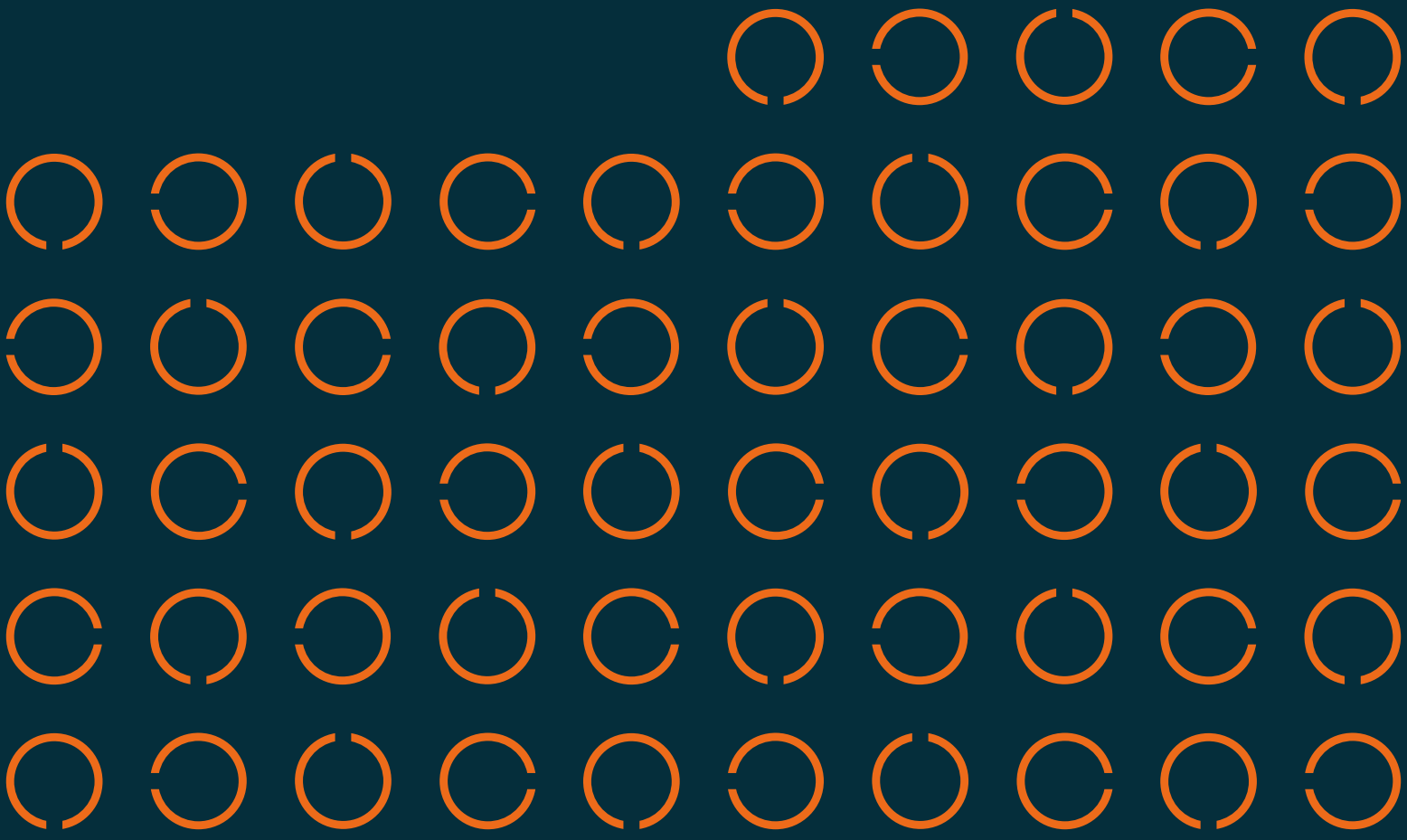
CO2RE THE GREENHOUSE GAS REMOVAL HUB

Delivering Greenhouse Gas Removal in the UK

Priorities for the government

Policy briefing

July 2024



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Introduction

Greenhouse gas removals (GGR), encompassing 'land-based', 'marine-based' and 'engineered' methods, remove greenhouse gases from the atmosphere and store them durably.[1] This group of methods will play an increasingly important role in reducing net emissions in the near term, counterbalancing residual emissions to achieve net zero by mid-century, and achieving net-negative emissions in the long term.[2] To realise these critical roles, a global GGR industry needs to be scaled up from the current low level of activity,[3] but not at the expense rapid of emissions reductions.

