C A R B O N F I N A N C E L A B S

Carbon Removal Portfolio Standard

CaRPS

A framework proposal for global carbon removal capacity scaling

February 2026 | Framework Proposal | Version 2.0

Executive Summary

> *Standardised carbon removal portfolios are essential to scale removal capacity to meet 2050 climate targets. Without a portfolio approach, the industry risks a destructive race to the bottom that stifles innovation, neglects equity, and compounds long-term costs.*

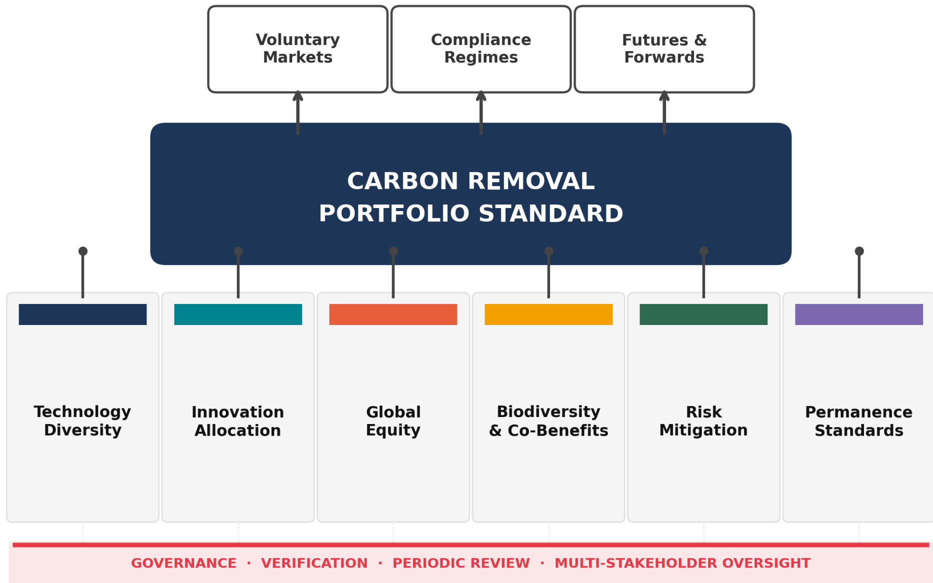
The world needs to remove roughly 10 gigatons of carbon dioxide per year by mid-century. Current removal capacity is a rounding error against that target. The gap is not primarily technological; it is structural. Individual carbon removal projects cannot, on their own, attract the scale of capital required, diversify risk across methods and geographies, or satisfy the governance demands of a trillion-dollar market. The solution is portfolio-scale standardisation.

The Carbon Removal Portfolio Standard (CaRPS) establishes minimum thresholds for technology diversity, innovation allocation, Global South participation, biodiversity co-benefits, permanence, and risk balance. Crucially, these thresholds set floors, not ceilings. Portfolio managers retain maximum freedom to optimise above the minimums. This design mirrors the proven logic of renewable portfolio standards in energy markets: mandate diversity, let markets compete on execution.

This paper makes three arguments. First, delay is the most expensive option: each decade of postponement raises mitigation costs by approximately 40 per cent. Second, minimum thresholds with maximum flexibility avoid both the fragility of prescriptive mandates and the moral hazard of unregulated markets. Third, a portfolio approach unlocks the financial instruments—futures, forwards, structured products—that will mobilise private capital at the scale climate physics demands.

CaRPS Framework Architecture

Six pillars feed a unified standard that channels into three market pathways



Source: Carbon Finance Labs · CaRPS Framework

Figure 1. CaRPS framework architecture: six pillars supporting three market channels

I. The Case for Action

Why Carbon Removal Requires Portfolio Thinking

Carbon removal is not a single technology problem. It is a systems coordination challenge. The portfolio of viable removal pathways spans direct air capture, bioenergy with carbon capture and storage, enhanced weathering, ocean alkalinity enhancement, biochar, soil carbon sequestration, and afforestation. Each method differs in durability, cost trajectory, scalability ceiling, and geographic suitability. No single pathway can meet the 10 Gt annual target alone. The question is not which technology wins, but how to build a diversified portfolio that is resilient to the inevitable failures, delays, and surprises that accompany any industrial transformation of this magnitude.

Without standardisation, each removal unit is a bespoke product—difficult to compare, verify, or trade. This fragmentation raises transaction costs, deters institutional investors, and prevents the emergence of liquid markets. Standardisation makes each unit of carbon removed quantifiable, comparable, and verifiable regardless of the method used. It is the precondition for moving from artisanal projects to industrial-scale deployment.

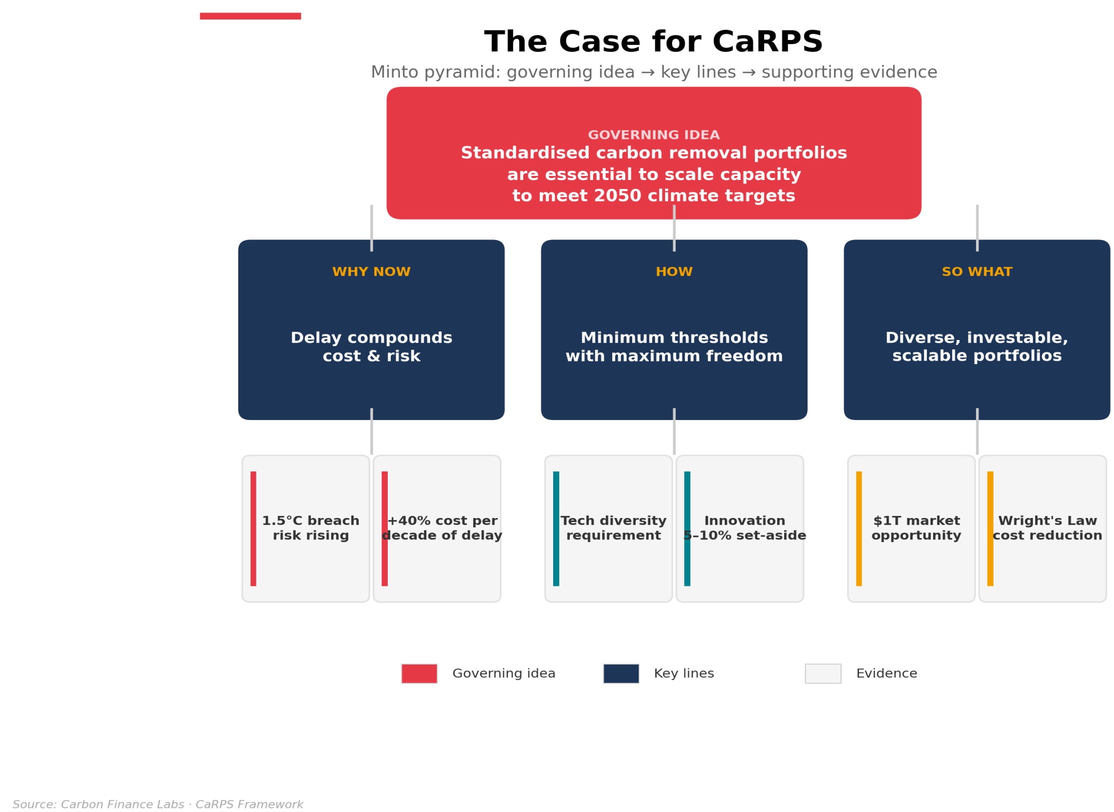


Figure 2. The Minto pyramid: CaRPS argument structure from governing idea to evidence

