Cleaning up Climate Change

Carbon Dioxide Removal and Practical Climate Resiliency

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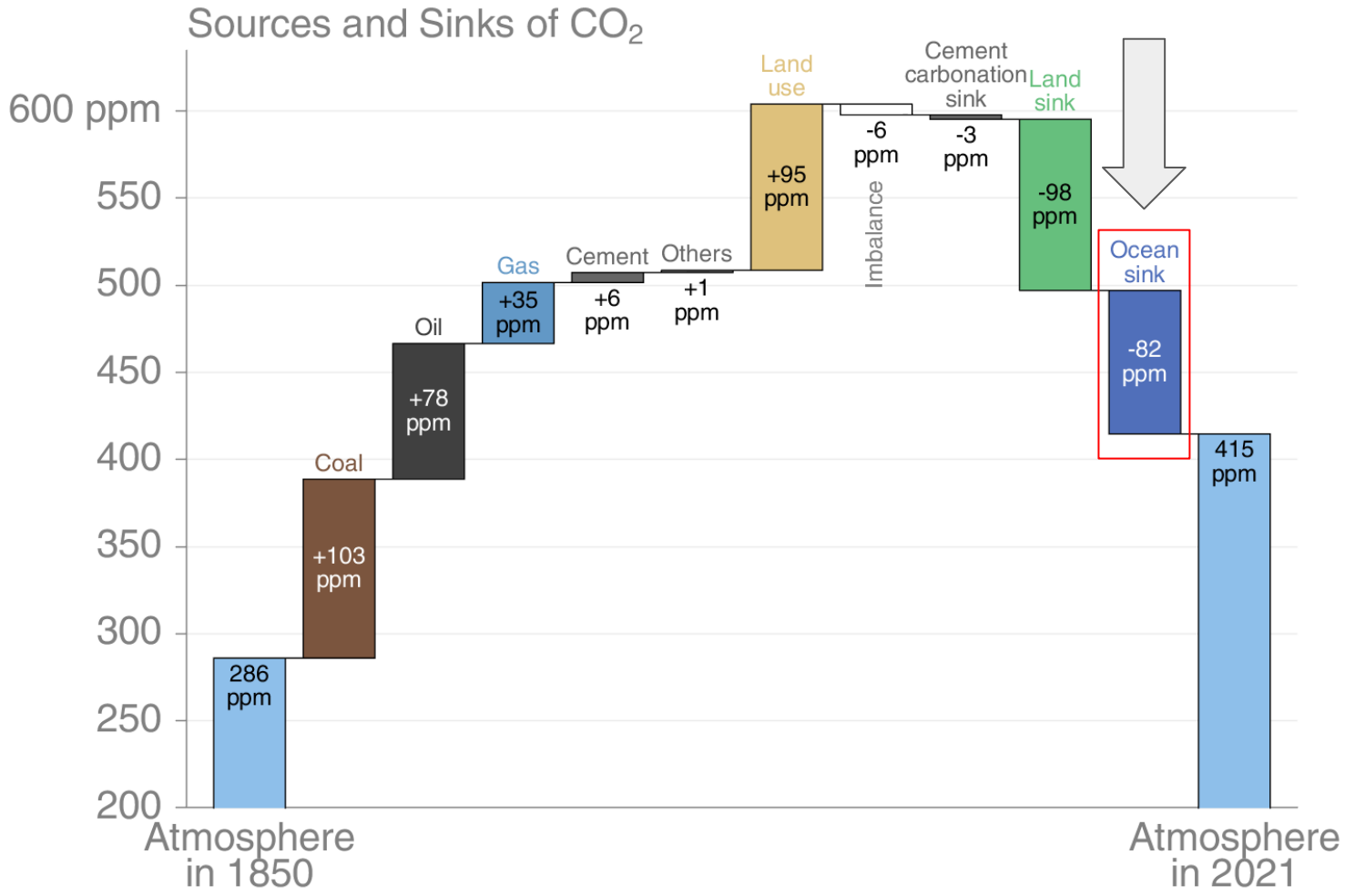
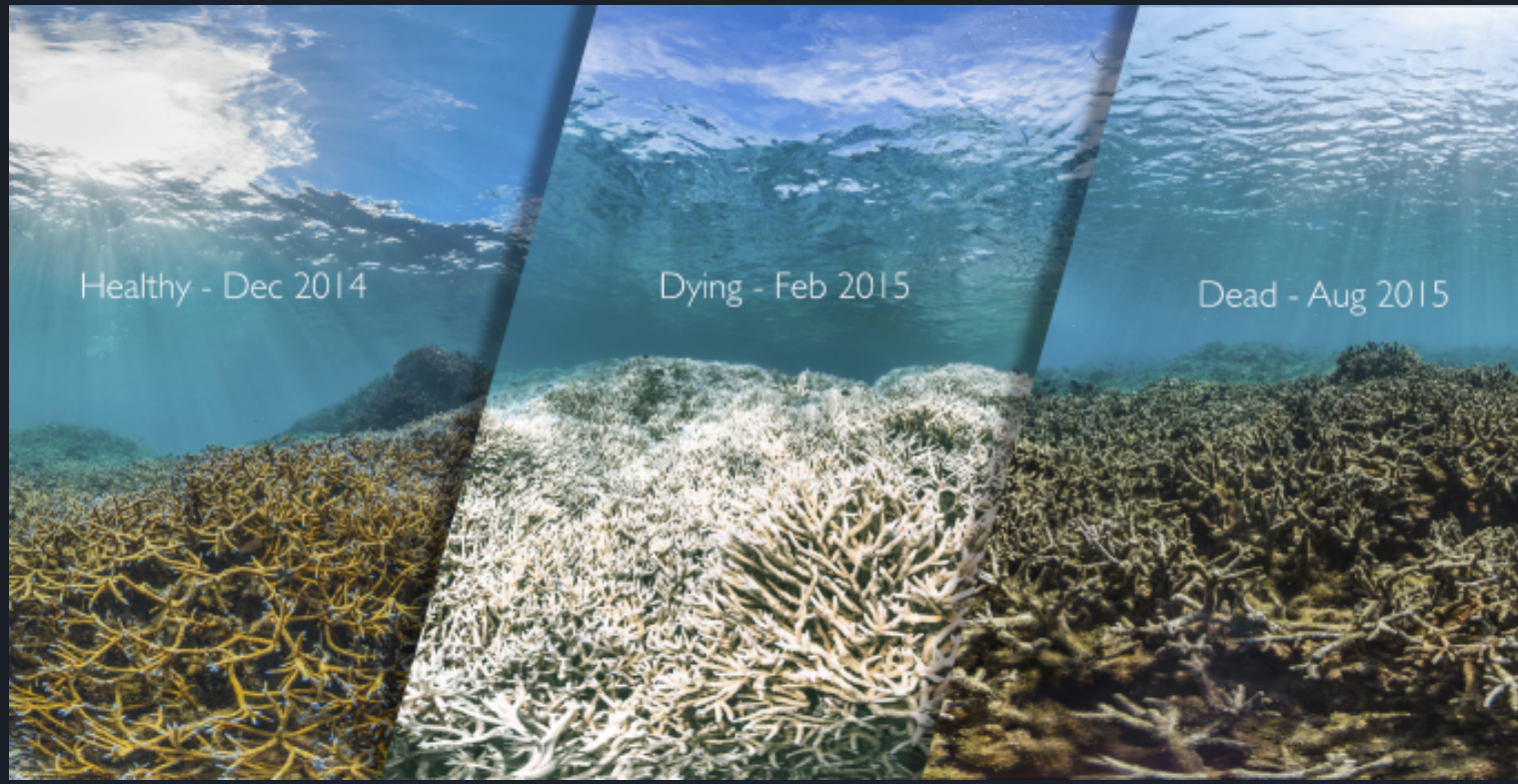
March 2023
ICR23, Columbus, OH

