green alliance...

The case for a UK Office for Carbon Removal

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By James Elliott

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Summary

“Greenhouse gas removals will be essential, but they have associated complications.”

Reaching net zero greenhouse gas emissions will require rapidly scaling up new measures to remove CO_2 from the atmosphere. Greenhouse gas removal (GGR) techniques and technologies will need to reach a scale that enables many countries to have net negative emissions after 2050 to avoid the worst impacts of climate change.

The Intergovernmental Panel on Climate Change (IPCC) estimates that between 100 and 1,000 billion tonnes of CO_2 will need to be removed and stored by 2100 to limit global heating to 1.5°C.[1] The size of the global GGR market is estimated to grow to as much as $1 trillion a year in the 2030s.[2]

The GGR industry today is tiny, and only a small number of countries, the UK amongst them, have policies in place to expand it. These methods will be essential, but they have associated complications. They are often assumed to be fully equivalent to fossil fuel emissions, leading to the mistaken belief that they will enable emissions to continue in the long term, balanced by removals. But this is not the case, because their availability will always be limited and, at large scale, they can present serious risks to nature and the wider environment. Over reliance on them, rather than reducing emissions, is therefore likely to lead to the net zero target being missed.

As with other innovations, it is very unlikely that the market alone will grow the industry fast enough or

> “The UK has a credible prospect of shaping the global market.”

prioritise the most sustainable options. Recent accusations that large quantities of carbon credits traded on voluntary carbon markets are, in fact, ‘phantom credits’ that do not do what they claim highlight the dangers of relying on unregulated markets.[3] In the past the UN’s Clean Development Mechanism suffered from similar problems.[4]

The current limited market for GGRs already shows the classic hallmarks of market failure: lack of accurate information about quality and availability of GGR over time, lack of business incentives to act due to stable climate being a public good, limited GGR capacity leading to a tragedy of the commons and the failure to price in externalities such as biodiversity (see appendix two on page 33).

The advantage of being a small industry is that, at present, there are few vested interests working to deter policy makers from effective governance to correct these market failures. Similarly, the industry is young enough that the UK has a credible prospect of shaping the global market. This will mean being directional: the government needs to decide which sectors are entitled to claim the benefits of GGR and who will pay the costs.

For example, there is too little available GGR resource for it to offset the huge emissions from petrol and diesel cars, as Shell’s ‘Drive Carbon Compensated’ programme has suggested.[5] These emissions should instead be avoided, for instance with faster uptake of electric vehicles, rather than allowed to continue unabated with offsetting. Sector specific standards should set acceptable limits for GGR use, based on science, and they should have democratic legitimacy.

> “A new Office for Carbon Removal should oversee vital new governance architecture.”

We propose a body is needed to provide effective governance of the GGR industry.[6] A new Office for Carbon Removal should work with existing arm’s length bodies and regulators, to oversee vital new governance architecture. It is necessary because:

- Responsibility for GGRs is split across government departments and existing arm’s length bodies and regulators. This means that, without a specific focus on the industry, there is a risk GGR will develop in a chaotic and sub-optimal way.
- GGR needs to scale up quickly to cover the entire economy in a just a few decades. This pace and scale of growth needs clear direction.
- GGRs are diverse and complex and require specialist knowledge involved in their oversight and regulation.

The right allocation of GGR is the most difficult but not the only challenge to be addressed. As well as clearly defining what counts as legitimate residual emissions to be offset, an Office for Carbon Removal should also oversee:

- Mandatory standards to avoid greenwashing.
- Support for scaling up less developed and more costly options.
- Rules restricting the use of GGRs where there is a high risk that carbon removed and stored will be re-released into the atmosphere in future.
- Powers to investigate and intervene on the supply side to prevent scale and cost pressures causing further environmental harm.

The UK has the natural capital available, such as large geological stores, making it an ideal place to lead the world in GGR.[7] However, it is currently falling behind the US, the market leader.

Getting the governance of the industry right will help put the UK on track to net zero domestically and also help to create rules and institutional infrastructure to shape the global industry, giving the UK a central role in this potentially huge and lucrative international market.

“Getting the governance of the industry right will help put the UK on track to net zero.”

Options for removing carbon

> “There is a diverse range of options for removing and storing carbon.”

The UK government has set a legally binding target to reach net zero greenhouse gas emissions across the economy by 2050. However, by that date, some sectors, most notably agriculture, aviation and waste are still expected to be net emitters of greenhouse gases, meaning the residual emissions will have to be removed from the atmosphere and stored to reach net zero.[8] In the second half of this century, GGRs will be a vital technology in getting economies beyond net zero to ‘net negative’, to return the planet to safer levels of CO_2 in the atmosphere.[9]

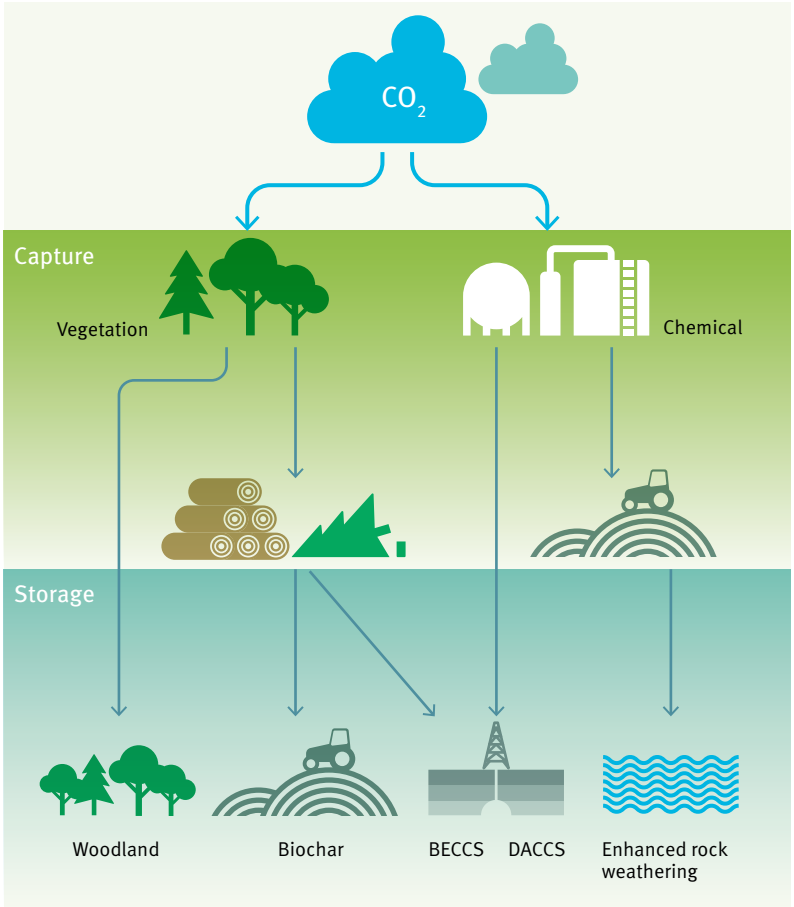
There is a diverse range of options for removing and storing carbon from the atmosphere. It can be biological, ie through the growth of living organisms, like trees or algae, or through chemical reactions.

