



**MIT  
Technology  
Review**

# **Carbon removal hype is becoming a dangerous distraction**

Corporations and nations are touting plans to suck greenhouse gases out of the air. But the crucial priority this decade is slashing emissions.

**James Temple** | July 8, 2021

**In February, oil giant Shell trumpeted a scenario in which the world pulls global warming back to 1.5° C by 2100, even as natural gas, oil, and coal continue to generate huge shares of the world's energy.**

Among other things, Shell's pathway involves rapidly installing carbon capture systems on power plants, scaling up nascent machines that can suck carbon dioxide directly out of the air, and planting enough trees to cover land nearly the size of Brazil in the hopes of absorbing billions of tons of the greenhouse gas.

This plan might be transparently self-serving, but Shell's outsize ambitions for carbon removal are far from anomalous. A growing number of companies are setting up programs to create or trade carbon offsets, using tree planting, soil management, and other means to purportedly

balance out emissions elsewhere. Meanwhile, numerous corporations and nations are announcing "net zero" emissions plans that rely upon these programs, and rapidly proliferating carbon-removal startups are highlighting what some consider overly rosy projections in their investor pitch decks.

The noise, news and hype are feeding a perception that carbon removal will be cheap, simple, scalable, and reliable—none of which we can count on.

"This topic is becoming so visible and so many people are pouring in, and a lot of it is just nonsense," says David Keith, a Harvard climate scientist who in 2009 founded Carbon Engineering, one of the first startups to attempt to commercialize so-called direct-air-capture technology. "It's adding confusion and thereby distracting from the set of immediate cost-effective actions needed to cut emissions," he added in an email.

## **Unrealistic expectations**

Global climate emissions continue to rise, ratcheting up temperatures and driving increasingly extreme heat waves, fires, and droughts. Since carbon dioxide persists for hundreds to thousands of years in the atmosphere, there's little scientific dispute that massive amounts of it will have to be removed to prevent really dangerous levels of warming—or to bring the planet back to a safer climate.

The question is how much. A variety of scientific models have put it at anywhere from 1.3 billion tons per year to 29 billion tons by mid century to hold global warming at 1.5°C. A 2017 UN report estimated that keeping the planet from heating past 2°C will require removing 10 billion tons annually by 2050 and 20 billion by 2100.

(A paper published in *Nature Climate Change* in June further complicated the matter by noting that removing tons of carbon dioxide from the atmosphere might not be as effective at easing warming as hoped, because the shifting atmospheric chemistry could, in turn, affect how readily land and oceans release their CO<sub>2</sub>.)

Ten billion tons is a giant number, nearly double the US's current annual carbon emissions. And there are limited options for large-scale carbon removal. These include direct air capture, the use of various minerals that bind with CO<sub>2</sub>, reforestation efforts, and what's known as bioenergy with carbon capture and storage (using crops as fuel but capturing any emissions released when they're combusted).

None of these options can be easily scaled up. Direct air capture is still prohibitively expensive and energy intensive. Using crops for fuel means snatching land from other uses, such as growing food for a swelling population. Yet suddenly, nations and corporations are increasingly relying, openly or implicitly, on large amounts of carbon removal in their net-zero plans, including those from oil and gas companies like Eni and Shell as well as businesses such as Amazon, Apple, Unilever, and United.

Venture capital firms are sinking at least tens of millions of dollars into early-stage startups promising to use machines, minerals, and microbes to draw down CO<sub>2</sub>, as well as those promising to verify and certify that all the removal is really happening.

"You are seeing lots of people making big promises right now, and they don't quite know how to keep them," says Klaus Lackner, director of the Center for Negative Carbon Emissions at Arizona State University, who pioneered the concept of direct air capture.

Jonathan Goldberg, chief executive of Carbon Direct, which advises companies looking to achieve net-zero goals, says corporate demands for tons of high-quality carbon removal currently outstrip the supply of reliable options "by orders of magnitude." And there's a large gap between what they're willing to pay per ton and the current cost for those limited dependable options, he adds.

All of this leaves the world facing a fundamental conundrum.

On the one hand, putting more money into carbon removal will help scale up—and drive down the cost of—technologies that will be needed in the future.

On the other hand, the growing excitement around these technologies could feed unrealistic expectations about how much we can rely on carbon removal, and thus how much nations and corporations can carry on emitting over the crucial coming decades. Market demands are also likely to steer attention toward cheaper solutions that are not as reliable or long-lasting.

## **Forest for the trees**

A 2019 Science paper claimed there's room to add nearly a billion hectares of trees around the globe, enough to draw down more than 200 billion tons of carbon. The authors declared it "one of the most effective carbon drawdown solutions to date."

Wide-scale reforestation offers numerous additional benefits as well, including protecting biodiversity, improving soil health, and providing valuable resources to local populations.

But researchers have roundly criticized that paper for significantly overestimating the carbon-removal capacity of those trees, underplaying the challenges presented by competing uses for that land, and including areas not particularly well suited to growing and sustaining forests.