2009:
389 ppm



The Ocean is an asset to our atmosphere.

A key consequence of that service is ocean acidification.

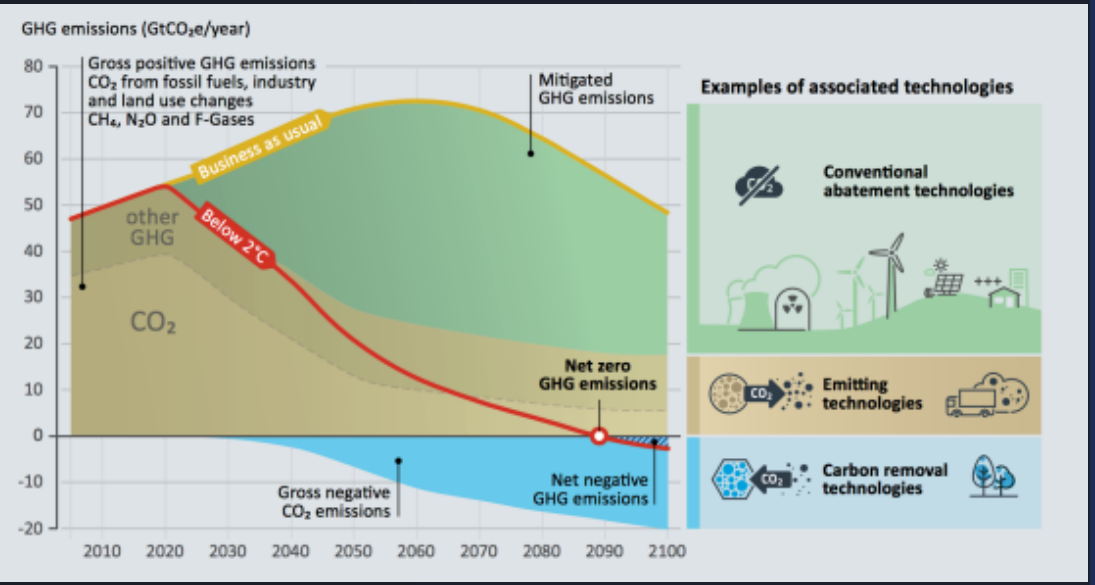


https://coralreefwatch.noaa.gov/satellite/analyses_guidance/global_coral_bleaching_2014-17_images/fig3_american-samoa_before-during-after_2015.jpg

2015:
401 ppm

What do we do?

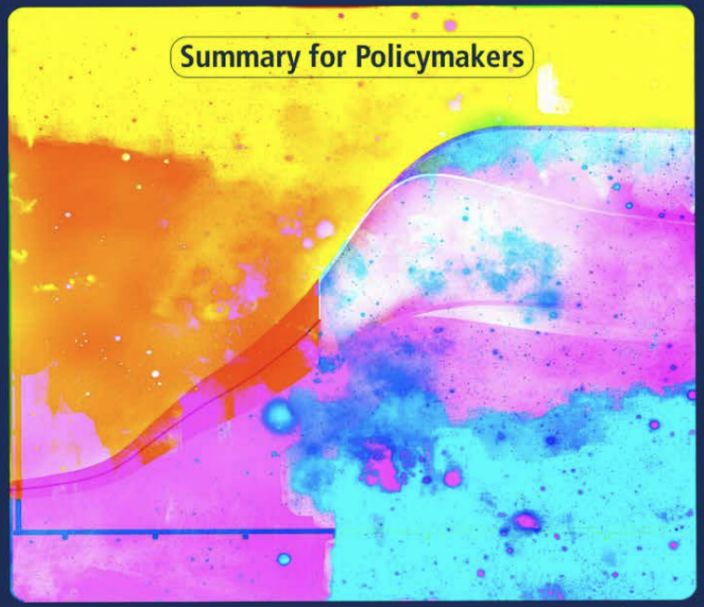
What *can* we do?



