CARBON CYCLE AND VEGETATION-BASED CLIMATE SOLUTIONS

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Human disruption of the global carbon cycle

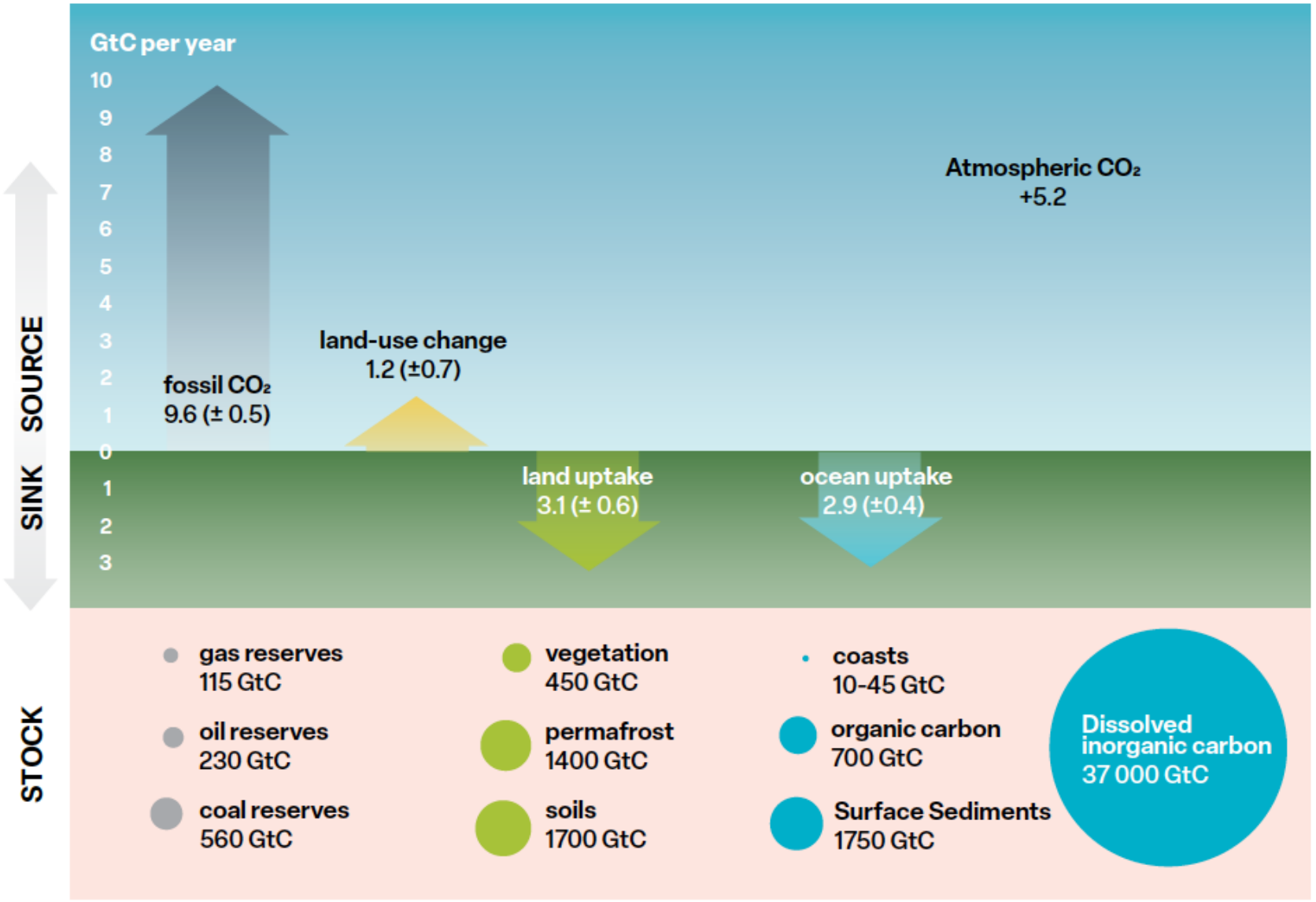


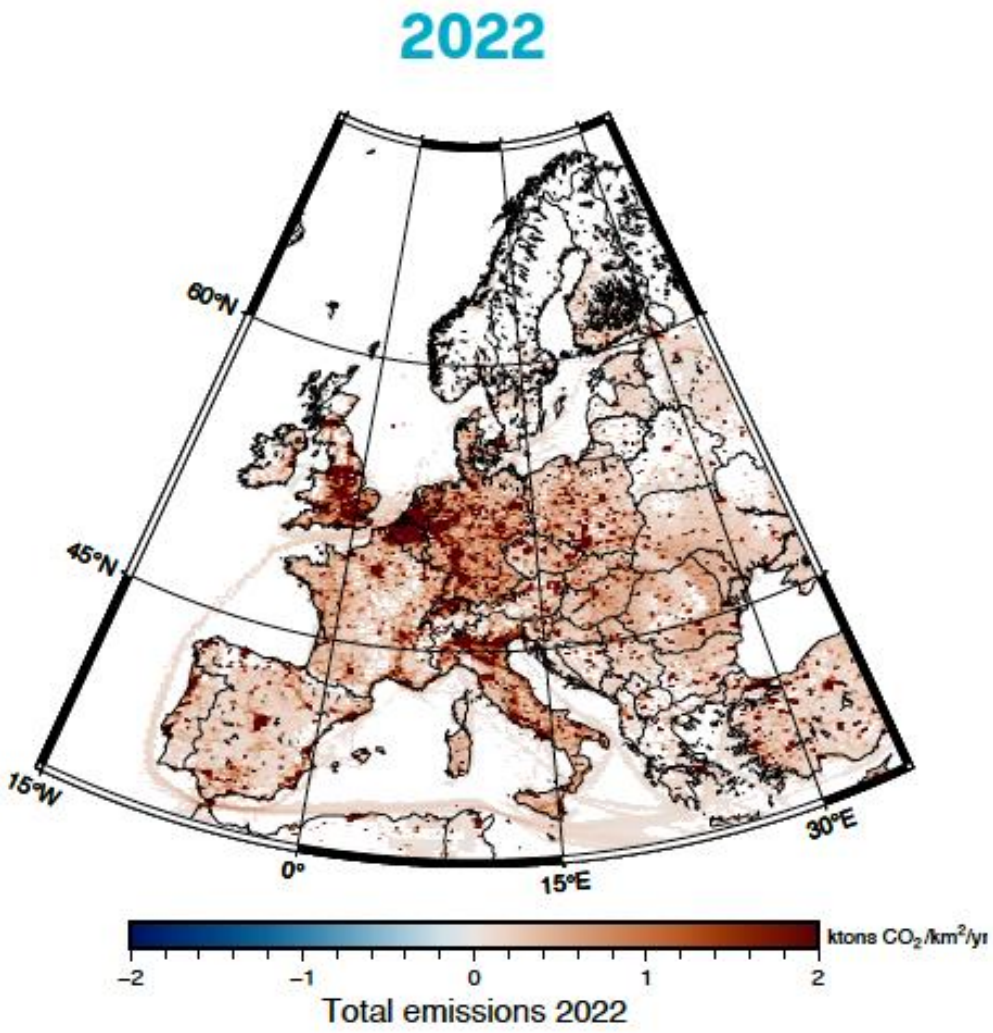
Figure 1. Average human influence in the global carbon cyclein GtC per year, gigatonnes of carbon, for the decade 2012-2021. adapted from Global Carbon Project 2022[1].

Land uptake/y c. 0.1 % of stocks!

