



The Navigator

Distilled insights to navigate rapidly evolving carbon markets | July 2025



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Letter from the editor

We started this quarter with two goals: step back from the day-to-day policy chaos, and surface the deeper shifts that matter.

The climate policy landscape feels particularly noisy right now. Federal rollbacks continue to make headlines in the US, but the real story is what's happening in the gaps left behind. In this issue, we spotlight the evolving role of the private sector and philanthropy in filling those gaps—especially when it comes to environmental justice ([pg. 6](#)). As our colleagues Leslie Aguayo and Rory Jacobson note, environmental justice has never waited for policy to lead. But without federal guardrails, the responsibility to get this right is quickly shifting.

Across the Atlantic, the EU is building its answer to the IRA. The Clean Industrial Deal is a sprawling policy package aimed at decarbonizing Europe's industrial sector and securing its clean-tech competitiveness ([pg. 9](#)). It's not law yet, but if implemented, it could reshape public procurement, investment flows, and the carbon intensity of everyday goods.

Our science insights this quarter are all about scaling up. Enhanced rock weathering continues to gain traction, with major offtake deals, prizes won, and the first verified credits issued ([pg. 13](#)). But scientific consensus is still catching up. Meanwhile, new insights on global land carbon sinks, electrochemical DAC, and wastewater-based ocean alkalinity enhancement are pushing the boundaries of what's possible and what's measurable ([pg. 17](#)).

On the market side, we explore how EU and UK aviation mandates are rapidly turning fuel compliance into a cost-avoidance strategy ([pg. 20](#)). These policies could soon reshape CORSIA demand and spark supply chain innovation. And VCMI's new *Scope 3 Code of Practice* adds important integrity guardrails to the ongoing scope 3 conversation ([pg. 23](#)).

As always, we hope *The Navigator* helps you find clarity in the noise. Thank you for reading, and please let us know what you'd like to see more of next quarter.

Bodie Cabiyo, PhD
Editor and Director of Interdisciplinary Science



Acronyms and abbreviations

AI: artificial intelligence	EU-ETS: European Union Emissions Trading System
BIL: Bipartisan Infrastructure Law	GHG: greenhouse gases
BRICS: Brazil, Russia, India, China, South Africa, Egypt, Ethiopia, Indonesia, Iran and the United Arab Emirates	HEFA: hydroprocessed esters and fatty acids
CCS: carbon capture and storage	ICVCM: Integrity Council for the Voluntary Carbon Market
CDR: carbon dioxide removal	IRA: Inflation Reduction Act
CID: Clean Industrial Deal	mCDR: marine carbon dioxide removal
CJF: conventional jet fuel	OAE: ocean alkalinity enhancement
CO₂: carbon dioxide	REC: renewable energy certificates
COP: Conference of the Parties (to the UNFCCC)	SAF: sustainable aviation fuel
CORSIA: Carbon Offsetting and Reduction Scheme for International Aviation	SBCE: Sistema Brasileiro de Comércio de Emissões de Gases de Efeito Estufa (Brazilian Greenhouse Gas Emissions Trading System)
DAC: direct air capture	SBTi: Science Based Targets initiative
EAC: environmental attribute certificates	UK: United Kingdom
EJ: environmental justice	UK-ETS: United Kingdom Emissions Trading System
ERW: enhanced rock weathering	US: United States
e-SAF: electro-sustainable aviation fuel	VCM: voluntary carbon market
ETS: emissions trading system	VCMI: voluntary carbon market integrity initiative
EU: Europe	WHCEQ: White House Council on Environmental Quality

Credits

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Given the highly collaborative nature of Carbon Direct, many people contributed insights to this report beyond the list below. The following team members contributed substantially to developing this report.

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Policy insights

Environmental justice: Our experts weigh in on the changing policy landscape

Leslie Aguayo

Rory Jacobson

Bottom line: In this Q&A, we speak with two Carbon Direct experts [Leslie Aguayo](#) (Environmental Justice Associate) and [Rory Jacobson](#) (Head of Policy). Leslie and Rory are both former federal civil servants who worked on environmental justice initiatives during the previous administration; Leslie was at the White House Council on Environmental Quality (CEQ) and Rory was at the Department of Energy's Office of Fossil Energy and Carbon Management. We asked them about the current state of climate policy and environmental justice (EJ) work. They emphasized that EJ, as a movement, has never waited for policy to push for progress. Over the next few years, there is an opportunity for the carbon management sector to continue to build trust with civil society.

How are the current administration's rollbacks on climate progress and EJ initiatives affecting climate policy and EJ outcomes?

Rory Jacobson: The consequences we're seeing are far-reaching and deeply interconnected. On Trump's first day in office, he [revoked numerous executive orders](#) that mandated environmental justice considerations across federal agencies. These executive orders have had rippling impacts on energy and environmental policy. The administration [has terminated entire arms](#) of the EPA, [canceled grants](#) that would provide support for EJ projects across the nation, and [removed community benefit plan requirements](#) from funding provided by federal agencies.

Without federal guidance and resources, there's less oversight to ensure carbon projects don't disproportionately burden frontline communities. Clean energy and decarbonization approaches that are less commercially mature may pose a higher

risk of exacerbating and reproducing environmental and economic disparities without this guidance. And while EJ is historically contextualized as a US-based movement, these policy changes undermine the US's global credibility on climate and energy justice.

Leslie Aguayo: Under-resourced communities are bearing the brunt of these rollbacks. Community-based nonprofit organizations are [now dealing with federal funding shortfalls](#) that will have substantial implications for a wide range of initiatives such as regional efforts to provide technical assistance, address legacy pollution, and support a just transition to clean energy. [EJ has deep and enduring roots](#) in communities across the US. Community groups will continue their work; however, the erasure of EJ priorities from federal policy is occurring while the administration also [loosens environmental regulations](#) that have protected overburdened and disadvantaged communities for decades.

These groups serve as crucial bridges between federal policy and local communities. Carbon projects depend heavily on social license, community engagement, and equitable benefit-sharing agreements—all of which become much harder to achieve without functioning EJ programs and staff.

What specific actions can the private sector take to address these gaps?

LA: I don't think anyone would argue that [Justice40](#) or the federal community benefits frameworks were perfect. But without these basic justice and equity considerations, private sector actors now need to take a more proactive approach to responsible project development. I'd say the biggest challenges for the private sector as a result of these rollbacks will be around maintaining meaningful community engagement, building trust, navigating inconsistent regulations, and compensating for the lack of federal guidance on community engagement and benefits planning.

The private sector can lead by integrating equity into every phase of carbon project development—from setting internal guardrails that exceed federal standards, to co-developing projects with frontline communities, to making EJ performance a core investment criterion. These steps help de-risk projects, build community trust, and ensure long-term viability.

