

# Demystifying Carbon Dioxide Removal

## March roundup

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Dear all,

I'm back after my holiday - thanks Jo for filling in while I was away! This month, we get back into it by taking a look at the US and EUs' approaches to building a CDR industry. The US has gamified the market, hoping buyers are interested in making their way up a CDR purchase leaderboard. In the EU, the framework for certifying carbon removals needs more thought around what CDR credits should be used for and which approaches should be included.

Next, we explore the current hype around ocean CDR and look at trials of new approaches underway in Singapore and the US. A new paper pointed out that ocean CDR was also in the limelight in the late 80s to early 2000s, after which public opinions shifted against it. The dire state of the climate has made us keen to explore the potential of the ocean as a climate solution once again.

Lastly, we break down the cost of CDR and look at how realistic it is to expect costs to fall significantly. One study suggested they might not drop as quickly as initially anticipated, but companies have taken novel approaches to try to make it happen.

As always, please feel free to share this newsletter with anyone who may be interested. You can [sign up here](#), or [click here](#) to see an archive of previous editions. Don't hesitate to get in touch if you have any questions, suggestions or feedback.

Till next time,  
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## Stat of the month:

845

The number of CDR companies currently listed on the [Allied Offsets database](#).



## On the policy agenda

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Carbon removals are receiving significant attention from the US and EU governments. The US Department of Energy's (DOE) announcement of a new initiative this month, the Voluntary Carbon Dioxide Removal Purchasing Challenge ( "[Helping YOU Buy Good Carbon Dioxide Removal Credits](#)" ), was a key indication. The Challenge "call[s] on organizations purchasing carbon removal credits to [make public bigger and bolder purchase commitments](#)," with a leaderboard tracking voluntary carbon removal purchases. Although there [aren't any additional benefits or funding provided](#), it seems the DOE hopes that gamification will bring out a little competitive spirit and spur investment in the developing field. Google was the [first company to join the challenge](#) and has already [matched the DOE's USD 35 million investment](#) in CDR. But, before the game (and its real world implications) go too far, [researchers are still calling for a more solid scientific basis](#) for nature-based climate solutions in the US.

In the EU, developments are helping to structure the CDR market rather than promoting large-scale investment and growth just yet. Following the announcement of the [proposed EU Carbon Removal Certification Framework](#) (CRCF) in late February, there has been [more discussion](#) of the shortfalls and gaps that need to be closed to make the framework implementable. The [Real Zero Europe campaign](#) has published an [open letter](#) calling on EU members of parliament not to "gamble with our future" and to vote to reject the provisional agreement on the CRCF this Wednesday, 10th April. They highlight that relying on carbon removals could risk locking us into temperature overshoot, threaten biodiversity and potentially violate international law.



## While we're here...

My team are launching a new newsletter this month, which will cover important stories from election regions and show how climate issues are influencing election conversations worldwide (if you didn't know, [2024 is a record year for elections](#)).

If you're interested, [sign up](#), or send the link to anyone you think might be.

[Sign up for the elections media monitor](#)

EU NGO Carbon Gap released a report envisioning a [Carbon Removal Strategy for Europe](#), which called for clarity around what purposes certified carbon removals should be used for as a key priority moving forward. The report was broadly welcomed at a launch event in Brussels, but there were some lively debates on the various issues with an EU market, such as fragmented access to research and knowledge products for policymakers, the need to ensure high integrity removals, and how to position removals alongside emissions reduction. There was also a call to those working on climate justice to step into the debate and help shape the market.

The CRCF has also prompted the formation of a new CDR industry group on enhanced weathering (EW). The [Enhanced Weathering Alliance](#) brings together CDR companies to advance EW - which involves grinding up rocks to speed up the natural process by which they take up CO<sub>2</sub>. The newly-launched Alliance “urges” policymakers to include EW in the CRCF and suggests that EW could be a [scalable and low cost carbon removal solution, with additional benefits for the agricultural industry](#).

The science, however, is currently [uncertain at best](#): A recent literature synthesis from climate nonprofit Carbon Plan looked at 116 studies on EW and found that estimates of carbon uptake “[span more than four orders of magnitude](#).” The authors write that “it’s clear that we are still in the [early stages of learning about enhanced weathering](#)” and “encourage caution when interpreting carbon removal estimates in the literature.”

Another piece of proposed EU legislation, the [Green Claims Directive](#), is also trying to prevent companies from making dodgy claims about removals. The directive suggests that certified removals should only be mentioned in advertising if companies “[have already reduced their emissions as much as possible and use these schemes for residual emissions only](#).”