The UK is well placed to benefit from the many opportunities that the scaling up of GGR offers, and this scale-up is vital if the UK is meet its own climate commitments.[4] But it presents an unprecedented challenge: key technologies need to fall in cost, business models need to be developed, and economic policies and legal and regulatory frameworks need to be put in place, in a way that is acceptable to the public and socially and environmentally robust.

While the voluntary carbon markets have played a role in mobilising greenhouse gas removals, they cannot be relied upon to achieve the scale and quality of removals needed. Governments will need to step in to help address multiple barriers, requiring interventions on both supply and demand sides.

The previous UK government has already initiated a programme of R&I support and policymaking. The new government will need to go much further to put the UK firmly on track to scale GGR activity in a sustainable, credible and timely way, in order to achieve legislated climate requirements alongside meeting broader goals.

To meet this challenge, the UK government should:

1. Take a strategic approach to greenhouse gas removal (GGR) to maximise opportunities for the UK and manage risks:

i. Develop a strategy for GGR

ii. Be outward facing in the UK's approach to GGR

iii. Address the institutional arrangements needed to develop and deploy GGR technologies

iv. Keep options open, monitor progress and adapt.

2. Put public engagement at the heart of GGR policymaking:

i. Embed public engagement into decision-making through mandating a Citizens' Assembly that goes beyond purely determining 'acceptability'

ii. Develop best practice methods and guidance on community engagement and mechanisms for embedding it into governance

iii. Communicate GGR responsibly.

3. Harness the potential for the UK to lead on aligning climate and broader sustainability goals:

i. Embed GGR into broader strategies for sustainable development and vice versa

ii. Develop governance frameworks that ensure genuine sustainability and social responsibility at project level and as GGR scales

iii. Play a leading role in developing standards and rewards systems that create a level playing field across technologies and incentivise multiple outcomes.

4. Create robust and flexible routes for GGR scale-up that build investor confidence:

i. Take a holistic approach to policymaking by developing and testing policy 'bundles' that work across the full system of supply, demand and the enabling environment

ii. Develop flexible policies that reflect the diversity of GGR methods

iii. Support local authorities to deliver GGR approaches and solutions.

1. Take a strategic approach to GGR to maximise opportunities for the UK and manage risks

The government should:

i. Develop a strategy for greenhouse gas removal.
A strategy should set out a vision for how the UK can scale up the supply of credible GGR[5] in the UK and clearly signal government demand for GGR (for instance through targets). It should communicate how GGR can help the UK reach its climate goals while realising a broader set of economic, social and environmental opportunities and co-benefits, drawing on the UK's unique capabilities and assets. The strategy must address the key risks proactively, including risks to delivery timescales and to sustainability.[6] If not addressed these could jeopardise the UK's ability to meet net zero goals,[7,8,9] environmental obligations[10] and broader goals. Given the sustainability limits on GGR deployment, urgent emissions reductions must remain the priority.[11]

The portfolio of GGR options, including land-based, industrial and marine methods, comprises diverse methods with complex supply chains that cross sectors and regulatory contexts, national infrastructures and private interests. These methods also have varying co-benefits and trade-offs. A GGR strategy must therefore be fully integrated with broader net zero strategy and with other adjacent policy areas.[12,13] Integrated strategies will help to ensure the success of policies by highlighting synergies and trade-offs, identifying respective roles and areas for coordination, and bringing sectors and stakeholders along.

The permanence of GGR storage, and the risks of reversal,[14] are critical factors affecting the quality of GGR methods, and their ability to contribute to net zero.[15] GGR methods that involve geological storage are more durable than those using biological storage (see Box 1). These two groups of methods will require different governance approaches[16] (see also Section 4). There is a case for requiring like-for-like removals, whereby only GGR methods employing permanent storage can be used to counter fossil fuel emissions.

Box 1 – Carbon removal and storage types

Most carbon removal in Paris-aligned pathways involves sequestering carbon from the atmosphere and storing it in biological or geological reservoirs.

