CEPLAS
Cluster of Excellence on Plant Sciences

Carbon Sequestration

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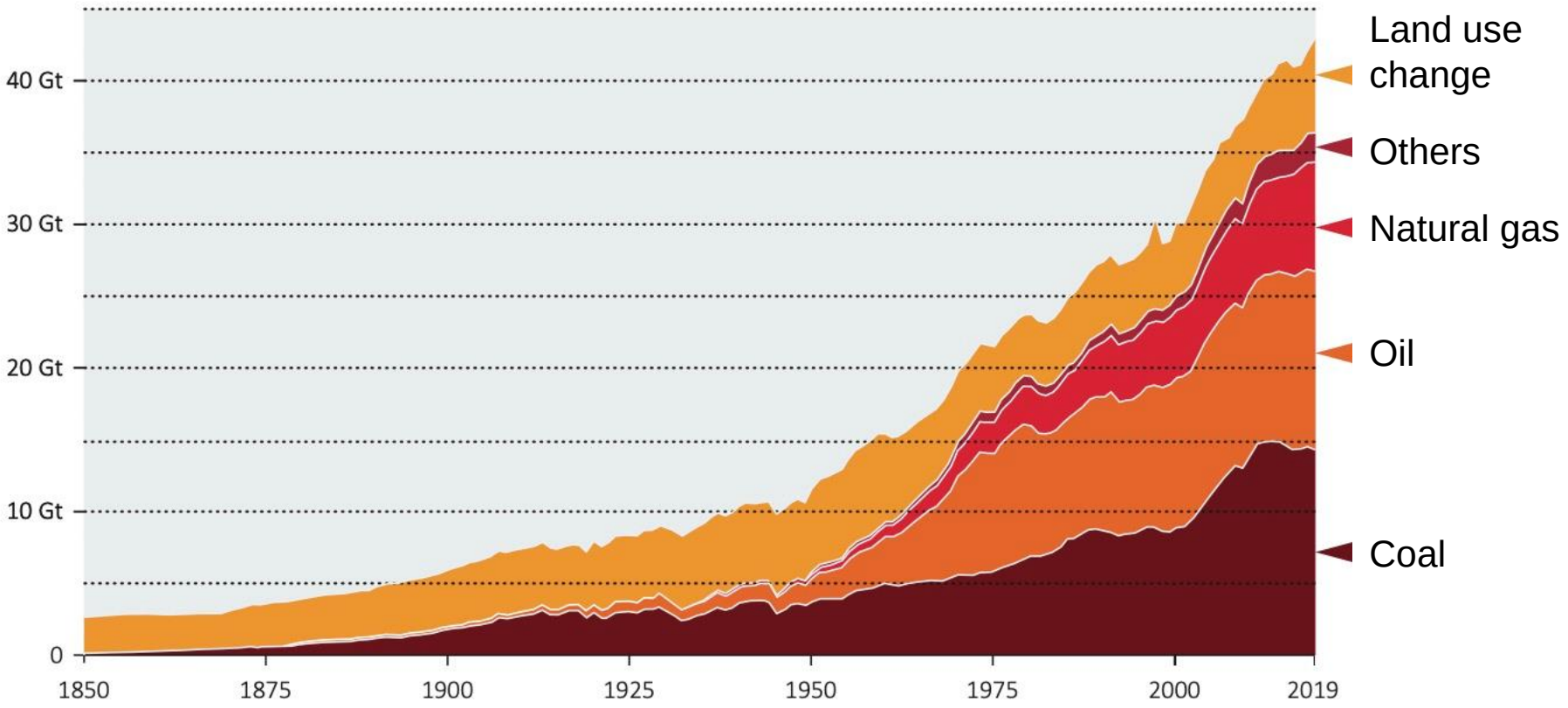
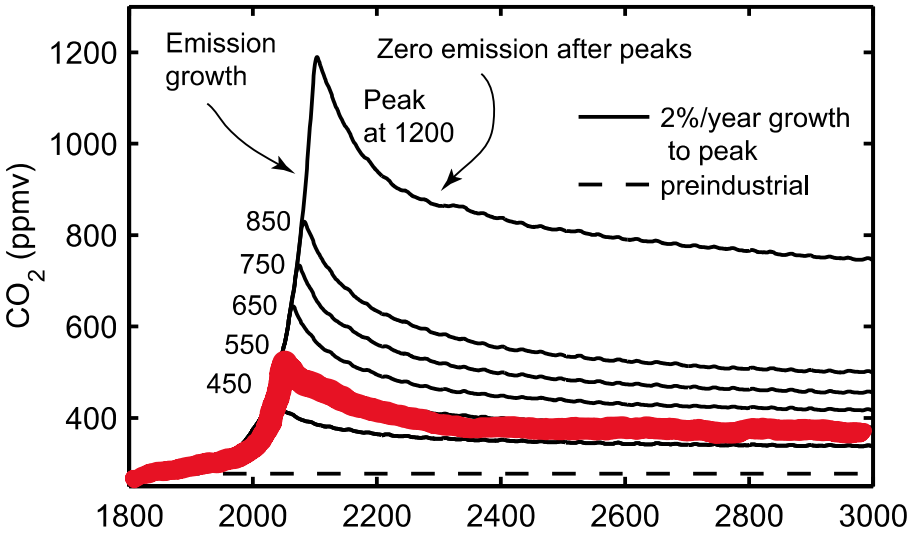
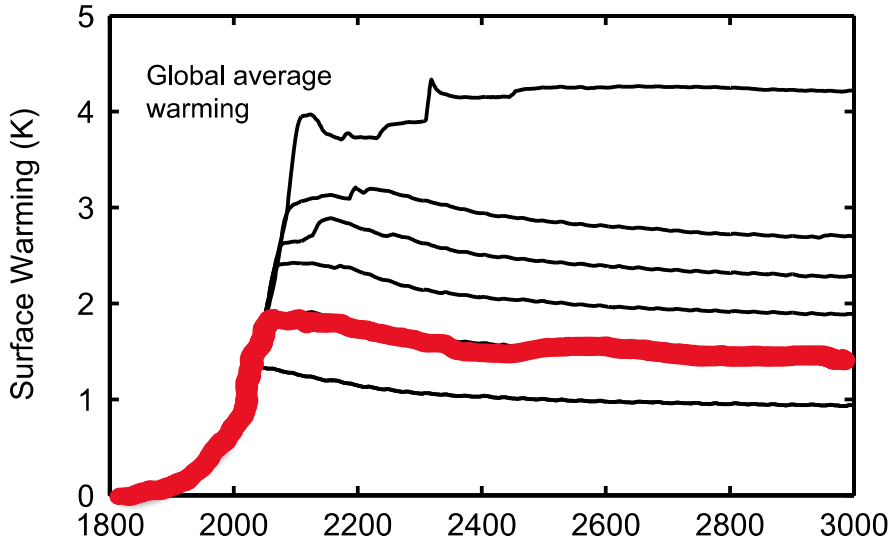
Anthropogenic global CO_2 emissions 1850-2019



