
Demystifying Carbon Dioxide Removal

November (pre-COP28) roundup

Dear all,

Attention on carbon dioxide removal (CDR) is growing as we approach COP28. But, it is important to keep our understanding of the role of removals in check, including understanding their physical limits. Research shows countries are already significantly over-relying on removals, particularly land-based approaches like planting trees, with real implications for reaching climate targets.

This month, we take a walk on the technical side to look at the proposal on carbon trading that has been put together for discussion at COP28, which covers CDR. In the EU, progress has been made on certifying carbon removals, while in the UK, environmental groups are suing the government over its planned use of bioenergy with carbon capture and storage (BECCS).

Lastly, we take a look at how the CDR industry has grown in recent years and the issues that still need to be figured out. Interest in - and prices for - direct air capture (DAC) remain high. Meanwhile, CDR newcomer Graphyte claims it can lower costs to under USD 100 per tonne of carbon removed by using a simple approach.

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,

Victoria

victoria.kalyvas@gscnetwork.org

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Stat of the month:

Ten million km²

The amount of land pledged by countries for land-based removals - larger than the entire area of the continental US.



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Risk of unrealistic CDR dependence at COP28

Going into COP28, different stakeholders are arguing that carbon removals cannot replace deep emissions cuts. The [Energy Transitions Commission](#) writes that “scaling carbon capture and carbon removals does not mean business-as-usual for the fossil fuel industry,” highlighting that CDR can annually remove 10 billion tonnes of CO₂ at most, “just one-quarter of current emissions from the fossil fuel energy system.” A [recent journal article](#) from climate experts on entering “uncharted territory” in the climate crisis reiterates this messaging: “Although research efforts should be accelerated, depending heavily on future large-scale carbon removal strategies at this juncture may create a deceptive perception of security and postpone the imperative mitigation actions that are essential to tackle climate change now.” Also, the newly-published [UNEP Emissions Gap Report](#) includes a chapter on CDR for the first time, underscoring that the “delay in stringent mitigation action” to bridge the emissions gap - the gap between where emissions projections are headed and where they should be to limit warming to 1.5°C - resulted in the need for it.

A team from the University of Oxford has taken this further, warning in a new study that over-reliance by countries on CDR to meet Paris Agreement targets could [breach international law](#). Many of the [major question marks around CDR future deployment](#) are acknowledged by countries in their climate targets. The study further highlights the big differences between net-zero pathways that entail steep and immediate emissions cuts and those that leave a heavy clean-up burden for future generations: “[Policymakers must recognise this point, and failing to act accordingly could see climate targets challenged in the courts.](#)” said lead author Rupert Stuart-Smith.



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The [Carbon Removals at COP website](#) serves as your go-to platform for all things CDR during COP28, with regular updates on the latest thinking and developments around removals.

Land-based removals, including planting trees or conserving forests, are a key feature of CDR over-reliance. The updated Land Gap report shows that countries really love trees - so much so that more than 100 countries have pledged [around ten million square kilometres of land](#) for land-based removals. This is more than [all of the continental United States](#), as Bloomberg points out, and a completely “unrealistic” way for countries to reach climate targets. Two-thirds of this land mass has been pledged by only two countries: Saudi Arabia and the US. “[Where is this land, can they use it for climate mitigation, and can we trust these targets that rely on so much land?](#)” asked project lead Kate Dooley in an interview, further stating that “These are all countries that should be betting on reducing emissions, not pledging large areas of land.”

At the same time, new research has shown that there is a critical [mismatch between the way emissions are calculated](#) in IPCC pathways and in the national greenhouse gas inventories of nationally determined contributions (NDCs). Matching them up, scientists found NDCs are over-optimistic about how much carbon can be sequestered on land, meaning emissions need to be reduced even more radically and countries will need to “increase the collective ambition of their climate targets [to remain consistent with the global temperature goals](#).” Ultimately, “emissions reported to the UNFCCC are effectively undercounted” and so “the UNFCCC will declare global net-zero emissions to have been achieved [several years earlier](#) than would be the case according to the IPCC definition.” There is still [a place for the conservation of forests](#), but by being realistic and taking into account the [worsening ‘land crunch’](#).



