

Are the planned rates of CO₂ sequestration in the IPCCs aggressive mitigation scenarios achievable and sustainable?

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Introduction

- Future emissions are estimated using socioeconomic models called IAMs¹
- Emissions scenarios used by the IPCC would result in temperatures ranging from 1.5° to 5°C by 2100^{1,2}
- Impacts of climate change are severe, even in mitigation scenarios limiting warming to 1.5°C^{1,2}
- Most aggressive mitigation scenarios limit warming through carbon dioxide removal (CDR) using bioenergy with carbon capture and storage (BECCS)^{1,2}

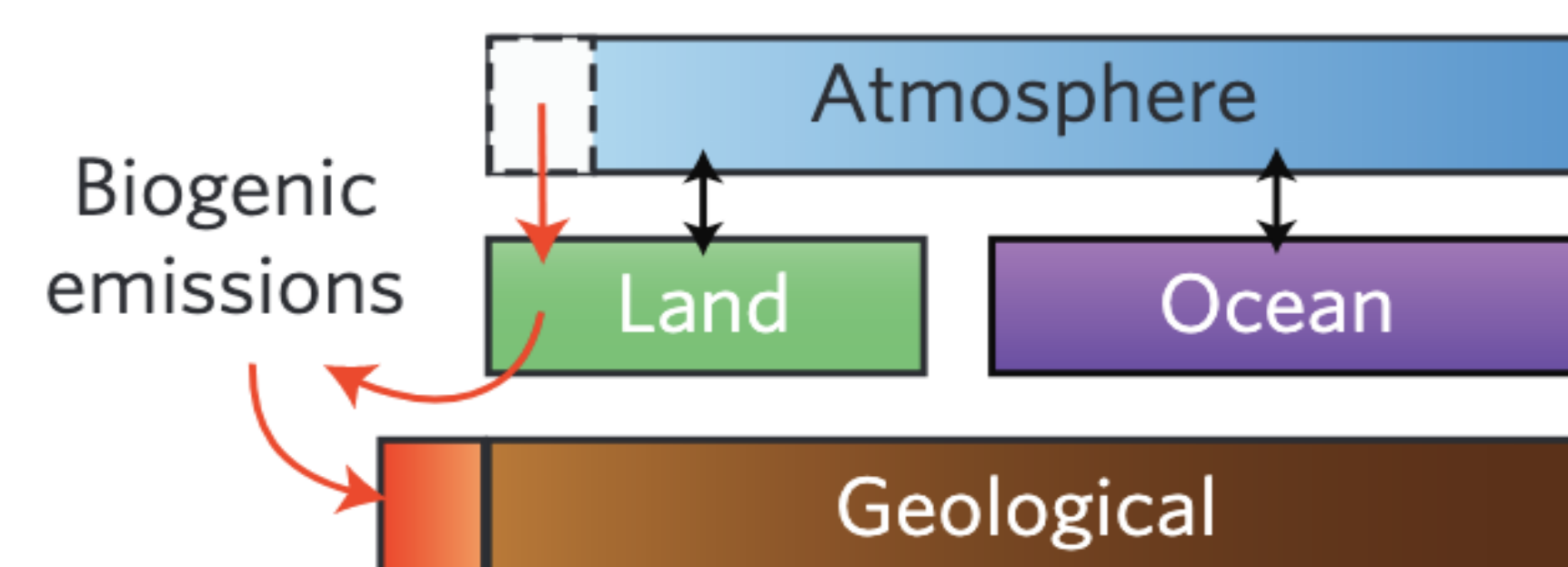


Figure 1: This figure demonstrates carbon flows between reservoirs when BECCS is used. Source: Smith et al., 2016¹⁰

- In some aggressive mitigation scenarios, BECCS is expected to sequester as much as two-thirds of current yearly global emissions every year³