The Compounding Cost of Delay

The economics of delay are unforgiving. The IPCC estimates that a 2°C increase in global temperature would cost roughly 2.5 per cent of global GDP annually—tens of trillions of dollars over the century. More pointedly, every decade of delayed action raises the cost of meeting the below-2°C target by approximately 40 per cent. This is not a linear penalty; it compounds. Early deployment drives learning-by-doing effects described by Wright's Law, reducing costs through cumulative experience. Delay forfeits those learning dividends.

The cost of direct air capture today ranges from $350 to $600 per ton. With aggressive early deployment and a 20 per cent learning rate, that figure could fall below $100 per ton by mid-century. Without early-stage investment, cost curves flatten and the 2050 capacity gap widens irreversibly. The carbon removal industry is projected to reach $1 trillion in scale—comparable to major segments of the global energy sector. The governance and standardisation infrastructure must be in place before, not after, that scale is reached.

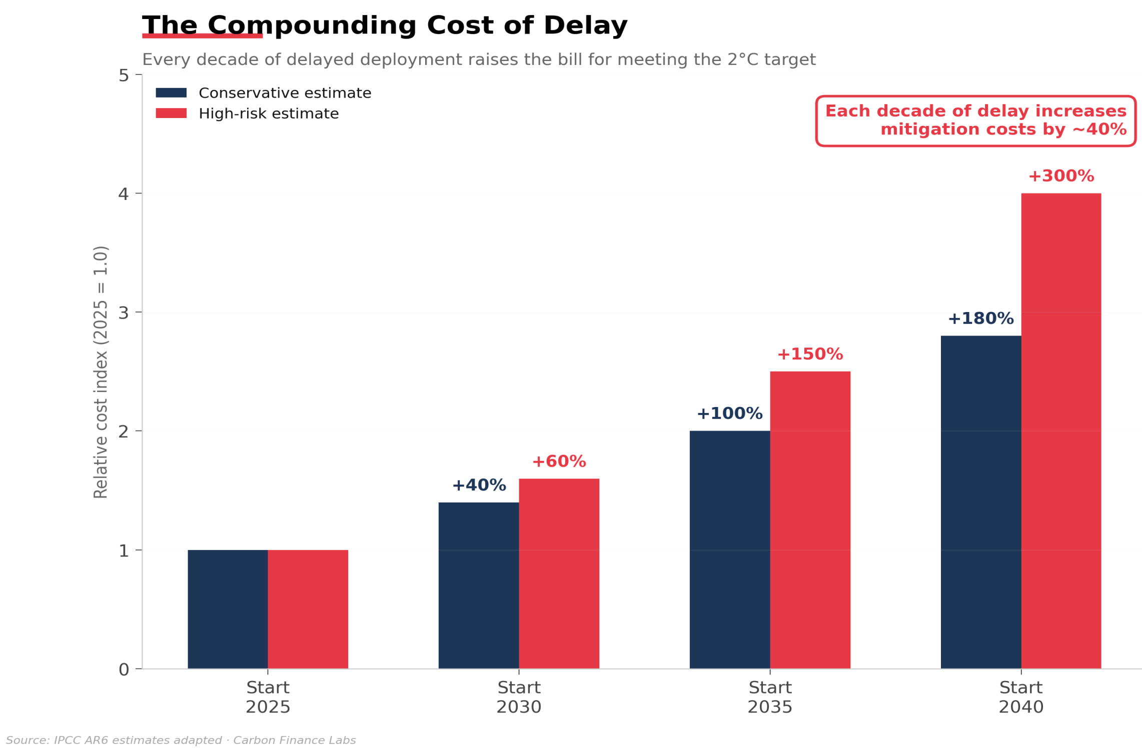


Figure 3. The compounding cost of delay: relative mitigation expense by decade of action

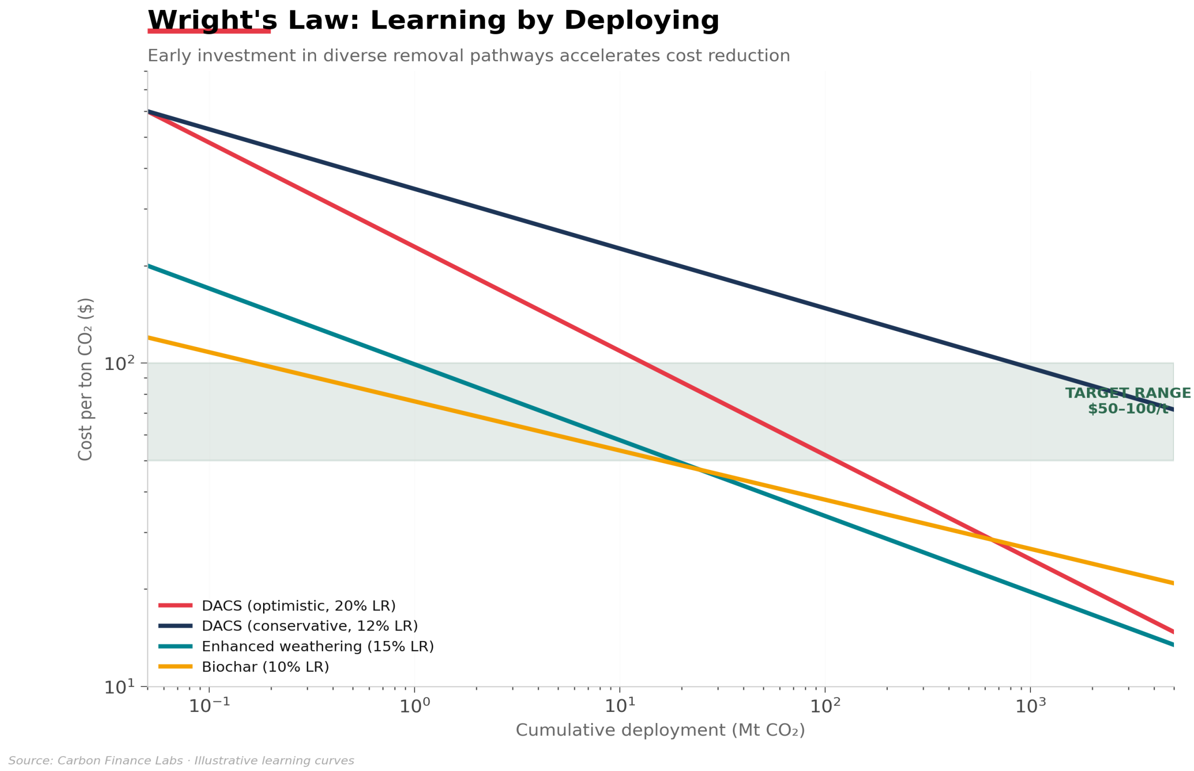


Figure 4. Wright's Law cost curves: early deployment accelerates learning and cost reduction