Once removed from the air, carbon can be stored in living vegetation, in soil, in the ocean or in geological stores like disused oil and gas fields. GGR methods combine these removal and storage options in different ways. Some of the main types being explored are summarised below.[10]

Common greenhouse gas removal methods

GGR option	Removal type	Storage type
Woodland	Biological	Living vegetation, soil
Bioenergy with carbon capture and storage (BECCS)	Biological	Geological
Direct air capture and carbon storage (DACCS)	Chemical	Geological
Enhanced rock weathering	Chemical	Ocean
Biochar (carbonised organic material mixed with soil)	Biological	Soil

Methods of removal and storage



In the UK, new woodland is expected to play a significant role. There are also ongoing trials to develop 'engineered' options such as bioenergy with carbon capture and storage (BECCS) and direct air carbon capture and storage (DACCS).[11] These usually involve capturing CO_2 and storing it underground in geological reservoirs. There are also trials of other capture and storage approaches in earlier stages of development, such as enhanced rock weathering, where rock dust spread on the land reacts with rainwater to capture CO_2, biochar where charcoal is incorporated into soil and ocean storage where chemicals are added to sea water to change its acidity so it can absorb more carbon from the atmosphere.

The options have different implications regarding features like the length of storage, the risk of the carbon being

released again into the atmosphere, positive or negative impacts on the wider environment, energy use or production, and cost per tonne of CO_2 removed (see below). In this sense, not all carbon is equal, and different GGR options will have different roles to play in the journey to net zero and beyond. There is no clear consensus on the appropriate use or scale of different options at present.

GGR options compared

	Indicative storage duration	Risk of release	Environmental co-benefits and trade-offs	Energy use or production	Estimated cost per tonne CO_2e by 2030[12]
Woodland	10s-100s years[13]	Medium - high	Likely positive	Negligible	£2-23
BECCS	1,000s-10,000s years	Low	Likely negative	Production	£50-270
DACCS	1,000s-10,000s years	Low	Negligible	High use	£150-700
Enhanced rock weathering	10s-1,000s years	Uncertain	Uncertain	Low use	£150-900
Biochar	10s-100s years	Uncertain	Uncertain	Negligible	£14-130

GGR industry growth

> “This will mean the growth of an entirely new industry.”

In the UK and globally, the GGR industry needs to be scaled up rapidly, with the UK Climate Change Committee’s (CCC’s) balanced net zero pathway relying on engineered GGR capacity, going from zero today to around 25MtCO_2 by 2035 and around 60MtCO_2 per year by 2050 (excluding land based carbon sequestration such as woodland).[14]

The government’s carbon budget delivery plan similarly aims for engineered removals reaching 5MtCO_2 by 2030, 23MtCO_2 by 2035 and 75-81MtCO_2 by 2050.[15] For context, in 2020 the total emissions from UK power stations was around 50MtCO_2.[16]

This will mean the growth of an entirely new industry, roughly equivalent in carbon terms to the power sector, in less than two decades.

However, the total quantity of GGR required to reach net zero will depend on the extent of emissions reductions achieved up to 2050 by other means. For example, while the CCC’s pathway relies on about 52MtCO_2 a year of BECCS by 2050, our recent research shows that the net zero goal could be met more cost effectively by increasing land based carbon removals, through the restoration of habitats like woodland and reducing meat and dairy consumption (see the graph on page ten).[17]

In other words, there are choices to be made about the quantity of residual emissions considered acceptable to be removed in different sectors by 2050, and the best mix of GGRs to do this.

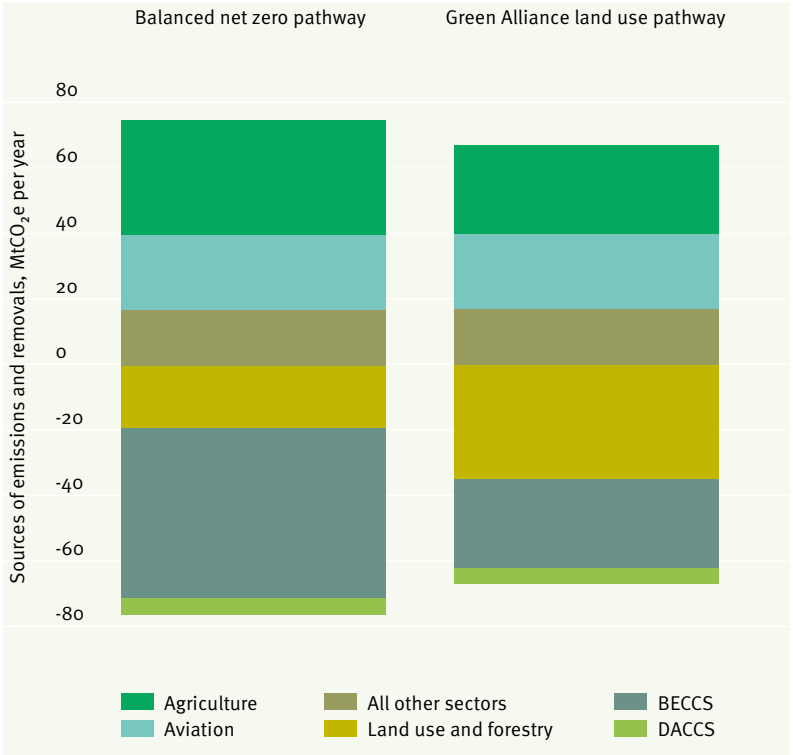
Furthermore, with the exception of DACCS, all the main methods we have outlined require land and this automatically places limits on how much capacity will be available. DACCS is limited by the amount of affordable

renewable energy available, as well as safe and accessible storage capacity. Therefore, GGR does not have infinite ability to balance out emissions across the economy, since emissions could easily outstrip the limitations of removal capacity.

