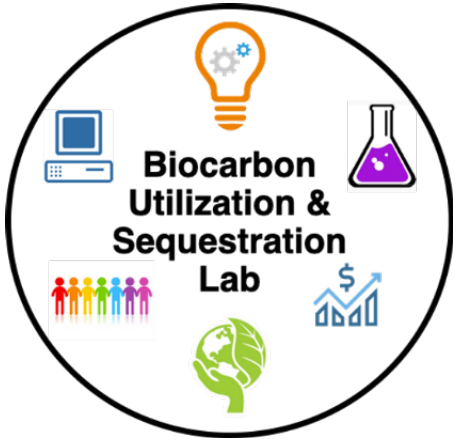
The Potential for Biomass Carbon Removal & Storage in the US Bioeconomy

Bio&Ag ENGINEERING

September 29th, 2023



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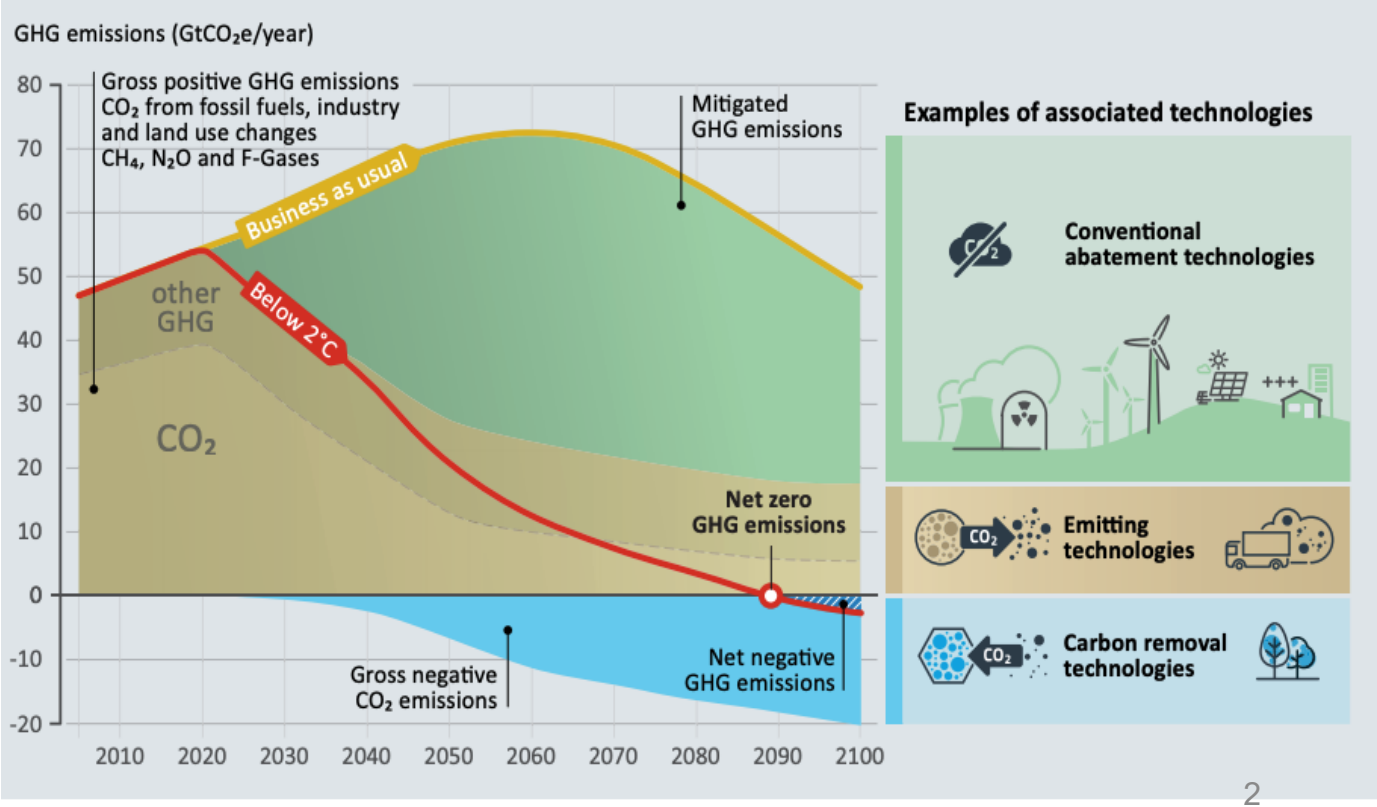
Carbon Dioxide Removal

