
Demystifying Carbon Dioxide Removal

January roundup

Dear all,

I hope you had a great start to the year.

The EU is hitting the ground running with policy developments in 2024, with several CDR-relevant policies set to be finalised this year. In the US and UK, not all government-funded projects are receiving good press.

New CDR approaches are setting out to reduce the amount of resources used by carbon removal tech. We take a look at one project aiming to prevent environmental damage, produce fresh water and take up carbon in a South Korean industrial complex.

Lastly, we explore why monitoring and verifying carbon removals remains a massive - and costly - challenge.

As we head into 2024, we would [love to hear your thoughts and any feedback you might have on the newsletter](#), if you have a few minutes to spare.

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

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Stat of the month:

634%

The growth of the CDR market in 2023 by tonnes purchased (for approaches that store carbon for 100 years or more).



Governments in action

2024 is gearing up to be a big year for climate policy in the EU. The [Carbon Removal Certification Framework](#), which provides guidelines on removals, will be discussed again this month, with final decisions set to come later this year. Over [350 organisations have called](#) for the framework to uphold a technology-open approach by developing clear, inclusive and science-based definitions of carbon removal. After COP28 negotiations on carbon markets failed to reach a consensus, the framework could help [pave the way for UN guidelines on CDR](#).

CDR policies are also being tackled in the EU's 2040 climate targets. Over 110 academics, businesses and civil society organisations signed an [open letter calling for the separation of emissions reductions, land-based sequestration and permanent carbon removals](#). The EU has introduced a [net target of 90% emissions reductions by 2040](#), but including removals and land use change in this figure [reduces ambition](#). "[Emission cuts must not be replaced by planting trees or permanent removals](#)," wrote Carbon Market Watch's removals expert Wijnand Stoefs. "Separating targets and policies enables the EU to work on urgently cutting climate destroying pollution, protecting and restoring ecosystems, and understanding and scaling up sustainable permanent removals," he added. A new study highlighted that currently, EU targets lack information about the [extent of the removals needed and who will deliver them](#). The EU's announcement that "[around 400 million tonnes](#)" of carbon removals will be needed to counterbalance residual emissions from hard-to-abate industries and achieve net zero by 2050 provides some details, however more clarity is needed.



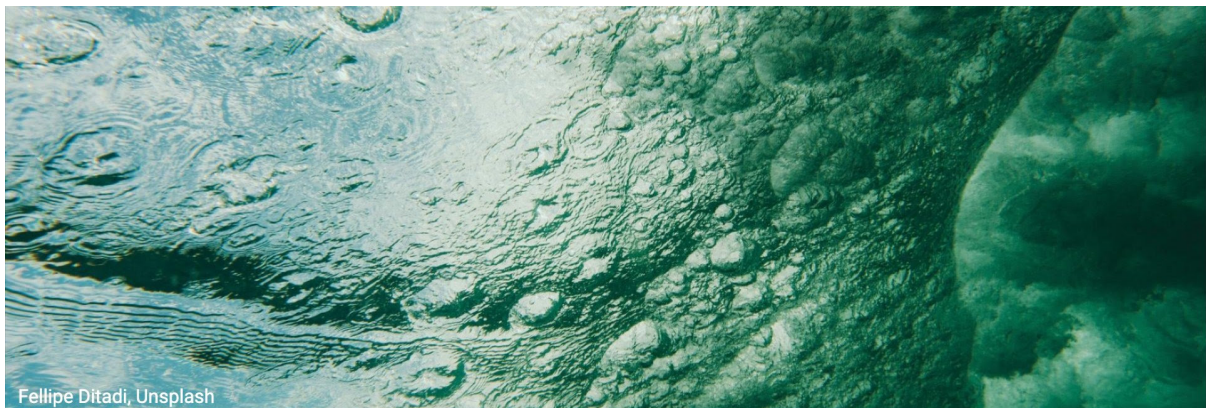
"This comes at a time where energy price hikes are already hitting consumers hard while fossil fuel providers profit - CDR companies risk following the same trajectory and exacerbating inequities."