RJ: What's concerning is that without federal guidance on community engagement, consultation, and benefits sharing, we risk that otherwise well-intentioned and technically sound carbon management projects will miss the mark on EJ. As Leslie points out, the private sector now [has to fill this gap](#) if they want to develop projects responsibly. We've already seen some project developers step back from previous community benefit plan commitments, now that they are not federally mandated. Developers who repeal proposed commitments for community engagement and benefits plans, could risk eroding trust built with frontline communities and negatively impact the reputation of the carbon management sector.

Aside from the private sector, how can philanthropy help fill policy gaps?

LA: Philanthropies play a crucial role in advancing EJ and climate policy. In this political environment, grantmakers are in a challenging position. How do [philanthropies] prioritize when everything is a priority? I think this is where the “how” you grant is as important as “what” you grant to.

First, philanthropies can be excellent bridge builders. They can serve as conveners, thought partners, and campaign strategists for communities with limited resources and in local governments with excessive red tape.

Second, philanthropies can build upstream capacity by giving to EJ organizations and local leaders, so that they can develop the needed skills and [knowledge](#) for environmental and climate policy interventions and decision-making processes. Simultaneously, they can support regional infrastructure by funding technical assistance to local and state EJ offices, which are now even more critical given federal retrenchment.

Third, philanthropies can help scale best practices by identifying, replicating, and sharing successful state-level EJ policies, programs, and models across different regions. Lastly, they can help to fill data gaps by [supporting EJ research](#) and data collection in states without strong EJ enforcement capabilities.

RJ: Both philanthropy and project developers can focus on building community trust by designing carbon management projects that deliver tangible benefits. These include measurable and meaningful outcomes like air quality improvement, water conservation, or even remediation of legacy pollution. With the unbiased support of philanthropy, project developers can partner with trusted local institutions to monitor and disclose the outcomes of carbon management investments to community members.



As former federal civil servants, what are your perspectives on advancing EJ despite these political setbacks?

LA: Having worked in the White House, I can tell you that policy implementation relies heavily on institutional knowledge and sustained coordination between agencies. When you eliminate programs and lay off staff, you're not just changing policy direction—you're dismantling the operational capacity to execute complex climate initiatives effectively. That said, EJ has a strongly rooted legacy in this country, one that has never been beholden to the changing winds of the federal government. As Jalonne White-Newsome, my former CEQ EJ Team Director, [said](#): "Environmental justice did not start with the federal government,

nor will it end with the federal government." Working in climate and EJ means we've signed up to play the long game.

RJ: Exactly. [It will take all of us](#) leveraging our unique roles in government, the private sector, non-profits, and communities to keep moving the needle forward. And what we're seeing now is that state and local governments will have to step up without the federal support they were counting on. This creates a patchwork system where your zip code determines your level of environmental protection. I am also particularly concerned that this administration has sought to [limit state and local efforts to mitigate pollution](#) while also [erasing the data](#) that could help the private sector reduce disproportionate burdens.

LA: It's reminding me of a sentiment that I heard often from communities during my time at CEQ, "we must stay ready, not get ready." And when I think about this time, where it feels like we are constantly getting ready to put out fires (literally and figuratively), I try to remind myself that we also have to stay ready. When federal protections fail, we have to keep building on what we have: the strengths of every sector and the momentum you and I both saw during our time in the federal government and do more than fill gaps—we have to build something fundamentally better and more equitable.

"Environmental justice did not start with the federal government, nor will it end with the federal government."

—Jalonne White-Newsome



The EU's Clean Industrial Deal: A smorgasbord of decarbonization tools

Rory Jacobson

Sarah Braverman

Bottom line: The European Commission has proposed a Clean Industrial Deal (CID), providing an extensive policy framework for decarbonizing the industrial and manufacturing sector and leveraging up to EU€100 billion in public funding. The CID could be a tremendous incentive for manufacturing businesses to maintain operations in Europe, especially as US tax credits from the Inflation Reduction Act (IRA) and Bipartisan Infrastructure Law (BIL) grants are increasingly threatened. However, unlike the IRA and BIL, the CID is not law—it is a list of policy measures the European Commission intends to consider. The European Commission still needs to table and implement the full portfolio of policy programs.

The EU's response to the American IRA and BIL

Although the EU has [delayed the implementation of its carbon border adjustment mechanism](#), the EU Commission continues to advance policy to decarbonize the industrial sector. In February, the Commission rolled out the CID, with the stated goal of enhancing the competitiveness of the EU's energy-intensive industries and clean-tech sectors. As a follow-on to the European Green Deal and the Green Industrial Plan, the CID represents a major financial investment in decarbonizing the EU economy and maintaining a competitive clean energy sector. The CID is expected to mobilize EU€100 billion.

In some respects, the CID reflects a formidable response to the decarbonization and clean energy incentives provided under the US's IRA and BIL—though the incentives authorized under the former were significantly repealed or reduced through [the Republican reconciliation package](#). Following the passage of the IRA and BIL, many sectors in the [EU expressed concern](#) that the

“buy American” requirements, coupled with the strong manufacturing incentives, would encourage industry to move business operations out of the EU. The CID can reasonably be considered the substantive policy response to these concerns.

A strategic window for EU manufacturers—but only if implementation follows

The CID could be a significant opportunity for industrial and manufacturing businesses with operations in the EU to advance their economic competitiveness, decarbonize their supply chains, and expand workforce development opportunities. But the CID isn't a perfect parallel to the IRA. The CID is a sophisticated portfolio of proposals, leveraging both demand and supply interventions.

Demand side: First, the Industrial Decarbonization Accelerator Act is a clear response to the IRA's “buy American” provisions, establishing “made in Europe” as well as sustainability criteria for public procurement. The EU Commission

intends to introduce details on these criteria at the end of 2025. Industrial manufacturers [seeking public procurement contracts](#) will need to comply with these criteria and will need to develop a comprehensive lifecycle assessment to demonstrate acceptable carbon intensity scores. Early adopters of industrial decarbonization technologies will have an opportunity to secure a strategic advantage in public markets across the EU through these procurement criteria.

Supply side: The CID includes an extensive list of planned public investment opportunities to help industry reduce the carbon intensity of their products. The CID will direct the EU Commission to adopt a state aid framework to accelerate and streamline financial assistance. Members will receive this assistance to deploy renewable energy and support clean energy manufacturing. The Commission will also scale and leverage the Innovation Fund and propose an industrial decarbonization bank, drawing from the finance available within the Innovation Fund, as well as additional revenue from the ETS and revision of

InvestEU. The CID also directs the EU Commission to update the InvestEU Regulation, which would unlock EU€50 billion in public funding. Industrial manufacturers across the EU should closely monitor the status of the Commission's progress in sourcing and distributing these funds. Businesses that successfully secure these public funds will gain a meaningful competitive advantage, both in public procurement bids as well as in reduced compliance costs under the ETS.