In particular, storage methods that are reversible (ie could later emit carbon), such as trees and soil, should not be considered as permanent offsetting options for fossil fuel emissions.

> **“Greenhouse gas removal does not have infinite ability to balance out emissions.”**

The amount of GGR required depends on decisions about how much to decarbonise ‘hard to abate’ sectors[18]



The risks of scaling up

> “The only removal method deployed at scale in the UK has been woodland.”

As well as different technical options for removing and storing carbon, there are also different mechanisms for funding carbon removal. These are likely to be direct government spending, voluntary and regulated carbon markets.

So far, the only removal method deployed at scale in the UK has been woodland. Most tree planting has been funded through direct government grants for woodland creation. In England, the Woodland Creation Offer pays for capital costs of planting as well as maintenance payments for ten years and additional payments for the nature, flood, water quality and public access benefits. There is an intention to directly fund more trees on farmland, through the agroforestry and hedge options under the new Environmental Land Management payment schemes.

Voluntary carbon markets have also played a significant role in woodland creation: across the UK, a total of 3,421 hectares of woodland were planted under the Woodland Carbon Code (WCC) in 2021-22, accounting for just over a fifth of the total planted in that year.[19] There are plans to extend voluntary markets for natural solutions via a new UK Farm Soil Carbon Code and a Hedgerow Carbon Code, and the government’s 25 year environment plan commits the UK to expanding voluntary carbon markets.[20]

Pre-commercial GGRs, like BECCS, are supported by demonstration grants, for example through the UKRI’s Greenhouse Gas Removal Demonstrators Programme.[21] The government believes a contracts model, like contracts for difference for the UK electricity market, will be the best option for funding the scale up of engineered GGRs. [22] It has consulted on contract options, which would provide certainty to project developers over the minimum price

they would be paid while, in some cases, allowing them to seek higher prices in private markets.

Over time – though with no deadlines set –the government intends to move towards funding via carbon markets. The consultation outlines options for both voluntary and compliance markets, such as the UK emissions trading scheme (ETS) or a new Negative Emissions Obligation, but there is no clear position on the route the government will take (see opposite).

> “The fundamental failures of the current market mean the net zero target could be missed.”

Because of the large cost differences between nature-based and engineered GGRs, it is unlikely voluntary markets would steer buyers towards engineered options at scale, unless voluntary carbon credit buyers start to value the longevity of geological storage more highly. Engineered GGRs are instead likely to be funded by a mix of direct government support and private funding through, currently undefined, compliance markets.

The government and businesses want to scale up GGR, but the combination of different options and their challenges presents a complex and uncertain future for the industry. The fundamental failures of the current market mean that the net zero target could be missed or environmental harm could be caused through unplanned development. These issues are not being properly addressed by current or proposed government policy.

In this report, we discuss five of the main challenges for GGR in more detail, and then outline our proposal for a new Office for Carbon Removal to correct market failures and address the policy gaps.

> “With no regulation to control how much businesses can use GGR to decarbonise, it is likely to lead to the over use of these methods.”

The inclusion of GGR in the UK emissions trading scheme (ETS)

The government has completed a call for evidence on various options to include GGRs in the UK ETS, as a way to scale up the GGR market.[23] It is likely that engineered GGRs would be top of the list for inclusion. But these options would present challenges.

The ETS does not include some of the big polluters, like international aviation, expected to have residual emissions in 2050. Leaving these sectors out of the ETS while bringing engineered GGRs in will put disproportionate costs on the sectors participating in the scheme to invest in engineered GGRs, while those sectors outside the scheme could continue to buy cheaper tree planting credits and avoid emissions reductions. This discrepancy highlights that more comprehensive obligations are needed on sectors to make the journey to net zero carbon emissions fair.

Mixing emissions reductions and GGR together in the same market (at least in the short term) risks suggesting that the two approaches are equivalent and is likely to deter efforts to cut emissions.

With no regulation to control how much businesses can use GGR to decarbonise, it is likely to lead to the over use of these methods without considering the sustainability impacts of large scale deployment. To counter this, a cap is needed on the total GGR that can be deployed under the ETS, informed by sustainability assessment.

The ETS would not be suitable for nature-based GGRs, since their comparatively low prices would undermine the market, and they have challenges with permanence. Nevertheless, they may have a place in a separate GGR market, provided careful limits are put in place. This could be linked to the ETS and include obligations for sectors outside the ETS to reduce and offset their emissions, with careful government scrutiny and enforcement of the rules.

1. Over stated claims of carbon sequestration

> “Residual emissions are likely to outstrip greenhouse gas removals”

Carbon offsetting schemes have had a poor track record, particularly in terms of the robustness of the estimates of how much emissions have been reduced or removed and their true additionality. For example, only seven per cent of the potential credits issued by the UN’s Clean Development Mechanism between 2013 and 2020 are estimated to be additional and not over estimated.[24] More recently, similar claims have been made about credits created by avoiding deforestation.[25]

The challenge can be due to fraud, but more often arises from a lack of robust evidence about the real impacts of an intervention. For example, removal claims are often based on modelled outcomes extrapolated from a small number of research papers, rather than measurements of actual removals and storage carried out.

Rainforest carbon credits[26]

Although they are emissions avoidance rather than carbon removals, scrutiny of rainforest carbon credits by *The Guardian, Die Zeit* and *SourceMaterial* has undermined confidence in voluntary carbon market standards.

The research argued that, of 94.9 million tonnes of forest carbon credits claimed through the private voluntary carbon offsetting standards business Verra, only 5.5 million represented real emissions reductions. Verra has now committed to phasing out and replacing its existing rainforest carbon credit standards.