ipcc
INTERGOVERNMENTAL PANEL ON climate change

Global Warming of 1.5°C

An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty



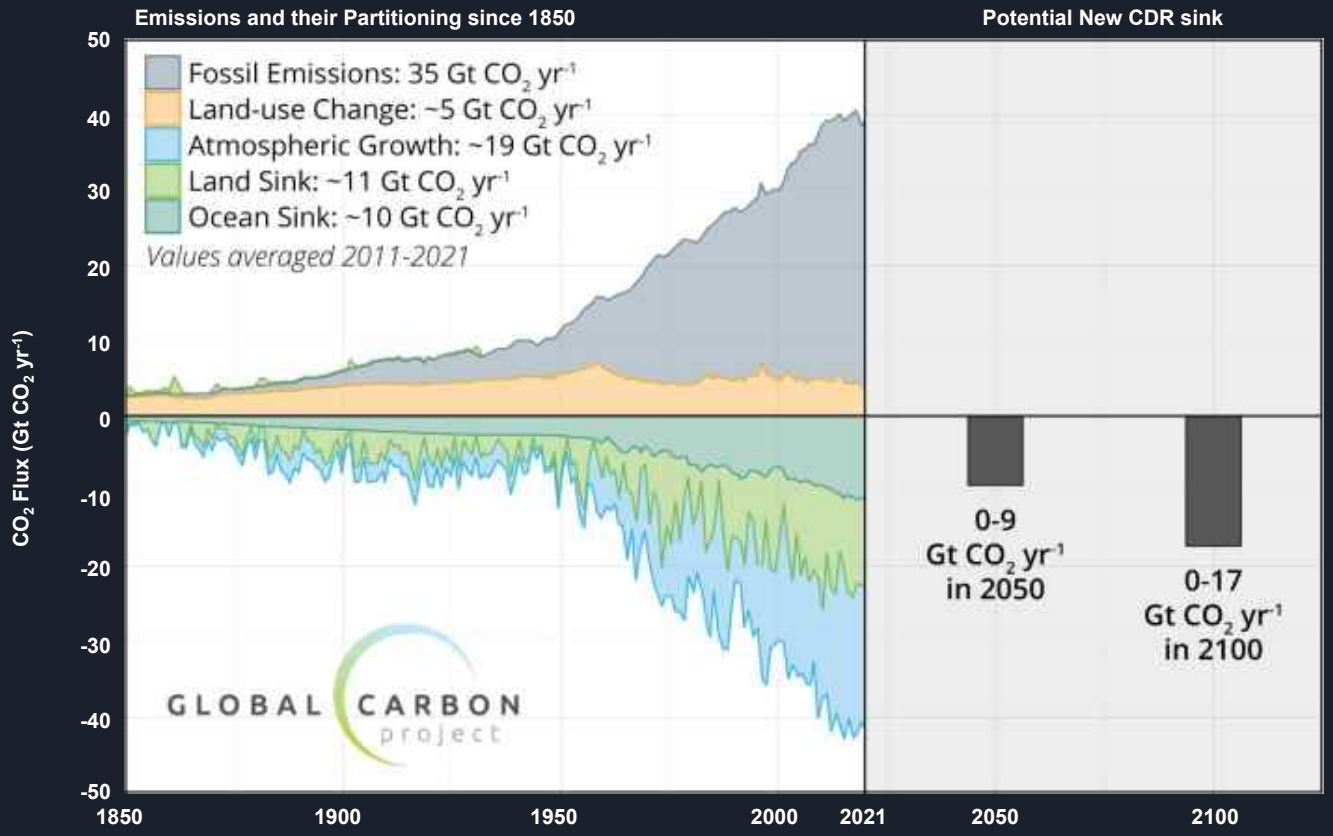
WG I WG II WG III

WMO UNEP

Can Kelp Help?

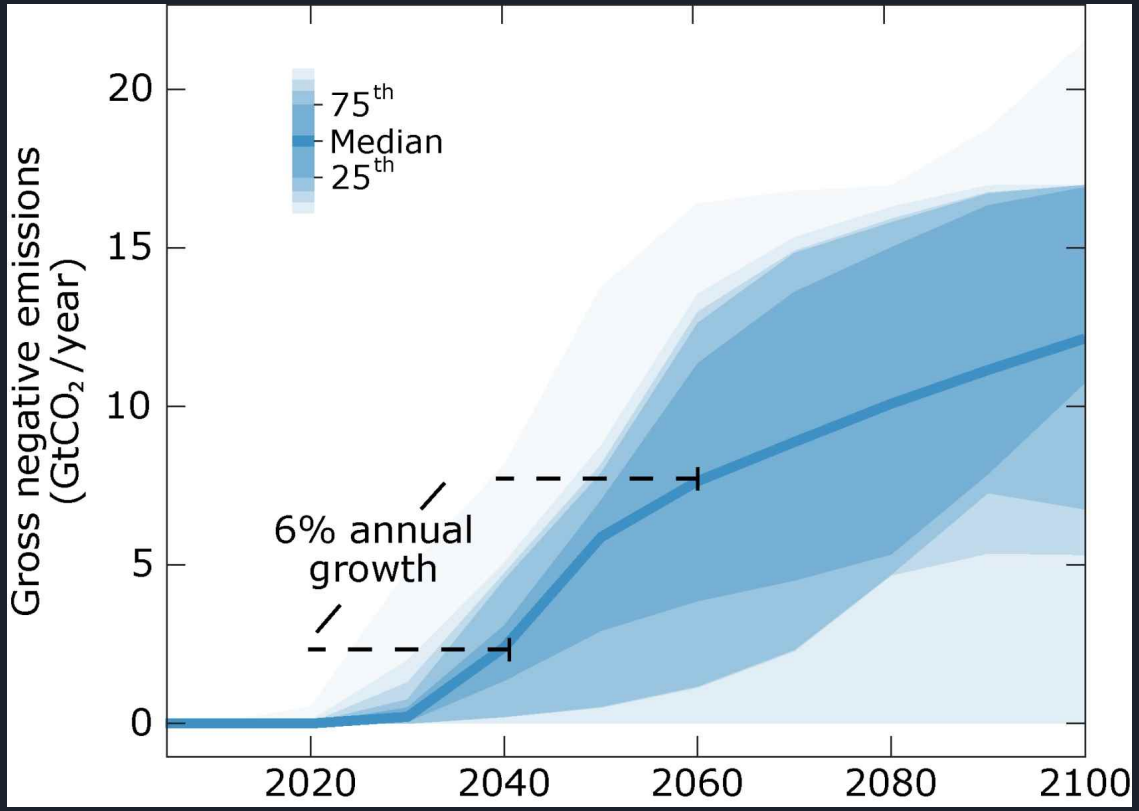
UNITED FISHERMEN OF ALASKA

It will be *very difficult* to double the land and ocean sinks for carbon.



From Friedlingstein et al., 2021

From Minx et al., 2018



Doing so will require 6% annual growth per year in negative emissions, in addition to emissions reductions.