Shifting from supply chain vulnerability to strategic coordination

Recent friction in global trade and supply chain instability may have been anticipated in the CID design. One example is how the CID directs the EU Commission to help European companies aggregate their demand for critical and raw materials. The EU critical raw material center would unlock economies of scale by enabling longer joint purchasing of materials through common supply chains. These mechanisms could reduce input costs and improve the reliability of European industrial and manufacturing businesses that rely on unpredictable and geopolitically vulnerable suppliers. To help standardize these trade opportunities, the EU Commission also plans to pursue reliable and mutually beneficial trade agreements with suppliers outside of Europe. In many ways, these policies reflect a unique mechanism for supply chain stability and trade that was not prevalent in the IRA or BIL (except for restrictions regarding Foreign Entity of Concern provisions).

Enabling a clean industrial workforce in the EU

Finally, there is a noteworthy parallel between the IRA and CID's workforce development elements. To obtain the highest credit values, applicants for the IRA clean energy and manufacturing tax credits must meet requirements for prevailing wages and apprenticeships, but the CID takes a different

approach. The EU Commission will establish a union of skills that "invests in workers, develops skills and creates quality jobs," although details are light. However, more promisingly, [Erasmus+](#) (the EU's program for education and training) will invest up to EU€90 million in funding to develop a skilled and adaptable workforce, with an emphasis on addressing labor shortages in the key sectors.



COP30 host launches nationwide carbon market

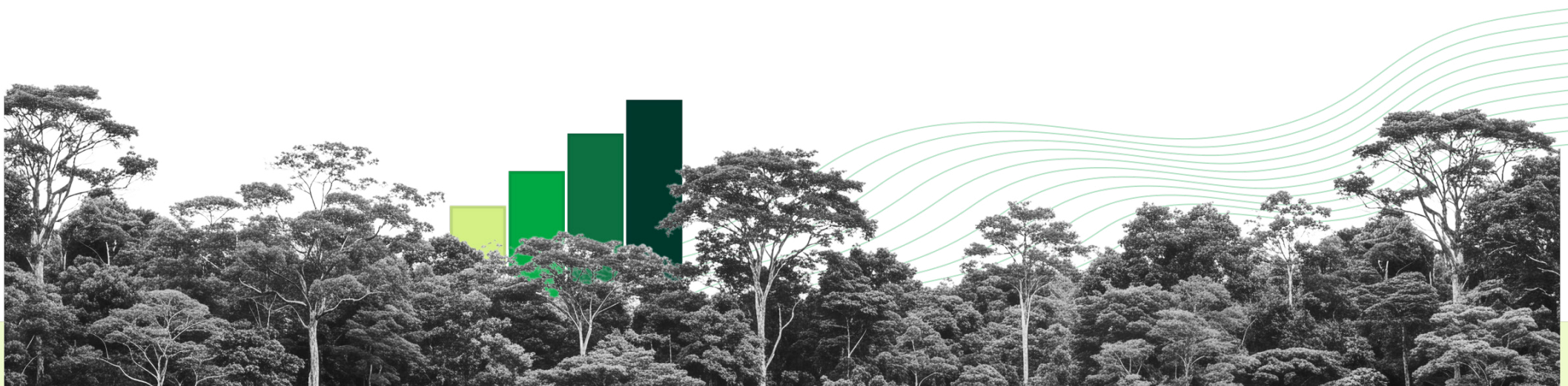
Sarah Braverman

Why it matters: Following a generally successful G20 presidency last year, Brazil will have the presidency of both the BRICS group and COP30 in 2025, heightening the country's influence on global climate efforts. Brazil ranks [fifth in the world](#) for total emissions, behind some other BRICS nations, with emissions produced predominantly from land use change. Current national leadership has been bullish on reducing these emissions. President Lula has pledged to end deforestation in the country by 2030 and has already achieved a [50% decrease in deforestation](#) since the start of his administration. Brazil's initial steps to launch a nationwide carbon market, just six months ahead of hosting COP30 in November, demonstrate the approach the country aims to pursue in achieving its climate goals.

Starting in 2026, Brazil will join a few of the world's largest emitters (the EU, China, and India) in adopting a nationwide carbon market. Brazil's national carbon trading system, known as the SBCE, differs from other national carbon markets, such as the EU ETS and China's national ETS, in a few key ways. The SBCE applies to all (approximately [4,000](#)) companies emitting more than 25,000 tonnes of CO₂ per year. By comparison, China's ETS initially focused only on the power sector, and the EU ETS covers power, industry, and aviation above certain thresholds.

The SBCE [explicitly defines](#) the carbon market into two entities: a regulated market, where government-mandated targets apply to specific sectors, and a voluntary market, where companies can offset emissions beyond regulatory requirements. This coexistence allows for both compliance-driven and voluntary transactions within a single national framework. This formal integration is unique.

SBCE is rolling out over a structured, multi-phase timeline spanning six years, with clear milestones for regulatory development, emissions reporting, and eventual full market operation. While other systems have also used phased approaches, Brazil's timeline is notably explicit and lengthy, emphasizing capacity building and regulatory clarity before imposing full compliance obligations.



