



Seminar Series

June 21, 2023

This session is being recorded

I-WEST is a collaborative initiative with partners across the Intermountain West

Co-led by Los Alamos National Laboratory and the University of Wyoming School of Energy Resources



Jolante Van Wijk
Los Alamos National Laboratory

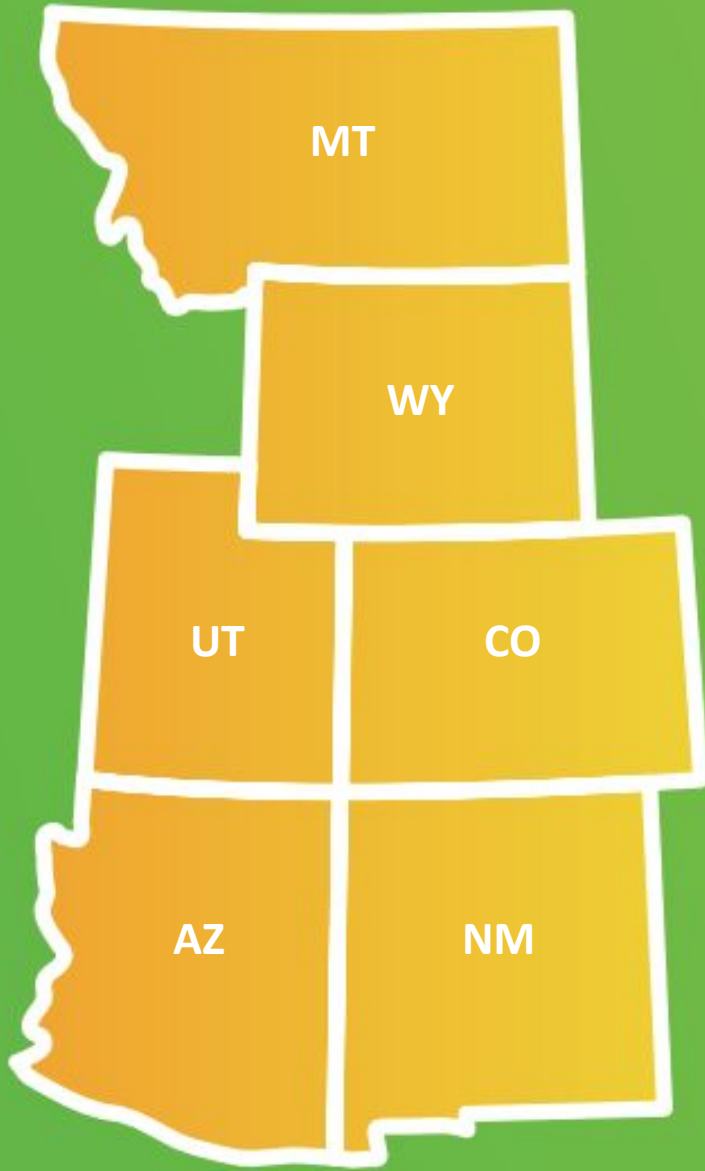


Scott Quillinan
University of Wyoming



I-WEST provides Intermountain West states with data, tools, and information for energy transition planning

- Place-based approaches focus on the unique geographical, environmental, and demographic attributes of the region
- Technology-neutral approach leverages opportunities across numerous symbiotic energy economies
- Integrated approaches to assessing technology readiness in tandem with societal readiness for a just and equitable energy transition
- Community engaged research and coalition building to encourage regional partnerships



Why should I trust you?

The why, what, and how of carbon sequestration certification



Dr. Stephanie Arcusa Arizona State University

- Postdoctoral researcher in the ASU Center for Negative Carbon Emissions
- Trained as a climate and earth scientist to measure change in natural complex systems
- Focused on on climate transitions and the design of certification for carbon sequestration as a tool to stabilize climate change

Featuring key findings from the
I-WEST Phase One report



the center for negative carbon emissions

Why should I trust you?

The why, what, and how of carbon sequestration certification

 **Julie Ann Wrigley**
Global Futures Laboratory™
Arizona State University

Dr. Stephanie Arcusa
Center for Negative Carbon Emissions
Arizona State University

**Carbon sequestration underpins global
climate mitigation efforts**

Only through robust certification programs will we know we are successful.

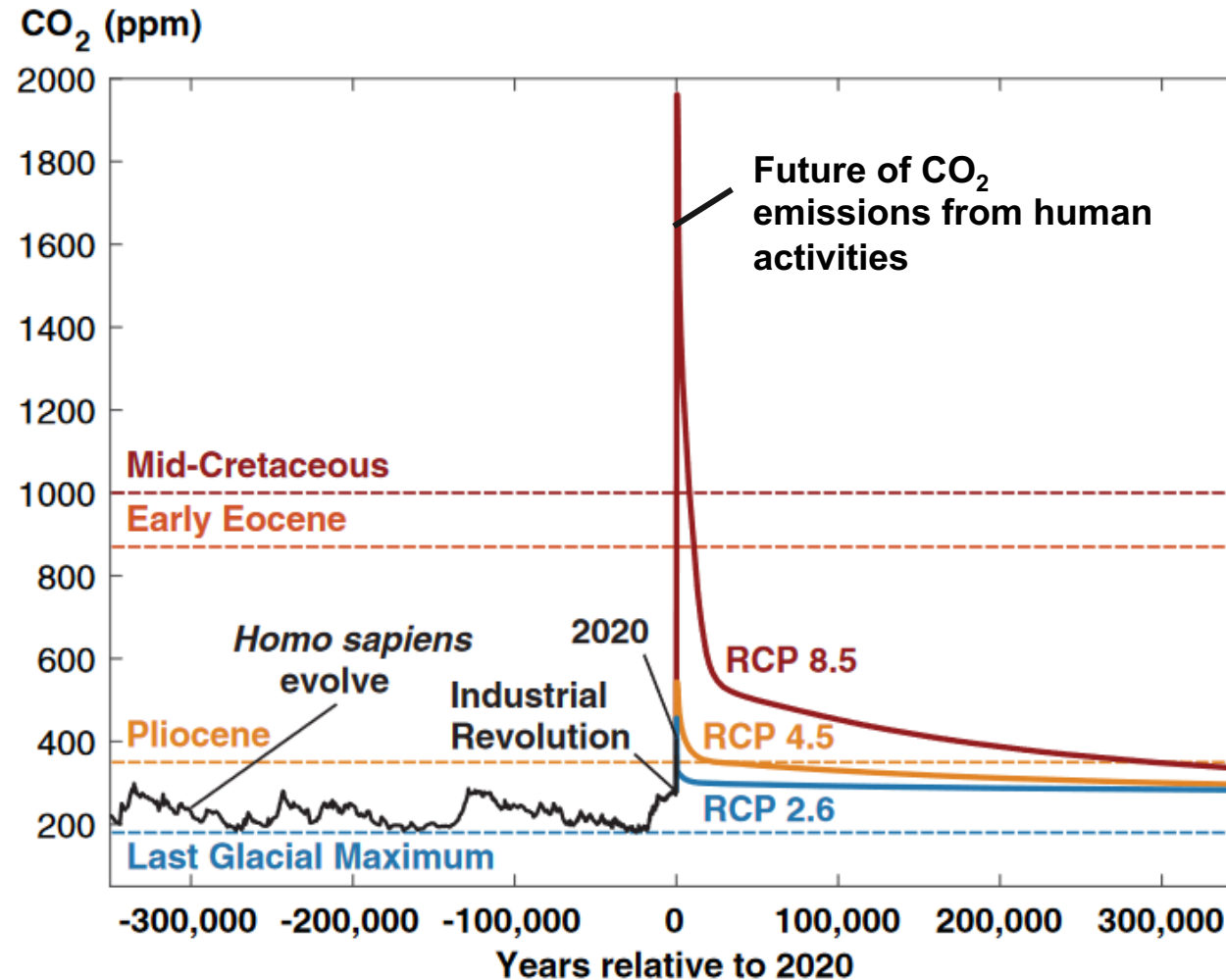
Most of the world is now experiencing impacts of climate change



The main driver of climate change is the unmitigated waste stream of CO₂ resulting from the still rising consumption of fossil fuels

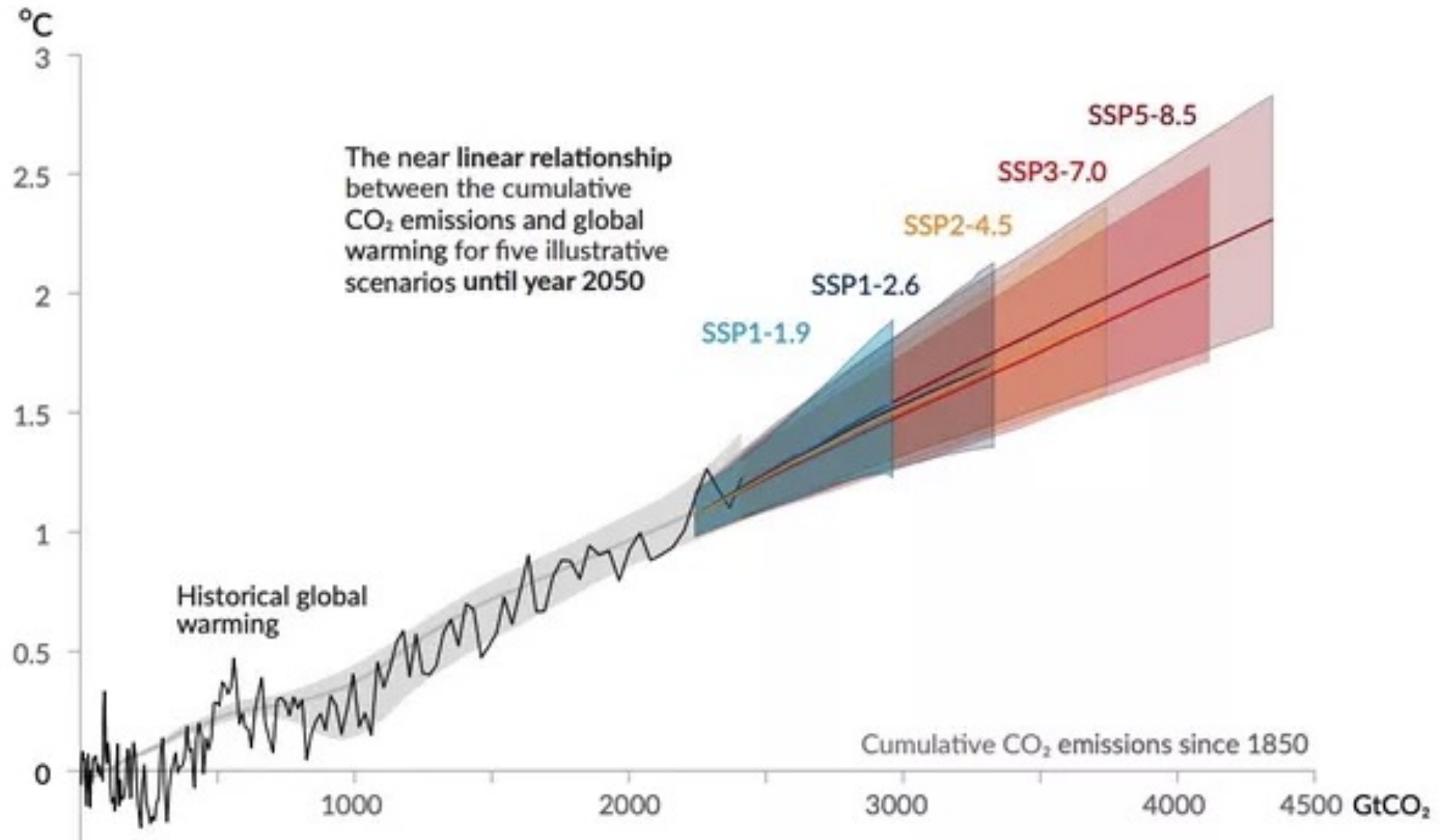


CO₂ in the atmosphere lasts “forever” on human timescales



Adapted from: Tierney et al. 2020

Every tonne of CO₂ emissions adds to global warming

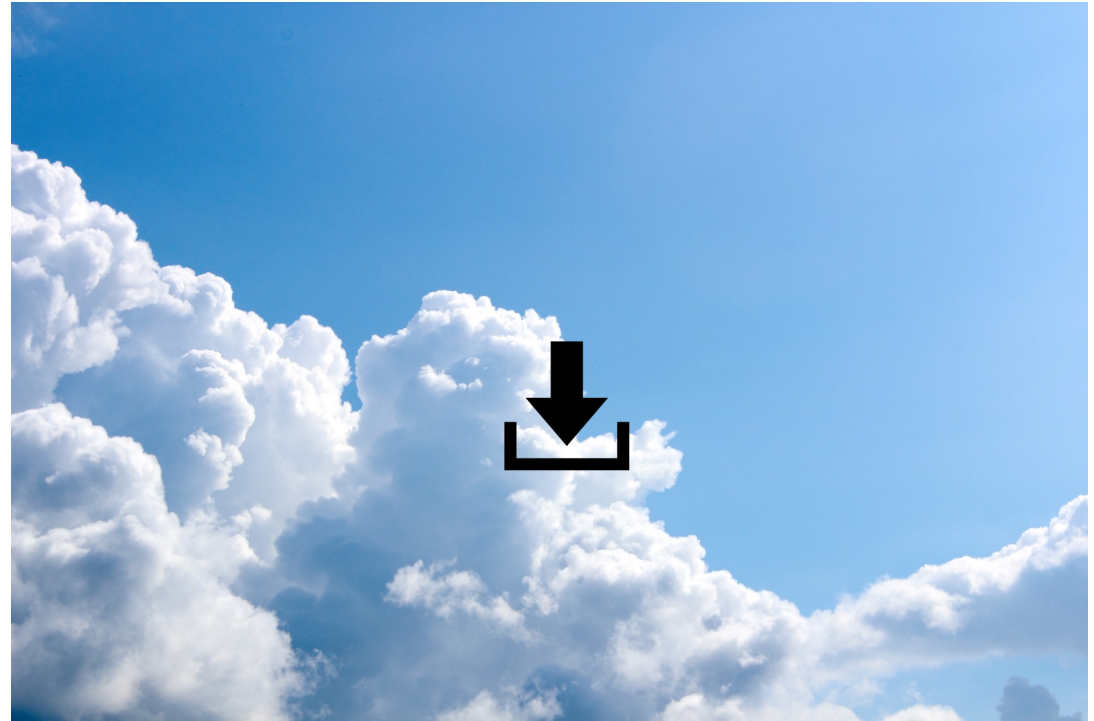


Climate change is a solvable problem

We must avoid emitting AND remove what we emit



Avoiding



Removing

Removal is the price to pay for not avoiding.