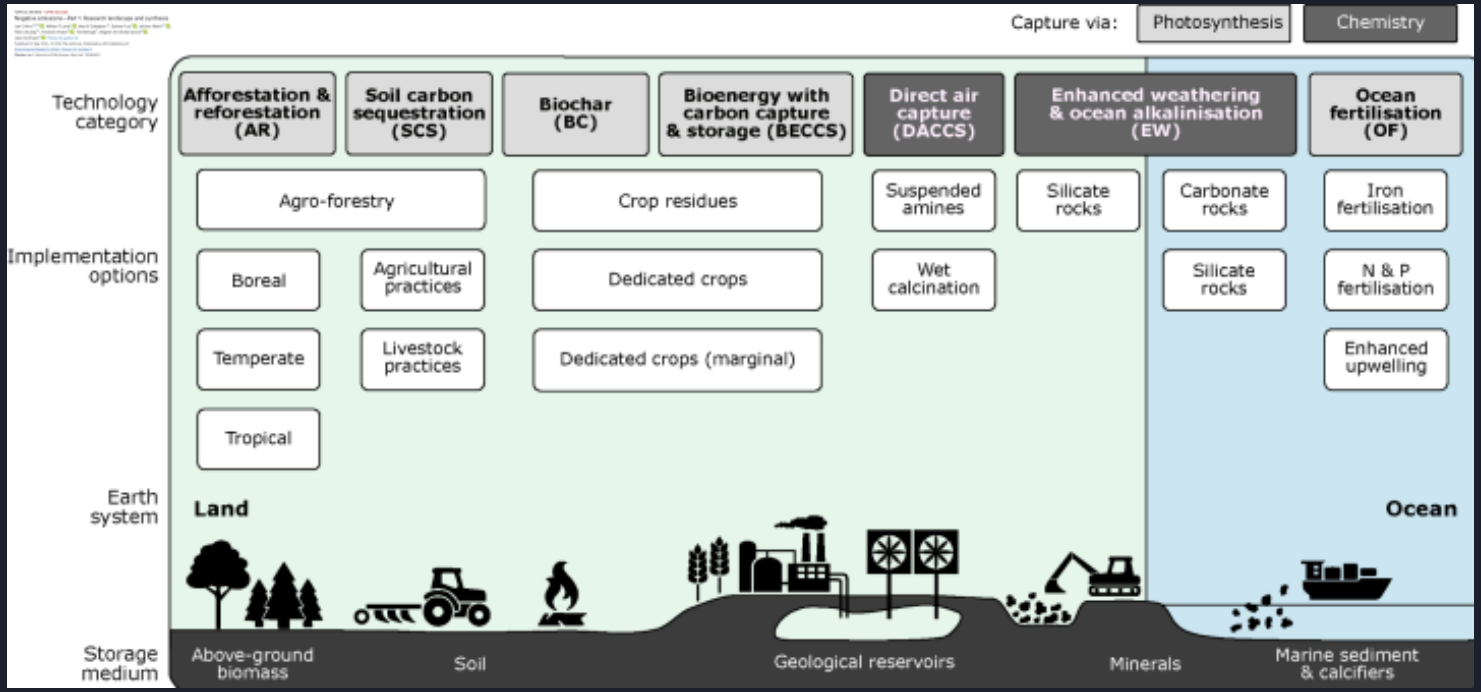
2020:
413 ppm

“I want to make Alaska the mariculture capital of the world.”

–Gov. Dunleavy

How can we remove enough carbon from the atmosphere?

Can CDR be safe, sustainable, and fair?



