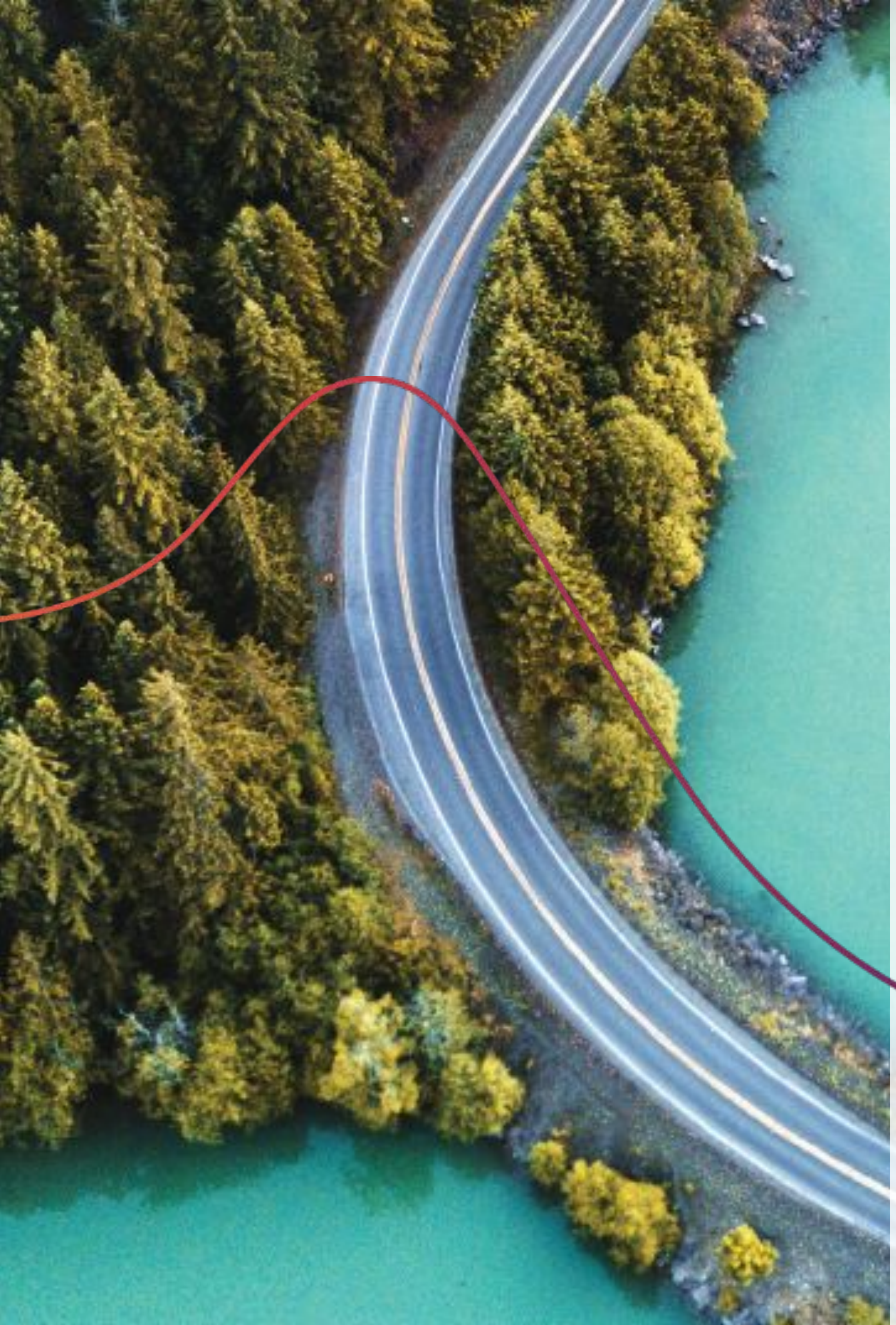


SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Session III: How long is long enough?

Approaches to define the durability of removals

Piera Patrizio, Humphrey Adun, Alice Farrelly

DISCLAIMER

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

- Please note, this document is for information purposes only in order to inform discussions and for no other purpose.
- The information provided by SBTI (including information supplied by third-parties) in this document is furnished on a confidential basis and must be treated as confidential.
- No such information may be divulged to any third party without the prior written approval of SBTi.
- This information shall not be used for any other purpose. SBTi reserves all rights in this document.

ANTITRUST

Antitrust Caution – Do not engage in any discussion, activity or conduct that may infringe on any applicable competition law.

For example, do not discuss:

- current or future prices, pricing strategies, or price related information;
- output, capacity, inventory levels, or costs;
- data related to market share;
- current or future business model transformation strategies.

Members are responsible for halting any activity that may violate this policy and reporting it immediately to SBTi.

CONFLICT OF INTEREST DECLARATION

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

- As per the EWG Terms of Reference and the SBTi COI policy, conflicts of interest must be declared
- At the start of each meeting the chair will ask members if a new COI has arisen
- A Conflict of Interest may be:
    - Actual: A true conflict exists between a Party's duties with the SBTi and their private interests.
    - Potential: Where a Party has personal or private interests that could conflict with their duties with the SBTi, or where it is foreseeable that a conflict may arise in future.
    - Perceived: Where an unbiased observer could reasonably form the view that a Party's private interests could influence their decisions or actions.

ARE THERE ANY COI THAT THE SBTi SHOULD BE AWARE OF?

Introduction | Our goal today is to discuss how long carbon must be stored to credibly count toward neutralizing residual emissions

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Today's topic	Objective
1. Recap from session II	Establish group consensus and divergence on how each removal option aligns with the SBTi principles
2. Why does durability of removals matter?	Lay the foundation of the two durability frameworks proposed in the CNZS V.2
3. What factors shall we consider when evaluating removals durability?	Explore and discuss why implementation challenges should be considered when setting durability thresholds within interim removal targets
Open discussion	
5. Next steps	Present updates on the meeting schedule and agenda/objective for next meeting

RECAP OF PREVIOUS DISCUSSIONS

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Broad convergence

How each removal option perform against SBTi principles?	Which removal option is best aligned with SBTi principles?	Guardrails, incentives, and design choices to align removal options with SBTi principles?
There was agreement that Option 1 (required targets) would send the strongest market signal	General agreement that option one is more ambitious due to its clear market signal, and investment incentives	Recommendation to shift from cumulative to annual removal targets to improve consistency with post net zero targets
Agreement that Option 2 was the least performing option against the SBTi principles	The groups highlighted concerns that excessive flexibility could weaken CDR signals	Integrate a minimum quality and permanence threshold

Open question

Assessing removal options against responsible principle requires additional sector-specific context

