NEGATIVE EMISSIONS

Clean carbon capture?

Some environmental campaigners have questioned the green credentials of combusting biomass for power. Meanwhile, carbon capture and storage advocates have bemoaned inconsistent policy regimes. *Jennifer Johnson* looks at whether a hybrid solution could make a useful compromise.

When it comes to the climate, policy ambition has yet to translate into fully meaningful action. While global greenhouse gas (GHG) emissions from fossil fuels are slowing, recent data indicates they're, at best, plateauing – and certainly not falling in line with the targets of the Paris Agreement. Estimates issued by the Global Carbon Project late last year had emissions from fossil fuels and industry rising 0.6% from 2018 levels.

In light of these figures, it's hardly surprising that much policy discussion in 2020 has centred around the prospect of actually removing carbon dioxide from the atmosphere.

Attendees at January's World Economic Forum in Davos notably threw their collective weight behind one CO2 removal technique: tree planting. Leaders of some of the world's most powerful companies – as well as President Donald Trump, a vocal climate sceptic – signed up to the 'one trillion trees' initiative at the conference. As its name suggests, the scheme aims to plant masses of trees by 2030 in an effort to sequester CO2. While many scientists have acknowledged the importance of forest restoration for global ecosystems, few believe the trillion trees strategy is a climate cure-all.

Finding feedstocks

Critics highlight the fallibility of forests – which can easily fall victim to fires or disease – and cite difficulties in measuring the precise quantities of sequestered CO2. In its recent land use report, the Committee on Climate Change (CCC), the UK government's independent climate advisory body, recommended that one-fifth of the country's agricultural land is released for carbon sequestration by 2050.

Some of this land should be devoted to low carbon farming, according to the report, and some should be devoted to afforestation, the process of planting trees where none grew before.

To reach net zero emissions by 2050, the CCC found that UK forestry cover must be increased from 13% to at least 17% by planting a minimum of 30,000 hectares of woodland each year. Forest residues could subsequently be harvested in line with sustainable guidance and combusted to generate heat and power.

Finally, emissions from this process could be captured and stored underground as part of a bioenergy with carbon capture and storage (BECCS) initiative. If executed properly, BECCS projects promise to produce 'negative emissions' – meaning they actually remove atmospheric CO2.

Fast growing energy crops such as miscanthus, a perennial grass with bamboo-like stems, may also prove to be a convenient biomass feedstock. Over the course of the next decade, the CCC has urged the government to facilitate a transition to BECCS-based heat and power. To execute this shift, policymakers will have to make some careful and considered decisions around land use. The large-scale planting of bioenergy crops, in particular, could have negative impacts on soil health and biodiversity.

Ultimately, BECCS feedstocks that aren't sourced sustainably will seriously hamper a project's environmental credentials. Some climate campaigners have raised concerns over the biomass supply chain at the Drax Power Station in North Yorkshire, which burns wood pellets imported from North America. The plant is currently piloting a carbon capture solution and has declared an ambition to be the world's first carbon negative power station in ten years.

Drax has defended the sustainability profile of its wood pellets, stating that they're made from sawmill residues and tree overgrowth that has been cleared to prioritise the health of forests. The company has also promised never to source biomass from sources that lead to deforestation. According to Dr Niall Mac Dowell, a Reader in Energy Systems at Imperial College London, carbon emissions from the

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shipping of Drax's wood pellets across the Atlantic are not significant enough to derail the project's negative emissions potential.

'Drax's approach – bringing in biomass from the United States and Canada – is absolutely fine,' Mac Dowell explains. 'In many cases, the amount of biomass you're getting per hectare of land is greater because the rate of growth is better in those climates. If you contrast that with the yields that we typically get here in the UK, for example, and the requirement for fertilisers, we're not winning.'

Measuring effectiveness

However, there are still some questions around the scalability of biomass production, as well as lingering uncertainties about the actual carbon removal potential of BECCS. In a paper titled *Net Zero and Beyond*, researchers from the think tank Chatham House questioned whether burning biomass for energy is inherently carbon neutral – and whether BECCS, in capturing and storing associated emissions, is by extension carbon negative.

In practice, a variety of variables determine how much CO2 is sequestered in biomass and how much remains in the atmosphere.

The true environmental profile of a BECCS feedstock can only be determined through a full carbon lifecycle analysis. This calculation, says the Chatham House report, must factor in the impacts of initial land clearance, losses of soil carbon during harvesting and supply chain emissions from the harvesting, process and transport of biomass. When trees are used, researchers must also consider the lengthy time delay until replacement forests are large enough to absorb CO2 at the same rate as their harvested counterparts.

In light of the uncertainties surrounding BECCS, Chatham House has recommended accelerating conventional emissions abatement measures so that the need for negative emissions technologies is minimised. The think tank states that BECCS has been deemed 'the pre-eminent carbon removal solution' due to its inclusion in some major integrated assessment models. But, the researchers urge, it should be considered alongside other negative emissions options – including afforestation and technologies that capture carbon directly from the air.

Evaluations of all methods 'need to be carried out on the basis of full lifecycle emission balances, as well as other local-to-global ecosystem and sustainability co-benefits,' reads the report. This is not to say that BECCS is somehow an unsuitable solution – just that it's no silver bullet or blanket fix for eliminating GHGs. As with any significant piece of energy infrastructure, policymakers must weigh the risks and rewards of investing in BECCS on a case-by-case basis.

'We've got to recognise that different countries will be more or less well-positioned to contribute to different parts of a negative emissions value chain,' says Imperial's Mac Dowell. 'For argument's sake, one will have a fantastic ability to rapidly produce sustainable biomass, and another will have a greater ability to consume and sequester that CO2.'

Mac Dowell urges countries with available carbon storage (depleted oil and gas fields or deep saline aquifers are preferred) to act swiftly: 'I'm concerned about the regimes for rapidly permitting and developing storage infrastructure,' he says. 'Let's crack on and do that.'

The time to act decisively on decarbonisation is now – and it's never been clearer that governments need all of the tools available to them to bring down emissions.