



The Role of Credible Carbon Removal in Corporate Climate Action

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Abbreviations and acronyms

CBAM: Carbon Border Adjustment Mechanism

CDR: carbon dioxide removal

CO₂: carbon dioxide

CRCF: Carbon Removal and Carbon Farming

CSRD: Corporate Sustainability Reporting Directive

ESG: environmental, social, and governance

EU: European Union

GHG: greenhouse gas

IRA: Inflation Reduction Act

IPCC: Intergovernmental Panel on Climate Change

ISO: International Organization for Standardization

ISSB: International Sustainability Standards Board

LCA: life cycle assessment

MMRV: measurement, monitoring, reporting, and verification

MRV: monitoring, reporting, and verification

SBTi: Science Based Targets Initiative

SEC: Securities and Exchange Commission

UN: United Nations

UNEP: United Nations Environment Programme

US: United States

VCM: voluntary carbon market

Executive summary

Companies navigate a shifting corporate climate landscape amid changing political winds on their path to achieving net-zero commitments. The scientific consensus is clear: achieving net-zero emissions by mid-century will require large-scale, durable carbon dioxide removal (CDR) alongside deep decarbonization. Even the most aggressive decarbonization scenarios require capturing and storing over 3 billion tons of carbon dioxide (CO₂) annually by 2050. Broader national climate strategies project more than 12 billion tons of residual emissions globally—all of which CDR must remove to achieve balance. Organizations committed to credible climate leadership have shifted from whether to integrate CDR to how to implement it transparently and effectively.

Carbon accounting frameworks built for an earlier era hinder the integration of high-integrity CDR at the scale climate science demands. A lack of consensus is fragmenting underlying carbon accounting frameworks and their reform, creating conflicting recommendations around temporal alignment, cross-protocol consistency, durability treatment, and the tension between accounting precision and innovation support. Meanwhile, stakeholders (including investors, regulators, customers, and advocacy groups) are intensifying scrutiny of climate commitments, demanding transparency, integrity, and alignment with scientific best practices. This shift from pledge-making to pathway validation is making credibility the currency of net-zero.

Our analysis of the evolving corporate climate landscape prompted us to create a comprehensive roadmap for integrating high-integrity CDR into net-zero strategies while maintaining stakeholder credibility. Over 10,000 organizations are recalibrating their climate commitments in response to policy changes, and the most successful strategies will combine aggressive near-term emission reductions with parallel high-quality CDR procurement. Embracing the complexity of credible CDR integrations positions organizations to lead climate action as stakeholder expectations shift and intensify.

Key takeaways

- **Deep decarbonization alone cannot achieve net-zero emissions by mid-century.** Organizations must deploy large-scale, durable CDR to offset residual emissions, with projections showing a need to remove billions of tons of CO₂ annually by 2050.
- **Many organizations have recalibrated or abandoned earlier climate pledges** as political shifts (e.g., US policy rollbacks) and implementation challenges in regions like Europe emerged since 2024, a contrast to the rapid surge in corporate climate commitments between 2018 and 2023.
- **Credibility has become the cornerstone of effective net-zero strategies.** Investors, regulators, customers, and advocacy groups now scrutinize climate commitments more closely, shifting the focus from making pledges to demonstrating credible pathways.
- **Quantifying CDR remains complex, and current protocols have notable shortcomings.** Organizations must track CO₂ across diverse CDR approaches, account for associated GHG emissions, and establish accurate baselines. Despite progress, fundamental gaps in timing, consistency, durability, auditing, accounting, and early investment continue to undermine the credibility, comparability, and scalability of climate claims.
- **We designed a four-stage CDR integration roadmap** to guide companies in embedding CDR into their net-zero strategies while ensuring credibility and effective implementation.

- **Leading in climate action requires embracing credible CDR integration.** Organizations that adopt strategic, science-driven CDR approaches build trust—the currency of net-zero—through transparency, integrity, and actions aligned with scientific reality, positioning themselves to meet rising stakeholder expectations.

The rise of climate pledges and the role of carbon removal

Paris Agreement and the net-zero movement

The Paris Agreement fundamentally reshaped global climate governance, establishing a framework that moved beyond aspirational targets to binding commitments. By committing to limit global temperature rise to 1.5°C above pre-industrial levels, it laid the foundation for a new climate economy rooted in long-term decarbonization. The agreement catalyzed unprecedented alignment across governments, financial institutions, and corporations to achieve net-zero greenhouse gas (GHG) emissions by mid-century.