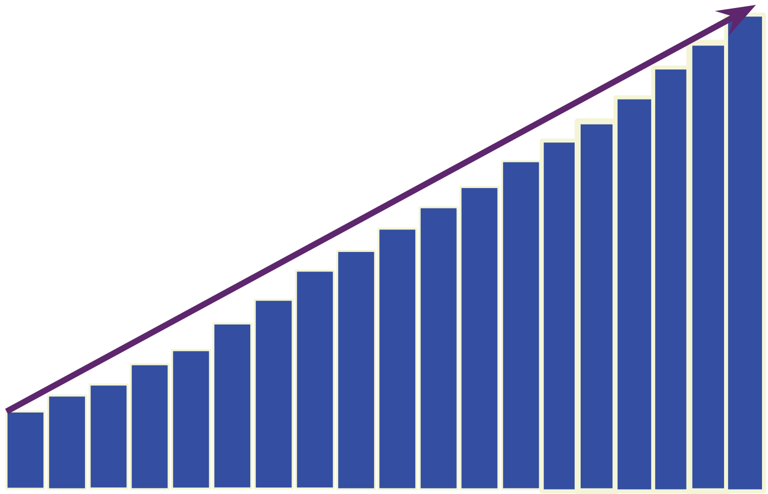
Will be discussed in the subsequent sessions

Sharp increase in removals required to address residual emissions post-2050

WIP

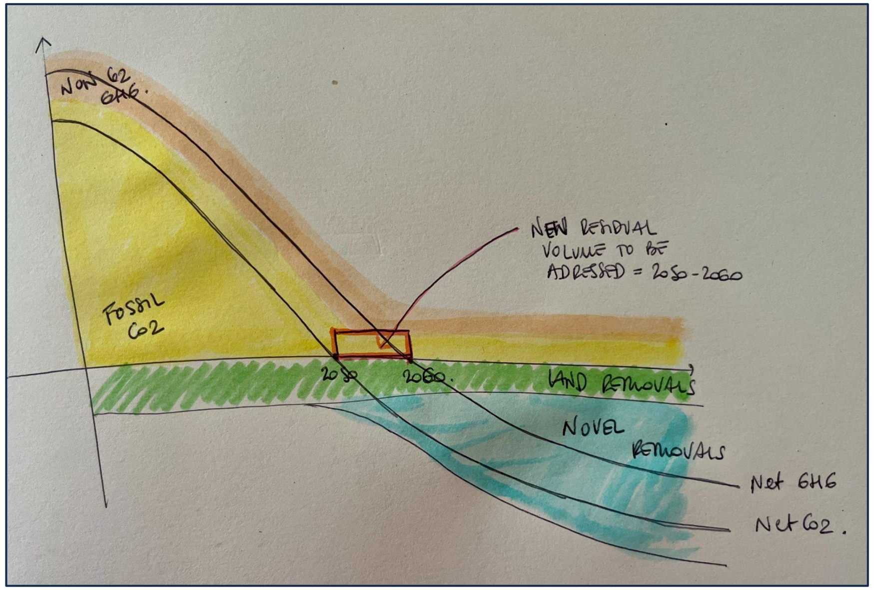
Residual emission framework: updated

Annual growth to net zero CO2 emissions (2050)



- Interim removal targets increase annually and linearly starting in 2030
- By 2050, 100% of net zero residual are addressed by durable removals
- The cumulative volume of removal required is **11 times higher** than the current proposal

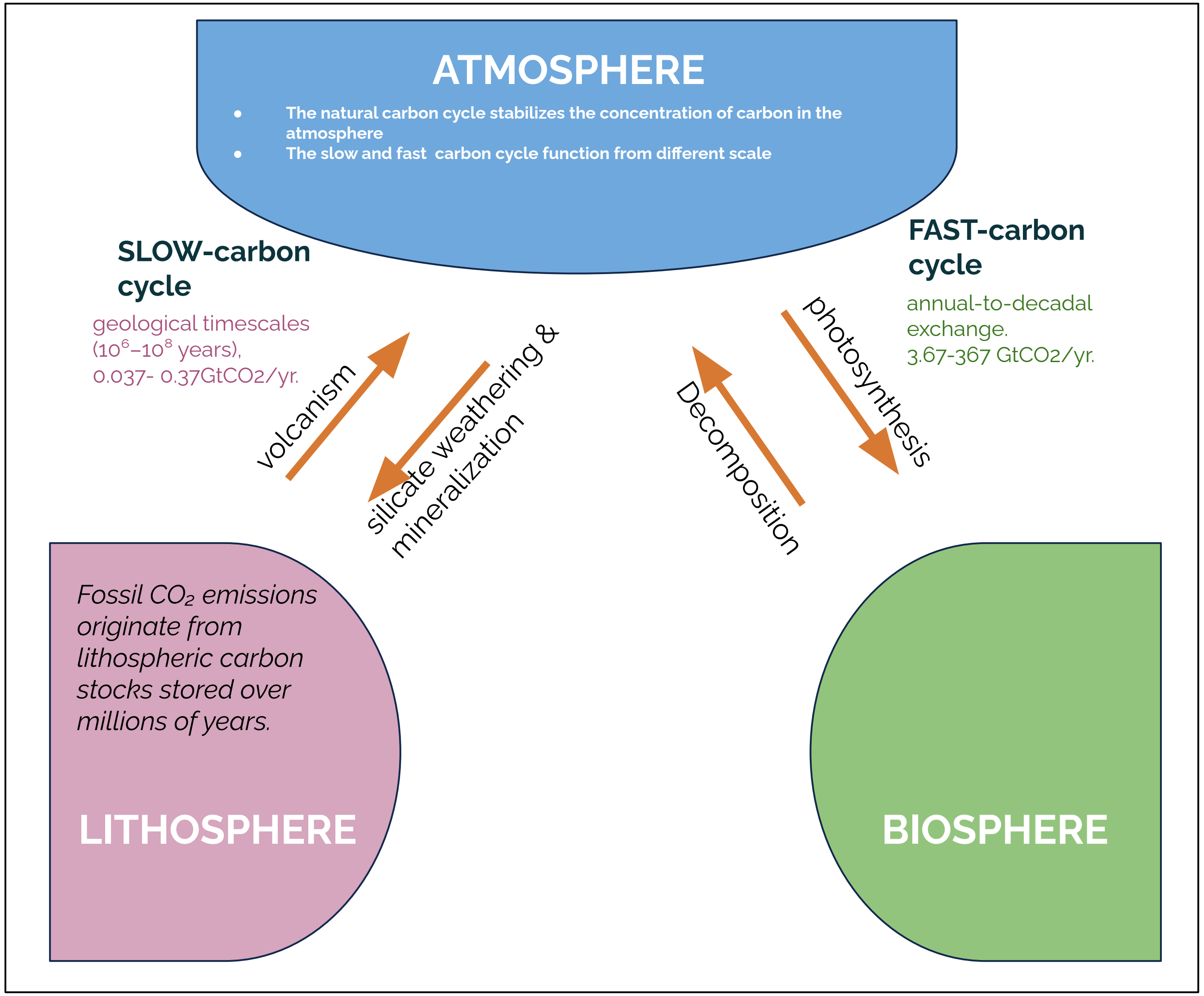
Cumulative volume until net zero GHG emissions (2065)