Science insights

Crushing it: enhanced rock weathering gains ground

Emily Kyker-Snowman

Katherine Vaz Gomes

Shirin Mavandad

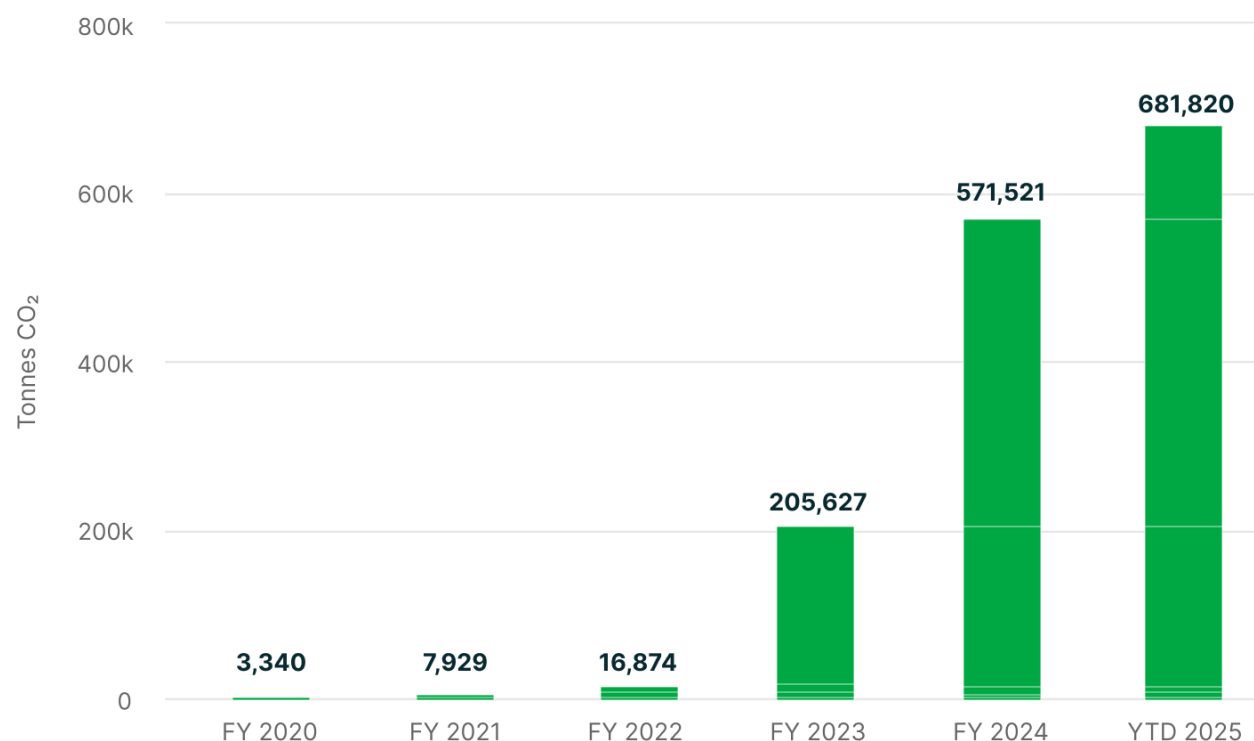
Bottom line: The [field of ERW](#) is experiencing rapid commercial and scientific development, marked by the first issuances of verified carbon credits, major corporate offtake agreements, and industry awards. This momentum is essential for scaling ERW, a solution with the potential to provide gigatonnes of durable CDR. However, commercial deployment is outpacing scientific consensus, particularly on key uncertainties around measurement and verification. Scaling ERW responsibly requires a dual focus: celebrating and enabling rapid progress while embedding a deep-seated caution. Prioritizing scientific rigor, transparency, and collaborative problem-solving will help solidify the integrity of every tonne of CO₂ removed via this exciting pathway.

XPRIZE and recent offtake deals highlight ERW's momentum

ERW is a CDR method that accelerates a natural geological process. Spreading finely crushed silicate rock, such as basalt, on agricultural lands speeds up the natural reactions between minerals, water, and atmospheric CO₂. These reactions create stable bicarbonate ions that are eventually transported to the ocean for durable storage. When deployed responsibly, ERW doesn't just durably remove carbon. It also improves soil health, boosts crop yields, and can benefit farmers financially. But, importantly, ERW projects must take steps to avoid any unintended negative environmental impacts.

The Musk Foundation's recent announcement of [XPRIZE Carbon Removal](#) winners sent a strong signal of support for ERW as a promising climate solution. [Mati Carbon](#) took first place, and [UNDO Carbon](#) placed as third runner-up, both ERW companies. XPRIZE Carbon Removal stands out as the first major competition to evaluate CDR based on science, scale, and impact. XPRIZE

Contracted ERW carbon removal credits, cumulative



Each bar indicates cumulative ERW credits contracted since 2020. Contracted credits for 2025 are current as of June 30th.

prioritizes technologies with the potential to scale to remove billions of tonnes of carbon while protecting ecosystems and avoiding unnecessary mining.

Momentum from the XPRIZE is being echoed in the private sector. Microsoft recently committed to buying CDR credits from [Terradot](#), a Brazilian ERW company, signaling growing confidence in this solution. In the past five years, ERW credit sales have increased exponentially as projects come online and scale up. Since 2020, buyers have contracted nearly 700,000 tonnes of CDR via ERW. In January 2025, [Isometric issued](#) the world's first batch of independently verified ERW credits for InPlanet's Project Serra da Mantiqueira. Isometric verified these credits based on a protocol that requires direct measurements to quantify net CDR in an open-system environment.

Collaborations target thorny questions of quantification at scale

Amid this excitement, the credit issuance warrants a healthy dose of caution. A core challenge remains: quantifying net CDR with high confidence. Recent peer-reviewed papers have rightly urged caution, highlighting how local soil chemistry can trap the alkalinity generated by weathering before it is exported from the watershed. This means that simply measuring the effects of ERW in the soil can overestimate the amount of carbon that is durably removed from the atmosphere. This quantification issue does not discredit ERW as a CDR pathway, but it is a critical uncertainty that demands further research.

Response to this challenge has been encouraging. Rather than defending simplistic models, leading actors are pursuing transparency and collaborative science. In June 2025, [Cascade Climate](#) launched the [ERW Data Quarry](#), a platform designed to enable researchers and project developers to share real-world operational data. The platform integrated anonymized data from the first ERW credit issuance, providing an example of how researchers and project developers can use verified commercial data to test and improve the models they utilize for future verification. Philanthropic grant programs that fund academic researchers (who can piggyback on commercial deployments) provide additional support for innovation. Combined, these efforts represent a sector-wide commitment to openly addressing common ERW pitfalls and accelerating the learning curve for everyone.

This collaborative approach extends to other operational areas. While research highlights the [agricultural co-benefits](#) of ERW, scaling responsibly also requires addressing potentially negative impacts. This includes sourcing from quarries with a low risk of releasing potentially toxic elements, establishing robust health and safety protocols to protect workers and communities from airborne dust, and understanding the downstream impacts of diverting basalt from existing supply chains like construction.

Since 2020, buyers have contracted nearly 700,000 tonnes of CDR via ERW.

A call to action for buyers: Funding the flywheel

In this evolving landscape, the structure of procurement agreements and carbon credit standards is a key driver of industry practice. Market participants are aiming to manage the risks inherent in an early-stage sector, while scientific and operational methods are still being refined.

Currently, purchases of ERW-based removal represent more than banked tonnes of CO₂. These purchases are direct investments in the science, technology, and infrastructure needed to bring this solution to gigatonne scale. See Carbon Direct's [A Buyer's Guide to Enhanced Rock Weathering in Croplands](#) to learn more. Buyers are uniquely powerful in accelerating ERW's development. By making purchases that are conditional on transparent data sharing, they can incentivize developers to contribute to the field's collective understanding.

Combined, market momentum and a shared commitment to scientific integrity will allow this nascent technology to mature and deliver on its potential to contribute to global climate goals.



