Stop spending public funds on carbon capture failure – researchers

By Simon Pirani

Forests, grassland and other biomass remove carbon dioxide from the air now – and, properly looked after, could do much more. Mechanical methods of removing carbon dioxide, such as carbon capture and storage (CCS) and direct air capture (DAC), are ineffective and may never work at scale.

So public funds poured into mechanical carbon capture projects, often operated by oil companies, should be redirected to proven biological methods, and to monitoring technologies that can check how effective they are.

These are the conclusions of a new paper by a US-based research team of scientists, economists and policy analysts, headed by June Sekera of the New School for Social Research in New York.

The Serra do Mar forests on Brazil's Atlantic coast

To avert dangerous global warming, the volume of CO2 and other greenhouse gases pumped into the atmosphere, mainly from burning fossil fuels, needs to fall to zero. CO2 removal could help compensate for emissions that are harder to stop.

The amounts of CO2 that could be removed from the atmosphere by biological methods will never come close to the amounts being poured in by fossil fuel burning. But, over time, they could help – and will definitely go farther than the mechanical carbon capture methods beloved of some politicians, journalists and other techno-optimists. (See "Quick technological catch up", below.)

In the US, the total amount of CO2 now being removed from the air by mechanical methods is zero, Sekera and her colleagues found – while biological methods are removing about 0.9 billion tonnes per year (Gt/year).

That amount could be more than doubled by the preservation and restoration of forests, grasslands and wetlands, amplified urban tree cover and accelerated regenerative agriculture practices.

An additional 1 billion Gt/year of CO2 captured would equate to around one-fifth of current US emissions. So it is no substitute for rapid decarbonisation. But the research team's results provide good reasons to cut off the billions of dollars of funding going to mechanical carbon capture projects – or "a taxpayer-financed sewer system for the fossil fuel industry", as Kert Davies, director of the Climate Investigations Centre, called it.

In the US, mechanical methods of carbon capture (CCS and DAC) received $10.7 billion in subsidies from Congress in 2010-2021; $1 billion in tax credits in 2010-2019; and $12 billion in the 2021 infrastructure spending package – 66 times more than the $180 million included for new programmes related, only indirectly, to biological sequestration.

Under president Biden's Inflation Reduction Act of 2022, tax credits of $50/tonne for mechanical carbon removal was bumped up to $180/tonne for DAC and $85/tonne for point source carbon capture. The Act also set aside $27.6 billion for agricultural and coastal conservation, and forestry, but it is unclear how much of that will go to biological carbon removal.

Mechanical methods result in zero CO2 removals, Sekera's team explained, because, firstly, CCS only removes new emissions from fossil fuel burning, not CO2 that is already in the air; and, secondly, while DAC could "theoretically" result in net CO2 removals, in practice it does not – mainly because DAC powered by fossil fuels causes more emissions than removals.

Of 12 existing CCS projects in the US, 11 use the captured CO2 for enhanced oil recovery: it is pumped into the ground to increase pressure in an oil reservoir, to enable extra volumes to be produced – all of which, of course, produce more greenhouse gas emissions.

US government policy of supporting mechanical carbon removal has "a track record of failures", they added. An extensive review of CCS projects globally undertaken between 1995 and 2018 found that "the majority failed".

> Larger plants with higher capture capacity are more likely to be ended or put on hold; much of the world had cancelled projects (EU, Australia, Canada, China, US); and a "growing sentiment" that the risks associated with scaling up the technology to "learn" more are not worth the large investments required.

In the US, a review of public records in 2021 showed that all subsidised CCS projects at US power plants had failed. A federal investigation in 2020 found that carbon capture projects claiming the tax credit failed to meet a requirement to document geological storage of the carbon for $900 million of the $1 billion claimed.

Here in the UK, the Tory government is dragging public policy down the same path, of support for mechanical CO2 removal projects.

The Chancellor, Jeremy Hunt, promised to spend £20 billion on CCS in his Budget speech on 15 March – while, once again, refusing to commit funds to home insulation and onshore wind. (More detail here.)