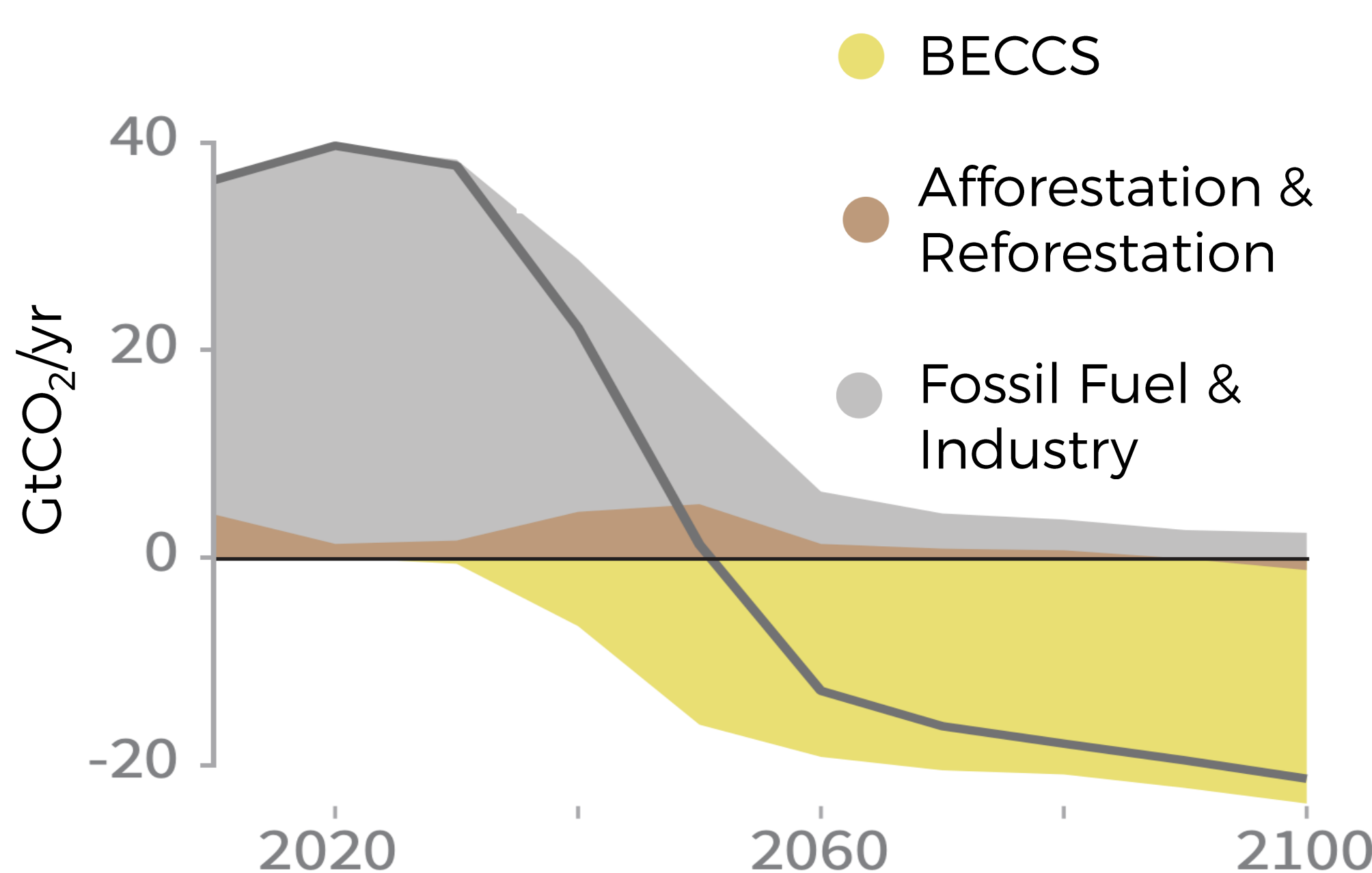


Figure 2: In this scenario, global warming is limited to 1.5°C without significant change to resource use, energy use or economic growth. BECCS sequesters more than 20 GtCO₂/yr by 2100. Source: IPCC, 2018²

Literature Review:

- Socioeconomic limitations of BECCS
 - At \$20 to \$400 USD per tCO₂ sequestered, cost of BECCS will likely exceed carbon pricing revenues⁹
 - All nations would have to cooperate, shifting from fossil fuels to BECCS⁵
 - Large scale BECCS would increase competition for land - potential to threaten food security²
 - Global south more vulnerable to impacts of BECCS - could exacerbate inequality¹¹