FLUXES, The European Greenhouse Gas Bulletin, ICOS, 2023

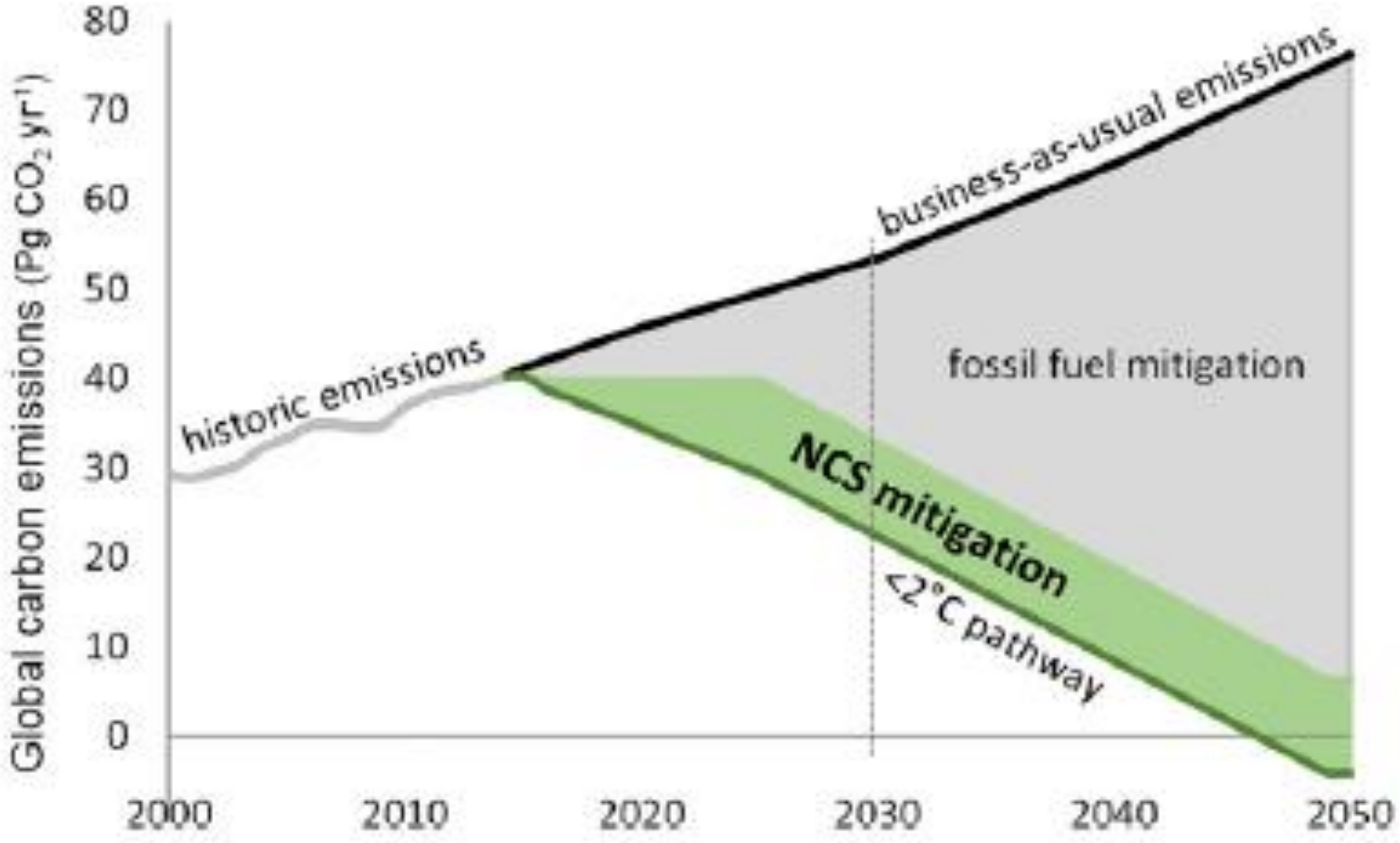
- CO_2 emissions from human activity include contributions from electricity production, industry, households, ground transport, aviation, shipping and cement production