II. Framework Design

Design Principle: Minimum Thresholds, Maximum Freedom

The central design insight of CaRPS is the use of minimum portfolio thresholds. Rather than prescribing exact allocations, the standard sets floors for key dimensions—technology diversity, innovation, geographic equity, co-benefits, permanence, and risk balance. Above those floors, portfolio managers retain full discretion. This approach preserves the information advantages of decentralized markets while ensuring that systemic priorities are not sacrificed to short-term cost optimization.

The analogy to renewable portfolio standards is instructive. In energy markets, RPS mandates did not specify whether utilities should build wind or solar; they required a minimum share of renewables and let competition determine the mix. The result was explosive growth in both technologies. CaRPS applies the same logic to carbon removal: mandate diversity, let markets deliver efficiency.

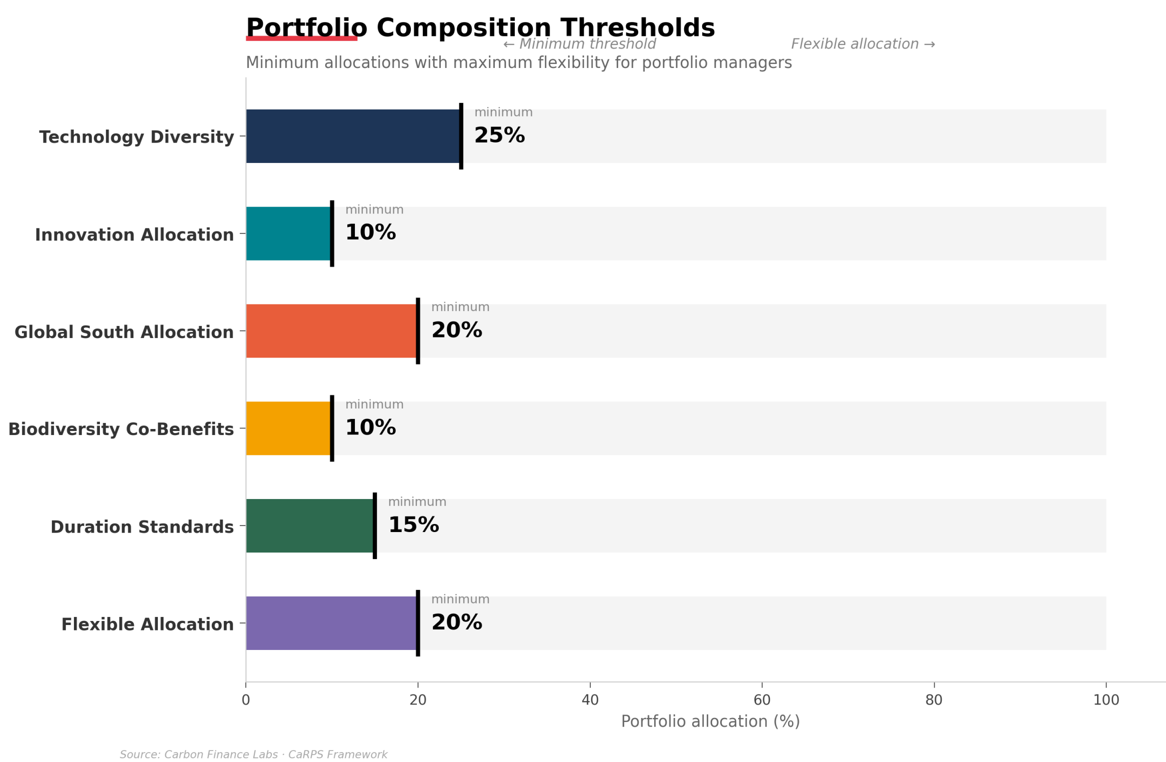


Figure 5. Portfolio composition thresholds: minimum allocations with flexible headroom

The Six Threshold Dimensions

1. Technology Diversity

A specified percentage of the portfolio must come from different removal pathways. No single technology may exceed a maximum share. This prevents the concentration risk inherent in backing a single method and ensures the portfolio benefits from the distinct cost curves, durability profiles, and scalability characteristics of multiple approaches.