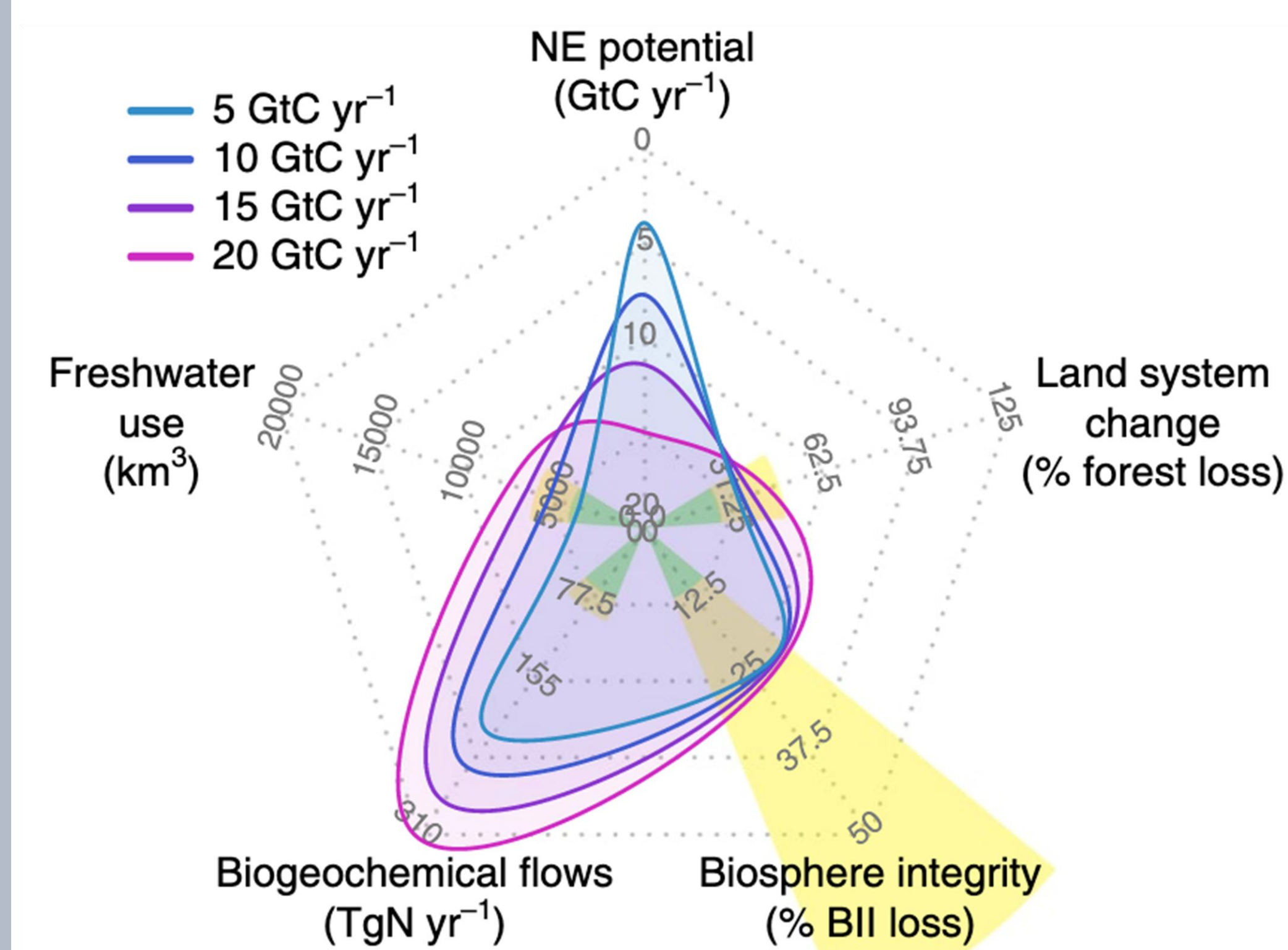


Figure 5: Each circle shows how planetary boundaries would be affected by different rate of BECCS in scenarios where biodiversity is prioritized. Shaded green area represents safe zones below the boundary while yellow represents uncertainty zones. Source: Heck, 2016¹¹

- Impacts of BECCS on the natural environment

- Large-scale BECCS would threaten planetary boundaries for fresh water, biogeochemical flows and biosphere integrity¹¹

- The geologic storage of carbon captured through BECCS could induce increased seismic activity⁸