There are many ways to remove carbon from the atmosphere

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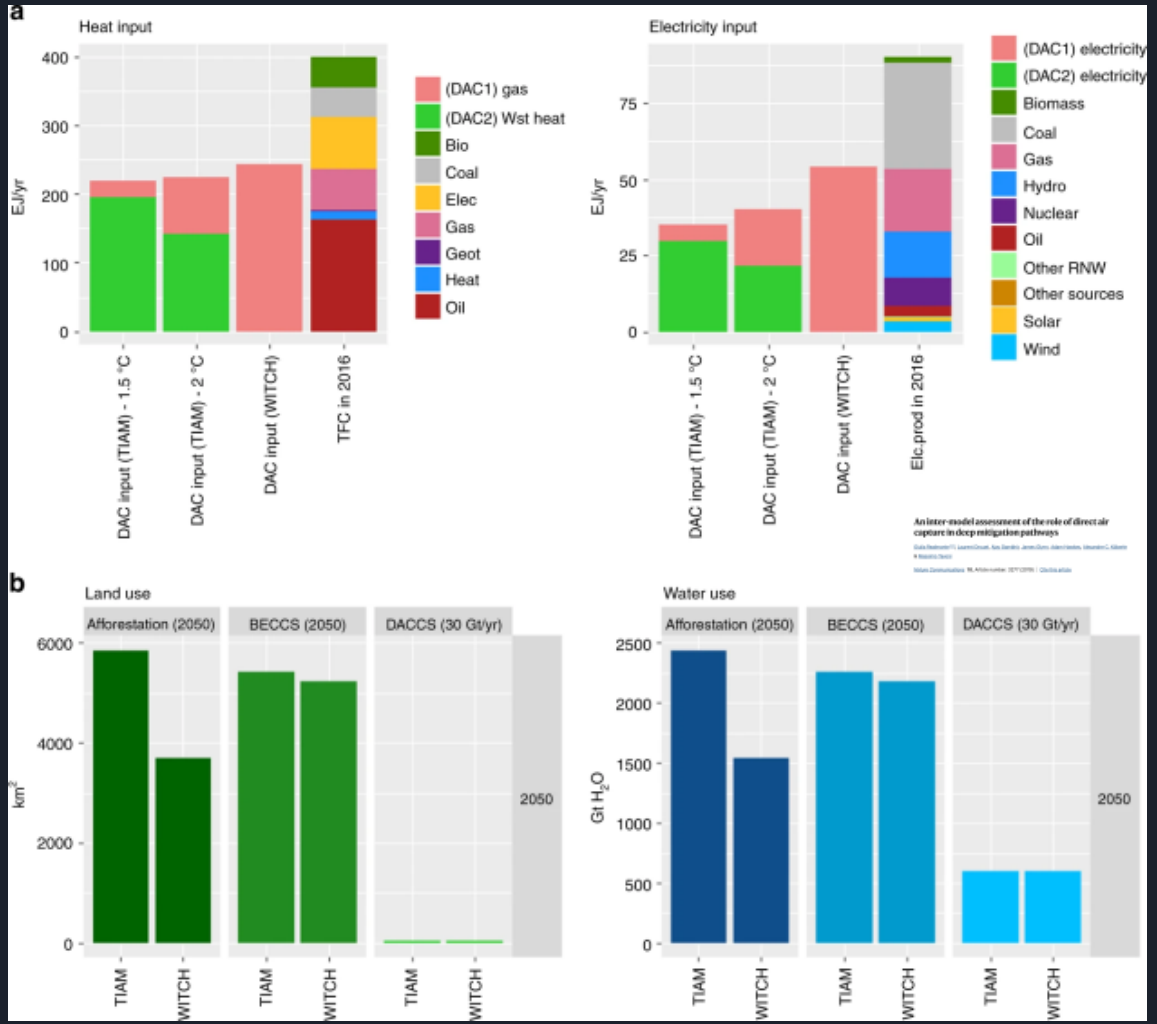
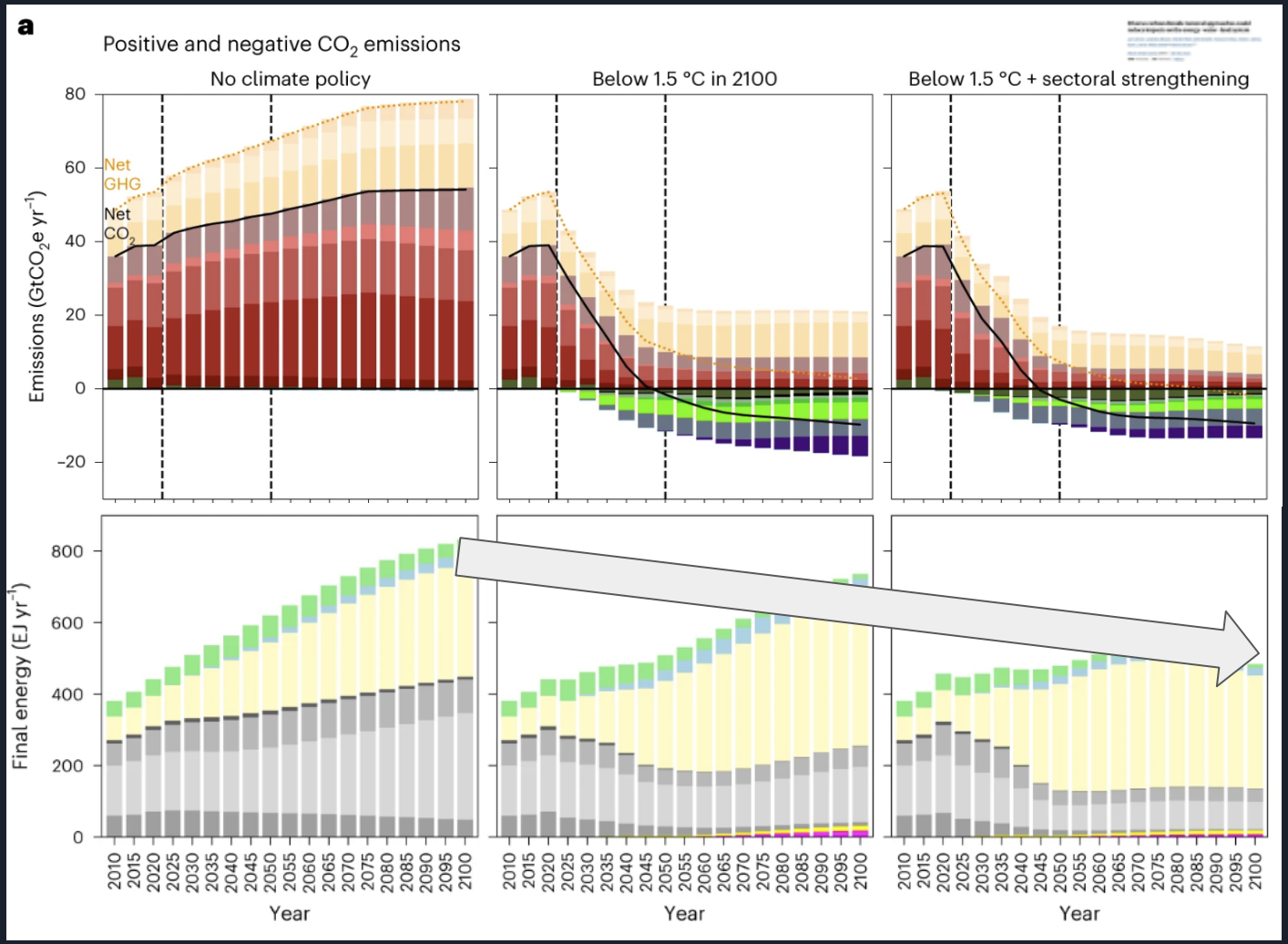
Some have important costs, such as high energy, water, or land use requirements.