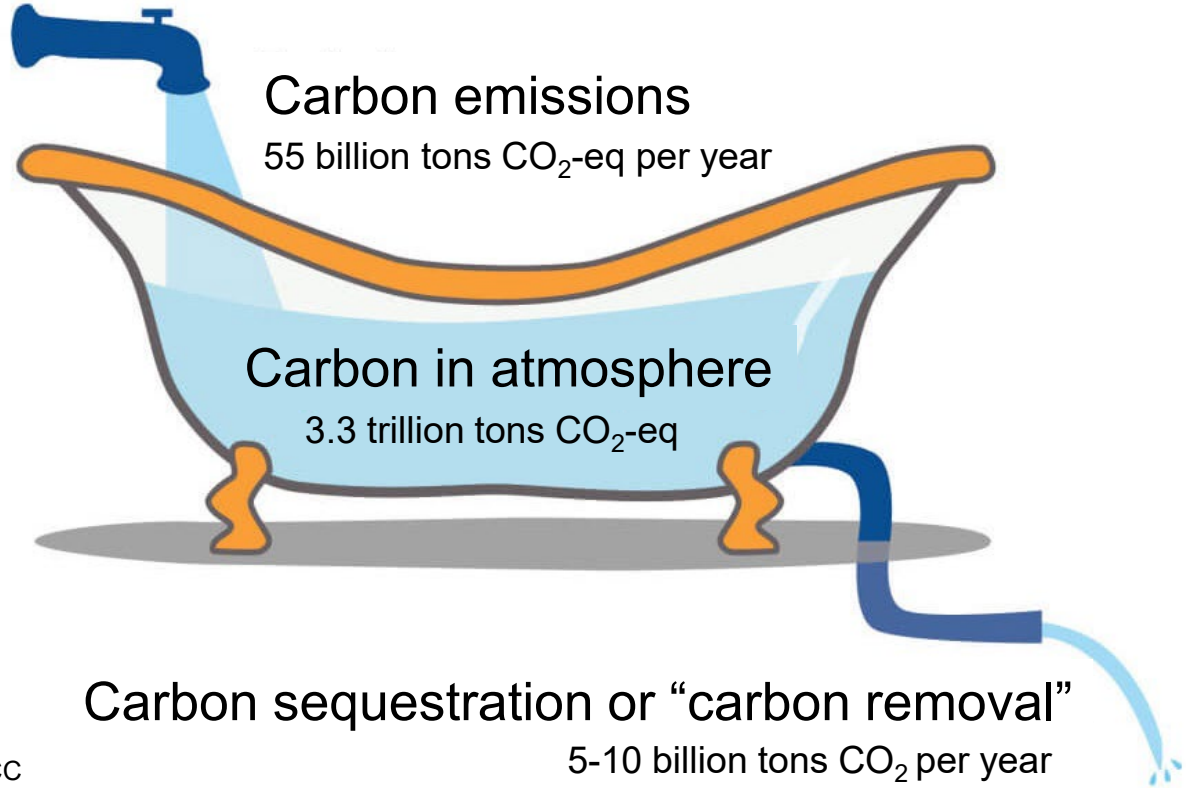
Intergovernmental Panel on Climate Change

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

1 billion tonnes = 1 gigatonne



Carbon Dioxide Removal



Carbon sequestration or “carbon removal”