Between 2018 to 2023, over 10,000 organizations committed to climate neutrality, many aligning with the Science Based Targets Initiative (SBTi) and the United Nation's (UN) Race to Zero campaign, driving an extraordinary surge in voluntary corporate climate commitments.¹

Since 2024, the landscape that once incentivized bold climate commitments has shifted dramatically. In the United States (US), recent administration changes have initiated a systematic rollback of federal climate policy. Measures include dismantling the previous administration's executive orders, scaling back key Inflation Reduction Act (IRA) provisions, suspending Securities and Exchange Commission (SEC) climate disclosure rules, and taking an adversarial stance toward environmental, social, and governance (ESG) regulations.² Many organizations have become increasingly cautious about public climate commitments, with hundreds retreating from earlier net-zero pledges altogether.³⁴

Europe presents a more complex picture. While the region has historically enforced strong climate regulation, the European Union's (EU) Corporate Sustainability Reporting Directive (CSRD) and the Carbon Border Adjustment Mechanism (CBAM) remain in effect but face implementation challenges and delays.⁵

¹ Newcomb J, Sonaike A, Walter D, Speelman L. 2023 Nov 29. Corporate Climate Action: Analyzing the Recent Surge of Climate Commitments. Rocky Mountain Institute (RMI); [accessed 2025 July 10].

<https://rmi.org/corporate-climate-action-analyzing-the-recent-surge-of-climate-commitments/>

² [US SEC] United States Securities and Exchange Commission. 2025 Mar 27. SEC Votes to End Defense of Climate Disclosure Rules. United States Securities and Exchange Commission; [accessed 2025 July 10].

<https://www.sec.gov/newsroom/press-releases/2025-58>

³ Goldhaber MD. 2025 Jan 22. Big banks and asset managers abandon the goal of net zero carbon emissions. NYU Stern Center for Business and Human Rights; [accessed 2025 Aug 14].

<https://bhr.stern.nyu.edu/quick-take/big-banks-and-asset-managers-abandon-the-goal-of-net-zero-carbon-emissions/>

⁴ Jiang X, Kim S, Lu S. 2025. Limited accountability and awareness of corporate emissions target outcomes. Nat Clim Chang. 15(3):279-286. <https://doi.org/10.1038/s41558-024-02236-3>

⁵ Segal M. 2025 Mar 27. EU council approves delay to CSRD and CSDDD sustainability reporting regulations. ESG Today; [accessed 2025 July 10].

<https://www.esgtoday.com/eu-council-approves-delay-to-csrd-and-csddd-sustainability-reporting-regulation/>

These recent political developments highlight the conflicting forces shaping corporate climate accountability. Some organizations continue advancing their climate strategies driven by internal governance, investor pressure, or competitive positioning. Others are recalibrating their approach in response to an increasingly fragmented regulatory landscape.

The importance of CDR to the achievement of net-zero

The scientific consensus is clear: achieving net-zero emissions by mid-century will require large-scale, durable CDR alongside deep decarbonization.⁶ Even the most aggressive decarbonization scenarios in the Intergovernmental Panel on Climate Change's (IPCC) assessment require capturing and storing over 3 billion tons of CO₂ annually by 2050. Broader national climate strategies project more than 12 billion tons of residual emissions globally, all of which CDR must remove to achieve balance.⁷

For organizations committed to credible climate leadership, the question has shifted from whether to integrate CDR to how to implement it transparently and effectively. The challenge lies in integrating CDR into existing carbon accounting frameworks that were designed for a different era. Current systems prioritize emission reductions while treating CDR as secondary, creating structural barriers to the transparent, accountable integration of high-integrity CDR at the scale climate science demands.

Integrating CDR into corporate climate strategies represents both an opportunity and a necessity. But without fundamental reforms to measuring, reporting, and accounting for climate action, it risks creating perverse incentives and unwanted climate outcomes.

The scientific and accounting realities of CDR

Why is CDR accounting so challenging?

Carbon dioxide removal aims to remove CO₂ from the atmosphere and store it securely in an alternative subsystem, such as plant biomass, oceans, or underground storage. The landscape of existing and emerging CDR approaches is vast (**figure 1**), each carrying its own accounting uncertainties and durabilities. In an era where trust is becoming the currency of net-zero, these details matter.

