

Climate Solutions

This is how much we can cool the planet by burying carbon underground

Carbon storage is becoming a more mainstream climate solution, but the world won't have enough room to bury all our CO2.

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By Nicolás Rivero

There's a big question hanging over the global fight against climate change: How much carbon dioxide can humanity bury?

To stave off the drought, famine, poverty and deadly diseases caused by climate change, people need to stop putting greenhouse gases into the atmosphere. But the planet is so polluted that — even in the best case — temperatures will rise and then have to slowly turn the planet's heat back into the air and storing it somewhere.

Most plans for fighting climate change rely on burying carbon underground. But United Nations scientists have said some carbon storage projects won't meet climate goals. But we might not be able to bury as much climate pollution as we need, a study published Wednesday in Nature.

The researchers started with a map of all the places on earth where it's technically possible to pump CO2 into spongy layers of sedimentary rock. ✨ Then they crossed out all the spots near cities and drinking water reservoirs, next to fault lines where pumping carbon underground could trigger earthquakes, within nature preserves, and in places where storing carbon would be unrealistically expensive or possibly illegal under international treaties.

After all those places were eliminated in the analysis, Earth's total carbon storage capacity shrank from 13 trillion tons to about 1.6 trillion tons. That's the difference between being able to cool the planet by about 5 degrees Celsius, under the most optimistic projections, or being able to drop global temperatures by only 0.7 degrees Celsius, in what the scientists say is a more realistic scenario.

"It puts a ceiling on how high we can go and still reduce temperatures back down to the long-term temperature goal of the Paris agreement," said Matthew Gidden,  an associate research professor at the University of Maryland Center for Global Sustainability and the lead author of the study.

The global goal is to keep warming to 1.5 degrees — and right now, the planet is on track to warm as much as 3.1 degrees Celsius by the end of the century. If the planet heats up that much, we'll never be able to cool it down to a safe level with our limited carbon storage capacity, Gidden said.

In the United States, some companies have experimented with using carbon capture equipment to keep running fossil fuel power plants while burying their emissions underground. But the study argues there isn't enough storage space to keep burying those plants' pollution forever; instead, companies should stop CO2 emissions as soon as possible, and focus on using carbon storage to remove the climate pollution we've already emitted.

"If we consider this a finite resource, we need to be thinking very hard about what is the best way to use it," he said.

Other scientists who study carbon storage think the limit is much higher than what Gidden's team proposed. Companies that store carbon — mostly oil-and-gas drillers who inject CO₂ into wells to push out more fuel — have figured out ways to bury CO₂ without setting off earthquakes or poisoning drinking water, even in areas near fault lines and aquifers, according to Susan Hovorka, a senior research scientist at the University of Texas at Austin.

"I don't think this paper was very up-to-date on what practitioners are doing these days," she said. "These things that they're pointing out are things that are being dealt with successfully."

Plus, the Nature analysis considers storing carbon only in sedimentary rock.  That's by far the most common way to do it, and projects to store millions of tons of CO₂ per year in sedimentary rock are underway in places such as Norway. But other rocks, such as basalt, can also store carbon. An early demonstration project is reportedly storing thousands of tons of CO₂ this way in Iceland.

"Sedimentary rocks are not the only storage sites," said Greeshma Gadikota, a professor of earth and environmental engineering at Columbia University. "It's a huge underestimation of the limit."

But even experts who think Gidden and company lowballed the world's carbon storage capacity agree there's a limit to how much climate pollution humanity can bury, and people will soon have to stop producing so much pollution.

"This paper usefully reminds us that geological carbon storage is large but not limitless and should be

prioritized, Jennifer Wilcox, a professor of chemical engineering and energy policy at the University of Pennsylvania, wrote in an email, adding, “we shouldn’t use storage as a license to pollute when cleaner options exist.”

Still, Wilcox believes the situation is less dire than does Gidden, who estimated the world may run out of carbon storage space by 2200.

“If we ever approach a prudent global limit, that would likely be after we’ve already cut gross emissions deeply and are using storage mainly for hard-to-abate industrial emissions and durable removals — a high-class problem to have,” Wilcox wrote.

In fact, U.S. spending on cutting greenhouse emissions and on storing CO₂ have been slashed as part of the Trump administration’s rollback of former president Joe Biden’s climate spending.

“It’s not the showstopper that we’re going to run out of space for storage,” Hovorka said. “We’ve had the reverse problem. We can’t seem to get it funded.”

What sources are saying

“Our study is based on a rich body of research on carbon storage, first holistically assessed by the IPCC in 2005. Over the past 20 years, estimates... [Show more](#)

Matthew Gidden

Associate Research Professor at the University of Maryland

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