
Demystifying Carbon Dioxide Removal

August roundup

Dear all,

The US Department of Energy has made a long-awaited announcement on direct air capture (DAC) funding, but not everyone is happy. Concerns were raised over how fossil fuel companies will use the funding and how the projects will impact local communities, among other issues.

On the business side, the carbon removal analytics website cdr.fyi released new figures showing a 437% jump in carbon removal purchases in the first half of this year compared to the whole of 2022. As CDR companies develop, they must be careful to learn from the mistakes of past carbon offset projects, which sold millions of credits that did not actually reduce or avoid emissions.

Finally, we discuss unpredictable changes to the Earth's climate and atmosphere, and what this means for carbon storage. Plans for removing and storing carbon often assume that our planet will remain relatively stable, but recent research shows that big and unprecedented changes to earth systems will likely affect future prospects for CDR and carbon storage.

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:

USD 1.2 billion

The funding announced by the US Department of Energy for developing two commercial DAC facilities in Louisiana and Texas.



Funding announced for US DAC hubs

This month, the US Department of Energy [announced the two direct air capture \(DAC\) facilities](#) that will receive up to USD 1.2 billion in government funding. At least [13 companies](#) competed for the funds, which will go towards Project Cypress in Louisiana, led by tech company Battelle in partnership with CDR companies Climeworks and Heirloom, and to the South Texas DAC Hub led by 1PointFive. 1PointFive - a subsidiary of Occidental Petroleum - will partner with Canadian DAC company Carbon Engineering, which it [recently acquired for USD 1.1 billion](#).

The Department of Energy emphasised that the USD 1.2 billion is the “[world’s largest investment](#) in engineered carbon removal in history” as “each Hub will eventually remove more than 250 times more carbon dioxide than the largest DAC facility currently operating”.

The largest DAC facility currently in operation [removes 4,000 tonnes](#) of CO₂ each year. Using [David Ho’s time machine analogy](#), removing 4,000 tonnes of CO₂ would only remove three seconds’ worth of carbon emissions a year. The two million tonnes of carbon removed each year from the two proposed facilities combined would amount to 25 minutes. Sasha Stashwick, from the advocacy group Carbon180, told E&E news that the funding announcement “[is a big deal](#) as it is going to be a lot of people’s first introduction to large-scale, technological carbon removal deployment”. However, she expressed concern that the projects should not rely on fossil fuels to power them.

[Occidental CEO Vicki Hollub's claim](#) that DAC “gives [the oil and gas] industry [a licence to continue to operate](#) for the 60, 70, 80 years” resurfaced in media coverage of the announcement, as well as accusations that Occidental has been “[inflating the role of CDR](#)”. IPCC author Glen Peters told Climate Home News that Occidental “do not really [understand the role of carbon dioxide removal](#)”. He added that Hollub’s views are “not consistent with the science” and that the company should not have been awarded the funding. Others suggested that instead of “[handing out money to fossil fuel companies](#),” CDR should be a state-run public service.



"Cumulative emissions from Canada's managed forests since 2001 clock in at 3.7 billion tonnes of CO₂ - equal to 10% of total global CO₂ emissions in 2022."

There was [concern from environmental groups](#) that the funding would go towards enhanced oil recovery (EOR), which involves pumping captured carbon underground to access more oil. Although some of the carbon captured at Occidental's other DAC plant may be used for EOR and to produce "net-zero oil", the company claims that carbon captured at the government-funded [South Texas DAC Hub will only be stored underground](#).

Pushback from the announcement also came from the residents surrounding the proposed DAC sites, who say they do not want to be "[test dummies](#)" for new projects. Residents and community groups in both Texas and Louisiana voiced their concerns about the projects, including scepticism that the technology would work as advertised and worries that pipelines will cut across land. One in five people live below the poverty line in the area of Louisiana where Project Cypress will be built, raising environmental justice concerns as some groups and academics claim [the facility could expose the community to additional risks](#), such as pipeline leaks and water contamination.