Concrete commitments, steely resolve: Building cleaner with EACs

Adrianna Sutton

Katherine Vaz Gomes

Bottom line: The AI boom and the proliferation of data centers are among several factors that have led to an increased demand for clean energy and sustainable building materials. While energy demands can be partly mitigated with solutions like [natural gas + CCS](#), embodied emissions from materials like concrete and steel pose a separate challenge. [Environmental attribute certificates](#) (EACs) can support decarbonization in these industrial sectors by allowing companies to purchase the environmental benefits of lower-carbon materials, unbundled from the physical commodities. EACs are meant to complement, not replace, direct procurement of low-carbon materials. Carbon Direct and Microsoft have developed [criteria for high-quality EACs](#) to ensure they are additional, catalytic, and verifiable. Decarbonizing both energy inputs and construction materials is essential, and EACs offer a valuable tool for scaling this transformation.

The AI boom isn't just an energy story, it's a materials story

In our [last issue](#), we spotlighted natural gas-fired power generation [paired with CCS technology](#) (NG+CCS) as a promising near-term solution to increased demand for electricity. The AI boom and the proliferation of new data centers partly fuel this demand. NG+CCS can offer reliable, dispatchable, and lower-carbon power that is capable of supporting data center energy needs and keeping emissions under control. However, energy is only part of the story.

Data centers also represent embodied emissions (GHGs released during the production, transportation, and full life cycle of physical goods, including construction materials like concrete and steel). Data center buildout requires significant amounts of concrete, steel, and other physical infrastructure. These materials are climate heavyweights.

Steel has a high carbon intensity due to upstream manufacturing processes. Concrete has a lower carbon intensity per unit but poses a challenge due to the sheer volume required for construction. Microsoft's 2023 emissions data revealed that a staggering [96.5%](#) of its emissions were [scope 3](#), with construction materials like concrete and steel doing much of the dirty work.

In a market where supply chains are fragmented and low-carbon materials are often regionally constrained or in short supply, it can be challenging for companies to directly procure low-carbon alternatives for these materials within their own supply chain. In response, Microsoft and similar firms are [investing in](#) novel materials, piloting approaches such as [mass timber](#), and pursuing innovative building design. While effective, these efforts alone are not enough to compensate for increased scope 3 emissions. That's where EACs come in.



What's an EAC and how can it help?

EACs enable buyers to purchase the environmental benefits of greener materials, such as lower-carbon concrete and steel, without having to physically receive those materials. EACs function similarly to [RECs](#) or [SAF credits](#). While EACs aren't a replacement for physical procurement of sustainable materials, they offer a flexible mechanism for signaling market demand and financing deep decarbonization in sectors like concrete and steel.

But with flexibility comes risk. Without clear guardrails, EACs could be used to avoid rather than advance true climate progress. Already, concrete and steel represent about [13%](#) of global GHG emissions. To encourage the use of EACs in the built environment and to ensure they support additional, catalytic, and verifiable climate benefits, Carbon Direct and Microsoft recently developed a robust set of [criteria for high-quality EACs](#). These criteria cover seven key areas:

1. **Qualifying conditions:** EACs must complement, not displace, direct procurement and represent significant emissions reductions.
2. **Social harms and benefits:** EACs must not further social harms and should promote community engagement and social benefits such as workforce development opportunities and community climate resilience.

3. **Environmental harms and benefits:** EACs must not perpetuate environmental harm, but instead should mitigate risks and provide additional environmental benefits.
4. **Additionality and baselines:** Projects funded by EACs must drive real emissions reductions in terms of financial, regulatory, and common practice additionality.
5. **Catalytic impact:** EAC procurement must prioritize transformative technologies with sector-wide decarbonization potential.
6. **Verifiability:** Projects must set a high bar for documentation, transparency, and independent auditing.
7. **Leakage:** Projects must address risks of emissions displacement to support net-positive outcomes.

Cleaner power and commodities: A winning combination

To meet the climate challenge at the scale and speed [needed in the AI era](#), the commitments of data center developers will simultaneously drive decarbonization of power inputs and construction materials. Power generation solutions like renewables, nuclear, and NG+CCS are vital to managing operational emissions. They must be paired with efforts to transform industrial supply chains, the foundational materials of digital infrastructure, or miss the mark.

EACs, if used carefully and transparently, offer a powerful tool to scale deep decarbonization of the built environment. They enable investment in first-of-a-kind technologies, by making them more bankable, and help mitigate embodied carbon during a period when physical procurement remains constrained by geography, availability, or cost. EACs can help signal demand and evolve the market toward maturity, where the physical procurement of low-carbon materials becomes the norm. But EACs are not shortcuts, they're drivers of change. Only when held to rigorous criteria can they deliver on their potential.



96.5% of Microsoft's total emissions in 2023 were scope 3.

New research highlights

Shirin Mavandad

Where is all the land carbon going?

[Recent gains in global terrestrial carbon stocks are mostly stored in nonliving pools](#) ↗

Context tl;dr

Terrestrial ecosystems are a key buffer against climate change, absorbing about a third of fossil fuel emissions every year. But where that carbon ends up (whether in living vegetation, dead biomass, or soils) remains uncertain. Scientists have been trying to understand this “land carbon sink” for decades, but most have assumed that carbon gains were in living biomass.

What they found

From 1992 to 2019, land sequestered ~128 billion tonnes of CO₂, but living biomass made up only ~4 billion tonnes sequestered. The remaining carbon was attributed to non-living sinks, mostly soils and dead wood. This mismatch forces a rethink of carbon accounting assumptions.

The wonky details

The authors compiled seven datasets to estimate above-ground biomass change (a “bottom-up” method) and compared this to top-down global

carbon sink estimates. They then assigned the gap between these approaches to nonliving carbon pools, some quantified directly (e.g., landfills), and others inferred by subtraction (e.g., deadwood, soils, litter). This attribution relies heavily on arithmetic rather than direct observation, a notable limitation.

Implications

If correct, the findings mean the land sink may be more durable than expected, since nonliving carbon is less susceptible to threats like wildfire. But the core insight is that forests are growing aboveground less than we thought they were. The authors assume this means more carbon is stored underground, but it could also mean that forests just aren't sequestering as much carbon as expected.

What comes next

Despite decades of work, scientists still don't fully understand global carbon flows. This study offers an important indication of where to look for carbon, but it is far from definitive. To validate these results, we'll need to improve direct measurement of soil carbon dynamics, especially in intact and regrowing forests.

Sewage to seas? Testing mCDR in wastewater infrastructure

[The potential of wastewater treatment on carbon storage through ocean alkalinity enhancement](#) ↗

Context tl;dr

Ocean alkalinity enhancement (OAE) is gaining traction as a scalable CDR pathway. This study explores a novel twist on OAE: using municipal wastewater treatment infrastructure, specifically the aerobic treatment stage, as a means to increase ocean alkalinity. By leveraging existing wastewater systems, this approach could sequester carbon while improving water quality and nutrient management.