In the US, two senators have reintroduced the "[CDR Removal Leadership Act](#)" which calls on the Department of Energy to procure an increasing amount of tech-based CDR, amounting to the removal of 40 million tonnes of CO₂ by 2035. The act could help lower one of the main barriers to

CDR. While the [market for durable carbon removal \(stored for 100 years or more\) grew 634% in 2023](#), a market survey conducted by CDR.fyi found that [price was the factor purchasers considered the most when choosing a durable CDR supplier](#). The Leadership Act, which was initially introduced in 2022, would make the US government a long-term CDR customer, reducing costs and helping the industry to overcome hurdles to commercialisation. The act suggests the government procure CDR for a maximum of [USD 750 per tonne in 2024-2025, declining to a maximum of USD 150 per tonne in 2035](#). The act would make up only a small proportion of emissions reductions needed in the US - proposed CDR purchases by 2030 would amount to [less than 0.001% of the emission cuts needed for the US to meet the targets set in its Nationally Determined Contribution \(NDC\)](#).

However, not all government-funded proposals for CDR have been met with praise. A planned direct air capture (DAC) plant funded by the US government wants to use [small modular nuclear reactors to power its CDR efforts](#). This type of nuclear reactor has never been built in the US, causing some experts to “worry that relying on novel nuclear plants could [jeopardize the development of a federally funded proposal to develop direct air capture](#).” Combining two complex and underdeveloped technologies “[adds complication upon complication](#),” according to Wil Burns, co-director of American University’s Institute for Carbon Removal Law and Policy. The interest in using nuclear to power the DAC plant was included in the initial proposal, although these were not publicly released.

In the UK, energy company Drax has come under fire after [receiving government permission to build carbon capture technology for its biomass energy plant](#). Climate research group Ember estimates that the proposed plant would add 1.7 billion pounds per year to energy bills, which over 20 years could make the project “[one of the most expensive energy projects in the world, funded from bill-payers’ pockets](#)”. This comes at a time [where energy price hikes are already hitting consumers hard while fossil fuel providers profit](#) - CDR companies risk following this same trajectory and [exacerbating inequities](#). Drax maintains that the project will be the world’s first “[carbon negative power station](#)”, but these claims have been challenged by climate experts and environmental organisations, and are now being investigated by the UK energy regulator.



Water-positive CDR

Sucking up carbon at scale could use huge amounts of energy, land and water - but what if it could conserve resources instead? “Water positive carbon removal” start-up [Capture6](#) has just signed an agreement with a South Korean water and wastewater treatment company to develop the “[world’s first fully integrated facility for carbon removal and water management using seawater desalination](#).” President of Capture6, Luke Shors, told the Verge that “if you do a DAC project, and that makes you

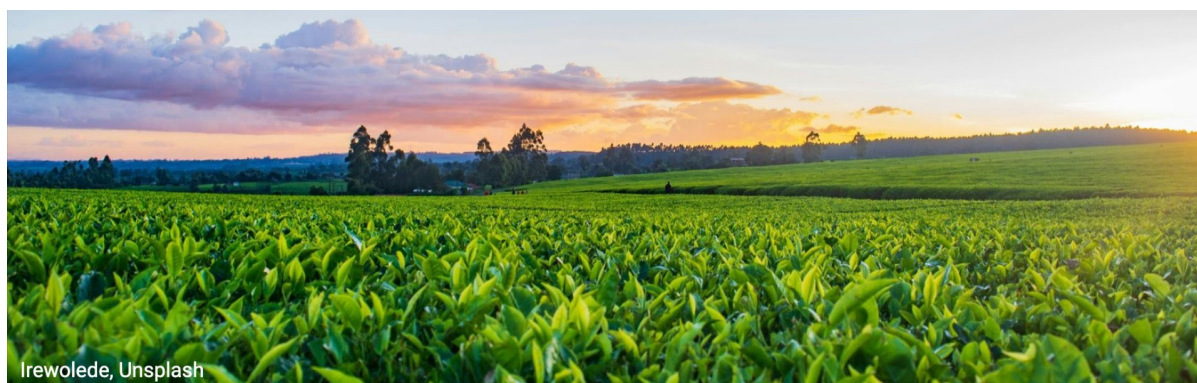
more water insecure, or more climate vulnerable, or if that perpetuates fossil fuels on the grid, [that's a problem](#).” Instead, “these projects can accomplish multiple climate goals.”