We need to reach a global emission level near zero



**Emissions
reduction**



**Difficult sectors
20-30%**



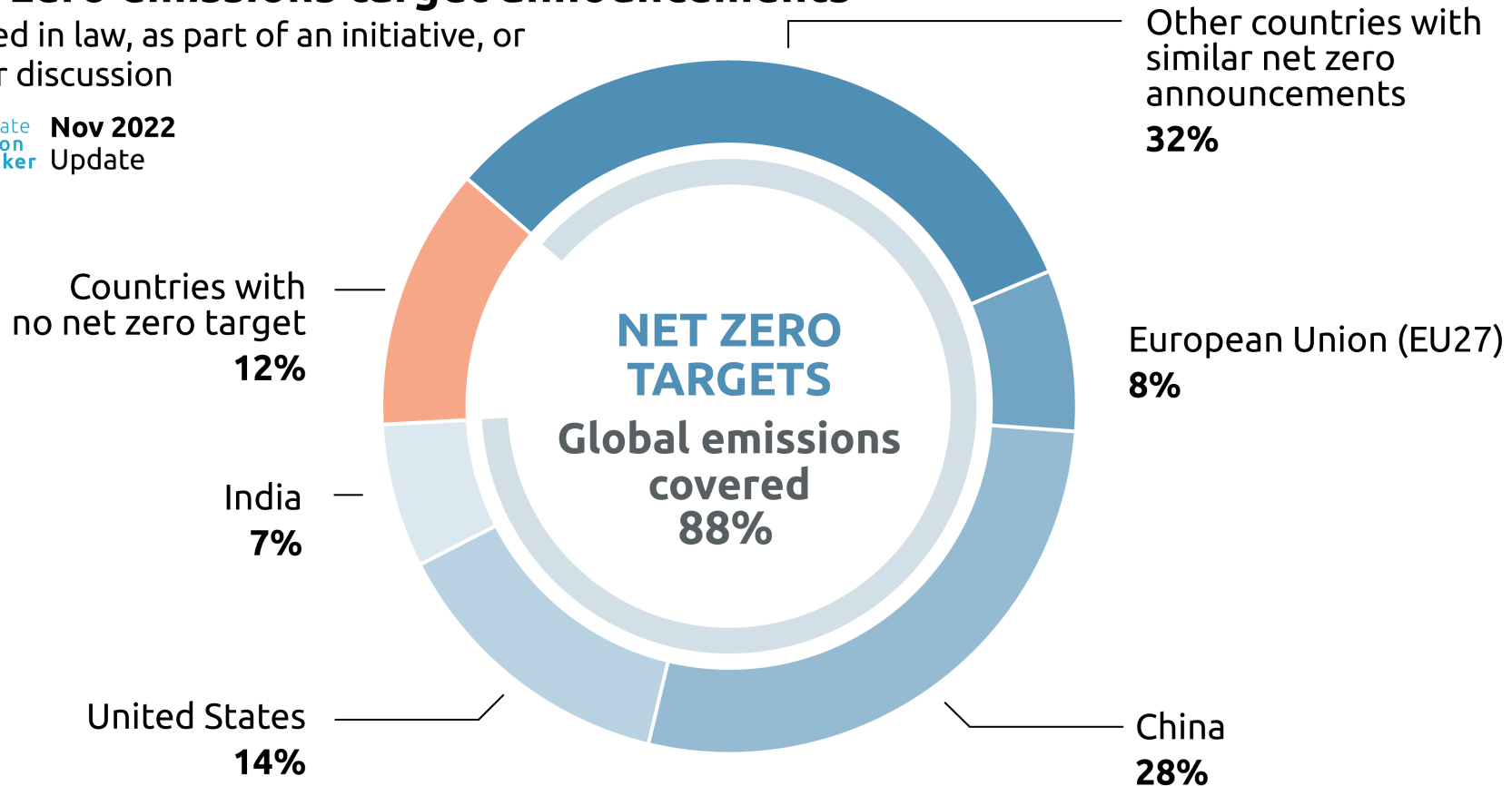
**Social & political
acceptability**

Getting to net zero emissions in the interim

Net zero emissions target announcements

Agreed in law, as part of an initiative, or under discussion

 **Nov 2022**
Update



Net zero implies balancing remaining emissions

Global sequestration needs

Very large storage need that must be developed rapidly

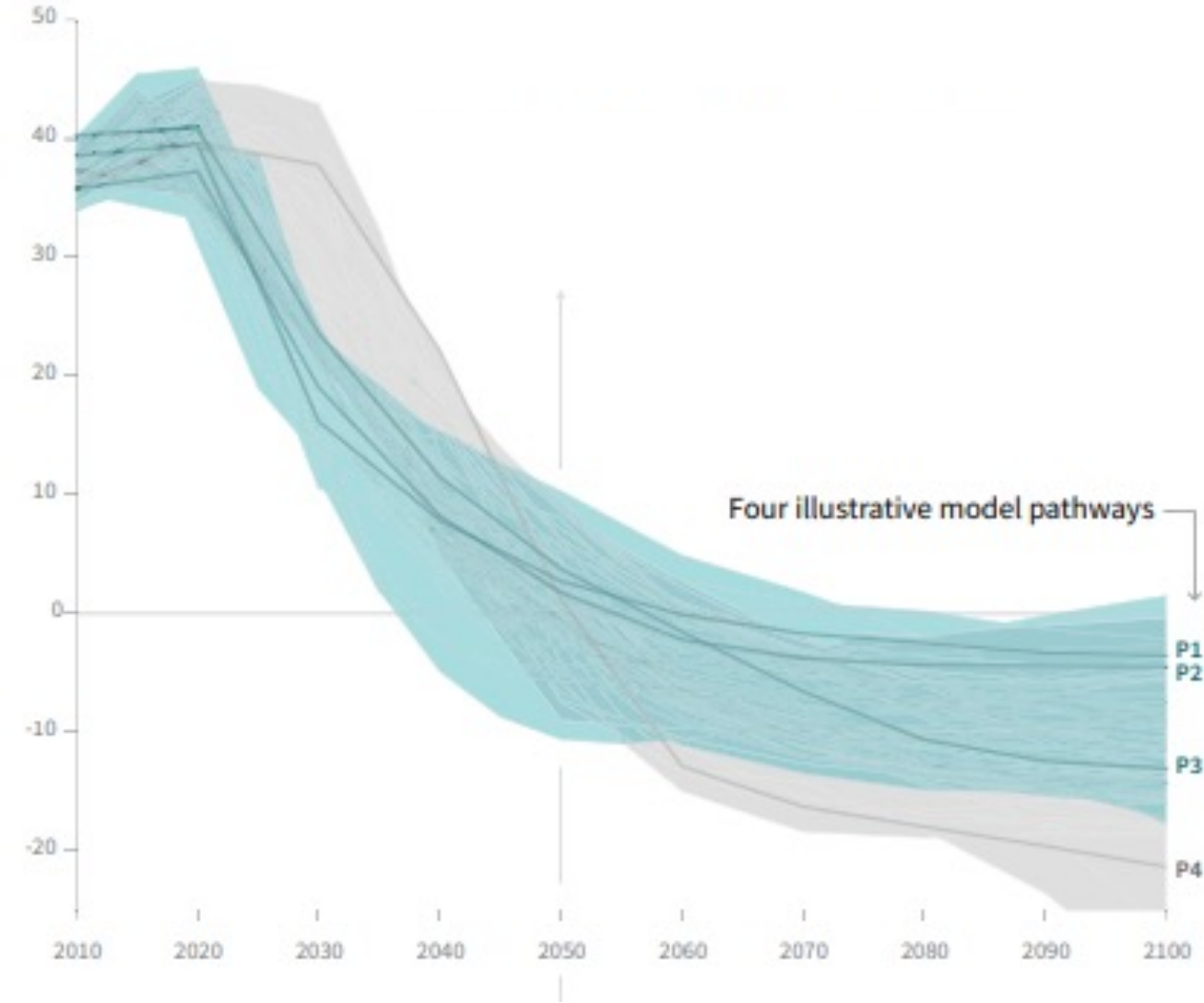
1 Gt CO₂ = 5.5 million blue whales

Sequestration



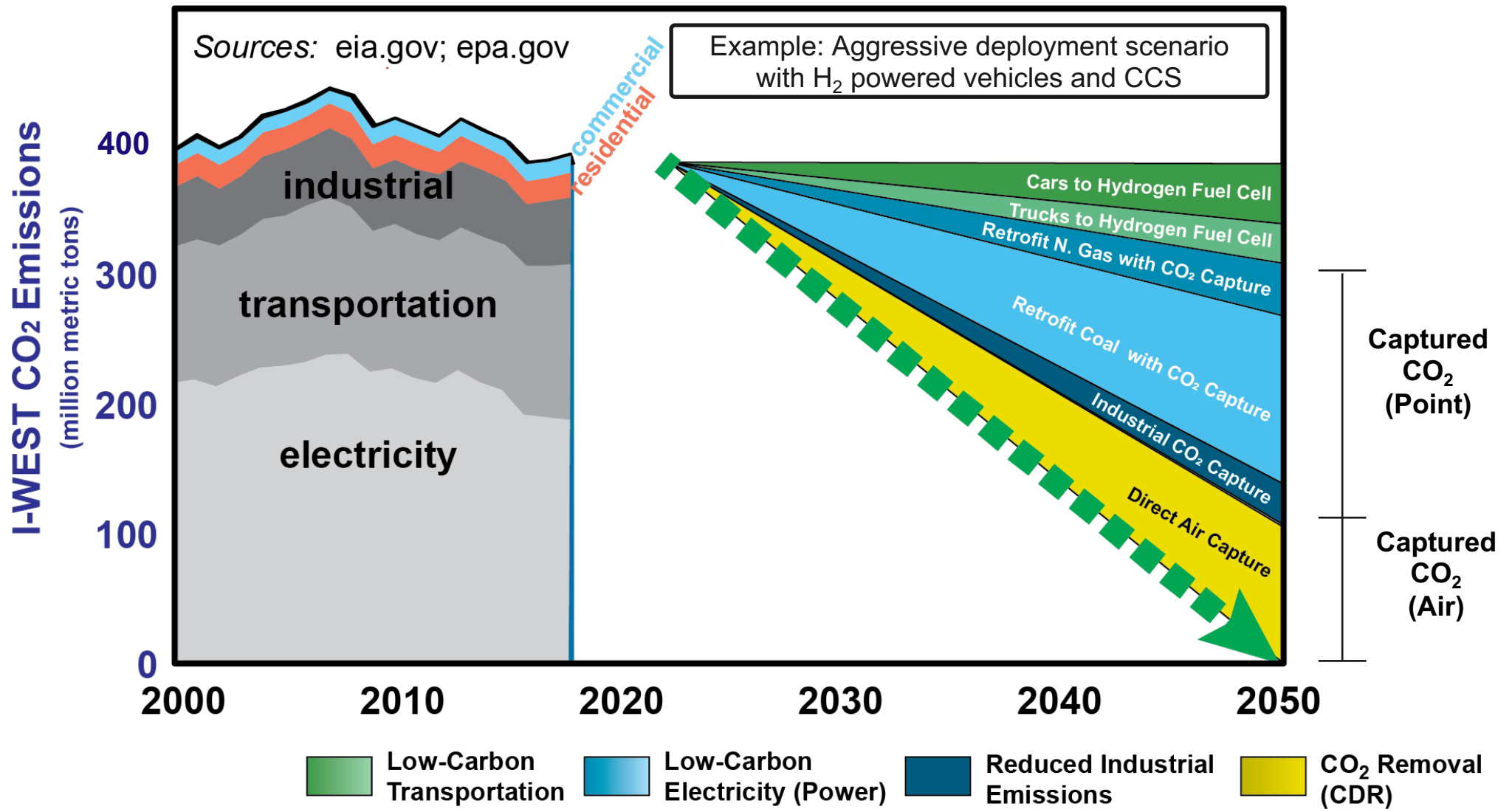
Global total net CO₂ emissions

Billion tonnes of CO₂/yr



Adapted: IPCC SRP 1.5 (2018)

Intermountain west region sequestration needs



A sequestration industry



Carbon capture and sequestration

A portfolio of options can reduce negative impacts* and reduce overall risk of failure

