

CARBON REMOVAL MUST BORROW MORE THAN CAPITAL TO SCALE

The cheapest path to gigatonnes runs through industries that already exist



DURABLE CARBON REMOVAL, THE WORK OF PULLING

carbon dioxide out of the atmosphere and locking it away, has raised money, attracted exceptional talent, and established itself as a serious climate tool. What it has not yet done is deliver at scale. Buyers have contracted roughly 49 million carbon removal credits, while suppliers have delivered only 1.5 million of them (about 3%), according to [CDR.fyi](#), an industry tracker. Even Shopify, a model corporate citizen when it comes to sustainability, [reported](#) that it received only 37% of the removal credits it had contracted for in 2025, despite committing well in advance and offering a premium.

Look at who is actually delivering and a clear pattern emerges. Five of the six largest suppliers, together responsible for about **55% of all carbon removal delivered**, are biochar producers. Plants pull carbon dioxide from the air as they grow but release it again when they decompose or burn. Biochar producers take that plant waste and heat it with little oxygen, converting it into a stable, charcoal-like solid that locks in the carbon and, when spread over soil, helps hold water and nutrients.

Every step of biochar is largely borrowed from industries that already operate at scale: feedstock from waste streams, thermal processing from charcoal production, and application from agriculture. Compare that to Direct Air Capture, which relies on purpose-built capture sys-

tems and a largely new industrial supply chain. It uses large fans to push air through materials that bind CO₂, then spends substantial energy releasing and concentrating that CO₂ for storage before the materials can be used again. Despite significant investment, this approach has only ever delivered about 2,000 carbon removal credits (or 0.13% of total deliveries). Biochar's lead is instructive: the pathway winning today is the one that borrowed from proven industrial processes.

Too much of the carbon removal field still treats each pathway as a lonely road from invention to mass production, with capture and storage both to be built afresh. That is reasonable, but it is also likely too slow. The planet needs gigatonnes of durable carbon removal within a decade or two. A pathway that must invent its supply chain from scratch may take longer than that to reach meaningful scale. A better approach is to find which forms of removal can borrow most heavily from pre-existing industries that already move and manage material at enormous scale.

That is because carbon removal is, at its core, a bulk-materials problem. For example, rock must be mined, crushed, and spread across fields; biomass has to be sourced, dried, and stored. The tricky part is doing this cheaply, at industrial scale, with proof that the carbon stays put. Durable removal needs to fall well below →

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→ \$200 a tonne to count as a climate tool rather than a luxury, and the list of things you can mine, move, or store for that price is short.

The world already has industries built for exactly this kind of work. Agriculture, mining, shipping, and waste management, while not glamorous, are the muscles of the physical world, practiced at moving low-margin material safely and cheaply. In 2024, journalist Emily Pontecorvo **asked** whether carbon removal had to be “dumb” to work. She pointed to U.S.-based Vaulted Deep adapting slurry injection, a method the oil and gas industry has used to dispose of drilling waste underground since the 1980s, and repurposing it for permanent carbon storage. Today, Vaulted Deep has risen to **number nine on the carbon removal delivery** table. The point is not that biochar or slurry injection dominates. It is that any pathway without a mature industry to borrow will face a hard road to becoming economical and delivered in time.

The danger otherwise is a boutique industry: scientifically serious, morally compelling, but too expensive to matter at the timescale climate scenarios assume. Avoiding that fate means treating scale not as a reward that arrives after invention, but as a constraint on the invention itself. The bias toward novelty is understandable. A first-of-its-kind machine photographs well; an old industry doing a new job does not. But history runs the other way: solar manufacturing benefitted enormously from techniques it borrowed from semiconductors rather than going it alone, and wind energy grew more efficient when it imported composites from aerospace.

The pathways delivering today are the ones that leaned hardest on industries that already exist. The ones that scale tomorrow will not just borrow an industry's know-how, they will run on the capacity it has already built.

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