Ari Natter wrote in Bloomberg that: "If the large hubs don't find innovative ways to engage with the public or otherwise stumble, [the results could hurt the industry's long-term prospects](#) — and potentially lead to more climate damage as a result."



CDR companies make moves

According to CDR.fyi, [437% more CDR was purchased in the first half of 2023](#) than throughout the whole of 2022, with three purchases alone accounting for 94% of the 3.4 million tonnes of CO₂ bought in total in 2023. Getting CDR to a billion-tonne level is an unofficial goal for many in the CDR industry - all emissions pathways that limit global warming to 1.5°C with limited or no overshoot rely on [multiple billion tonnes of CDR](#) each year. But, there are very real limits to how much CDR can be done due to financial and biological constraints, like limited availability of land. CDR.fyi estimates

that getting removals to a billion-tonne a year scale “requires an ambitious growth trajectory - [a 40%-50% compound annual growth rate over the next 27 years](#)”. The data also shows that just 2.6% of the CDR purchased has been delivered - 92% of which uses biochar.

With plans to add to these removals, Finnish startup Carbo Culture has opened one of Europe’s largest biochar plants. The EU-funded plant will be capable of removing 3,000 tonnes of CO2 each year, “[roughly equivalent to the emissions of 1,500 petrol cars](#)” - or two seconds’ worth of global emissions. It will use dust pellets from the sawdust left over from nearby wood manufacturers as feedstock. To ensure net carbon removal, Carbo Culture CEO Henrietta Moon stated: “It is critical... that the plant uses only waste wood that couldn’t be used for another primary use, such as a building material”. The company acknowledged the amount of carbon that will be sequestered at the plant is not huge, but stated that the facility will act as proof that the technology works for investors before building a commercial-scale facility. Carbo Culture has already sold credits to be generated from this future commercial site, including to the multinational investment bank Rothschild & Co and Mitsubishi.

Further steps towards a proof of concept for a new CDR technology came from startup Running Tide, which [delivered its first-ever open ocean carbon removal credits](#). The removals were verified by a third-party auditor, but additional [monitoring, reporting and verification \(MRV\) is needed](#). A total of 1,000 tonnes of wood pellets were sunk throughout May, June and July off the coast of Iceland, resulting in 275 tonnes of CO2 removal, according to founder Marty Odlin. The pellets were made of wood that would otherwise have been burned and were coated in limestone, which provides the additional benefit of making seawater more alkaline as it dissolves, to help store more CO2. In addition to sinking wood, the startup is exploring other novel approaches, including removal via enhancing ocean alkalinity and growing macroalgae.

Marine scientists and [CDR NGOs](#) have expressed concern that the ocean CDR industry is moving too fast and worry there could be [unexpected effects that arise when intervening with the ocean](#). Bloomberg writes that Running Tide is working with research partners, “deploying a system of sensors that help [monitor where in the ocean the biomass sinks](#)”, and designing CDR systems to have “the lowest localized impact,” alongside other approaches to [address potential negative outcomes](#). The removals were pre-purchased by e-commerce giant Shopify, which received 100 tonnes of CDR credits from the 275 tonnes of CO2 removed. “Funding innovation by being a first buyer, and taking big risks with pre-payments, is [exactly what’s needed to kickstart the carbon removal industry](#),” said Stacy Kauk, Shopify’s head of sustainability.

To produce high-quality CDR credits and rebuild trust, removal projects will have to avoid replicating the mistakes made in the past. A recent assessment of reducing emissions from deforestation and forest degradation (REDD) projects published in Nature found that “most of them [have not reduced deforestation significantly](#), and those that did have benefits substantially lower than claimed”. The research looked at projects across six tropical countries and found that only 6% of a potential 89 million credits resulted in actual emissions reductions via forest preservation. “We now have [robust and credible evidence that offset programs have deficiencies](#),” said the study’s senior author Andreas Kontoleon. Some 14.6 million carbon credits from the projects assessed had already been used by individuals or organisations to offset emissions, meaning the “projects have already been used to offset almost three times more carbon than they have actually mitigated through forest preservation,” Kontoleon said.