- Highest emissions are seen in industrial areas and densely populated cities



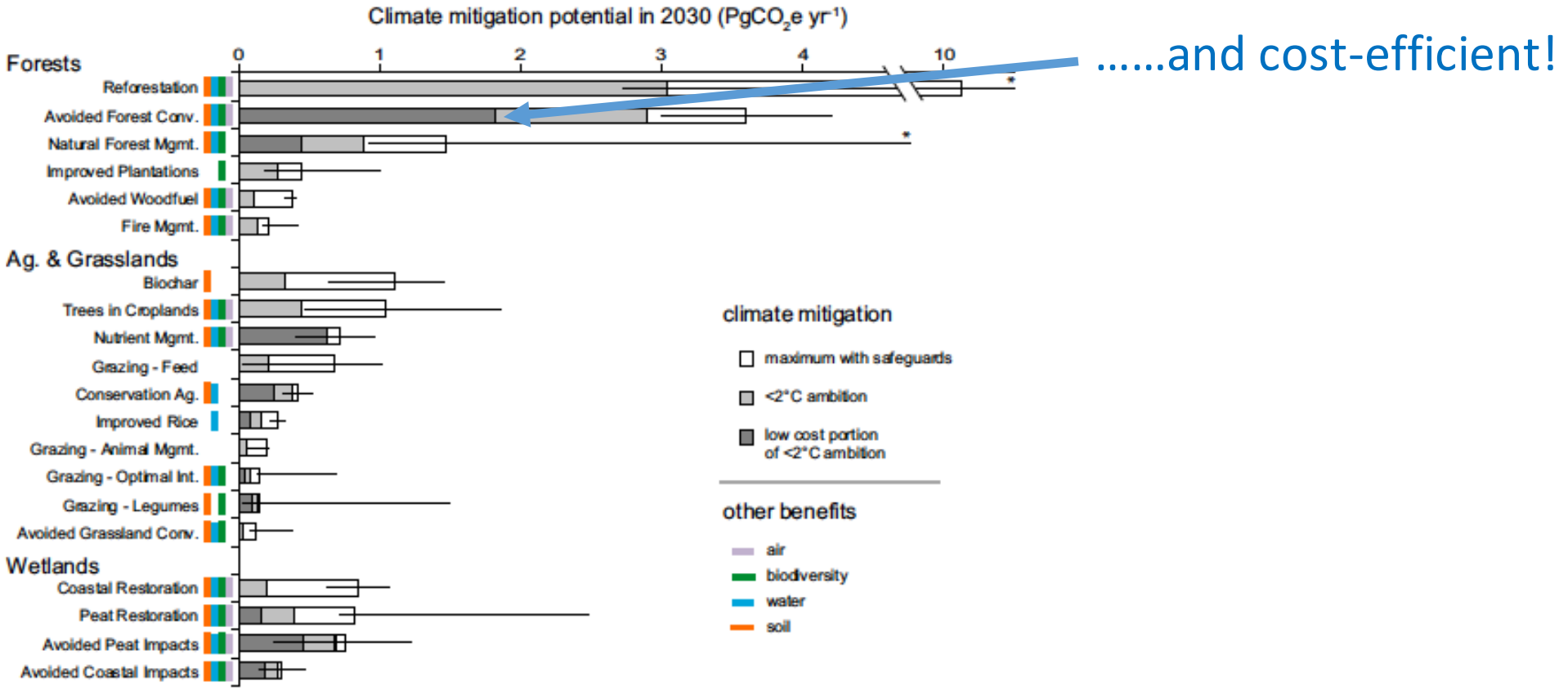
Natural sinks – climate solutions - refer to the removal of CO_2 from the atmosphere and storing it long-term in forests, wetlands, soils (agricultural, grasslands) and oceans

Natural climate solutions (NCS) can help with mitigation!