- The volume of residual emissions to be addressed covers the period between net zero CO_2 (by 2050) and net zero GHG (by 2065).
- By 2050, 100% of net zero residual are addressed by durable removals
- The cumulative volume of removal required is **15 times** higher than the current proposal

The carbon cycle

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION



Adapted from Carbon gap

- Carbon circulates between major reservoirs: atmosphere, terrestrial biosphere, oceans, and lithosphere.
- Fast carbon cycle Involves annual to decadal exchanges of carbon through photosynthesis, respiration, decay, and surface ocean–atmosphere gas exchange, moving approximately 3.7–370 $GtCO_2$/year
- Slow carbon cycle operates over geological timescales (millions to hundreds of millions of years), governed by chemical weathering, sedimentation, and volcanic outgassing, with fluxes around 0.037–0.37 $GtCO_2$/year
- Human activities (fossil combustion, deforestation) inject 36-40 GtCO2/year into the fast cycle, exceeding the absorptive capacity of terrestrial and oceanic sinks.

Source: NASA

Durability of removals: why it matters for residual emissions

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

When removals are used to counterbalance residual emissions, the fungibility between the removal and the emitting activity must be considered. This means accounting for the timeframe over which the CO_2 storage is maintained (i.e., the durability of removals).

This fungibility change depends on the source of the emission or removal. In particular:

- Fossil CO_2 emissions represent a near-permanent increase in atmospheric carbon stocks, transferring carbon from otherwise permanent geological sinks to the atmosphere, where it remains for centuries to millennia (Carton et al., 2021).
- Some removal methods, particularly where carbon is stored in biomass or terrestrial sinks, store CO_2 for a potentially much shorter time.

Why are we focusing on the concept of durability?

Durability refers to the timeframe for which the storage of carbon is reliably maintained. It is a key metric that serves different purposes:

- **Preserving environmental integrity** *:* by ensuring removals are appropriate for neutralizing long-lived fossil CO_2 emissions.
- **Facilitating accountability** *:* by establishing clear benchmarks for monitoring reporting and verification (MRV)
- **Clarify the roles of permanent and temporary removals:** Helps establishing fungibility between different storage medium

Temporary removals present greater challenge to ensure environmental integrity. But some literature suggest that, ***when factoring durability and risk and reversal,*** temporary removals can have a comparable mitigation impact as the permanent reduction or removal of 1 ton of CO_2..

See, for instance:
Groom and Venmans, 2024: The social value of offsets
Mac Dowell and Prado, 2023: The cost of permanent carbon removal

Matching removals and (residual) emissions

As defined in Scenario 4 of the SBTi S3 discussion paper

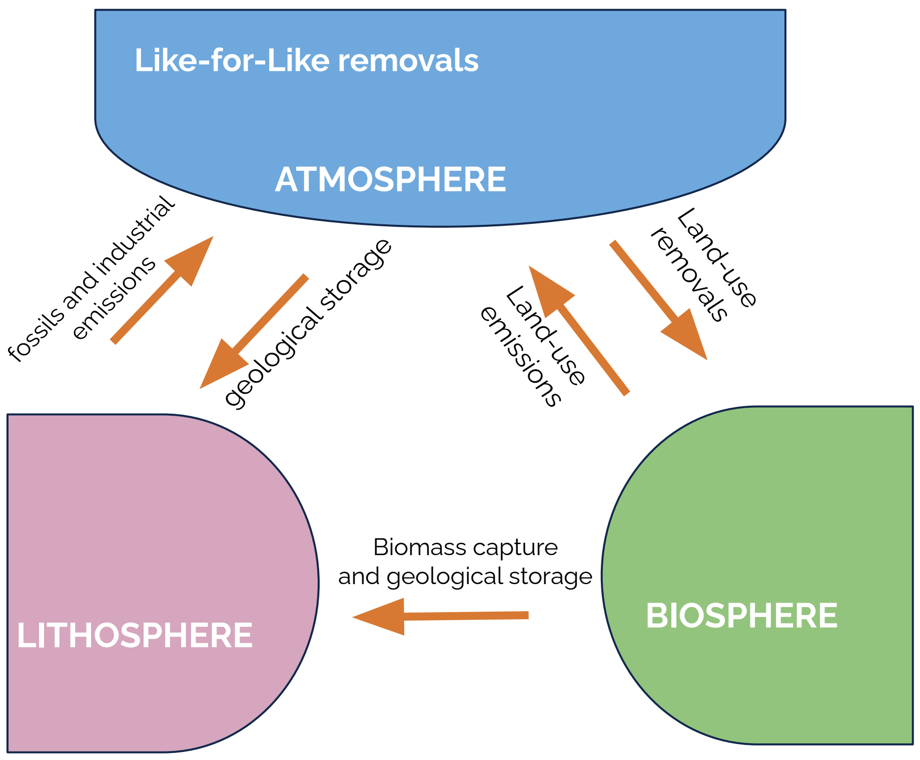
SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Durability framework