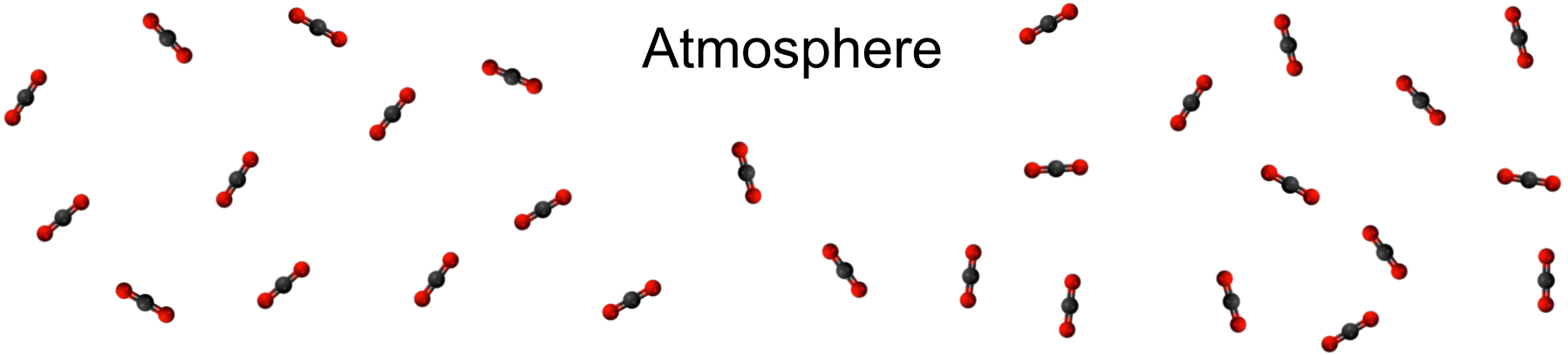
5-10 billion tons CO_2 per year

Source: Climate Interactive, IPCC

Natural Processes

Engineered Processes

Atmosphere



Lithosphere

Biosphere

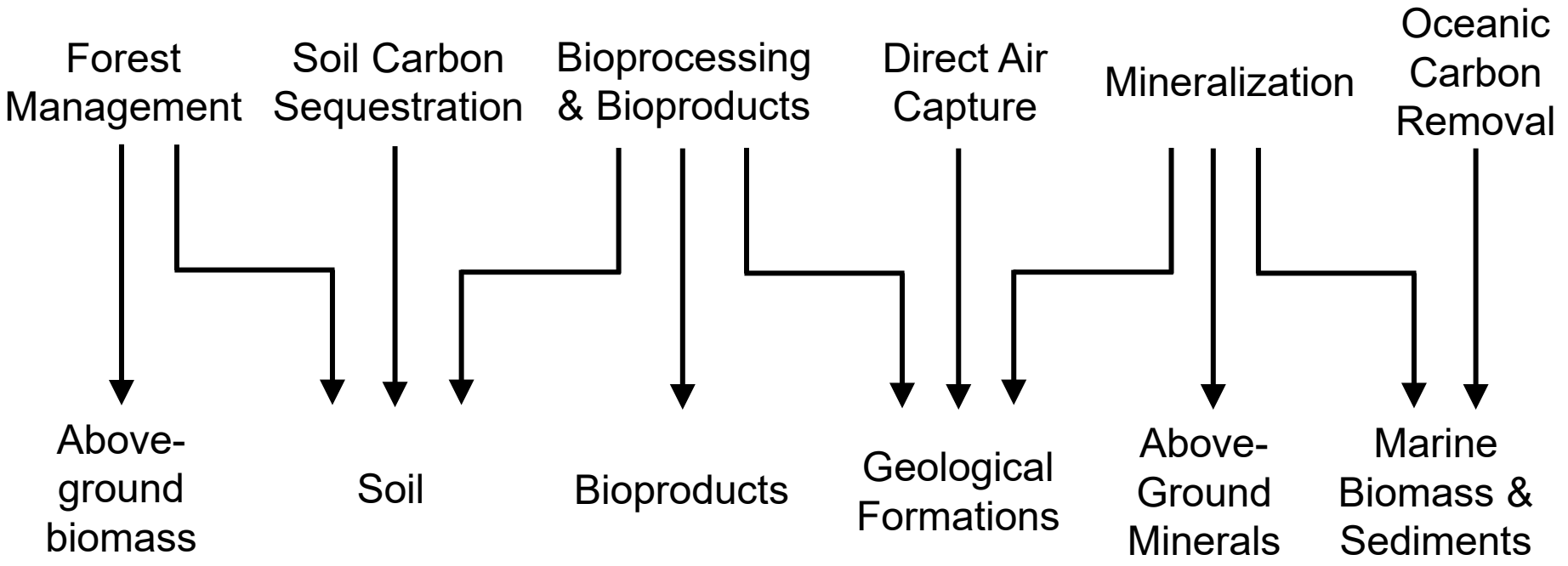
Hydrosphere

415ppm -> 300ppm

CO_2 Removal

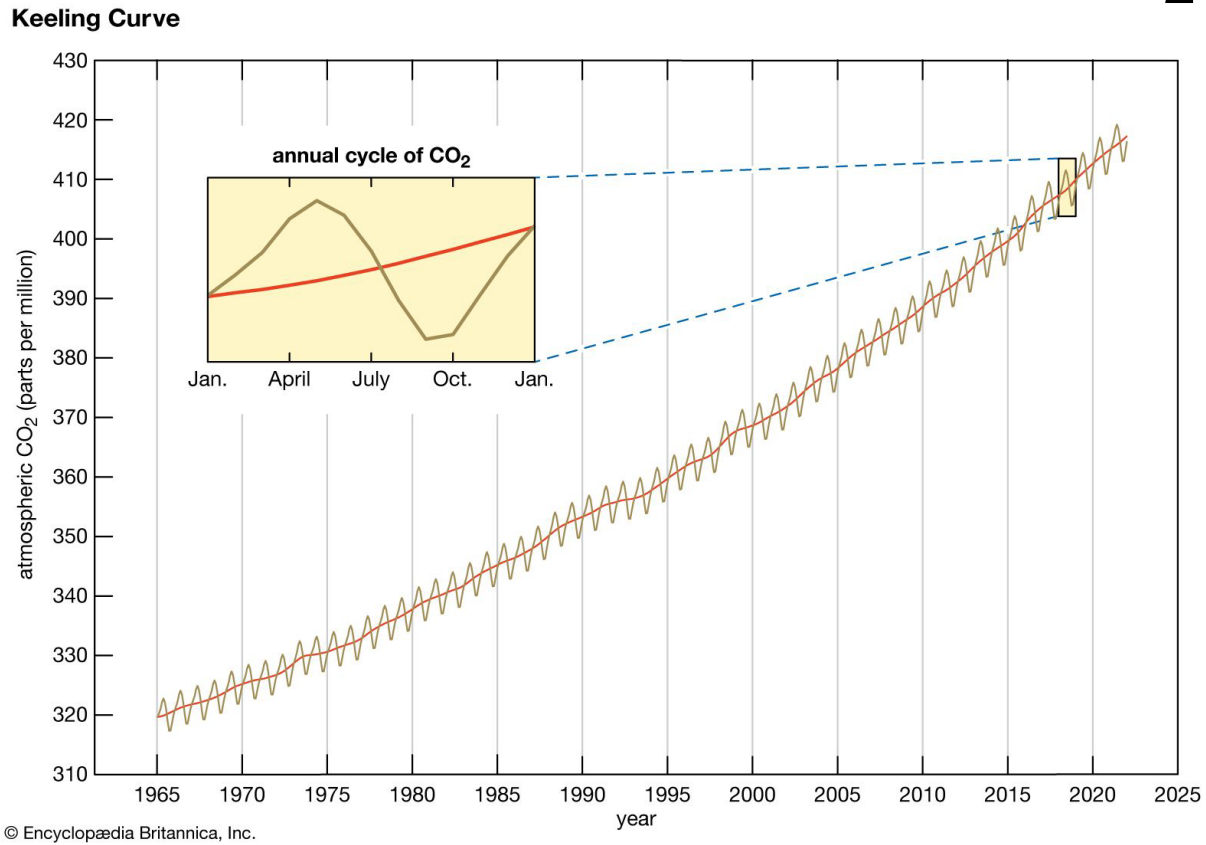