„Peak Carbon“ – w/o sequestration CO_2 will remain high





Solomon et al., 2009 *PNAS;* not considering tipping points

Plant biomass can capture > 300 Gt C

875 Gt C
In current atmosphere
(410 ppm CO_2)

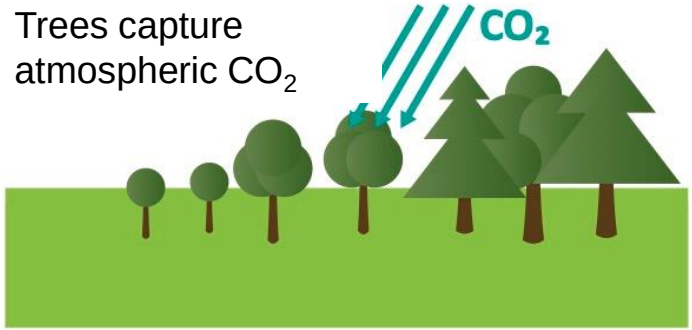
450 Gt C
In plant biomass

916 Gt C
Potential for plant biomass

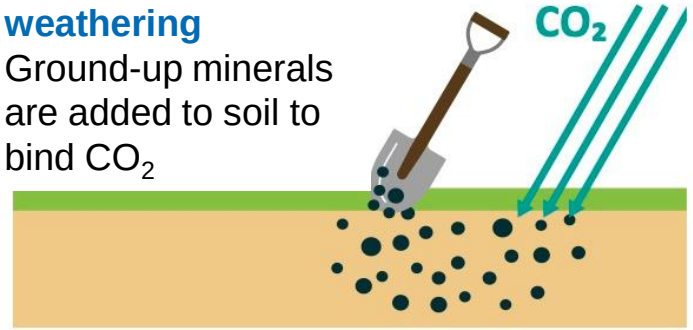
300 Gt C have been emitted to atmosphere since 1850
105 Gt C current net primary productivity
50% of terrestrial plant biomass lost since Neolithic