The outcome of this is that residual emissions are likely to outstrip greenhouse gas removals. This increases the likelihood of missing the net zero target. Or, if there is good data available about the gap between claims and actual removals, the government is likely to have to pay to make up the gap through other means.

Another potential effect is stifling growth in the GGR market due to the lack of confidence amongst buyers in what they are buying and the appropriate claims they can make about it. This is explored further opposite.

2. Failure to grow the market fast enough

> “Lack of business confidence about the quality of credits could stifle demand.”

Currently, the only market for GGRs is in voluntary carbon offsets. However, lack of business confidence about the quality of credits available, as well as a lack of public trust in claims made, could stifle demand. There are already businesses which have set net zero goals which will not use removal offsets until they have completed their emissions reduction journey. While it is vital that businesses do not use offsetting instead of emissions reductions, there is an important role for GGR in offsetting emissions that cannot be reduced by other means at a particular point in time. These legitimate residual emissions will reduce over time, and for many sectors will be zero by 2050, but offsetting with carbon removals in the period between now and when emissions reach zero is important for preventing the build up of greenhouse gases in the atmosphere, and for increasing demand for GGRs, helping technologies to develop and scale up.

Lack of confidence stifling demand

In January 2023, the Net Zero Asset Owners Alliance announced it would ban members from counting carbon removal schemes towards their emissions targets before 2030 at the earliest.[27] The decision applies to alliance members and the companies they invest in, accounting for $11 trillion in assets. This decision was due to concerns about the quality of carbon offset credits in voluntary markets.

More fundamentally, voluntary carbon offset markets are unlikely to provide sufficient funding to scale up a range of GGR technologies. These have been growing, as 40 per cent of the largest 2,000 global businesses have set net zero goals, and nearly half of these plan to use offsets.[28] But it is questionable whether there will ever be sufficient pressure on all businesses, particularly those with low public profiles, to act voluntarily. A stable climate is a public good, so incentives are limited for any individual or business to act alone.

Different GGR technologies are at different stages of development and have huge disparities in costs for a tonne of carbon removed. If policy and markets treat them all the same, and focus on least cost options, then less mature but

potentially significant GGR options will not develop and grow fast enough.

Limiting the portfolio of options raises the risk of insufficient supply to meet future demand. It also increases sustainability risks. Wider environmental impacts and other externalities of technologies do not follow linear growth. For example, there are a range of potential feedstocks for BECCS with different levels of environmental impact. As the BECCS industry grows, it will become necessary to use less sustainable sources of biomass to feed demand (see more on this on page 20).

> “GGR technologies have huge disparities in costs for a tonne of carbon removed.”

The government’s intended ‘technology neutral’ approach risks favouring the cheapest and most developed technologies, leading to a lack of diversity and potential negative impacts from relying on the large scale deployment of a small number of options.

The government has consulted on business models for BECCS and DACCS, but further work will be needed to implement them and develop suitable models for scaling up other removal methods.

3. Risk of releasing carbon again without compensation

Different technologies have very different characteristics affecting their cost, duration of carbon storage, risk of reversal, additionality (whether removals are more than what would have happened anyway) and wider sustainability impacts. Of particular concern is the duration of storage and risk of reversal.

If one GGR unit is being used to compensate for a fossil fuel emission, there needs to be a guarantee that carbon will be safely stored over hundreds or thousands of years. For land based removals, like woodland, such a guarantee is impossible as it is easy for circumstances outside a manager’s control, such as disease, fire or other impacts of climate change, to cause trees to die and the carbon to be released into the atmosphere. In other cases, such as ocean storage, there is scientific uncertainty about whether carbon will be stored over long time periods.[29]

If reversible GGRs are used to compensate for fossil fuel emissions, it could lead to higher levels of greenhouse gas emissions in the atmosphere in future. Because of the timescales involved, even if legal safeguards are in place to assign liability to ensure the carbon stays stored or is replaced, businesses involved could cease trading over time. In this case, the government will bear the liability.

> “Carbon offsetting can deter businesses, individuals and governments from taking action to reduce emissions.”

4. Abatement deterrence

There is growing evidence that the perceived or actual availability of carbon offsetting, as a way to reach net zero emissions, can deter businesses, individuals and governments from taking all the action they could to reduce emissions.[30] If GGRs were truly equivalent in capacity to all the greenhouse gas emissions generated this would not be a problem. But this is not the case for two reasons.

First, there is uncertainty around storage. Offsetting could create a false sense of security and lead to a greater temperature rise in future than if it had not been used. If offsetting is used to justify higher emissions, and then the removal is reversed in future, the total greenhouse gases in the atmosphere could be greater than if no offsetting had been used in the first place. This effect is summarised in the table below.

> “There is a high risk of locking in high carbon business models and infrastructure.”

Poor quality offsetting can lead to higher net emissions

	Emission from producing product or service	Removals	Net emissions	Net emissions if removed carbon re-released
No carbon removal offset available	Zero (emissions reduced rather than offset, or consumers choose not to buy or use product/ service)	Zero	Zero	Zero
Carbon removal offset used	+1 (producer chooses to offset rather than reduce emissions, or consumer buys extra product or service due to net zero claim)	-1 (carbon removed to compensate for emissions)	Zero	+1 (net emissions higher than if offsetting had not been available)

Second, GGR capacity is not infinite. Physical, cost and sustainability places limits on what is available. The limits are still poorly understood and there is a high risk of locking in high carbon business models and infrastructure, on the mistaken assumption that removals will balance higher emissions.

Abatement deterrence could ultimately lead to residual emissions outstripping the sustainable supply of GGRs, due to a combination of physical limits (the amount of land available for woodland and biomass production, the capacity of geological stores etc); cost limits (the marginal cost of additional GGR capacity, once the cheapest options like woodland are used up); or sustainability limits (competition with food production, high energy use, impact on natural ecosystems and biodiversity). If this happens, either climate action will be too slow and the net zero target will be missed, or taxpayers will have to foot the high bill for GGR options the market will not pay for. Society will also bear the costs of any negative sustainability impacts like biodiversity loss (see page 20).

> “Greenhouse gas removal markets will seek the lowest cost of carbon, undervaluing the social and environmental sustainability implications.”