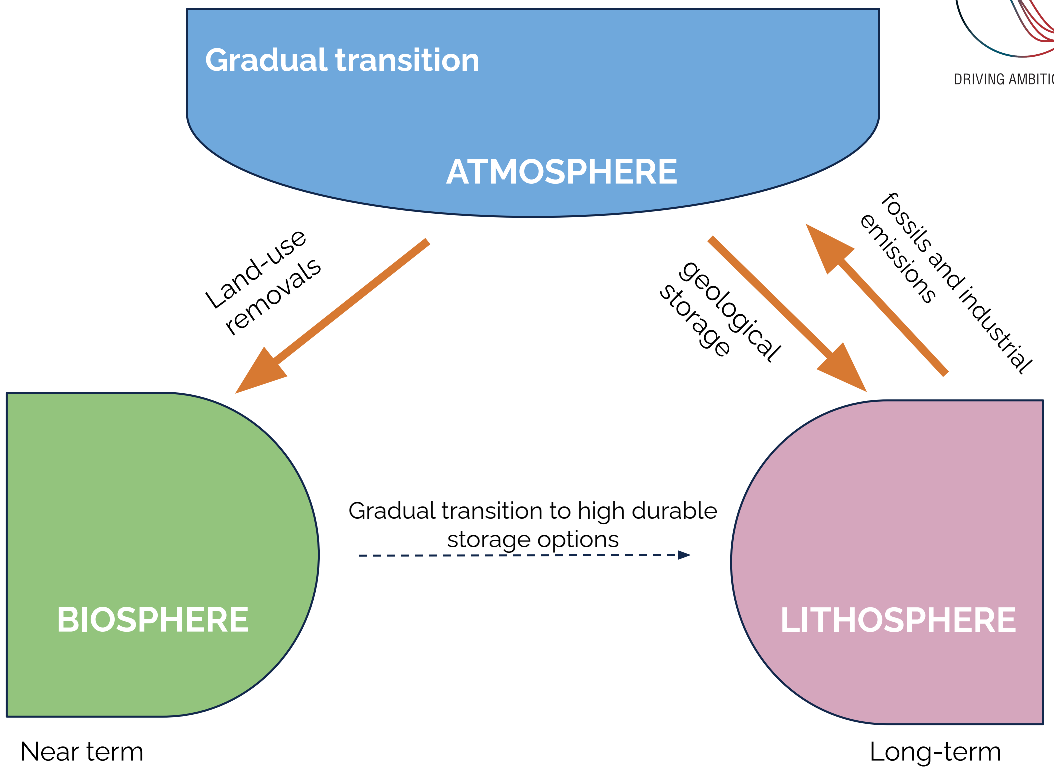
Matching emissions type with storage type **(Biogenic or geologic)**	This approach would require that the type of carbon removal matches the type of emission, whether biogenic or fossil, to ensure compatibility with the carbon cycle's slow or fast domains
Matching atmospheric lifetime with storage timescale **(Physical equivalence)**	This approach would require the storage duration to match the atmospheric lifetime of the residual GHGs, allowing short-lived GHGs (e.g., methane) to be neutralized by temporary storage and long-lived GHGs (e.g., Carbon dioxide) by long term storage
Establishing fungibility between removal methods **(Economic equivalence)**	Other approaches involve creating equivalence ratios to quantitatively value CDR with different levels of permanence, balancing the economic effects of reducing warming temporarily against long-term climate damage costs. However, these approaches carry risks due to potential discrepancies in assessing storage times, costs, and impacts on long-terms temperature changes

Setting a durability threshold: two approaches proposed in CNZS v2.0

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION



Adapted from Fankhauser et al.



Like-for-Like: The biosphere and geosphere compensate for respective emissions. Each sphere is balanced and the concentration of atmospheric carbon is durably stabilized

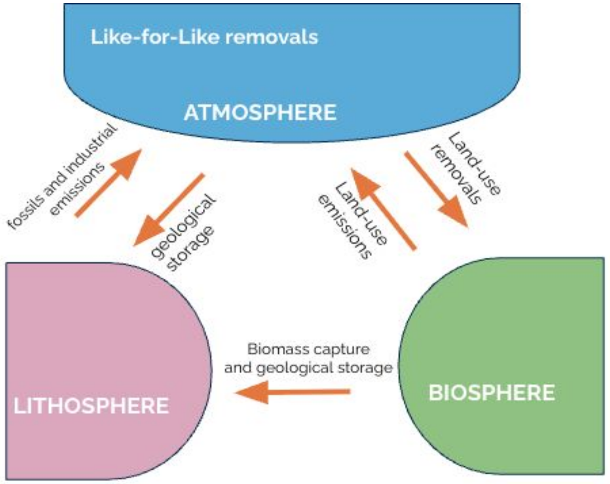
Sink separation: Fossil-based emissions must be neutralized with permanent geological storage to preserve carbon cycle integrity.

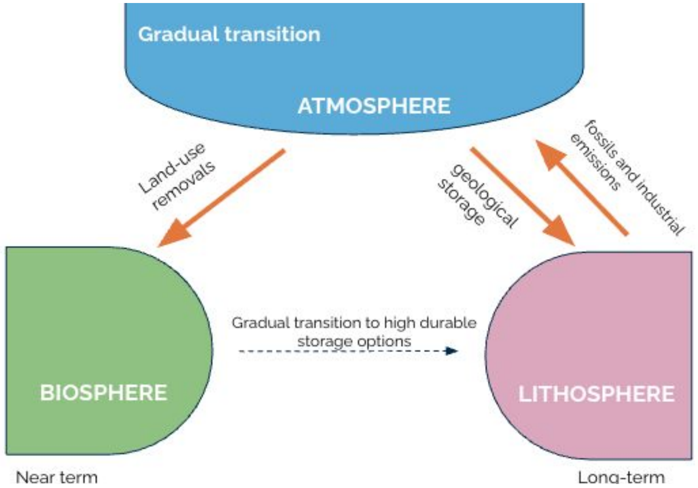
Lifetime-Based Matching: The required duration of carbon storage is matched to the atmospheric lifetime of each GHG—short-lived gases with temporary removals, long-lived gases with permanent ones.

Gradual transition: Allows the use of lower-durability removals in the near term, provided the share of **permanent removals increases over time, reaching 100% durable removals by 2050**, with safeguards in place to manage reversal risks

Reversal risk: Temporary removals should integrate risk mitigation mechanisms (e.g., buffer pools, insurance) aligned with their durability class and require minimum durability thresholds and MRV systems to ensure environmental integrity.

Survey poll on durability approaches





Which option do you think the SBTi should implement for the interim removal target?