Measures for negative CO_2 Emissions

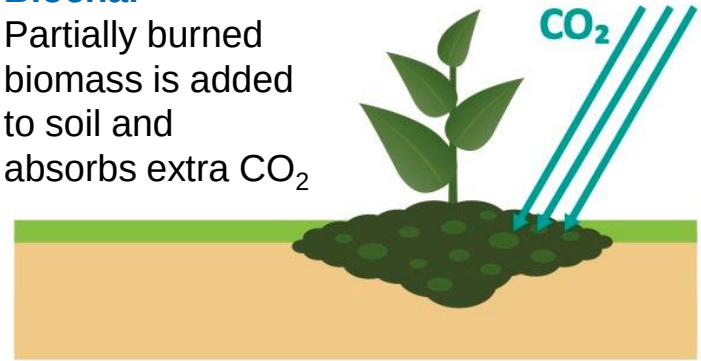
Reforestation
Trees capture atmospheric CO_2



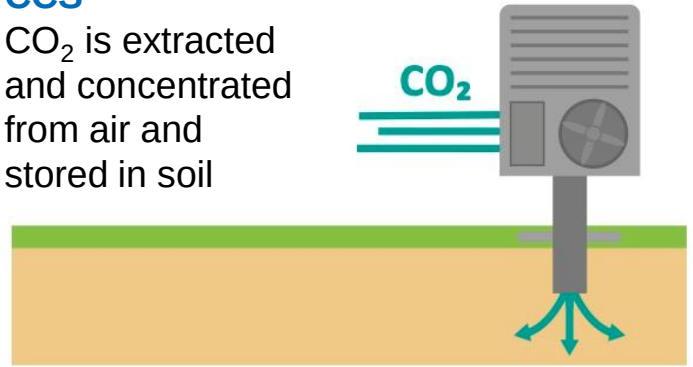
Enforced weathering
Ground-up minerals are added to soil to bind CO_2



Biochar
Partially burned biomass is added to soil and absorbs extra CO_2



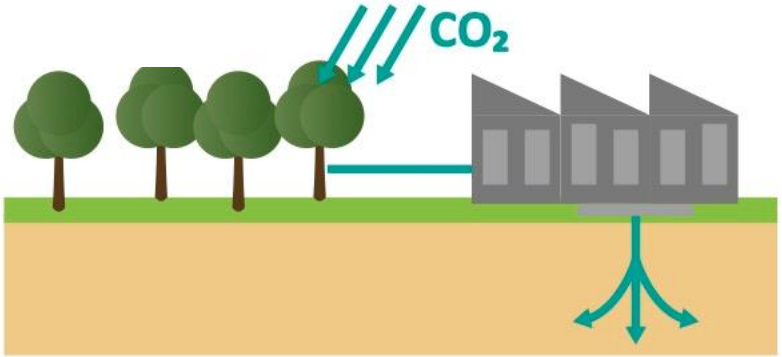
CCS
CO_2 is extracted and concentrated from air and stored in soil



