Working Paper:
Science-based Carbon Dioxide Removal for Corporate Net Zero

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Recommendations for CDR Integration into SBTi's Corporate Net-Zero Standard v2

assembled by RMI

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Introduction

The Science Based Targets Initiative (SBTi) has played a central role in driving more corporate actors to commit to credible, science-based targets for reaching net-zero emissions. As SBTi prepares to update its Corporate Net-Zero Standard (CNZS), it is considering how to further integrate a science-based approach to carbon dioxide removal (CDR).

To support this effort, academic and civil society groups have developed a robust set of design recommendations that SBTi can adopt to create a science-based framework. These recommendations reflect an independent review of the best available scientific evidence and an extensive stakeholder outreach effort to understand the perspectives of industry, including corporates with SBTi net-zero targets.

CORE PREMISES

The need for scaled, durable CDR in 2050. Carbon dioxide removal will be needed globally to reach net zero in 2050. Furthermore, high-durability CDR (1,000+ years of durability) will be needed to sustain net zero over time and to minimize global temperature increase.

The value of all forms of CDR on the road to 2050. Low-durability CDR methods are affordable and scalable today in many cases, which may be useful to minimize risks associated with overshoot and climate tipping points. However, they carry higher risks of reversal and the need for replacement in perpetuity if being used to compensate for long-lived emissions in a science-based manner. High-durability CDR methods typically have a lower risk of reversal, making it an important solution for compensating for long-lived emissions, but most approaches need support to down-cost and scale. On the road to 2050, CDR of all durability levels has a role to play.

The scale limitations of every individual approach and the need for a portfolio. To reach the scale of CDR required, targeted actions across the CDR ecosystem are needed. Cultivating a portfolio of high-durability CDR approaches is especially important due to the scaling limits all CDR pathways face. All of this will take time. As a consequence, funding is required now for all known high-durability CDR pathways to support further technology development and deployment to enable scaled deployment at a reasonable cost in mid-century.

Design Recommendations for SBTi

The Corporate Net-Zero Standard revisions present an important opportunity for SBTi. As the leading standard-setter for corporate net-zero targets, SBTi has unique influence over corporate action on CDR. While other sources of demand (e.g., compliance policy, government procurement) will also be critical, policy action often lags corporate leadership in the voluntary carbon market. Because of this, it is critical for SBTi to issue ambitious guidance now to chart a clearer and quicker path to scaled demand for high-quality CDR.

This section presents recommendations for integrating CDR into the CNZSv2 that will accomplish this in a way that is science-based and manageable for corporates to undertake. Specifically, we address the following components:

- **Topic 1:** Increasing ambition
- **Topic 2:** Interim removal targets to address residual emissions
- **Topic 3:** Minimum durability thresholds
- **Topic 4:** CDR quality criteria
- **Topic 5:** Fostering innovation
- **Topic 6:** Addressing Scope 3 emissions
- **Additional design considerations**

Topic 1: Increasing ambition

CORE POSITION: Interim removal targets should require gradually increasing *annual* targets for CDR procurement, rather than *cumulative* targets, to provide a clear demand signal to the market for the volumes that will be needed to serve SBTi companies at net zero.

What is in the Draft Standard

Slide 52 of SBTi's Explanatory Guide for the CNZSv2 clarifies that the interim removal targets suggested for Options 1 and 2 in the draft are cumulative totals starting in 2030, rather than annual removal targets that steadily increase over time.

For example, if we make a simple assumption that all companies with net-zero targets in 2050 represent 80 million metric tons (Mt) of residual emissions, corporates will be required to purchase a *total* of 80 Mt of CDR between 2030 and 2050, with interim target percentages set according to Table 2.2 of the Target-Setting Methods Documentation (see Topic 3). Every year thereafter, corporates will have to purchase 80 Mt tons of removals annually.

Discussion

As discussed in more detail in Topic 2 below, the amount of CDR required at net zero will take a massive build-out of infrastructure, requiring meaningful near-term demand signals and significant continued investment to support long-term needs. SBTi's suggested approach (called the *Cumulative Target Approach* in this document), with cumulative rather than annual interim removal targets, would lead to **just one year's worth of demand for CDR spread over the course of 20 years**. Compared to an approach that requires companies to purchase gradually increasing amounts of CDR *annually* to reach 100% of their projected residuals by the net-zero target year (called the *Step-Up Target Approach* in this document), this approach represents roughly 90% less demand.

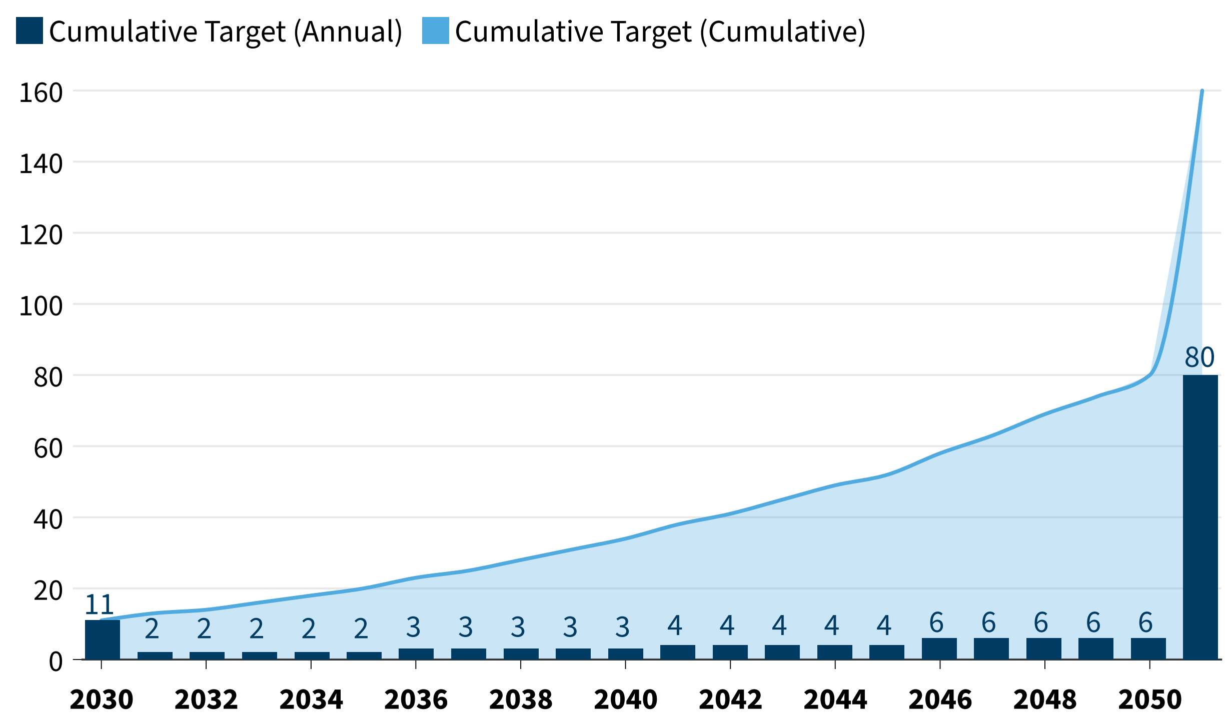
To further illustrate the difference, we consider the two approaches below. **Exhibit 1** illustrates two important points about the *Cumulative Target Approach*. First, the first year of procurement in this approach is the largest because of how the interim target percentages are constructed. Annual demand drops roughly 80% in 2031. Second, the nature of the first 20 years of removals procurement results in a dramatic increase in demand starting in 2051. A gradual step up in demand is needed to build out necessary infrastructure and allow learning curves to bring down costs.

