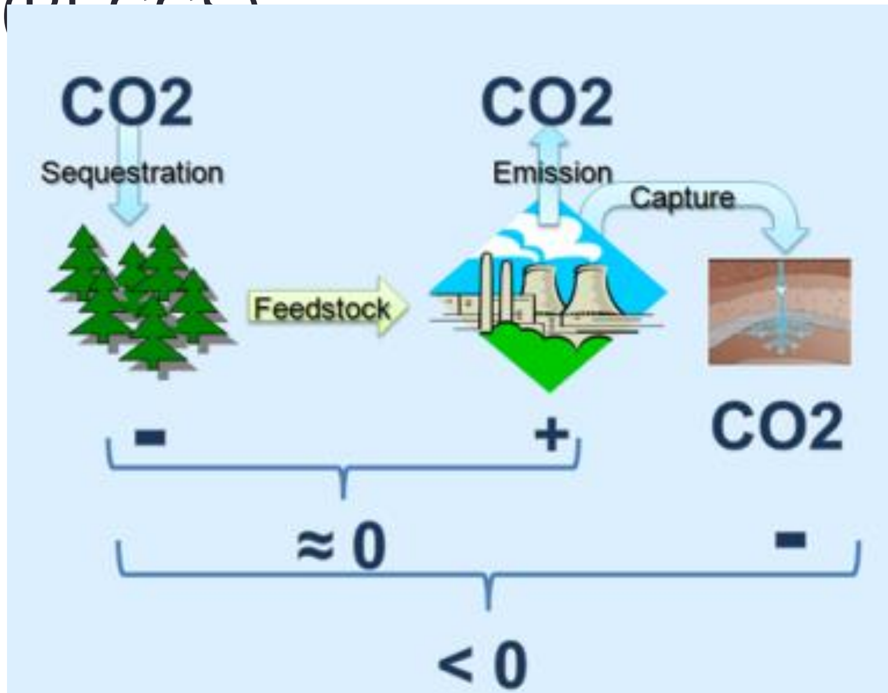


Source: Fuss et al. (2014), Nature Climate Change.



How can we go (net) negative?

- The technology most widely used in climate stabilization scenarios of AR5 is Bioenergy combined with CCS (BECCS)



Source: Applied Energy Handbook, Wiley.

<u>Other technologies:</u>

- Afforestation
- Direct air capture
- Increases in soil carbon storage (biochar…)
- Etc

Important notes on alternative options

Land-use and management changes:

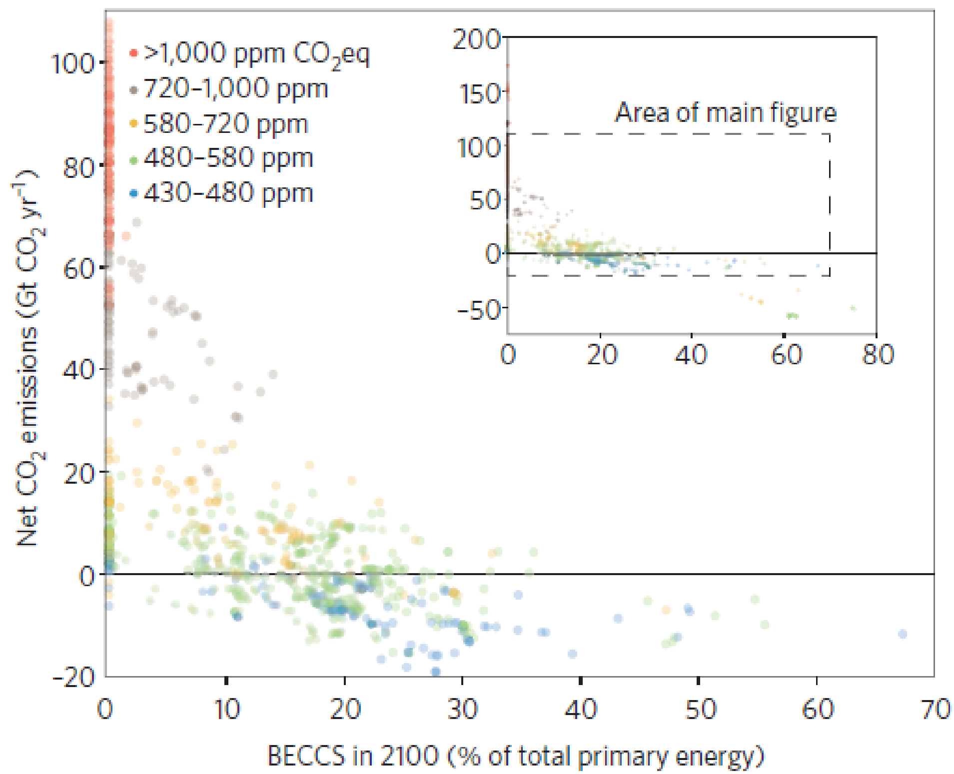
- Saturation of CO2 removal over time
- Sequestration reversible (terrestrial carbon stocks inherently vulnerable to disturbance)

