Introducing the Carbon Takeback Obligation

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The Oxford Net Zero initiative

Negative Emissions Platform

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What is a removal?

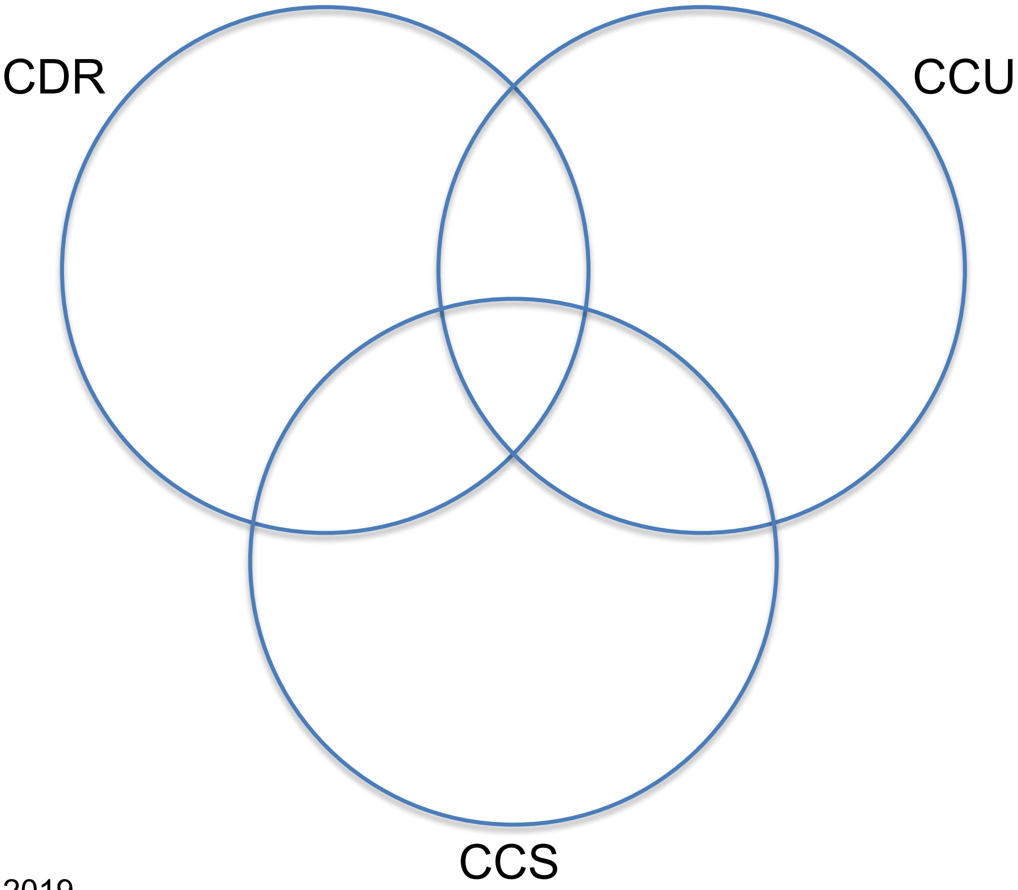
Removing CO_2 from the atmosphere?

Close, but incomplete…

Removing CO_2 from circulation in the *active carbon cycle,* and stewarding its storage in a monitored carbon stock.

Removal is more completely described as the end-to-end process of "carbon removal and storage"

What is a removal?



Adapted from Hepburn et al 2019

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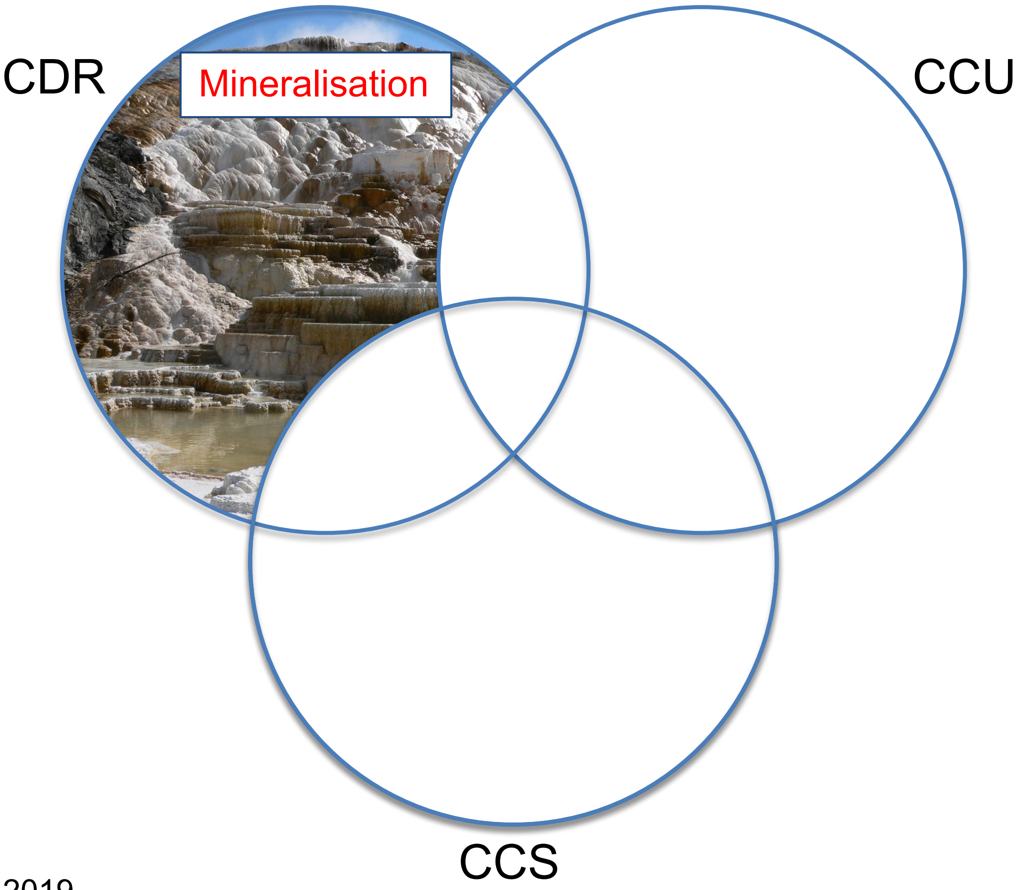

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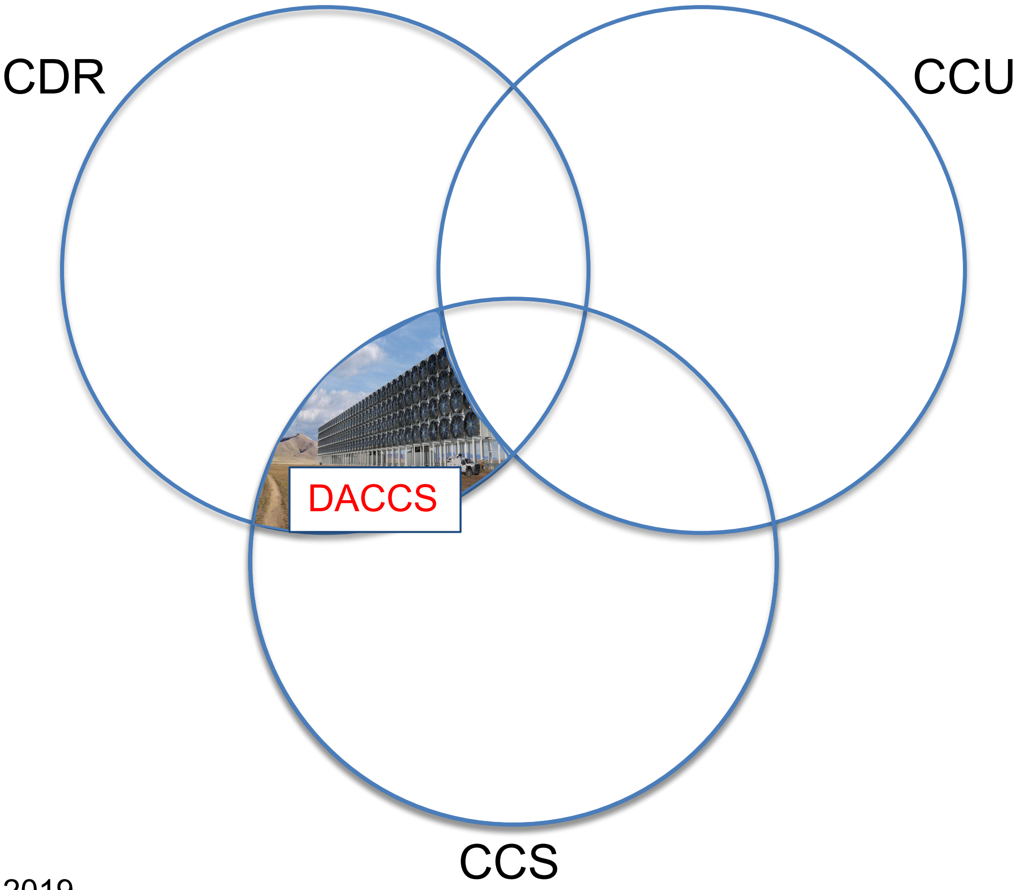