Exhibit 2 illustrates the demand signaled under the *Step-Up Target Approach*, where corporates must purchase slowly increasing amounts of removals to reach 100% of their projected residual emissions in the net-zero target year. In contrast to the Cumulative Target Approach, this approach results in a more progressive increase in demand to avoid dramatic shifts in overall demand.

Exhibit 3 compares the cumulative demand of both approaches to illustrate the significant difference in demand over the 2030-2050 period.

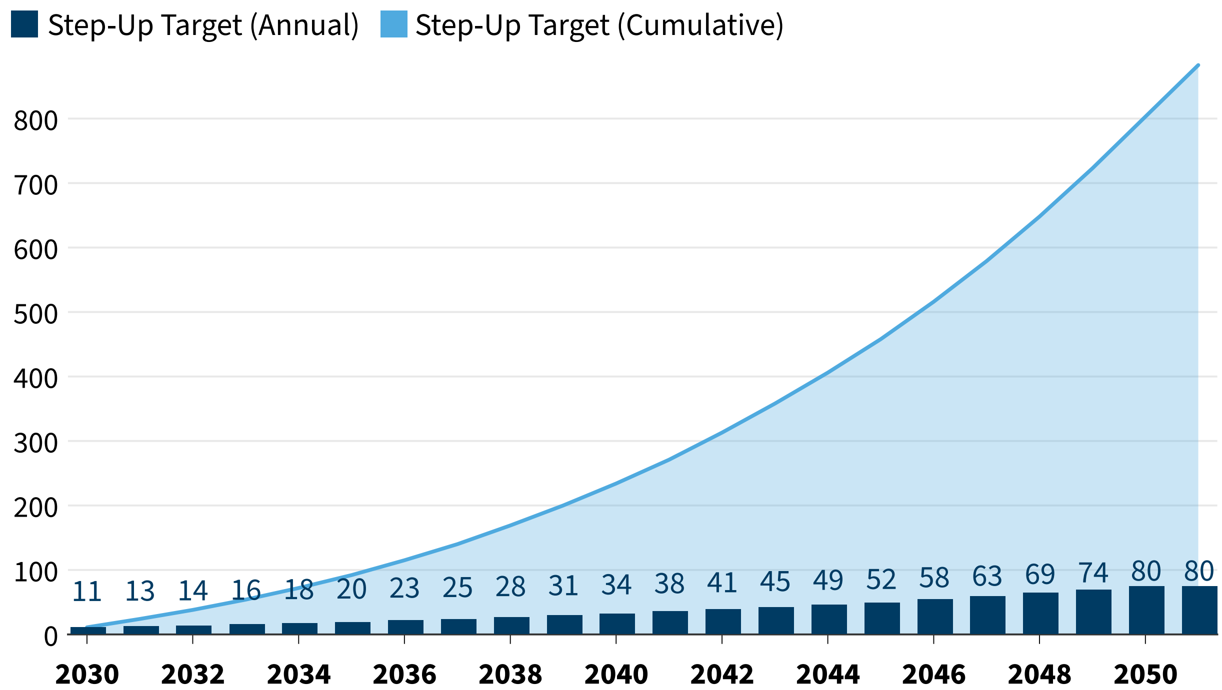
When viewing these Exhibits, it is important to note that SBTi guidance is not explicit about whether companies must purchase credits on an annual basis or simply demonstrate at each milestone year that they purchased the required amount to cover the years since the last milestone year.

Exhibit 1. Illustrative demand signal from the Cumulative Target Approach, Scope 1 emissions only (millions of tons CO_2e)



Note: *This Exhibit represents the CDR requirements for 800 million metric tons per annum (Mtpa) of Scope 1 emissions, an estimate of the Scope 1 emissions from all SBTi companies with net-zero targets and the like-for-like minimum durability threshold phased in by 2030 (see Topic 3). The Exhibit assumes companies purchase CDR yearly. This Exhibit also assumes that the cumulative amount of removals through 2050 must equal a company's residual emissions, which then must be matched on an annual basis starting in 2051.*
Source: RMI analysis.

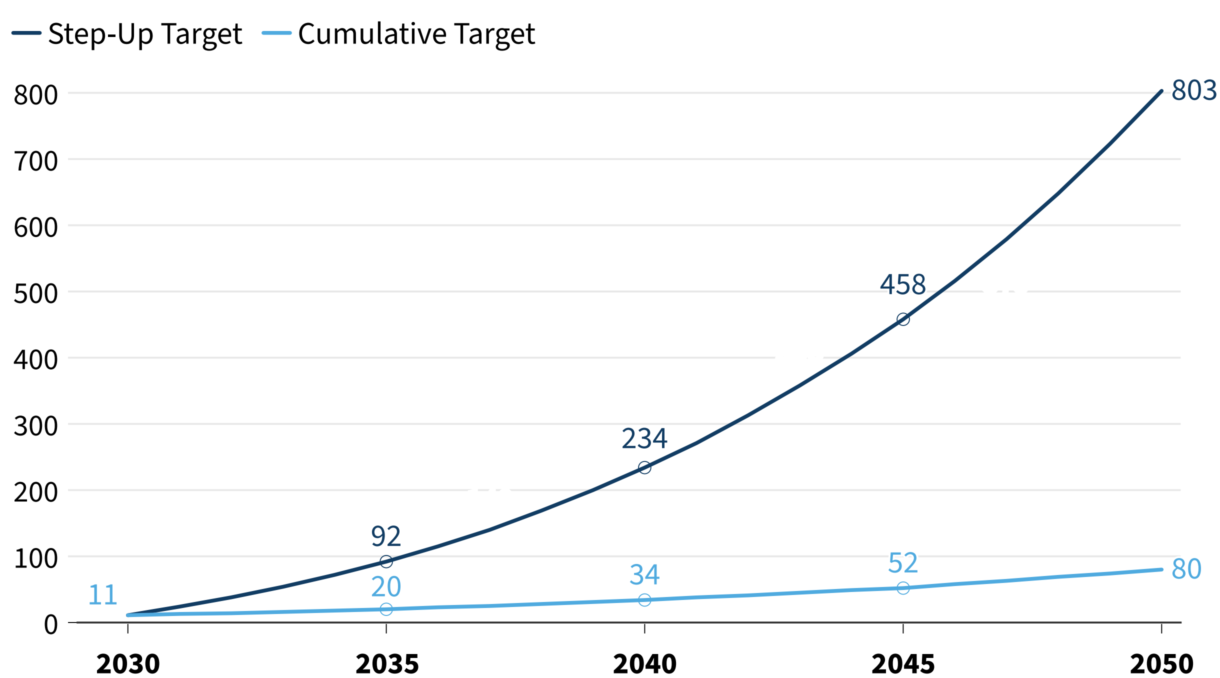
Exhibit 2. Illustrative demand signal from the Step-Up Target Approach, Scope 1 emissions only (millions of tons CO_2e)



Note: *This Exhibit represents the CDR requirements for 800 Mtpa of Scope 1 emissions, an estimate of the Scope 1 emissions from all SBTi companies with net-zero targets and the like-for-like minimum durability threshold phased in by 2030 (see Topic 3). The Exhibit assumes companies purchase CDR yearly.*

Source: RMI analysis.

