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# Demystifying Carbon Dioxide Removal

## May roundup

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Dear all,

The second edition of the State of Carbon Removal report was released last week, which highlighted the growing gap between the amount of CDR proposed by countries and how much will be required to meet climate targets. At the same time, a separate analysis of national climate plans found that countries are planning to still have a significant level of emissions at net zero, which could lead to an over-reliance on removals in future.

Elsewhere this month, Climeworks started operating the largest direct air capture (DAC) plant in the world, but acknowledged the struggles of operating DAC plants in practice. Oil companies and big tech made new CDR investments and launched new initiatives, spurred by the ballooning carbon footprint of AI.

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 previous editions. Don't hesitate to get in touch if you have any questions, suggestions or feedback.

Till next time,

Victoria

[victoria.kalyvas@gscnetwork.org](mailto:victoria.kalyvas@gscnetwork.org)

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Stat of the month:

<1%

The proportion of a typical coal power plant's annual emissions that the [world's largest DAC plant will be able to remove](#) in a year, once it reaches full capacity.



## The state of CDR

The second annual [State of Carbon Dioxide Removal report was released last Tuesday](#) (4 June), which identified a growing gap between the amount of proposed CDR and how much will be required to meet Paris Agreement targets. The authors calculated an annual gap of between 0.4 to 5.4 billion tonnes by 2050 between proposed levels of CDR and what is needed to reach Paris Agreement temperature goals. This gap is actually likely to be larger, as most of the scenarios used assume that emissions reductions have already happened, when, in reality, emissions have increased since 2020. The Summary for Policy Makers (SPM) of the IPCC's Working Group III report contains [important reminders of the trade-offs that come with deploying different types and levels of CDR](#) and other mitigation options.

The team behind the report improved their analysis this year to include more scenarios that feature 'novel' CDR methods, like DAC or enhanced weathering, and calculated CDR projections based only on scenarios that include sustainability criteria, like limiting the use of water and land. They estimate that 7 to 9 billion tonnes of carbon removal is needed annually by 2050. Currently, removals are estimated at around 2.2 billion tonnes a year – almost all of this comes from reforestation and afforestation and only 0.06% from novel methods.

The report also highlighted that

- So far, most demand for CDR has come from voluntary actions, as opposed to government actions
- There has been a rapid expansion in announcements of CDR demonstration plants, although there is "little grounds for credibility at present"
- The number of publications on CDR have increased rapidly
- Funding for CDR via research grants and investment in startups grew significantly, although it plateaued or declined in 2023.

To increase CDR innovation and scale-up in the sector, the authors stated that policies to create demand for removals are needed. Policy support is also needed to help bring coherence to the accounting of removals: the report identified 102 different monitoring, reporting and verification (MRV) protocols for CDR, 40% of which have been developed since 2022.

We will be attending the **3rd International Conference on Negative CO<sub>2</sub> Emissions** hosted at the **University of Oxford** this June. Don't miss next month's newsletter for all the insights.

## Reports point to CDR over-reliance

A review of long-term national climate change strategies found that [governments are over-relying on the future availability of CDR](#). Based on the few countries that have submitted plans and quantified their residual emissions (this refers to the emissions left over after actions to cut emissions have been taken), total residual emissions could be equivalent to [up to 2.9 billion tonnes of carbon dioxide, or 5% of current global emissions](#). 2.9 billion tonnes is a big goal for CDR – one billion tonnes of carbon dioxide is equivalent to the [annual CO<sub>2</sub> emissions of about 257 coal plants](#), according to E&E news.

The study explained that some countries' climate strategies involve high levels of residual emissions at net zero, enabling them to continue or expand fossil fuel production but increasing future reliance on CDR. "Given the known limits of CDR methods, [this risks the credibility of their target and risks a failure to meet national and global net zero](#)."