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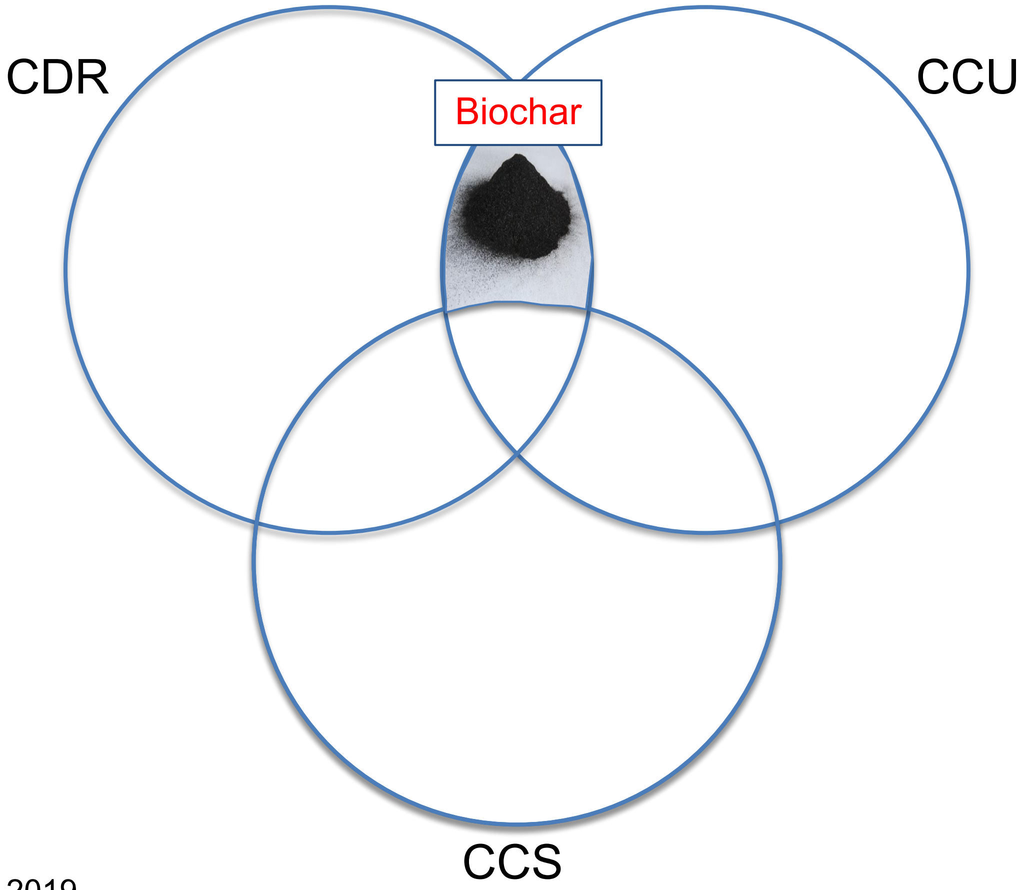

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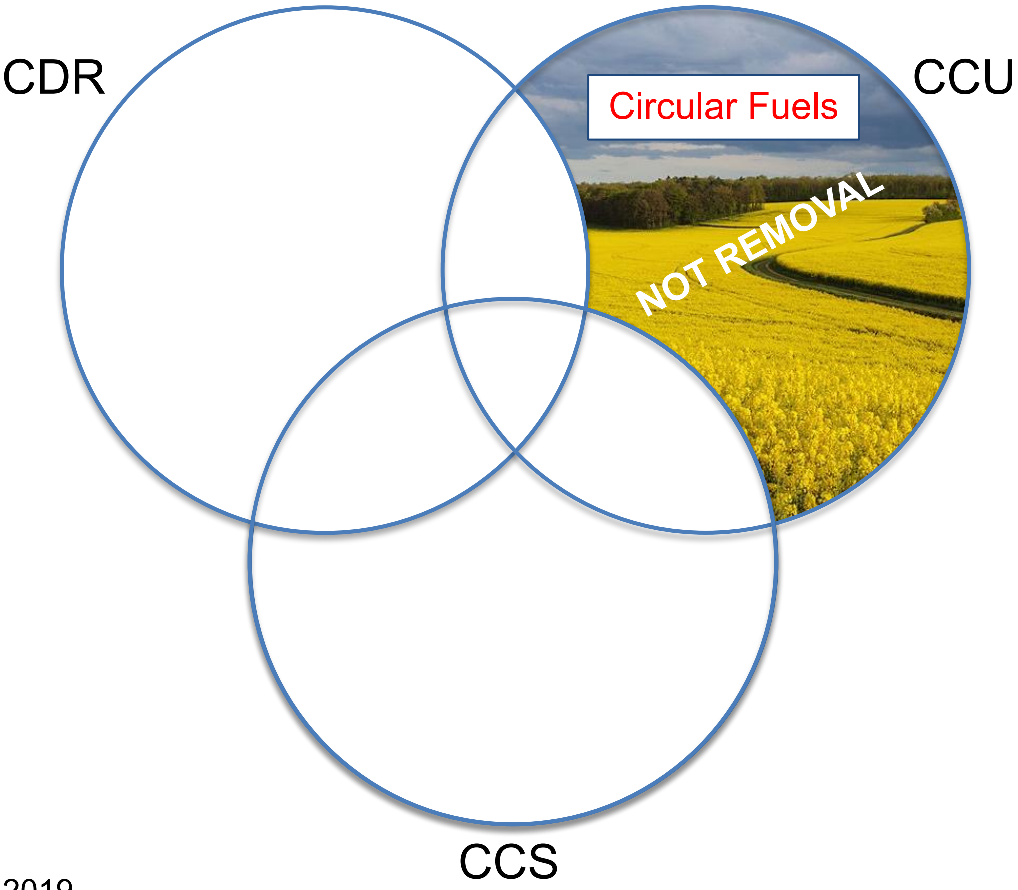

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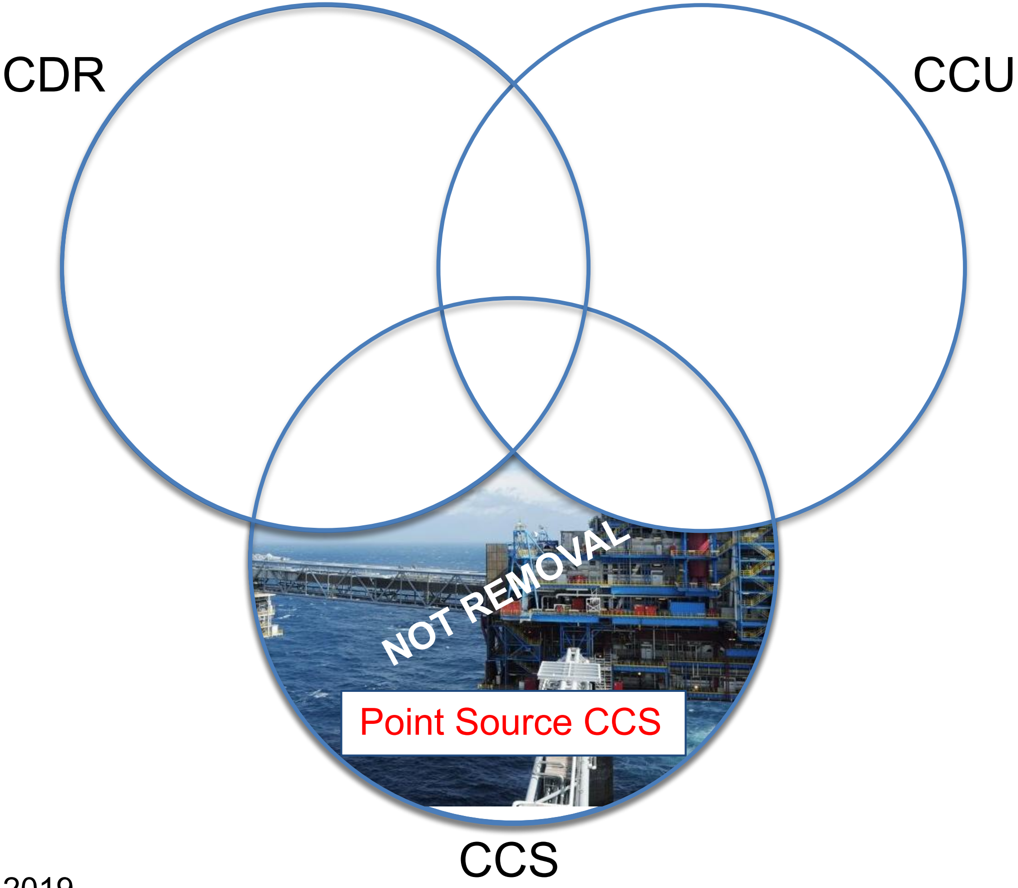

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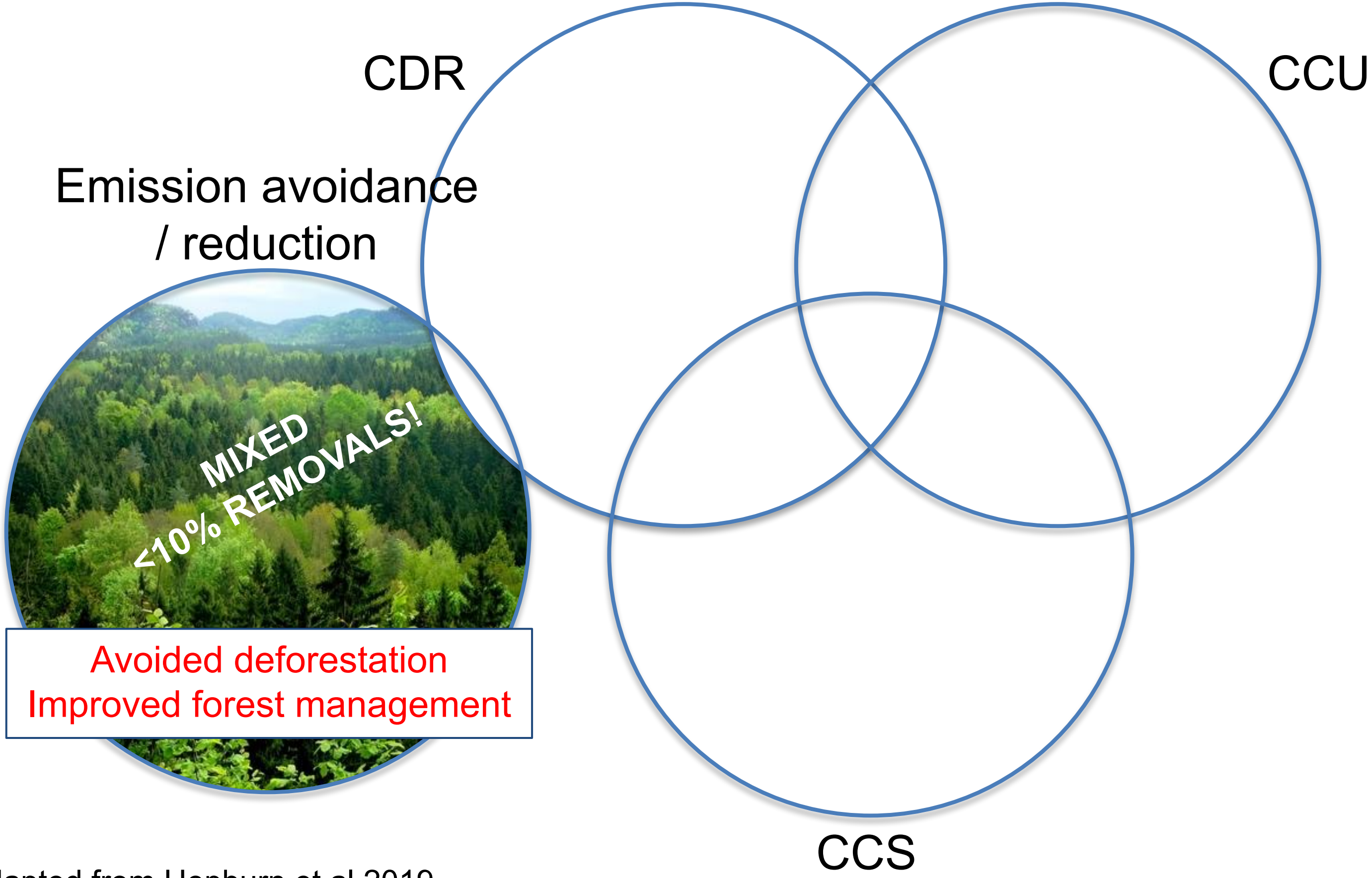