Planetary unpredictability and CDR

Plans for removing carbon from the atmosphere work on the assumption that the planet will remain in a reasonably stable state. However, research is indicating that our changing planet can't be relied upon to support carbon removal needs. For example, CDR banks on the idea that forests, mangroves and other ecosystems can act as carbon sinks, but the unpredictability in how these natural systems will respond to climate change means that this may not be a reliable assumption.

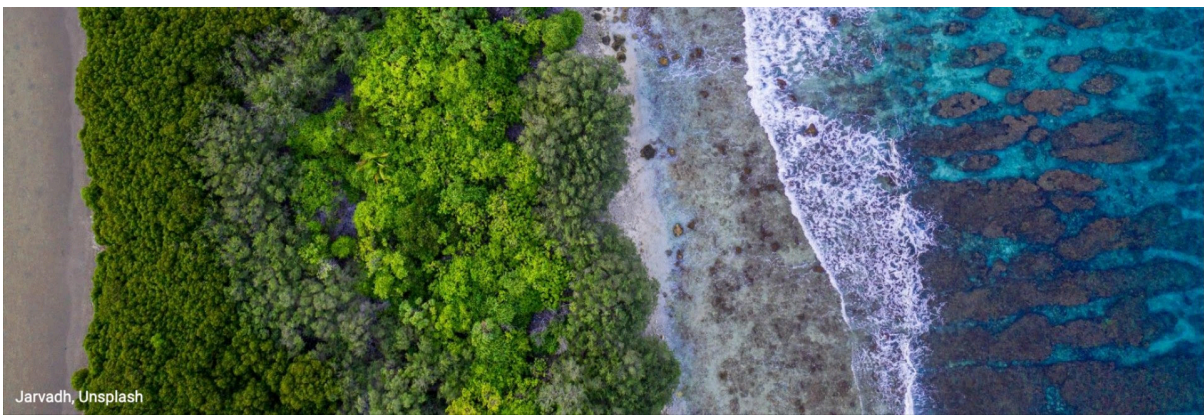
A [new paper in Nature](#) found that temperatures could get so high that some types of leaves in tropical forests will no longer grow or conduct photosynthesis, meaning they will stop absorbing CO₂. The authors suggest that tropical forests can withstand an increase in global temperature of up to 3.9°C - seen in some worst-case scenarios of projected warming - "before a potential tipping point" in how the vegetation functions. 'Tipping point' refers to the stage when a series of smaller incremental changes cross a threshold, resulting in larger - and sometimes permanent - changes. Even if the long-term average temperature doesn't get as high as 3.9°C, heatwaves could mean some tropical forests experience these effects even at lower levels of warming. Mat Disney, a professor at University College London, [told the Guardian](#): "If we adopt a do-nothing response to climate change and tropical forest air temperatures increase by greater than 4°C, there could be massive leaf death, possible tree mortality and species turnover across all tropical forests," as well as "reduced carbon uptake" and "possible transitions from forest to savannah".

Some forests have already experienced significant tipping points that mean they no longer absorb more carbon than they release. Using data from the EU's Earth Observation Program and the Canadian national greenhouse gas inventory, Barry Saxifrage of the National Observer showed that [2001 was the tipping point year for Canada's managed forests](#), which have been releasing more carbon than they absorb for the past 22 years. Before 2001, the forests acted as a carbon sink by absorbing more carbon than they released. The amount released has also increased each decade, as forest growth cannot keep up with current levels of logging, more wildfires, and other growing threats like droughts and pests. Taking into account the carbon released during this year's extreme wildfires, cumulative emissions from Canada's managed forests since 2001 clock in at 3.7 billion tonnes of CO₂ - equal to [10% of total global CO₂ emissions in 2022](#).