Griscom et al. PNAS 2017

Mitigation potential is huge, especially in forests……

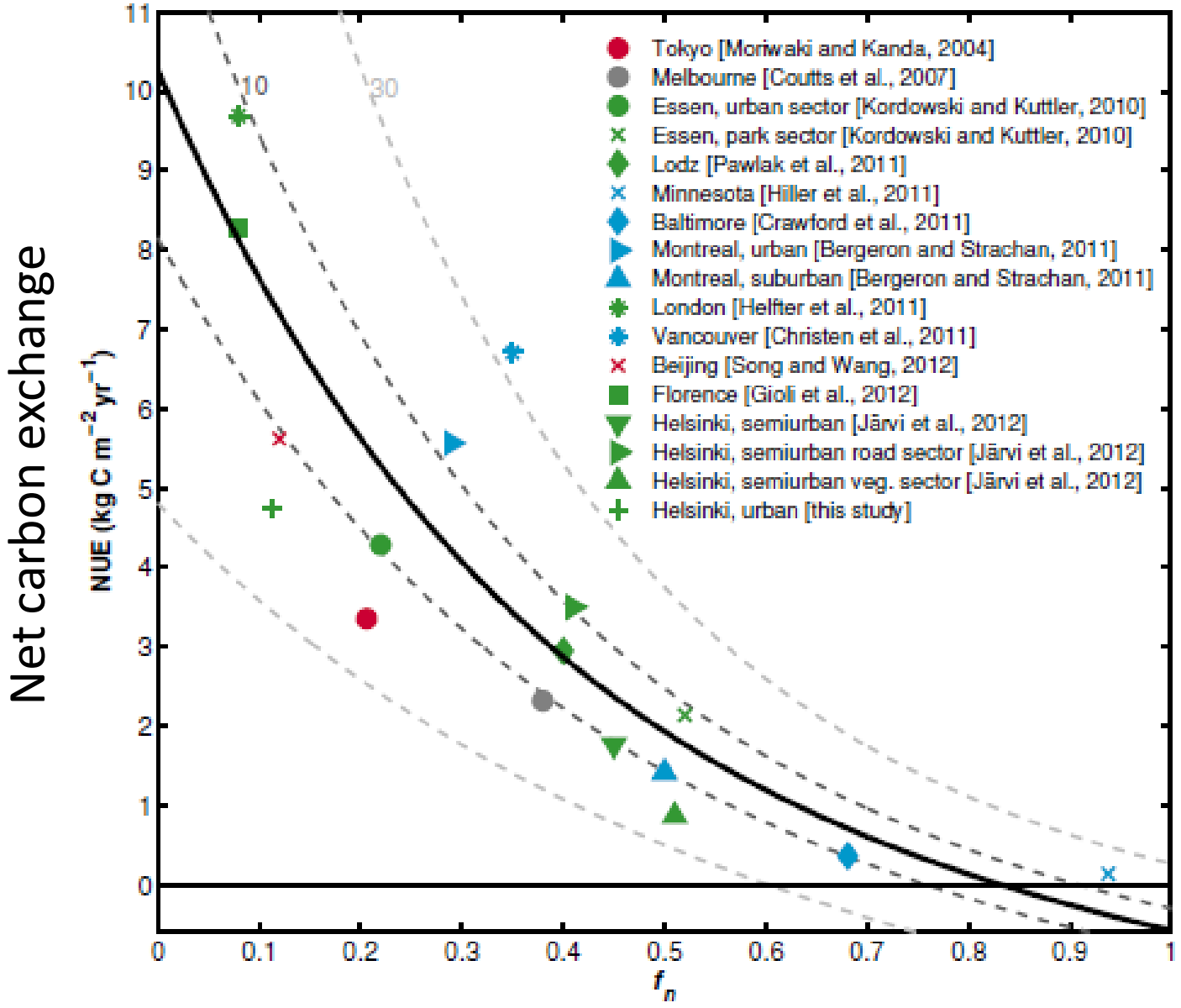


……and cost-efficient!

Fig. 1. Climate mitigation potential of 20 natural pathways. We estimate maximum climate mitigation potential with safeguards for reference year 2030. Light gray portions of bars represent cost-effective mitigation levels assuming a global ambition to hold warming to <2 °C (<100 USD $MgCO_2e^{-1}\ y^{-1}$). Dark gray portions of bars indicate low cost (<10 USD $MgCO_2e^{-1}\ y^{-1}$) portions of <2 °C levels. Wider error bars indicate empirical estimates of 95% confidence intervals, while narrower error bars indicate estimates derived from expert elicitation. Ecosystem service benefits linked with each pathway are indicated by colored bars for biodiversity, water (filtration and flood control), soil (enrichment), and air (filtration). Asterisks indicate truncated error bars. See *SI Appendix*, Tables S1, S2, S4, and S5 for detailed findings and sources.

1 $PgCO_2$ = c. 0.3 GtC

Vegetation as such in cities is not big sink but at least it is not emitting!