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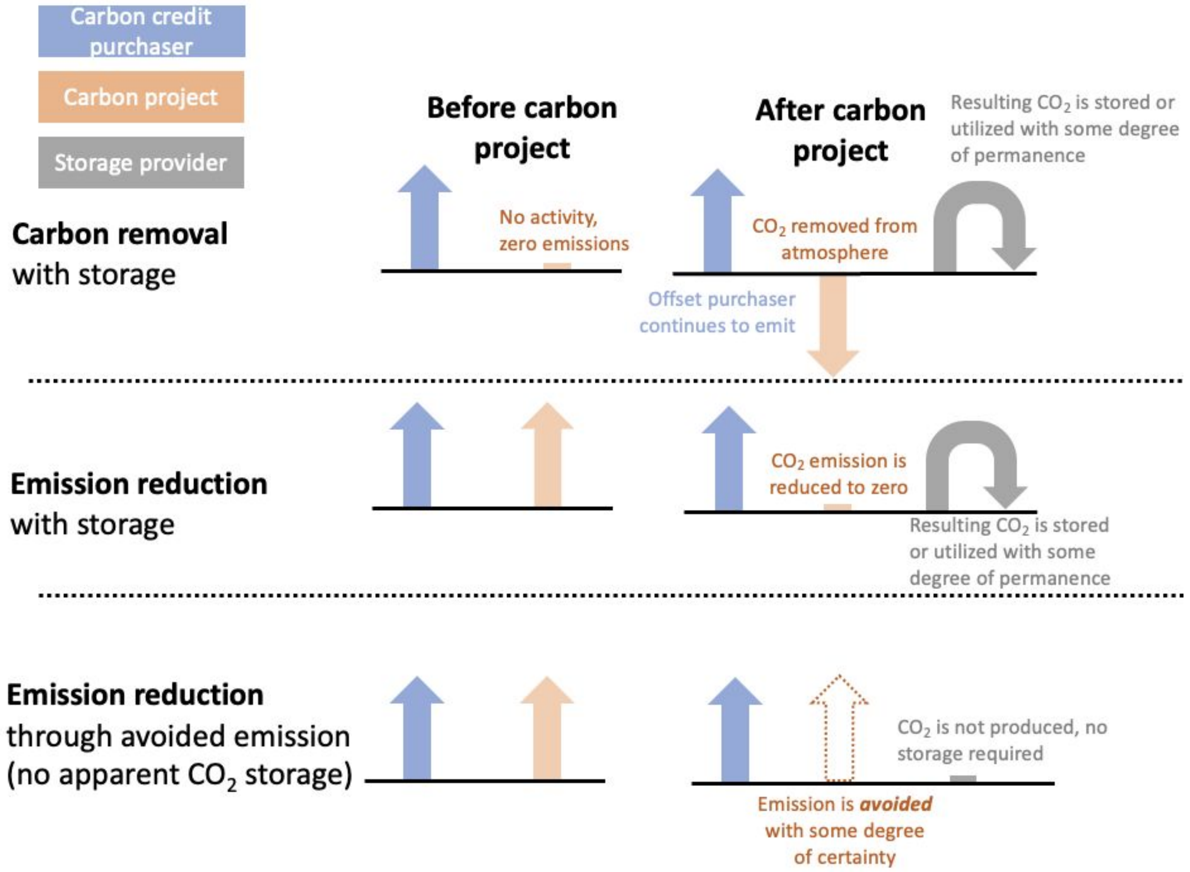

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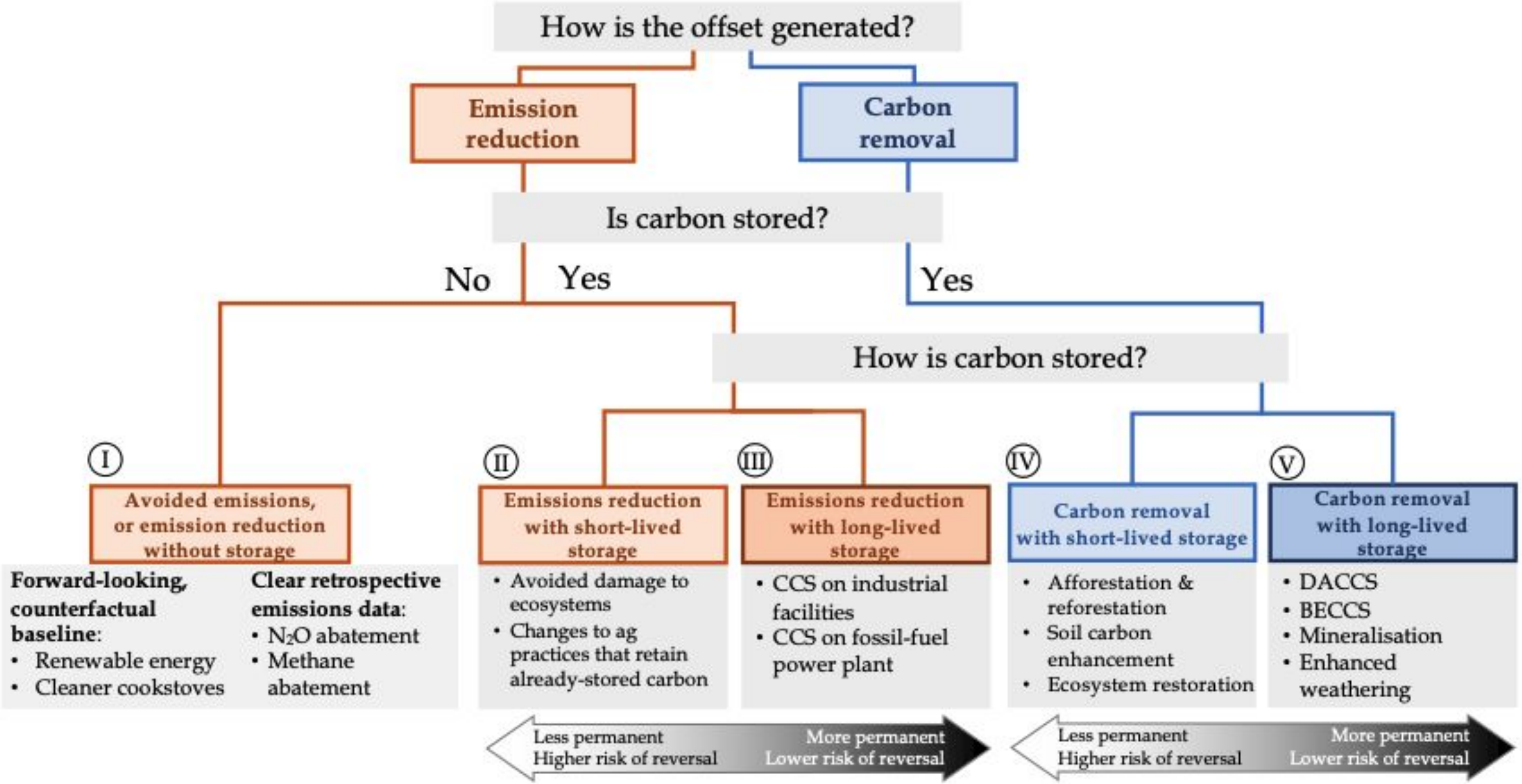
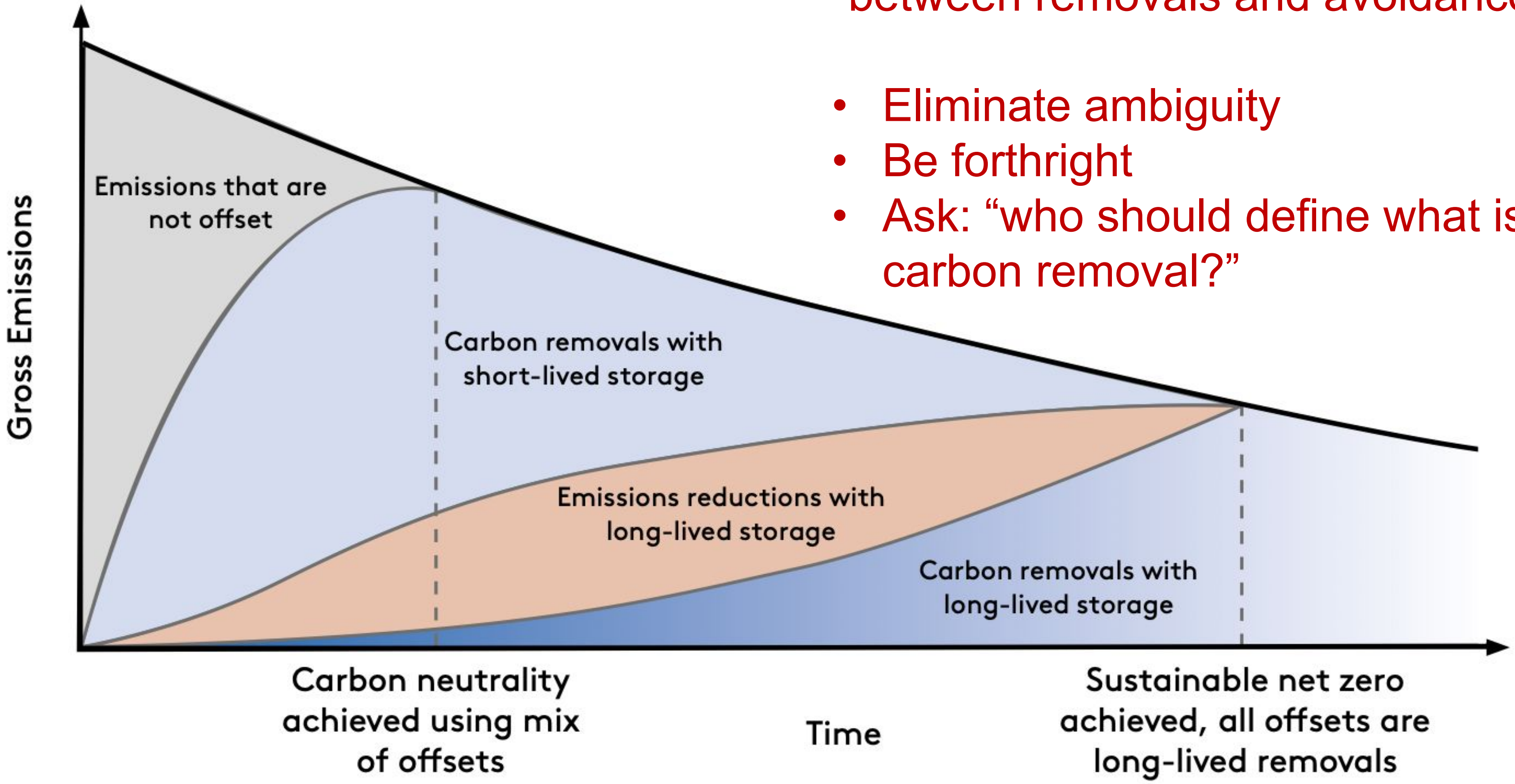