## Ocean CDR goes ahead

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There is a lot of hype around ocean CDR at the moment, spurring new research and trials of techniques that were largely theoretical a few years back. Although it's not yet clear if this will result in [“an ocean of opportunity – or harmful hype”](#) that could threaten ocean ecosystems, a recent market report predicted the market for ocean CDR will [more than triple](#) between 2023 and 2030.

Following the success of its two pilot plants, ocean CDR company Equatic announced plans to build the largest ocean carbon removal plant in the world on the [desalination facility of Singapore's Water Agency](#). Equatic's process uses renewable energy to split seawater - which contains CO<sub>2</sub> - into hydrogen and oxygen. At the same time, the CO<sub>2</sub> combines with minerals in the seawater to produce limestone, [“essentially trapping the CO<sub>2</sub> for at least 10,000 years.”](#) Air is then bubbled through the depleted seawater which traps CO<sub>2</sub> from the air, 'refilling' the seawater with CO<sub>2</sub> and removing carbon from the atmosphere.

When the plant is first built in 2024, it will remove around 365 tonnes of CO<sub>2</sub> per year. This capacity is expected to [increase ten-fold to 3,650 tonnes per year by 2025](#), nearing that of the largest CDR plant currently in operation - [Climeworks's 4,000 tonne-per-year Orca plant in Iceland](#). However, EcoBusiness points out that in 2021, Singapore emitted [“more than 13,000 times what the plant aims to remove”](#).

The new facility will be a demonstration plant for a [larger commercial facility which could remove 100,000 tonnes per year](#). Ideally, the demonstration plant will help Equatic troubleshoot engineering challenges before committing to the bigger project. Equatic has said that [“scaling up the physical size of the unit and maintaining the performance at a larger scale”](#) are the main challenges it faces at the moment. However, commentators have raised [additional red flags](#), such as high electricity demand and potential impacts on shellfish. To finance the endeavours, Equatic has already pre-sold Boeing [62,000 tonnes of CDR credits and 2,100 tonnes of hydrogen](#) (which can be used to make sustainable aviation fuel). Selling credits at this stage is risky, as it bets on technology that has not yet been built at these scales.



Many scientific uncertainties still need to be investigated before we meddle too much (more) with the ocean.

In California, testing for another ocean CDR approach got underway. Project Vesta's trial, which involved pouring 9,000 tonnes of sand mixed with carbon-sucking olivine into the sea, marked the first time a company has received a federal permit to run a "[stand-alone carbon removal test in US waters](#)". The trial is important to build knowledge on [what sorts of ocean CDR could be viable](#) - "We want to measure everything very carefully at this stage and make sure that we are [fully understanding the safety profile and the carbon removal data from this project](#)," Vesta CEO Tom Green told Heatmap News.

The company underwent an [18-month review process to get the permit](#) and there's good reason for the large amount of red tape. Many scientific uncertainties still need to be investigated before we meddle too much (more) with the ocean.

A new paper published in Global Environmental Change concluded that the current period of hype around ocean CDR, which started in 2014, did not arise from any technological breakthroughs or a reduction in scientific uncertainties, but more because a "[heightened sense of urgency around the climate crisis is being used as a justification not to disregard any solution](#)". This is in part due to the IPCC's findings that [limiting warming to 1.5°C or 2°C will require some level of CDR](#). The paper highlights that ocean CDR also had a period of popularity and research advancement from the 80s into the early 2000s, before a series of controversies and disappointments meant it lost its appeal.



## Conflicting opinions on cost

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Many companies are adamant that the currently prohibitive cost of carbon dioxide removal will come down in the coming years, but the topic is hotly debated. An article by James Temple in the MIT Tech Review explained [warnings raised by investors about the amount of money being invested in DAC](#), considering how small the market is and how much it costs. “I’m not saying we won’t need it. And I’m not saying there won’t eventually be good businesses here. I’m saying right now the markets are very nascent, and I don’t see how you can possibly make a venture return,” the article quoted Rachel Slaybaugh of Deep Tech Venture Capital.

The issue, according to Emily Grubert, an Associate Professor at Notre Dame University, is that [CDR is not inherently profitable](#): “CDR is a pure cost, and we’re trying to force it to be something that’s profitable—and the only way you can do that is with public money or through voluntary markets”. Financing 100 billion tonnes of CDR at USD 100 a tonne would [cost USD 10 trillion](#), venture capital firm DCVC calculated last year. To give an idea of scale, global GDP is currently [around USD 109 trillion](#). Temple explained that [some are worried](#) the removals market will collapse, or limited funding will make companies push for larger quantities of cheaper, less-reliable forms of CDR.