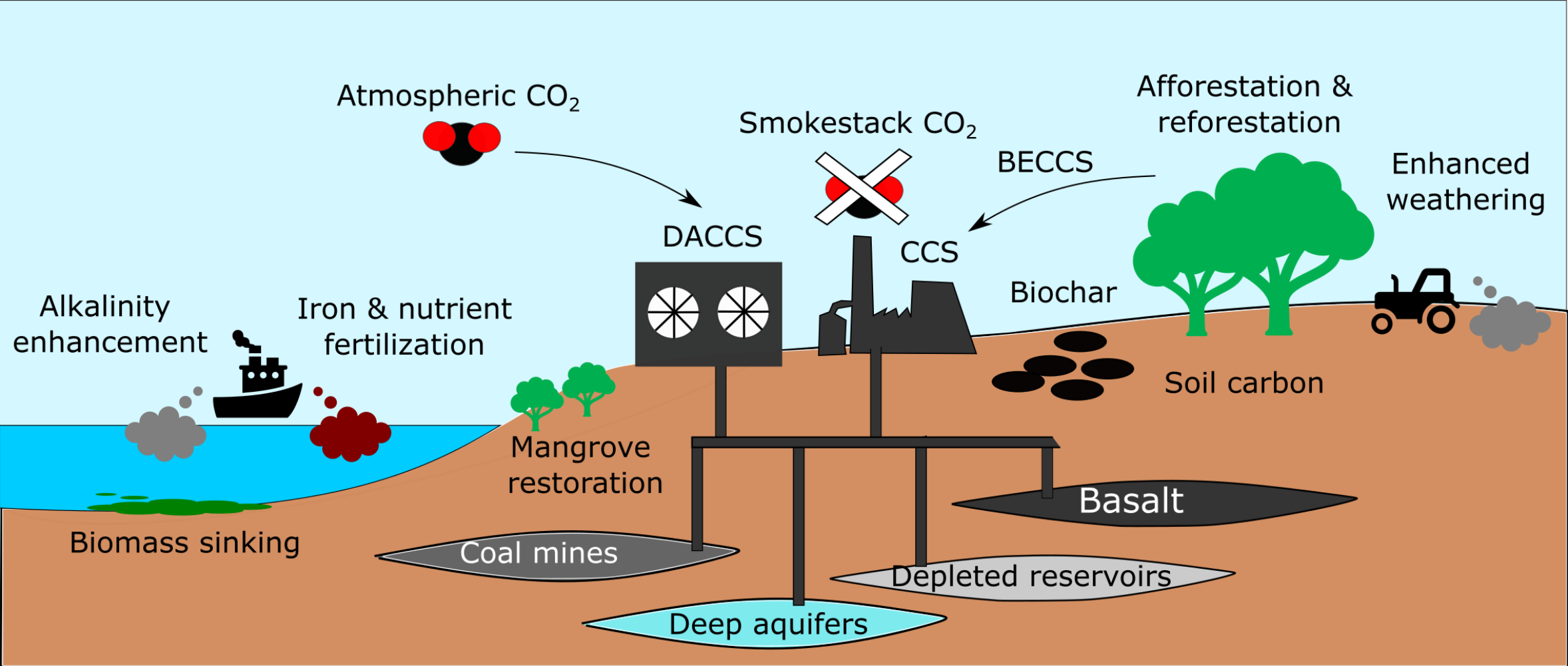


Image: Arcusa; (*) study: Fuhrman et al. 2023

Every method is different

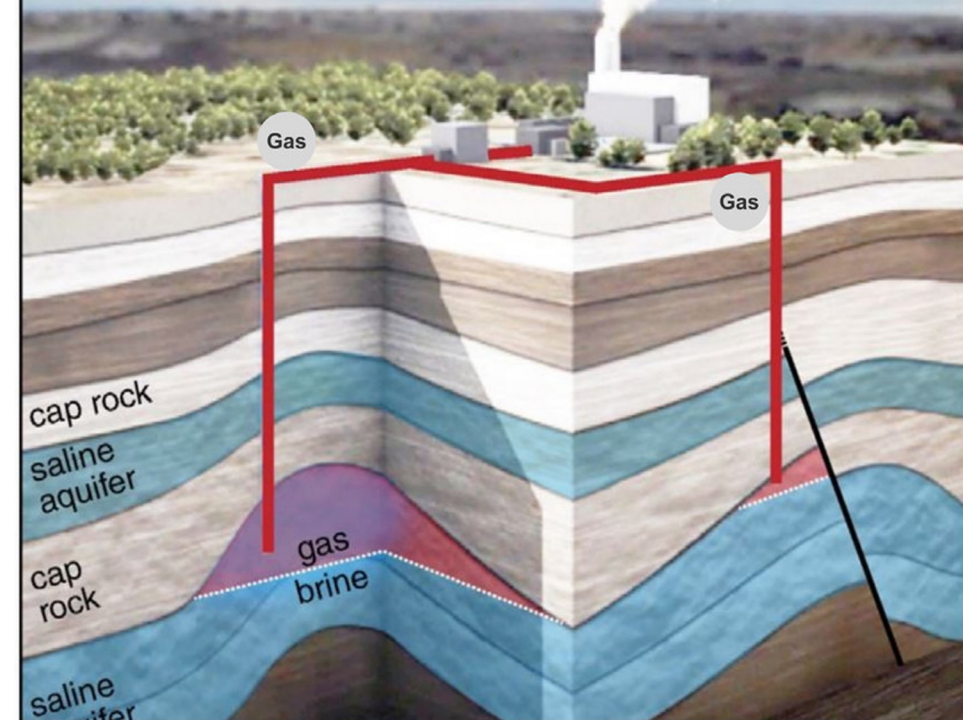
Durability & reversal risk

Costs & investments

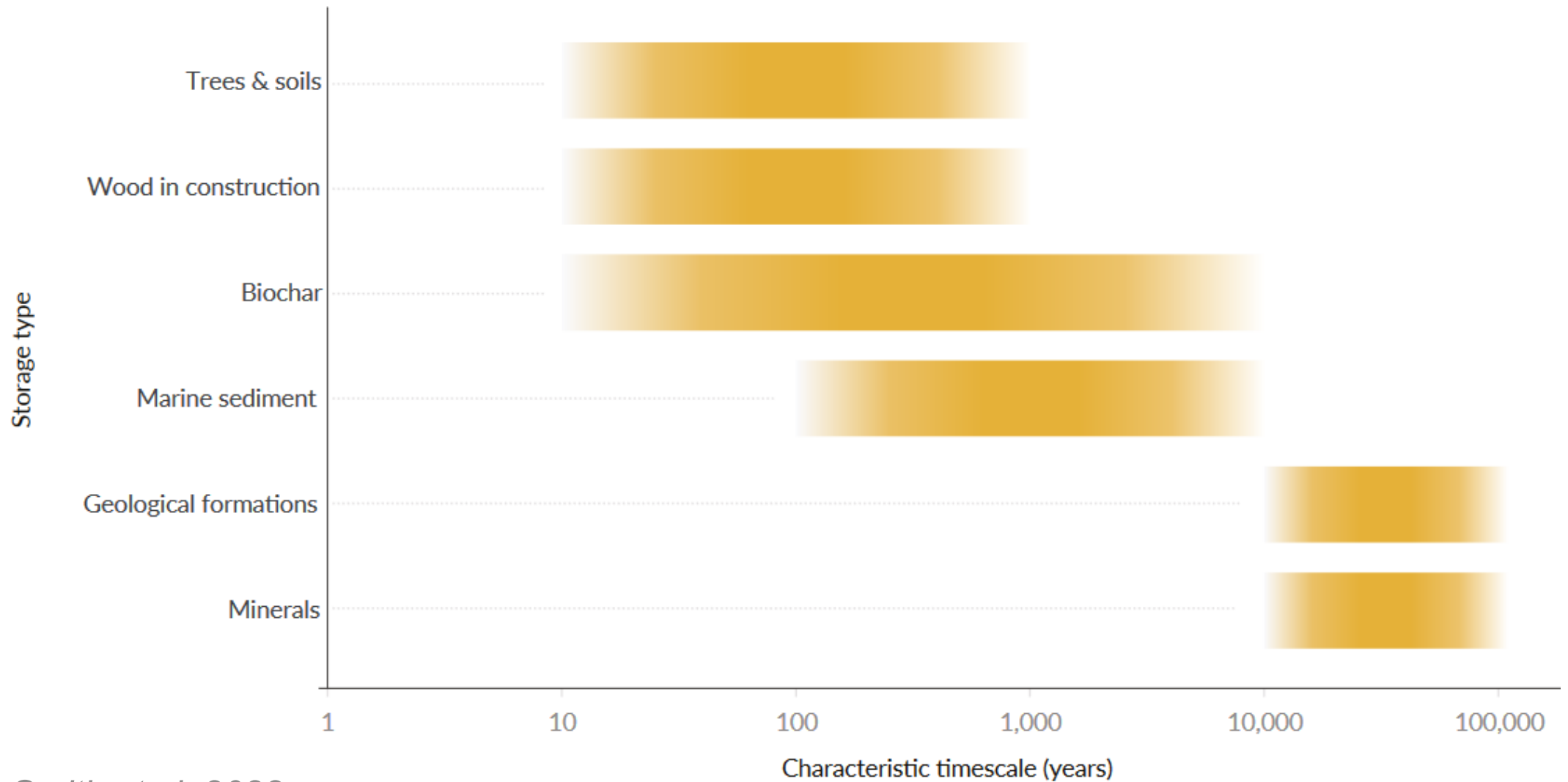
Deployment & verification readiness

Benefits & side effects

Social & environmental justice



Durability: Reservoirs will keep carbon stored for various lengths of time



Source: Smith et al. 2022

Verification readiness

*MRV = monitoring, reporting, verification

	MRV durability risks		MRV scalability risks			
	Storage duration	Human-induced disturbance	MRV precision	Market maturity	Policy awareness	MRV cost
BECCS (biomass growth)	High risk	High risk	Medium risk	Low risk	Low risk	Medium risk
BECCS (capture and storage)	Low risk	Low risk	Low risk	Medium risk	Low risk	Low risk
DACCS	Low risk	Low risk	Low risk	Medium risk	Low risk	Low risk
Soil carbon sequestration	High risk	Medium risk	Medium risk	Low risk	Low risk	High risk
Biochar	Medium risk	Low risk	Low risk	Low risk	Low risk	Medium risk
Afforestation/reforestation	High risk	High risk	Medium risk	Low risk	Low risk	Low risk
Peatland restoration	High risk	High risk	Medium risk	Medium risk	Medium risk	Medium risk
Ocean alkalinity enhancement	Low risk	Low risk	High risk	High risk	High risk	High risk
Enhanced weathering	Low risk	Low risk	Medium risk	High risk	High risk	High risk
Ocean fertilisation	Medium risk	Low risk	High risk	High risk	High risk	High risk

Source: Mercer and Burke 2023

What do we need to build this industry?

R&D

- CDR activities
- Technology
- Sensors
- Cost
- Pilot sites

Deployment

- Deployment sites
- Economic viability
- Financing
- Community engagement
- Social acceptability
- Political support

Supporting infrastructure

- **Regulation**
- Auditors
- **Accounting standards**
- Insurance products
- **Certification**
- Workforce training

Certification: a tool that builds trust



Standards, certification, verification – why?



Safety

- Enormous volumes of storage are anticipated
 - Affects everyone
- Today and in the future



Performance

- Only two actions possible: don't emit or emit and clean-up
- CDR is a promise to clean up emissions
- All removal activities must have the same result to hold that promise



Trust

- Odorless, colorless gas
- Successful CDR won't have a noticeable impact for years/decades (?)

The role of certification is to provide direct (buyers) and indirect (public) assurance that a product, service or person meets certain claims – role of certification needs clarification

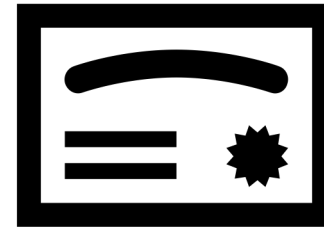
Certification is a process



PROJECT



STANDARD



CERTIFICATION

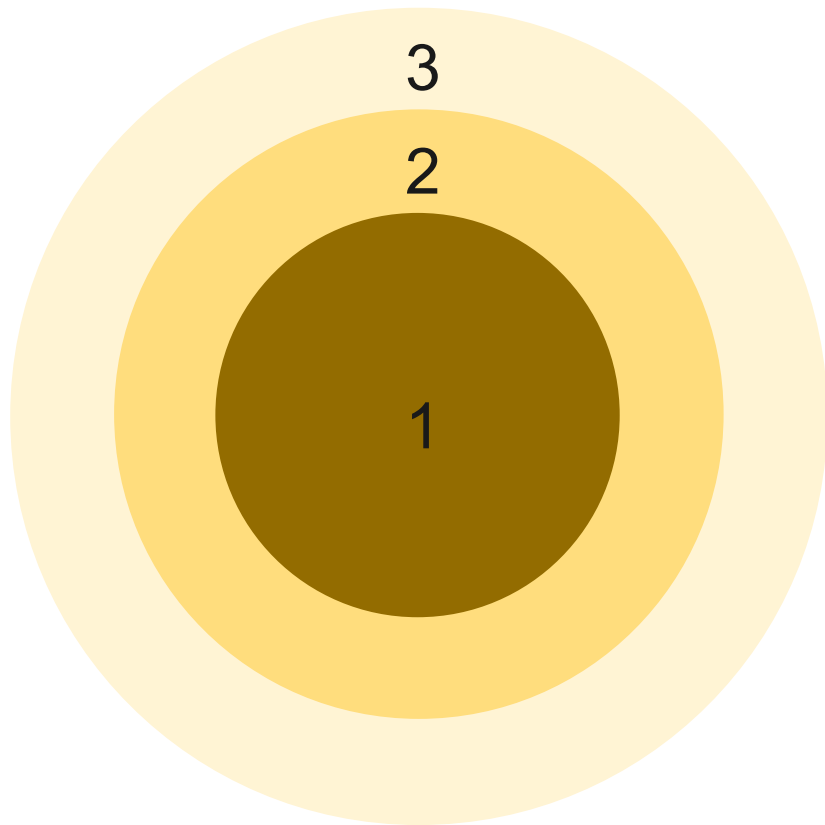


TRADE

The entire process rests upon the ability to account for stored carbon.