Oxford Principles for Net Zero Aligned Carbon Offsetting

What is a removal?

The market will soon demand a clear distinction between removals and avoidance / reduction!

- Eliminate ambiguity
- Be forthright
- Ask: “who should define what is and is not carbon removal?”



Mitchell-Larson et al 2021, https://www.gla.ac.uk/media/Media_770459_smxx.pdf

Introducing the Carbon Takeback Obligation

Carbon Takeback / Storage Obligation

- The bulk of the benefits (profits) from emissions accrue upstream at the wellhead (fossil fuel extraction), but ***few climate policies harness this value.***

- The most expensive mitigation we'll need to stop climate change is permanent carbon storage, but ***conventional climate policies fail to incentivise it before it's too late.***

The Carbon Takeback / Storage Obligation links these two insights, requiring the permanent storage of CO_2 as a condition of extracting more carbon from the Earth.

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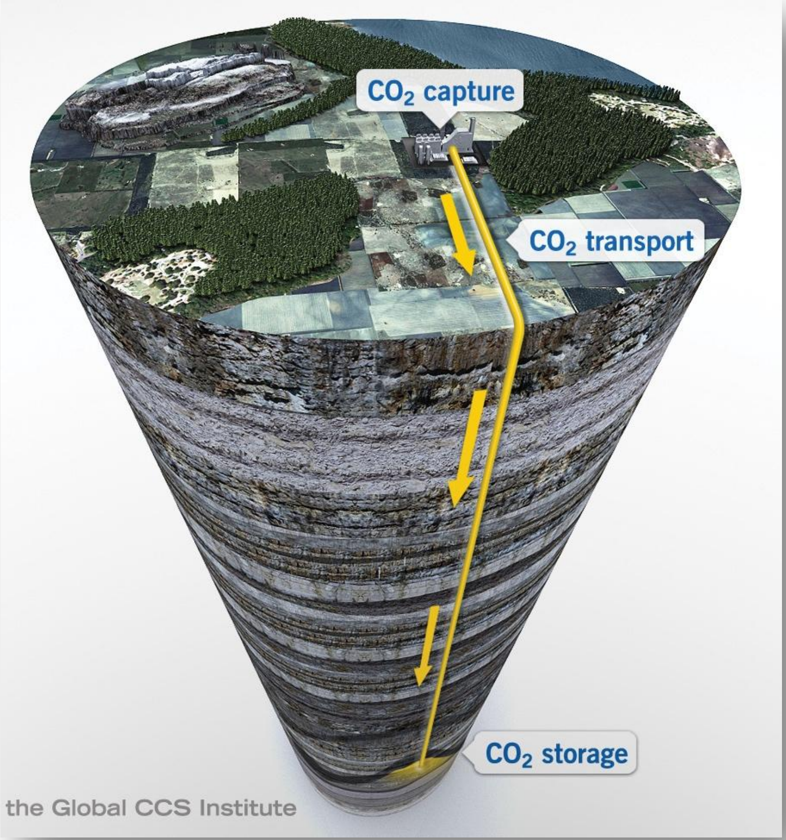
The only sustainable way to stop fossil fuels from causing global warming: high-durability CO_2 disposal



Not for long…

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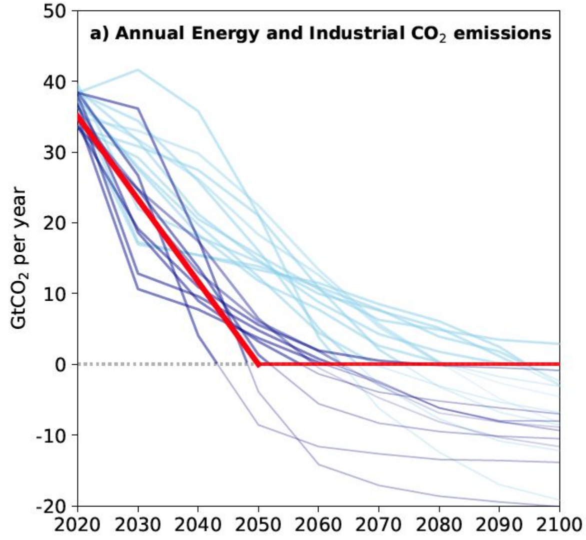
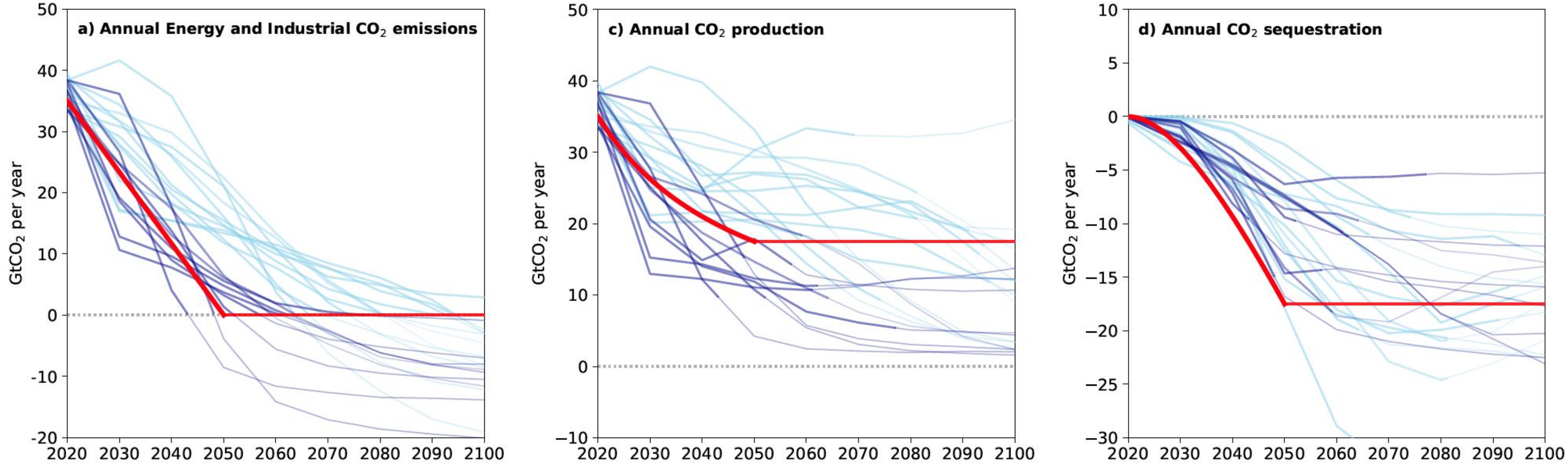
CO_2 energy and industrial process emissions in cost-effective 1.5°C and <2°C scenarios



Blue lines: 1.5°C (SSPx-19) and <2°C (SSPx-26) scenarios
Red lines: Trajectory delivered by a Carbon Takeback Obligation
Jenkins et al, 2021

Tracking progress to Net Zero CO_2 emissions: Emissions = Production – Storage ⟶ 0