Exhibit 3. 2030-2050 cumulative by scenario, Scope 1 emissions only (millions of tons CO_2e)



Note: *This Exhibit represents the CDR requirements for 800 Mtpa of Scope 1 emissions, an estimate of the Scope 1 emissions from all SBTi companies with net-zero targets and the like-for-like minimum durability threshold phased in by 2030 (see Topic 3). The Exhibit assumes companies purchase CDR yearly.*

Source: RMI analysis.

Topic 2: Interim removal targets to address residual emissions

> **CORE POSITION:** Interim removal targets should be *required* starting in 2030 for companies with net-zero targets. If companies begin procuring and retiring removal credits before 2030, they should be *recognized* for doing so.

What is in the Draft Standard

Three options are under consideration for interim removal targets to address residuals in the draft Standard. Options 1 and 2 both entail setting interim removal targets, defined as a percentage of projected Scope 1 residual emissions at the year of net zero. Target percentages are defined at "milestone years" every five years, with a method to calculate the target percentages in between milestones. The exact percentage required each year depends on the approach to meeting the durability threshold. By 2050, 100% of residual emissions would be covered by CDR that meets quality criteria (see Topic 3 below).

The main difference between options 1 and 2 is that removal targets are mandatory for companies in option 1. In option 2, companies are recognized for setting removal targets, such as through the SBTi Target Dashboard, but it is not required for companies to do so.

Option 3 varies by allowing both additional emissions reductions and CDR to address residual emissions. Companies can choose to reduce emissions beyond the requirements for their science-based targets, use removals, or combine both to address projected residual emissions. The percentage of residual emissions eligible to be covered by CDR increases annually, like in options 1 and 2, to cover 100% of residual emissions by 2050.

Discussion

Interim removal targets should be required; making them optional is unlikely to provide a significant enough demand signal because the existing range of proposals already represents relatively modest demand volumes and some companies would opt out. Additionally, optional targets would be more unpredictable and make it more difficult for suppliers to secure financing based on anticipated demand.

The massive scale of CDR that is needed will require supply chains and infrastructure that will take time to build out. Additionally, given the scale needed, affordability is a major barrier, particularly for high-durability CDR. Building projects and supply chains now is essential to bringing costs down over the long term. Moreover, early-stage CDR approaches need continued R&D, pilot deployments, and learning to understand how they can scale in the near term, to have a portfolio of CDR approaches in the long term.

Private companies cannot and should not be responsible for bearing the weight of scaling all the CDR the planet needs, but procuring in small, increasing amounts over time will help enable the needed buildout and draw down the price of CDR. Emissions reductions must continue to be the top priority for companies working toward net zero, and carbon removal must be an addition rather than a substitution for reductions. **SBTi's goal should be to guide companies toward a sound long-term investment strategy for achieving net-zero targets.**

While more analysis is needed to understand the optimal balance, there is some research that demonstrates that, over the long run, investing in scaling and deploying CDR now results in lower long-run costs of addressing climate change. For example, Chiquier et al (2025) conclude that delaying scaled CDR deployment until mid-century would cause a spike in modeled carbon price relative to a longer deployment timeline that starts earlier in the century. Adun et al (2024) present similar findings: the average 2025 to 2050 modeled carbon price is 59% to 79% greater when CDR deployment is delayed than scenarios in which CDR is deployed earlier. Additionally, regardless of cost, near-term deployment of CDR is needed before 2040 so that CDR can be deployed at the necessary scale in 2050 (Nemet et al, 2023).

Why not Option 3?

Reducing emissions where technically and economically possible is preferred to using carbon removal to counterbalance emissions. However, **unless accelerated mitigation is reducing a company's projected residual emissions, this action does not serve to reduce the total need for carbon removal at the point of net zero or stimulate supply of carbon removal to meet demand at the point of net zero**. Because of this, Option 3 does not satisfy the need to address long-term balancing of carbon removal supply and demand and should not be considered.

Topic 3: Minimum durability threshold

CORE POSITION: To fully address the atmospheric impact of residual emissions in a science-based way at the point of net zero, removals should be matched to emissions on a "like-for-like" basis such that the durability of the removals counterbalances the atmospheric lifetime and warming effect of the original emissions. We propose to phase in like-for-like by 10 years before a company's net zero date to create a more gradual ramp up while still charting a course to a science-based framework.

What is in the Draft Standard

SBTi proposes two options for setting minimum durability thresholds. The first option is a "like-for-like" framework, in which the durability of the storage matches the atmospheric lifetime of the greenhouse gas emitted, while the second proposes a gradual increase in the share of residual emissions covered by high-durability CDR.

Under the proposed like-for-like design, fossil CO_2 and SF_6 emissions must be addressed by high-durability CDR. Other greenhouse gases that are short-lived, like methane (CH_4), may be addressed through low-durability CDR that matches the minimum durability threshold in **Table 1** below. The proposed design also specifies differing percentages of residual emissions that must be addressed in milestone years depending on the gas. This option will be referred to as *Like-for-like, 2030* in this document.

Defining high-durability CDR as 1,000 years of storage aligns with SBTi's goals to minimize global temperature increase. Brunner et al. (2024) show that at least 1,000 years of storage is needed for high-durability CDR to keep the global temperature increase below 2^{o}C by 2500; a shorter duration of storage leads to additional climate warming.

Table 1. Removal target percentages (as a percentage of residual emissions) for milestone years under Like-for-Like, 2030

Greenhouse gases (GHG)	Min. durability threshold (yrs)	2030	2035	2040	2045	2050
Fossil CO_2 (1,000 year)	1,000	5%	16%	35%	60%	100%
CH_4	12	44%	56%	69%	84%	100%
N_2O	120	44%	56%	69%	84%	100%
SF_6	3,200	5%	16%	35%	60%	100%

Source: Table 2.2, SBTi Target-Setting Methods Documentation

The second option is to gradually increase the share of residual emissions addressed by high-durability CDR versus low-durability CDR. In this case, companies would not have to report emissions by type of greenhouse gas. Instead, they would address their overall residual emissions each year through a distribution of low-durability and high-durability CDR that, in total, would address 100% of residual emissions by 2050. In the CNZSv2, SBTi refers to low- and high-durability CDR as conventional and novel CDR, respectively. **Table 2** below details how the distribution of durable vs. temporary CDR would shift over time. The distribution is based on modeling from the Intergovernmental Panel on Climate Change. This option will be referred to as *gradual transition* from this point on.