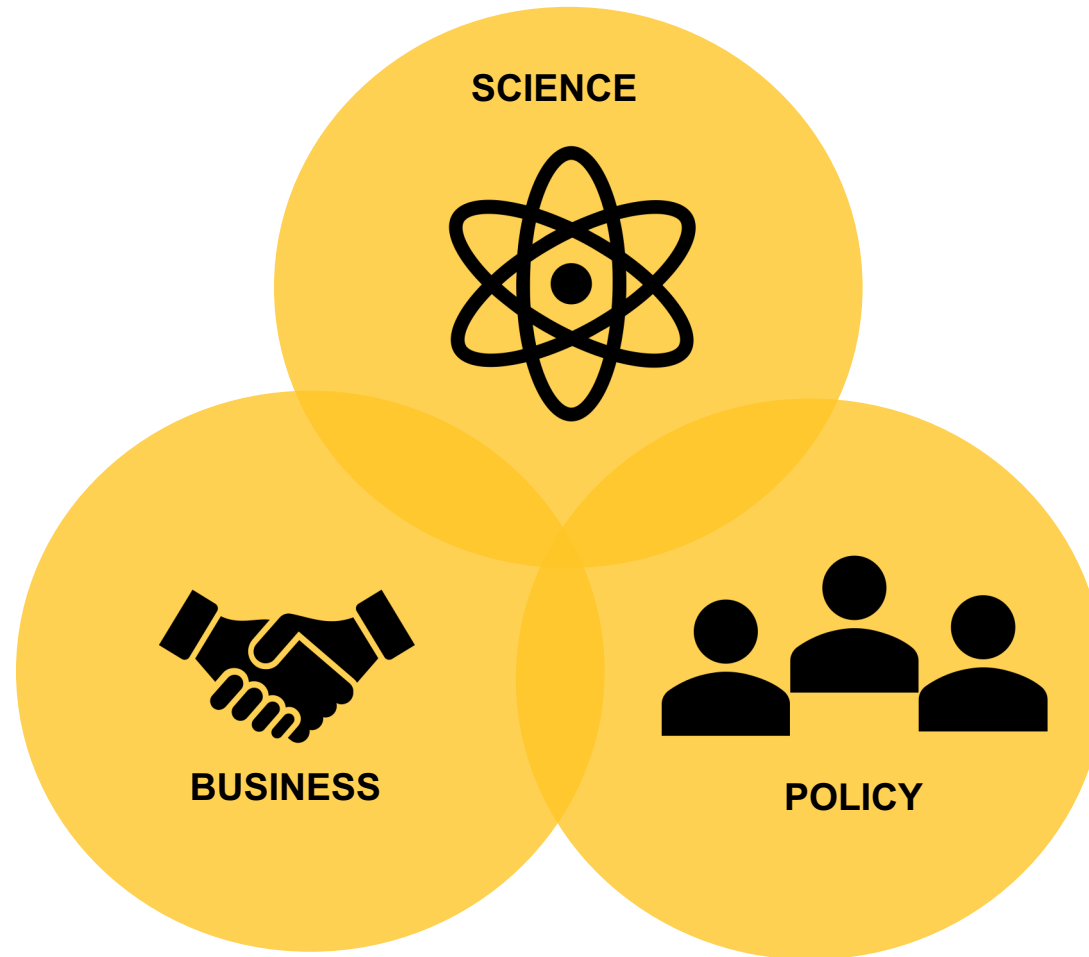
Tons stored, permanently, safely and ethically

Framework for the development of standards



1	Does the proposed method store carbon and can it be accurately measured?
2	Is the proposed method fit-for-purpose?
3	Can the proposed method be implemented ethically and safely?

Standards answer these questions through science, business practice and policy



Scientific input



What questions to ask



What is the state of a system



How a system works



How to design experiments that will find information



Observations, measurements, replication

Policy decisions

Open questions

Business practice



RESPONSIBILITY



PRODUCT
GUARANTEE



ETHICAL PRACTICE



Standards in the certification process are one of the tools to foster the **trust** that carbon storage is **successful**.

It is critical to get it right!

Potential consequences from failing to certify properly



Waste of time and resource

- Urgency of climate action
- Resources needed
- No time/resources for boondoggles



Scams/Fraud

- Undermine credibility
- Price tag



Communities and environmental harm

- Biodiversity loss
- Impacts on food/water
 - Environmental destruction
 - Human rights violations
- Carbon colonialism



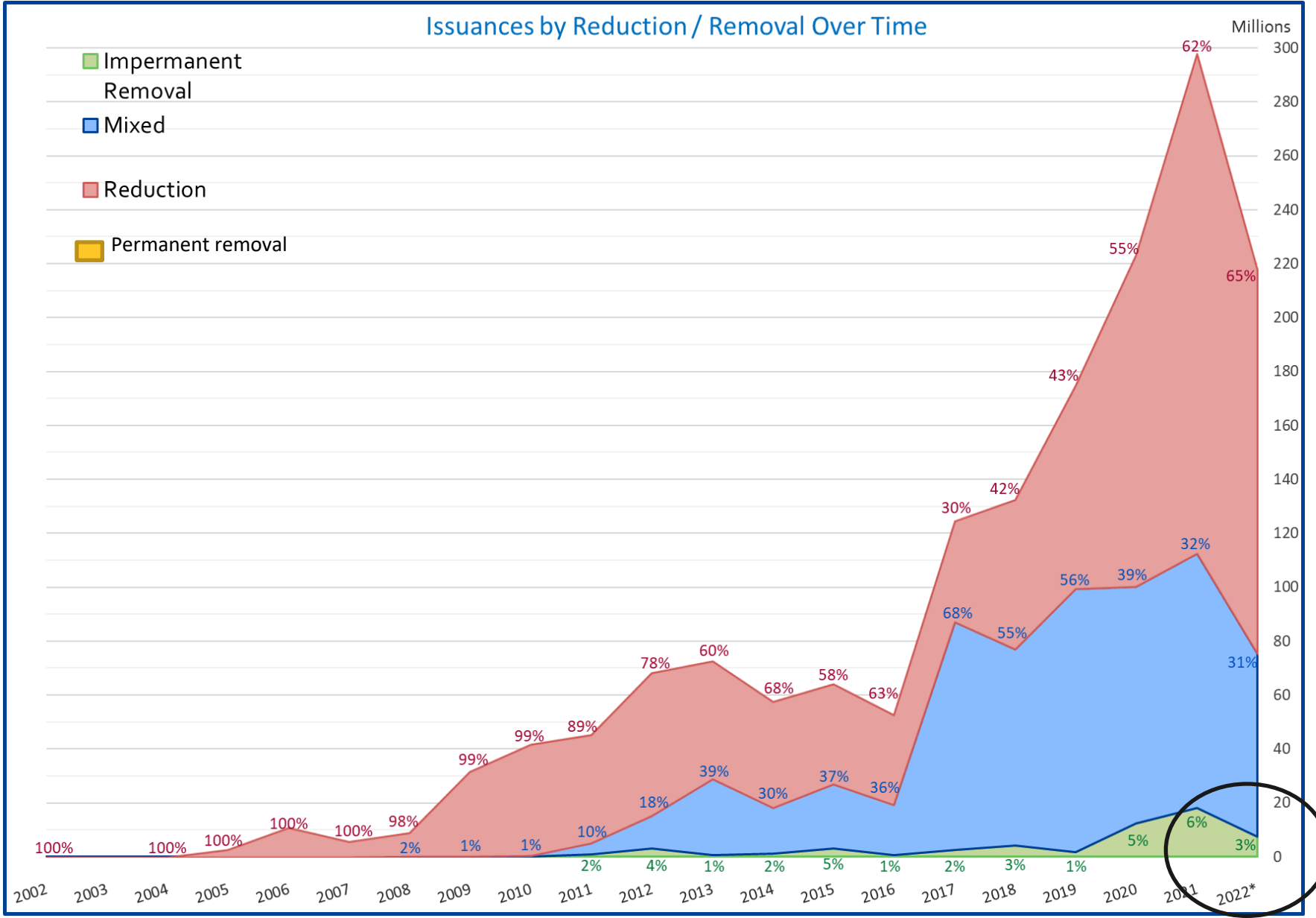
Fail to address climate change

- If certification is inadequate, CDR will likely fail
- If CDR fails, limited options for 1.5°C commitments

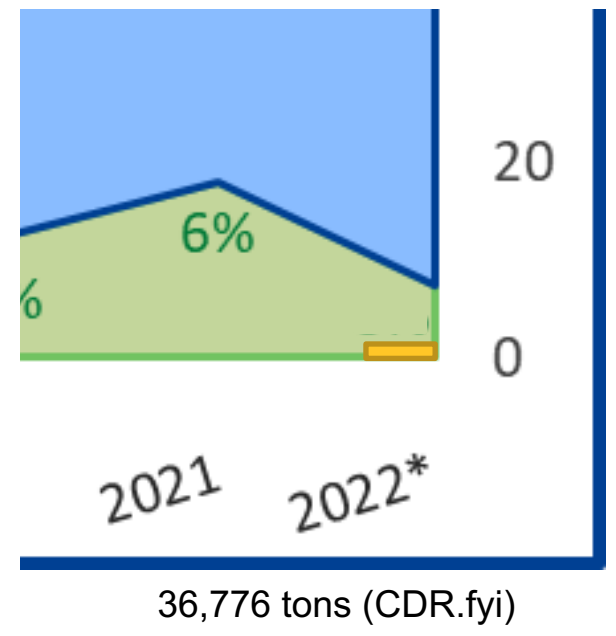
Some of these consequences are already evident.

Current situation

Today's voluntary carbon market

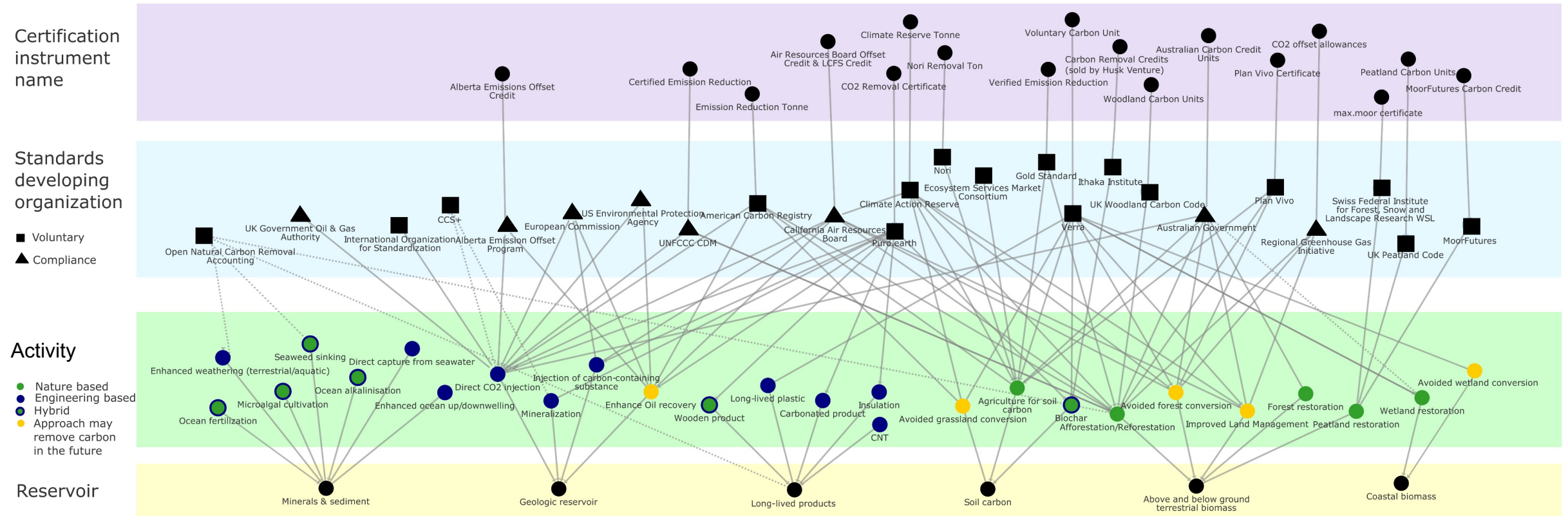


Berkeley Carbon Trading Project's Voluntary Registry Offsets Database November 2022



The global market is rapidly evolving and messy





No two standards are the same – different decisions lead to different outcomes



Source: Arcusa & Sprenkle-Hyppolite (2022). For more information, check out: <https://osf.io/fu59w/>

Quality is suffering

Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon

Thales A. P. West , Jan Börner , Erin O. Sills , and Andreas Kontoleon  [Authors Info & Affiliations](#)
Edited by Eric F. Lambin, Stanford University, Stanford, CA, and approved August 12, 2020 (received for review March 6, 2020)
September 14, 2020 | 117 (39) 24188-24194 | <https://doi.org/10.1073/pnas.2004334117>

Do carbon offsets offset carbon?

Raphael Calel, Jonathan Colmer, Ant and Matthieu Glachant
November 2021

Faulty Credits Tarnish Billion-Dollar Carbon Offset Seller

South Pole, the world's leading purveyor of offsets, is facing allegations that it exaggerated climate claims around its forest-protection projects. The uncertainty could influence how legions of companies try to slash their emissions.

By [Ben Elgin](#), [Alastair Marsh](#) and [Max de Haldevang](#)
March 23, 2023 at 11:00 PM MST Updated on March 24, 2023 at 12:44 PM MST

Systematic over-crediting in California's forest carbon offsets program

Grayson Badgley^{1,2}  | Jeremy Freeman³  | Joseph J. Hamman^{3,4}  | Barbara Haya⁵  | Anna T. Trugman⁶  | William R. L. Anderegg⁷  | Danny Cullenward^{3,8} 

Revealed: more than 90% of rainforest carbon offsets by biggest certifier are worthless, analysis shows

Patrick Greenfield, Wed 18 Jan 2023

'Worthless': Chevron's carbon offsets are mostly junk and some may harm, research says

Exclusive: investigation finds energy giant's efforts to offset its huge emissions rely on schemes with little impact

Nina Lakhani, The Guardian. Wednesday, 24 May 2023



Australia's carbon credit scheme 'largely a sham', says whistleblower who tried to rein it in