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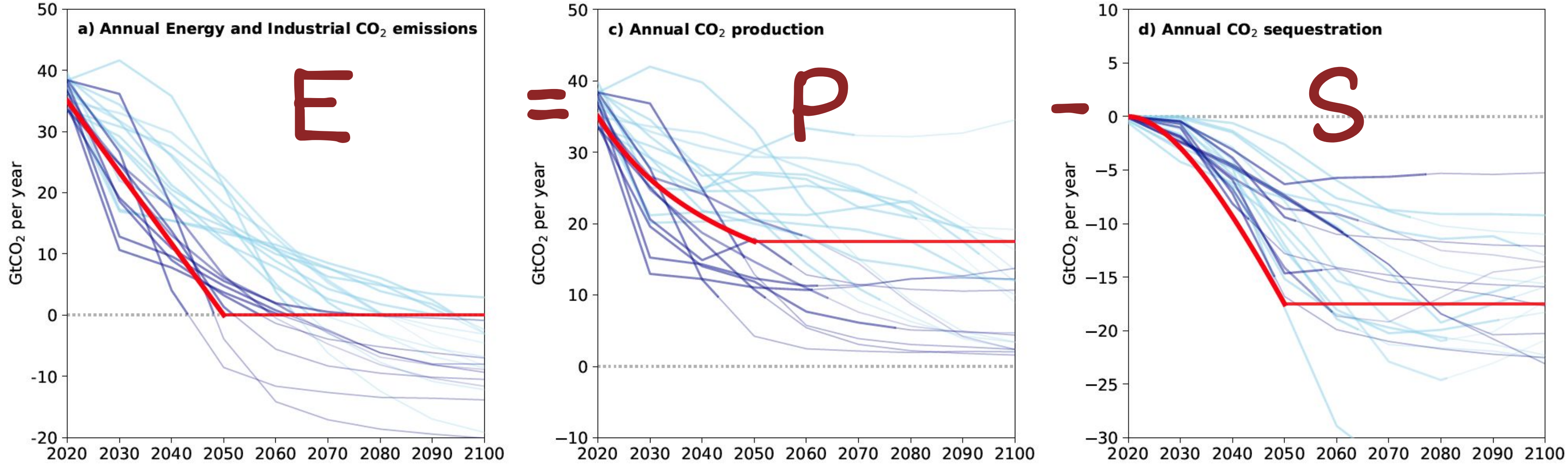

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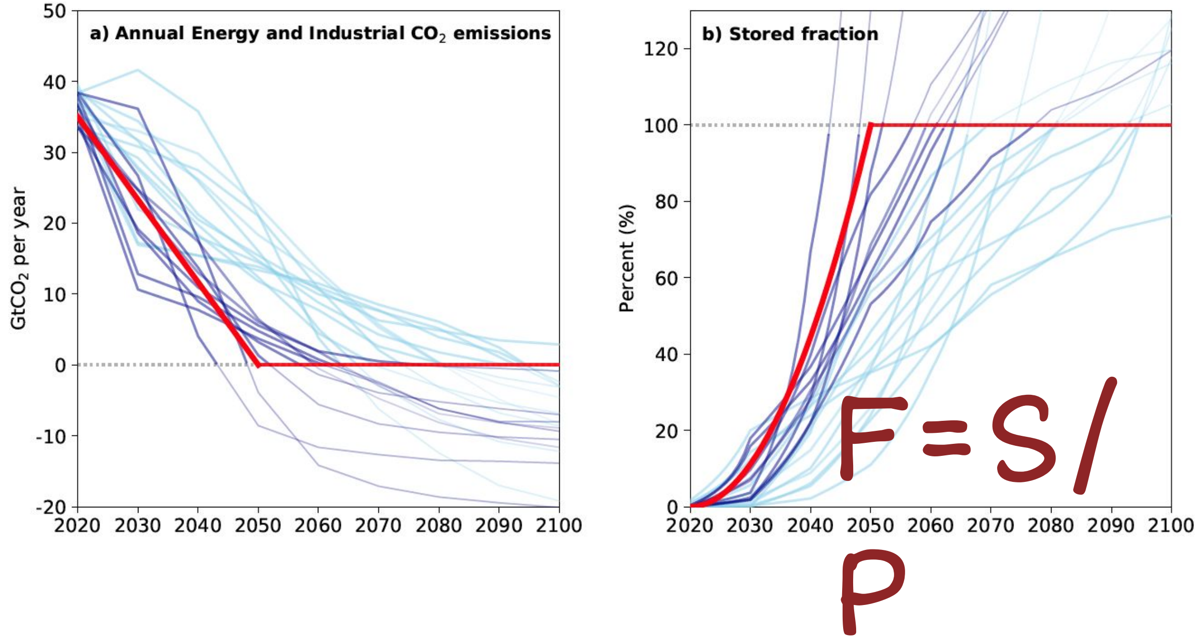
Tracking progress to Net Zero CO_2 emissions: Stored Fraction = Storage/Production → 100%



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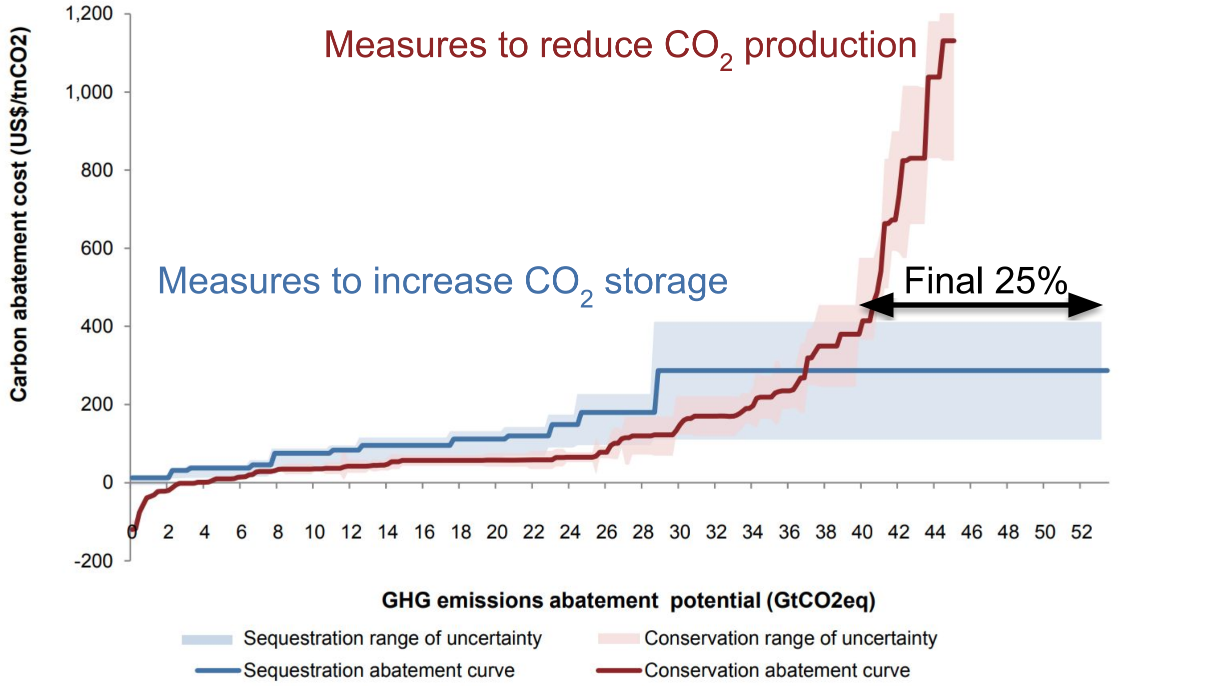
So it is clear what is needed: why are we taking so long to develop CO_2 storage?

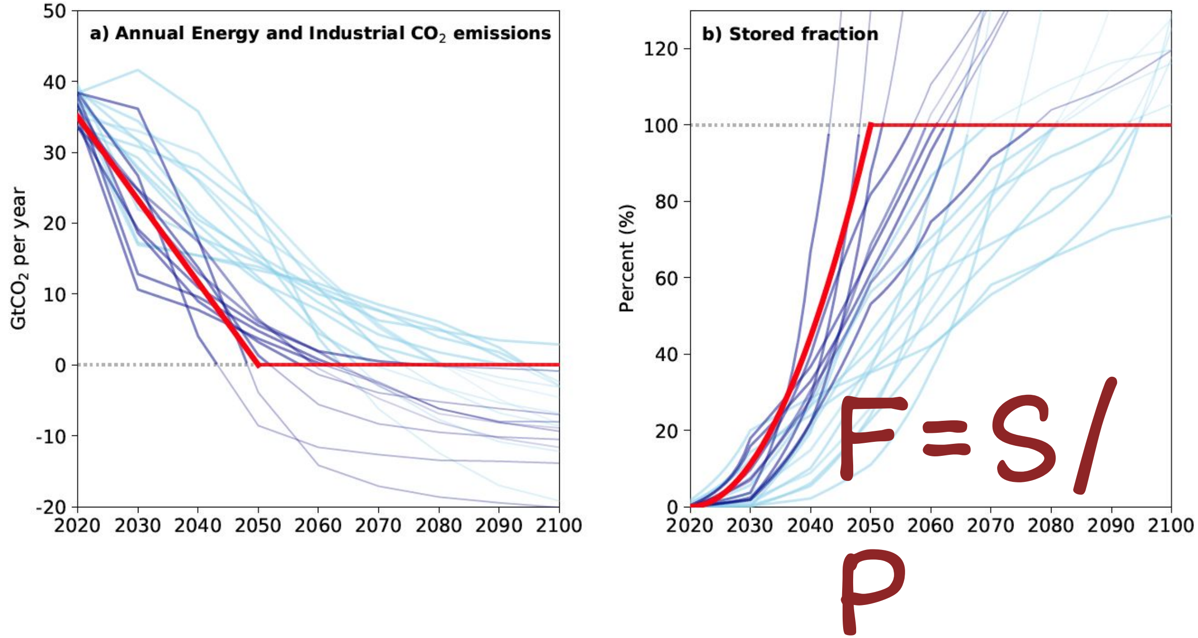


Source: Goldman Sachs Global Investment Research

We can halve emissions with very little use of CO_2 storage, but we can't get to net zero…

https://www.goldmansachs.com/insights/pages/gs-research/carbonomics-10-key-themes-from-the-inaugural-conference-f/report.pdf

Red lines: a stylized "Carbon Takeback Obligation" scenario



Fossil fuel suppliers store a rising fraction of the CO_2 contained in their products, increasing quadratically to 100% in 2050.