*ppm not to scale**

Carbon Removal Pathways

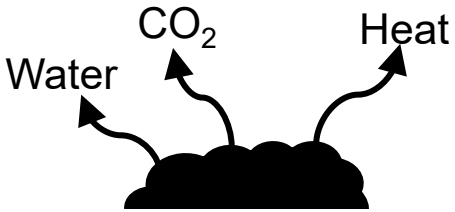


Carbon Storage Mediums

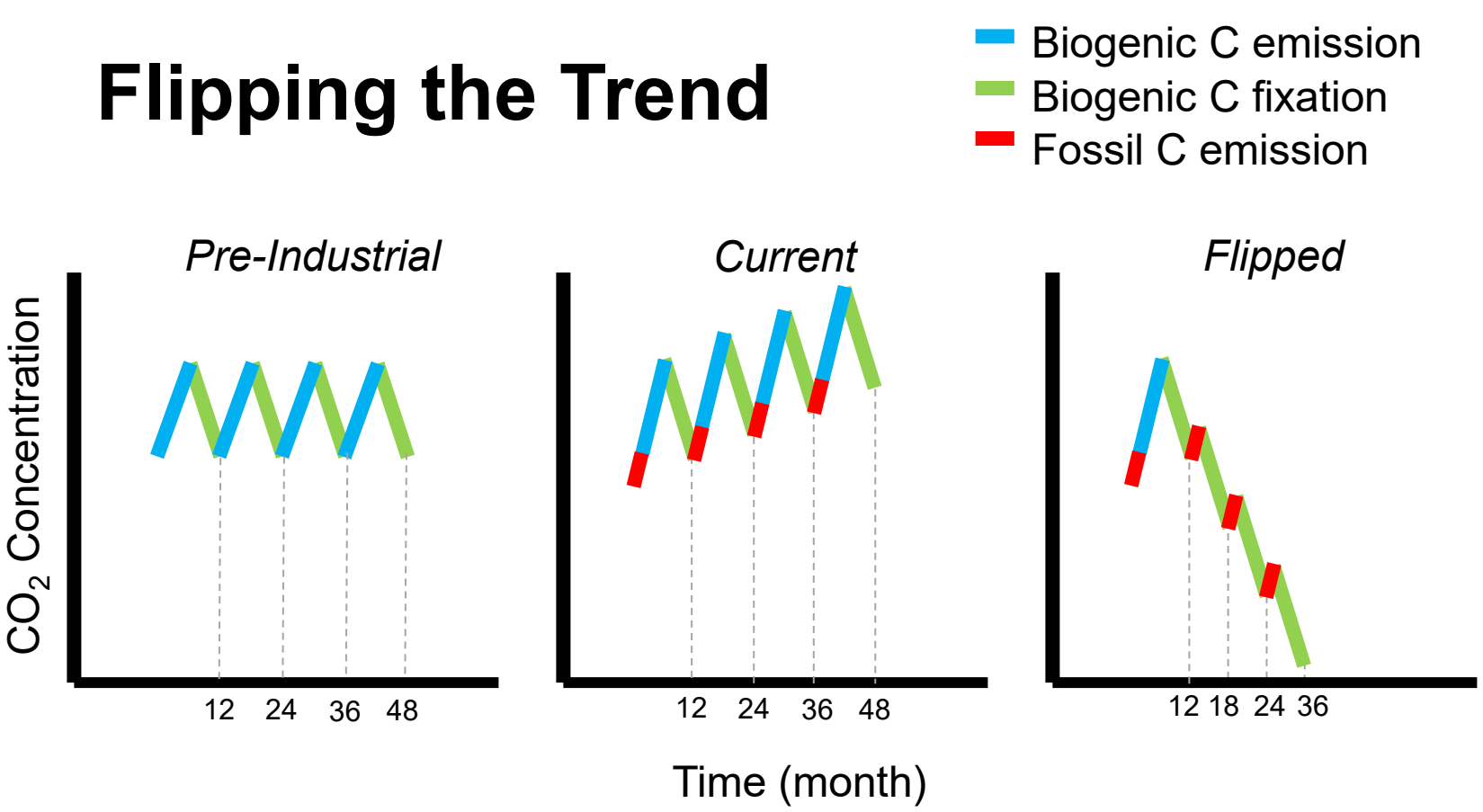
Atmospheric CO_2 Flux



Each year, gigatons of CO_2 are fixed via photosynthesis and emitted via microbial respiration



