

Greenhouse gas removal 'not a silver bullet to achieve net zero'

UK scientists say carbon capture is 'hard and expensive' and focus must be on reducing emissions

Many of the UK's top scientists working on carbon capture technologies do not believe they will be developed and scaled up in time to reach net zero and [limit global heating to 1.5C](#).

Experts speaking at a Greenhouse Gas Removal Hub event in London warned that these techniques, including [direct air capture](#), biofuels, biochar, afforestation and enhanced weathering, are not a silver bullet and should make up just a fraction of the efforts to decarbonise.

Event organisers polled attendees (mostly scientific researchers, plus a handful of government officials and journalists) on whether they believed the carbon removal targets would be met. Of the 114 who voted, 57% said they were "not confident" the UK would meet the 2030 goals in the net zero strategy of 5m tonnes of engineered greenhouse gas removal, and 30,000 hectares a year of tree planting; 25% said they were quite confident, and 11% said there was no chance.

The scientists are taking part in a £70m [government-funded competition](#) to find the best ways to remove greenhouse gases from the atmosphere. These technologies are due to begin removing vast amounts of carbon dioxide from the atmosphere by 2030, with the hope being that the winning methods could be scaled up and ready for market in two years' time.

The government appears, on the whole, to be confident that carbon capture methods will be developed fairly rapidly. The Department for Transport has stated, for example, that greenhouse gas removal (GGR) technologies will enable Britons to take "guilt-free flights" by the end of next year, but those involved in the programme were less optimistic.

But when [shown a press release](#) from the government declaring that these technologies will enable net zero flights by 2023, Prof Mark Taylor, the deputy director of energy innovation at the Department for Business, Energy and Industrial Strategy (BEIS), seemed sceptical. He told the Guardian: "No, that's not the case. We've got to get people to believe this can work, but maybe that claim is a little bit cheeky."

Gideon Henderson, the chief scientist at the Department for Environment, Food and Rural Affairs (Defra), said: "GGR is hard and expensive. And we cannot afford to see it as a surrogate to compensate for continued emissions in sectors that can be decarbonised. It is not an excuse not to decarbonise, so we must drive down emissions anyway."

By far the most popular technology based on applications to the programme was direct air capture. This process involves removing carbon from the air, usually using giant fans, and heating it to a very high temperature. This carbon can then be stored in geological formations or combined with hydrogen to create synthetic fuels.

While ministers like this idea, those leading the programme believe it may not be the answer, due to the energy intensity required and how expensive it is.

Taylor said: "People see it as having the biggest market, there's been funding from American companies – it feels like a silver bullet, there are lots of people who like it. Ministers like it because they think: 'Oh, that sounds easy, you can take it out the air and that's it.' And that's the thing that gets investment.

"I'm very much on the fence as to whether it is the best solution. It's very, very expensive. So some of the other technologies may emerge as winners, but the good thing about our

competition is we pick the best one.”

Greenhouse gas removal methods being trialled with UK funding

Afforestation

Henderson said this is the “poster child” of GGR, because “everyone seems to love it, and it’s nice to have more trees”.

However, he said trees “are not a panacea” because of the amount of land they need, [which is taken out of food production](#), which then causes tensions with food security. There is also a tension between woodland, which has more biodiversity benefits but is slower growing, and forests, which grow quickly and lock in more carbon sooner.

Storing in soil

While storing carbon in soil is a popular method, according to Henderson there are concerns over how long the carbon can be stored in the soil and how it is measured. If the soil begins to release carbon again shortly after it is stored, this could cause problems, especially if it is not being measured effectively and counted in net zero targets.

He explained: “I think that if we see significant financial resources coming into this area to incentivise storing soil carbon without being able to measure it, and being sure of its permanence, there’s a risk of continued emission from storage which isn’t permanent or sufficiently well measured.”

Enhanced weathering

Dropping tiny rock particles into the sea in order to cause chemical reactions that lock carbon in the ocean is potentially a very exciting technology, but it is in an earlier stage than many of the other carbon capture methods. It has interesting potential, as the ocean stores carbon in higher concentrations than in the air. There is even hope that it could help to [reverse ocean acidification](#). However there are also concerns that the process could upset the delicate balance of the oceans.

Direct air capture

The idea of a machine that can suck carbon dioxide out of the atmosphere and stick it permanently in rocks is a very attractive one, and it is perhaps unsurprising that this is the most popular technology for scientists trying to solve this problem.

But it is currently a very energy intensive process. Taylor explained: “We need to use energy to extract the CO₂, the pure stream CO₂ from the solid, so what we’re looking for an integration that can drive down the costs of DAC, and particularly drive down the cost of extracting the CO₂ and the energy costs of extracting the CO₂. Because at the moment, there’s no point in capturing CO₂ from the air and then using natural gas to run a heat process to extract a pure CO₂ stream.”

Biofuels

While Henderson pointed out that this is carbon storage that is already happening at some scale in the UK, and could be “a really potent form of greenhouse gas removal”, there are concerns over biodiversity and pressure on land use. This is because growing the crops often creates a monoculture, and this land is taken out of production for food.

Biochar

Biochar is a stable, long-lived, charcoal-like product produced from heating biomass in the absence of oxygen. It is carbon-rich and can be applied to land to sequester CO₂ in soils for an extended period of time. This could be relatively easy and cheap, but there are concerns as to how long the carbon would be stored, and whether it would have any negative impacts on the soil.