

Dear Frontier buyers,

Our World in Data has a [landmark chart](#) that reads: “The world is awful. The world is much better. The world can be much better.” The crux of this sentiment—that there’s been huge progress *and* that there’s still a very long way to go—is well-applied to carbon removal.

For most of the world, the starting gun for carbon removal was the [2018 IPCC report](#). In just six years, the number of startups working on carbon removal has grown from a handful to hundreds, and demand has gone from [millions](#) to [billions](#) of dollars. The volume of durable carbon removal delivered and verified grew 300% in 2024 alone¹.

At the same time, the scale at which carbon removal is operating remains almost negligibly small. Demand, while growing, needs to quickly scale to tens of billions per year. In short, carbon removal has made tremendous progress *and* still has a very long way to go.

And yet, progress is made ton by ton, year by year. Here’s some of what happened in 2024 at Frontier and in the field more broadly.

What’s happening at Frontier?

Our goal at Frontier is to get carbon removal on its best possible trajectory. Of course, the primary way we do that is by purchasing carbon removal, typically via offtake agreements. In 2024 we signed a record number of offtakes, totaling \$279M (up from \$166M in 2023), across seven outstanding companies that represent four distinct carbon removal pathways: [Vaulted](#), [Stockholm Exergi](#), [280 Earth](#), [CarbonRun](#), [Terradot](#), [CO280](#), and [CREW](#). Two notable themes across these deals were tighter integration with big industrials and a greater focus on co-benefits, both of which make it easier to deploy quickly.

In addition to writing [offtakes](#) for growth-stage companies, we completed [a fourth round of prepurchases](#) for nine early-stage companies to help them get out of the lab and into the field. Our hope is that many of these companies grow to become offtake-eligible in the coming years (indeed ~75% of our offtake companies started as a prepurchase!).

Still, carbon removal companies need many more customers beyond current Frontier buyers alone. To that end, we [published our offtake template](#) to help other buyers turn dollars into deals faster, added new members like [Salesforce](#), and launched [Climate Orders](#) which enables anyone to [buy tons of carbon removal](#) via Frontier.

How do we know that the things we’re doing at Frontier are actually helping to get carbon removal on its best possible trajectory? It’s too early to say definitively, but we can triangulate with several imperfect-yet-valuable leading indicators.

¹Source: CDR.fyi data, excluding biochar and lower durability tons. Subject to change as 2024 deliveries are processed.

One indicator is the number of companies for whom Frontier buyers were the first customer. While the most important factor is selecting the right companies, buying early suggests we're helping accelerate a company's progress. We're pleased to have been the first-ever customer for 78% of companies (26 of 33 of prepurchases), and first offtaker for 82% (9 of our 11 offtakes).

We can also look at whether the companies in our portfolio are actually beginning to deliver on offtake contracts. Last year we saw great progress here. [Vaulted delivered 12,000 tons](#) in 2024—the most of any company working on carbon removal, by significant margin; [Charm injected 2,500 tons of bio-oil underground](#) and now has eight pyrolyzers running 24/7; and Lithos applied 300,000 tons of rock this year, positioning them to deliver 75,000 tons of carbon removal as the rock weathers and their fields are sampled.

Another proxy for impact is whether our purchases help attract additional investment, an important enabler of continued learning and scaling. Last year our portfolio companies raised >\$400M in equity, including [Heirloom's \\$150M Series B](#), [CarbonCapture's \\$80M Series A](#), [Terradot's \\$58.2M seed & Series A](#), [280 Earth's \\$50M Series B](#), and [Vaulted's \\$32M Series A](#).

Finally, we can simply *ask* carbon removal companies the extent to which we've been accelerative. In an anonymous survey sent to the 44 companies in the Frontier portfolio, 97% of founders said Frontier had accelerated their company's trajectory and 83% said it had done so significantly. Furthermore, 67% of founders in Frontier's most recent prepurchase cohort said Frontier's launch played a role in their decision to *start* a carbon removal company.

As we head into 2025 we'll continue hunting for carbon removal solutions that we think have a meaningful chance of being part of the gigaton-scale portfolio and do everything possible to help accelerate their progress.

The field more broadly

What ultimately matters is the amount of carbon dioxide permanently removed from the atmosphere. In 2024 the field delivered roughly 35,000 tons of carbon removal with >1,000-year durability, ~3X the verified tons delivered in 2023. While this growth is encouraging, the number itself is tiny relative to the 5-10 billion tons of removal needed annually by 2050. This isn't especially surprising as deliveries are a lagging indicator, so it's important to look further upstream to assess whether we are creating the conditions for more deliveries to happen in the future.

Demand

Last year we saw meaningful progress from both the voluntary sector and governments. Beyond Frontier-facilitated deals, [Microsoft](#), [Google](#), and [BCG](#) all signed major offtakes. In the US, Senators Bennett and Murkowski [introduced a bill](#) that would provide an uncapped ~\$250/ton tax credit for permanent carbon removal (and importantly it's technology-neutral, meaning any high-quality, permanent carbon removal would qualify). Pilot procurement programs launched in the [US](#), [Canada](#), [Sweden](#), and [Denmark](#), which lay the groundwork for building state capacity and pave the way to larger scale (and a recent report from the Rhodium group quantifies the [jobs](#) carbon removal could create in the process). Proposed [trade policy](#) and [border adjustments](#) could result in net new demand, and there are early signs of carbon removal being incorporated into compliance regimes, including the [EU ETS \(proposed\)](#), the [GX-ETS \(incorporated\)](#), and the [UK ETS \(proposed\)](#). Finally, new [protocol development](#) and [quantification standards](#) have made it meaningfully easier for buyers to quantify carbon removal across pathways.

This is meaningful progress. And yet, even if these all do materialize there's still a [big demand gap](#). The existence of a critical mass of customers over the long-term remains a meaningful risk for the field. Just as a diverse portfolio of technologies is needed on the supply side, we also need a diverse portfolio of demand-side ideas. To that end Stripe launched a new program called [Stripe Climate Fellows](#), funding seven people working on initiatives that could collectively stack to billions of dollars per year, and we published a [piece](#) on how the world might fund all the carbon removal needed to solve the problem.

Implementing and operationalizing policy takes time. In the interim—especially in the next two to five years—voluntary buyers continue to play a critical role bridging the gap, allowing the most promising companies to keep building while policy-driven demand materializes.

Supply

So far we've highlighted some of the supply wins: the growing number of carbon removal companies, the diversity in approaches, and growth in deliveries. As we head into 2025, a few things are top of mind.

First, not all carbon removal startups will succeed. The carbon removal ecosystem is early and we should *expect* a number of companies, approaches, and even some pathways altogether, to fail. This isn't because they weren't good ideas, but rather because (1) ideas have to be tested in the real, physical world, and (2) most startups fail—building *any* company is hard, let alone a carbon removal company. This is the decade to shake the tree for the best ideas and figure out what does (and doesn't) work, so that heading into the 2030's and 40's, we know where to double-down to get to gigaton scale.

Second, a question we continue to ask ourselves is: are there any ideas we think could be *way* cheaper, bigger or faster? While there probably isn't a silver bullet solution, we suspect there are still some great ideas that are being under-explored relative to their potential.

Thank you

Carbon removal has made huge progress over the last year *and* there's still a very long way to go. Without early buyers, this progress wouldn't have been, or be, possible. We're tremendously thankful for your partnership and excited to keep building the field together in 2025 and beyond.

Best,
Nan Ransohoff