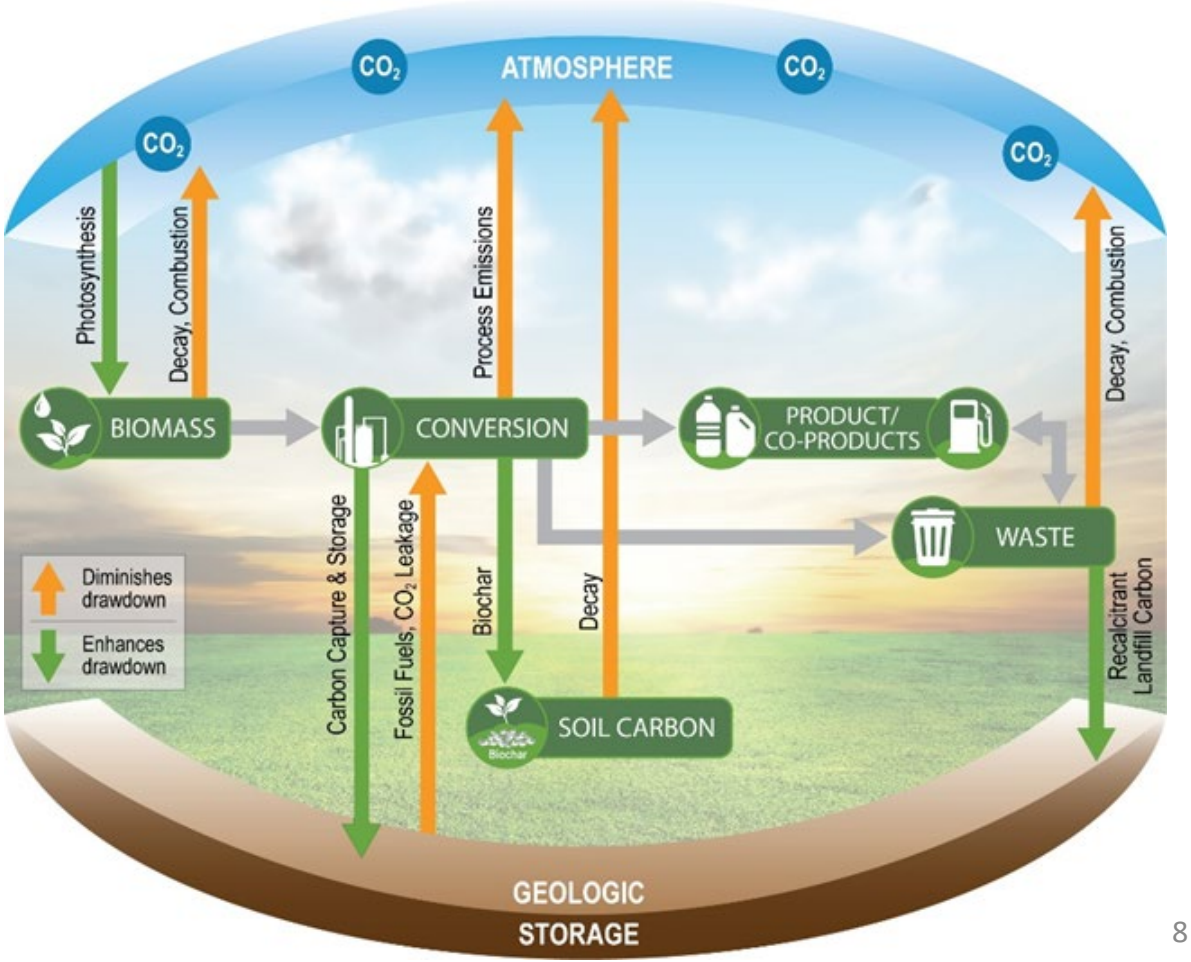
Flipping the Trend



Tracking Carbon in the Bioeconomy

Green arrows: carbon sinks

Orange arrows: carbon emissions



Dees et al. (2023) *Green Chemistry*

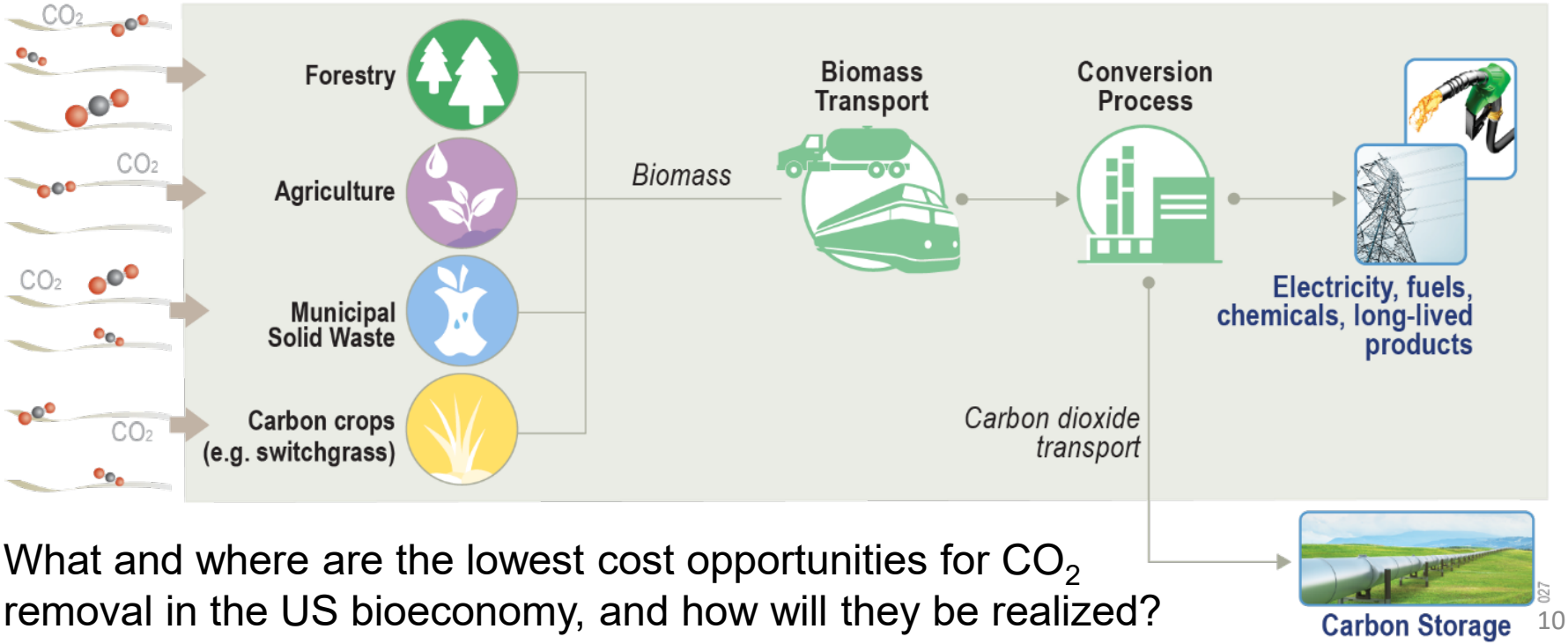
Biomass Carbon Removal and Storage (BiCRS)

- Use biomass to remove CO_2 from the atmosphere
- Store that CO_2 underground or in long-lived products
- Do no damage to—and ideally promote—food security, rural livelihoods, biodiversity conservation and other important values

Bioenergy → Biocarbon
Paradigm shift?

Aines et al. (2021)