https://www.menti.com/alryr8jy82xf

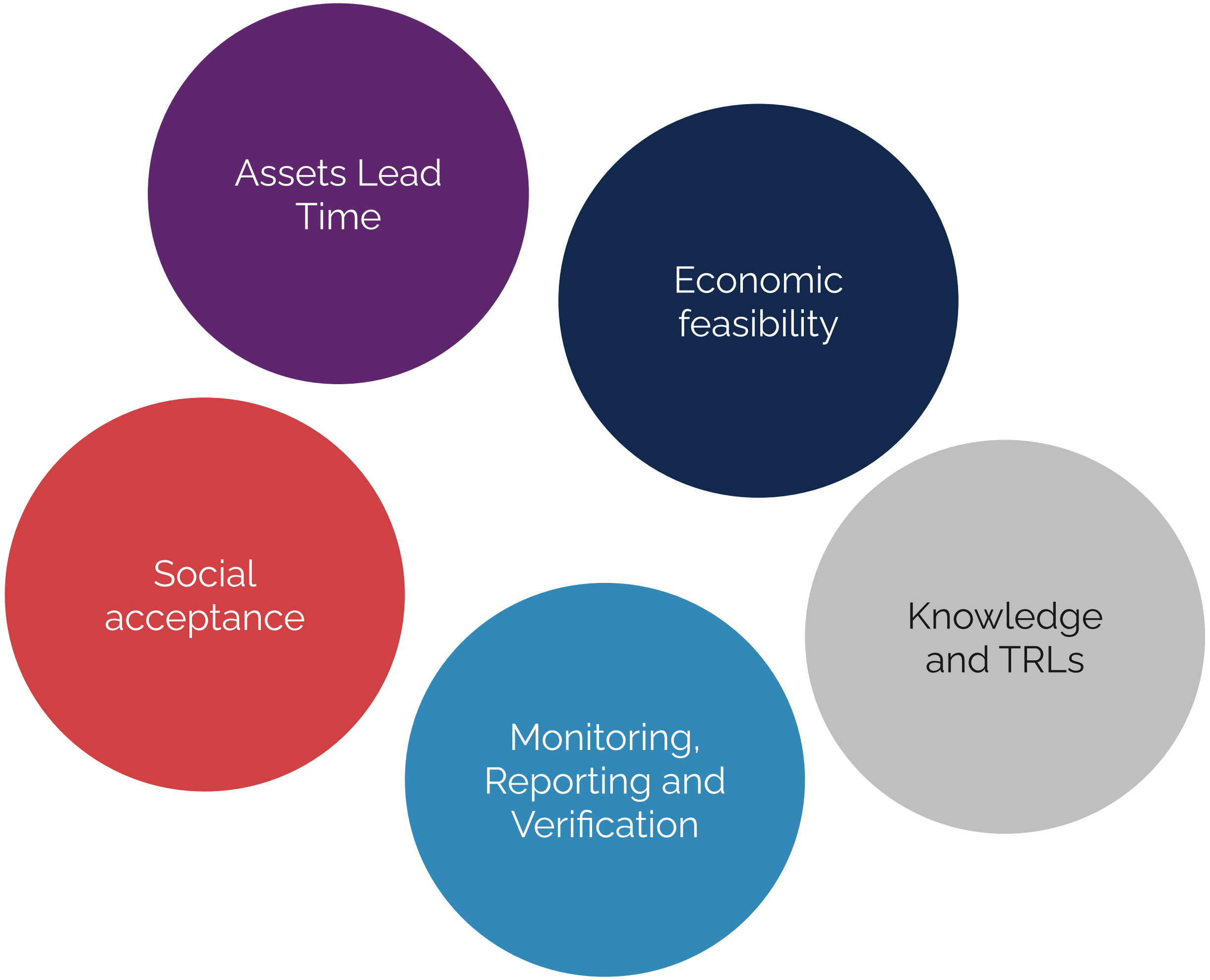
Implementation challenges: not all CDR are created equal

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

In theory, only the storage 1 ton of CO_2 over a millennial timescale offer a comparable mitigation impact of 1 ton of CO_2 reduced (or not emitted in the first place).

In practice, the CDR policy and evidence landscape (in terms of e.g. their readiness, effectiveness and storage durability etc) is rapidly evolving. In addition, important implementation challenges need to be factored in when designing removal targets. Including:

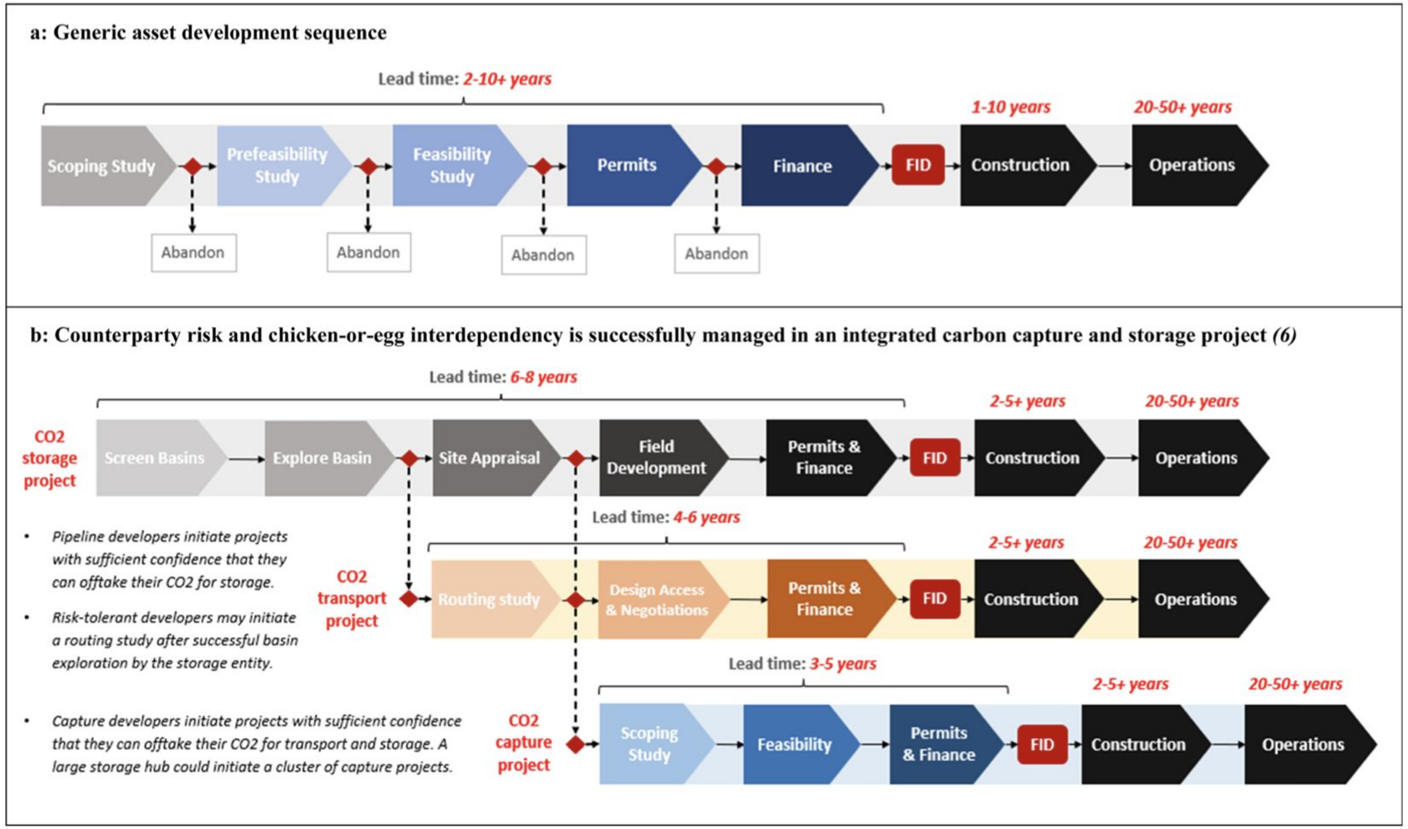
- The social acceptance of technological solutions
- The status of MRV protocols
- Their cost
- Their readiness to deliver ex-post removal credit within the next 5 years
- The risk associated with complex infrastructure projects



Are we ready for permanent CO_2 storage?

