Demystifying Carbon Dioxide Removal

May roundup

Dear all,

Record-breaking CDR purchases this month mean the cumulative amount of carbon removal credits purchased has reached over six million tonnes - equivalent to around 0.02% of annual energy-related emissions. Big deals could be a key step in getting the industry off the ground, but a focus on biomass-based approaches from Microsoft, JP Morgan and CDR financier Frontier means removals need to be scrutinised closely. Read on to find out why.

Carbon removals were also mentioned in reference to discussions at COP28. We see how technical discussions on carbon trading in preparation for COP sparked tensions between the UNFCCC and the CDR community.

Finally, we take a look at how more research is needed to build solid science and overcome monitoring and verification challenges for under-researched areas like enhanced rock weathering and ocean CDR.

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. Do get in touch if you have any questions, suggestions or feedback.

Till next time,
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Stat of the month:

3.4 million tonnes

The amount of CDR purchased in May 2023, more than all cumulative CDR purchased before.

CDR spending spree

CDR purchases broke all records this month, with major investment from firms like Microsoft, JP Morgan and Frontier, which is led by ecommerce giant Shopify and others. Microsoft's pre-purchase of 2.76 million tonnes of removal credits over 11 years from Danish energy company Ørsted is one of the largest purchases of carbon removals to date. The deal was backed by Danish state subsidies and will remove CO2 by installing carbon capture devices at two power stations powered by wood chips and straw, with the captured CO2 transported for underground sequestration in the North Sea. The facilities aim to capture a total of 430,000 tonnes of CO2 annually by 2026 - roughly equivalent to how much CO2 a single gas-fired power plant emits in a year.

However, bioenergy with carbon capture and storage (BECCS) is a "tricky balancing act". To make sure it's carbon negative, there needs to be more CO2 captured from growing the tree and then is emitted in the process of harvesting and transporting the wood, and from operating the power facility and carbon capture devices. But previous studies have shown that BECCS isn't always net-negative - in some cases, it can even result in net CO2 emissions. Carbon removal portfolio director at Microsoft told tech news website The Verge that, to be effective, the biomass must be "harvested from appropriate areas" and, vitally, all process emissions must be accounted for. Ørsted claims they only buy wood pellets and wood chips from suppliers offering biomass solely "sourced from forest areas where there is ongoing reforestation, and where the ecosystem and biodiversity are protected". However, this is easier said than done and claims of CDR will have to be clearly monitored and verified.

Like Microsoft, the majority of JP Morgan's USD 200 million worth of credits - 450,000 tonnes - will come from BECCS. The carbon will be removed by the relatively unknown company CO280 over 15 years. JP Morgan and Frontier also purchased from Charm, a company that utilises biomass in a different way. It collects agricultural and forestry waste - mainly from harvesting corn - and heats this to high temperatures in the absence of oxygen to form bio oil, which is then buried in abandoned wells. Charm claims to have removed more than 5,000 tonnes of carbon so far and Frontier hopes that its USD 53 million agreement for 112,000 tonnes of removal will help it scale up faster.

Other large purchases included a USD 318 million deal between 3M and clean-tech manufacturer Svante to develop material that can trap and remove CO2 and USD 12 million in funding for British enhanced weathering company UNDO.

Away from commercial deals, philanthropic funding for CDR nearly doubled between 2021 and January 2023, reaching USD 175 million according to NGO ClimateWorks. Of this, 72% went to natural solutions like reforestation, biochar and soil carbon removal, and 14% to tech solutions such

as direct air capture (DAC). ClimateWorks highlights ocean CDR, which received only 4% of total philanthropic funding, as an area in need of further support. In addition to philanthropic funding, US Department of Energy funding is expected to contribute to a sharp increase in DAC facilities.

As more facilities are built, they can help states meet climate targets while benefiting host communities and landowners if project proceeds are shared fairly, according to new research.