Table 2. Removal target percentages (as a percentage of residual emissions) for milestone years in the gradual transition approach to the minimum durability threshold

	2030	2035	2040	2045	2050
Aggregated GHG	28%	40%	55%	74%	100%
Share of GHG residual emissions addressed by conventional removals (100+ years)	93%	83%	74%	68%	59%
Share of GHG residual emissions addressed by novel removals (1000+ years)	7%	17%	26%	32%	41%

Source: Table 2.4, SBTi Target-Setting Methods Documentation

Discussion

As we note in our Core Premises above, all forms of removal have a role to play on the road to 2050. A like-for-like approach allows for a clear role for both low- and high-durability CDR. At the same time, durability is only one consideration. The timing and cost of removals also have implications for climate outcomes and the feasibility of scaling. To minimize overshoot and the risk of hitting climate tipping points, for example, it may be advisable to maximize removals in the near term, even if they are lower durability.

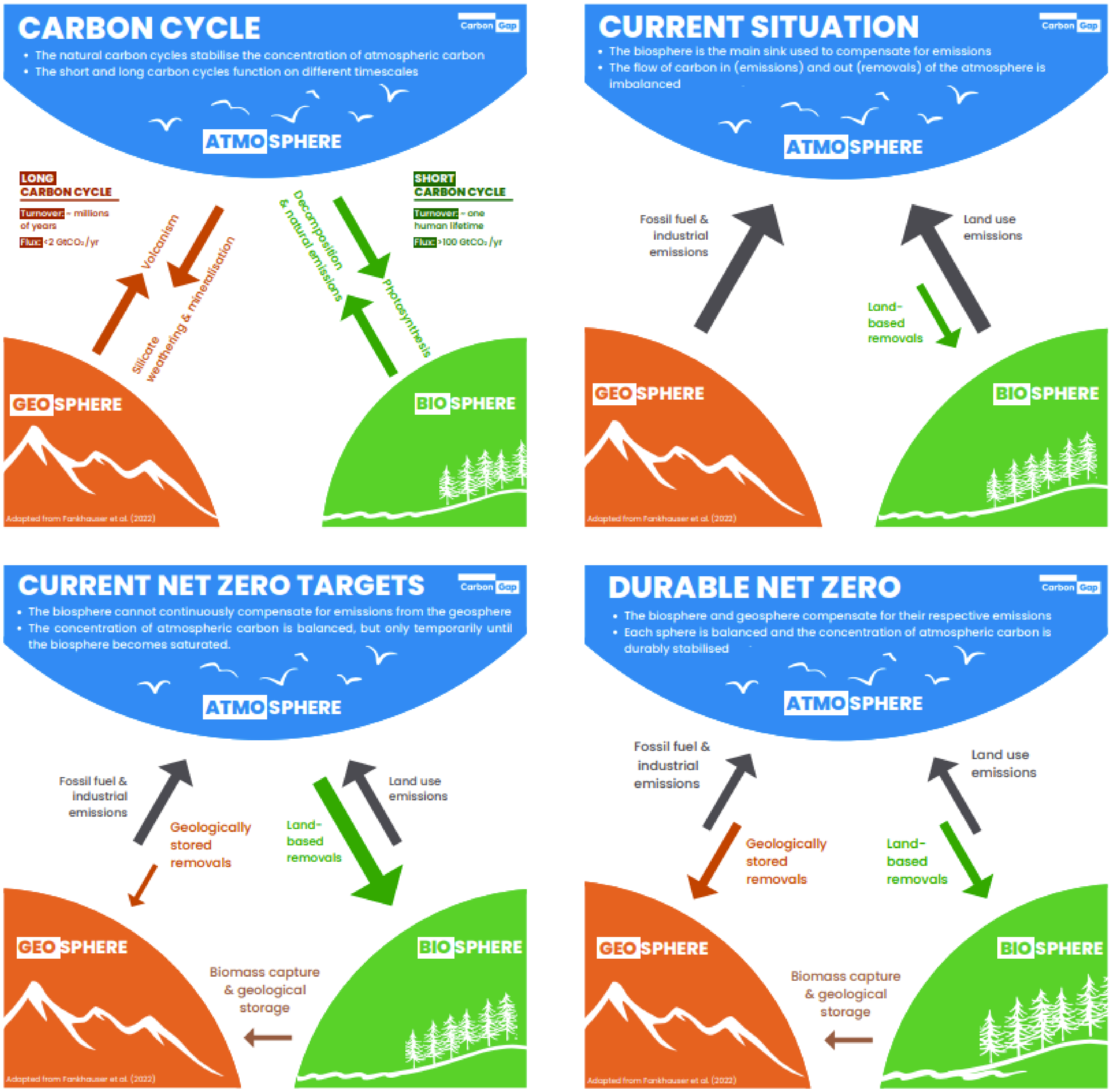
Below we discuss the importance of like-for-like, the potential benefits and impacts of a phase-in period of like-for-like, and other considerations to balance the need for near-term removals with the need to scale high-durability CDR.

Like-for-like is central to a science-based approach to carbon removal

The natural carbon cycle has both a short cycle and a long cycle. In the short carbon cycle, CO_2 flows from the ocean and land biosphere into the atmosphere, and vice versa. In the long carbon cycle, CO_2 fluxes are between the lithosphere and the atmosphere. Humans impact the short carbon cycle by emitting CO_2 through emissions related to land use and land use change (e.g., deforestation). Humans impact the long carbon cycle through fossil fuel use (e.g., combustion, process emissions.

To be successful in reducing and reversing global warming trends, it is necessary to achieve and sustain net zero over many decades. Durable net zero, which would be sustained over many decades, is a different condition than a temporary net-zero condition (see **Exhibit 4**).

Exhibit 4: Like-for-like principal explained



Source: Exhibit from Carbon Gap, adapted from Fankhauser et. al (2022).

In a temporary net-zero condition, net anthropogenic CO_2 fluxes into and out of the atmosphere are balanced. However, the flow of CO_2 into the atmosphere is dominated by fossil fuel emissions and the flow of CO_2 out of the atmosphere is primarily accomplished through land-based removals. This is not a stable net-zero condition because the CO_2 emissions are from the long carbon cycle, while the CO_2 removals are part of the short carbon cycle.

In contrast, durable net zero is achieved when net anthropogenic CO_2 fluxes into and out of each sphere (lithosphere and biosphere) are balanced. A necessary condition of durable net zero is Geological Net Zero, at which point "one tonne of CO_2 [is] permanently restored to the solid Earth for every tonne still generated from fossil sources." Balancing the flows into and out of each sphere means emissions and removals are balanced in both the short and long carbon cycle, allowing temperature to stabilize over a multi-decadal time frame.

Durable net zero requires a like-for-like approach to durability of removals. Otherwise, any net-zero state attained will not be sustainable over the long term.

Phasing in like-for-like: A middle ground option

A like-for-like approach is the most scientifically-grounded approach to carbon removal. However, there have been some concerns over the feasibility of implementation in 2030 due to the ramp up it would cause in corporate purchasing of high-durability CDR. Below we present two additional options for phasing in like-for-like gradually over time, reaching full like-for-like implementation in 2040 or 2050. In both cases, the endpoint is the minimum durability thresholds proposed by SBTi, detailed above in Table 1. Prior to reaching the "phase-in year", a decreasing percentage of fossil CO_2 and SF_6 emissions may be compensated for with low-durability CDR (see **Table 3** below). Corporates are still free to compensate all of their fossil CO_2 and SF_6 emissions with high-durability CDR if they so choose.