Most permanent solutions require infrastructure projects with long lead times

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION



According to the IEA, the lead time for a DAC project ranges from 6 - 8 years. If all the 130 DAC facilities at various stages of deployment today were to advance as planned, in 2030 we could reach a deployment in line with the NZE scenario.

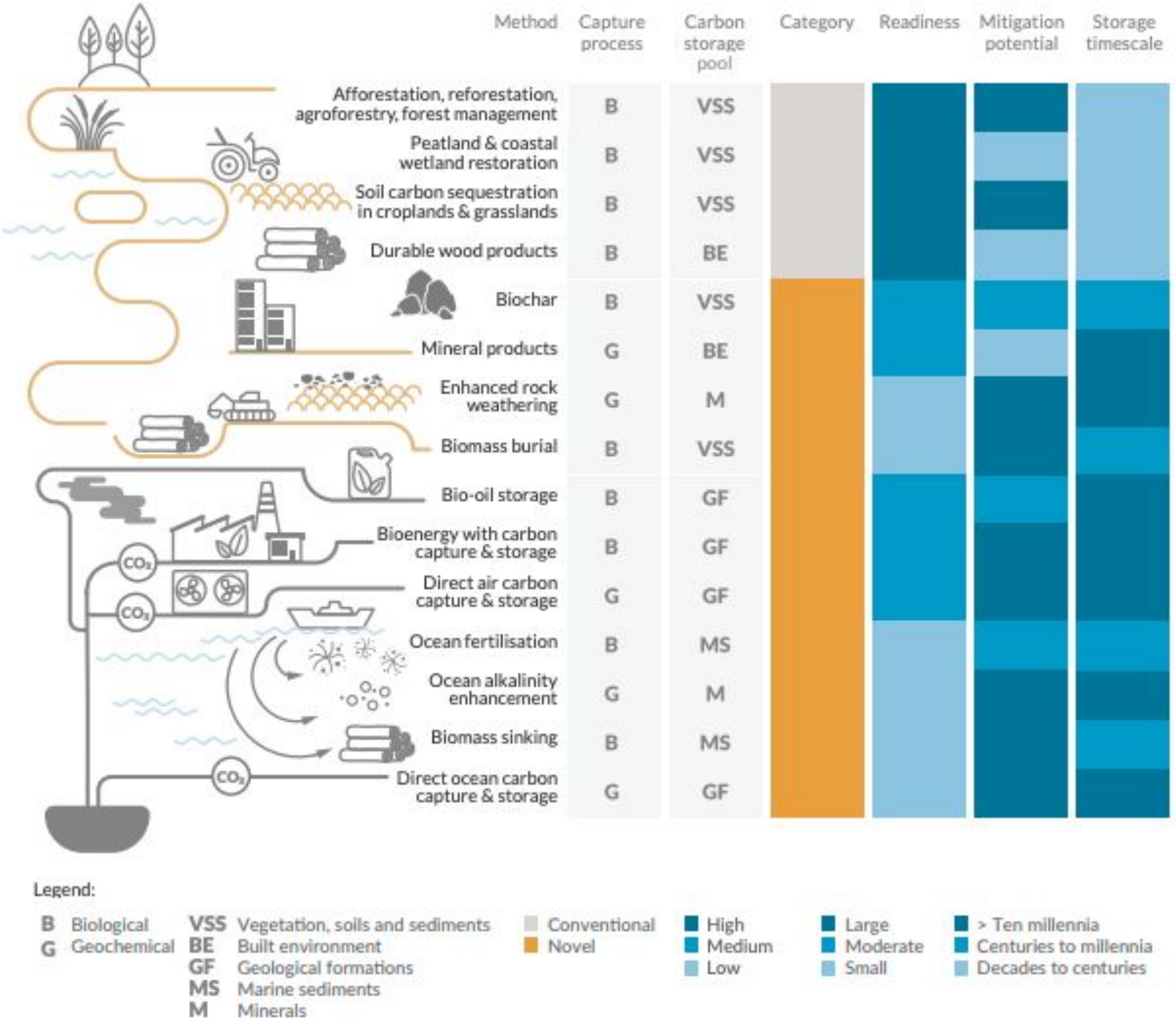
However, based on previous project experience, it can take decades to characterize and develop a CO2 storage site (Bui et al 2018)

CO2 transport and storage projects face high capital cost, complex chain of risk and often require coordinated private and public sector partnership.

Bui et al (2018).Carbon capture and storage: the way forward. Energy & Environmental Science
Uden, S., Socolow, R. Greig, C.(2022) Energy & Environmental Science

Most removals available today rely on temporary storage

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION



Only few solutions relying on geological storage are in operation today:

- Most BECCS facilities are used for the production of fuels, and have lower carbon efficiency (i.e. ratio of biogenic carbon consumed over CO2 stored)
- There are 19 DAC facilities in operation, all but two of these facilities sell their CO2 for use,

Most of the facilities announced to date are at very early stages of development. Without policy support they risk **not reaching final investment decision (FID) and operational status** without policy support (IEA, 2024)

Smith et al (2024) The Status of Carbon Dioxide Removal, 2nd Edition

Public perception has a strong influence on the political and economic feasibility of CDR deployment