Carbon removal to the biosphere involves enhancing the carbon stored in the biosphere, such as by restoring healthy ecosystems (e.g., woodlands, grasslands, wetlands, and marine habitats) or enhancing soil carbon on agricultural land.

Carbon removal to the geosphere involves extracting CO_2 from the atmosphere and storing it in the geosphere, such as through direct air capture with geological storage (DACCS) or converting atmospheric carbon into rock through remineralisation.

From: Revised Oxford principles for net zero aligned carbon offsetting (February 2024)

ii. **Be outward-facing in the UK's approach to Greenhouse Gas Removal.**
A strategy needs to reflect the UK's unique context.[17] It needs to identify where along global GGR value chains the UK should operate to realise opportunities[18] and build UK comparative advantage globally. The UK can draw on learnings from policy developments and progress on GGR deployment in other countries,[19,20] as well as learnings from other policy domains such as renewable energy.

The UK can play a role in global GGR deployment. For example, the UK can support the development of credible climate finance flows to developing countries for funding GGR, as well as working in partnership with researchers from other countries to fill gaps in evidence[21] and building on existing global collaborations such as Mission Innovation.[22] It can also contribute to global governance,[23] drawing on its extensive research base and expertise.

GGR requires resources such as land, renewable electricity and a supply of biomass, all of which are constrained in the UK by limited land area. Resource constraints and other factors, including the UK's capacity for geological storage,[24] will determine how much of the UK's GGR requirements for its own net zero targets can be supplied domestically and how much will need to be supplied from elsewhere in the world. These decisions could impact other countries' emissions ('carbon leakage') and cause other impacts which will need to be addressed. Marine-based approaches, located in coastal areas or the deep sea, could greatly increase removal capacity but their efficacy in removing carbon, and co-benefits and impacts, are less well understood.[25]

iii. **Address the institutional arrangements needed to develop and deploy GGR technologies.**
The diversity of opportunities and challenges for the different technologies, the complexity of the GGR landscape and the question of how GGR is paid for all have implications for the optimal institutional arrangements needed to drive

innovation and deployment and safeguard environmental integrity.[26] This could be achieved either by expanding the remit of existing institutions or creating new institutions. The institution(s) will need to communicate the vision for the GGR sector and lead delivery of the strategy, with flexibility to evolve with changing circumstances. Lessons can be learned from current[27] and former public private partnerships.[28]

iv. **Keep options open, monitor progress and adapt.**
GGR methods are at varying technology readiness levels. Support for a breadth of options is needed initially, with the support gradually concentrated on fewer options as it becomes clearer which offer the most promise;[29] the challenge here is the short timescale for scaling up GGR. As methods mature, the policy focus for specific GGR methods will need to shift over time from support for 'learning by doing' to larger-scale planning and deployment. Any GGR plans will need to be flexible and adapt as novel GGR methods surface, evidence about the effectiveness of technologies and policies emerge[30] and/or circumstances shift. Tailored plans for individual GGR methods are needed.

A set of metrics and milestones for monitoring the UK's progress on GGR should accompany the strategy, with clear timelines for review. Good access to data, along with good visibility of what is going on 'on the ground' – including the pipeline of projects being delivered by both public and private sector actors – will need to underpin the monitoring and review process.

2. Put public engagement at the heart of GGR policymaking

The government should:

i. **Embed public engagement into decision-making through mandating a Citizens' Assembly that goes beyond purely determining 'acceptability'.**
The actual scalable potential of GGR will depend on sociopolitical factors, including public perceptions (and their influence on political mandates), uptake by relevant market actors and successful development of a social license to operate.[31] The question of how GGR will be funded, and whether costs are passed to consumers, will also affect public acceptability. Regional differences in public perceptions exist, highlighting the importance of considering both physical and social contexts – including historical contexts and where policies have been problematic in the past,[32,33] – when making decisions about GGR development and deployment.[34]

Understanding citizen views of GGR through upstream engagement[35] – engaging early and continuously with a diverse and inclusive range of general publics and local communities – can facilitate more ethical and effective technology development.[36] This understanding can also help shape the design of GGR governance arrangements which is essential, as public perceptions research shows that support for GGR is conditional on the appropriate responsible governance arrangements being in place.[37,38]