⁶ [UNEP] United Nations Environment Programme. 2024. Emissions gap report 2024: no more hot air...please! With a massive gap between rhetoric and reality, countries draft new climate commitments. UNEP; 2024. <https://doi.org/10.59117/20.500.11822/46404>

⁷ Buck HJ, Carton W, Lund JF, Markusson N. 2023. Why residual emissions matter right now. Nat Clim Chang. 13(4):351–358. <https://doi.org/10.1038/s41558-022-01592-2>

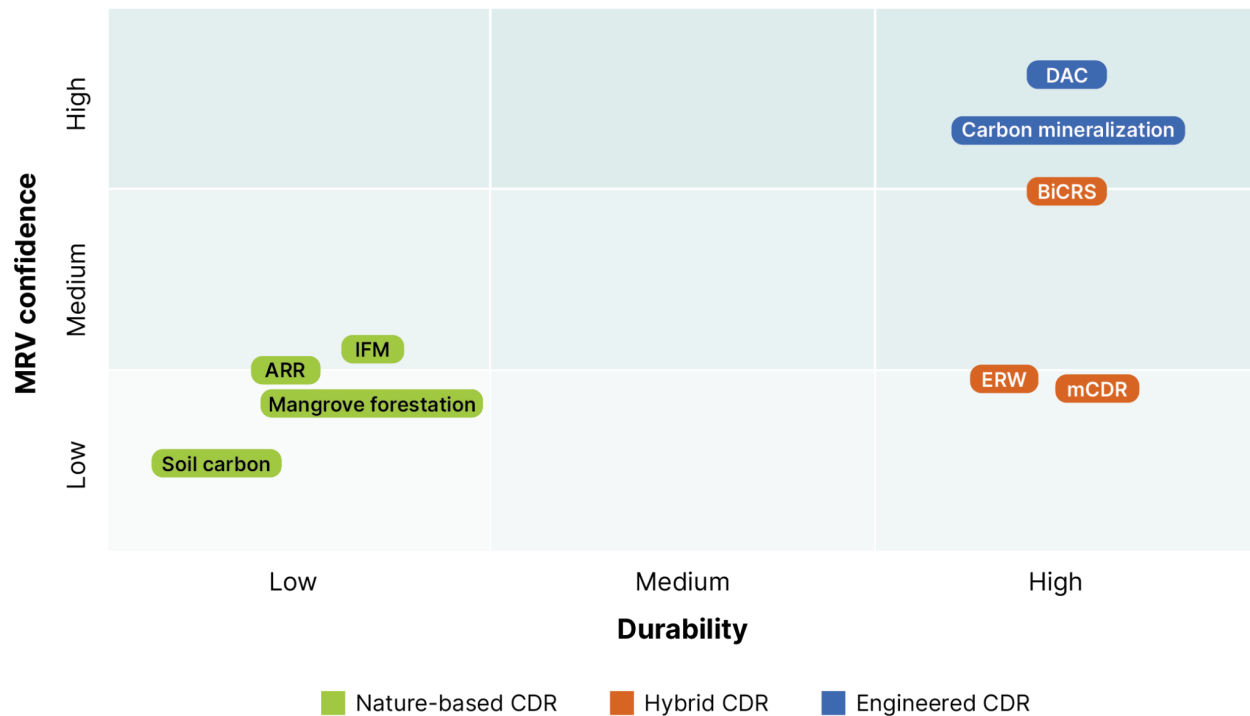


Figure 1. CDR pathways mapped by monitoring, reporting, and verification (MRV) confidence and durability. MRV and durability axes are suggestive averages and may not apply to specific technologies. Note: ARR = afforestation, reforestation, and revegetation; BiCRS = biomass with carbon removal and storage; DAC = direct air capture; ERW = enhanced rock weathering; IFM = improved forest management; mCDR = marine carbon dioxide removal. Source: Carbon Direct.

The foundation of credible CDR claims rests on confidently answering: "How does this intervention change atmospheric CO₂ concentration relative to doing nothing?" This question encompasses three critical components: What does the CDR activity do, what would have occurred without intervention, and how do these answers change over time?

What does the CDR activity do?

Accurately quantifying CDR is a multifaceted challenge. Some systems are straightforward, tracking CO₂ directly. More complex systems track CO₂ as it changes form and blends into existing subsystems, where measurement becomes challenging and boundaries are difficult to define.