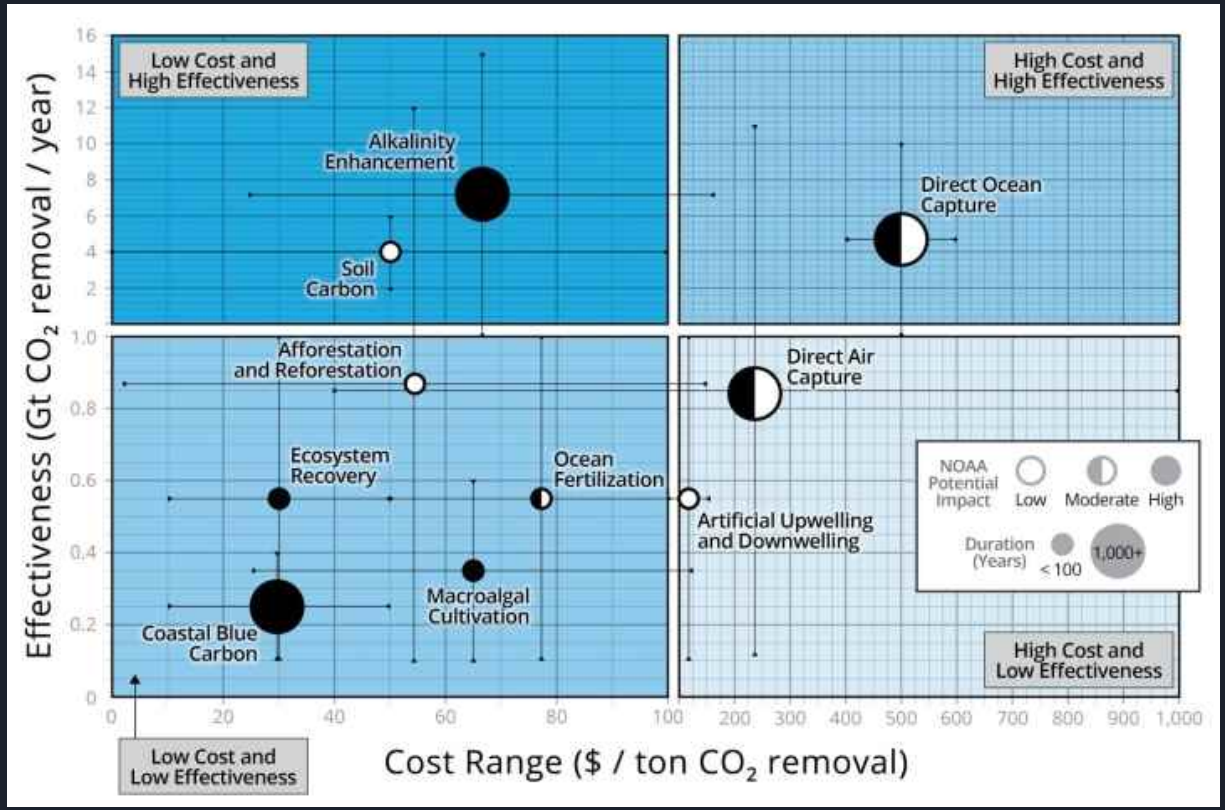


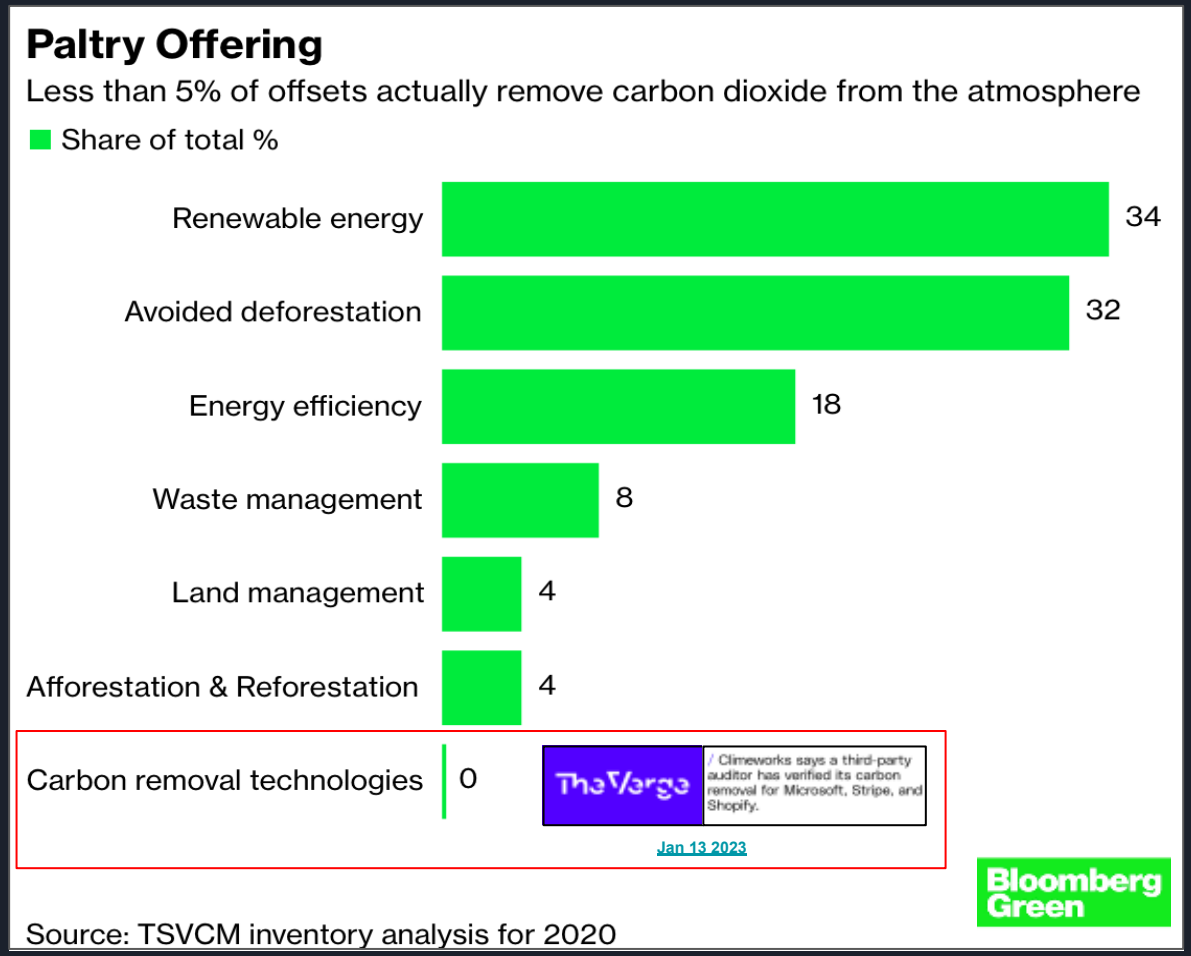


A diverse portfolio– and the right incentives– can limit these pressures.

SUSTAINABLE DEVELOPMENT GOALS

Cheap, effective, and durable methods could have the highest potential impact.





One key challenge of CDR implementation is measuring the actual removal part.

This is especially true for ocean or marine CDR, and this is reflected in market settings.