Fossil fuel offsetting vs agriculture

Fossil fuel companies have been one of the main buyers of woodland creation carbon credits, both internationally and in the UK.

BP is the single biggest holder of Woodland Carbon Code pending issuance units, which are the carbon emissions expected to be sequestered in future in woodland planted under the scheme, holding around a third of the units available.[31]

Shell also has its own large woodland creation scheme. This presents several problems. First, woodland carbon is by far the cheapest carbon removal technology and is likely to remain so. In the UK, Woodland Carbon Code credits usually cost between £10-£20 per tonne.[32] Of the engineered removals, commercially available DACCS is currently closer to £1,000 per tonne for individuals to buy and, even after scaling up, is expected to be several hundred pounds per tonne.[33] BECCS is over £100 per tonne.

By purchasing and holding the cheap pending issuance units, fossil fuel companies are hedging against much higher future prices and potential regulation. But, unless regulated, they could easily come to control all the potential woodland sequestration for decades into the future, presenting a problem for other sectors like agriculture, not currently in a position to buy GGR credits, but expected to have significant residual emissions in future. Therefore, more scalable but expensive GGR options for poorer sectors may have to be bought by the taxpayer, if wealthy polluting sectors have already moved to control the cheapest options.

5. Scale and cost pressures lead to environmental damage

GGR markets will seek the lowest cost of carbon, undervaluing the social and environmental sustainability implications. There are particular risks where removals lead to substantial changes in land use and management, such as in the case of woodland planting or crops for BECCS. Our research has highlighted the impact of changing land use on local communities which can result in strong opposition where public engagement is inadequate.[34]

Some standards, such as the Woodland Carbon Code, go some way to providing incentives to deliver environmental services, but are insufficient. This is because standards that address the sustainability impacts of individual projects do not also address the cumulative impact of large scale

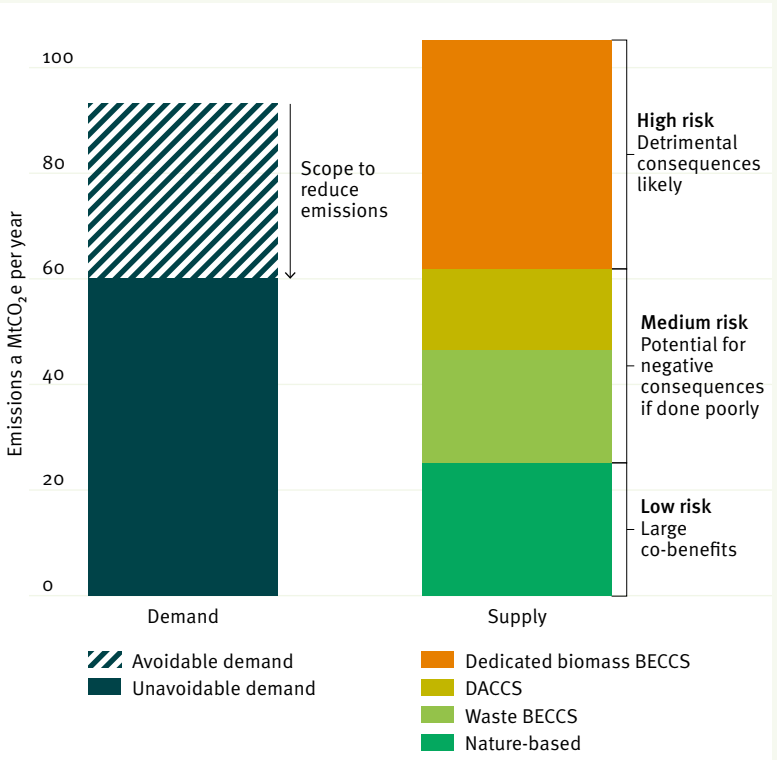
deployment. This is compounded by the fact that responsibility for different aspects of GGR policy and deployment is split across government departments (see appendix one, page 32). The result is likely to be that GGRs will be deployed in ways that damage nature, food production and local communities, both in the UK and abroad. There is some evidence that these pressures already exist in the bioenergy sector (see page 20).

The risk of unsustainability

In 2022, BBC Panorama alleged that Drax power station was burning wood sourced from clear felled, old growth forests in Canada, with long lasting and potentially permanent damage to local biodiversity. Drax's use of forestry residues from North America and Eastern Europe is driven by the economies of scale available. However, this type of biomass is arguably not sustainable at large scale.

As illustrated below, as the need for GGRs grows, it is likely to increase reliance on less sustainable options.

Demand and supply of engineered and nature-based GGR under the UK's Net Zero Strategy[35]



GGR governance requirements

> “To limit risk around this new industry, more effective governance is needed.”

With variation and discrepancies in the price and nature of GGR methods, the roles they should play in climate action are not clear, either at a business or economy wide scale. Trends in business investments, for example carbon offsetting used to make net zero claims, reflect this uncertainty, with radically different approaches taken.

Current policy is inadequate to address these risks, nor will businesses be able to solve them alone. Without a government steer, voluntary standards of varying quality will proliferate, while information failures and a tendency to prioritise least cost interventions will continue to drive investment towards a limited range of solutions, even if some businesses adopt best practice.

To limit risk around this new industry, more effective governance is needed. This was recognised by a government Monitoring, Reporting and Verification Task and Finish group in 2021.[36] It reflected our recommendation and proposed the establishment of a new regulatory function for effective GGR deployment. This was accepted by the government in its Net Zero Strategy.[37] The *Mission Zero* review in January 2023 also called for a new Office for Net Zero Delivery and regulation of voluntary carbon markets.[38] The parliamentary Environmental Audit Committee has also raised issues around governance and policy to deliver GGR.[39]

> “New rules should be introduced to govern how and when types of GGR can be used to offset emissions.”

New governance needs to fulfil the following five requirements.