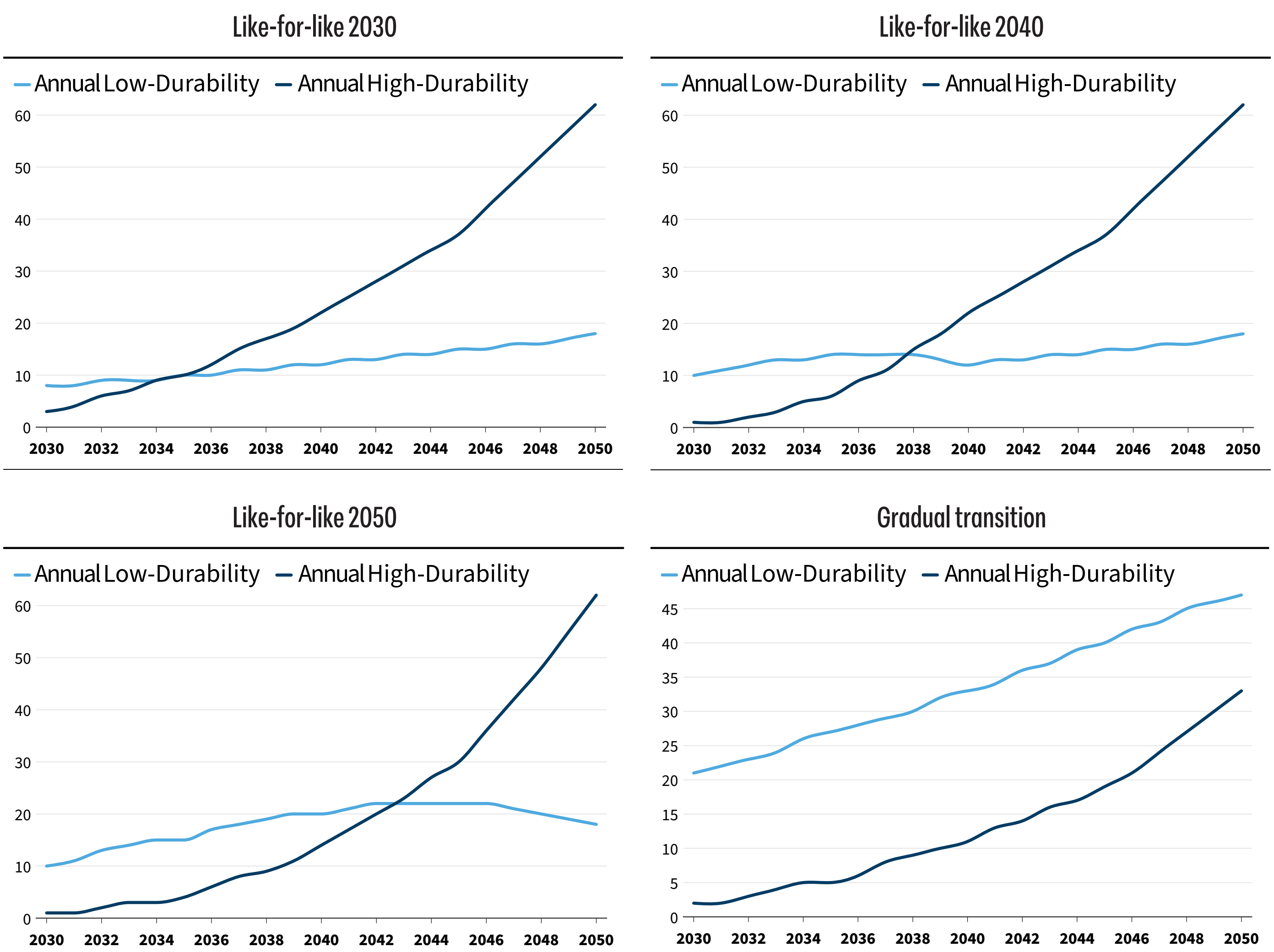
Table 3. Phase-in of like-for-like in 2040 and 2050

	Phase-in Year	**2030**	**2035**	**2040**	**2045**	**2050**
Percentage of high-durability CDR target that can be covered by low-durability CDR	**2040**	75%	38%	0%	0%	0%
	2050	75%	56%	38%	19%	0%

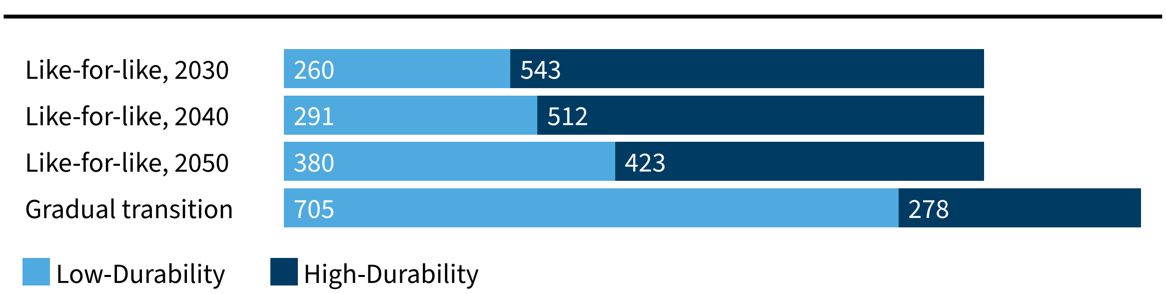
Note: *These percentages would be applied on top of the minimum durability thresholds in Table 1 above. For example, in 2030, a company must purchase removals to counterbalance 5% of fossil CO_2 emissions. Under a phase-in approach, 75% of the 5% could be met with low-durability CDR.*
Source: RMI analysis.

To better illustrate the difference between the like-for-like approaches and the gradual transition approach, see Exhibit 5 below.

Exhibit 5. Comparing demand under Like-for-like 2030, 2040, and 2050 approaches and the gradual transition approach in million tons CO2e



Distribution of cumulative low- and high-durability CDR from 2030 to 2050 (million tons CO_2e)



Note: *This Exhibit represents the CDR requirements for 800 Mtpa of Scope 1 emissions, an estimate of the Scope 1 emissions from all SBTi companies with net-zero targets and the Step-Up Target Approach (see Topic 1).*
Source: RMI Analysis

The exhibit above shows that delaying the phase-in of like-for-like to 2040 would result in only a modest reduction (31 Mt) in overall demand for high-durability CDR between 2030 and 2050 compared to the overall demand stimulated. A 2050 phase-in year would result in a significantly higher shift in demand to low-durability CDR, but high-durability CDR would still make up the majority of demand from 2030-2050. A gradual transition approach would result in a greater overall demand for removals from 2030-2050, but the majority of this would be for low-durability CDR.

Other Considerations

In addition to our core recommendations above, it will be important for SBTi to address the following:

- SBTi must ensure that minimum durability thresholds are aligned with the GWP factor used to convert non-CO_2 emissions to CO_2 equivalent. For example, SBTi should use GWP20 factors if using removals of less than 100 years will be allowed. Alternately, SBTi could use GWP100 factors and set the minimum durability threshold at 100 years.
- SBTi should consider and clearly form a position on the merits of using novel approaches such as horizontal stacking of credits to achieve higher levels of durability claims.

Why not the gradual transition approach?

While this approach may result in more removals (almost entirely low-durability) sooner, it is not recommended for several reasons. First, the framework does not offer any science-based matching of emissions with removals based on durability and risk of reversal, or a pathway to implementing such a framework.