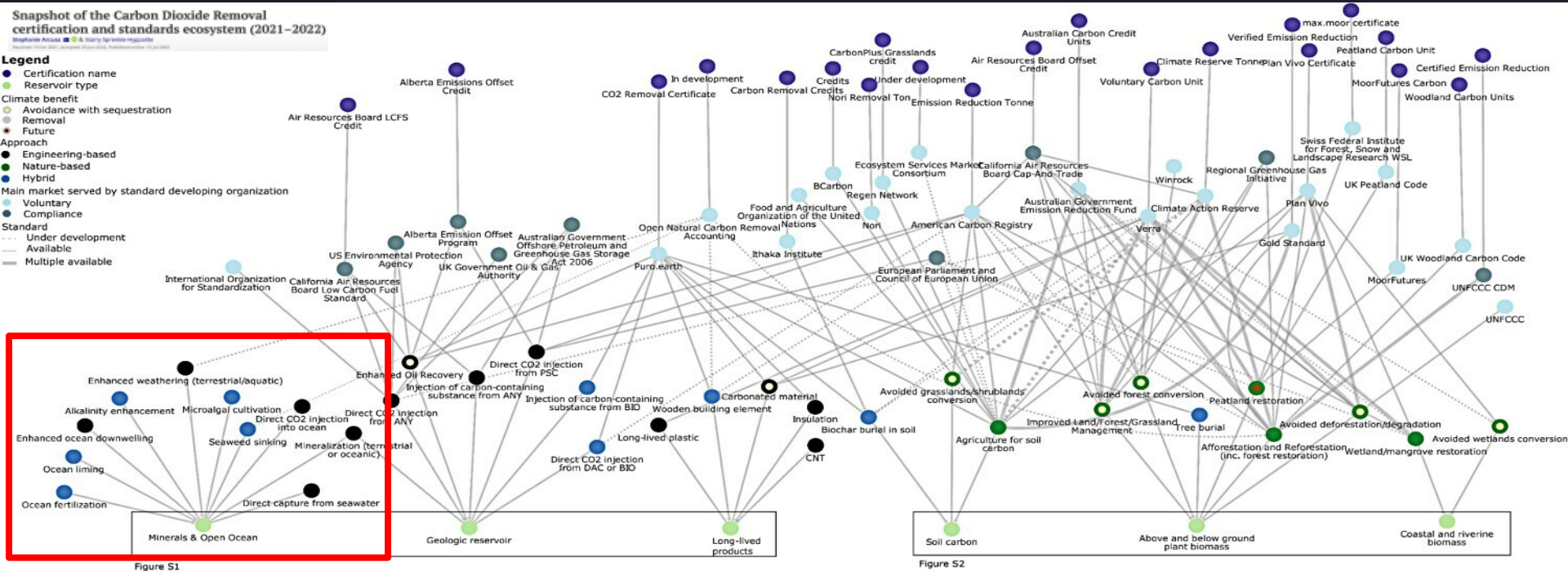
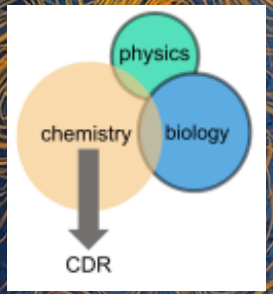
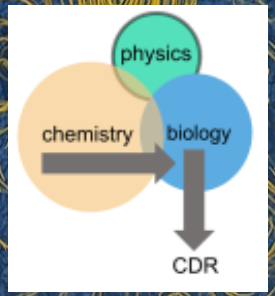
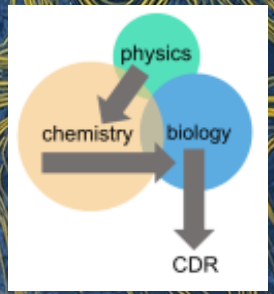


Figure S1

Figure S2



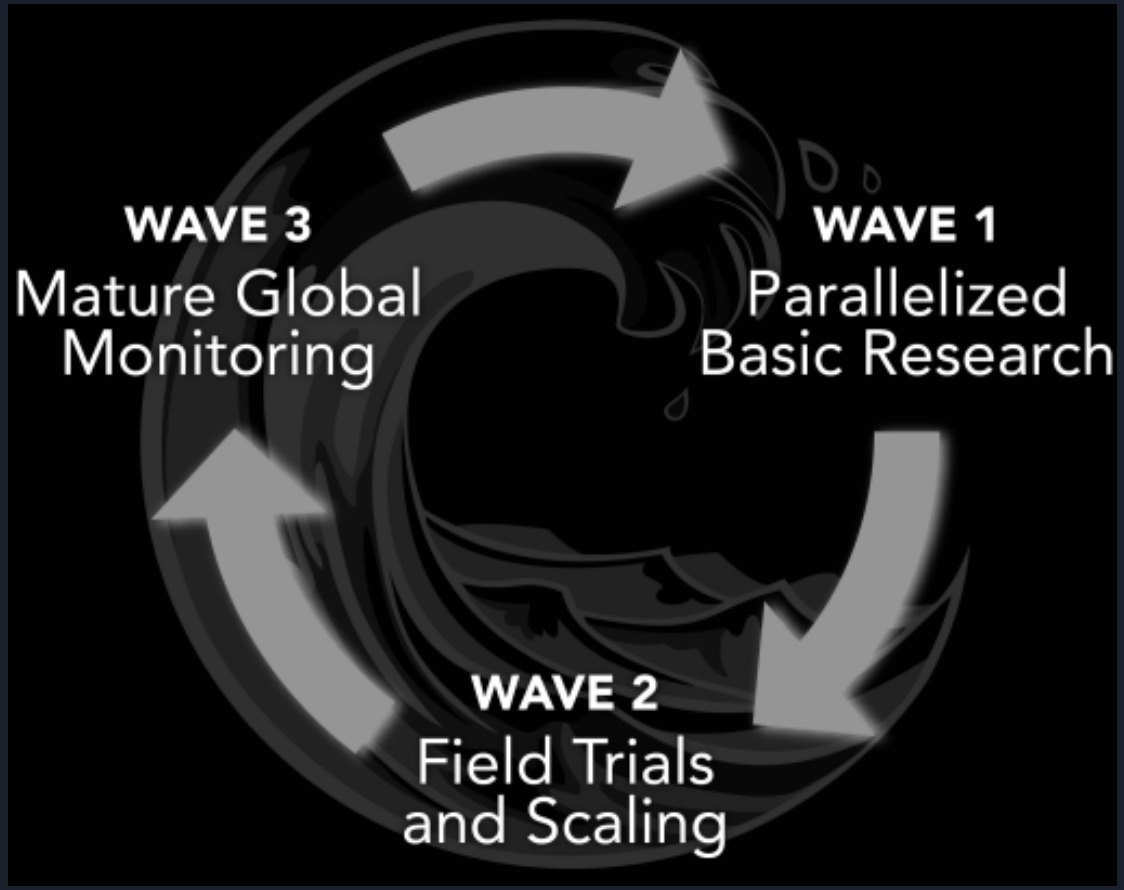




Why is it so difficult to measure carbon removal?