CDR activities also emit greenhouse gases, directly and indirectly. Tracking these emissions is critical to understanding the net climate outcome of an activity. As in corporate financial accounting, carbon accounting results are only as good as the underlying data. The wide array of CDR approaches, their various inputs and outputs, and their relative nascency make access to quality data challenging. Compounding this problem is an evolving and somewhat fragmented ecosystem of energy accounting frameworks,⁸ likely the most important input to measure accurately.

⁸ Carbon Direct. 2025 Jun 17. Electricity emissions accounting: GHG Protocol and LCA explained. Carbon Direct; [accessed 2025 Jul 21]. <https://www.carbon-direct.com/insights/electricity-emissions-accounting-ghg-protocol-and-lca-explained>

What would have occurred without intervention?

In CDR accounting, a system baseline represents the total GHG impact that would have occurred without the CDR intervention, which can vary greatly based on the approach. In relatively straightforward engineered systems, it is easy to prove that a giant machine designed to remove CO₂ from the sky would not exist had it not been built. In more complex systems, such as using agricultural amendments to draw CO₂ into the soil, measuring the baseline CO₂ uptake is necessary to capture a clear before-and-after picture of climate impact.

How do these answers change over time?

Some CDR approaches deliver consistent annual results (1,000 tCO₂ removed per year), while others ramp up over time, removing less CO₂ in the first year and more in subsequent years. Still others might make a claim that is definitive in year one, but prone to decay or re-emit over time. This addresses two separate issues: temporal misalignment and differing permanence risks. Temporal misalignment describes the gap between claiming CDR credits and when actual removal occurs. CDR pathways have widely different permanence risks, meaning that credits claimed at one point in time may reverse, eliminating them from the “climate ledger” but not necessarily from the corporate ledger.

Measuring direct impacts, establishing baselines, and tracking temporal changes become even more complex when corporations integrate CDR into their climate strategies. The scientific uncertainties inherent in CDR measurement collide with the corporate need for standardized reporting and accountability, creating a tension that existing climate frameworks struggle to resolve effectively.

Frameworks guiding corporate climate action

Corporate climate commitments have evolved from aspirational statements into complex strategic undertakings governed by uncoordinated standards. Each framework imposes distinct requirements for scope coverage, methodologies, and the treatment of offsets and removals, creating a conflicting web of recommendations that companies must navigate.

This complexity is particularly acute when it comes to CDR. While most frameworks acknowledge the necessity of CDR for achieving net-zero emissions, they diverge on how to account for it, when to use it, and what quality standards should apply. Some treat all carbon removals equally, while others distinguish between natural and technological approaches. Some allow immediate use of CDR to meet targets, while others require deep emission reductions first.

Organizations committed to integrating high-integrity CDR into their climate strategies must navigate what each framework requires and the trade-offs built into different approaches.

Table 1. Comparison of major carbon accounting and reporting frameworks based on their current treatment of CDR, implementation status, and key limitations for net-zero strategies.

Framework	CDR addressed	Status	Key CDR guidance	Limitations
GHG Protocol (Corporate Standard)	Limited	Under revision (expected updates in 2027)	Basic removal accounting; no net-zero guidance	Lacks CDR-specific standards; outdated for modern needs

GHG Protocol (Land Sector and Removals Draft)	Yes	Draft (2024)	Nature-based and technological removals; accounting methods	Draft status; limited to land use and forestry focus
SBTi Corporate Net-Zero Standard	Yes	Under revision (V2.0)	90-95% reduction before CDR for Scope 1 only; residual function only	Rigid hierarchy; unclear on early CDR deployment
International Organization for Standardization (ISO) 14068-1	Yes	Published 2023	Carbon neutrality framework; CDR quality criteria	Emphasizes transparency, integrity, alignment with mitigation hierarchy
CSRD	Yes	In implementation	EU reporting requirements; separate CDR disclosure and quality standards	Regional scope; evolving integration with Carbon Removal and Carbon Farming (CRCF) regulation
International Sustainability Standards Board (ISSB)	Limited	Published 2023	Climate transition plans; Carbon credit disclosure	Financial focus; no specific CDR methodology or criteria guidance

Where do current protocols fall short?

Despite recent advancements, significant tensions remain that limit the credibility and interoperability of climate claims.