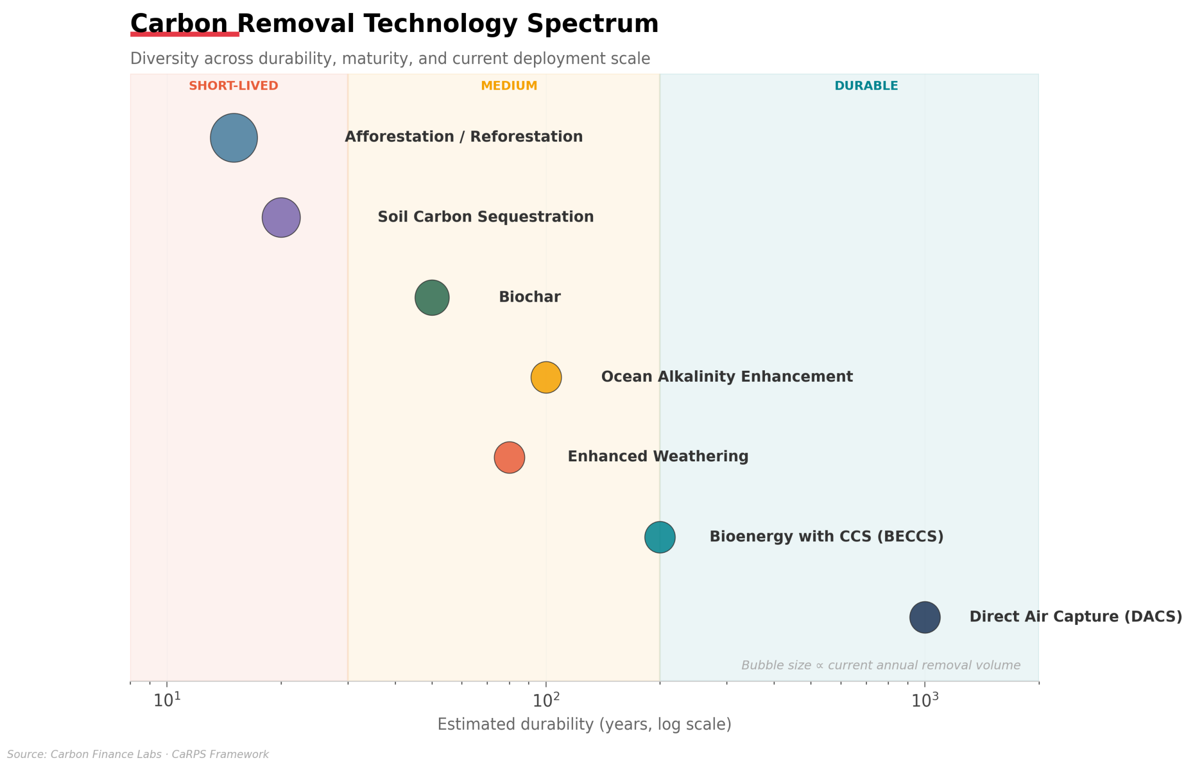


Figure 6. Technology spectrum: removal methods vary in durability, maturity, and current scale

2. Innovation Allocation

At least 5 to 10 per cent of the portfolio must be dedicated to technologies that have cumulatively removed less than 10 million metric tons of CO_2e. This carve-out for emerging methods ensures that the portfolio does not calcify around today's best options at the expense of tomorrow's breakthroughs. Innovation allocation is the portfolio's venture capital function: high risk, but essential for long-term cost reduction and resilience.

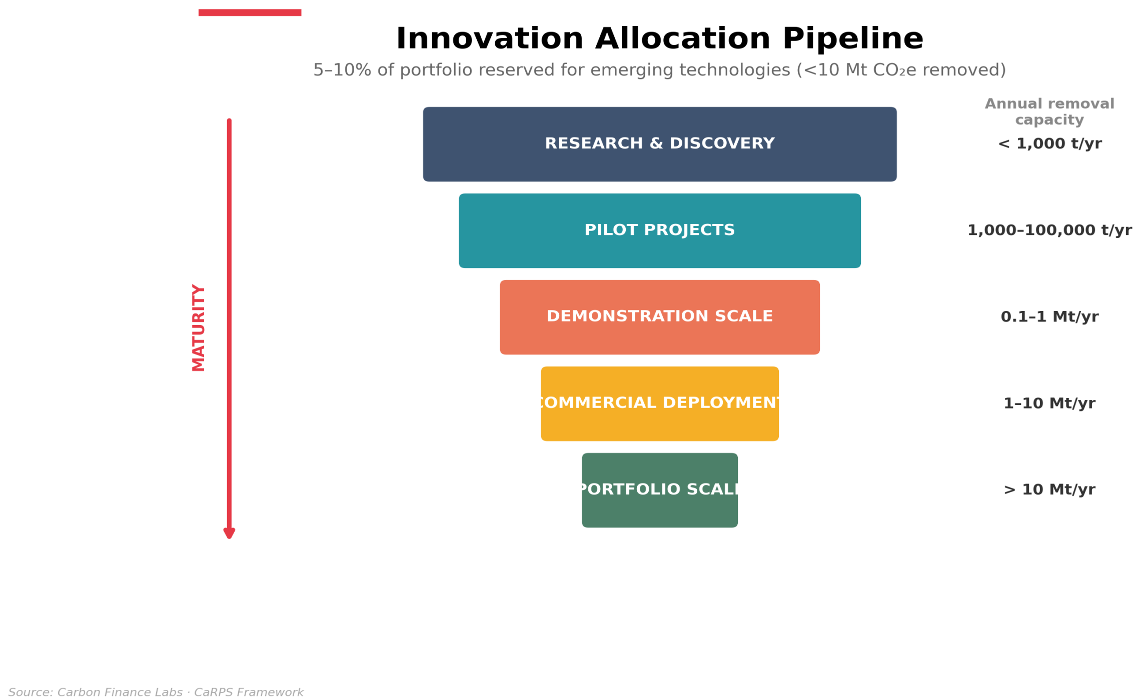


Figure 7. Innovation pipeline: from lab-scale research to portfolio-grade commercial deployment

3. Global South Geographic Allocation

A minimum of 20 per cent of removals must originate from projects in the Global South. This threshold serves dual purposes. It promotes equity by directing investment to the regions most affected by climate change and least responsible for historical emissions. It also captures cost advantages: many nature-based and enhanced weathering approaches are cheaper to deploy in tropical and subtropical regions.

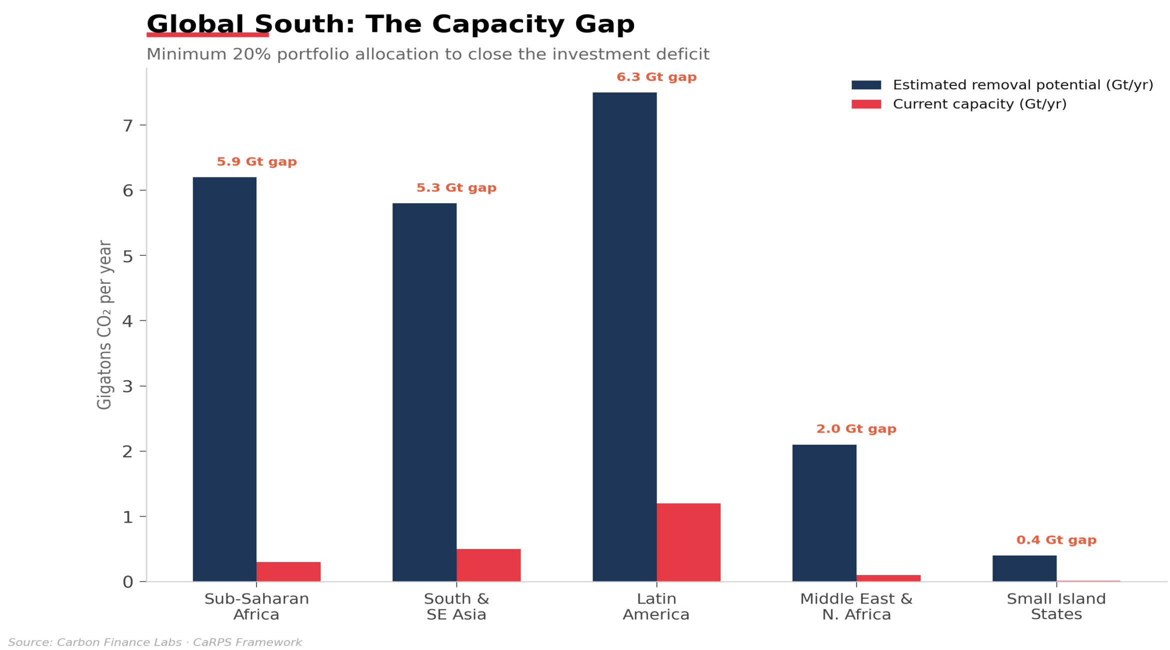


Figure 8. Global South capacity gap: vast removal potential versus negligible current deployment

4. Biodiversity and Co-Benefits

Projects contributing to biodiversity conservation or other sustainable development goals receive priority weighting. Carbon removal should not come at the expense of ecological integrity; it should reinforce it. This threshold aligns the standard with the broader architecture of international sustainability commitments.