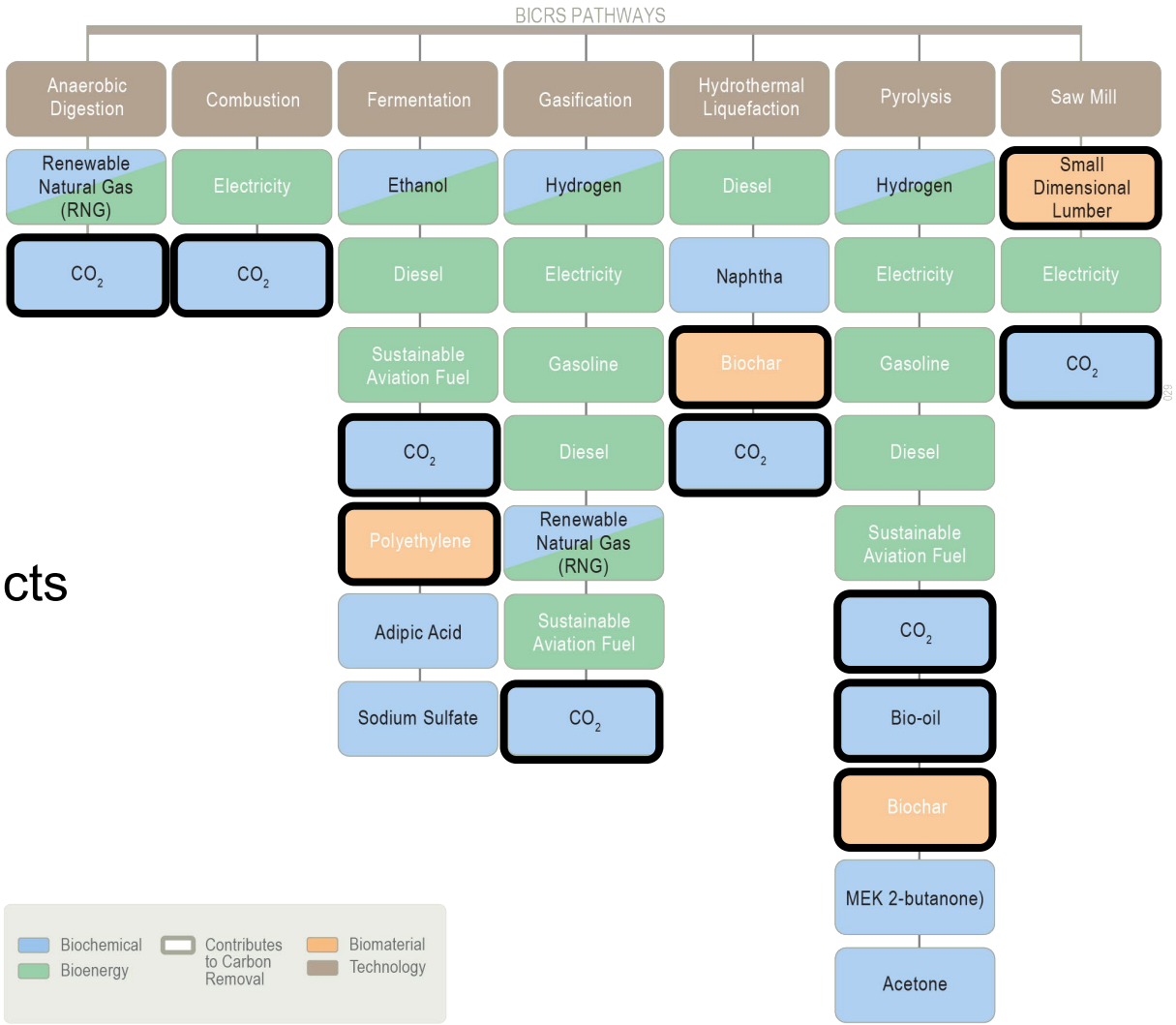
Roads to Removal: A National Assessment of Carbon Removal in the US Bioeconomy



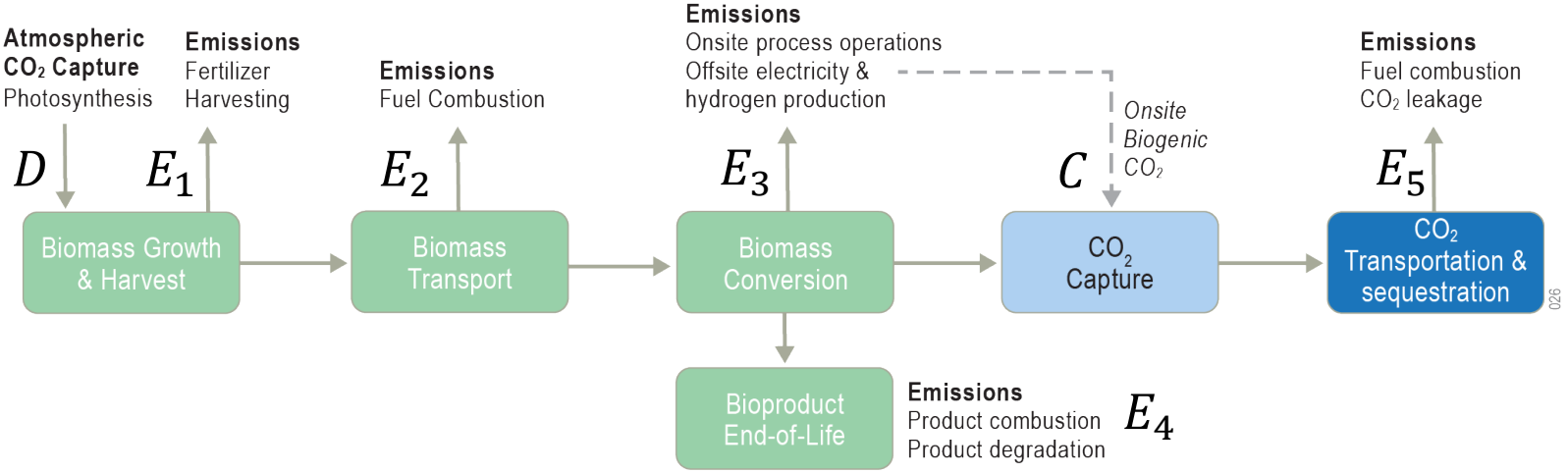
What and where are the lowest cost opportunities for CO_2 removal in the US bioeconomy, and how will they be realized?