Furthermore, the framework is based on projections of CDR supply that are highly uncertain and may be less applicable to today's CDR landscape. For example, the share of conventional vs. novel removals is based on integrative assessment models (IAMs) used in the IPCC's 6th Assessment Report (AR6). The percentage proposed by SBTi in the gradual transition approach for each type of removal is the median of scenarios that limit warming to 1.5°C with limited or no overshoot. In this modeling, conventional removals are modeled primarily from afforestation and reforestation (A/R). Novel removals are modeled primarily from bioenergy carbon capture and storage (BECCS), and from direct air carbon capture and storage (DACCS) to a lesser extent.

However, the CDR industry has rapidly changed since 2022, with a wide range of new approaches advancing in development, deployment, and securing offtake agreements. Beyond BECCS and DACCS, these include multiple forms of Biomass Carbon Removal and Storage (BiCRS), enhanced rock weathering (ERW), and other mineralization-based approaches. Indeed, Chapter 12 of the Working Group III contribution to the AR6 highlights the limited scope of CDR methods including in its modeling:

> *"Among CDR methods, BECCS and A/R are most commonly selected by IAMs to meet the requirements of scenarios that limit warming to 2°C (>67%) or lower. This is partially because of the long lead time required to refine IAMs to include additional methods and update technoeconomic parameters."*

While this limited scope of CDR approaches may be necessary for model tractability, and it is true that BECCS has historically been used as a placeholder, it is nevertheless true that many CDR approaches that have advanced in recent years were not considered in this modeling. As a result, the IPCC's projections of distribution across removal types should not be used to set standards for how removals will be handled in 2050. In addition to the significant advances in CDR technology, other factors will impact the availability and cost of removals, including political dynamics that may impact the pace of policy evolution and investment in innovation, and the possibility of hitting climate tipping points, which may impact the availability of key inputs to removals, particularly biomass.

Topic 4: CDR quality criteria

> **CORE POSITION:** CDR used to meet interim removal targets must be verified by an unconflicted third party and comply with other widely accepted quality criteria.

What is in the Draft Standard

The draft standard addresses this topic on both pages 64 and 65, where it states:

> *"Removal activities used by companies to address residual emissions shall adhere to high-integrity quality and sustainability criteria, such as the GHG Protocol Draft Land Sector and Removals Guidance. (NOTE: This is a placeholder which will be further explored and refined through the consultation process.)"*

Discussion

We agree with SBTi's preliminary view that "*Removal activities used by companies to address residual emissions shall adhere to high-integrity quality and sustainability criteria.*" High quality is central to ensure that removals deliver the promised climate benefits and to build trust and credibility in removals as a tool for corporates to meet net-zero targets.

There are currently no widely recognized quality criteria that are in use today and are designed to cover all CDR approaches. SBTi should identify external standards or frameworks for CDR quality to reference well before 2030 to ensure that corporates can use it to inform their offtake decisions, which will need to be made in advance for 2030 delivery.

Additionally, we encourage SBTi to allow for CDR suppliers to align with multiple quality frameworks to ensure that SBTi does not become an additional administrative burden on projects and allow suppliers maximum flexibility while maintaining high quality (e.g., EU CRCF, UK quality criteria, Article 6, etc).

Some criteria that should be considered included:

- **Additional.** The removal needs to result from human intervention that would not have occurred otherwise.
- **Net negative.** The total removals minus the total emissions associated with the activity must be negative.
- **Third-party verified.** To ensure integrity and trust in the credits, an independent third party must verify the volume of removals, associated lifecycle emissions, and other aspects of the quality criteria.
- **Reverse traceability.** The removal must be able to be traced back through its lifecycle to its source.
- **Data transparency.** To the extent possible without compromising sensitive business information, the data surrounding the removal's measurement, monitoring, reporting, and verification should be open and accessible to ensure quality of and develop trust in the removal.
- **Adherence to sustainability, environmental impact, and equity criteria.** The removal must use resources sustainably, not harm the environment, and support equity, among other criteria.
- **Address uncertainty.** To ensure integrity in the removal**,** a mechanism to account for uncertainty and risk of reversibility (e.g. insurance, buffer pools) should be incorporated.

In the process of determining which quality criteria to use, SBTi should consider the following existing sources of quality criteria:

- Core Carbon Principles (Integrity Council for the Voluntary Carbon Market)
- Carbon Removals and Carbon Farming Certification Framework (European Union)
- 2024 Criteria for High-Quality Carbon Dioxide Removal (Carbon Direct and Microsoft)
- UNFCCC Article 6 (United Nations)

Topic 5: Addressing Scope 3 emissions

CORE POSITION: SBTi should require aviation emissions in companies' Scope 3 to be addressed by interim removal targets. Additionally, SBTi should *recognize* companies that choose to include Scope 3 emissions within their Interim Removal Targets and express intent to review the question of removals that address Scope 3 emissions in the future.

What is in the Draft Standard

SBTi explains on page 64 of the draft standard its logic for not including Scope 3 emissions in residual emissions calculations: "in recognition of the uncertainties involved in projecting long-term residual emissions for scope 3." The draft standard also does not explicitly ask about its definition of residual emissions for the interim removal targets. However, Question 77 of the survey asks for "any suggestions for other approaches that could support the SBTi in its mission" and so presents an opportunity to suggest the inclusion of Scope 3 emissions within the residual emissions for the interim removal targets.