Government should mandate and organise a Citizens' Assembly that goes beyond purely determining 'social license' or 'public acceptability'. This will enable a broader discourse and the incorporation of views that can help shape successful GGR development and deployment. Citizens' Assemblies have shown great promise in other fields, as long as they are fully embedded in a meaningful policy process.[39]

ii. **Develop best practice methods and guidance on community engagement and mechanisms for embedding it into governance.**
Early inclusion and participation of local communities in GGR is vital; experiences from other technologies highlight the risks of a top-down approach without appropriate community engagement.[40,41] In practice, GGR community engagement is happening with a number of projects, but there is more to do to develop best practice approaches and embed these into governance processes.[42] The current project-led, ad-hoc approach to public engagement runs risks; for instance, from 'perception spillover' where people's perceptions are influenced by their views on other controversial technologies.[43] Government has a role to play in embedding a more systematic best-practice approach.

Government should support the development of best practice methods and guidance on community engagement that can be embedded into governance processes in a consistent and robust way, building out from public perceptions research and Citizen's Assemblies.

iii. **Communicate GGR responsibly.**
Communicating GGR presents a challenge due to low prior awareness and the risk of spillover effects from controversies in related sectors, as discussed above. The way in which the different technologies are framed can influence people's attitudes to the technologies. Developing responsible approaches to communicating and engaging with the wider public and potential adopters needs to become a priority.[44] For example, it is vital to avoid the sense that mitigation is not needed, to communicate both benefits and negative attributes and to be transparent about uncertainties.

Government should adopt responsible communication practices around GGR, drawing on the lessons emerging from evidence on public perceptions.[45]

3. Harness the potential for the UK to lead on aligning climate and broader sustainability goals

The government should:

i. **Embed GGR into broader strategies for sustainable development and vice versa.**
With the appropriate guiderails in place, GGR deployment presents the opportunity to pursue multiple sustainability goals concurrently with climate goals. These include: an equitable transition to net zero, socio-ecological sustainability[46] and new economic opportunities.[47] Conversely there are risks associated with large-scale deployment such as competition for land and renewable energy and food insecurity. Indeed, certain goals cannot be managed successfully in isolation from each other[48] and they reflect many of the priorities and concerns identified by the public in GGR public perceptions research.[49,50] The importance of aligning international climate, biodiversity and SDG agendas is already recognised by the UK government,[51] and internationally.[52]

The UK is well placed to be ambitious in its efforts to lead on aligning climate and broader sustainability goals through its GGR plans led by DESNZ, and ELMS[53] and the forthcoming Land Use Framework led by DEFRA. There is, however, currently a clear gap in connecting and following through on wider environmental objectives, as highlighted by the Office for Environmental Protection.[54]

The UK can monitor developments across the multitude of EU policies on technology, GGR and environment, but be more flexible and agile. While there is a continuing need for research and innovation that centres on co-benefits and trade-offs of GGR, and flexibility to incorporate new knowledge, there is also enough evidence to underpin initial decision-making.

ii. **Develop governance frameworks that ensure genuine sustainability and social responsibility at project level and as GGR scales.**
The sustainability of GGR depends not only on what type of GGR method is being deployed, but how it is being deployed and where. A clear definition of sustainability is required to underpin GGR project-level assessments,[55,56,57] by means of practical but comprehensive monitoring, reporting and verification (MRV) schemes that incorporate multiple outcomes, and not just carbon.[58] The risk of off-shoring environmental, social and ethical impacts can be avoided through establishing clear system boundaries and carrying out assessments of sustainability across the full supply chain, not just in domestic components.

As GGR scales, close monitoring along the life-cycle of activities can ensure consequential impacts remain beneficial.[59,60,61] Modelling upscaling goals with risks incorporated, combined with close monitoring, can provide the evidence base for decision making. Embedding the flexibility to limit certain GGR methods from scaling further, based on emerging evidence, will avoid unintended social and environmental impacts.