CDR and COP

Recent discussions suggest CDR will be on the agenda at COP28 later this year. In an interview with MIT Tech Review, executive director of low carbon solutions and international growth for the Abu Dhabi National Oil Company (ADNOC), Musabbeh Al Kaabi, claimed that "the importance of CO2 removal cannot be understated". Meanwhile, COP28 President Al Jaber stated that: "If we are serious about curbing industrial emissions, we need to get serious about carbon capture technologies." Others are less certain if the push for carbon capture and CDR is what we need, arguing they are a distraction from the real business of cutting emissions. As head of ADNOC, the COP president's connection to the fossil fuel industry has been an ongoing cause for concern, most recently resulting in over 100 US lawmakers and members of the EU parliament to call for his removal.

Technical discussions for COP28 are also underway. Sessions on the contentious Article 6.4 - the section of the Paris Agreement that refers to carbon trading - have started developing text to be discussed at COP. However, an information note provided by the UNFCCC caused a stir due to its sceptical stance on engineered CDR. The note describes engineering-based activities as "unproven" with "unknown risks", stating they "do not contribute to sustainable development, [and] are not suitable for implementation in developing countries". Eve Tamme, founder and managing director at climate policy advisory Climate Principles, highlighted that the note was not aligned with IPCC messaging or inputs received from CDR experts. The note does describe land-based activities in a more positive light, with the only "con" being their risk of reversal, but this ignores other key issues in relying on natural carbon removal, such as the finite amount of land available for carbon uptake.

The company is thinking big, with aims to "establish a global network of 200 farms over the next ten years"

In response, the CDR industry quickly submitted feedback on the note. The Carbon Business Council put together an open letter with over 100 signatures from CDR experts in support of better defining carbon removal and setting out criteria for high-quality CDR. Wil Burns, co-director of American University's Institute for Carbon Removal Law and Policy, says the decisions on Article 6.4 are "a big deal", which, if made well, can help "rigorously set up uniform rules that… will create more integrity in the carbon removal marketplace."

Outside of the UN, carbon accreditation standard Verra has also started to better differentiate between removals and reductions, saying it plans to "launch labels and associated Verified Carbon Standard (VCS) Program updates to enable differentiation between reduction credits and removal credits" by the middle of this year. Verra also made it into the news due to the resignation of its CEO following a high profile media investigation into worthless forest carbon offsets.

Ocean-based opportunities

Negative emissions startup Carbon Drawdown Initiative has published the preliminary results of two-and-a-half years of enhanced rock weathering experiments conducted in "close-to-nature" settings. The experiment uncovered various hurdles that need to be overcome to both ensure actual removal of CO2 from rock weathering and to develop a sound monitoring, verification and reporting (MRV) approach, especially if removals are to be measured over short timescales to verify credits. A study by the Grantham Institute also found that "promising but under-researched" CDR methods, like enhanced rock weathering and ocean-based approaches, "suffer from a lack of foundational science, which hampers MRV development."

Speaking of ocean-based CDR, a number of new pilot projects are cropping up. In Ireland, Carbon Kapture announced the launch of its first seaweed farm, which it claims could ultimately cultivate 11,000 tonnes of seaweed each year. The company is partnering with shellfish farmers in Ireland to

grow seaweed on ropes, which is then converted into biochar that is donated to farmers to enrich soil and reduce the need for fertiliser. Customers can currently "sponsor" a rope, but the company is investing in MRV and plans to develop a crediting system. In general, more research is needed to accurately determine the durability and permanence of biochar for CDR. The company's chief revenue officer is thinking big, however, with aims to "establish a global network of 200 farms over the next ten years, which could capture over 364,000 tonnes of CO2 per year". Carbon Kapture is already in talks to set up farms in Singapore, Canada and the Seychelles.