1. Mandatory government approved GGR standards, where credits are being used to make carbon neutral or net zero claims.
2. Acknowledgement of the need for a portfolio of different GGR options and implementation mechanisms to scale up multiple technologies with different costs and from different levels of development.
3. Recognition that the varied nature of GGR technologies means they will each have different roles. New rules should be introduced to govern how and when types of GGR can be used to offset emissions, particularly those with a short storage life or where there is a high risk of reversal.
4. A clear definition of legitimate residual emissions for businesses in different sectors over time, and rules that only these can be offset with removals to make carbon neutral or net zero claims.
5. Adequate information and data on the sustainability impacts and future risks of different technologies, and limits on the type and scale of deployment where there is a risk of harm to people or the environment.

Why an Office for Carbon Removal is needed

> “Fragmented governance is unlikely to lead to the industry growing sustainably.”

Green Alliance proposes the creation of a new Office for Carbon Removal to fill the existing vacuum of governance.

Various proposals for new government bodies related to net zero have been proposed, including a Carbon Regulator proposed by the Energy Systems Catapult and an Office for Net Zero Delivery proposed in the *Mission Zero* review. While we have no argument against the establishment of these, there are a number of reasons why a separate government body dealing with GGR is needed.

Fragmentation

The GGR policy and regulatory landscape is complicated and fragmented, involving many areas of government policy and regulation, but very few have GGRs as their explicit focus (see appendix one on page 32). Fragmented governance is unlikely to lead to the industry growing sustainably.

The scale and pace of growth

GGR needs to grow from almost nothing to a sector managing as much CO_2 as the UK power industry produces today, within less than two decades. While regulatory functions around GGR could be given to existing bodies, like the Environment Agency, these bodies do not have a UK wide remit, or the resources to oversee all aspects of this growing sector.

Specialist knowledge

GGR involves very different mechanisms to capture and store carbon. Performance of storage, co-benefits etc also varies. While it makes sense for some functions to be carried out by existing regulatory bodies, for example around the geological storage of carbon in former oil and gas fields, it will also be important to centralise the specialist knowledge of the pros, cons, risks and opportunities. There is a lack of independent expert information about how techniques and technologies perform and compare, leaving potential business buyers struggling to judge the accuracy of claims made by those selling solutions.

See appendix three on page 34 for a detailed outline of existing policy and the governance gaps.

“There is a lack of independent expert information about how techniques and technologies perform.”

New governance alternatives

> “The choice for the government is to balance an appetite to intervene with the risk of failure to meet the net zero target.”

Outcomes will depend on the extent to which the government decides to intervene in the market. Here, we explore four possible levels of governance, ranging from a light touch where the market leads, with government intervention limited to support on monitoring, reporting and verification, to one where the government directly funds GGR with no market mechanisms.

The extent to which these options fulfil our five requirements and avoid risks varies. The choice for the government is to balance an appetite to intervene and shape the emerging market with the risk of failure to meet the net zero target or other environmental and social goals.

1. Standards and measurement, reporting and verification (MRV)

This approach would involve minimal intervention in the emerging markets. The Office for Carbon Removal would provide expert advice on the scale and mix of methods required, forecast future availability and costs, and monitor and report on deployment. It could also provide market oversight by establishing the baseline criteria for independently developed standards, verification bodies and rating agencies. It could set up a central database for MRV of GGR credits sold across the UK’s four nations but have no enforcement function.

This route starts to address problems caused by information failures and externalities. But its effectiveness depends on businesses not over relying on GGRs to fulfil their net zero strategies. Also, wealthier sectors like aviation and industry must voluntarily choose to use the more expensive GGR options, rather than buying up all the cheaper land based options. While standards help to ensure

individual projects are sensitive to wider sustainability impacts, there would be no safeguards against the cumulative impacts of multiple projects. Finally, the market failure whereby individual decision makers do not act collectively to protect a public good is not addressed, making it unlikely that market demand will be high enough to ensure sufficient scale up to meet the national net zero target.

> “The Office for Carbon Removal could provide clarity about which options are appropriate in different circumstances.”

2. Regulating and enforcing

This goes further than standards and MRV, with the government taking a more active role in standard setting and regulation of the claims that can be made around offsetting. As the governance body, the Office for Carbon Removal could, in this case, develop or commission standards and codes directly, investigating and enforcing breaches. It could also set rules around the claims made by users of carbon removal credits and obligations to reduce emissions before offsets can be used. Finally, it could provide clarity about which options are appropriate in different circumstances and ensure the costs of more expensive GGRs are shared with wealthy polluting sectors. It could set time and quantity constraints around the use of land based credits, eg for woodland.

This goes some way to addressing all five of our requirements at a project level, but it still leaves open the possibility of damage caused by wide scale deployment. For example, there may be several BECCS plants, which would individually meet the standards set but which together would put unsustainable pressure on land in the UK or abroad.

3. Directing delivery

This would involve the government taking a much more active role in directing the growth and deployment of the GGR sector. As well as setting and enforcing standards, it could outline an explicit framework specifying which sectors and businesses are allowed to use particular GGRs, and who is responsible for paying for them. It would regulate the quantity and location of credit supply to ensure any sustainability impacts are acceptable at the aggregate,

as well as a project, level. The government could also regulate business to develop net zero strategies that comply with its standards, which cap the level of GGRs available to different industries and set an obligation on big polluters to buy engineered removal credits. Carbon credits could be sold via a government body to ensure a mix of options is used, in line with its assessment of the scale that can be sustainably delivered.

“The government could also regulate business to develop net zero strategies that comply with its standards.”

This provides the most certainty that risks will be avoided, but it is a more interventionist approach. It assumes the government is able to determine what a suitable mix of GGR options is, and that it would not discourage investment in the UK. The advantage is greater certainty that the net zero goal will be met and that a strategic, spatially explicit approach to land resources would minimise conflicts and maximise environmental benefits.

4. Direct government purchase

In this case, the government would directly pay for enough GGRs to balance residual emissions and meet net zero by 2050. As with directing delivery, this would involve carefully regulating emissions reductions, but would not use any market mechanisms to direct and fund GGR deployment. This route would probably involve the government applying a levy on polluting industries to fund carbon removal.

What would an Office for Carbon Removal do?

> **“An Office for Carbon Removal would be the hub for new and existing functions to govern market development.”**

Our preferred version of new governance would sit somewhere in the middle of the spectrum of choices we have presented, between regulating and enforcing, and directing delivery.