Kevin Anderson, professor of energy and climate at Manchester university, commented that there is "little, if any, merit" in making CCS a major plank of policy, "given the huge cost, very high life-cycle emissions, and appalling record of working as promised".

As if to prove his point, researchers who work on CCS, in a letter supporting the government's approach, could only point to projects at the Snohvit and Sleipner gas fields, in the Norwegian section of the North Sea. These projects, among the few working CCS projects in Europe, enhance gas production and thereby support fossil fuel burning.

The headline conclusion reached by Sekera and her colleagues – that biological methods of removing carbon dioxide from the atmosphere are more effective and resource-efficient than CCS can ever be – is borne out by the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, the final Synthesis of which was published on 20 March.

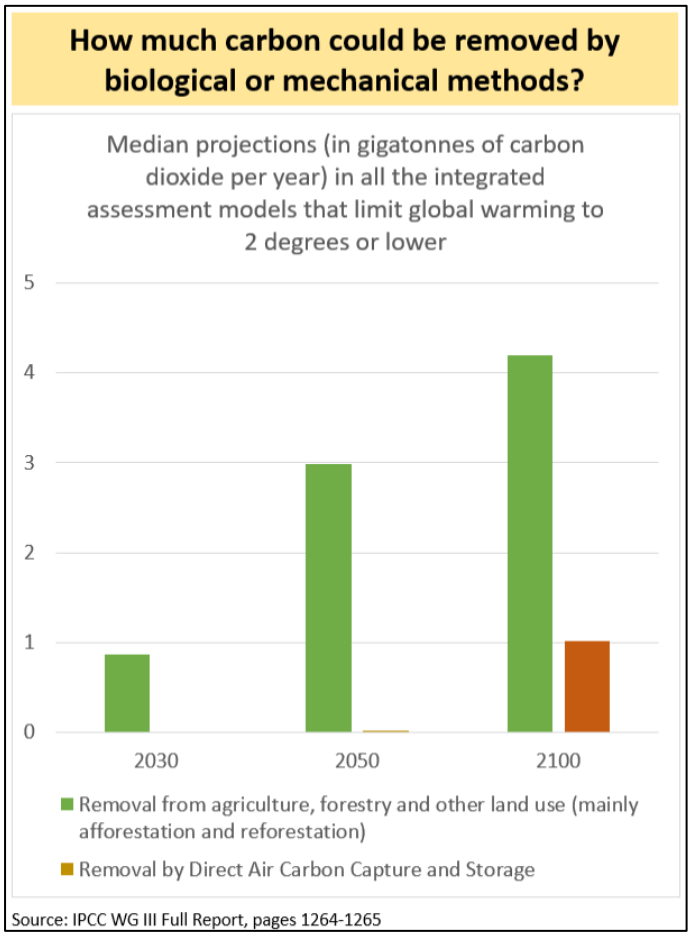
Sekera wrote:

> Both my research and the IPCC's findings show that the more effective, and faster, way to remove billions of tonnes of CO2 from the atmosphere is to restore and expand the carbon sequestration capabilities of plants and soil. So long as biological sequestration is not connected to carbon "offset" schemes, it can be powerful tool to address climate change.

The IPCC's Working Group III report, on mitigation of climate change, shows that the consensus among researchers is that, by 2030, **NO** CO2 will be removed from the atmosphere by mechanical methods.

Estimated levels of greenhouse gas removal are shown in the graphic. These are median levels, derived by the report's authors, from scenarios worked out by teams of climate scientists using computer models. They have only included scenarios that assume global warming will be kept below 2 degrees above pre-industrial levels.

The median estimate for mechanical CO2 removals in 2050 is just 20 million tonnes, less than one percent of removals by biological methods. Only in 2100 does the forecast of mechanical removals creep above 1 billion tonnes – about one-fortieth of the volume of CO2 pumped into the atmosphere in 2021.



In other words, not only have researchers shown that biological CO2 removal works now, and will always be more effective than mechanical methods, but also there is a consensus that mechanical methods will never play a major role in tackling global warming.