Measures for negative CO_2 emissions

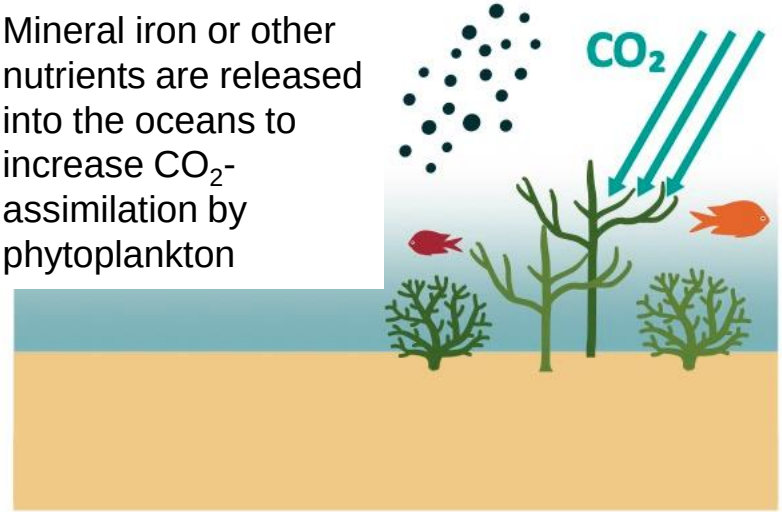
BECCS

Plants convert CO_2 to biomass. Biomass is used as energy source to make, e.g., electricity. Released CO2 is directly captured and stored in soil.

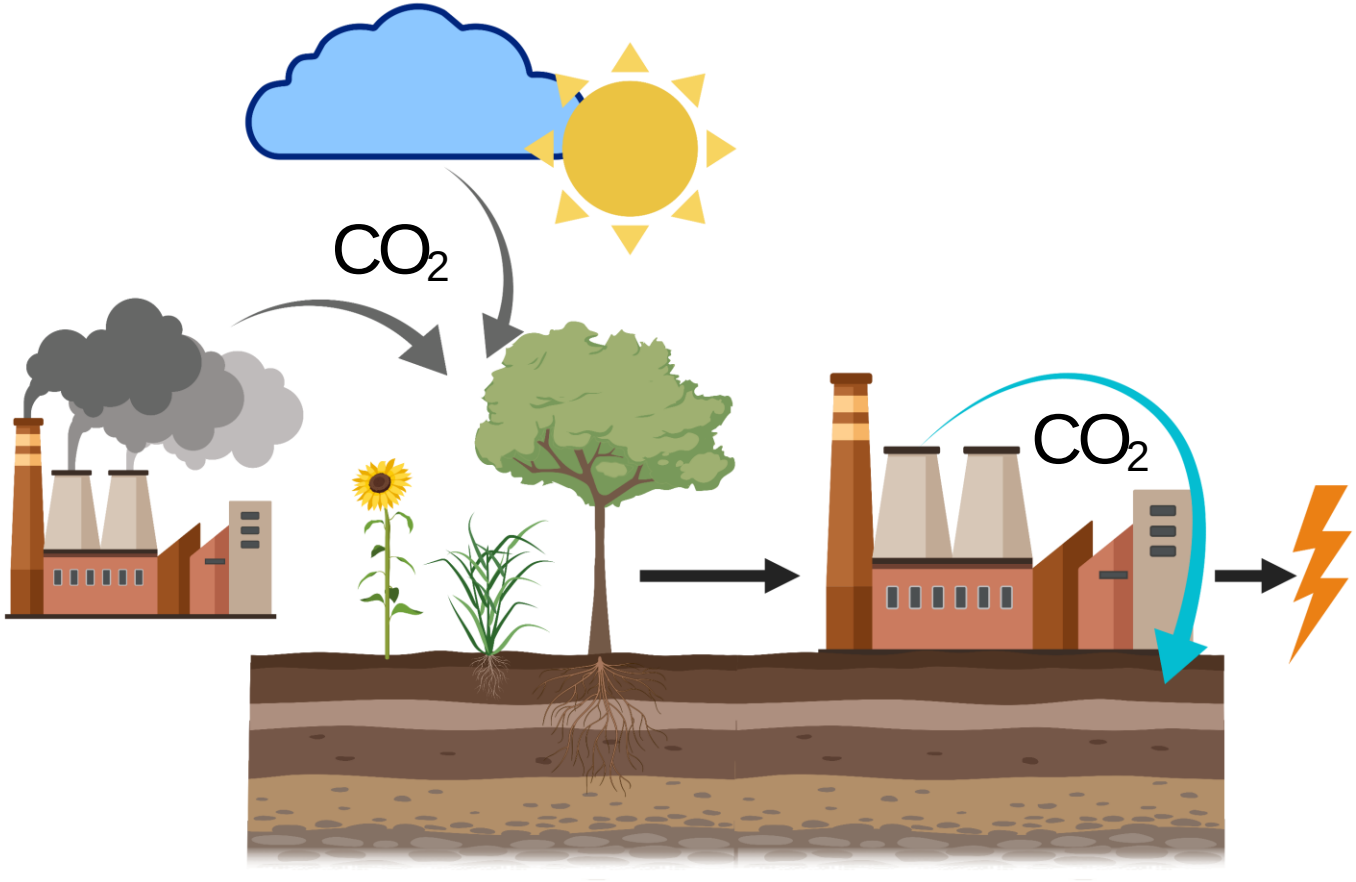


Ocean Fertilization

Mineral iron or other nutrients are released into the oceans to increase CO_2-assimilation by phytoplankton