The facility, called “Project Octopus” (CDR companies love an animal-themed name), [would work in coordination with a desalination plant](#). Desalination removes salt from seawater to make fresh water, producing salty brine as waste. Usually, this waste is just released back into the ocean, with harmful impacts on ecosystems. However, Capture6 plans to extract salt from the waste - producing more fresh water as a byproduct - and then use the salt as a feedstock for DAC. The project will be built in the Daeson industrial complex, which produces “[40% of South Korea's petrochemicals derived from oil and gas](#)”. Octopus would only initially capture 500 tonnes of carbon a year (around one-eighth of the capacity of the largest DAC facility in operation, [Climeworks' Orca](#)), but if it can scale into a commercial facility, this [could grow to 500,000 tonnes](#), according to Capture6. This represents around 3% of the 17 million tonnes produced by the industrial complex.

A key drawback of the project is that it will be powered by electricity from the grid, which is predominantly generated using fossil fuels. The large amount of energy needed for both the desalination and DAC plant make it “[unclear whether the facility will have a net negative impact on emissions](#).”

In Switzerland, researchers are developing a [CDR approach that doesn't require energy from the grid at all](#). For the process to work, air is passed through a liquid containing [a compound that reacts in the presence of light](#). When the light is switched on and the compound is activated, CO2 bubbles out and is captured for storage. Once the CO2 is captured, the light is switched off and the process can start again.

Unlike other similar CDR approaches, the process doesn't require heating or cooling, “so [it requires much less energy](#),” says study lead Maria Lukatskaya, and could potentially run off sunlight alone. Additionally, using chemical reactions triggered by light allows for switching between carbon capture and release much faster than other methods. The research is still in its early stages, with many steps before it can reach the market.



Monitoring costs

Removing carbon is one massive feat - verifying removals is another. In the agriculture sector, regenerative practices can provide benefits for ecosystems and conserve resources, “[but the carbon angle has been oversold](#),” Pete Smith, professor of soils and global change, told the Financial Times. According to Smith, soil-based carbon capture has been promoted by those in the livestock industry who want to use it as a “[get out of jail free card](#)” to offset agricultural emissions.

Many major agrifood companies claim to be taking up carbon via regenerative agriculture initiatives. However, as there is no clear definition of soil sequestration, most lack qualitative targets. Without feasible monitoring and verification processes, these remain mostly “[unsubstantiated claims](#)”.

Accurately measuring how much carbon is stored in soils with available technology can be very expensive - to the point that “[the cost of doing it can outstrip the value of the carbon](#).” As a result, most companies rely on computer models that use farmers' self-reported practices to estimate how much carbon is being stored. Some companies acknowledge there are limits to this approach and use additional monitoring, such as satellite imagery, to verify farmers' claims. Other companies [feel the current process is robust enough](#). Startup Andes, which uses microorganisms to store CO₂ in soil, is working with farmers and scientists to publish a paper to showcase their findings on soil carbon uptake. Andes CEO Gonzalo Fuenzalida told Forbes “[We feel that's the way to build reputation](#) and reduce risk towards customers who buy our credits.”



“A key of the problem is that there are no verified independent guidelines on quantifying removals, which means ‘students grading their own homework.’”