Sekera and her colleagues framed their conclusions as policy advice to governments, that:

□ "Public funding for mechanical methods should be ended or narrowly restricted";

□ Public funds should be invested directly in proven biological methods – not "offset" programmes or "carbon credits", which undermine the methods' effectiveness and are often damaging to indigenous peoples who live in or near forests; and

□ Public funds should be put into measurement and monitoring technologies to track the effectiveness of carbon removal.

Three more points came to my mind when reading this research.

First, neither Sekera's research team, nor this blog, are suggesting that biological CO2 removal is a magic bullet to tackle climate change. No serious researcher would.

David Ho, an oceanographer who has worked on CO2 removal for many years, last week put it like this: deploying either biological or mechanical removal techniques "is pointless until society has almost completely eliminated its polluting activities".

Furthermore: the biosphere is complex. As a carbon store, it towers above mechanical methods, but is not perfect. And CO2 removal needs to be considered alongside other uses of land, including agriculture. A research team based in Australia suggested last year that no more than 103 billion tonnes of CO2 could be biologically removed in the 80 years between 2020 and 2100 – lower than other estimates.

Second, Sekera and her colleagues highlight the dangerous role played by "carbon offsets" and the commodification of nature as "eco-system services".

These ideas, nourished by the intergovernmental agreements on climate change, provide for rich countries and companies to continue large-scale pollution from fossil fuel burning, while paying others for biological sequestration of carbon. Monitoring is insufficient and by its nature inconclusive. But it is already clear that these schemes often damage economies in the global south while failing to achieve the CO2 reductions they claim to make.

Third, Sekera and her colleagues have powerfully underlined that no technology is socially or politically neutral.

Their research shows that technologies that do not effectively remove CO2 from the atmosphere, and may never do so, have been lavishly funded by governments. Mechanical CO2 removal is hyped by "techno-optimists", not only in oil companies, but also across the media and universities – while a veil of silence covers technologies that work, that work alongside nature rather than against it, and that can be rapidly and effectively put to use.

This sabotage of effective action on global warming is a social process involving all the power structures of global capital, not just a conspiracy of a few oil companies and politicians.

These are issues of obvious importance in wider discussions about how to bring together action on climate change with action on social justice. *SP, 13 April 2023.*

How the research was conducted

To compare biological and mechanical methods, June Sekera and her colleagues developed a method of measuring whether and how they were meeting "collective biophysical need", that is, humans' need to avert dangerous climate change.

They measured *effectiveness* (does the process achieve a net removal of CO2 from the atmosphere?); *efficiency* (at a scale relevant to the climate problem, i.e. removal of 1 Gt/year, how much energy and land are needed); and *co-impacts* (significant co-benefits or adverse impacts).

The research did not cover carbon offsets, due to their widespread ineffectiveness and misuse. Nor did it look at Bio Energy with Carbon Capture and Storage (BECCS), which is a method of energy production rather than a CO2 removal method (see below).

Quick technological catch up

Direct air capture (DAC) is a group of mechanical techniques for extracting CO2 from the air. The biggest difficulty is that they require large amounts of electricity and other inputs. More here.

Carbon capture and storage (CCS) is a group of methods for extracting CO2 emissions during or after the burning of fossil fuels. CCS can not result in net reductions in the level of CO2 in the atmosphere, because CO2 is first added to the atmosphere before being subtracted, even in the best case with leakage and inefficiencies, while energy (often produced from fossil fuels) being expended for the CCS process itself. More here.

Bio Energy with Carbon Capture and Storage (BECCS) is a speculative technology, untested at scale, for growing biomass, combusting it as fuel, and capturing the carbon with CCS. Scientists have criticised the IPCC for including implausible levels of BECCS in many of its projections. More here.

Also relevant

□ Carbon Capture Won't Fix our Climate Problem, by June Sekera

□ Carbon dioxide removal sucks. There are better ways to tackle global warming, People & Nature

□ Geo-engineering: let's not get it back to front, People & Nature

□ Research on nature-based solutions (by Cécile Girardin and others in *Nature* journal, 2021), and national climate strategies (by Harry Smith and others in *Communications Earth & Environment*, 2022)

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