5. Risk and Return Balance

The portfolio must balance proven technologies with high-risk, high-potential innovations. This mirrors modern portfolio theory: diversification across uncorrelated risk profiles reduces aggregate risk while maintaining upside exposure. CaRPS portfolios are explicitly designed to be investable, with risk characteristics that institutional allocators can underwrite.

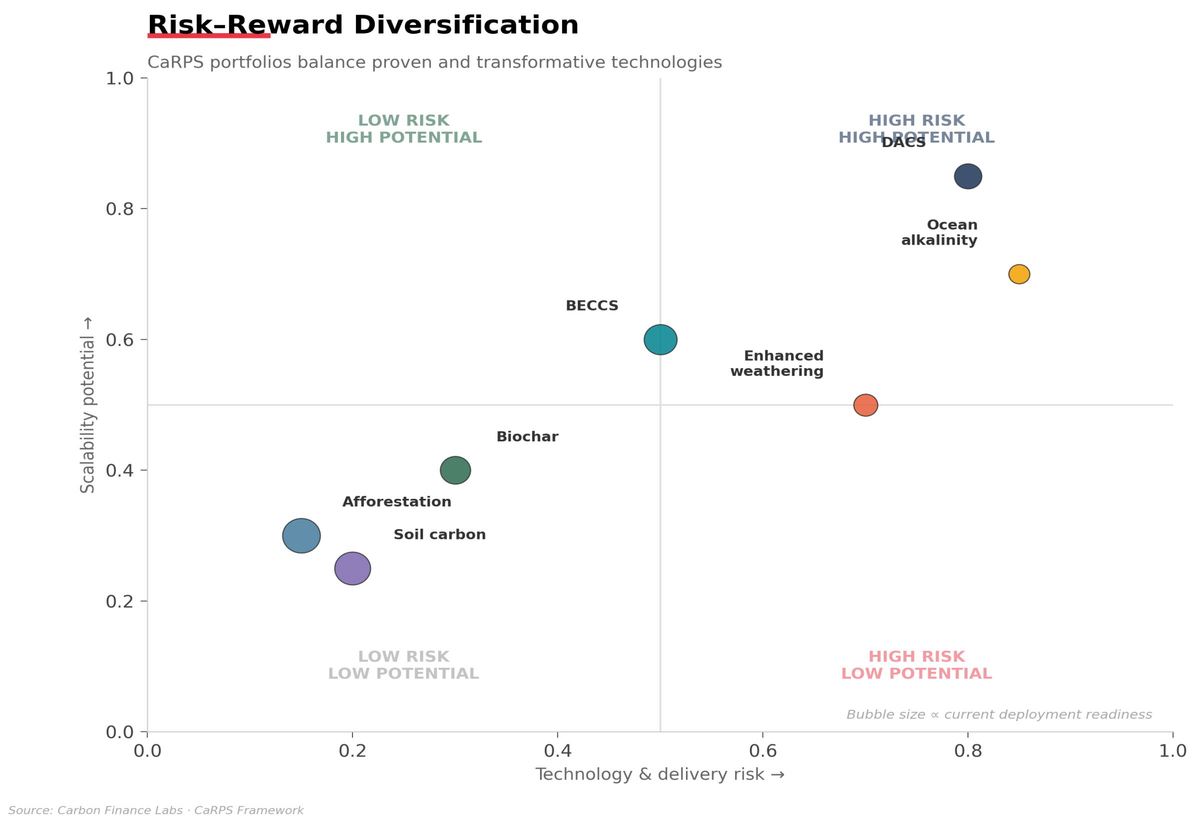


Figure 9. Risk–reward matrix: portfolio diversification across technology readiness and scale

6. Permanence and Performance Standards

A weighted-average or minimum threshold for carbon storage duration applies to every portfolio, with a preference for solutions demonstrating 95 per cent confidence of maintaining removal for at least 100 years. Short-duration removals may participate, but the portfolio as a whole must meet the permanence floor. This ensures that removal claims represent genuine, durable climate benefit.