Quantifying soil carbon sequestration is particularly tricky since it's not just about how much carbon is stored in the soil, but for how long. Soils only have a “finite capacity” for taking up carbon - [around twenty years by some estimates](#).

Similar problems for monitoring and verification arise for enhanced weathering, which takes up carbon by spreading crushed-up rocks over land. [Removals can be measured directly](#) by monitoring the transfer of gases above the soil, water composition and how much rock has dissolved. But, like soil carbon, “[the hard part is doing it across huge areas of farmland without breaking the bank](#).”

A key of the problem is that there are no verified independent guidelines on quantifying removals, which means “[students grading their own homework](#).” This doesn't automatically mean that CDR companies are overstating their impact, but it risks making estimates of carbon uptake less reliable. Companies can also implement carbon removal practices within their supply chains, known as insetting, which [takes place with even less oversight](#). Carbon registry Puro.earth has [published the first third-party standard](#) for CDR by enhanced weathering, but [no credits have been verified with it yet](#). Even with a standard in place, verifying enhanced weathering at larger scales will mean estimating rates of CDR based on only a few indicators. This can be tricky to get right, as uptake rates vary greatly across regions. CDR company InPlanet, which is doing large-scale enhanced weathering in South America, claims that “[weathering rates in Brazil are fully 50 times faster than in temperate sites](#).”

Other CDR approaches, [particularly those that are ocean-based](#), will need to overcome much larger knowledge gaps [before carbon removal can be confidently verified and quantified](#).



Our pick of the news

[This oil company invests in pulling CO2 out of the sky — so it can keep selling crude](#) (NPR)

DAC plants owned by fossil fuel companies, like Occidental Petroleum's Stratos, raise the question of whether DAC is "a way to save the world? Or a way to save the oil industry?"

[Can Submerging Seaweed Cool the Climate?](#) (Eos)

Companies, researchers and organisations all over the world are working to understand how seaweed can drag down carbon.

[California's Oil Country Faces an 'Existential' Threat. Kern County Is Betting on the Carbon Removal Industry to Save It](#) (Inside Climate News)

Previous oil extracting regions are reinventing themselves as carbon storage sites.

[Why Humans Are Putting a Bunch of 'Coal' and 'Oil' Back in the Ground](#) (Wired)

Creating and storing biochar is basically "fossil fuels, but in reverse."

[Can Kenya become a direct-air-capture hub?](#) (Chemical and Engineering News)

Even without the large-scale support provided by governments - like in the US - DAC company Octavia is set to generate over USD 1 million in revenue from the presale of carbon offsets in the first quarter of 2024.

[It is time to draw down carbon dioxide but shut down moves to play God with the climate](#) (The Conversation)

Climate expert Tim Flannery suggests it is time the Australian government promote forest protection and invest in CDR research, while condemning risky geoengineering approaches.



Useful resources this month

[Research](#): A new paper published in Science highlights our over-reliance on large scale land-based CDR and recommends three ways this can be limited.

[Announcement](#): The IPCC's upcoming assessment cycle will include a CDR methodology report, covering the nitty gritty technical guidance for greenhouse gas inventories.

[Study](#): New research suggests that "[future projections of climate and sea-level rise may be too optimistic](#)" because, in reality, ecosystems are likely to store less carbon in the future."

[White Paper](#): The World Economic Forum has defined best-practice guidelines for new technologies, using advice from the industry's "first movers".

[Trends](#): Market maturation and globalised trade: This watching brief lays out four CDR trends to keep an eye out for in 2024.

[Brief](#): The Carbon Business Council has put together an issue brief on marine CDR, highlighting recommendations for responsible deployment.

[Report](#): The Rocky Mountain Institute has put together a - very - comprehensive innovation roadmap for CDR, covering 32 approaches. Energy Monitor spoke to them [about what they found](#).

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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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