What they found

In small-scale experiments using artificial wastewater, adding olivine-rich rocks to wastewater during aerobic treatment dramatically increased total alkalinity and phosphate removal, enabling the effluent to absorb and store dissolved CO₂. Based on extrapolations from local seawater conditions, the authors estimate that the potential carbon sequestration from this pathway is ~19 million tonnes per year. Not a huge amount of carbon, but worth pursuing!

The wonky details

Finely ground olivine dissolution was up to 20 times faster in aerobically treated wastewater than in seawater, due to high CO₂ and organic acid concentrations. The alkalized wastewater reached total alkalinity levels over 10 mmol/kg with a strong 1:1 relationship between total alkalinity and dissolved inorganic carbon. However, the stability of stored CO₂ is dependent on avoiding carbonate precipitation, which is linked to the saturation thresholds for aragonite in receiving waters.

Implications

Wastewater-based OAE could be a solution for both climate mitigation and improved water quality. Because effluent chemistry is tightly controlled at point sources, this approach allows for highly engineered CDR with potential co-benefits like nutrient recovery. However, there is still a risk of misclassifying carbon reductions as removals. Additionally, local hydrochemistry must be accounted for, especially to minimize CO₂ re-release via calcium carbonate formation in ocean discharge zones.

What comes next

Scaling OAE via wastewater treatment will require geographic customization, policy incentives, and greater investment in coastal wastewater infrastructure. The study identifies the EU, US, and China as top locations for deployment based on treatment capacity. Researchers will need to conduct additional modeling and field trials to validate CO₂ permanence, manage mineral sourcing, and optimize system design for real-world implementation.

Setting the stage for cheap electrochemical DAC

[Electrochemical CO₂ capture with pH-independent redox chemistry](#) ↗

Context tl;dr

Traditional DAC methods either rely on high-temperature heat or fairly brute-force electrochemical swings, both burning through huge amounts of electricity and driving up costs. A leaner, lower-temperature electrical approach could cut that energy bill.

What they found

In this preprint study, the authors tested novel electrochemical approaches to CO₂ capture. They demonstrate a 97% reduction in electricity demand for the capture-release cycle, taking it down to just 16 kWh per tonne of CO₂.

The wonky details

At the heart of the system is TEMPO, a cheap, stable redox molecule that flips the pH without shuttling protons around. That clever twist collapses the DAC cell voltage to just 0.022 V—orders of magnitude below the 0.2–0.6 V typical of pH-swing DAC cells—and both halves of the cell do useful work, keeping losses to a minimum. All materials are off-the-shelf, and lab cycling at high CO₂ concentrations shows robust performance.

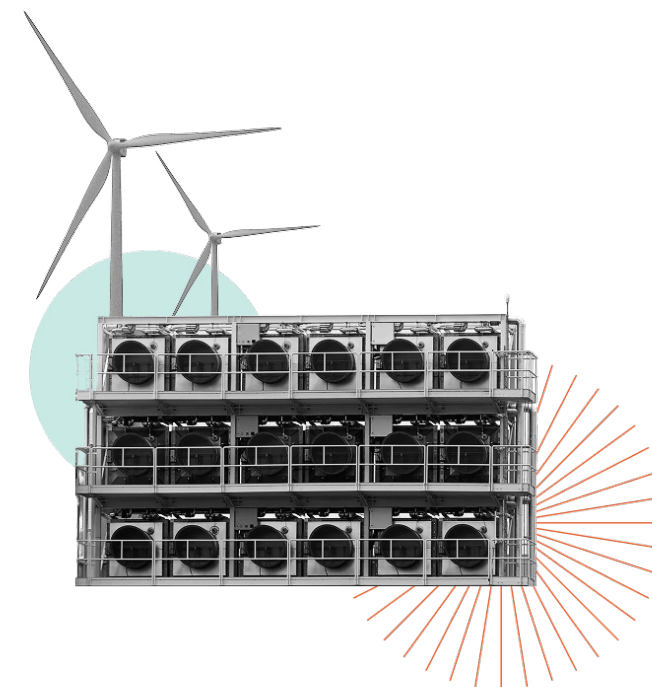
Implications

If this chemistry carries over to ambient air capture, electricity costs could plunge to just dollars per tonne captured—dramatically undercutting the

electric bills of today's systems. And because the hardware mirrors redox-flow batteries, developers could tap existing manufacturing and supply chains rather than inventing entirely new reactors.

What comes next

This work is at a very early, lab-scale stage. Scaling this approach will require numerous engineering breakthroughs. It remains to be seen whether the low-voltage promise can survive the jump from bench to pilot (let alone commercial) scale. Still, Nobel laureate Steven Chu is leading this work and lends credibility to the chemistry. Just don't expect CDR tonnes from this pathway anytime soon.



Market insights

SAF mandates in the EU and UK: Reshaping aviation fuel markets

Hannah Williams

John Dees, PhD

Bottom line: SAF and e-SAF mandates in the EU and UK are transforming the aviation fuel market, driving structural demand growth. Falling short of these mandates has a hefty price tag. In the EU, penalties roughly triple the cost of compliance. In the UK, buy-out prices are up to 13 times more expensive than simply buying the fuel. This flips SAF from being a premium fuel to a cost-avoidance tool. Yet supply is lagging behind: global production capacity is expected to reach about two million tonnes this year. With global targets and mandates requiring nearly 10 million tonnes by 2030, production must grow five-fold within five years or mandates will hit a wall. When CORSIA becomes mandatory in 2027, EU and UK regulations will allow airlines to use the SAF they are already required to purchase under domestic mandates toward their international CORSIA offset obligation. This will double the compliance value of each gallon purchased and dampen demand for CORSIA credits.

European SAF mandates are ready for takeoff

Sustainable aviation fuel (SAF) is one of the few near-term tools available to decarbonize long-haul aviation. But it's still in short supply and far more expensive than conventional jet fuel (CJF).

Undeterred, regulators in Europe are forging ahead. Starting in 2025, ReFuelEU will require aviation fuel suppliers to blend a minimum percentage of SAF and e-SAF at EU airports. That obligation ramps up to 6% SAF by 2030, including 1.2% e-SAF. To discourage [tankering](#) (airlines loading up on cheaper fuel outside the EU), the regulation also mandates that airlines refuel 90% of their annual fuel needs at EU airports.

The intent is clear: Regulators are serious about pushing aviation toward sustainable fuels.

Across the Channel, the UK is more ambitious. [The UK Department for Transport](#) is targeting a 9.5% SAF blend by 2030, with a declining cap on hydroprocessed esters and fatty acids (HEFA) fuels to encourage the development of more advanced technologies. The HEFA share drops from 100% in 2025 to just 42% by 2040, while a separate sub-target for e-SAF ensures further supply chain diversification.