A recent report released by ETH Zurich (the Swiss research institute from which Climeworks emerged) suggested that the [cost of carbon removal won't fall as fast as previous estimates](#). The research looked at three DAC approaches being used by three leading companies (Climeworks, CarbonEngineering and Heirloom) and suggested these will still cost between USD 230-540 per tonne in 2050, almost double previous estimates. However, Robert Höglund from funding platform Milkywire argued that we are already [on track for a steeper cost reduction curve](#) than is outlined in the study. He highlighted that prices of carbon removals sold [fell by 43% per tonne on average](#), from USD 1261 to 715, between 2022 and 2023.

CarbonCapture is one DAC company working on cutting costs in its process. It uses large fans to [pass air through “industrial sponges” that take up CO2](#) and it is trying to make the sponge-like part of its technology cheaper and more efficient. The design of the machines means that these ‘sponges’ can be easily replaced with better versions as they are developed, “not unlike [swapping out the ink cartridges in your printer](#).”

German company Greenlyte believes it can [get the price of its approach to below USD 100](#) once it scales past 10,000 tonnes removed per year, from a current price of USD 400-500 per tonne. It uses a [liquid to absorb CO2](#), instead of using a solid material like CarbonCapture. In addition to improving energy efficiency and savings from economies of scale, [selling hydrogen produced as a byproduct of the process will be key in keeping costs low](#). Other CDR companies, like Equatic and British startup Parallel Carbon, also [plan to sell their hydrogen](#).

CDR company Spiritus’ approach to cheap DAC is quite different. It plans to use white squishy balls made of a material that attracts CO2 to passively remove carbon from the air. The balls are the size of a tennis ball, but have a “branch-like interior structure [that] [has a surface area equivalent to a tennis court](#)”. “Spiritus will [manufacture millions of these balls, lay them out on trays, and stack the trays on tree-like rigs](#) — hence the name Orchard One”, explained Emily Pontecorvo in Heatmap News. This passive approach will save energy by avoiding the need for massive fans to move around large volumes of air, although some energy will be needed to heat the balls to release the CO2, which will be captured and stored underground.

The key to Spiritus’ low prices, however, are the materials it uses, which enables it to manufacture its sorbent (the material that collects CO2) for “[a tenth of the cost of others](#)”, according to founder

Charles Cadieu. Spiritus estimates that the cost of its first phase will be USD 149 per tonne of carbon removed, but that the project ultimately could be scaled up to capture 2 million tonnes per year at [less than USD 75 per tonne](#). The company is only expected to reach its first phase of implementation in 2026.



## Our pick of the news

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[Can Big Oil run in reverse?](#) (The Economist)

Technologies like DAC might be used by the oil industry to cling on to the fossil fuel past its use-by date.

[‘Carbon casting’: the low-hanging fruit of carbon removal](#) (Energy Monitor)

“Instead of focusing on capture, Graphyte aims to preserve the carbon that has already been captured by plants by eliminating the causes of biomass decomposition – microbes and the water they depend on.”

## Useful resources this month

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[Visual](#): Visual Capitalist highlights how critical CDR is to a net-zero future in this to-the-point infographic.

[Map](#): A map to keep track of DAC facilities “amid feverish momentum and upcoming announcements” by the DAC Coalition and AlliedOffsets.

[Calendar](#): Andrew Lockley has put together the most comprehensive carbon removal event calendar you will ever need.

[Paper](#): Large-scale CDR will need substantial land area, with potential impacts on the environment, land competition and food production. A new paper suggests that this could give rise to legal issues

and “calls for an internationally coordinated governance approach.”

[Research](#): A study claims that public perceptions of climate intervention technologies, including CDR, are “significantly more favorable” in the Global South than the Global North. However, the study admits it does not have a valid explanation for the difference in responses between regions and unfortunately attempts to theorise using cultural assumptions.

[Recordings](#): Want to learn more about what a carbon removal strategy for Europe could look like? EU NGO Carbon Gap held a series of panels on the topic at the launch event of their [new report](#).

[Launch](#): Another day, another CDR alliance. Last week, the French Association for Negative Emissions (AFEN) was officially launched, with the aim of accelerating the development of CDR technologies in France.

[Event](#): The second State of Carbon Dioxide Removal Report will be released on June 4. Save the date!

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Each month the demystifying carbon dioxide removal newsletter digs into the world of CDR to bring you the latest stories on everything from carbon credits and net-zero plans to nature-based solutions (NbS) and new technologies. Feel free to forward this email to your colleagues!

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