Allen et al, "The Case for Mandatory Sequestration", Nature Geoscience, 2:813-814, 2009

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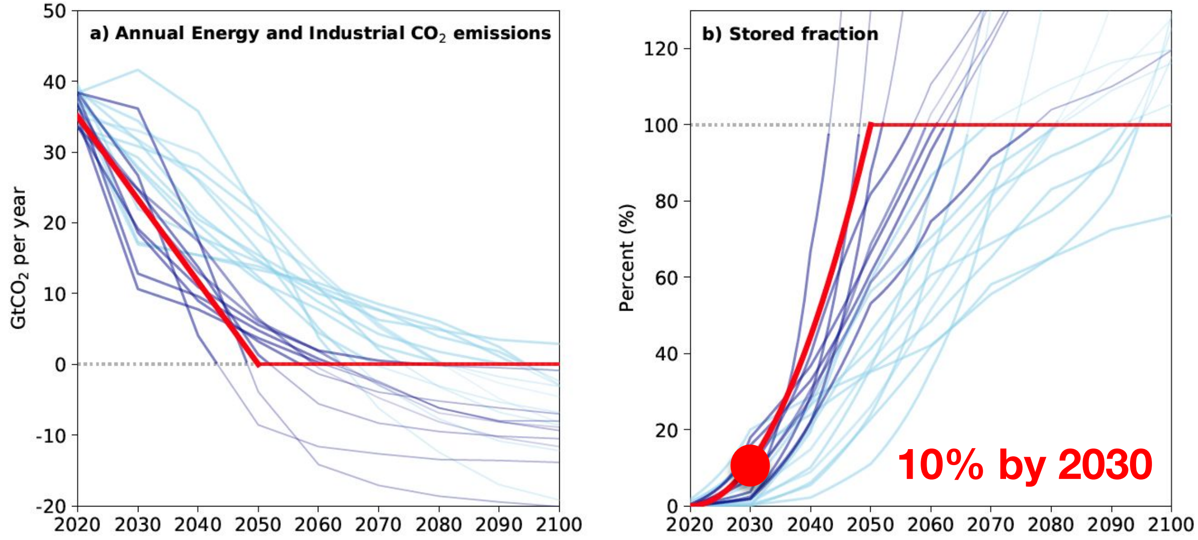

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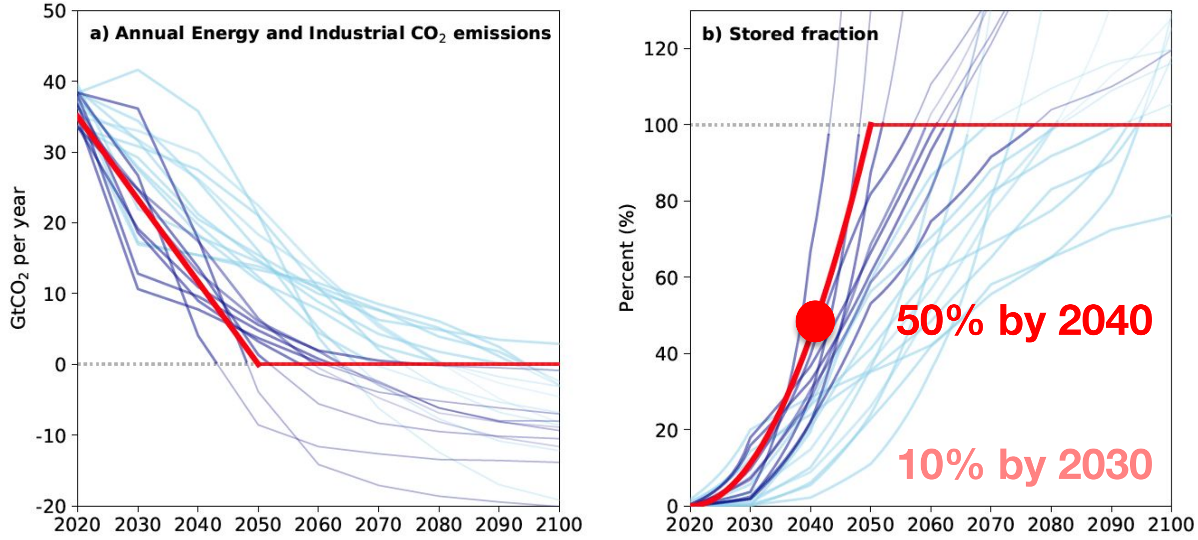

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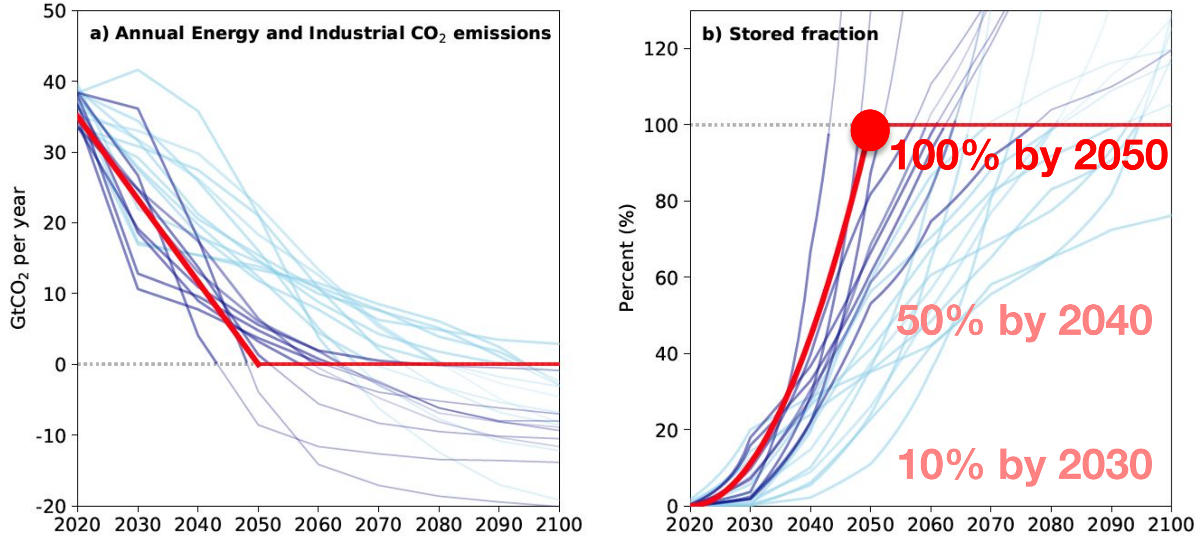

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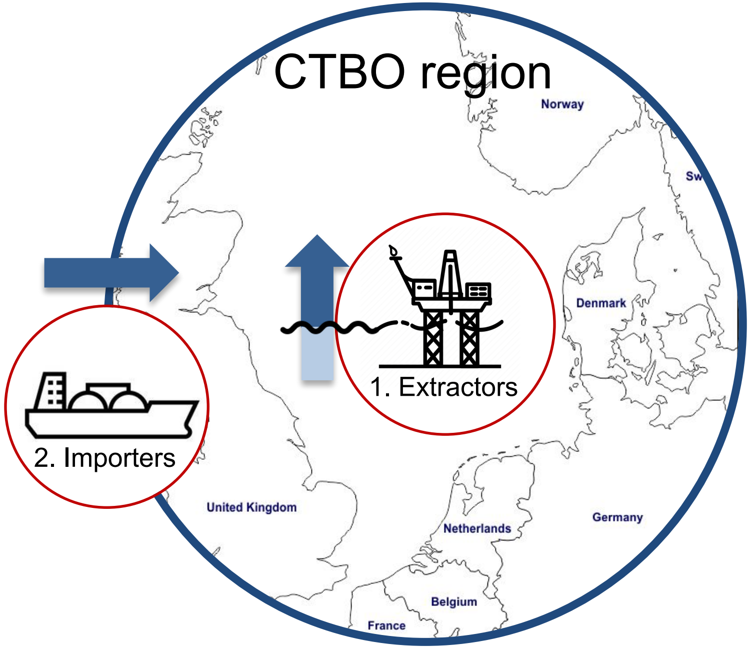
From physics to policy

Carbon Takeback basics:

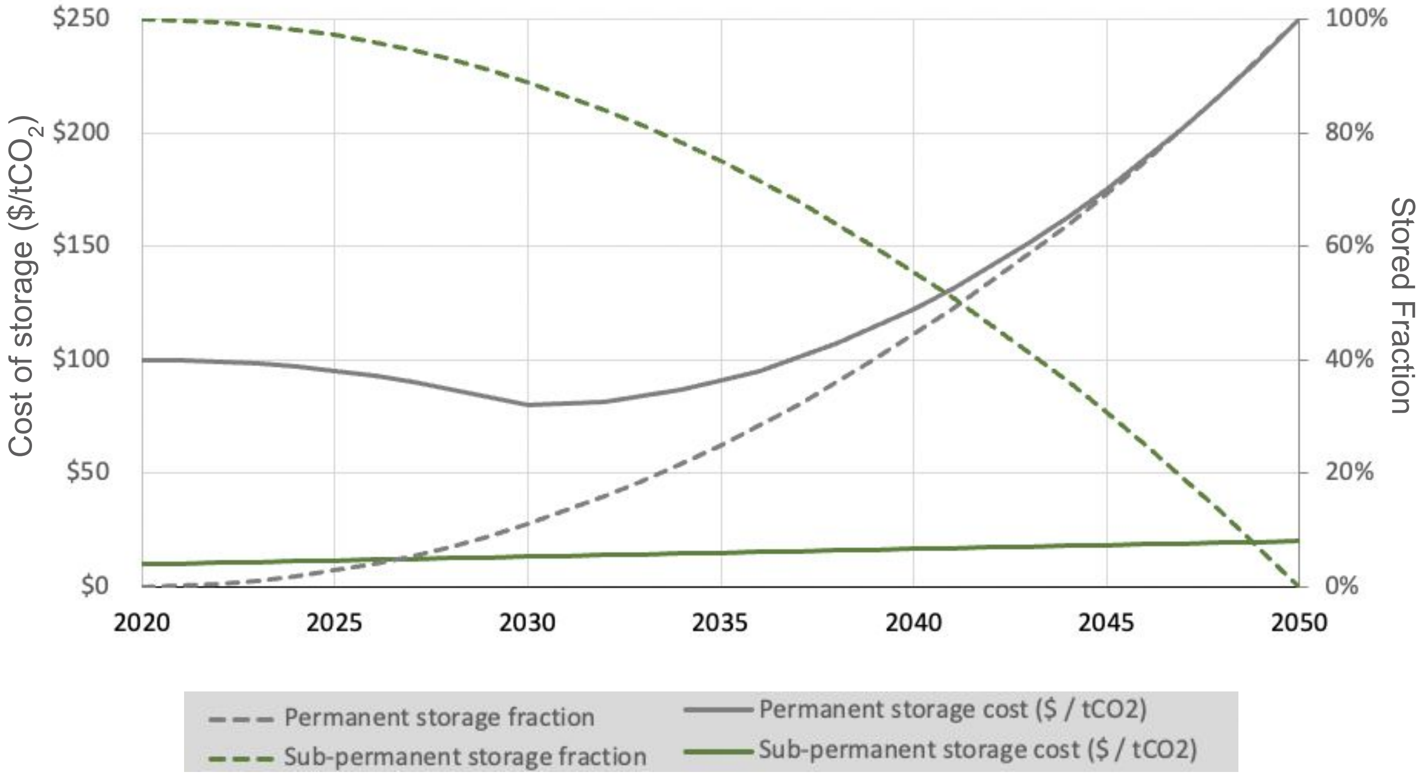
- Extractors & importers (or suppliers) must permanently store an escalating fraction of the fossil carbon contained in their products
- Carbon Storage Units (CSUs) can be traded among obliged entities
- Stored fraction escalation dictated by policy:
  - Quadratic increase to 100% by 2050
  - OR driven by warming itself…. 100% by the time 1.5C reached

Who is obliged?



See Zakkour et al 2020 and preceding papers for more on CSUs

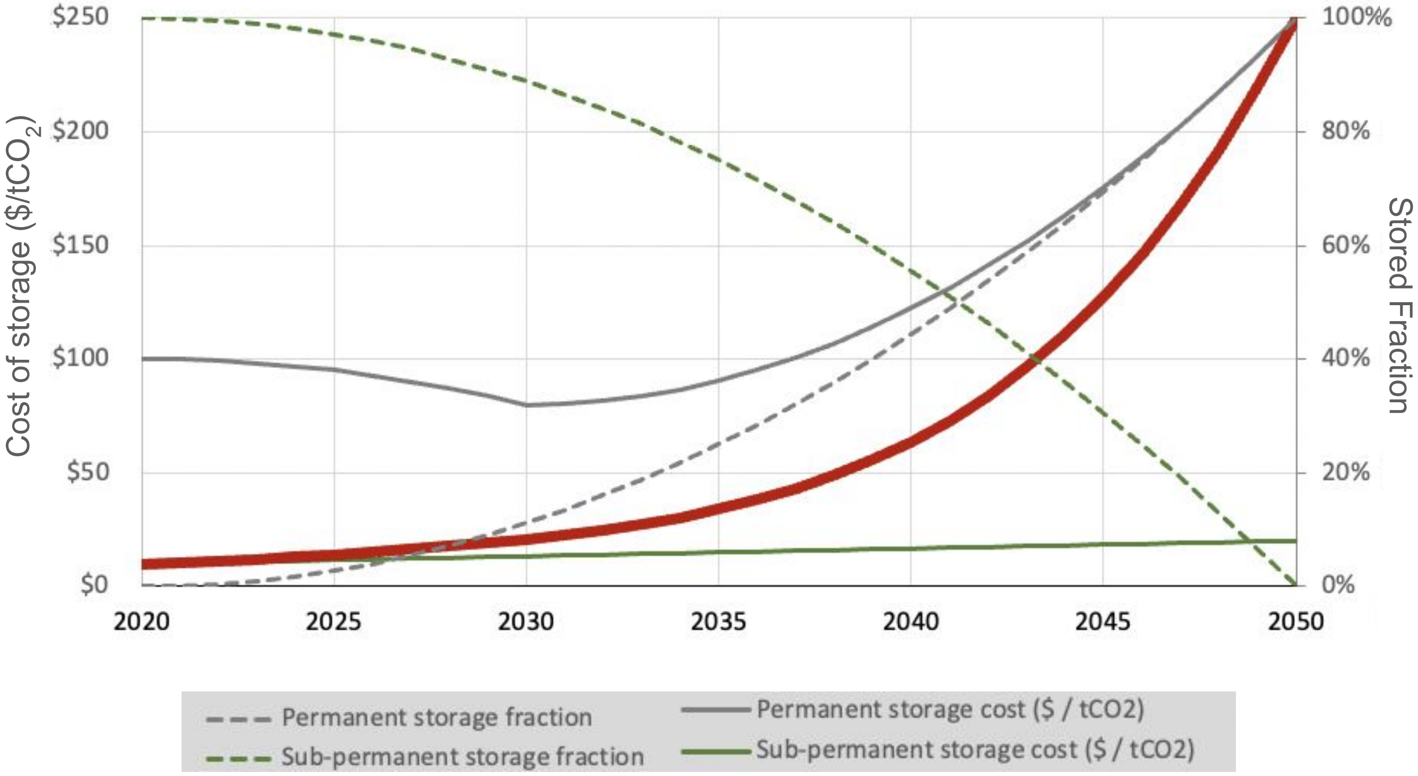
The surprising economics of Carbon Takeback



- Initially low stored fraction…
- …very low initial cost of compliance, while still delivering permanent carbon storage!

Mitchell-Larson and Allen 2021, Prosets: making continued use of fossil fuels compatible with a credible transition to net zero.

The surprising economics of Carbon Takeback



- Initially low stored fraction…
- …very low initial cost of compliance, while still delivering permanent carbon storage!
- Blended cost of compliance gradually approaches the cost of DACCS

Mitchell-Larson and Allen 2021, Prosets: making continued use of fossil fuels compatible with a credible transition to net zero.

Why adopt Carbon Takeback?

- **PREDICTABLE**. Pathway to net zero, market discovers its own least-cost means of permanent CO_2 storage.
- **SIMPLE**. Light regulatory burden.
- **NO TAX**. No direct taxpayer subsidy, price support mechanisms, or taxes.
- **AFFORDABLE**. Initially high costs of geological storage ($50 - $100/tCO2 depending on source) spread over the full volume of fossil fuels sold. Desired outcome (permanent storage in line with climate requirement) assured with a small addition to carbon price.
- **SAFE**. CO_2 is stored safely and permanently, primarily underground and offshore, reducing pressure on ecosystems and aboveground land uses.
- **ALIGNED WITH PUBLIC SENTIMENT**. Bake in the cleanup costs into a still profitable industry!