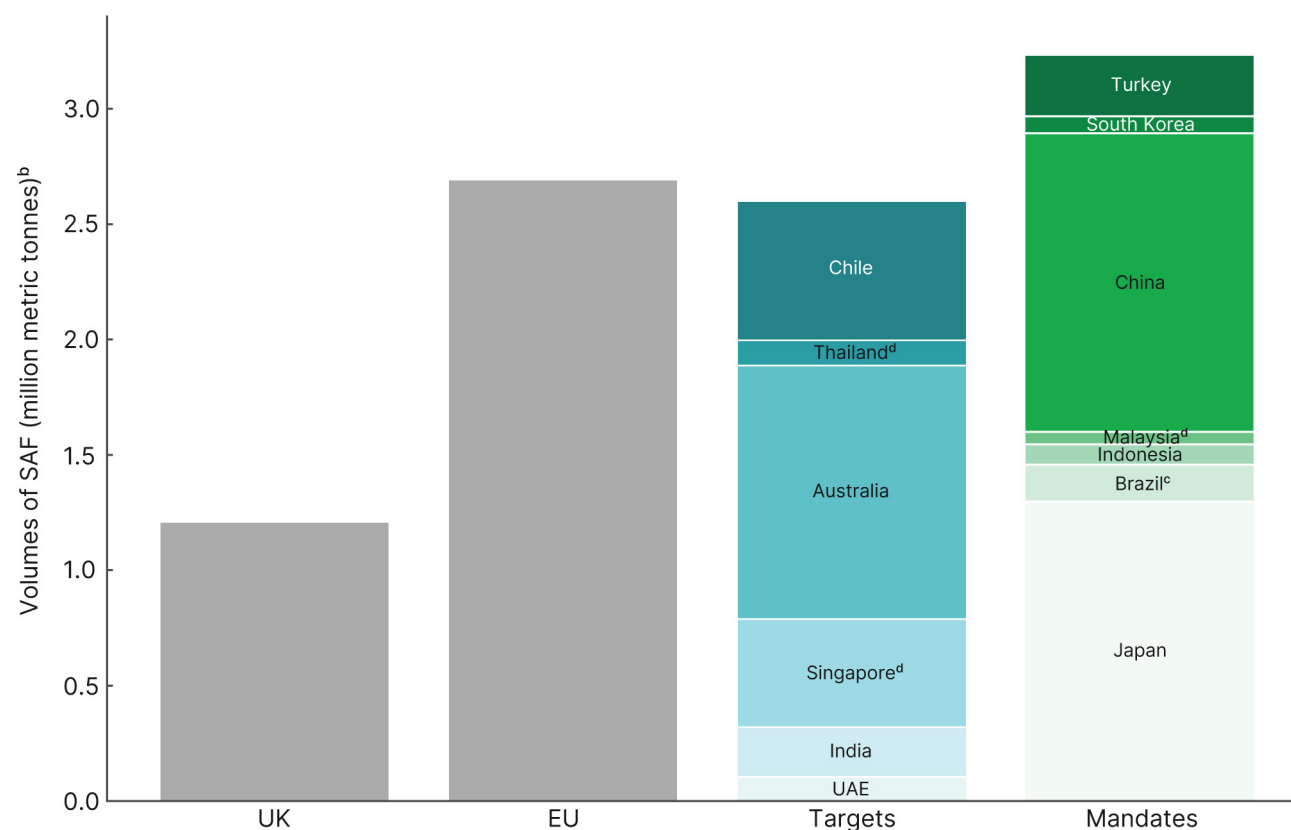
Non-compliance has a steep price tag, and demand for SAF is set to soar

The price gap between SAF and CJF remains wide. By 2030, [interpolated price estimates](#) put the price of SAF at US\$5.26/gallon, **more than double** the price of CJF. This disparity is even more pronounced for e-SAF, with the price (US\$9.70/gallon) expected to be **nearly four times** the price of CJF. That gap might deter voluntary uptake, but Europe's mandates change the math:

- Penalties for non-compliance in the EU are set at two times the price difference between SAF and CJF per gallon of unmet obligation. Additionally, fuel suppliers must supply any unmet fuel obligations in subsequent reporting periods, which pushes **the cost of non-compliance in the EU to three times the cost of compliance.**
- In the UK, penalties are even higher: **suppliers who fall short must pay a [buy-out price](#)** per megajoule of unmet obligation. This translates to US\$23.55/gallon of unmet SAF obligation and US\$24.92/gallon of unmet e-SAF obligation—**up to thirteen times the cost of compliance.**

The intent is clear: Regulators are serious about pushing aviation toward sustainable fuels.

Estimated SAF demand volumes under targets and mandates by 2030^a



^a South Korea has confirmed a mandate of 1% by 2027, but a 2030 mandate has not yet been announced. The UAE mandate does not begin until 2031. Chile has only announced a 2050 target, no short term targets have been confirmed.

^b These volumes were determined using kerosene-type jet fuel consumption data from the United Nations (UN) to create projections of each region's conventional jet fuel (CJF) demand volume to 2030, using IATA compound annual growth rates (2.3% for Europe, 5.3% for Asia-Pacific, 2.9% for Latin America, 3.9% for Middle East) and fuel efficiency gains of 0.96% per year. These volumes were then multiplied by the mandate/target blending requirements.

^c Brazil does not have a SAF blending mandate, this is their GHG reduction mandate. To calculate the volume of SAF required to meet Brazil's GHG reduction mandate, kerosene-type jet fuel consumption from domestic aviation was projected to 2030 and an emission factor of 3.22 tons of CO₂ per ton of jet fuel was assumed (using a conversion rate of 330.25 gallons per ton). The value listed would offset 3% of the total emissions in 2030, assuming SAF has emissions savings of 70%.

^d Malaysia, Singapore, and Thailand do not yet have legally-binding 2030 blend percentages, but these provide a mid-case demand estimate consistent with current policy signals.

Mandates without molecules: The looming supply gap

Meeting the EU and UK mandates in 2030 will require about 3.9 million tonnes of SAF every year, **almost four times today's European output**. Current production capacity in Europe is roughly one million tonnes; the only operational facility in the UK produces SAF via the HEFA pathway which will eventually face limits under the UK mandate.

Beyond Europe, the pressure only intensifies. New mandates and targets across Asia-Pacific, the Middle East, and Latin America echo the same message: SAF is becoming compulsory. Add those policies to those in the EU and UK, and annual demand could approach 10 million tonnes by 2030, excluding US targets or voluntary airline commitments.

Global SAF production this year is expected to reach just 2.1 million tonnes. To meet mandates and targets in just Europe, Asia-Pacific, Middle East, and Latin America, capacity must **expand by at least five times within five years**. Without a significant increase in production capacity, SAF supply will be the hard ceiling on aviation decarbonization.