Increasing methane emissions from natural sources is another source of concern for carbon removal projections. After plateauing at the end of the 1990s, atmospheric methane levels have been [unexpectedly accelerating since late 2006](#), driven by emissions from natural sources like wetlands. Euan Nisbet from Royal Holloway University in London says that rapid increases in methane levels have happened before, when "[sudden surges in methane marked the transitions from cold ice ages to warm interglacial climates](#)". The Earth's climate has switched between long, cold glacial periods

and shorter, warm interglacial periods over the past few million years - global climatic switches which have the uplifting name “terminations”. However, we are already in a warm interglacial period, so what happens now that methane levels are rising again is unprecedented. The impacts will have “very significant” consequences for the biosphere, including forests, mangroves and other ecosystems that act as carbon sinks.

Finally, the idea that using CDR to remove carbon and reduce the global temperature after overshooting 1.5°C may not be as straightforward as thought. In this [paper we highlighted last month](#), modelling was conducted for a hypothetical scenario where global atmospheric CO2 rises for 140 years and then falls back to initial levels over another 140 years. The study results suggest that the local climate in these areas would not return to normal for more than 200 years after the CO2 levels fell. "I think that the main message of our study is that [we should reduce carbon dioxide emissions now](#), because afterwards it gets really difficult," lead author Seo-Yeon Kim told Space.com. "We cannot control nature, we cannot reverse the consequences that easily; we cannot fix nature."



Our pick of the news

[Can blue carbon unlock net zero?](#) (Energy Monitor)

A thorough look at the potential benefits and risks of marine and coastal ecosystems as carbon sinks.

[A Green Revolution In California's 'Carbon Valley'](#) (Noema Magazine)

As groundwater dries up and threatens agriculture in California's Kern County, the County's Planning and Natural Resources Department has a plan to make CDR the next big industry.

[How Oil and Tech Giants Came to Rule a Vital Climate Industry](#) (The Wall Street Journal)

The new funding announcement from the US Department of Energy has made it clear that “carbon removal is now the realm of giant companies and big government support”.

[Growing and burying algae in the Sahara is the latest solution for the climate crisis](#) (CNN)

London-based startup Brilliant Planet is using 6,100 hectares of land in Morocco to cultivate and bury algae.

[Ebb Carbon wants to pull CO2 from the sky with electricity and seawater](#) (Canary Media)

Startup Ebb Carbon has just unveiled a demonstration project that uses electrochemistry to take up carbon from ocean water.

[Is Carbon Capture and Storage a Climate Solution?](#) (Inside Climate News)

Carbon capture and storage is attracting a lot of attention from fossil fuel companies and the US government, but environmentalists and scientists warn that it's a "dangerous boondoggle".



Useful resources this month

Podcast: Canary media discusses the role of CDR in the UN and the US funding announcement.

Explainer: Sifted gives an explanation of different carbon removal methods and the companies working on them in Europe.

Video: Al Gore's recent Ted Talk lays down some [strong views](#) about the involvement of fossil fuel companies in CDR.

Interview: Giana Amador discusses the Carbon Removal Alliance's priorities and the US government's involvement in CDR.

Calendar: The Carbon Business Council has put together a calendar of CDR events at New York Climate Week.

Map: CDR.fyi has published a handy map of 221 CDR companies.

Study: A new study suggests that spreading crushed rocks on farmland could remove over 200 billion tonnes of CO₂ over the next 75 years. Cost and logistical concerns, rather than weathering potential, are likely to be the key limiting factors for large-scale deployment.

Paper: A new analysis of how CDR might play out in the US pegs Texas as a leader.

Methodology: CDR company Andes has released a transparent blueprint to quantify and credit microbial carbon mineralisation, which stores carbon in soil.

Strategy: New Zealand is starting to develop a carbon removal strategy.

Tracker: Want to keep up with all the developments in CDR policy in the EU? Carbon Gap's Carbon Removal Policy Tracker can help.

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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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