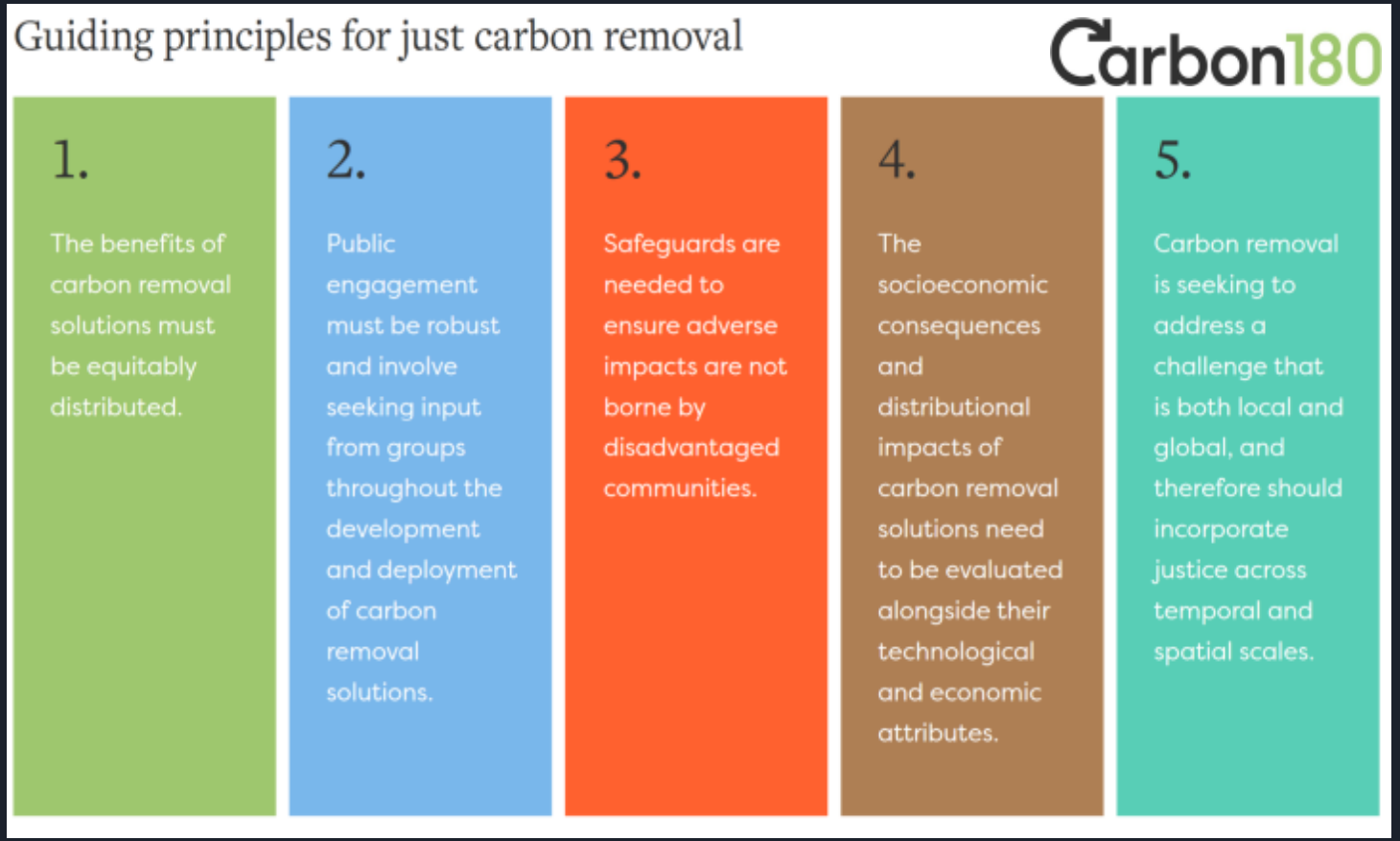
If we're going to learn how to measure CDR, we need new tools.

Current NOAA Assets		Development Necessary for CDR	Potential Impact of new NOAA CDR Research
Observing Networks	**Global Atmospheric and Ocean Observing (e.g., GGGRN; GO-SHIP; Argo; GOA-ON)**	Fill regional gaps; develop deep-sea monitoring network	NOAA continues to verify global Carbon Budget at necessary scales to identify CDR
	Local Atmospheric and Ocean Observing (e.g., CarbonTracker; IOOS RAs; NOA-ON)	Expand to many more sites for comprehensive local-scale monitoring at CDR installations	NOAA verifies, monitors impact of single CDR projects
	Technology Development Programs (e.g., DART; ITAE)	Early investment and partnerships with industry, other agencies	NOAA catalyzes global CDR monitoring and verification potential (e.g., trading accredited offsets)
Modeling, Scaling, and Projection of CDR Pathways	**Earth System Models (e.g., CMIP6) and regional models (e.g., ROMS)**	New CDR-specific modeling packages	NOAA projects near-term and long-term CDR impacts to identify changes, risks, cobenefits for earth system
	Process study models	Development of virtual "testbeds" for CDR research	NOAA designs quality process studies for investigating the impacts of experimental CDR methods
Environmental Impacts	**National ecosystem monitoring programs**	Expand to many more sites for comprehensive local-scale monitoring at CDR installations	NOAA verifies, monitors environmental impacts of single CDR projects
	Ecosystem modeling	Modify ecosystem models to evaluate the effect of CDR	NOAA projects impacts of CDR on marine ecosystems
	Laboratory research	Design and implement CDR-specific experimental studies for key species	NOAA identifies environmental risks, cobenefits of single CDR projects
Decision Support	**Data management and synthesis (e.g., NCEI, OCADS)**	Data preservation, interoperability and compatibility, discovery and access, quality control and synthesis	Bridging the gap between observations and subsequent research, MRV efforts to account for carbon credits, and decision support based on these data
	Marine Spatial Planning (e.g., NCCOS, OCM)	Apply new CDR knowledge using existing spatial planning tools	NOAA resolves use conflicts, enhances decision support for CDR implementation requests
	Aquaculture Research, Development, and Policy	Development of sustainable farming methodology; expanded permitting support	NOAA maximizes sustainable coastal marine services
	Collaborative Research and Stakeholder Engagement (e.g., SeaGrant)	Improve pathways for stakeholder participation in NOAA CDR Research	Research reflects stakeholder needs
	Blue Carbon Conservation (e.g., CCAP)	Fill local gaps; conserve existing natural carbon storage sinks	NOAA protects and restores existing natural carbon sinks



Creating the right space for CDR to flourish will require new models for research and partnerships.

Safe, sustainable, fair CDR will keep people at the forefront.



That means we need You.

2022:
417 ppm…

…Still not too late.

Questions and Discussion