

## **COP28 PRIMER: CO<sub>2</sub> Removal and the Dangerous Myth of ‘Net Zero’**

Humans spew 50 billion tons of CO<sub>2</sub> and other greenhouse gases into the air each year. Scientists tell us we must bring those emissions down to zero by mid-century to avoid suffering the worst climate impacts and crossing key tipping points, like the melting of the great ice sheets.

Net zero is the idea, the hope, that we don’t have to reduce global emissions to near zero because various CO<sub>2</sub> removal strategies will scale up rapidly to suck the equivalent of our remaining CO<sub>2</sub> emissions out of the air each year, perhaps [10 billion tons](#) a year or more.

But the latest science shows [the 3 most prominent removal strategies](#) by far do not scale and two of them make things worse. These three are planting trees; direct air carbon capture and storage (DACCS), which pulls CO<sub>2</sub> out of the air and buries it; and bioenergy plants with carbon capture and storage (BECCS), where growing biomass removes CO<sub>2</sub> from the air and a BECCS system buries it.

The last two worsen things as two new UPenn reports explain: First, [“Why scaling bioenergy and BECCS is impractical and would speed up global warming,”](#) presents new modeling that shows **scaling up BECCS is not carbon removal and is more like deforestation**. Second, [“Why direct air carbon capture and storage \(DACCS\) is not scalable and ‘net zero’ is a dangerous myth”](#) explains why scaling up DACCS would be a costly misuse of a vast quantity of renewables through at least 2050.

A [2022 review](#) by the European Academies’ Science Advisory Council—the “collective voice of European science”—noted that **“up to 20 times as much energy is required to remove a tonne of CO<sub>2</sub> from the atmosphere than to prevent that tonne entering in the first place.”**

DACCS and BECCS have a combined problem. Sequestering just 3 GtCO<sub>2</sub>/a year—6% of total emissions—would mean capturing, transporting, and storing a volume of compressed CO<sub>2</sub> [greater than the amount of oil](#) extracted each year by the global oil industry, **which took a century to develop**. In the U.S., CCS could require [60,000 miles](#) of new CO<sub>2</sub> pipelines—even though building a single new pipeline is increasingly difficult, and 1,300 miles of planned CO<sub>2</sub> pipeline [were scrapped last month](#).

Planting trees is also not scalable as you must plant a vast number of trees over huge tracts of land to make even a small difference, as [Climate Interactive modeling](#) has shown. **Planting one trillion trees would at best remove just 6% of the CO<sub>2</sub> needed by 2050** to avoid the worst warming impacts. **That would require an unrealistic amount of land—over two billion acres, which is over 2 billion football fields, larger than the area of the lower 48 states.**

But studies suggest the world may need over [a billion acres](#) of good agricultural land just to feed everybody in 2050. And a [major UN report said in 2021](#), “agricultural systems [are] breaking down” and so “There is little room for expanding the area of productive land.”

Thus, carbon dioxide removal (CDR) has been overhyped, and **“We must be prepared for CDR to be a failure,”** as a [2023 Nature](#) article warns. So, the idea we can overshoot a temperature target by 2050 and then turn global emissions massively negative to quickly cool back down is magical thinking.

“In private, scientists express significant skepticism about the Paris Agreement, BECCS, offsetting ... and net zero,” argued [three leading climate scientists in 2021](#). Recent studies and analyses make clear that all these supposed climate solutions deserve significant skepticism—expressed in public.

We should invest in R&D and demonstration of promising CDR strategies to see if any might be usefully scalable by 2050. **But right now, we must rapidly deploy carbon-free energy in every sector or the Paris targets will be overshoot irreversibly on a century timescale. Fortunately, the world has the technology and money to meet the targets.**

*UPenn PCSSM primers aim to quickly inform COP28 decision-makers about problems with specific climate solutions.*

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