READ OUR BLOG

[Beyond the transatlantic core: Emerging SAF mandates in global markets](#) ↗

CORSIA completes the compliance puzzle

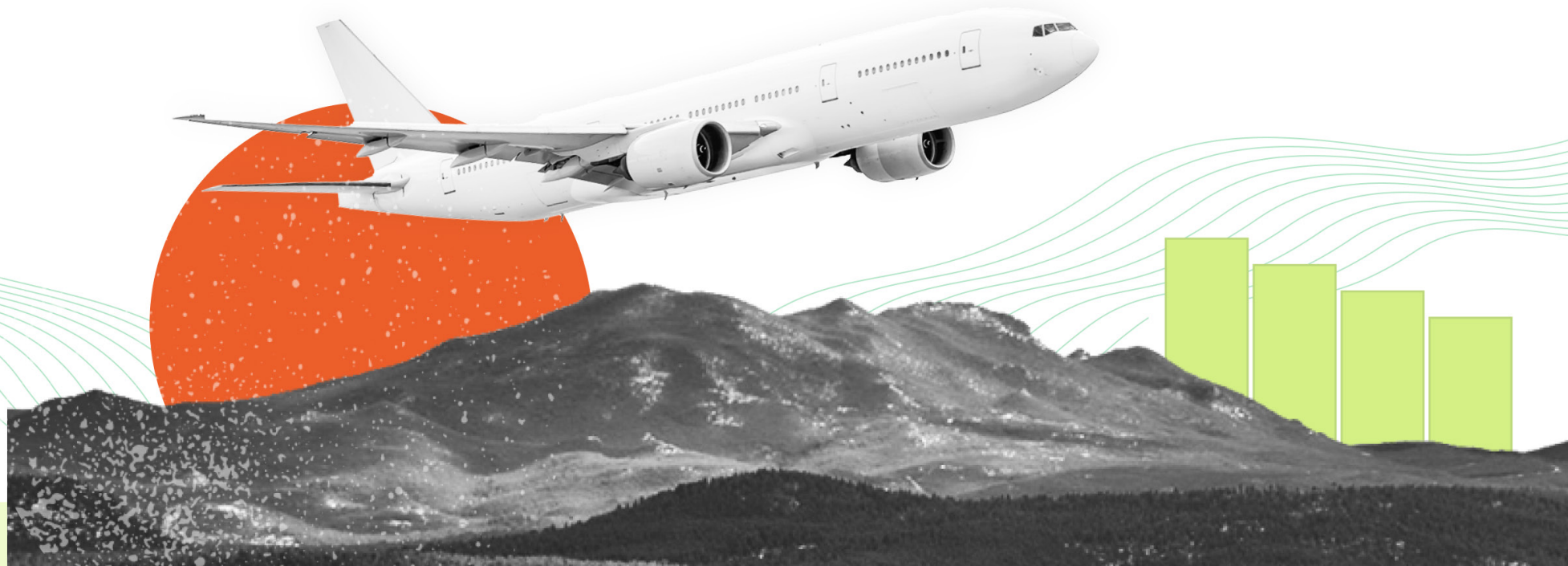
Beginning in 2027, [CORSIA](#) will require airlines to offset any emissions above 85% of their 2019 baseline. Carriers have two levers to achieve this: buy CORSIA-eligible carbon credits or SAF.

Credits are cheaper on paper, but [EU](#) and [UK](#) regulators are encouraging airlines to count the SAF they are already required to purchase under domestic mandates toward their EU/UK ETS or CORSIA tab (domestic vs. international flights).

That gives every mandated gallon of SAF extra compliance value, closing the cost gap compared to credits and making SAF a more attractive option.

The 10 million tonnes of SAF, required to meet mandates and targets across Europe, Asia-Pacific, Middle East, and Latin America **could cover nearly 23% of total CORSIA demand by 2030**. This assumes demand for CORSIA credits is around 100 million tonnes, an emissions factor of 3.22 for CJF, and 70% emissions reductions using SAF. This back-of-the-envelope math points toward SAF playing a more significant role in CORSIA than previously considered.

We can reasonably expect mandates in other countries to demonstrate similar compatibility with CORSIA. The result is clear: SAF is moving from optional to non-negotiable. Demand will only climb, and the clock is ticking on supply.



VCMI's new *Scope 3 Action Code of Practice*

Nicole Egna

Why it matters: The VCMI's [Scope 3 Action Code of Practice](#) provides a framework for companies to manage their challenging indirect (scope 3) emissions. Because scope 3 emissions often represent the vast majority of a company's total carbon footprint, their reduction is critical for achieving global net-zero goals. By offering a pragmatic approach that integrates carbon credits, the VCMI seeks to unlock finance for climate projects, maintain momentum on corporate climate action even when direct reductions are difficult, and bring greater integrity and transparency to the VCM. It provides a credible path for companies to demonstrate their commitment to climate action while navigating the complexities of their value chains.

The VCMI's [Scope 3 Action Code of Practice](#) offers a framework to help companies tackle their indirect scope 3 emissions, which often form the largest part of a company's carbon footprint. These emissions occur across the entire value chain, from suppliers to product use and disposal.

Recognizing the difficulty in directly cutting these complex emissions, the VCMI's code provides a practical approach that allows companies to bridge their emissions gap—the difference between current scope 3 emissions and their science-aligned reduction targets for scope 3.

Specifically, the code sets a 2040 deadline by which companies are expected to have overcome their primary challenges to direct scope 3 emission reductions and be fully aligned with their long-term decarbonization goals. Until then, the code stipulates

that companies should retire high-quality carbon credits while meeting standards like the ICVCM's Core Carbon Principles and Article 6.4 (once it is available). These credits should cover their emissions gap, though generally limiting credit use to no more than 25% of total scope 3 emissions in any given year.

For companies looking to comply, we recommend mapping and disclosing scope 3 emissions, quantifying the annual emissions gap, prioritizing high-quality credits, engaging suppliers, and reporting progress toward 2040 net-zero goals. Further, while SBTi's forthcoming [Corporate Net-Zero Standard v2.0](#) (due to release in early 2026) limits near-term removals to scope 1, organizations looking to address their scope 3 emissions can adopt VCMI's guidelines from Q3 2025.

VCMI's *Scope 3 Action Code of Practice* requires companies to:

- 🏢 Maintain a GHG inventory
- 🎯 Set and disclose near-term science-based targets
- 📋 Report scope 3 barriers and a 2040 timeline
- 📅 Quantify annual emissions gaps with strict caps
- 📉 Retire equivalent high-quality carbon credits for any gap
- 🔍 Ensure transparency of the above actions via independent verification



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