It's simple enough to say, as Shell did, that we can just plant a Brazil's worth of trees. But people live in the places where those trees would go. And populations around the world have very different plans for their land, including housing, agriculture, livestock grazing, mining, wind farms, solar plants, and more. Notably, the oil giant's scenario advocated planting trees on the scale of the world's fifth-largest nation at the same time it was calling for a gigantic increase in the production of biofuels, which will also require vast amounts of land.

We've also seen repeatedly that the systems humans create to incentivize tree planting or preservation often overcount carbon savings or provide carbon credits for forests that weren't actually at risk of being cut down.

"Questionable, wonky, and often blatantly dishonest carbon accounting is rampant," wrote Lauren Gifford, a researcher focused on offsets at the University of Arizona, in an assessment of forest carbon programs published last year in *Climatic Change*.

What's more, trees naturally fall down and rot, which releases carbon dioxide back into the atmosphere. And climate change itself is making forests increasingly susceptible to fires, insects, and droughts.

So to make any real progress from a climate perspective, we don't just have to plant billions of trees. We have to plant and maintain billions more than the billions that are dying, burning, or being chopped down each year.

But one of the key things muddling the carbon removal conversation today is the notion that trees and other natural approaches are just as reliable and durable as higher-priced technical options, Keith says.

Forest offsets—which represent emissions either sucked out of the air by trees or not released because forests that might have been cut down were instead preserved—cost around \$5 to \$15 a ton. Meanwhile, the online payments company Stripe, which created a program aimed at helping to scale up carbon removal, agreed to pay Switzerland-based Climeworks \$775 per ton to remove CO<sub>2</sub> using its direct-air-capture technology.

Obviously, given the price difference, most bottom-lined-focused businesses will go with the former option. But they're not buying the same thing: while trees die and release their CO<sub>2</sub>, the carbon dioxide Climeworks captures is converted into minerals and stored away deep underground.

Lackner notes that the actual price of carbon removal through forests would be significantly higher if landowners were forced to bear the ongoing costs of monitoring carbon levels and the liabilities for additional carbon removal should their trees die.

"We can't let nature-based carbon removal set the market price, because for many reasons we've seen they're not reliable, not permanent, and very often not above and beyond what would have happened in the absence of such systems", says Duncan McLaren, a research fellow at Lancaster University's Environment Centre.

It's creating "a discourse that makes net zero seem like a relatively easy thing to accomplish at relatively low costs," he says.

## **Separating the goals**

So how can we strike the right balance, using carbon removal to reduce the rising dangers of climate change without allowing it to become a distraction from the higher priority of cutting emissions?

At a minimum, the world's legislators shouldn't allow lofty corporate net-zero goals and buzz about carbon removal to ease the pressure for aggressive climate laws and regulations that mandate emissions cuts or incentivize a shift to cleaner technologies.

"There will be a risk of fossil-fuel companies and others using carbon removal as an imagined way to not shift their business models as long as we don't have a mainstream plan for ending fossil fuels," says Holly Buck, an assistant professor in the department of environment and sustainability at the University of Buffalo.

Some argue that governments should also create separate targets to ensure that carbon removal (sometimes called "negative emissions") does not count toward emissions reduction goals.

"Failure to make such a separation has already hampered climate policy, exaggerating the expected future contribution of negative emissions in climate models, while also obscuring the extent and pace of the investment needed to deliver negative emissions," McLaren and others argued in *Frontiers in Climate* in 2019.

Sweden did a version of this, setting a goal of cutting emissions by at least 85% below 1990 levels by 2045 and relying largely on carbon removal to get the rest of the way to zero.

The European Union included a similar provision within the proposed European Climate Law, limiting the role of carbon removal to 225 million tons, or a little more than 2 percentage points of the overall goal: a 55% reduction in emissions by 2030.

"It is now set in stone that the overwhelming majority of the EU's mitigation efforts will need to be done by reducing emissions, with carbon removal helping to go the extra mile," wrote Frances Wang and Mark Preston Aragonès, both of the ClimateWorks Foundation.

## **Early stage and high risk**

Sally Benson, a professor of energy resources engineering at Stanford, says the money she sees flowing into carbon-removal startups today strikes her as very similar to the situation in clean tech in the 2000s, when investments poured into technologies that were very early stage and high risk.

Many of those investments didn't pay off, as companies developing advanced biofuels and alternative solar materials failed in the marketplace.

"I do worry a little bit that that's where we are with the carbon removal technologies," she said in an email. "Some of the ones that are most mature and likely to succeed and make a material difference, like BECCS [bioenergy with carbon capture and storage], are getting a lot less attention compared to less mature technologies like direct air capture and mineralization."

But she stresses that these are likely to be crucial technologies in the future, and "we've got to start somewhere."

Benson thinks we should spend the next decade doing what we know works—cleaning up the electricity sector, shifting to electric vehicles, and decarbonizing heating—while also significantly increasing investments into research and development for carbon removal technologies.

"Then we see what role they can play," she says.

**Source:** [www.technologyreview.com/2021/07/08/1027908/carbon-removal-hype-is-a-dangerous-distraction-climate-change/](https://www.technologyreview.com/2021/07/08/1027908/carbon-removal-hype-is-a-dangerous-distraction-climate-change/)