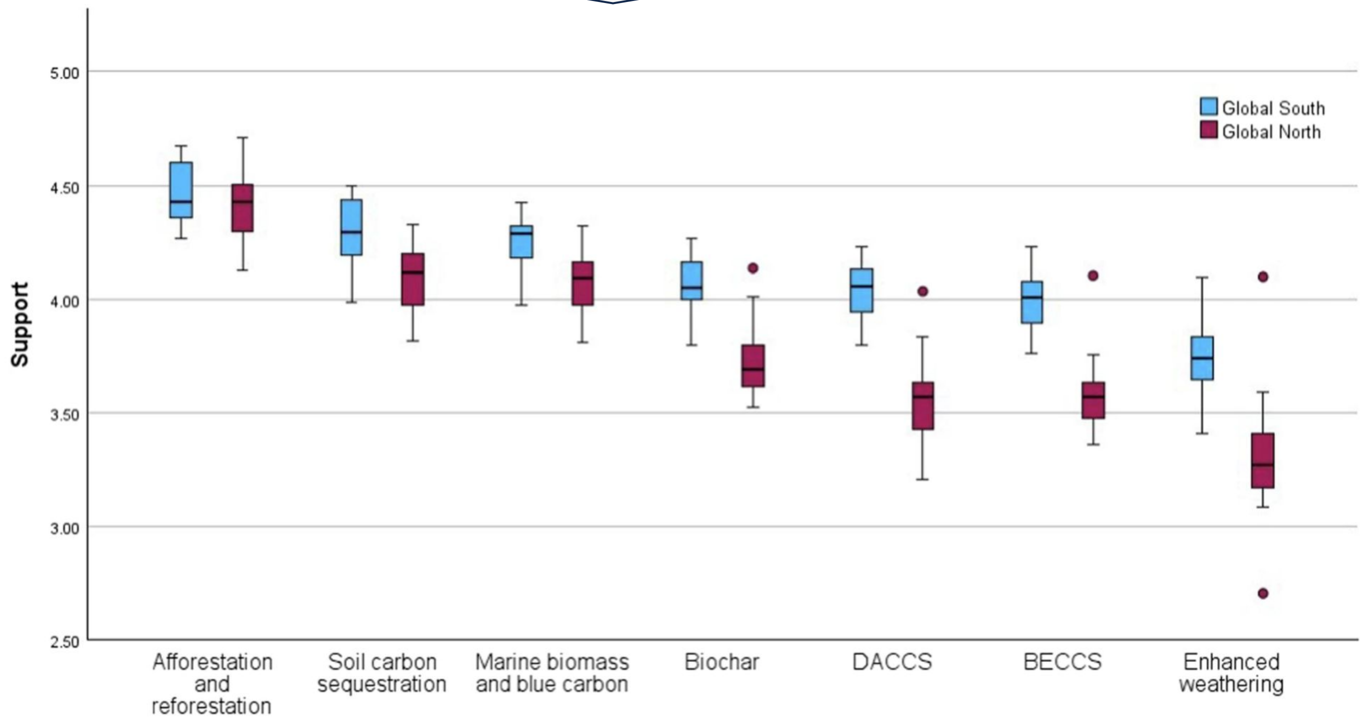
SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Carbon removal will ultimately be paid for by the general public, through their taxes or purchases. Scaling up carbon removal therefore means appreciating the importance of public opinion.

1) CDR relying on geological storage and cross country infrastructure face higher social (and regulatory) barrier.

2) Trees are always in the frame: Study surveyed > 3,000 reps and showed that removal options relying on geological storage shows lowest public support overall.

"We ran a nationally-representative public survey in the UK and US (*n* = 2026), and found that "trees" was the most common response when asked for the first thought that came to mind when they heard the term "carbon dioxide removal"



Cox et al (2025).Carbon removal beyond the trees. Carbon removal beyond the trees. *Commun Earth Environ* 6, 253 (2025).

Robust MRV protocols are paramount to any CDR governance framework

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

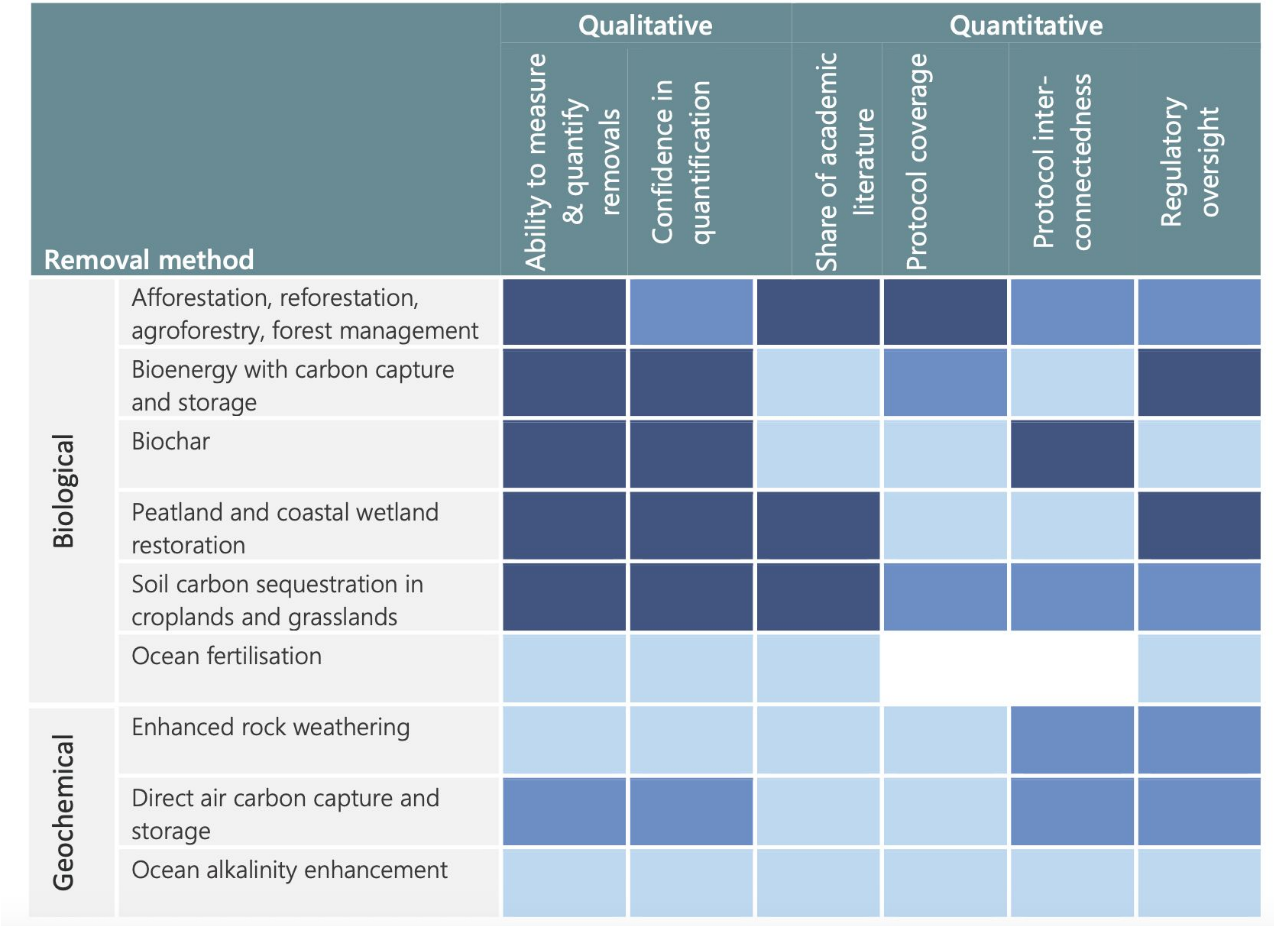
But MRVs are at different stages of development for different removal methods

Processes for MRV of CO2 captured are more developed for BECCS and DACCS than for other removal methods, as inputs are easily measurable and the foundational science is mature.