Under our proposal, an Office for Carbon Removal would be the hub for new and existing functions to govern market development and growth effectively, in a way that meets the five governance requirements we have outlined.

Similar to bodies like Natural England, it could offer information provision and expert advice to government along with having some regulatory and oversight responsibilities.

Its basic functions could be to provide expert advice on the scale and mix of GGRs required, forecast future availability and costs, and monitor and report on deployment. But, to address all the requirements adequately, it could be given powers to develop and oversee the implementation of frameworks and rules on the supply side, around standards for credits, and around the appropriate use of different technologies on the demand side. It should limit the use of non-permanent carbon storage and define which emissions are genuinely residual, ensuring only they are offset.

Finally, it could be given powers to amend rules and frameworks to avoid threats to sustainability and biodiversity, and to create value through boosting the potential co-benefits.

Because GGR markets work across the UK and internationally, it would need to be a UK-wide body, drawing its powers and accountability from Westminster and the devolved administrations. It could work with a wide range of existing bodies across all UK jurisdictions to implement the new rules and frameworks. How we envisage this could work is summarised in appendix four on page 35.

Conclusion

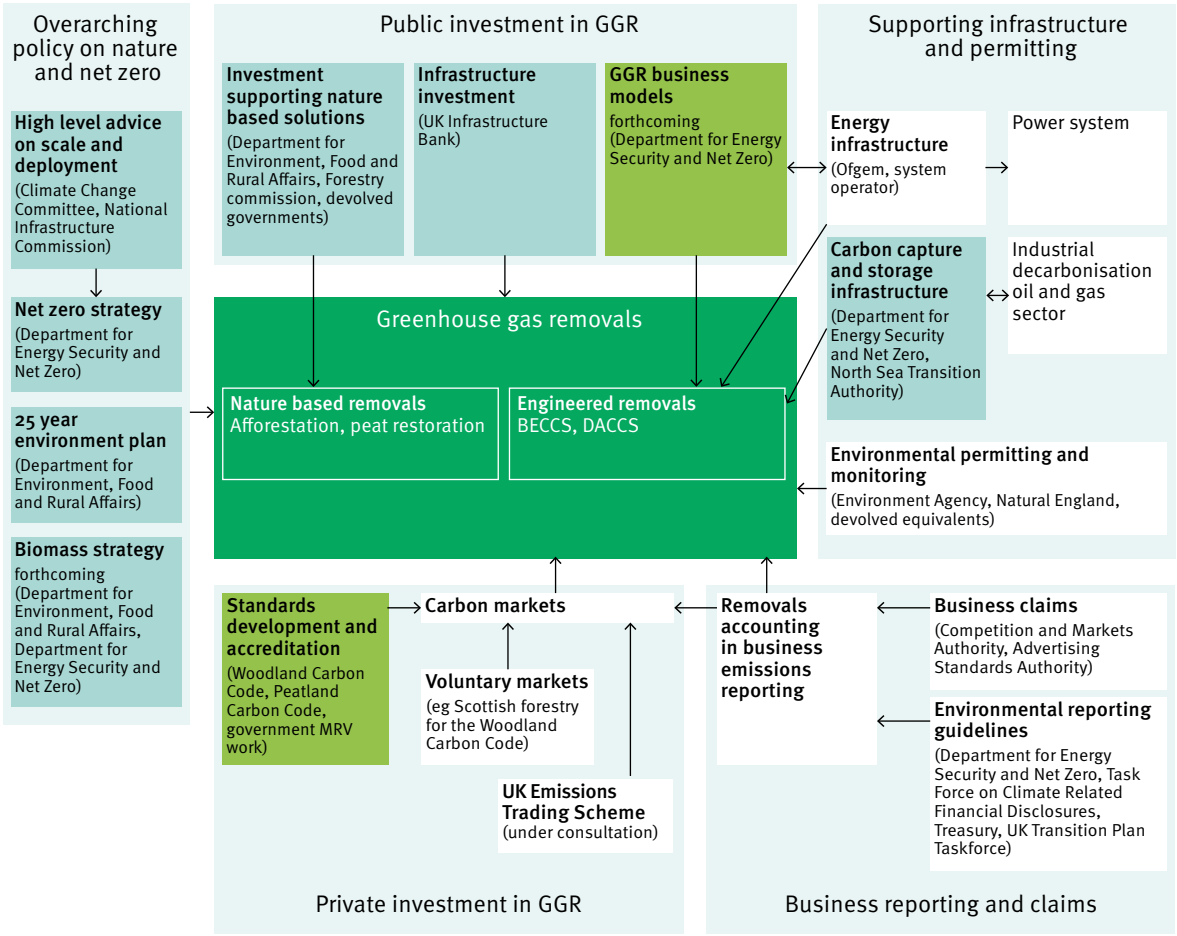
“The government should take an active role in shaping the market and setting its boundaries..”

Rapid growth of the greenhouse gas removal industry is vital to keep global temperature rise below 1.5°C and avoid the worst effects of climate change. To ensure this happens sustainably a new Office for Carbon Removal should be created that can:

- ensure removals do not lead to an over reliance on offsetting and delay in emissions reductions;
- provide certainty that removal credits are effective and of high quality;
- create a clear framework providing certainty around which types of removals are appropriate for which circumstances, who should bear the costs and which claims can be made by businesses relying on credits;
- investigate and take enforcement action to ensure the industry does not have unacceptable negative impacts on the environment and society;

For GGRs to scale up quickly enough to address climate change, while avoiding their most negative impacts on the environment, the government should take a proactive role in shaping the market and setting its boundaries. If done well, the prize will be to position the UK as a global leader in this significant new industry of the future.