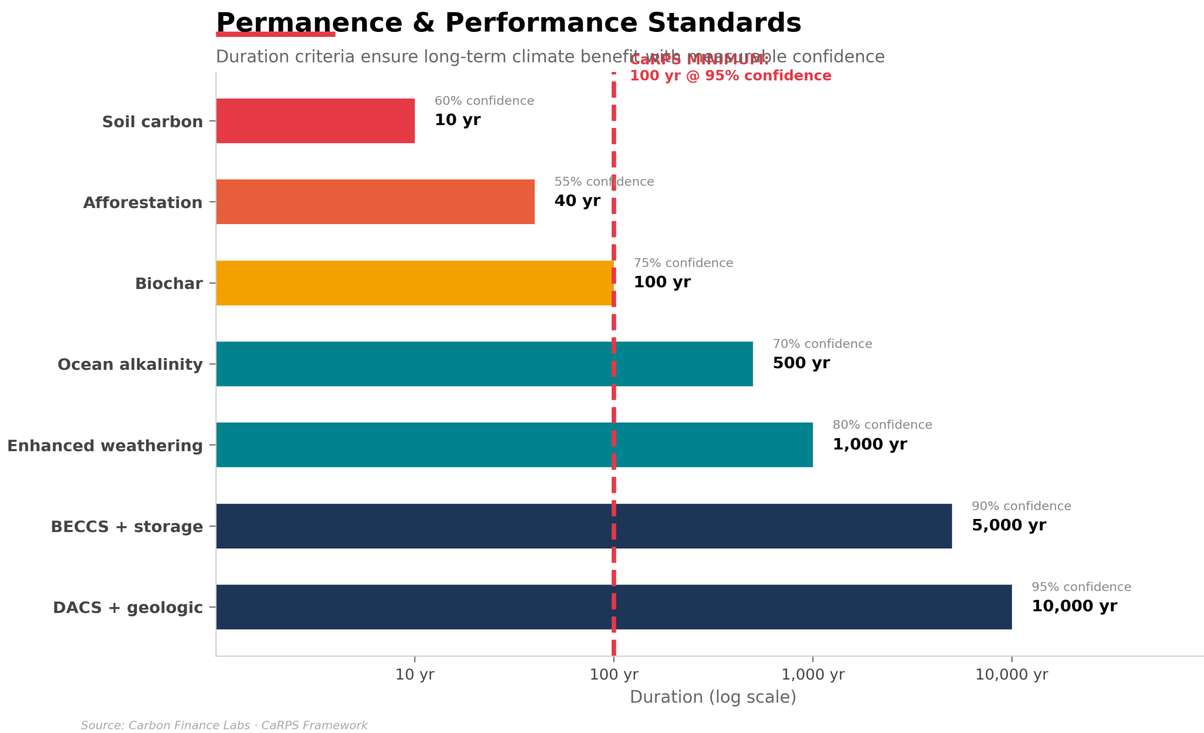


Figure 10. Permanence standards: durability and confidence levels across removal methods

III. Avoiding the Race to the Bottom

The carbon removal market faces a structural temptation: purchase the cheapest available credits today and defer the harder, more expensive work of building durable, diverse capacity. This is the classic race to the bottom—and it leads to precisely the outcomes the climate cannot afford.

A cheapest-to-deliver strategy stifles innovation by starving emerging technologies of revenue. It neglects environmental and social integrity by rewarding low-cost methods regardless of their broader impact. It creates concentration risk by funneling capital into a narrow set of approaches. And it generates market volatility, because the cheapest methods today are often the least scalable—meaning costs will spike when demand eventually overwhelms the limited supply of bargain removals.

The projected $1 trillion scale of the carbon removal industry makes these risks systemic, not marginal. Without portfolio standards, the sector risks the same adverse selection dynamics that have plagued voluntary carbon markets: low-quality credits crowd out high-quality ones, buyer confidence erodes, and the entire market's credibility suffers. CaRPS is designed to break this cycle by embedding quality, diversity, and innovation requirements into the market's structural foundations.

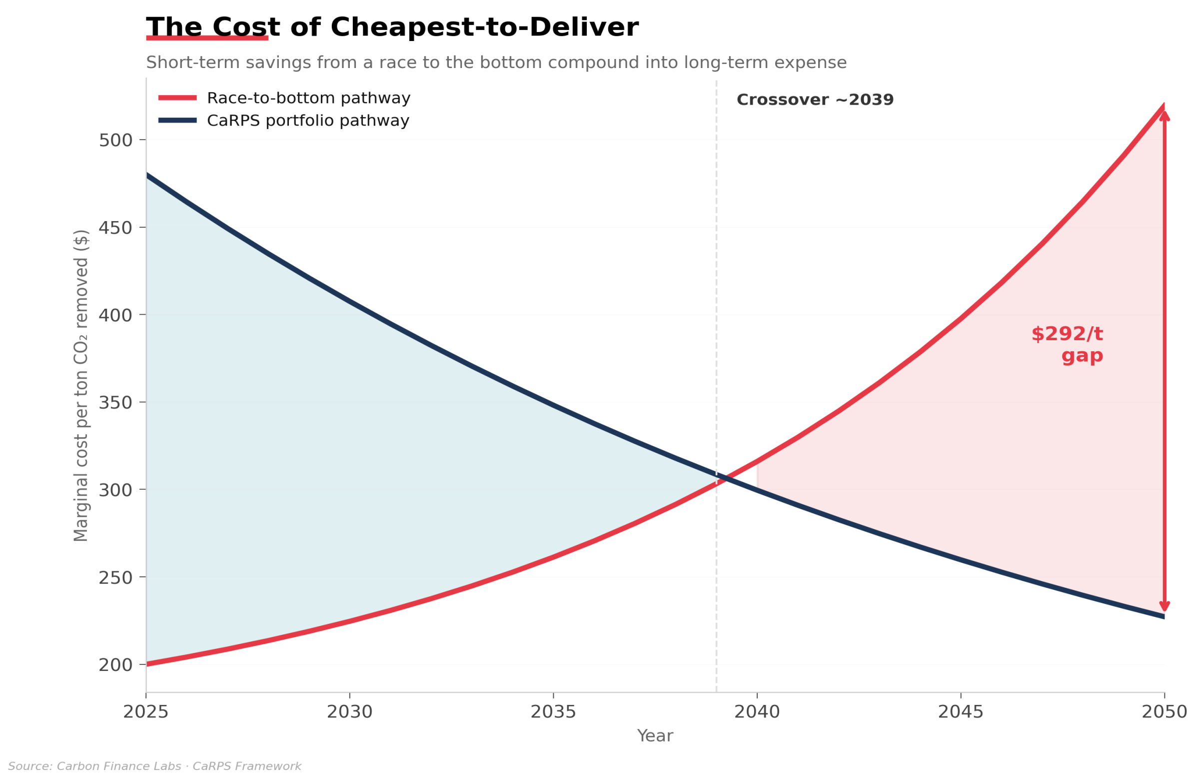


Figure 11. Cost trajectory comparison: race-to-bottom versus CaRPS portfolio pathway

IV. Market Integration

The pathway from standardised removal units to tradeable portfolio instruments follows five stages: standardise, aggregate, certify, trade, and finance. At each stage, the CaRPS framework provides the common language and quality benchmarks that allow diverse market participants to transact with confidence.

Standardisation creates uniform measurement, reporting, and verification criteria. Aggregation bundles individual projects into portfolios that offer risk diversification and scale. Certification by trusted third parties ensures environmental integrity. Trading on voluntary and compliance markets provides price discovery and liquidity. Financial structuring—futures, forwards, and portfolio-backed instruments—mobilises the institutional capital required for multi-decade deployment.

The standard is designed to operate across both voluntary and compliance regimes. For voluntary buyers, CaRPS provides assurance that portfolio-level purchases meet rigorous quality criteria. For compliance markets, the standard offers a benchmark that regulators can reference when setting domestic or international carbon removal obligations.