3 Gt C per year by BECCS would require 50% of our cropland



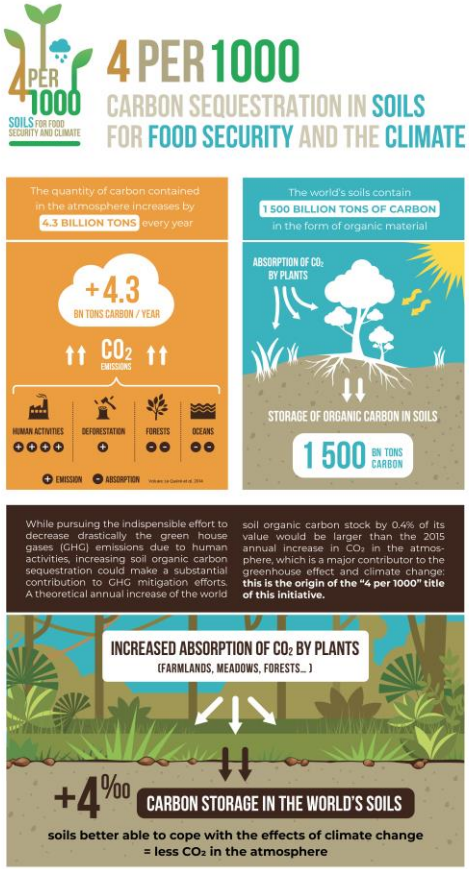
Based on: Harper et al., 2018 *Nat Commun*

Future challenges

Photosynthesis-driven carbon mitigation strategies

- > 300 Gt of atmospheric C must be captured and stored in the form of plant biomass (*w/o considering effects of tipping points*)
- BECCS and other plant-based mitigation strategies can make a substantial contribution
- Must be achieved w/o compromising food security, increasing land use, increasing input of other ressources, increasing loss of biodiversity…

”4 per 1000” Initiative



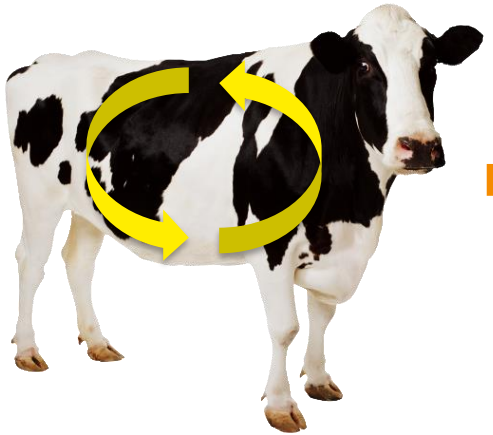
Salk Harnessing Plants Initiative

https://www.salk.edu/science/power-of-plants/

Disruptive change in livestock farming is part of the solution

Replacement of livestock by plant products

Plant-based feed



Meat, dairy etc.

Plants

Efficient processing

„Meat, dairy etc“

Vegan meat surrogates for non-vegans

- 100 % vegan; leghemoglobin produced by yeast fermentation
- Massive reduction in land and water use, CO_2/CH_4 footprint

Founder: Patrick O. Brown
Investors: Bill Gates, Google Ventures, Horizons Ventures, Khosla Ventures

Action points for future research

Wenn wir ohne Scheuklappen herangehen

- Maximized yield per unit area land (e.g., through increased photosynthetic efficiency)
- Increased water and nutrient use efficiency (e.g., CAM photosynthesis)
- Deep-soil deposition of carbon (aliphatic, hard to metabolize C)
- Increased energy contents of plant biomass (from 16,000 kJ/kg to 30,000 kJ/kg)
- Designer crops that replace livestock products