Geo-engineering options:

- Quicker and cheaper to ramp up
- Embody a much larger scale of mostly unknown risks
- Not able to deal with other consequences of increased CO_2 concentrations such as ocean acidification

The Extent of BECCS Use in IPCC Scenarios

- 101 of the 116 430-480ppm scenarios rely on BECCS.
- About 67% of these have a BECCS share in primary energy exceeding 20% in 2100.
- **BUT: many uncertainties remain. Can we really bet on BECCS?**



Source: Fuss et al. (2014), Nature Climate Change.

The challenge

- Huge and rapid up-scaling: requirement for BECCS is 2-10 Gt CO2/yr in 2050, i.e. 5–25% of 2010 CO2 emissions and 4–22% of baseline 2050 CO2 emissions (cf. current global mean removal of CO2 by ocean and land sinks is 9.2 ± 1.8 Gt CO2 and 10.3 ± 2.9 Gt CO2, respectively.
- Safe storage needed in addition to CO2 storage from fossil CCS, which is also behind schedule in terms of upscaling
- Balance with other land- and biomass uses under uncertainty of potentials: 100-300 EJ/yr^-1?
- Responses of natural sinks could offset part of the NE effect
- Costs and missing incentives; no global governance framework

Four dimensions of uncertainty

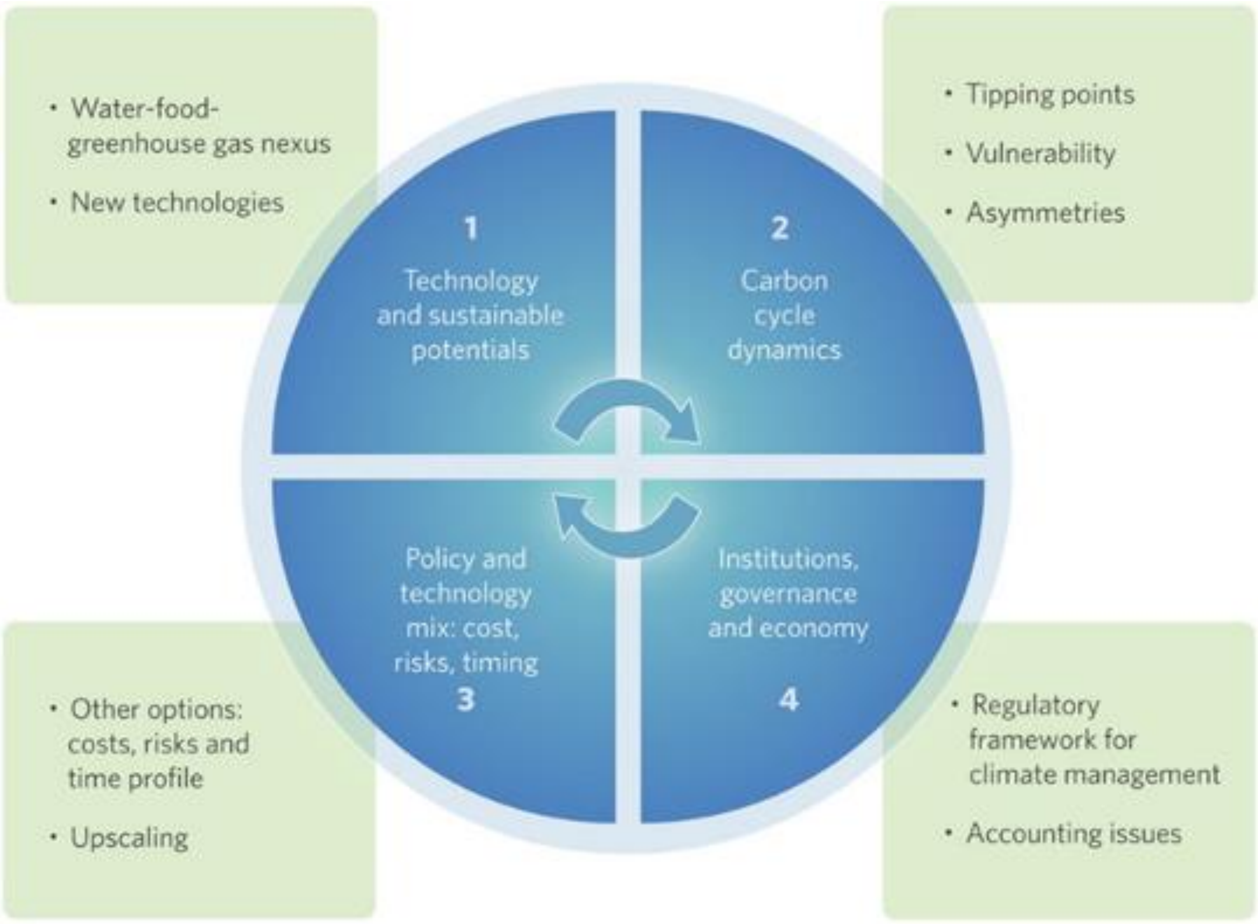
1. Physical constraints on BECCS
   a. Sustainability of large-scale deployment relative to other land and biomass needs (food security), carbon-neutrality of bioenergy
   b. Presence of safe, long-term storage capacity for carbon;
2. Response of natural land and ocean carbon sinks to NE;
3. Costs and financing of an untested technology;
4. Socio-institutional barriers, e.g. public acceptance of new technologies and the related deployment policies