In the case of afforestation and reforestation, there are relatively well-established methods to measure removals based on changes in volume of tree bases or estimates based on context specific emission factors.

Soil carbon monitoring is complex and faces particular challenges, with different approaches having trade-offs between costs and confidence in accuracy

Overall there are lower number of protocols for geochemical removals, but the regulatory oversight is higher for project where public sector collaboration is required (coastal restoration and CO2 infrastructure projects)



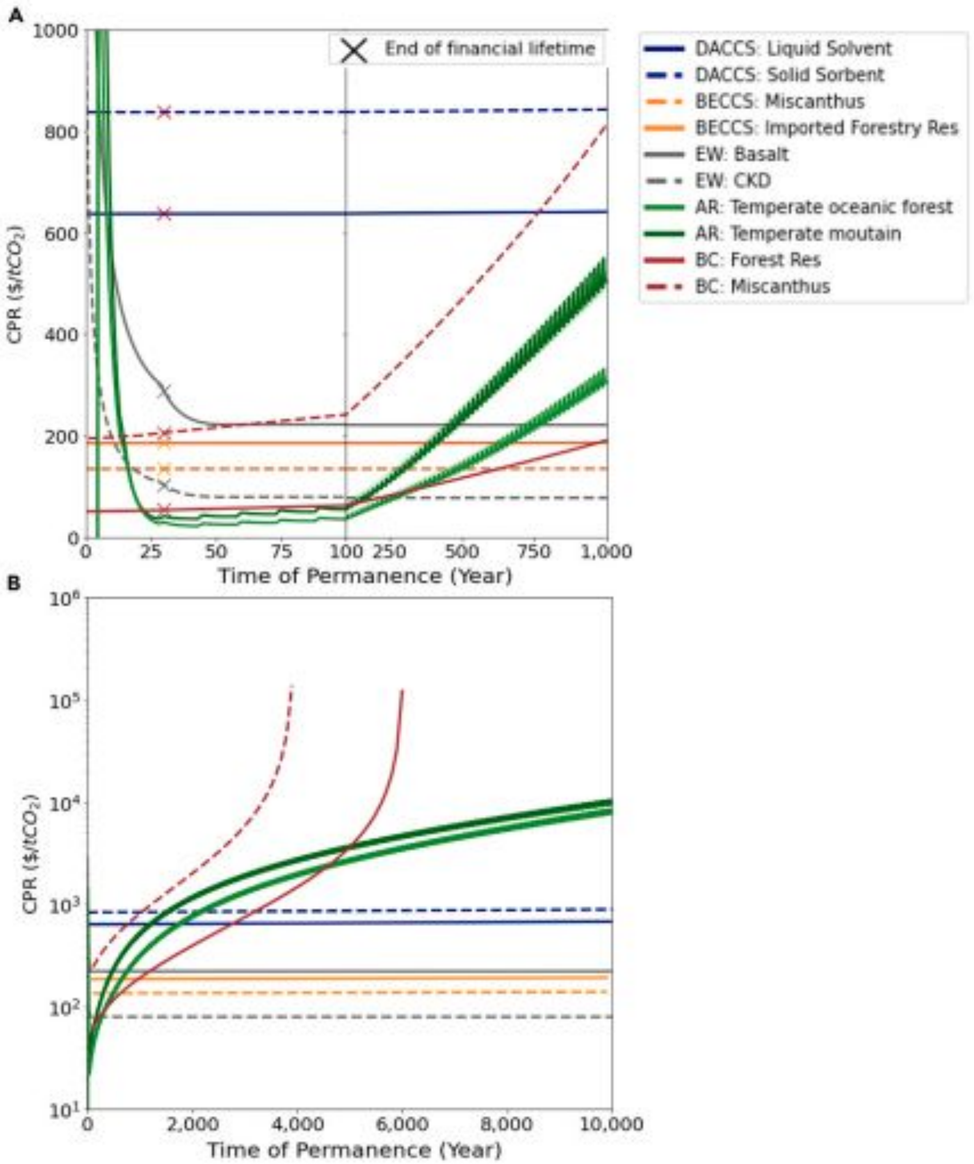
European Scientific Advisory Board on Climate Change: *'Scaling up carbon dioxide removals – Recommendations for navigating opportunities and risks in the EU'*

Permanent removal methods are costly

But the cost of temporary often does not factor in the cost of robust MRV

SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION



The Sisyphean task of maintaining temporary sinks

Most studies of the costs of individual methods have been estimated from cost studies over relatively short time horizons (i.e. using reference period of less than 100 years) and do not account for the future costs of reversal or saturation.

If CO2 captured by an afforestation project is assumed to be released from storage again after a number of decades, which brings with it a '**commitment to perpetual removal of carbon'** to maintain the same level of CO2 removal in the long-term.

Similarly with regards to sink saturation, as forest management practices may still need to be maintained indefinitely in order to prevent stored carbon being re-released. This may result in ongoing costs without any additional removal benefits.

This 'Sisyphus' task' is often not reflected in shorter-term marginal abatement cost estimates for temporary removal methods, and therefore makes direct comparisons between the costs of temporary and permanent removal methods difficult

Prado & Mac Dowell (2023), The cost of permanent carbon removal. Joule

Survey poll on the implementation challenges

1. ***Do ALL these challenges influence whether a SBTi company achieve its removals milestones?***
2. ***Does one of these challenges stand out?***
3. ***Are we missing any?***

https://www.menti.com/alt6xiquy4p5

New EWG meeting schedule

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

15th April
Addressing residual emissions Pt 1

SBTi principles and options overview

7th May
Addressing residual emissions Pt 2

Which option best align with SBTi principles?

28th May
Durability of removals Pt 1

Overview of durability thresholds: How long is long enough?

19th June
Durability of removals Pt 2

Group alignment on proposed framework

15th July
Joint session with BVCM EWG

Presentation of the RTR framework

NEW DATE AND THEME!

6th August
Quality criteria

Quality requirement, standards and practices

10th September
Target implementation

Credits procurement strategies, vintage and what counts

IN PERSON MEETING
Tuesday- Thursday
26-28 Aug
2-4 Sept
9-11 Sept
16-18 Sept