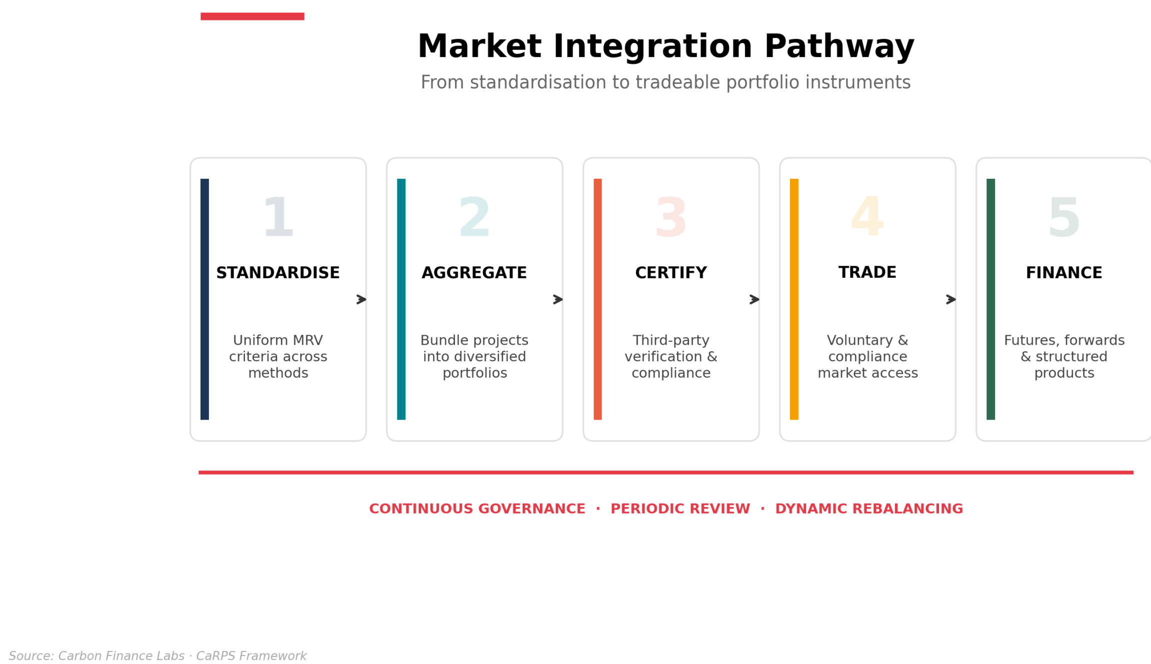


Figure 12. Market integration pathway: from standardisation to structured financial products

Deployment Pathway to 2050

The CaRPS framework envisions a phased deployment ramp. An initial standard adopted around 2030 would set baseline thresholds for early portfolios. By 2035, portfolio-scale purchasing would become the market norm. Compliance integration—linking CaRPS criteria to national and international regulatory frameworks—would follow by 2040. By 2050, the goal is a diversified, global removal capacity of approximately 10 Gt per year, sufficient to close the gap between emissions reduction and the net-zero target.

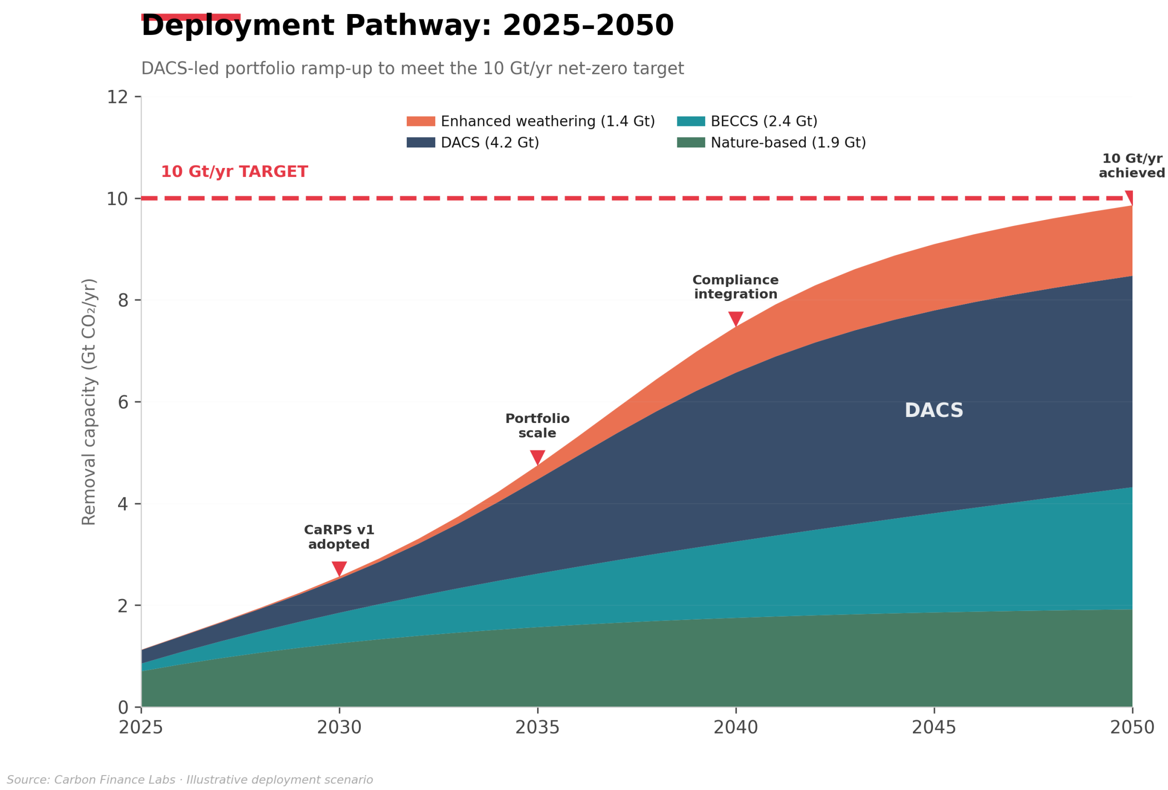


Figure 13. Deployment pathway: phased portfolio ramp toward 2050 net-zero removal capacity

V. Governance

Effective governance is the difference between a standard that evolves with the science and one that calcifies into irrelevance. The CaRPS governance framework is designed around three principles: broad representation, structured deliberation, and mandatory periodic review.

The governance committee includes climate scientists, ecologists, environmental economists, carbon removal enterprises, renewable energy sector representatives, government officials, international bodies such as the UNFCCC, environmental NGOs, indigenous and local communities, green finance experts, insurance professionals, technology assessors, and ethicists. A rotating chair ensures no single perspective dominates. Working groups focus on specific domains—technology assessment, policy integration, finance mechanisms—and report to the full committee.

Public consultation mechanisms provide transparency and incorporate broader stakeholder input. An annual review process, with flexibility for interim adjustments, ensures the standard adapts to technological breakthroughs, market developments, and evolving climate science. The governance model is designed to be as durable and adaptive as the portfolios it oversees.