Another report released by the International Panel of Experts on Sustainable Food Systems looked at what [over-reliance on CDR means for land](#). The report said that governments are planning to allocate almost 1.2 billion hectares of land – an area equivalent to all global cropland – for carbon removal initiatives. Interest in using nature to offset emissions has resulted in a wave of 'green grabs', which currently account for [around 20% of large-scale land deals](#), adding to the pressure on land and contributing to farmers and communities [being pushed out](#). As the CDR sector grows, "[so too will the scrutiny of whether these green sectors are proving to be good for local people, as well as for the planet](#)," writes Simon Mundy in the Financial Times.

These studies, along with the findings of the State of Carbon Dioxide Removal report, highlight the need to stop burning fossil fuels and reduce planned residual emissions, with CDR only included in decarbonisation plans as a last resort.

### Policy watch

- The US government has released a "[Joint Statement of Policy and new Principles for Responsible Participation in Voluntary Carbon Markets \(VCMs\)](#)", aiming to improve market integrity. However, Tim McDonnell at Semafor pointed out that while the government is investing in CDR and laying out the rules, these "[don't resolve the critical question of whether the carbon market really is a solution at all](#)."
- An [analysis of CDR policies](#) found that while policies for carbon capture-based carbon removals are lacking in China, Brazil and India, the level of regulation on land use change in these countries is higher. This regulation [could be repurposed for CDR, according to lead researcher Felix Schenuit](#).

- During his US visit, Kenyan president Ruto said he wants to see energy-intensive industries, including CDR, [shifted to Kenya](#), where renewable energy is abundant.

## Mammoth plants, but questions remain

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Earlier this month, the world's largest direct air capture (DAC) plant [began operating in Iceland](#). Named 'Mammoth', the plant [has the potential \(once it is fully operational\) to remove 36,000 tonnes of carbon](#) from the atmosphere each year. Climeworks uses a modular approach to construction – so far only [12 modular containers have been installed, with plans to install 60 more](#) this year. When complete, Mammoth will be able to suck up nine times as much carbon as Orca, Climeworks' first DAC plant. However, E&E news highlights that when it is operating at full capacity, even as the world's biggest the plant will only remove [less than 1% of an average coal power plant's annual emissions](#).

Climeworks admitted that implementing the technology has not been straightforward. Reflecting on their lessons learned, the DAC leader acknowledged that Orca [only took up around 1000 tonnes of carbon in 2023, a quarter of its advertised capacity of 4,000 tonnes](#). This was due to a [less efficient filter material being used and interruptions in the plant's operations](#), including from extreme weather and testing, among other issues. There are many hurdles to smooth-running CDR, even after facilities have been funded and built.

## Oil, gas and direct air capture

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Climeworks' Mammoth won't be number one for long. Occidental Petroleum (Oxy) is aiming to have its Stratos facility begin operations in mid-2025, which is projected to have a capacity of 500,000 tonnes of carbon per year once it is fully operational – [14 times that of Mammoth](#).

While this might seem impressive, Oxy's climate strategy has raised concern that it "could result in [more emissions than it prevents](#)." Around 90% of Oxy's carbon footprint comes from the oil and gas it sells – known as scope 3 emissions – which [Oxy aims to reduce to zero by 2050](#). However, a new report from Carbon Market Watch highlighted that [Oxy doesn't have any plans to phase down oil and gas production](#) (it actually aims to increase oil and gas production by around 10% in 2024 compared to 2022) and is just planning to construct 135 DAC plants by 2030 to offset its emissions. Even if it succeeds and all the plants have the same capacity as Stratos, this [would only cover 11% of the company's carbon footprint](#), according to the report.



As more fossil fuels get entangled into the CDR world, it will be important to keep a critical eye on their activities and intentions.

Oxy [has not announced plans to use renewable energy](#) to power the plant and CEO Vicki Hollub has been [hopeful about pumping captured carbon underground to access more oil](#) in a process called enhanced oil recovery. As a result “they’ll be [releasing more CO2 than they’re capturing](#),” Charles Harvey, a professor of civil and environmental engineering at MIT, told Grist.