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Thank you

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https://carbontakeback.org

https://netzeroclimate.org

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Appendix

Global warming has passed 1.1ºC, and rising at over 0.2ºC per decade

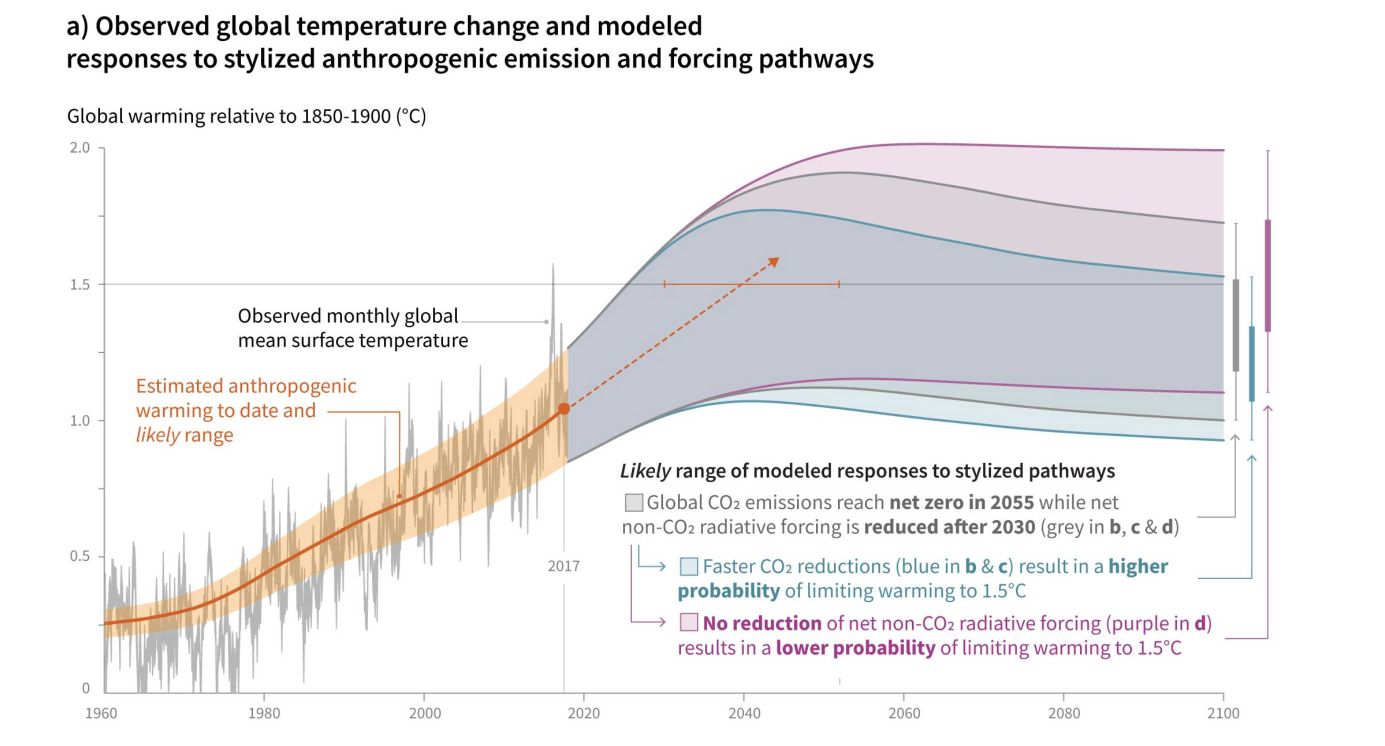

Figure SPM.1 from the 2018 IPCC Special Report on 1.5ºC

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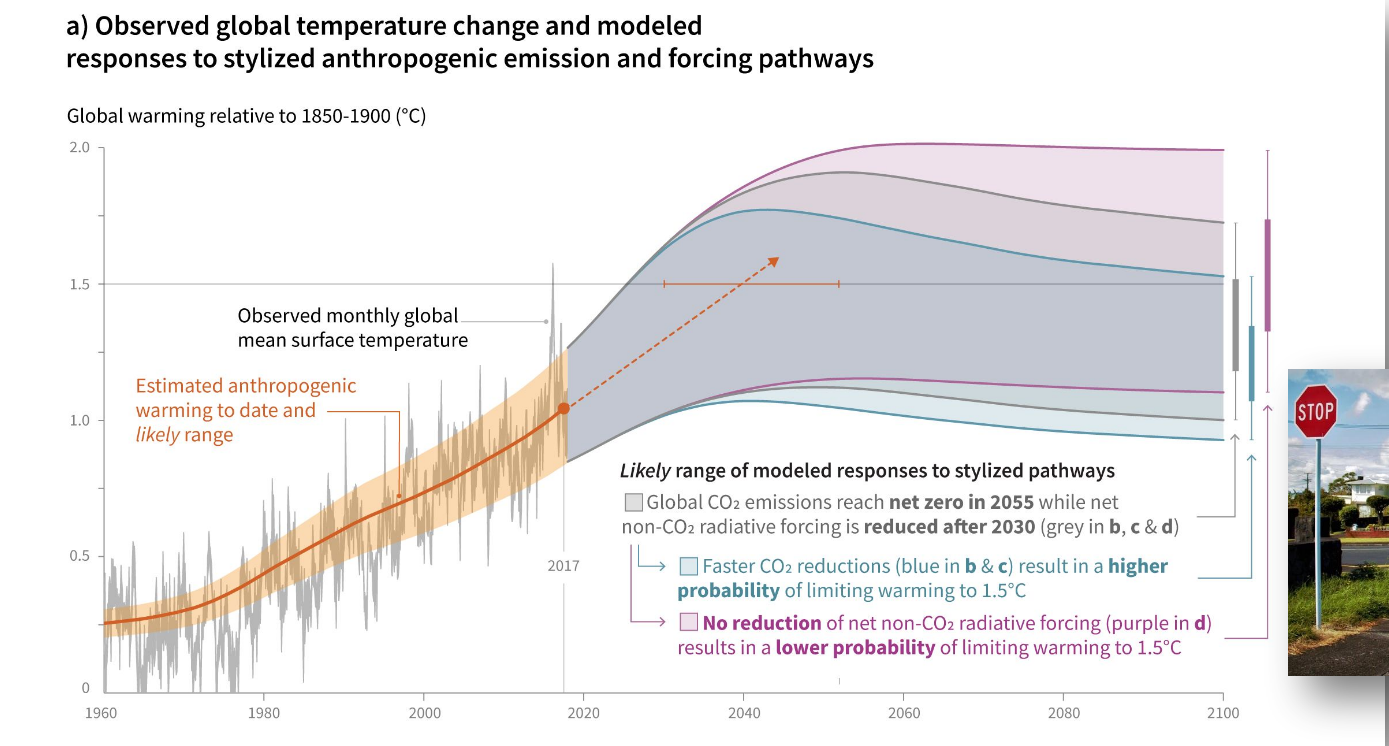


Figure SPM.1 from the 2018 IPCC Special Report on 1.5°C almost certainty

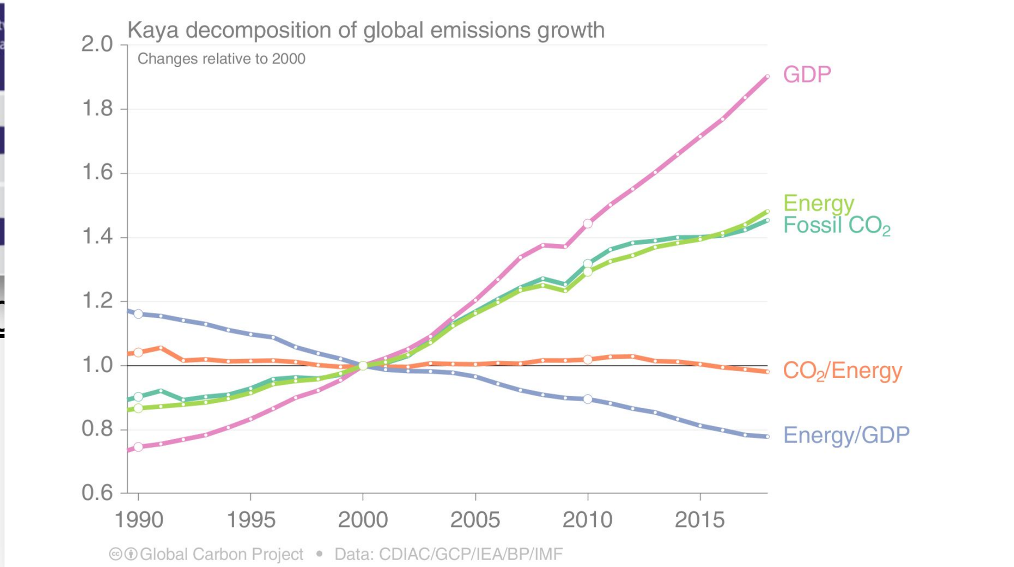
To meet Paris goals, we need to stop global warming before the world stops using fossil fuels

Lignite mining in Anthochori, Greece, 2007

To meet Paris goals, we need to stop global warming before the world stops using fossil fuels

	2020-2029	2030-2049	2050 Absolute Zero	Beyond 2050
Road vehicles	Development of petrol/diesel engines ends; Any new vehicle introduced from now on must be compatible with Absolute Zero	All new vehicles electric, average size of cars reduces to ~1000kg.	Road use at 60% of 2020 levels - through reducing distance travelled or reducing vehicle weight	New options for energy storage linked to expanding non-emitting electricity may allow demand growth
Rail	Growth in domenstic and international rail as substitute for flights and low-occupancy car travel	Further growth with expanded net electric trains; rail becomes domina freight as shipping declines		
Flying	All airports except Heathrow, Glasgow and Belfast close with transfers by rail	All remaining airports close		
Shipping	There are currently no freight ships operating without emissions, so shipping must contract	All shipping declines to zero.		

Allwood, J. et al, 2019: https://doi.org/10



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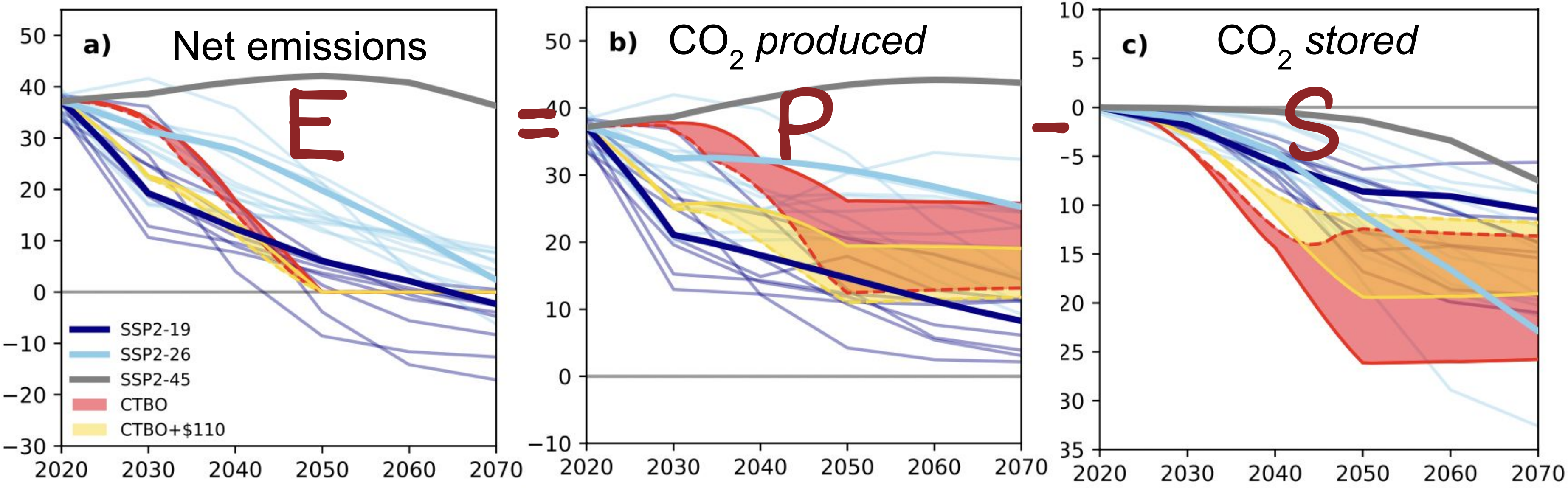

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The surprising economics of Carbon Takeback

- Suppose CO_2 disposal costs
  - \$50/tCO_2 *stored* initially (CO_2 captured at source),
  - \$250/tCO_2 at net zero (point sources + direct air capture).
- Cost per tCO_2 of fossil carbon *sold* = $S(50+200S)$ where S is stored fraction.
- This is equivalent to a carbon price of:
  - \$ 0.52 /tCO_2 at S=1% (early 2020s)
  - \$12.00 /tCO_2 at S=15% (early 2030s)
  - \$250 /tCO_2 at S=100% (2050s)