Adam Morton, Wed 23 Mar 2022

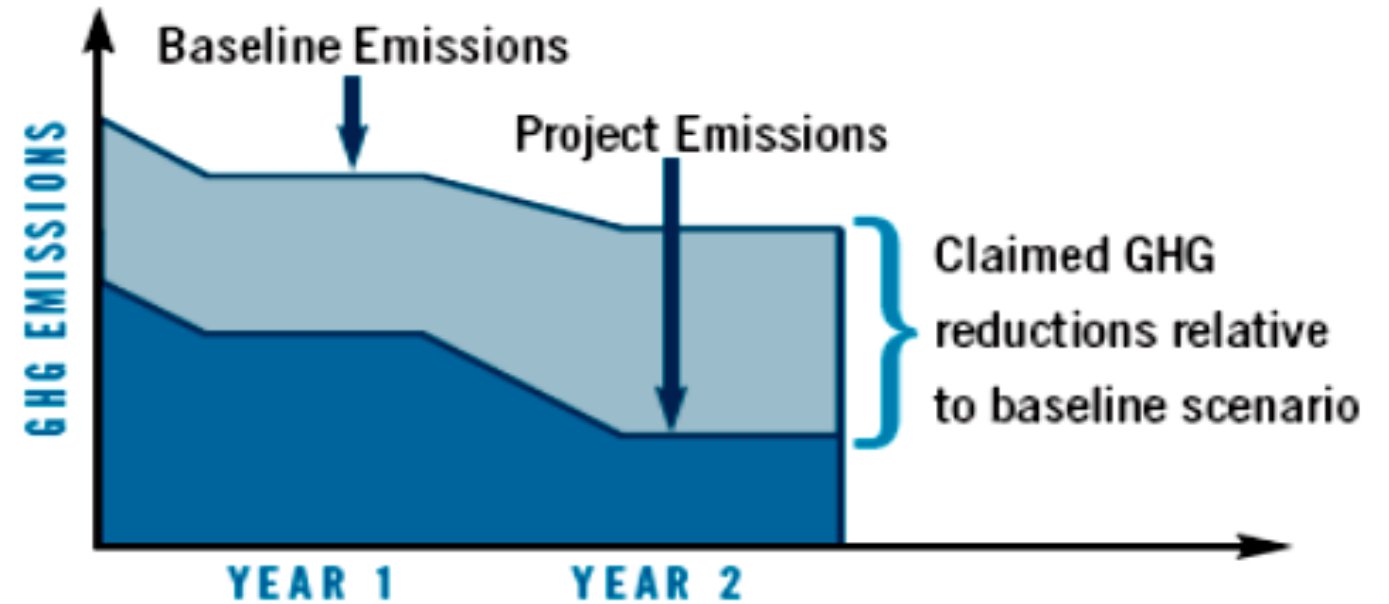
How a thriving marketplace for phony carbon offsets holds back progress in the climate fight

Ben Elgin, Bloomberg. December 9 2020

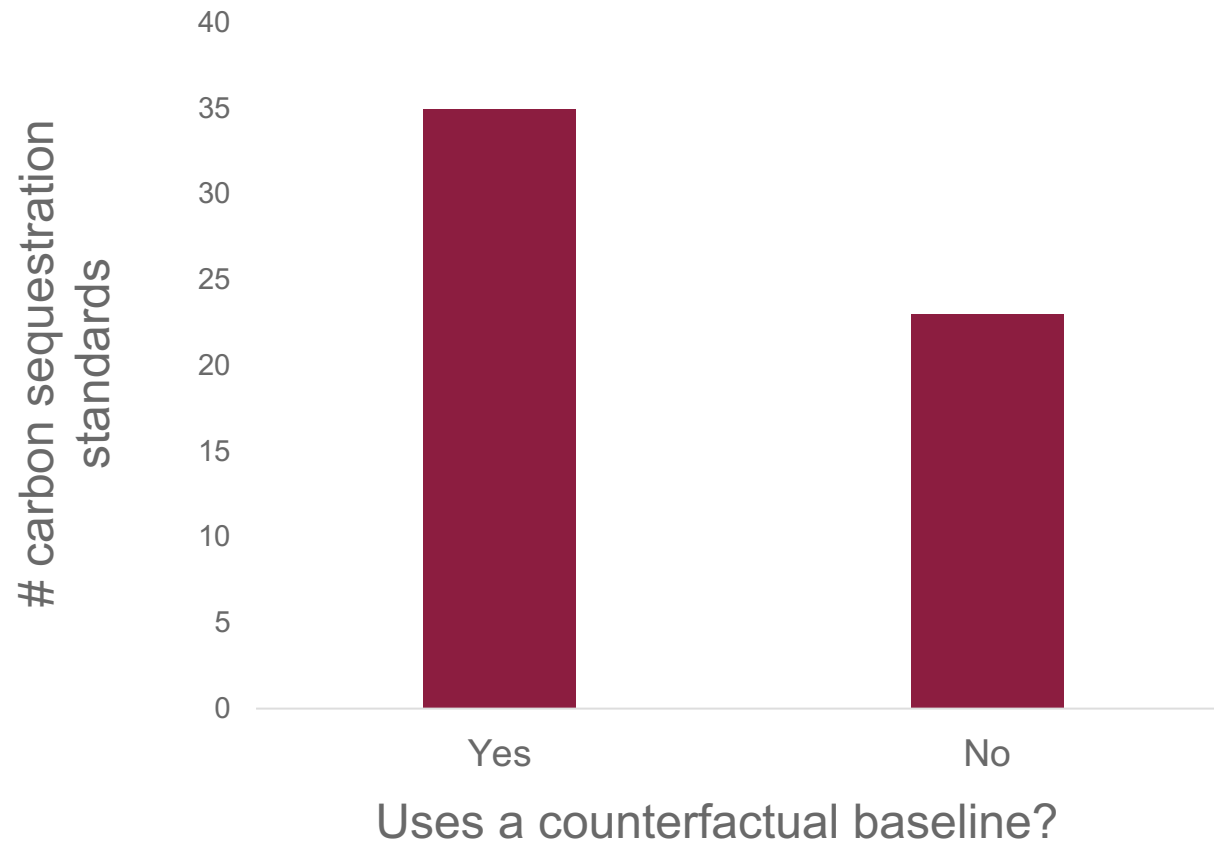


#1 lesson: counterfactual baselines are super tricky

what would have happened if the project did not happen



Carbon sequestration standards are being developed in the likeness of standards for carbon offsets



The concern is that counterfactuals continue to be used.

How much longer can this continue?



Carbon Offsets: A Coming Wave of Litigation?

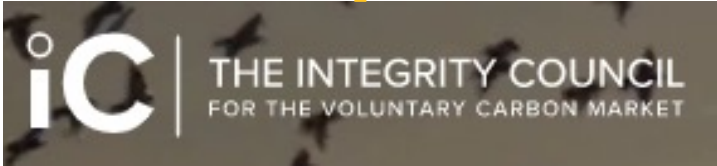
Not all carbon offsets are created equal. Regulators, investors, and NGOs are increasingly scrutinizing the quality of offsets used by companies to meet “net zero” goals. Businesses must carefully examine what they are buying and ensure they are not getting drawn into scams and that their public statements align with what the offsets are actually likely to achieve.

Sheriffs are in town



Certification of carbon removals – EU rules

TASKFORCE ON SCALING VOLUNTARY CARBON MARKETS



U.S. SECURITIES AND EXCHANGE COMMISSION



MORNINGSTAR Investor



And more...

Efforts are underway to assess and rate credits, and regulate credit use, claims, and trades of credits in carbon markets.

Unfortunately, this is likely not enough – the system is built on weak foundations

The future of certification needs rethinking



What needs rethinking?

What can neutralize an emission?

Where should neutralization be applied for maximum efficiency?

What practices are acceptable in certification?

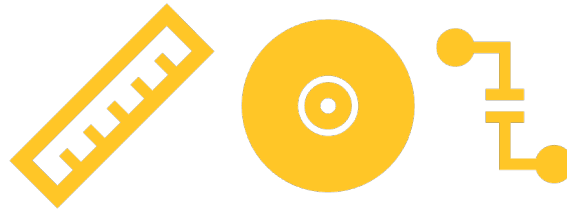
What should be the foundation of certification?

What does permanent sequestration mean?

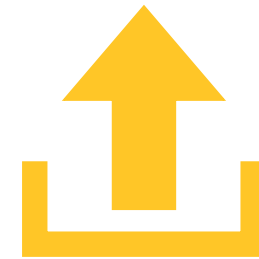
What is needed for more robust certification?



Uniform, technology agnostic rules



Evidence-based protocols



Remediation for carbon lost from storage

Key takeaways



There is and will be a growing demand for carbon sequestration.

Certification can foster trust, but must be robust.

Certain aspects of certification will need to be rethought.



Thank you for participating!

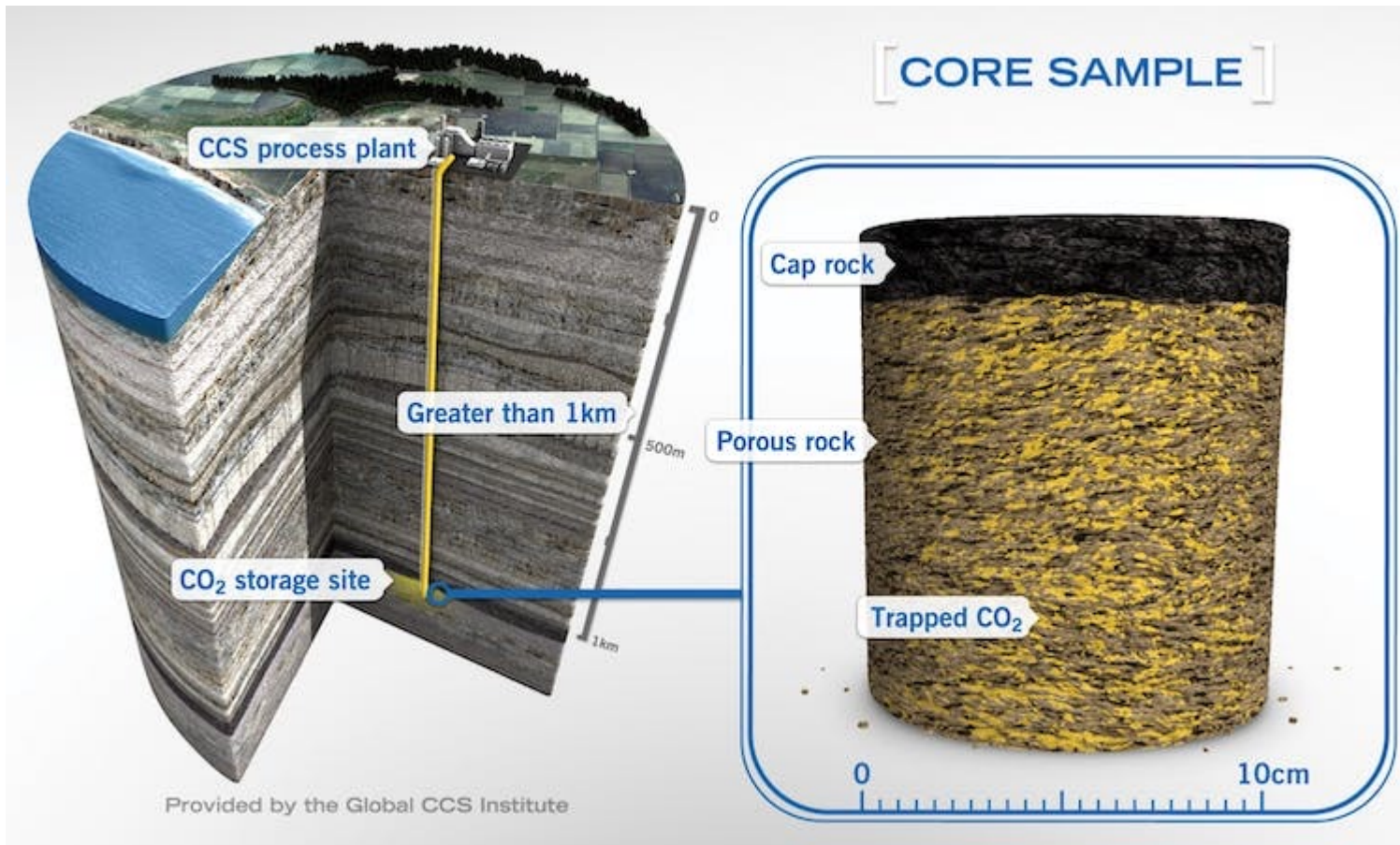
A recording of this seminar will be available
on the Events page of the I-WEST website

www.iwest.org

Extras

An example

EPA's class VI wells



Protecting groundwater

Measuring injection

Monitoring for leaks

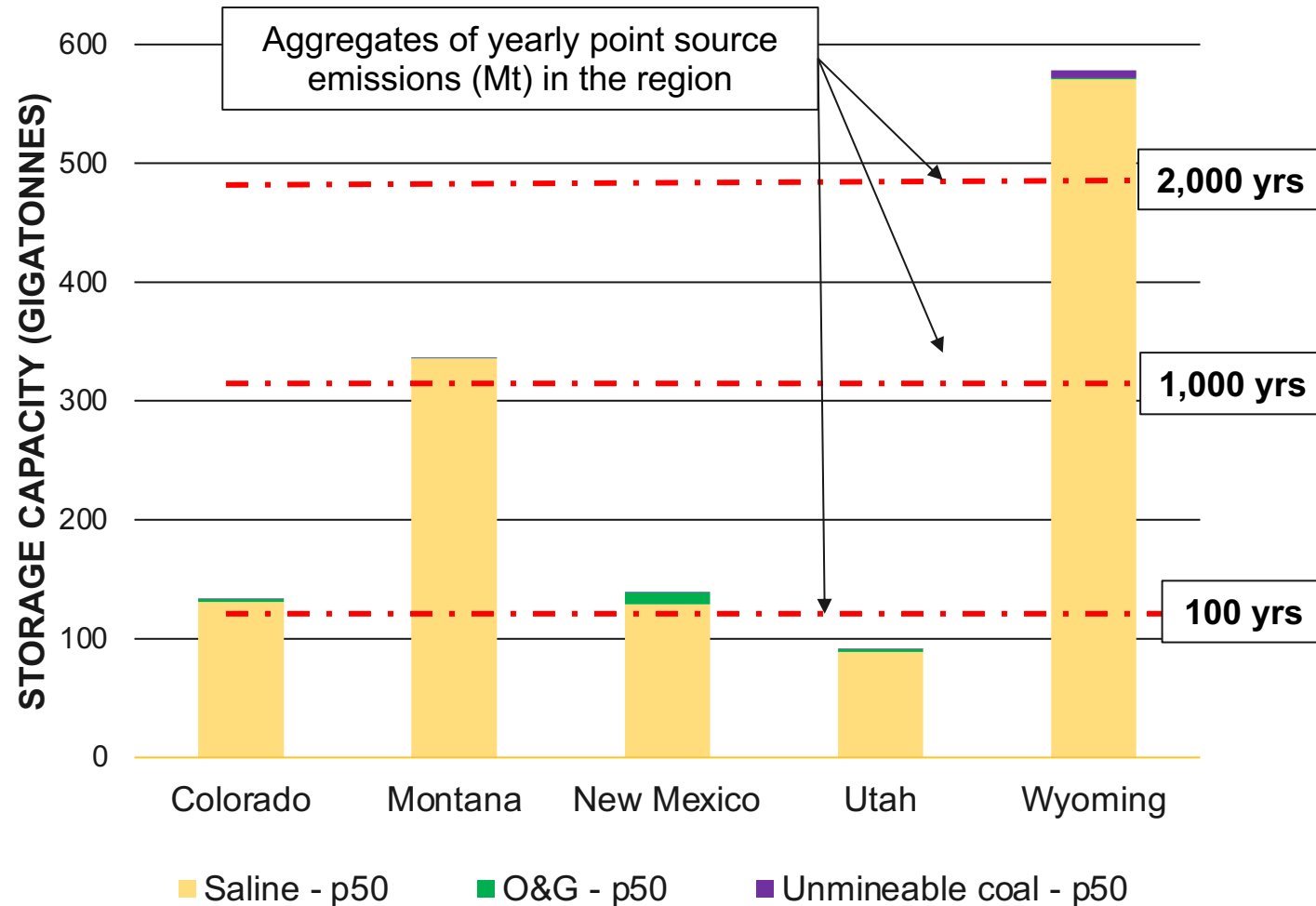
Leaks cancel 45Q
credits

Where to improve

Positive accounting: measuring the presence of carbon, not its absence

Remediating leaks like emissions

Favorable geologic reservoirs exist across I-WEST



Capacity data from DOE's Carbon Storage Atlas – Fifth Edition
<https://www.netl.doe.gov/coal/carbon-storage/strategic-program-support/natcarb-atlas>