A new transdisciplinary research agenda

1. Examine consistent narratives for the potential of implementing and managing negative emissions
2. Estimate uncertainties and feedbacks within the socio-institutional, techno-economic and Earth system dimensions
3. Offer guidance on how to act under the remaining uncertainties.

➢ An agenda to be realized under the new Global Carbon Project initiative **MA**naging **G**lobal **N**egative **E**missions **T**echnologies (**MAGNET**).

The four components of consistent NE narratives



Source: Fuss et al. (2014), Nature Climate Change.

Current activities/Outlook into the near future

MCC

1. Interaction with other land-based mitigation strategies such as REDD+
   - Increased pressure on forests and other resources, but also:
   - Team up with REDD+ efforts to certify sustainability of biomass feedstock for BECCS (so that we really achieve negative emissions)
   - Integrated REDD+BECCS strategy to help raising private sector finance by introducing broader scope for economic benefit.
   - BECCS could benefit from aligning with REDD+ in terms of public acceptance (both bioenergy and CCS unpopular in different countries).
   - REDD+ to buy time for more BECCS research and scaling it up.
   - However: both needed to achieve climate stabilization and implied tradeoffs (also with other objectives) need careful consideration.
2. Systems view of negative emissions: water footprint? Fertilizer needs?
3. Bringing together bottom-up research on potentials (e.g. collaboration with Indonesia and IEA and other regional case studies) with top-down requirements from IAMs.

Contact and Acknowledgements

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