- Temporal misalignment:** Most systems treat carbon removals as fungible annual tons, ignoring timing differences. GHG and ESG disclosure regimes prohibit use of undelivered claims for emissions reductions, but do not explicitly prevent these claims in ESG reports. This can create a system where companies earn ESG-related benefits before tonnes are ever removed—or, worse, without removing tonnes at all. It can also lead to temporal arbitrage, where companies front-load benefits and offload risk.
- Cross-protocol inconsistency:** Renders comparability impossible; organizations following the GHG Corporate Standard may find their CDR approach incompatible with ISO 14068-1 methodologies, forcing complex multi-framework approaches. Further, buyers might “ton-shop”, favoring more lenient protocols over more rigorous ones.
- Durability liability:** Current treatment largely ignores distinctions between short-lived forest credits and millennial-scale geological storage, encouraging reliance on cheaper, less permanent solutions. This creates a risk of climate backsliding as credits once claimed in a net-zero pathway ultimately revert to the atmosphere. Further, there is no durability-linked liability recognition, leaving most of the accountability for reversals on the developer.

- **Counterfactual auditing:** There is a lack of mandated auditing in baseline and additionality claims due to a combination of technical, economic, and institutional barriers. This same issue caused a shakeup in the VCM in 2023 due to notorious overcrediting of avoided emission credits.^{9, 10} Without a global authority mandating cross-registry auditing standards, governance fragments, and costly audits remain a low priority without regulatory or market pressure.
- **Lack of traditional accounting principles:** CDR accounting lacks the mechanisms that make financial accounting rigorous and auditable, such as a double-entry system, financial regulatory oversight, or standardized credit rating systems. The CDR credit single-entry system creates a disconnect between the credits purchased and actual environmental liabilities, undermining transparency. Furthermore, a company that lists CDR as an asset is not required to disclose the duration, reversal risk, or market delivery failure. This complicates risk assessment and potentially overvalues short-term credits with uncertain durability.
- **Support for CDR scale-up:** Reaching the multi-gigatonne level of durable CDR by mid-century requires a massive investment in the scale-up of new technologies today. Current protocols rightly prioritize near-term emissions avoidance and reduction, but treat removals as a far-off solution and underestimate the role of early CDR capital mobilization. Early investment in these solutions can also enhance monitoring, reporting, and verification (MRV), improve trust and transparency, and set the path to achieving ambitious scaling targets.

Moving forward: A roadmap for credible CDR integration

Integrating CDR into corporate climate strategies requires grounding decisions in evolving scientific understanding of carbon removal effectiveness, permanence, and timing. Unlike emission reductions, which provide immediate atmospheric benefits, carbon removals present complex questions about when and how they can be credibly claimed and realized.

To help companies navigate these challenges, our roadmap (**figure 2**) outlines key steps we believe are necessary for integrating CDR into net-zero strategies while maintaining credibility, guiding actions from foundational planning through portfolio development, operational integration, and strategic scaling.

⁹ Haya BK et al. 2023. Comprehensive review of carbon quantification by improved forest management offset protocols. *Front For Glob Change*. 6 [accessed 2025 Aug 15]. <https://www.frontiersin.org/journals/forests-and-global-change/articles/10.3389/ffgc.2023.958879/full>. <https://doi.org/10.3389/ffgc.2023.958879>

¹⁰ Dawes A. 2024 Feb 2. What's Plaguing Voluntary Carbon Markets? Center for Strategic & International Studies; [accessed 2025 Aug 15]. <https://www.csis.org/analysis/whats-plaguing-voluntary-carbon-markets>