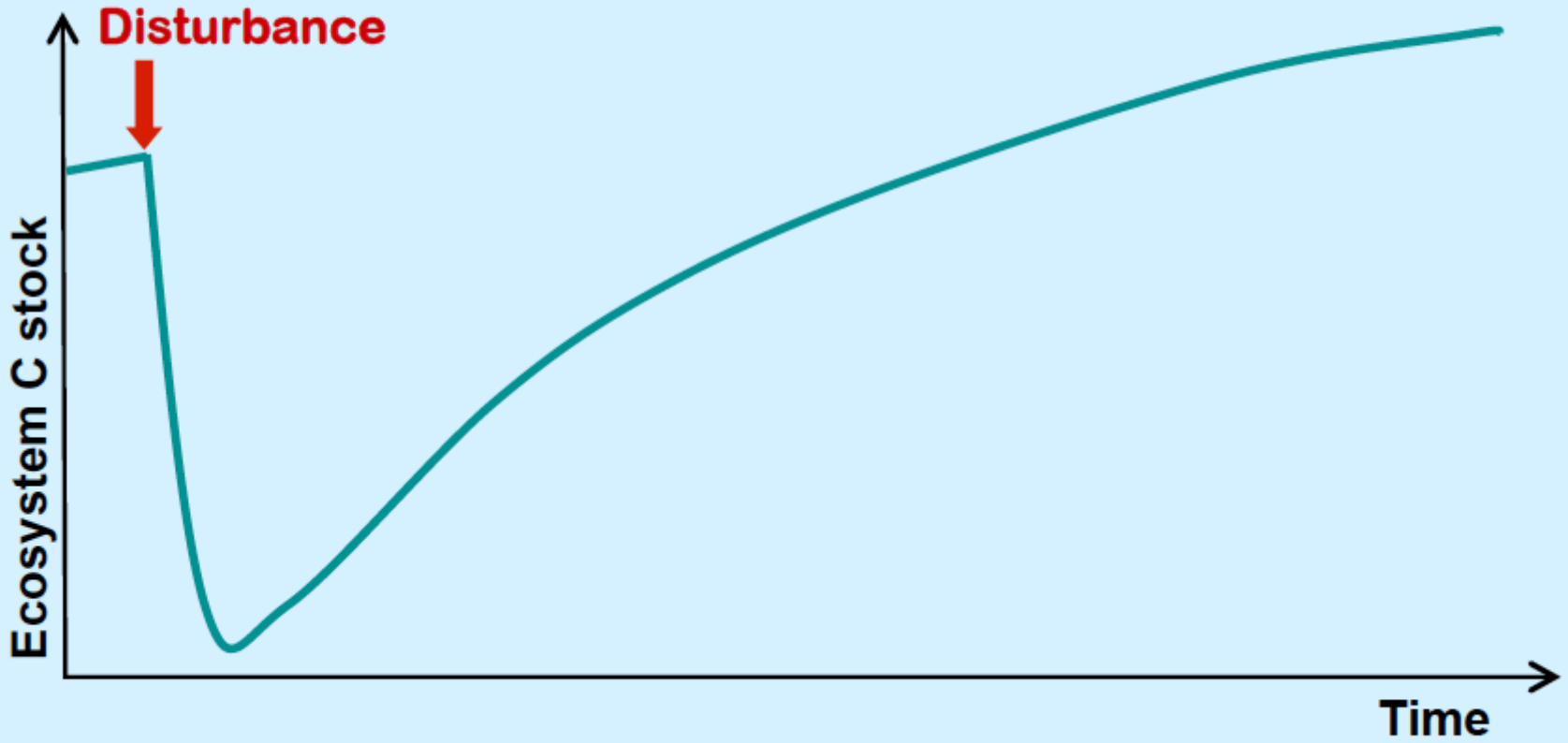
Nordbo et al., GRL, 2012

But lot of worries, also beyond narrow-minded natural sciences

- How permanent are natural stocks due to feedbacks from climate change?
- How high are social and political barriers to implementation
- What are the best pathways socially and culturally responsible?
- How to enhancing resilience and improving food security for a human population?

Fast out – slow in

Disturbances cause a sudden release of C,
the subsequent accumulation needs much more time.