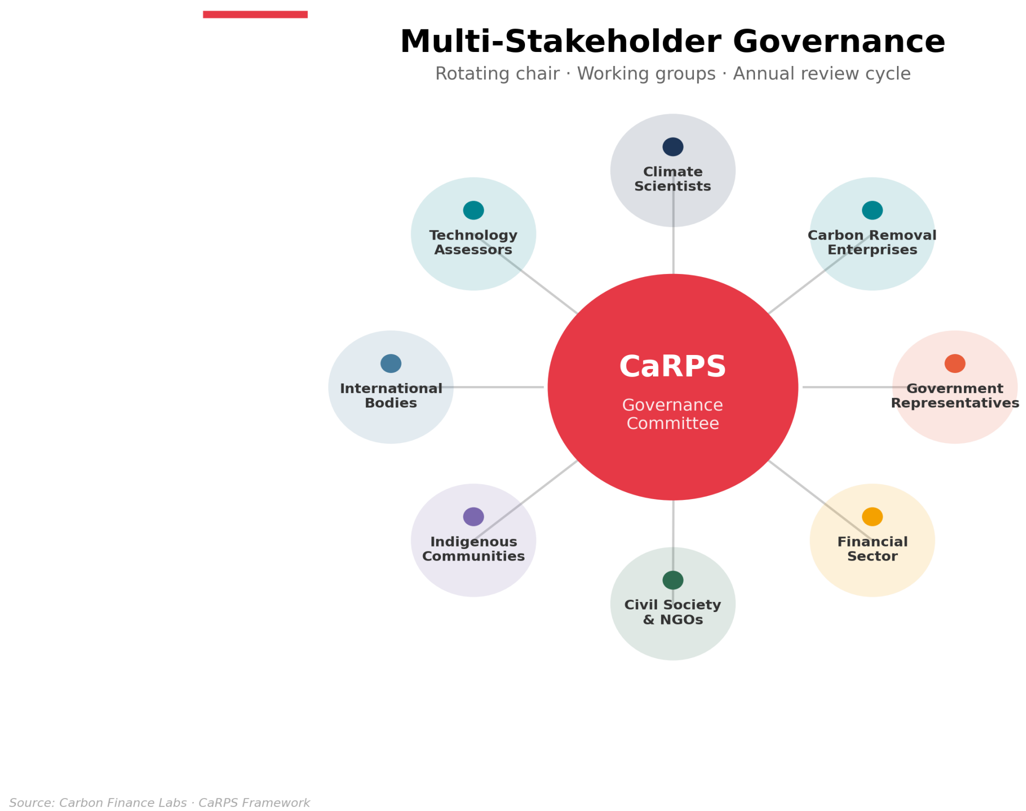


Figure 14. Multi-stakeholder governance: eight constituent groups around a central committee

VI. Risks of Non-Implementation

Failure to implement carbon removal at scale by 2040 generates cascading risks across climate, economic, political, and ecological domains.

Temperature overshoot. Without sufficient removal capacity, the likelihood of breaching the 1.5°C limit increases substantially. Current policies set the world on a path to approximately 2.7°C of warming by century's end.

Economic damage. The IPCC estimates economic losses of 2.5 per cent of global GDP per year at 2°C of warming. Delayed implementation raises the cost of meeting climate targets by roughly 40 per cent per decade of postponement.

Innovation stagnation. Without early deployment, Wright's Law learning effects are forfeited. Costs remain high, and the technologies needed for mid-century scale are not developed.

Market failure. Adverse selection—where cheaper but less effective credits dominate—erodes buyer confidence and stunts the market's growth.

Political instability. Public trust in climate policy erodes when promised results fail to materialize. In extremis, governments may turn to geoengineering as a last resort, with poorly understood geophysical consequences.

Biodiversity collapse. More than half the world's GDP depends on natural systems. Continued high emissions without effective removals accelerate the loss of those systems.

Insurance crisis. The increasing frequency and severity of climate-related disasters raises insurance costs and creates uninsured losses, straining governments and communities.

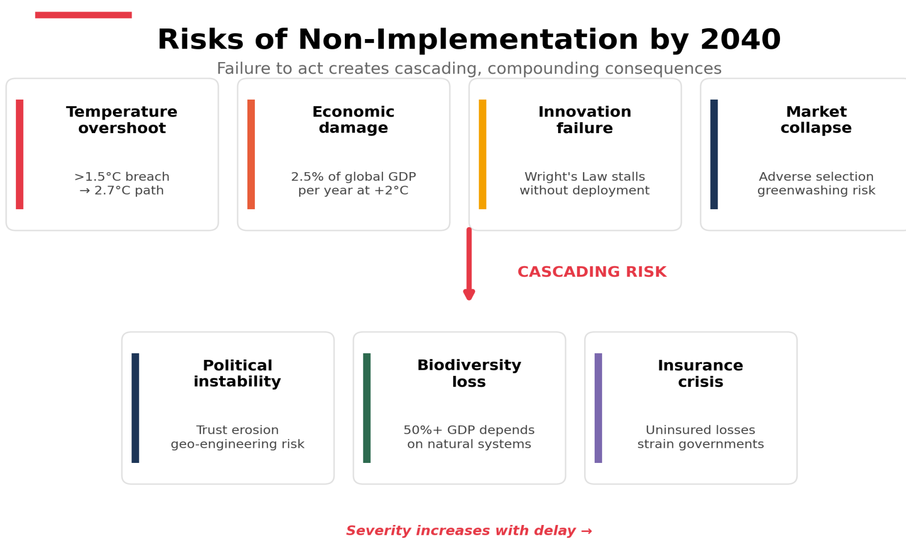


Figure 15. Risk cascade: non-implementation triggers compounding consequences across domains

Conclusion

> *The question is not whether carbon removal will scale—climate physics demands it. The question is whether it scales well or badly. CaRPS is the architecture for scaling well.*

The Carbon Removal Portfolio Standard provides the structural foundation for a global carbon removal market that is diverse, innovative, equitable, and financially robust. By setting minimum thresholds rather than prescriptive mandates, CaRPS preserves market flexibility while ensuring that systemic priorities—technology diversity, innovation, Global South participation, biodiversity, permanence, and risk balance—are embedded in the market's DNA.

The alternative—fragmented, unstandardised, cheapest-to-deliver carbon removal—is not merely suboptimal. It is dangerous. It stifles the innovation pipeline, concentrates risk in a narrow technology base, neglects the communities most affected by climate change, and ultimately raises the cost of the transition by forfeiting the learning dividends that only early, diversified deployment can deliver.

Implementing CaRPS requires coordinated global action: investment in research and development, the establishment of clear policy frameworks, and the political will to embed portfolio standards in both voluntary and compliance carbon markets. The governance infrastructure proposed here—multi-stakeholder, periodically reviewed, publicly accountable—is designed to earn and maintain the trust that a trillion-dollar market will demand.

The time to act is now. Every year of delay compounds the cost and narrows the pathway to a liveable climate. A standardised, portfolio-based approach to carbon removal is not a luxury of foresight; it is a necessity of arithmetic.