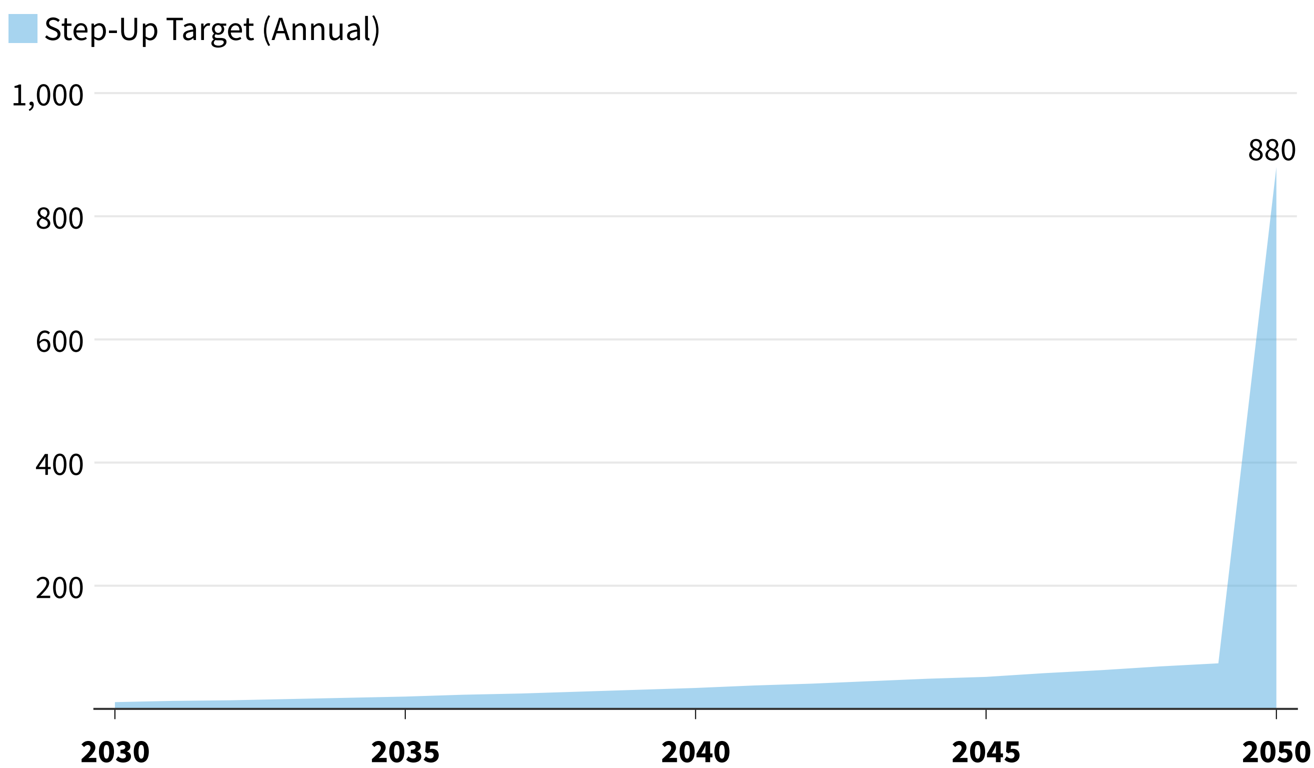
Discussion

Companies cannot achieve net-zero targets without addressing residual emissions in Scope 3. SBTi currently requires that corporates counterbalance Scope 3 residual emissions with CDR at the point of net zero (2050 for most companies with targets today). For most industries, Scope 3 residual emissions will make up a majority share of their overall residual emissions. As a result, a significant amount of demand for CDR will be delayed until 2050, which may impact the industry's ability to scale and cost-down CDR over time.

To demonstrate the impact of delaying removals for scope 3 residuals until 2050, **Exhibit 6** shows the 2050 spike in demand for three different archetypal companies with the same overall emissions but different distributions of Scope 1 and 3 emissions. See the Analysis section for more detail on these archetypes.

Exhibit 6: CDR demand including Scope 3 demand beginning in 2050 (million tons of CO2e)

Only requiring companies to counterbalance residual Scope 3 emissions starting in 2050 will cause a significant spike in the total CDR required to be purchased. Exhibit is illustrative and assumes the Step-Up Target Approach (see Topic 1).



Note: *This Exhibit represents the CDR requirements for 800 Mtpa of Scope 1 emissions and 8000 Mtpa of Scope 3 emissions, an estimate of the emissions from all SBTi companies with net-zero targets, and the like-for-like minimum durability threshold phased in by 2030 (see Topic 3). The Exhibit assumes companies purchase CDR yearly.*
Source: RMI analysis.

At the same time, SBTi raised valid concerns about the prospect of requiring corporates to include Scope 3 residual emissions in their interim removal targets, including the uncertainties involved in projecting long-term residual emissions in Scope 3.

To manage the trade-offs, and recognizing that SBTi has indicated that Scope coverage is not under consideration during the consultation, we recommend that:

- SBTi encourage and recognize companies for setting removals targets for their Scope 3 emissions
- Express intent to review the issue of Scope 3 residual emissions in a future update cycle for the Standard, with the intent to phase-in coverage of Scope 3 emissions.

Topic 6: Fostering Innovation

CORE POSITION: The world will need a portfolio of CDR approaches; investing in innovation and learning through deployments is therefore critical to achieving long-term climate targets, but procurement from nascent approaches may not yet meet all quality criteria. SBTi should support the need for innovation in CDR, for example, by recognizing purchases and investments in nascent CDR approaches under the Beyond Value Chain Mitigation category.

What is in the Draft Standard

The draft standard does not explicitly address or propose methods to support innovation in the CDR field. However, Question 77 of the survey asks for "any suggestions for other approaches that could support the SBTi in its mission" and so presents an opportunity to suggest mechanisms to foster innovation.

Discussion

The world will need a portfolio of CDR approaches, which requires investment in the near term to develop. CDR approaches will face scaling limits, such as the availability of sustainable biomass for BiCRS or clean electricity for DAC. There are also many CDR approaches that are still early-stage and need continued R&D, pilot deployments, and learning to know if and how they will be scalable. Supporting the development of a portfolio now can help ensure the CDR industry can reach the scale needed by 2050.

Supporting a portfolio of solutions means that some focus in the near term will need to be on learning rather than on the number of tons produced. Other major CDR purchasing mechanisms have recognized this: Frontier has contracted approximately 30,000 tons of CDR through pre-purchase agreements and Milkywire has a Seed CDR Portfolio to support the development of early-stage technologies.

To balance the need to support innovation while building trust in the field and stimulating demand for more mature CDR approaches, we propose that SBTi recognize purchases from or investments in nascent CDR pathways under the Beyond Value Chain Mitigation category. Using BVCM will ensure that interim removal targets will be met with credible, high quality CDR credits. This option may also resonate with corporates because it creates flexibility and allows them to advance innovation and learning with their procurements.

Additional important design considerations

In addition to the topics addressed above, recommend SBTi consider the following.

- **The use of CDR to address hard-to-abate emissions and overshoot.** Allow the use of CDR in other situations related to hard-to-abate emissions and missing progress milestones. The use of CDR must meet the durability and quality criteria proposed in Topics 3 and 4. SBTi must clearly define hard-to-abate emissions and hard-to-abate sectors.
- **Allowable vintage of credits.** Credits must be retired in the year for which a company is seeking to counterbalance emissions, but companies may use credits that have been delivered in previous years, up to 5 years
- **Geographic flexibility for credits.** Companies should be free to procure credits from outside of the country where the emissions are occurring, as long as credits meet quality criteria to avoid burden-shifting and double-counting.

Analysis: Impact of a science-based standard on demand and cost to corporates

Modeled scenarios

This analysis models the impact of the interim removal targets in multiple scenarios. First, we modeled two interpretations of the removal target percentages: the *Cumulative Target Approach* and the *Step-Up Target Approach* (see Topic 1 for more discussion).

Secondly, to understand the impact of the minimum durability threshold on both CDR demand and the cost to corporates, four minimum durability threshold scenarios were modeled. Three of these scenarios include the like-for-like principle as described above under Topic 3. The fourth scenario illustrates the gradual transition approach, presented by SBTi as outlined in Table 2 above.

Note that all results shared below are **cumulative removals from 2030-2035** and base residual emissions on **Scope 1 emissions only.** For results that base residual emissions on both Scope 1 and Scope 3 emissions, please see RMI's calculator tool here.

Impact on SBTi corporates overall

We estimate the total impact of required interim removal targets in the standard on all SBTi companies with net-zero targets. In this case, we make a simplistic assumption that Scope 1 emissions are 800 Mtpa and Scope 3 emissions are 8,000 Mtpa. The residual emissions subject to an interim removal target may vary significantly based on several factors. Therefore, readers should treat this analysis with caution and focus more on the *relative* differences between scenarios than the overall volumes of removals.