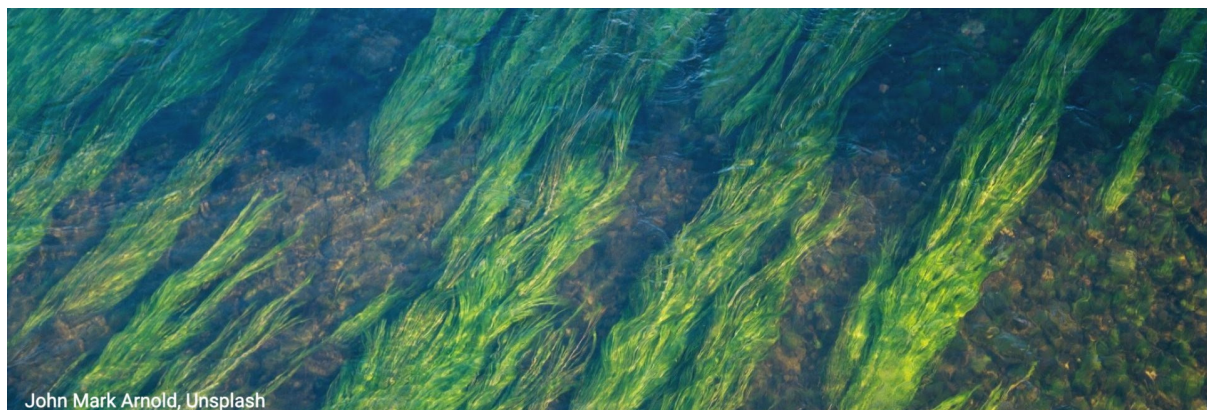
Rules and regulations

On the technical side, carbon removals will be discussed at COP under Article 6.4 of the Paris Agreement, which sets out new rules for global carbon trading. New recommendations for Article 6.4 text have been put forward. If accepted at COP28, global carbon trading could [start as early as next year](#), including carbon removals. Agreeing the recommendations for removals was one of the most difficult parts of Article 6.4, due to “[disagreement on matters addressing permanence and risk of reversals](#),” according to Olga Gassan-zade, who chaired the discussions. Pushback from the CDR community over previous recommendations which were claimed to be [skewed in favour of nature-based approaches](#) has resulted in recommendations that are [technology-neutral and acknowledge that a lot more guidance will be needed in future](#).

The EU has also made progress on its removal certification rules. Last week, the European Parliament [voted in favour of the Carbon Removal Certification Framework](#), with MEPs agreeing to

set up a system to develop the EU's capacity to quantify, monitor and verify carbon removals. The initial proposal by the European Commission was [significantly improved](#) by a European Parliament Environment Committee report, but key issues still need to be addressed. For example, the current proposal still does not outline the role or use of certified carbon removals. This "[undermines efforts to cut emissions](#) by allowing offsetting and double counting" and leaves the rules open to greenwashing, according to Wijnand Stoefs, lead expert on carbon removals at Carbon Market Watch. The EU parliament also voted on a Net Zero Industry Act, which could establish a "[first of its kind obligation](#)" for the oil and gas industry to develop storage for CO2.

In the UK, environmental groups are taking the government to court on its planned large-scale use of Bioenergy with Carbon Capture and Storage (BECCS). The two environmental groups leading the case, the Lifescope Project and the Partnership for Policy Integrity, wrote in a statement that "the government's rationale for BECCS as providing negative emissions [violates international carbon accounting protocols underpinning the Paris Agreement](#)." They add that BECCS will not contribute to the "government's legal obligation to achieve net zero by 2050" as it is an "accounting gimmick" that can only result in net-zero - not net-negative - emissions. The thinking behind BECCS being carbon-negative assumes that new trees are planted and will grow for long enough to take up the same amount of carbon as initially used. This is referred to as a 'carbon payback period' and can take "[several decades](#)." An expert review commissioned by the UK government on its biomass strategy found that BECCS could contribute to permanent CDR, "[but only with tight regulation and robust monitoring of supply chains and forest stocks](#)."



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State of the industry

While the CDR industry has moved quickly in recent years, there is still a very long way to go. Perspectives on just how large a scale-up is required is uncertain, but "if it turns out to be 10 gigatons by 2050, [we need 30 companies the size of Shell doing this](#)," Julio Friedmann, chief scientist at Carbon Direct, told Latitude Media. "That is a big market. That is the biggest market in all of human history." Advancements made during this "[formative](#)" decade for CDR are likely to shape developments.