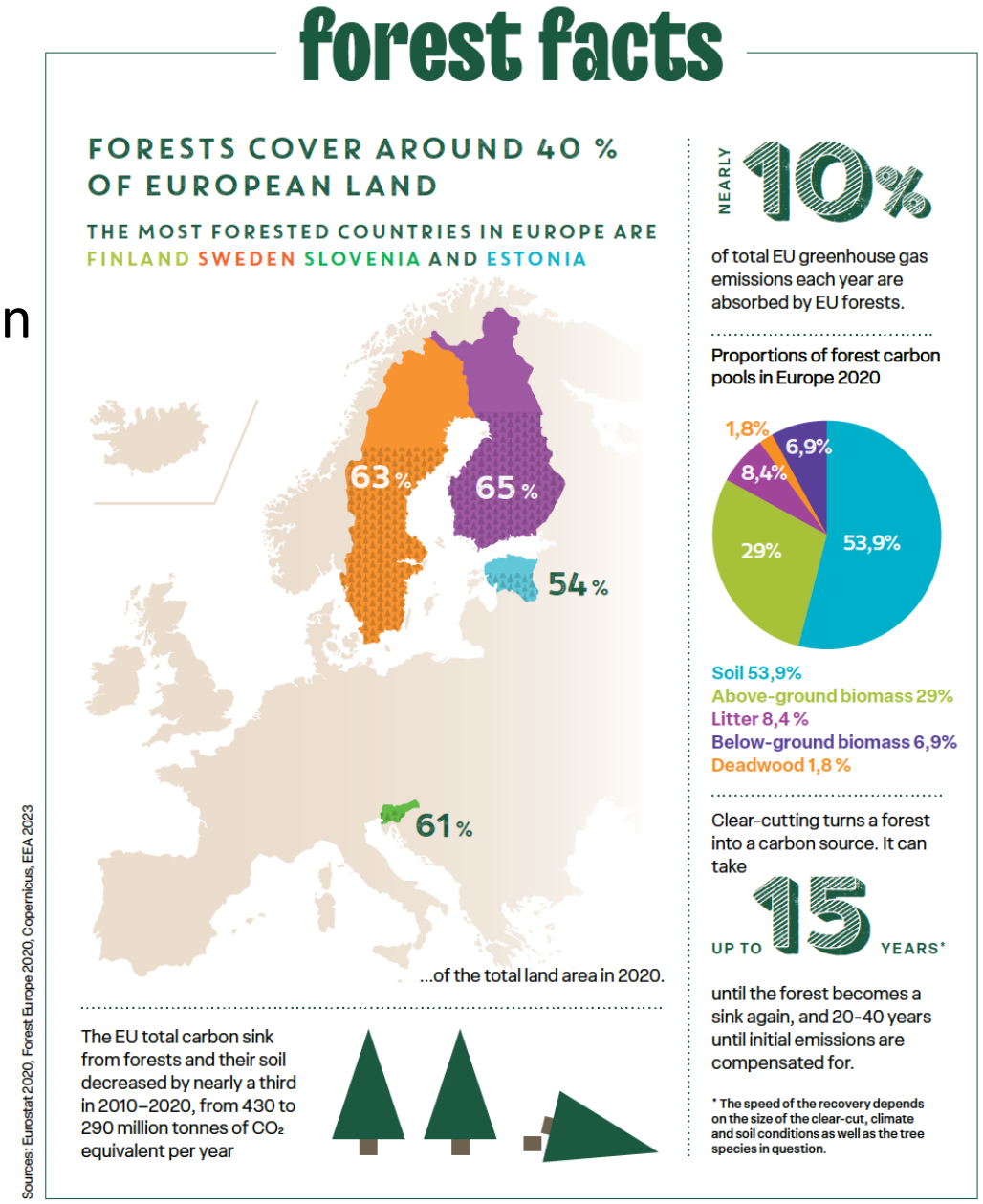


A. Lindroth, Lund University

Reality indeed strikes back ☹

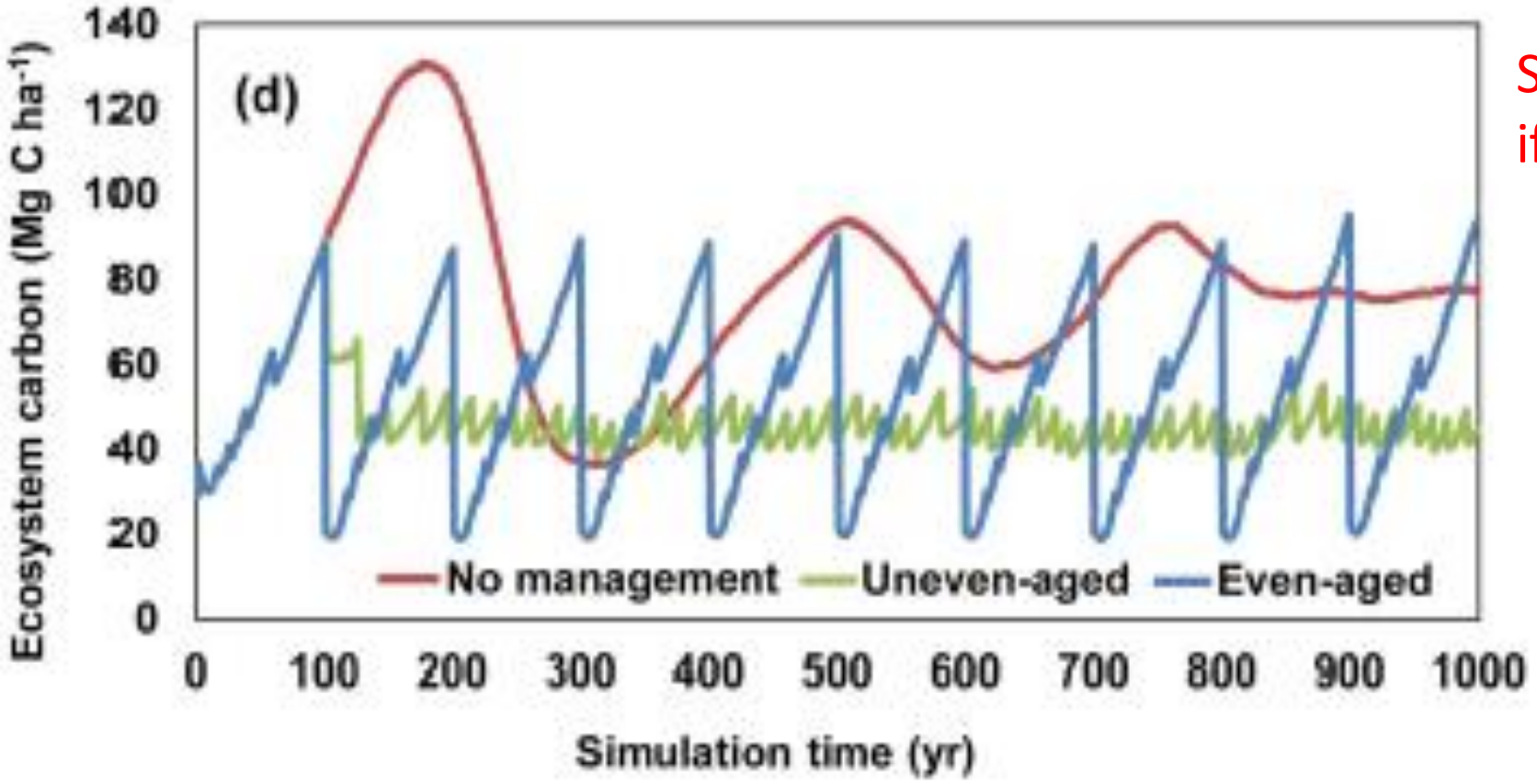
The decrease in the forest carbon sink has been attributed to

- increasing harvests
- stress factors
- natural ageing of the forests
- note though that old forests have high stocks



FLUXES, ICOS, 2023

Mean carbon stock in the no-management forest 1.5 times higher than in even-aged one



Selected time period matters if anything!

Kellomäki et al., Forestry, 2021

Summary

- Only 30 years left to mid-century to be carbon neutral (emissions = sinks)
- Lowering harvesting (or net sinks) by 10-20%
- Increase of the rotation time, that is cut when older
- Optimal thinning, avoidance of deforestation, afforestation of abandoned fields
- Beyond carbon: cooling from vegetation in cities