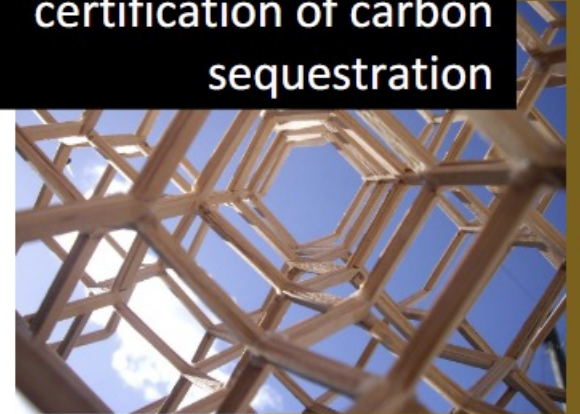
A different approach?

- A system designed for negative emissions
- Focused on evidence
- Built on responsibility
- Agnostic

For more info: search for ASU KEEP Arcusa

2022

A conceptual framework for the
certification of carbon
sequestration

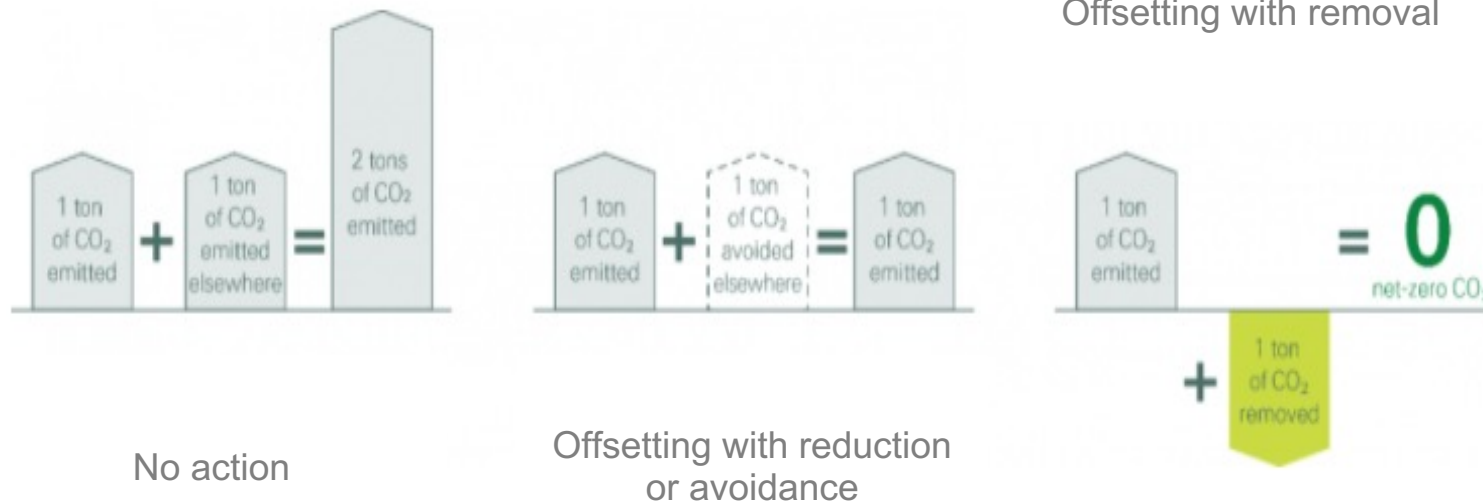


Version 2.0

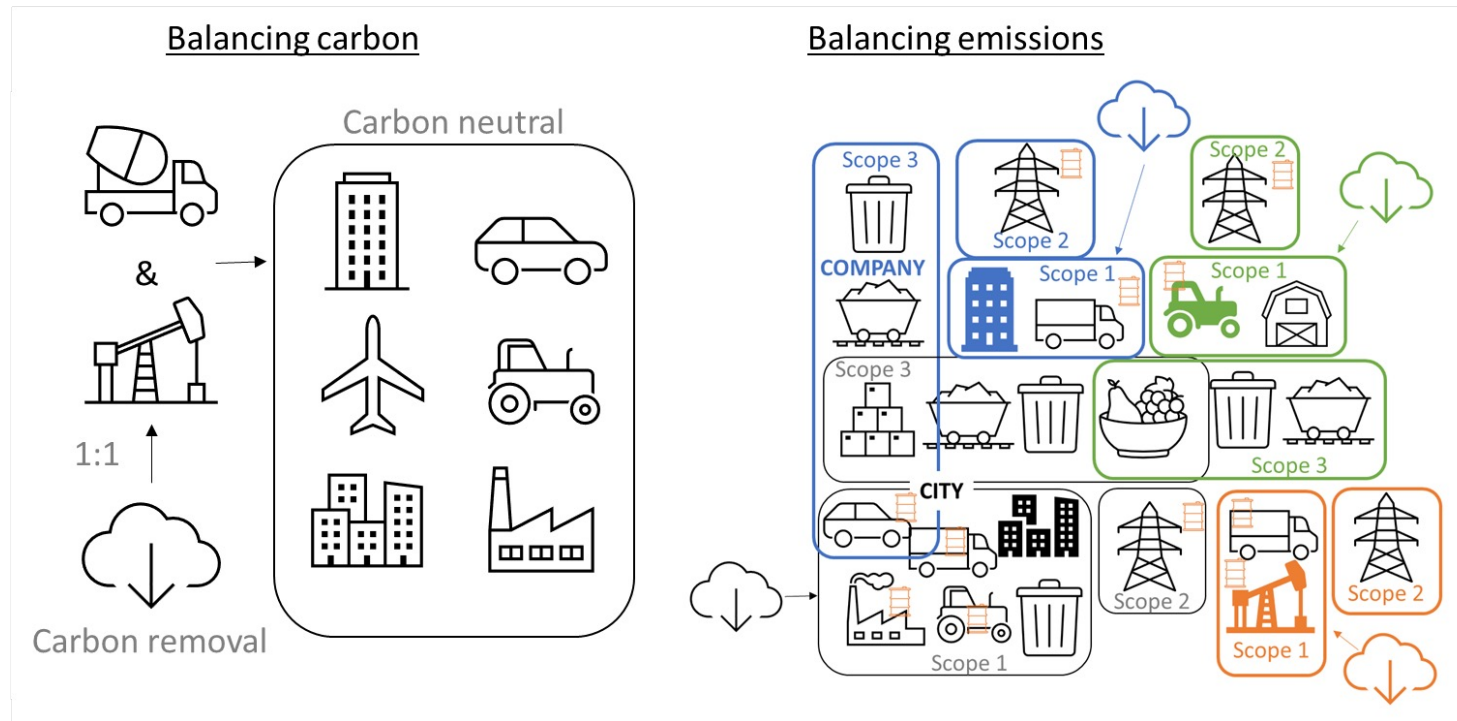
5/12/2022

What can neutralize an emission?

- Neutralizing (balancing) an emission can only be done through carbon removal, not through credits of reduction or avoidance.



Where neutralization should be applied for maximum efficiency?



- Carbon balancing is simple and comprehensive when applied at the source.
- Accounting at the source eliminates need for LCA in certification of carbon sequestration, increasing robustness of carbon accounting.

What practices are acceptable in certification?

- Carbon removal must be measured against a measurement of carbon storage, not a model, statement, or counterfactual as it is now.
- Although “additionality” thought to be the cornerstone of quality, it is a challenging criteria to prove because it uses counterfactuals, allowing the concept to become a door for manipulation.

2000-2009

Voluntary Compliance with Market-Based Environmental Policy: Evidence from the U.S. Acid Rain Program

Juan-Pablo Montero
Catholic University of Chile and Massachusetts Institute of Technology

Project-based mechanisms for emissions reductions: balancing trade-offs with baselines

Carolyn Fischer*
Energy and Natural Resources Division, Resources for the Future, 1616 P Street, NW, Washington, DC 20036, USA

2010-2019

The trouble with voluntary emissions trading: Uncertainty and adverse selection in sectoral crediting programs[☆]

Adam Millard-Ball*
Environmental Studies Department, University of California – Santa Cruz, 1156 High St, Santa Cruz, California 95064, United States

Baseline manipulation in voluntary carbon offset programs

Xiaoyu Liu^{a,b}, Qingbin Cui^{a,*}

^a *Department of Civil and Environmental Engineering, University of Maryland, College Park, MD 20742, United States*
^b *Department of Economics, University of Maryland, College Park, MD 20742, United States*

2020-

Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon

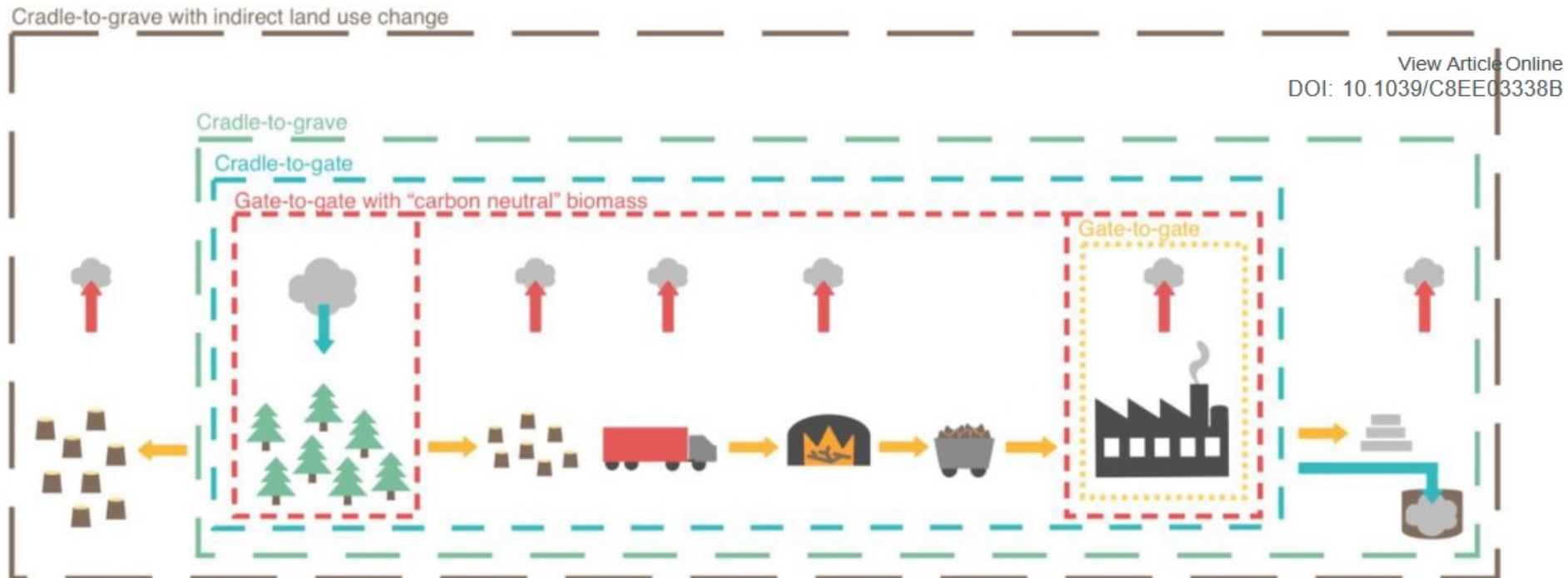
Thales A. P. West^{a,b,c,d}, Jan Börner^{c,d}, Erin O. Sills^e, and Andreas Kontoleon^{f,g}

^aLand Use Economics and Climate Division, Scion-New Zealand Forest Research Institute, Rotorua 2010, New Zealand; ^bCentre for Environment, Energy and Natural Resource Governance, University of Cambridge, Cambridge CB3 9EP, United Kingdom; ^cCenter for Development Research, University of Bonn, 53113 Bonn, Germany; ^dInstitute for Food and Resource Economics, University of Bonn, 53115 Bonn, Germany; ^eDepartment of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27695; and ^fDepartment of Land Economy, University of Cambridge, Cambridge CB3 9EP, United Kingdom