Roadmap for credible CDR integration

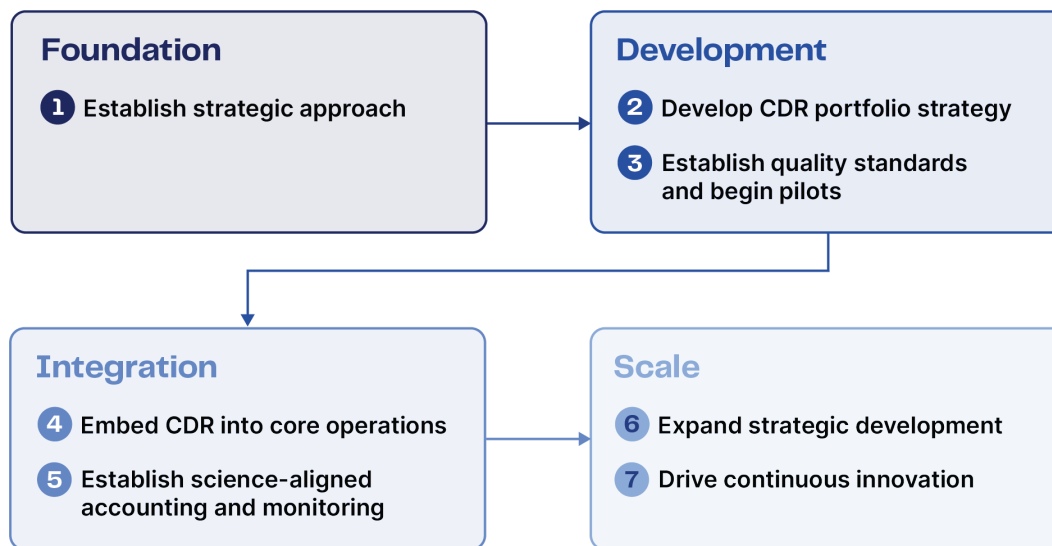


Figure 2. Roadmap for credible carbon dioxide removal (CDR) integration. Source: Carbon Direct.

Foundation

1. **Establish strategic approach:** Conduct a comprehensive emissions baseline, distinguishing between emission categories and hard-to-abate sources, while mapping decarbonization potential across all scopes with realistic timelines. Develop internal CDR policies defining deployment criteria,¹¹ permanence standards, and governance structures. Build stakeholder alignment by educating internal teams and fostering transparent external communication that positions CDR as a complement, not a substitute, to decarbonization efforts.

Development

2. **Develop CDR portfolio strategy:** Create a diversified CDR portfolio balancing risk, cost, and impact across different technologies and permanence profiles. Start with high-permanence, high-additionality solutions, for immediate credibility, and incorporate nature-based solutions with appropriate risk management protocols.
3. **Establish quality standards and begin pilots:** Implement sophisticated life cycle assessment (LCA) accounting for full emissions profiles of removal technologies, including energy inputs and reversal risks. Launch small-scale CDR purchases focused on learning rather than scale, prioritizing projects with transparency, strong measurement, monitoring, reporting, and verification (MMRV) protocols, and clear additionality while documenting lessons learned to refine procurement processes.

Integration

4. **Embed CDR into core operations:** Building on the strategic approach (step 1), integrate CDR considerations into business planning, including supply chain management,

¹¹ Carbon Direct. 2025 Jul 10. What makes carbon removal high quality? Inside the 2025 criteria. Carbon Direct; [accessed 2025 Aug 8]. <https://www.carbon-direct.com/insights/what-makes-carbon-removal-high-quality-inside-the-2025-criteria>

investment decisions, and risk assessment. Develop long-term procurement strategies that align with decarbonization timelines and residual emission projections, while strengthening market capabilities through advanced commitments and strategic partnerships.

5. **Establish science-aligned accounting and monitoring:** Develop or leverage robust accounting systems that distinguish between removal types, disclose permanence risks, and employ conservative, technology-specific practices. Establish ongoing monitoring systems to track CDR performance and additionality over time, with protocols in place for addressing potential reversals, including buffer reserves and replacement strategies. Ensure public statements align with the scientific consensus on the timing of removal claims, taking into account storage permanence and monitoring capabilities.

Scale

6. **Expand strategic deployment:** Scale CDR deployment using lessons learned and market maturity, aligning with emission reduction progress to ensure CDR addresses residual emissions rather than substituting for feasible reduction opportunities. Take leadership roles in market development, standard-setting, and technology advancement while sharing best practices with industry peers.
7. **Drive continuous innovation:** Regularly review and update CDR strategies in response to evolving scientific, technological, and policy landscapes. Maintain flexibility to adapt to new CDR technologies, changing cost structures, and emerging quality standards while contributing to broader market maturity and credibility.

Embracing credible CDR integration allows organizations to lead in climate action and meet rising stakeholders expectations for sophisticated, science-aligned climate strategies. Organizations that pursue strategic CDR integration will discover that trust truly is the currency of net-zero, earned through transparency, upholding it with integrity, and realized through strategic, science-driven action.

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About Carbon Direct

Carbon Direct Inc. helps organizations go from climate goal to climate action. We combine technology with deep expertise in climate science, policy, and carbon markets to deliver carbon emission footprints, actionable reduction strategies, and high-quality carbon dioxide removal. With Carbon Direct, clients can set and equitably deliver on their climate commitments, streamline compliance, and manage risk through transparency and scientific credibility. Our expertise is trusted by global climate leaders including Microsoft, American Express, and Alaska Airlines, as well as by the World Economic Forum, which selected Carbon Direct as an Implementation Partner for the First Movers Coalition. To learn more, visit www.carbon-direct.com.

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