Concerningly, Carbon Market Watch calculated that Oxy has either already sold or is in negotiations to sell [almost 2 million tonnes of CO2 credits](#). These sold credits [could be double counted](#) if Oxy also counts them to their own net zero goals.

Oxy is not the only oil and gas company that has shown interest in DAC. Saudi Aramco (the biggest oil and gas company in the world) [invested in](#) and [signed an agreement with US-based DAC company Spiritus](#) in May to potentially expand its DAC operations into [Saudi Arabia](#). As more fossil fuels get entangled into the CDR world, it will be important to keep a critical eye on their activities and intentions.



## Big techs' big plans

The growing use of AI has increased energy consumption in – and therefore also emissions from – the technology sector, causing tech companies to turn to CDR. Microsoft’s latest sustainability report shows that its [current emissions are 30% higher than in 2020](#), making its goal of removing more carbon than it emits by the end of the decade harder to achieve.

This month, the company made its [biggest ever carbon removal deal with Stockholm Exergi](#) for over 17 million tonnes of CDR from bioenergy over 10 years. This will come from a facility that is currently



[in the planning phase and seeking funding](#), so there are a lot of ifs and buts. There are also [specific conditions required for bioenergy with carbon capture and storage \(BECCS\)](#) to actually lead to net carbon removals, which it is not clear will be met at the proposed plant.

Google is also trying to counteract [potential emissions growth](#) with CDR. A [small-scale DAC plant built by its spinout company 280 Earth](#) will use waste heat from its data centre as energy.

Another way Microsoft and Google are aiming to combat emissions is by teaming up with Meta and Salesforce to plant trees. The companies launched the Symbiosis Coalition in May to “[[grow](#)] the [market for high-quality restoration](#).” Planting trees to cancel out emissions is not a new idea, but, despite [evidence](#) pointing to the ineffectiveness of nature-based carbon credit schemes, “[Big Tech thinks it can plant trees better than everyone else](#),” said Justine Calma at The Verge.

The coalition takes a similar approach to that of CDR funding initiative Frontier by using an advanced commitment to buy removals once they are developed. The coalition has so far committed to remove 20 million tonnes of carbon dioxide via nature-based approaches, which Calma reiterates [is just slightly over the 15.4 million tonnes of carbon emitted by Microsoft alone last year](#). Although the coalition focuses on nature, rather than on new removal technologies like Frontier, there is always a risk that the pre-purchased removals are never developed. Frontier has only delivered [around 0.3% of the more than 510,000 tonnes of carbon removal it has contracted](#).



## Elsewhere in the news

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[Biochar booms towards gigatonnes, but low-quality concerns cloud market growth](#) (Tech EU)

Carbon removal marketplace Supercritical released a [new report](#) which classified 88% of biochar capacity that will be available by 2028 as low-quality according to their standards, risking the reputation of the removals market.

[New Enzyme Trial Aims To Boost Natural Carbon Removal Process](#) (Forbes)

Waste management company Veolia has partnered with biotech startup Fabric Nano in the UK to see if using an enzyme will help enhanced weathering happen faster.

## Useful resources

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[Figure](#): NGO Carbon Gap estimates “the US government has spent a total of \$1.86 billion on carbon removal research, development, and innovation compared to the EU €613 million.”

[Map](#): The Enhanced Weathering Alliance has put together a map of enhanced weathering projects.

[Research](#): A new study in Nature Communications found that biodiversity decline from climate and land use change could result in large amounts of carbon dioxide being released (between 7.4 to 146.0 billion tonnes depending on the scenario). This would result in a self-reinforcing feedback loop where biodiversity decline contributes to CO2 release, and vice versa, and highlights the important role that conservation and nature restoration play in reaching mitigation targets.

[Brief](#): Zero Carbon Analytics has put out a brief on why “relying on soil-based carbon capture to offset livestock emissions is risky”.

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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!

Contact me at [victoria.kalyvas@gscnnetwork.org](mailto:victoria.kalyvas@gscnnetwork.org)

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