Systematic over-crediting in California's forest carbon offsets program

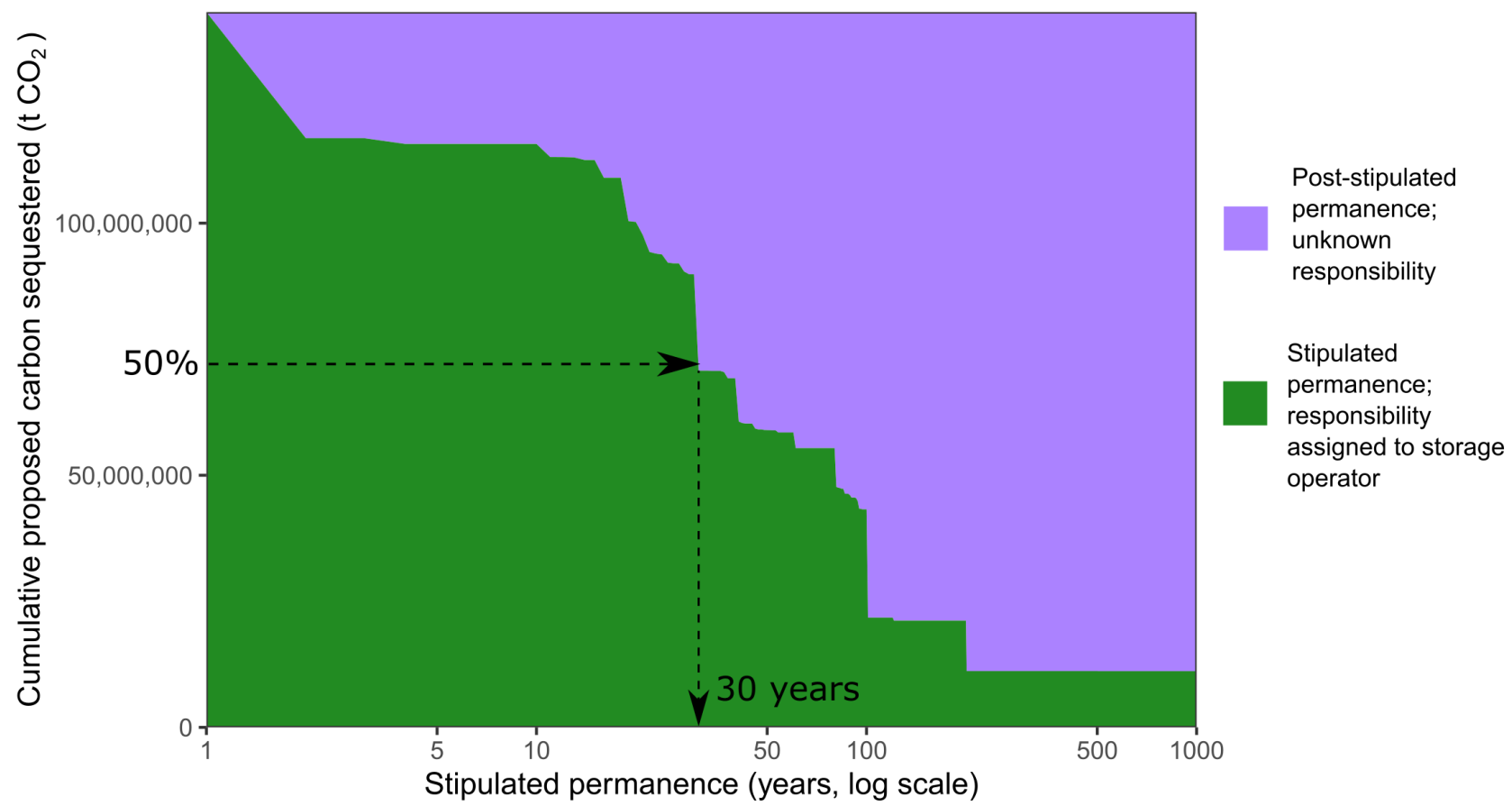
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What tools should be the foundation for certification?



Source: Tanzer and Ramirez (2019)

What does permanent sequestration mean?



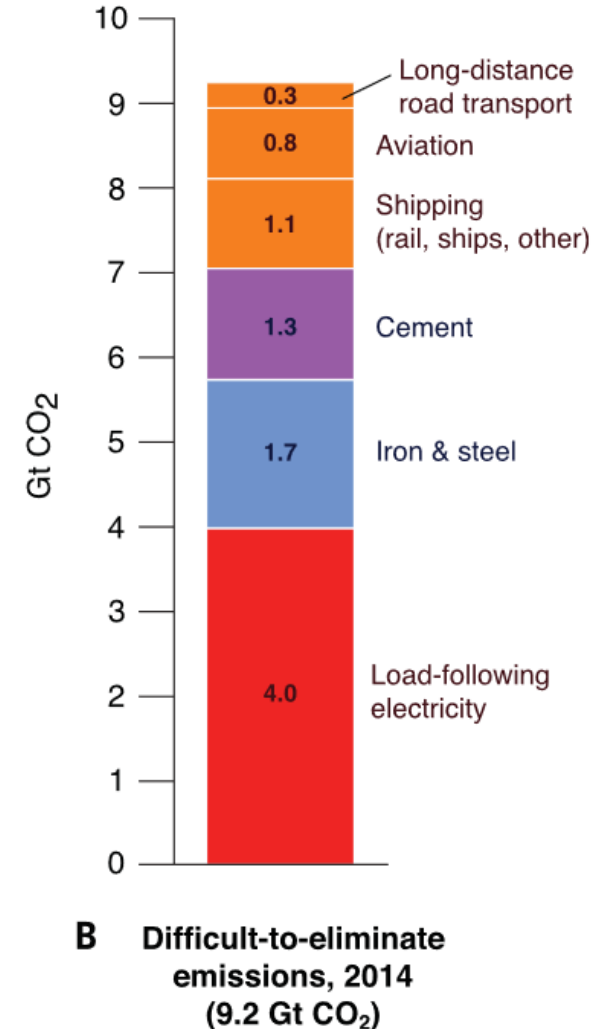
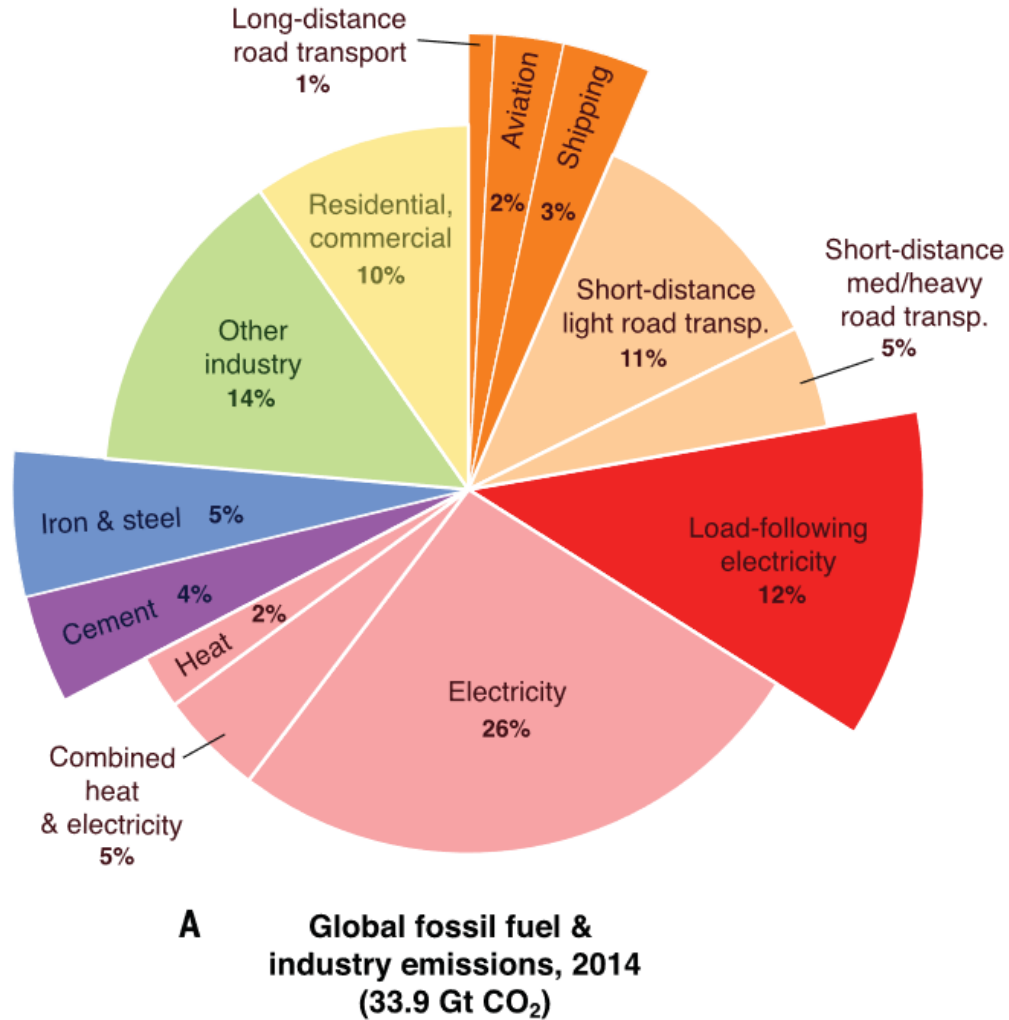
- The definition of permanent storage must be consistent with the understanding of the climate system but at the end of the day is a societal choice with consequences for future generations.

Arcusa and Lackner (2022)

Getting to zero emissions (avoid)

70% “easy”
 Renewables
 Substitution
 Efficiency
 Behavior change

30% “hard”
 Limited technology
 High reliability
 Stop industry?



Source: Davis et al. 2018. Net-zero emissions energy systems. Science 360.

Different types of carbon credits exist



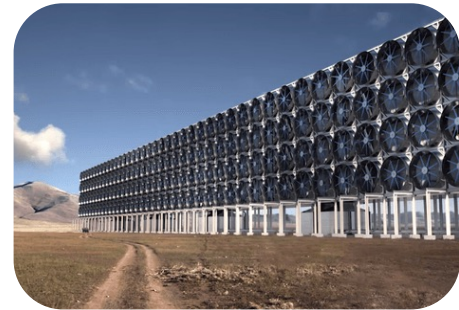
Avoidance



Reduction



Mixed (reduction and removal)

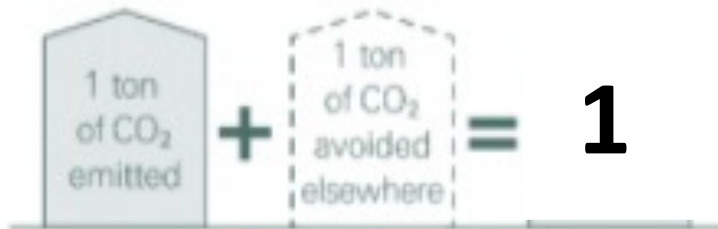


Removal

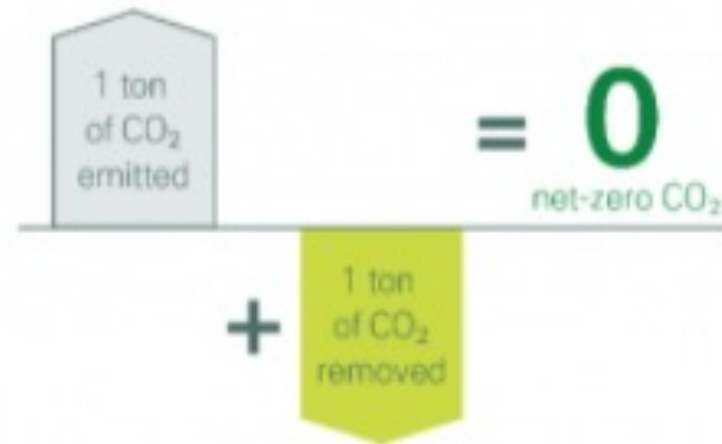
But they are not the same...