The government and its stakeholders have been at the forefront of developing standards.[62] Ongoing engagement between government and stakeholders will help to ensure the relevant environmental factors are sufficiently addressed in regulation to control how GGR is deployed and in certification schemes that incentivise sustainable GGR. The government can continue to learn from best practices in existing regulatory protocols/frameworks outside carbon markets. A strong regulatory function is needed that can look across multiple GGR technologies and multiple sustainability outcomes.

iii. **Play a leading role in developing standards and rewards systems that create a level playing field across technologies and incentivise multiple outcomes.**
The UK has embarked on developing its own MRV system for 'engineered' removals[63] and standards for nature markets.[64] Close collaboration between DESNZ and DEFRA will help to ensure fungibility across GGR technologies,[65] which is necessary for creating a level playing field and investor confidence.[66,67,68]

The government's MRV pillars[69] align closely with UNFCCC pillars for greenhouse gas MRV; these should extend to broader environmental and sustainability measures to ensure investor and public confidence. The government has the opportunity to use more stringent goals, that can then be used as a "tool" to push voluntary markets to act in a more ambitious, transparent and environmentally responsible way. Flexibility will be required to respond to new knowledge, and to coordinate and consolidate with international standards.[70]

As ELMS and nature markets emerge, MRV schemes will allow services such as biodiversity, food security, reduced flood risk or enhanced water quality to be rewarded concurrently with carbon sequestration. Collaboration between DESNZ and DEFRA will enable projects generating multiple outcomes[71] to be appropriately rewarded by 'stacking' or 'bundling' environmental goods,[72] and to limit the risk that one outcome is prioritised over another. Ongoing review of incentives will help to ensure alignment with changing national goals, technology readiness and scale-up.

4. Create robust and flexible routes for GGR scale-up that build investor confidence

The government should:

i. **Take a holistic approach to policymaking by developing and testing policy 'bundles' that work across the full system.**
A holistic approach to GGR policymaking will help to create a clear, predictable and investable market environment, allowing GGR providers to make long-term decisions.[73] Multiple policy interventions working together – policy 'bundles' – must address multiple barriers and work across the full system upon the:

- demand side – market-led or government-led options, fiscal incentives;
- supply side – finance, skills, innovation, infrastructure, other resources, such as land & energy;
- broader business environment – regulatory risk, public acceptability, policy risk.

Policy development should also consider the entire value chains of the different GGR methods, encompassing capture, transport and storage. Policies should undergo rigorous testing using a holistic set of criteria[74] in order to determine which systems of market-led, government-led or hybrid support will work best.[75] Demand-side policy and clarity on how GGR will be paid for is vital for attracting private-sector investment into the nascent GGR sector. A range of demand-side policy tools exist including Emissions Trading Schemes,[76] Contracts for Difference and mandated demand.[77,78]

ii. **Develop flexible policies that reflect the diversity of GGR methods.**
The characteristics of different GGR methods vary in terms of their cost, technological maturity, storage duration, risk of reversal and additionality (i.e. that the carbon removed by a project or activity is over and above what would have happened in its absence). This presents a particular challenge for introducing GGR into compliance markets.[79] In addition to taking account of their technological maturity, different policy regimes will be needed for different types of GGR according to their permanence,[80] a characteristic that fundamentally affects the climate impact of each method. Implementation will need to address MRV – a foundational element – as well as de-risking, durability, fungibility[81] and liability.[82,83]

Policy interventions need to be examined under different future scenarios so that they are robust and flexible as circumstances evolve.[84] The government's role may also change over time.[85] Policy development should be future-facing, reflecting the need to act fast and scale rapidly in the short term while anticipating the transition to the long-term compliance market and link to international carbon markets. It will also be important to maintain innovation support for technologies not yet integrated into the policy landscape.

iii. **Support local authorities to deliver GGR approaches and solutions.**
Awareness of GGR in local authorities is currently low, but GGR will need to be part of their own decarbonisation plans and play a role in how they influence area-wide emissions through the various policy levers they have at their disposal.[86]

Collaborative delivery involving government, regional agencies and local authorities will be needed to develop policies and solutions that harness local knowledge and networks and ensure GGR deployment is appropriate for the local geographical and social context. The government must provide guidance and frameworks that guide local authority decision-making on GGR, as well as playing a coordination role.

Endnotes

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Funded through the UKRI SPF Greenhouse Gas Removal Demonstrators (GGR-D) Programme, CO$_2$RE co-ordinates the Programme and conducts solutions-led research to evaluate a balanced portfolio of economically, socially and environmentally scalable Greenhouse Gas Removal options, with associated policy design, engagement and outreach.

For more information on the issues raised in this briefing, contact co2re@smithschool.ox.ac.uk.

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