Meanwhile in Israel, start-up Rewind thinks it can lock away more CO2 a year more quickly than other approaches, and at a lower cost, by taking readily-available biomass, like agricultural waste, and sinking it to the bottom of the Black Sea. One of the key issues in sinking biomass is the uncertainties of how it will interact with microbes in the water. According to Rewind, this makes the Black Sea the ideal spot for testing this approach, as below 150 metres the water lacks oxygen, inhibiting microbes that decompose biomass into CO2, "creating an environment that preserves organic matter very well", according to CEO Ram Amar. Accessing large amounts of unwanted organic material to sink won't be a problem, the company says, as the Black Sea is based in the heart of Europe's breadbasket. Being in the early stages of development, the company will have to monitor trials carefully to make sure its assumptions are correct.

Also in Israel, BlueGreen Water Technologies is removing carbon by treating harmful algal blooms in lakes. The company does this by sprinkling a hydrogen peroxide powder over the water, causing the algae - which has taken up CO2 from the atmosphere - to die and sink to the bottom of the lake, storing carbon in the process. The company has already worked with carbon accreditation standard Social Carbon to develop a detailed carbon accounting methodology and is selling credits for USD 100 a tonne. The company claims it can remove on average 8,000 tonnes of CO2 per square kilometre of treated lakewater and that it has already sequestered up to three million tonnes. However, concerns remain over the potential release of methane, which may negate any carbon removed.

Other ocean CDR approaches, such as SeaChange's electrochemical water treatment plant, also featured heavily in the media this month. However, one of the most unorthodox suggestions to use the ocean for CDR is whales. While some see this as no more than an April fools' joke, the fact we have "allowed the natural capital on which we all depend to be depreciated off the books" means some companies are seriously considering turning whales into carbon-based assets.

Our pick of the news

Can carbon removal become a trillion-dollar business? (The Economist)

While the involvement of oil and gas companies in CDR has attracted criticism, “the willing involvement of giant oil firms, with their vast capital budgets and useful expertise in engineering and geology, is to be welcomed”.

Europe encourages carbon removal with a stick, rather than a carrot (Greenbiz)
The EU Carbon Removal Certification Framework (CRCF) has some way to go to ensure that regulation can be implemented in a way that acts as a "driver of innovation and market creation" while maintaining high standards.

European carbon removal pioneer lured by US subsidies (Energy Monitor)
An interview with Climeworks’ climate policy manager Peter Freudenstein about the company’s move to the US.

What is carbon capture? Some say it will help save the world, for others it’s a dangerous distraction (CNN)
While CDR is beginning to have a "starring role in climate policies", experts say we need to proceed with caution.

Now is the time to lean in on federal procurement of carbon removal (Carbon180)
A review of what CDR can learn from existing industrial procurement policy in the US.

Useful resources this month

Paper: An analysis of international carbon markets for CDR calls for the current “gold rush” atmosphere of removal markets to quickly be replaced by a “coordinated and credible approach”.

Mapping: CDR tech company Carbonfuture has put together a map of the current state of CDR and CCS policy across the 50 US states.

Research: A new study assessed an underwater Portuguese volcano as a potential storage site for CO2, estimating it could store the equivalent of 24 to 125 years of Portugal's carbon emissions.

Announcement: Klarna has announced a new multi-million dollar contribution towards climate solutions, including CDR, from its internal carbon tax - an approach it believes could replace carbon credits.

Article: Journalist Stephanie Lee uncovers how deep the oil industry’s influence runs in shaping the research agenda at Stanford University.

Approach: A Canadian company is using drones to plant trees in places where it's dangerous for humans to go.

Announcement: Oil company Occidental plans to distribute any excess cash from high oil prices to shareholders instead of funding DAC plants.

Correspondence: A response to David Ho's article in Nature (as discussed in last month's edition) last month highlights that "focusing on mitigating carbon emissions over safe and regulated carbon dioxide removal risks undermining inclusiveness in the quest for climate-change solutions."

Commentary: The IEA discusses if it's possible to scale up DAC through carbon markets.

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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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