... as not every type of carbon credit can balance emissions

Balancing with emission reduction/avoidance

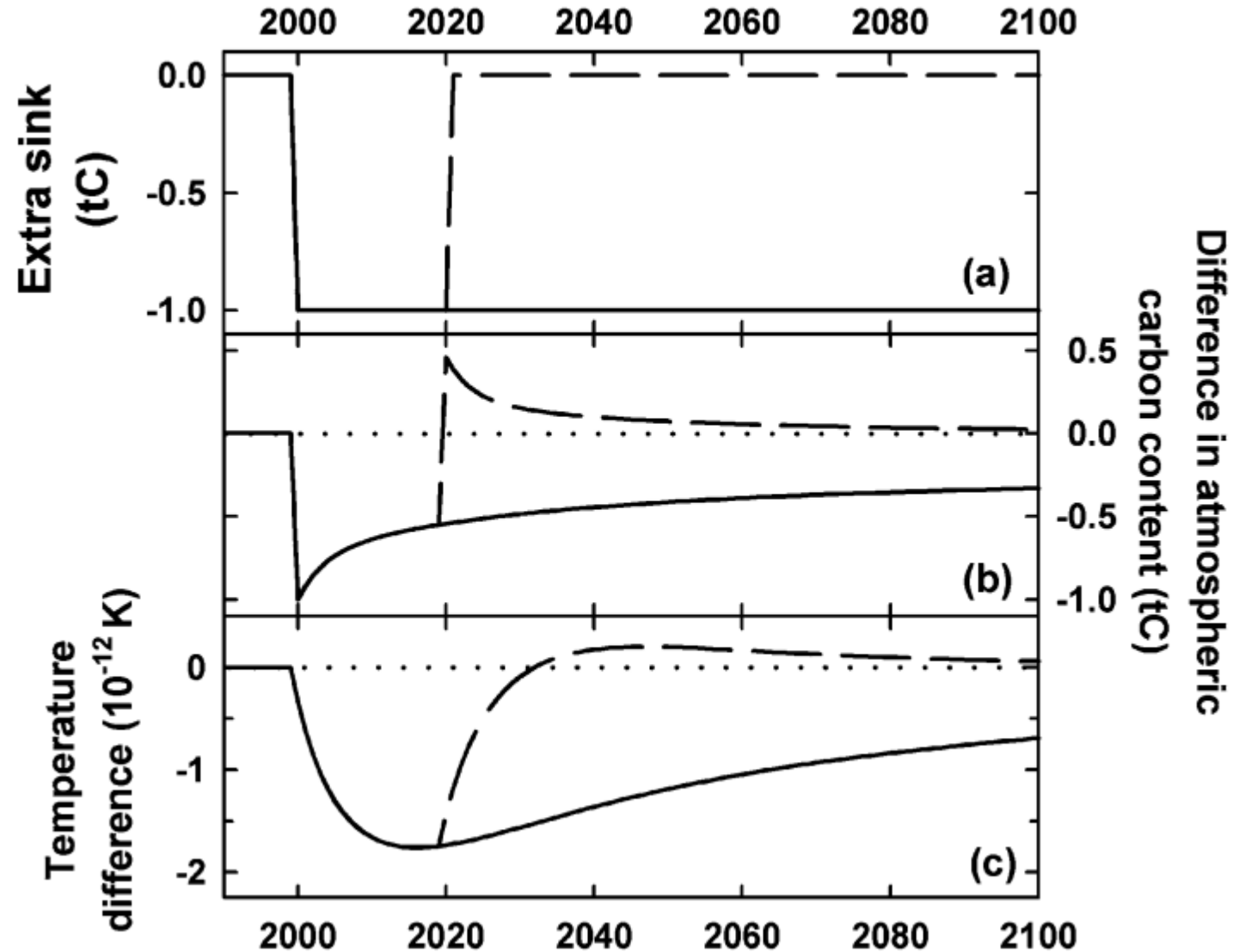


Balancing with emission removals

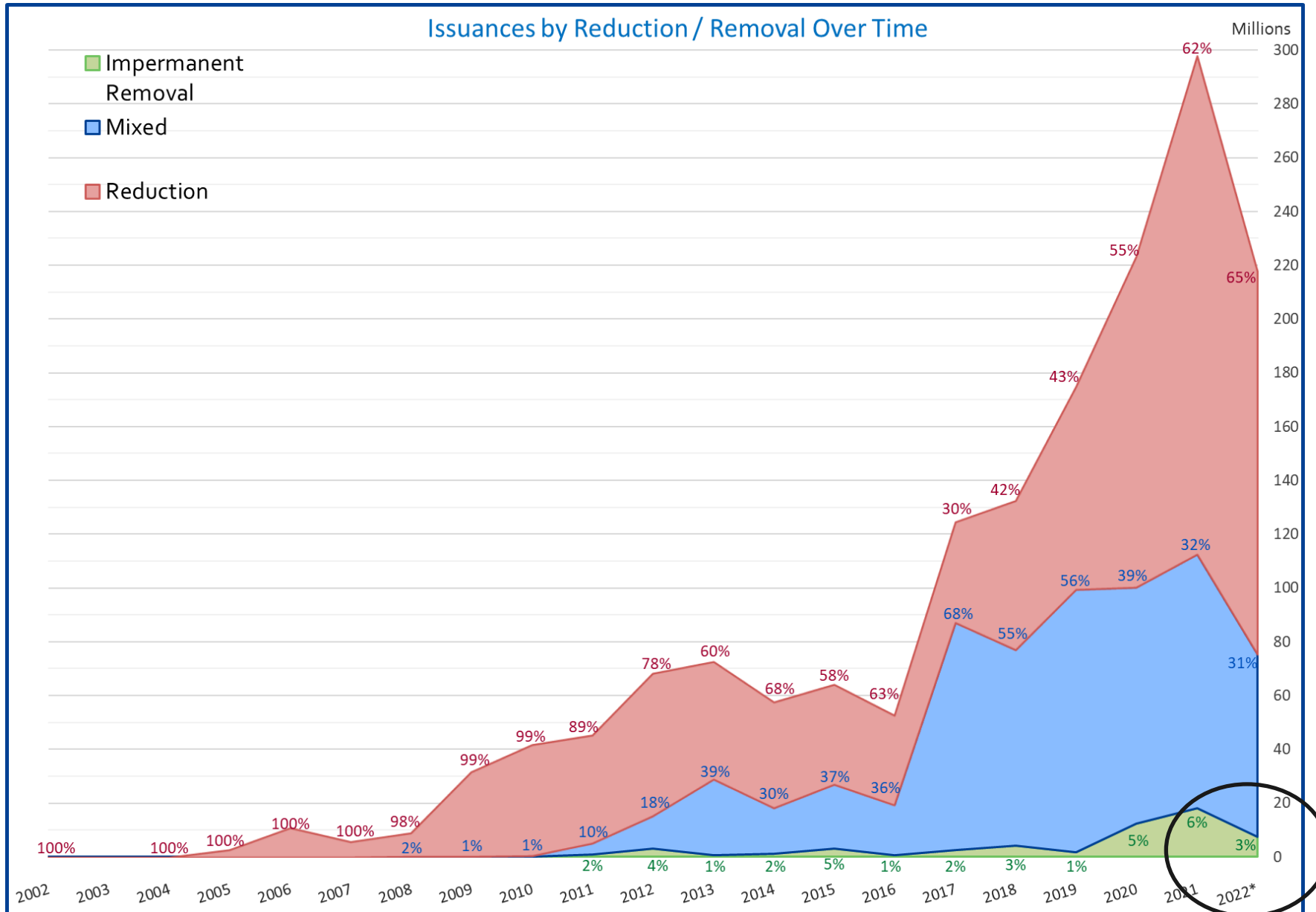


Adapted from Puro.Earth & SwissRe

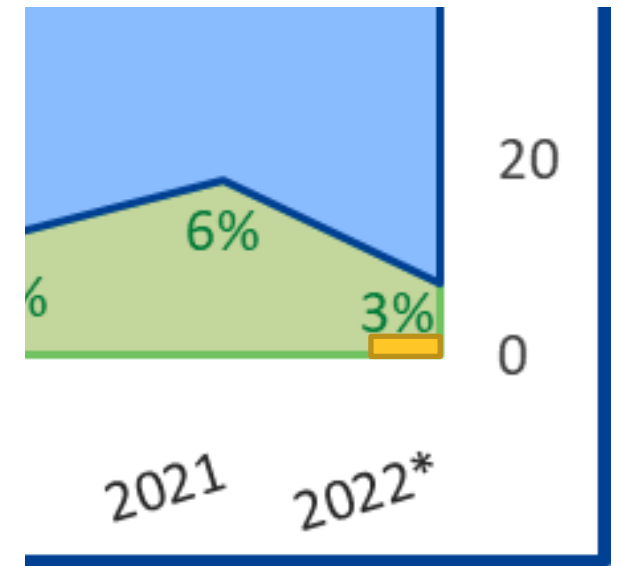
And only “permanent” removal can neutralize an emission



Today's carbon credit market



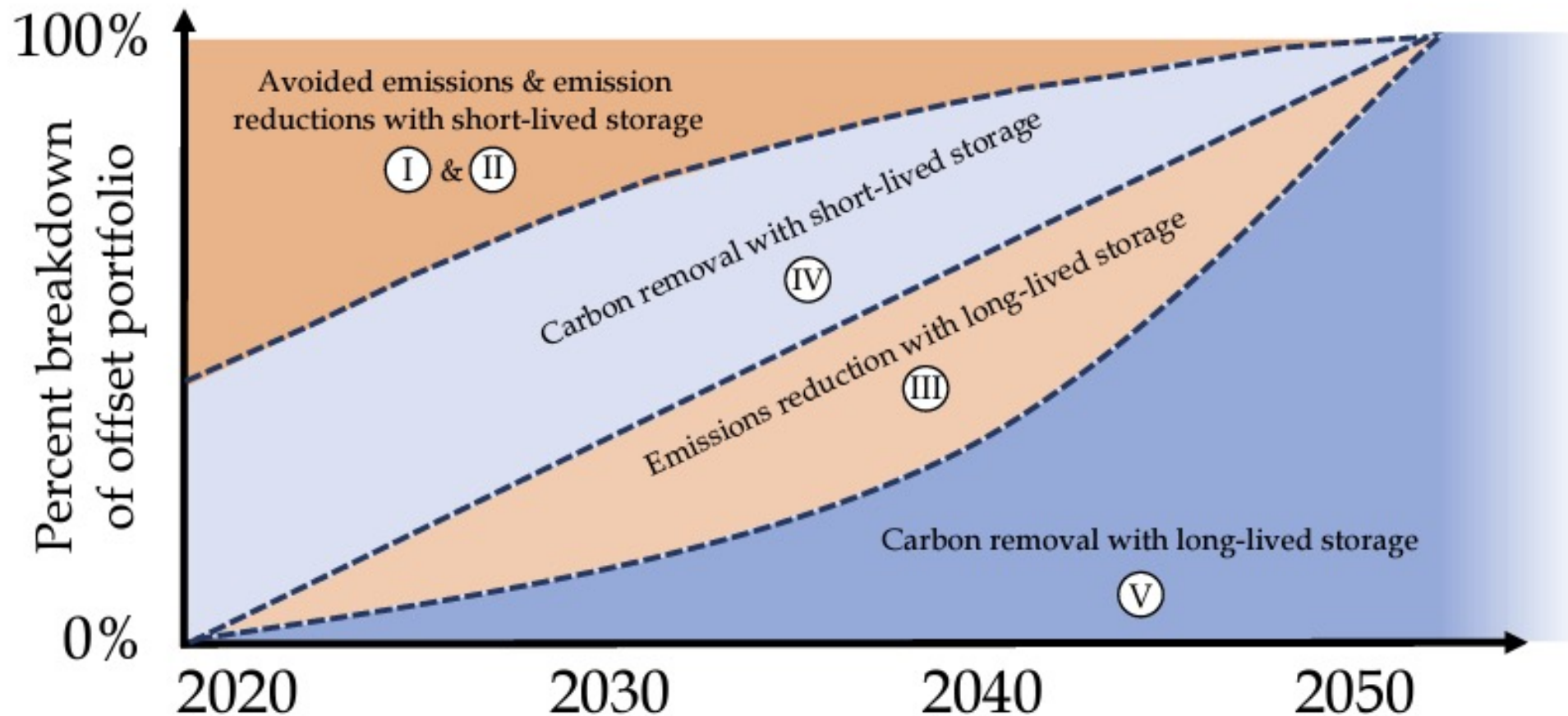
Berkeley Carbon Trading Project's Voluntary Registry Offsets Database
November 2022



36,776 (CDR.fyi)

Advice is to move to carbon removal credits

Figure 2: Example net zero aligned offsetting trajectory



What does success look like?

Long-term market stability = trust = quality

CDR average
2020-2022

~ \$400

Emission
reduction/avoidance
average 2020

~ \$2.50

* Information from CDR.fyi, Ecosystem Marketplace, and CarbonCredits.com

Why strive for quality?

Low quality is a liability

Slowing climate change can only be achieved through high-quality credits

What are counterfactuals

The counterfactual starts at the same level as the treatment, but shares the trend of the control

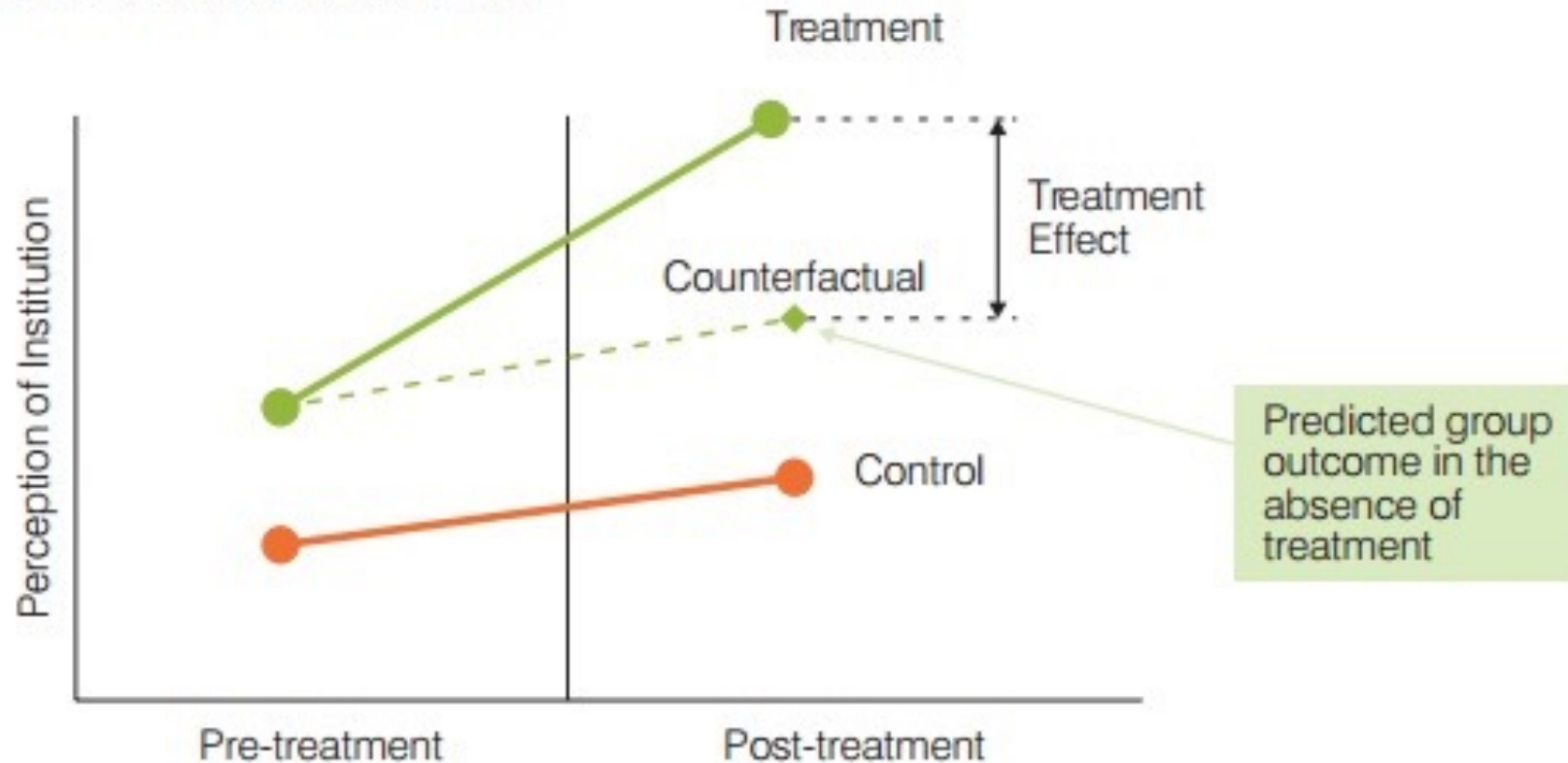


Figure 5. Illustration of Difference-in-Difference Estimation