BiCRS Technologies

- Seven technologies
- Seventeen bioproducts
- Five bioproducts contribute to carbon removal



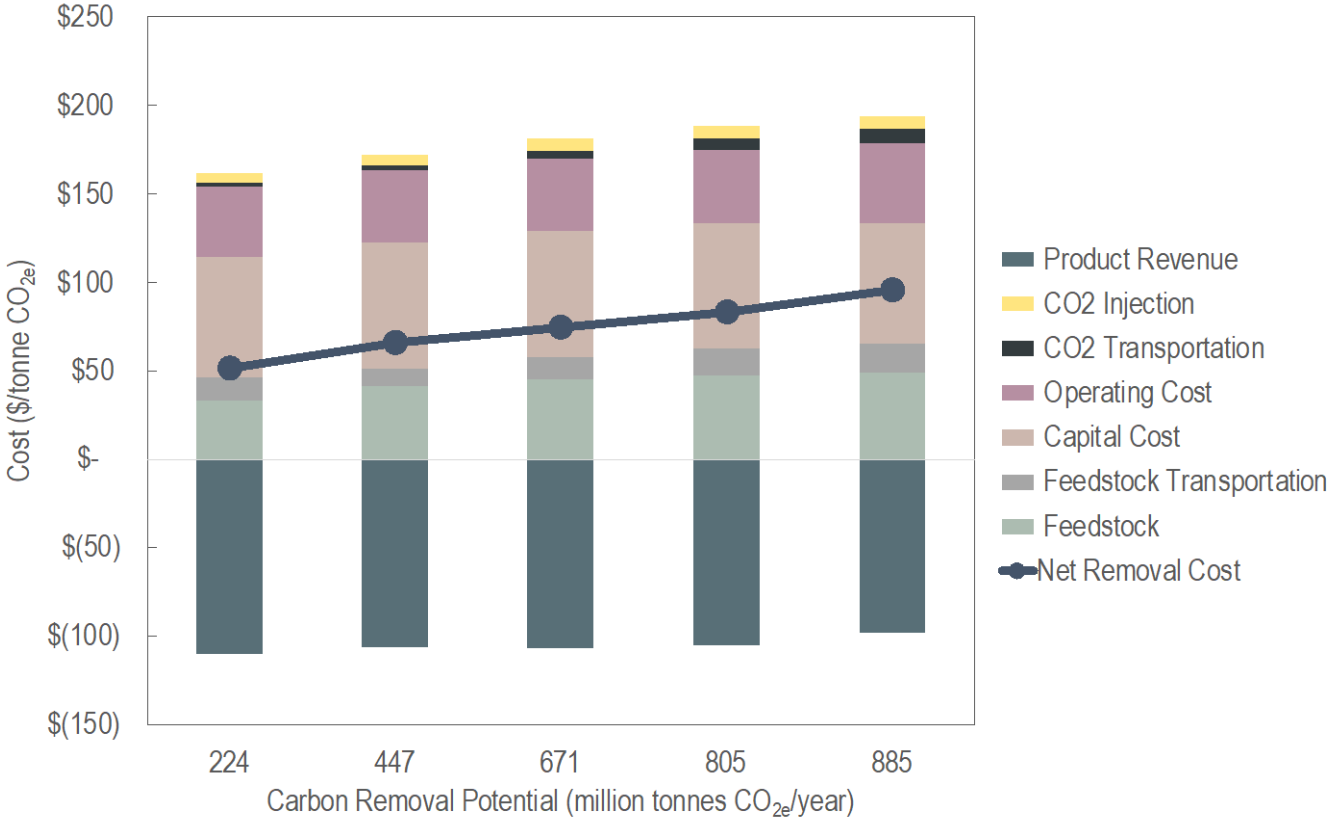
Life Cycle Assessment



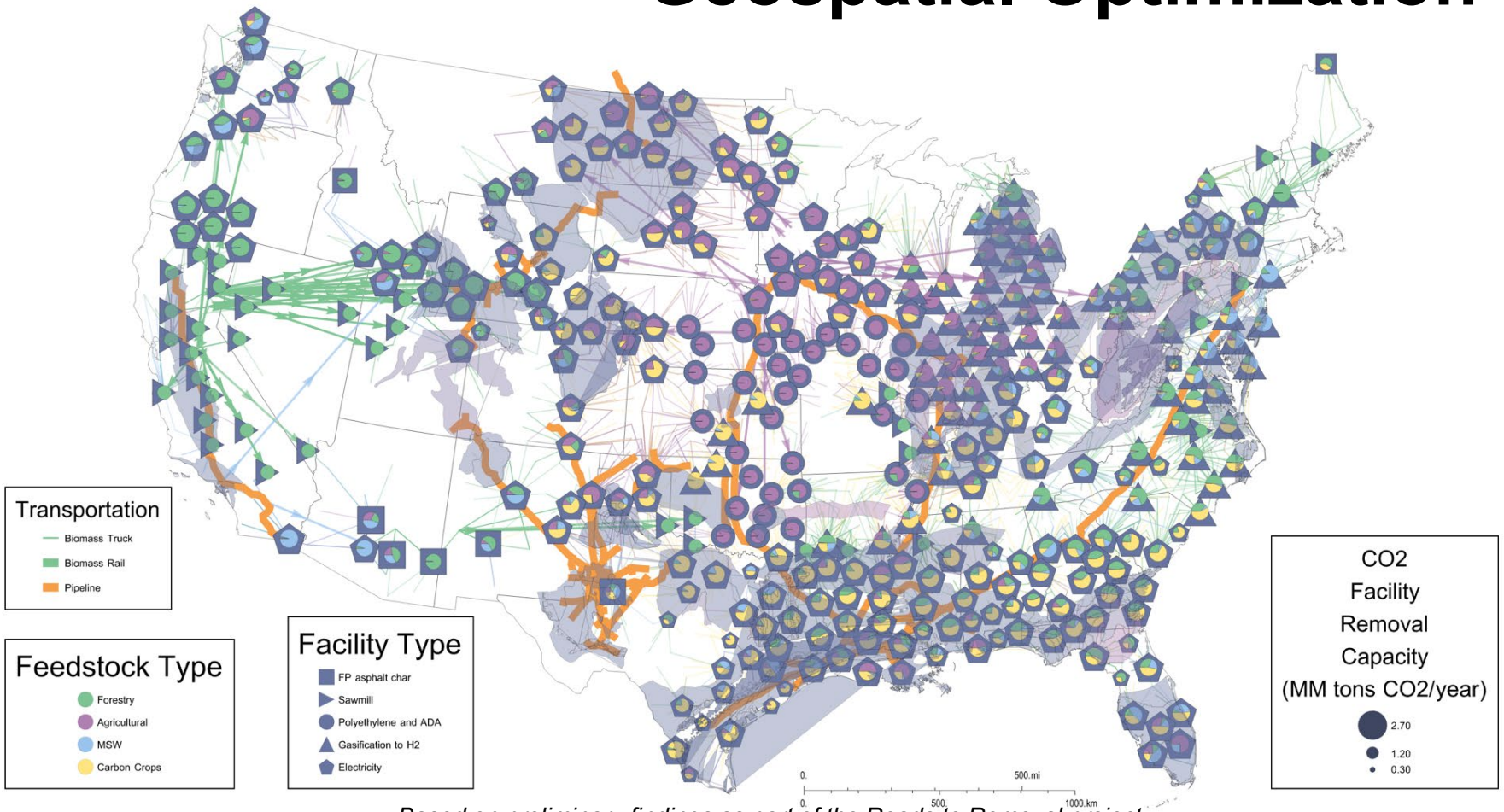
$$Net\ Carbon\ Removal = D + C - \sum_1^5 E\ [=] \frac{tCO_2\ removed}{tBiomass}$$