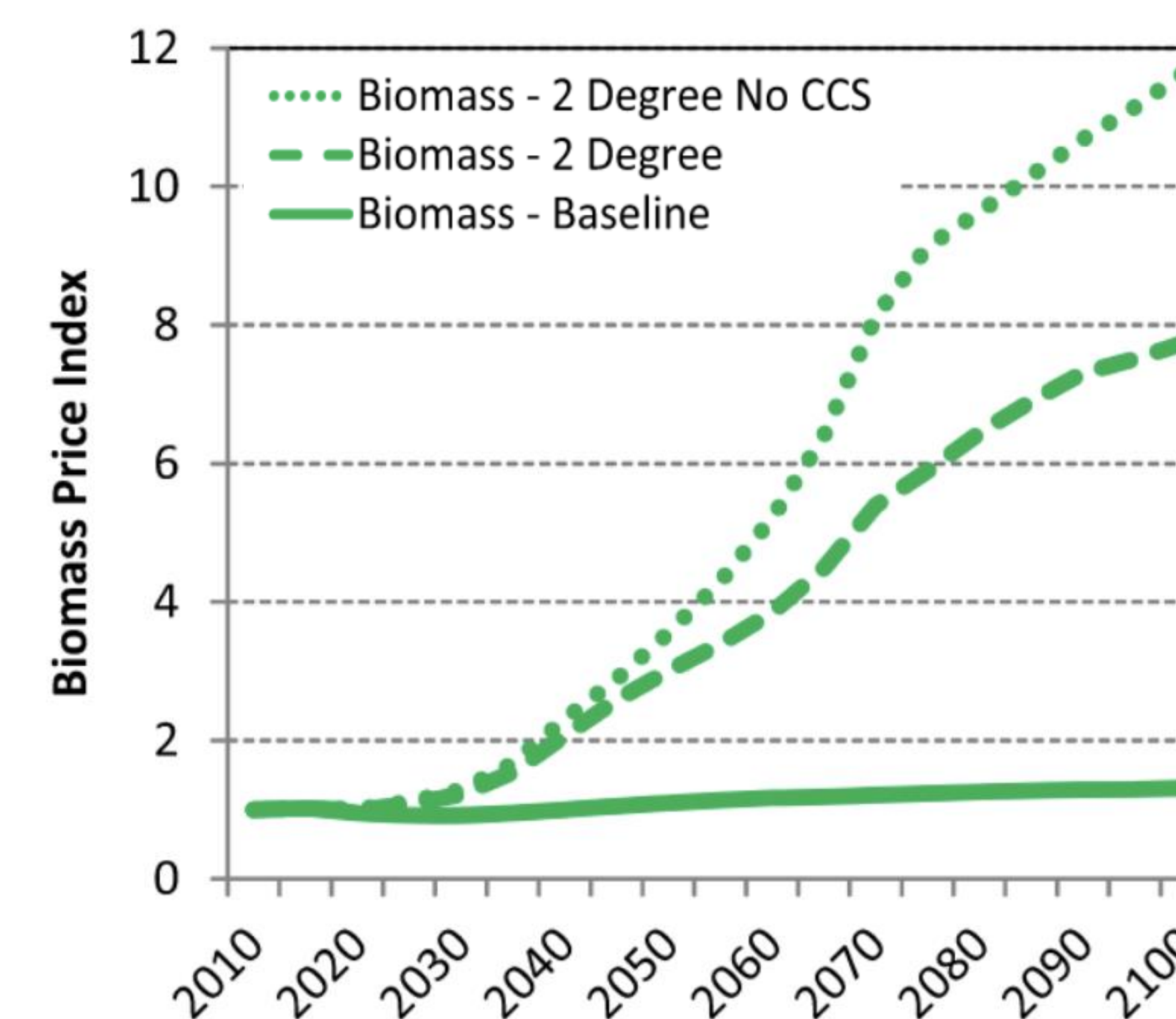


Figure 4: In comparison to a business-as-usual scenario (baseline), biomass energy will be expensive in scenarios limiting warming to 2.0°C with BECCS (thick dashed line) or with bioenergy but no carbon capture and storage (thinner dashed line). Source: Muratori, 2016⁹

- Physical and technical Limitations of BECCS

- Negative emissions may not reduce warming at the same rate as positive emissions⁴
- CO₂ sinks may weaken during periods of negative emissions, which would weaken the effectiveness of BECCS^{5,6}
- In many environments, BECCS will not have an immediate effect due to decreased albedo and increased land-use-change emissions⁷
- Best estimates of future capacity of BECCS are 0.5 to 5.0 GtCO₂/yr - less than a quarter of expected capacity in some aggressive mitigation scenarios⁸

Conclusions:

- The likelihood of BECCS fulfilling expected capacity for aggressive mitigation scenarios is uncertain due to physical, technical, and socioeconomic limitations
- Current best estimates of BECCS capacity are not aligned with estimated capacity in most aggressive mitigation scenarios
- Optimistic outcomes of BECCS capacity alone would not be enough to ensure we can follow aggressive mitigation scenarios - global cooperation would also be necessary³
- If BECCS exceeds expectations and can reduce emissions as predicted, BECCS would still have negative natural impacts

Recommendations:

- IAMs should be modified to favour a more diverse mix of CDR options¹²
- The IAMs modelling community should focus less on modelling socioeconomic outcomes and instead prescribe them to emphasize our agency to change our economy and society
- The Precautionary principle should be used, emphasizing emissions reductions over technofixes like BECCS

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