Table 4: Cumulative CDR demand from 2030 through 2035

a) Cumulative Target (2030-2035, in total)

Cumulative Target						
	High-durability		Low-durability		Total	
Scenario	**Volume (Mt)**	**Spend ($M)**	**Volume (Mt)**	**Spend ($M)**	**Volume (Mt)**	**Spend ($M)**
Like-for-like, 2030	10	$3,992	10	$641	20	$4,633
Like-for-like, 2040	6	$2,496	14	$884	20	$3,380
Like-for-like, 2050	4	$1,744	15	$1,006	20	$2,750
Gradual transition	5	$2,176	27	$1,726	32	$3,902

b) Step-Up Target (2030-2035, in total)

Step-Up Target						
	High-durability		Low-durability		Total	
Scenario	**Volume (Mt)**	**Spend ($M)**	**Volume (Mt)**	**Spend ($M)**	**Volume (Mt)**	**Spend ($M)**
Like-for-like, 2030	39	$15,724	53	$3,432	92	$19,156
Like-for-like, 2040	19	$7,600	68	$4,399	87	$11,999
Like-for-like, 2050	14	$5,764	74	$4,790	88	$10,554
Gradual transition	20	$8,104	143	$9,291	163	$17,395

Note: *We assumed a cost of $400/ton for novel CDR and $65/ton for conventional CDR. Numbers may not sum exactly due to rounding. This table represents the CDR requirements for 800 Mtpa of Scope 1 emissions, an estimate of the Scope 1 emissions from all SBTi companies with net-zero targets, under the four minimum durability threshold requirement scenarios (see Topic 3).*
Source: RMI analysis.

Impact on individual corporates

Defining archetypal companies

It is also important to recognize that the minimum durability threshold will impact corporates differently, depending on the make-up of their GHG emissions. To explore the impact of the different design scenarios on a range of companies, we analyze the implied CDR obligation and cost for three archetypal companies. Each of these archetypal companies has the same total emissions for easier comparison, but different compositions of emissions. See Table 5 below for a description of each archetypal company.

Table 5: Emissions distribution for each of the three archetypal companies modeled

Archetype	Scope 1 emissions (Mtpa)	Scope 3 emissions (Mtpa)	GHG distribution	Example
Heavy Scope 1 Emissions Company	0.8	0.2	Global average	Transportation company
Mix of Scope 1 and 3 Emissions Company	0.2	0.8	Global average	Technology hardware company
High CH_4 Emissions Company	0.2	0.8	Average for largest oil and gas producers	Oil and gas company

Note: *For all archetypal companies, we assume residual emissions are 10% of Scope 1 emissions.*
Source: RMI analysis.

Results by archetype

Demand for novel and durable CDR was estimated for each of the three archetypal companies, under each of the four modeling scenarios of the minimum durability threshold. Both the cumulative demand from 2030 to 2035 and the cost to the archetypal company were calculated. For ease of comparison, the results for the *Cumulative Target* scenario are shown below (see Table 6).

Table 6: Cumulative CDR demand from 2030 through 2035, for three archetypal companies

a) Heavy Scope 1 Emissions Company (2030-2035, in total)

Cumulative Target						
	Novel		Conventional		Total	
Scenario	Volume (kt)	Spend ($M)	Volume (kt)	Spend ($M)	Volume (kt)	Spend ($M)
Like-for-like, 2030	10.0	$4.0	9.9	$0.6	19.9	$4.6
Like-for-like, 2040	6.2	$2.5	13.6	$0.9	19.8	$3.4
Like-for-like, 2050	4.4	$1.8	15.5	$1.0	19.9	$2.8
Gradual transition	5.4	$2.2	26.6	$1.7	32.0	$3.9

b) Mix of Scope 1 and 3 Emissions Company (2030-2035, in total)

Cumulative Target						
	Novel		Conventional		Total	
Scenario	Volume (kt)	Spend ($M)	Volume (kt)	Spend ($M)	Volume (kt)	Spend ($M)
Like-for-like, 2030	2.5	$1.0	2.5	$0.2	5.0	$1.2
Like-for-like, 2040	1.6	$0.6	3.4	$0.2	5.0	$0.9
Like-for-like, 2050	1.1	$0.4	3.9	$0.3	5.0	$0.7
Gradual transition	1.4	$0.6	6.6	$0.4	8.0	$1.0

c) High CH_4 Emissions Company (2030-2035, in total)

Cumulative Target						
	Novel		Conventional		Total	
Scenario	Volume (kt)	Spend ($M)	Volume (kt)	Spend ($M)	Volume (kt)	Spend ($M)
Like-for-like, 2030	1.8	$0.7	5.0	$0.3	6.8	$1.0
Like-for-like, 2040	1.1	$0.4	5.7	$0.4	6.8	$1.0
Like-for-like, 2050	0.8	$0.3	6.0	$0.4	6.8	$0.9
Gradual transition	1.4	$0.6	6.6	$0.4	8.0	$1.0

Note: *This table represents the CDR requirements for three archetypal companies (see Table 5). This table assumes a Cumulative Target (see Topic 1) under the four minimum durability threshold requirement scenarios (see Topic 3). We assumed a cost of $400/ton for novel CDR and $65/ton for conventional CDR. Numbers may not sum exactly due to rounding.*
Source: RMI analysis.

Discussion

It is clear that the impact of interim removal targets will depend heavily on the way it is implemented. A scenario in which the removal target percentages are cumulative requirements will create significantly less demand than in a scenario in which the removal target percentages are annual requirements. There is the potential for a maximum of only 10 Mt of demand for high-durability CDR in total from 2030 through 2035 in the *Cumulative Target* scenario, roughly one-fourth of the maximum demand in the *Step-Up Target* scenario. Over the 20-year period from 2030 to 2050, the *Cumulative Target* scenario is likely to create a total CDR demand of only 10% of that of the *Step-Up Target* scenario.

As expected, a company's emissions profile will significantly affect the impact of the standard on CDR demand and the cost to corporates. If only Scope 1 emissions are used to calculate the residual emissions subject to the interim removal targets, then the breakdown of Scope 1 and Scope 3 emissions has a significant impact on that standard's impact. Across all modeled minimum durability threshold scenarios, the Heavy Scope 1 company (80%/20% Scope 1 to Scope 3 split) has a greater high- and low-durability CDR requirement and spend than the Mix of Scope 1 and 2 Company and the High CH_4 Emissions Company (20%/80% Scope 1 to Scope 3 split).

Regardless of the breakdown of corporate emissions or the way the removal target percentages are implemented, phasing in a like-for-like approach as early as possible will generate more demand for high-durability CDR in the near term. However, a later phase-in of like-for-like does lower overall cost due to substituting purchases of high-durability CDR with low-durability. Because both CDR methods will be needed to reach durable net zero, creating demand for both in the near term may be beneficial. A delayed phase-in of like-for-like could also allow more time for early-stage CDR approaches to develop, strengthening the supply of high-durability CDR when the like-for-like principle comes into effect.

Conclusion

The need for large volumes of high-quality CDR at the point of net zero is clear, as is the need to start scaling up gradually now to meet the long-term needs at a reasonable cost. While SBTi is just one vector for driving this change, it is an important one. As the leading standard setter for voluntary corporate action, SBTi has the opportunity to provide critical science-based guidance to ambitious corporates to help catalyze further growth in CDR.