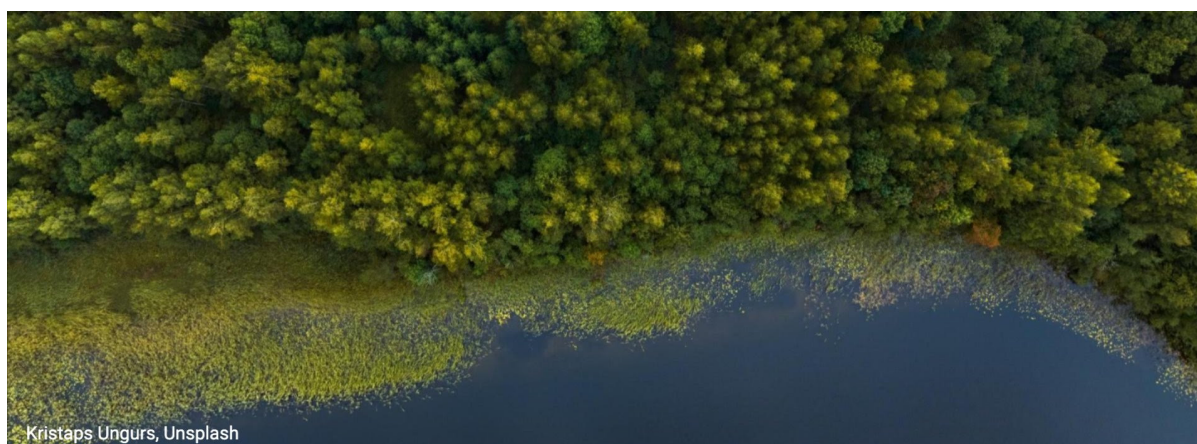
Currently, the industry is still "[figuring it out](#)". Heatmap looked back at the progress made by the largest direct air capture (DAC) plant in operation - Climeworks' Orca - since it opened two years ago, and [outlined lessons for the industry](#). Orca is "[small and climatically insignificant on purpose](#)," with the main goal being to enable learning at low costs and risks. This is "not like Tesla doing EVs when we have been building cars for 70 years... [it's completely new](#)," Climeworks chief marketing officer told Heatmap. While Orca is meant to be sucking out 4,000 tonnes of CO2 a year, the [net](#)

[removal is around 3,000](#) due to inefficiencies and the machinery having to be switched off for periods of time for testing.

Big investors like Microsoft believe that [“it’s too early to predict which carbon removal technologies will work best”](#) and are investing in a wide array of approaches. For DAC, the industry has not yet met on a ‘dominant design’, so “there’s lots of different ways that are being tried right now.” [Two main alternative approaches](#) are used by different companies - a high-temperature approach and a more energy-efficient low-temperature approach. Climeworks chief executive, Christoph Gebald, believes that the more energy-efficient approach which it uses [could help bring down costs](#). Regardless, DAC is still very expensive - and will remain so for a while. Climeworks estimates show technology costs decreasing from [“close to USD 1000 per \[tonne\] of CO2 to USD 400-500 by the end of the decade, and USD 300-400 by 2040”](#), which is [significantly higher](#) than estimates given in previous years.

Other deployable DAC is around the same price point. CDR company Heirloom, which opened its first commercial DAC facility in November, does not disclose exact costs but “experts estimate that direct air capture currently costs [around USD 600 to USD 1,000 per \[tonne\] of carbon dioxide](#).” This has not prevented investment, with Frontier recently purchasing [26,900 tonnes of CO2 removal](#) from Heirloom. The company’s novel approach uses limestone powder to take up CO2 from the air. The powder is then heated up to release the CO2, which is pumped into a storage tank, after which the powder can be continually reused in the same process. The new facility can take up a maximum of [1,000 tonnes of CO2 per year](#). Chief executive Shashank Samala admits that getting to Heirloom’s goal of [one billion tonnes by 2035](#), which will require a tripling of capacity for the next 12 years, won’t be easy.