Appendix one
The policy and regulatory landscape (analysis conducted in spring 2022)



Appendix two
Summary of market failures

Outcome	Cause	Underlying failure
Failure to meet net zero or disproportionate costs falling on tax payer	Over stated claims of carbon sequestration	Information (fraud or lack of robust scientific evidence)
	Market for GGRs fails to scale up fast enough	Public goods (insufficient business incentive to remove carbon); information (low confidence in market)
	Carbon is re-released and not compensated for	Externalities (lack of legal, market or other policy mechanisms to ensure liability for future releases is clearly taken)
	Abatement deterrence	Information (lack of reliable information about future availability and the price of GGRs; lack of understanding of qualities and value of GGR options)
Other environmental harms	Scale and cost pressures lead to damage eg to biodiversity	Externalities (negative and positive externalities of GGR technologies are not priced into the market)

Appendix three
Governance gaps

Risk	Existing and proposed schemes and policy	Gap	New governance needed
Poor quality credits	Woodland Carbon Code voluntary standard Soil Carbon Code voluntary standard in development Proposal for the British Standards Institute (BSI) to develop natural capital market standards Emerging businesses offering ratings services for offsets Competition and Markets Authority (CMA) and Advertising Standards Authority (ASA) guidance on environmental claims[40]	Voluntary approaches leave open the possibility of poor quality offsets used to make net zero claims. CMA and ASA guidance still relies on considerable engagement from consumers to understand claims, and only requires transparency about the basis for claims, without limits on what types of credits businesses can use to make carbon neutral or net zero claims.	Legal requirement to follow government approved removal standard when making carbon neutral or net zero claims.
Market fails to scale quickly enough	Various policy to increase woodland planting, including planting grants, agri-environment scheme funding, private and government carbon payments Consultations on business models for power BECCS, other BECCS and DACCS. Government funded research projects on other GGR options.	Woodland planting policies are not keeping pace with government tree targets, and they lag behind levels needed for scenarios where GGR options that present sustainability risks are limited, like BECCS using dedicated biomass. There is no consideration of frameworks necessary to scale up a wide range of GGR options in a context of technologies at different stages of development and with different underlying costs.	A GGR policy framework which provides for a portfolio of different options and develops policy for scaling up technologies that have different costs, qualities and are at different stages of development

Risk	Existing and proposed schemes and policy	Gap	New governance needed
Reversibility	The Woodland Carbon Code includes a buffer to compensate for up to 20 per cent loss of planted woodlands across the scheme. The government has consulted on the possibility of bringing land based carbon removals like woodland into the compliance ETS market.	There is no framework that acknowledges the different storage timescales and reversibility risks of different GGR options and places appropriate limits around how they can be used.	A framework outlining the roles that different GGRs can play in reaching net zero, with rules for what claims can be made on the basis of types of carbon removal, including the types of greenhouse gas emissions that can be offset by different types of GGR
Mitigation deterrence	Voluntary approaches to ensuring mitigation happens before offsetting eg Science Based Targets Initiative, BSI carbon neutral standard (PAS, 2060). High emitting sectors regulated under UK ETS have de facto emissions reductions over time.	Sectors falling outside the UK ETS have no requirement to reduce emissions. Most voluntary standards, including those using PAS 2060, do not distinguish between removal and reduction based offsets in making carbon neutral claims. There is no requirement to apply voluntary standards and approaches.	Government approved sector specific decarbonisation trajectories, based on climate science, with a requirement to have a plan to meet these trajectories for offsetting to be used to make carbon neutral or net zeroclaims. At least two separate targets (emissions reductions and carbon removal) for the economy, in addition to the overarching net zero target.
Wider environmental damage	Government biomass sustainability standards. Voluntary standards like the Woodland Carbon Code have requirement on where and how trees can be planted to ensure sustainability.	Allegations about the origin of forestry biomass used by Drax power station suggest sustainability standards are inadequate or are not being effectively enforced. Even if effective at a project level, biomass sustainability standards do not address the effects of overall scale of deployment. No policy is in place to ensure a range of GGR options to spread risk and limit negative impacts from each individual technology.	Gathering information and data on sustainability impacts and future risks of different GGRs. Limits on the type and scale of deployment to avoid harm to people and the environment.

Appendix four

The role of an Office for Carbon Removal in plugging governance gaps

Governance requirement	Role of existing bodies	Role of Office for Carbon Removal
Standards for GGR credits	Develop standards (eg BSI, Forestry Commission). Monitor, investigate and enforce application of mandatory standards (eg Environment Agency, Oil and Gas Authority etc).	Approve standards and commission development of new standards where necessary. On behalf of ministers, develop and oversee implementation of a framework of rules, for when and where application of approved standards is mandatory. Provide accreditation for market enablers such as ratings agencies.
Diverse portfolio of GGRs	Implement policy to support diverse portfolio of GGRs (eg Environment Agency, UK ETS Authority etc).	Regularly monitor and report on state of full range of existing and potential GGR technologies. Make recommendations on policy mechanisms to support growth of a diverse portfolio of options.
Rules limiting the use of non-permanent GGRs	Implement and enforce rules on use of different types of GGR (eg Advertising Standards Authority (ASA), Competition and Markets Authority (CMA), UK ETS authority etc).	On behalf of ministers, develop a framework of rules outlining which types of GGRs are suitable for which roles in the journey to net zero and beyond based on their qualities such as permanence and risk of reversal

Governance requirement	Role of existing bodies	Role of Office for Carbon Removal
Defining which emissions are genuinely residual at different points in time	Set standards for measuring and reporting emissions. Implement and enforce standards and net zero or carbon neutral claims (eg Environment Agency, ASA, CMA).	On behalf of ministers, develop and oversee implementation of a framework for determining realistic emissions reduction trajectories for different sectors, defining the level of acceptable residual emissions over time throughout the transition to net zero. Define rules ensuring that only genuinely residual emissions can be offset with suitable GGRs to make carbon neutral or net zero claims.
Monitoring, forecasting and action to prevent wider sustainability impacts of large scale deployment	Gathering and provision of data (eg Natural England, Forestry Commission etc)	Working with other agencies to gather information and carry out analysis to monitor and forecast potential sustainability impacts of scaled up GGRs, in the UK and internationally. Powers to update the rules and frameworks governing GGRs to avoid risks and take advantage of co-benefits.

Endnotes

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4 M Cames, et al., 2016, *How additional is the Clean Development Mechanism*?

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9 IPCC, 2018, op cit

10 Here we consider a selection of the most commonly considered removal options. There are other potential options, such as soil carbon sequestration, ocean carbon storage and peat and saltmarsh restoration.

11 See for example: www.ukri.org/what-we-offer/browse-our-areas-of-investment-and-support/greenhouse-gas-removal-demonstrators-directorate-hub/

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