BIOPRODUCT	CARBON SINK	100 YR CARBON DURABILITY
Carbon Dioxide	Geological Storage	100%
Bio-polyethylene	Product/Landfill	60%
Bio-Oil	Asphalt	77%
Biochar	Soil	80%
Small Dimensional Lumber	Structures/Landfill	50%

Carbon Removal Capacity & Costs

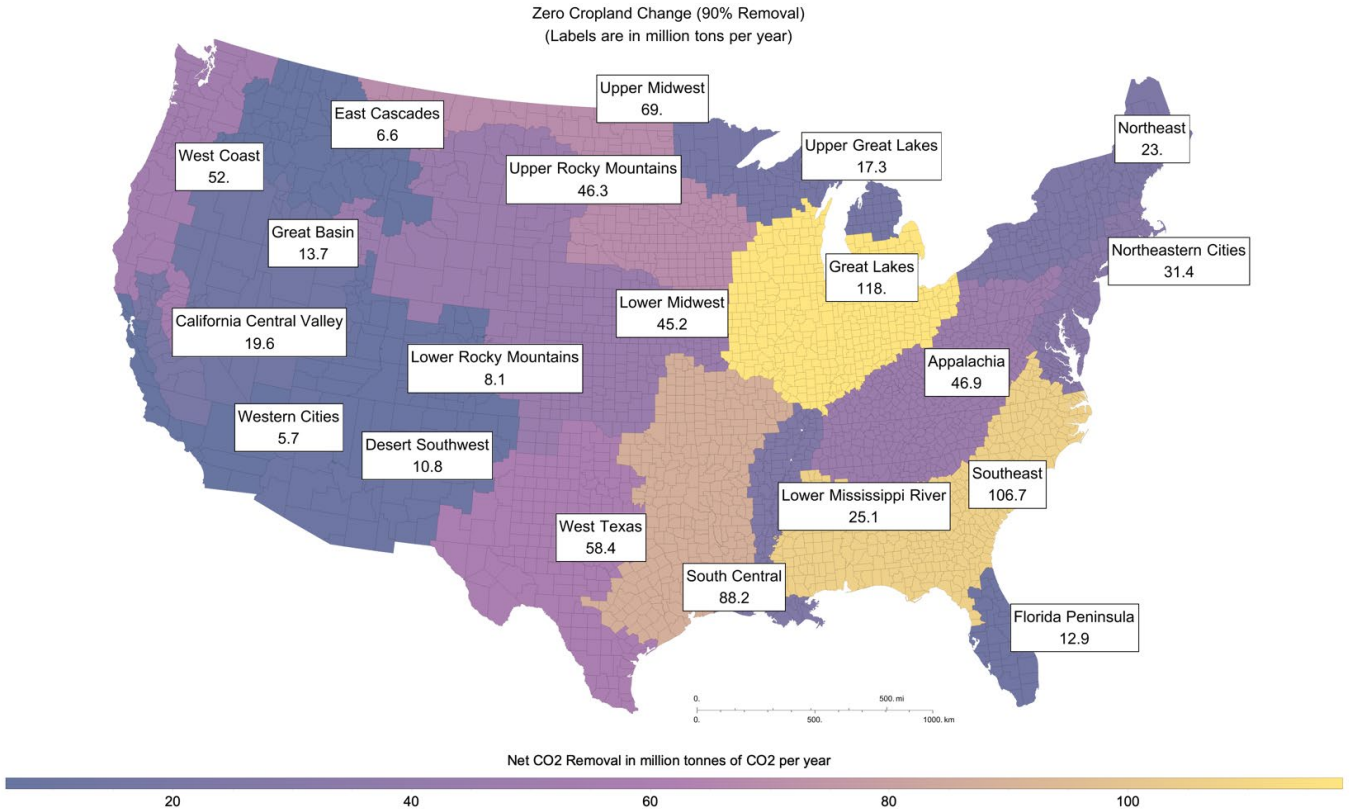


Geospatial Optimization



Based on preliminary findings as part of the Roads to Removal project

Regional Variability



Based on preliminary findings as part of the Roads to Removal project

Summary of Findings

- The US bioeconomy can remove > 800 million metric tons of CO_2 from the atmosphere per year without disrupting food production
- A multitude of biorefining technologies and bioproducts enable long-term carbon removal
- Costs of biomass carbon removal vary between $50 and $100 per tCO_2
- The southeastern region has the 2nd highest potential for carbon removal across the US

Biocarbon Utilization & Sequestration Lab

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