Gates-backed CDR newcomer, Graphyte, thinks taking things back to basics can lower prices. The company makes compressed [“bricks of smushed pieces of plants”](#) that are dried and coated with a special polymer to prevent decomposition and buries them underground. It might not be as “scientific or as sexy” as other approaches but [“the simplicity of the Graphyte approach is so exciting”](#), Daniel Sanchez, a science adviser for Graphyte, told The Washington Post. “You don’t need very expensive equipment or processes,” he added. With proper monitoring and verification, Graphyte says the carbon can be stored for thousands of years. The company claims it has [dropped the price below the industry target of USD 100 per tonne](#), though according to TIME “it declined to specify exactly what its internal cost per [tonne] is.” There is no pilot plant yet, just plans to build one in 2024, but the company says it [does not see any reason why it can’t scale up rapidly](#).



Kristaps Ungurs, Unsplash

Our pick of the news

[A Startup Using Crushed Rocks to Capture Carbon Has Delivered Its First Removals](#) (Bloomberg)
CDR company Eion delivered the first 50 tonnes of a 500-tonne purchase from Stripe by spreading crushed rock over fields. The startup has a contract with a mining partner to provide it with at least 500,000 tonnes of carbon-sucking rocks a year.

[Is ocean iron fertilization back from the dead as a CO₂ removal tool?](#) (Mongabay)
After a decade-long hiatus, new funding is enabling a new round of research into ocean iron fertilisation for CDR. This involves adding iron into areas of the ocean with low productivity so that organisms can grow and sink to the bottom of the ocean - taking the carbon with them.

[Another weapon to fight climate change? Put carbon back where we found it](#) (National Geographic)
Nat Geo takes a detailed look into the carbon removal industry, featuring interviews with CDR companies in the US, Australia, Switzerland and more.

[Carbon removal looks more promising by the day. Is methane next?](#) (E&E news)
Carbon dioxide isn't the only climate-warming gas that needs to be curtailed to limit warming. Experts are also starting to look towards methane removal.

[Africa's first carbon-removal plant stokes questions about responsible climate solutions](#) (NBC)
"Calls for investment in Africa are tempered by watchdogs who say foreign investment in the global South can be harmful if investors from the global North prioritize profit over the safety and rights of local populations," writes Nidhi Sharma.



Useful resources this month

[Website](#): The Carbon Removals at COP website serves as your go-to platform for all things CDR during COP28, with regular updates on the latest thinking and developments around removals.

[Paper](#): If you've read a thing or two about CDR the one thing you will know is that it is divisive. CDR experts collaborated on a viewpoint published in Nature, discussing the controversies in carbon dioxide removal.

[Research](#): A group of researchers have looked at how emerging climate technologies are discussed on Twitter. They found that attention has shifted from general geoengineering to specific CDR methods, with "methods perceived closer to nature have the highest shares of positive sentiments." Thankfully, there is still "[great concern](#)" over solar manipulation.

[Training](#): The Carbon Business Council released a CDR Responsible Deployment Training - an interactive online training and suite of resources to support project developers with the responsible

deployment of carbon removal.

[Code](#): The Aspen Institute has put together a Conduct for Marine Carbon Dioxide Removal Research.

[Survey](#): CDR.fyi is conducting the first 2024+ Durable CDR Market Outlook Survey to assess current and future capacity and demand for durable CDR.

[List](#): Canary Media highlights six start-ups working on CDR in cement and concrete.

[Report](#): Carbon Removal Canada has released a report highlighting the economic and climate benefits of scaling CDR in Canada.

[Publication](#): The Oxford Institute for Energy Studies has put together a piece outlining how carbon trading can unlock carbon dioxide removals.

[Study](#): A research team has identified the most cost-effective areas for iron fertilisation in the Southern Ocean, finding that this is restricted to locations on the Antarctic Shelf where CDR costs can be less than USD 100 a tonne.

[Code](#): The Aspen Institute has put together a Code of Conduct for Marine Carbon Dioxide Removal Research.

[Interview](#): Wired speaks to Michelle You, cofounder of carbon-accounting firm Supercritical, on why “it’s time to get serious about carbon removal”.

[Blog](#): Bill Gates says that while lowering costs gives important future options for CDR, how much CDR actually ends up being part of the solution will be up to governments.

[Article](#): New papers have been released in a series on mitigation deterrence, including an article on the petrochemical industry.

[Brief](#): Don’t really understand what Article 6 is all about? This brief covers what is at stake for one of the most confusing parts of the Paris Agreement.

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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@gscnetwork.org