GREENHOUSE GAS REMOVAL
RESEARCH PROGRAMME

UK GGR Research Programme

Policy Brief

Assessing Mitigation Deterrence effects of Greenhouse Gas Removal

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Summary

There is much debate about the potential for Greenhouse Gas Removal (GGR) methods to contribute to the attainment of net zero emissions, but not so much consideration about how GGR could delay or deter reductions in emissions. This lessening of efforts to reduce emissions due to the perception that GGRs can be used instead is known as mitigation deterrence (MD).

Mitigation deterrence matters. Assumptions that GGR can compensate for emissions that are hard to decarbonise, and remedy overshoots where cumulative emissions exceed safe limits to global warming, can undermine the pressure on policy makers and other decision-makers to accelerate mitigation efforts. This is problematic if GGR approaches do not fulfil their promises when they are deployed and scaled up.

The AMDEG project has developed a new framework to understand previously unconsidered mitigation deterrence effects of GGR and used this to conduct the first quantitative estimate of MD risk. This estimate suggests the deterrence of mitigation from GGR could result in a 1.4℃ overshoot of the 1.5℃ target by 2050.

Recommendations

GGR should be pursued, but alongside this the risk of MD should be taken seriously. The Assessing Mitigation Deterrence from GGR project proposes several recommendations on how to pursue GGR whilst minimising MD risk.

Thorough assessments that include MD risks should be undertaken using a wide set of criteria, going well beyond tonnes of carbon, price and resources used and including framing effects, power relations and justice impacts.

A key principle for developing policy for the safe pursuit of GGR is the separation of negative emissions from emissions reductions, to avoid MD processes involving unplanned substitution (McLaren et al., 2019) (see Box 1).

Robust systems of accountability must be developed, involving effective monitoring, reporting and verification to avoid double counting and to ensure that carbon is stored for the long-term, rather than diverted into short-life products, or unreliable forms of storage. Nature-based GGR techniques should be assessed with the same rigour as high-tech forms, to avoid similar risks of hype and exaggeration.

To prepare for the risk of MD there is a need to raise awareness in a way that does not polarise the views of those who see GGR as an important contribution to net zero and and those who see GGR as a source of MD. Instead there is a need to integrate both views into a low-MD GGR policy.

Separation of emissions from emissions reductions

- Separate targets for negative emissions and reductions in emissions.
- Redesign of offsetting and trading systems, so that the GGR techniques are protected from low carbon prices, at least until mature.
- Changed incentives and portfolio building, for example directed support for early stage development of a range of GGR techniques.
- Separate evaluation and assessment methods for negative emissions appraisals and emissions reduction options could be enabled by virtual information barriers similar to so-called ‘Chinese walls’ in finance sector. These could ensure that negative emissions and emissions reductions get rigorous assessment, unprejudiced by views about the potential for the other and independent of prospects of trading between them.
- GGR techniques that can be justified on the grounds of co-benefits should be supported on those grounds alone, and these co-benefits should not be treated as tradeable carbon.

BOX 1

1. Mitigation deterrence risk has been under-recognised

Different stakeholders apply the concept of GGR with different meanings (Markusson et al., 2018). In science and engineering, it is a set of proposed technologies to remove greenhouse gases from the atmosphere in the future. Whilst in climate modelling, GGR is an assumed set of methods to help keep climate projections within limits set by policy makers. In policy making it is an approach to reach targets.

Scientists and engineers depict the promise of GGR technologies, modellers incorporate these promises in their projections, and policy decisions about GGR based on these models become part of the target framing to which modellers work.

In all these areas of practice the potential of GGR can be exaggerated and side effects downplayed. Scientists and engineers depict the promise of GGR technologies, modellers incorporate these promises in their projections, and policy decisions about GGR based on these models become part of the target framing to which modellers work. As such, technology promises, modelling approaches, climate targets and policy debates have developed together. And typically in ways that have served to preserve the economic and emissions status quo (Markusson et al., 2018; McLaren & Markusson, 2020).

2. Mechanisms of Mitigation Deterrence

To be successfully deployed, GGR techniques need to be developed, tested, scaled-up, tested at scale, and embedded within society through policies, regulations, financing and skills sets.

Most of the modelling which demonstrates that GGR can allow us to stay within 1.5℃ warming has assumed future availability of GGR. The models focus on price and resource competition and downplay the interaction of GGR with mitigation. As such, current modelling work either omits MD risks or under-estimates them, especially in models that allow an overshoot of carbon budgets and heavily discount future costs.

Earlier research has identified debatable assumptions made in climate modelling about GGR and suggested that these assumptions

The solution lies in not only improved modelling but also addressing the wider dynamic between science, modelling and policy.

have already lessened the urgency felt by policy makers to accelerate mitigation efforts (Anderson & Peters, 2016; Beck et al., 2018; Fuss et al., 2014).

The assumption that a technology can deliver before it has been validated in the real world is not specific to GGR. Nor is its subsequent impact on mitigation (Markusson et al., 2017). Deterrence effects have occurred for past climate policy options; for example, Carbon Capture and Storage (CCS) on fossil fuel-sourced CO_2 (Markusson et al., 2017; McLaren & Markusson, 2020).

However, when it is assumed that GGR could reverse an overshoot of carbon budget, the risk of MD from GGR may be more serious than from previous technological promises. The solution lies in not only improved modelling but also addressing the wider dynamic between science, modelling and policy.

3. A framework to understand how mitigation deterrence effects arise

3.1. Substitutability and failure

Research by Markusson et al. (2018) suggests that MD-type effects are more likely when negative emissions technologies are perceived to be readily substitutable with emissions reductions. In turn this type of substitution is more likely to occur when climate policy goals are narrowly perceived, focussing on emitted or removed tonnes of CO_2 and ignoring environmental, social, economic and political side-effects (McLaren et al., 2019).

Such narrowly constructed substitutability is also at the heart of emissions trading (McLaren, 2020). Trading negative emissions for emissions reductions requires them to be 'fungible' – an extreme form of substitutability that views all emissions as the same, with no relevant qualities other than the warming potential (Carton et al., 2021).

Substitutability becomes a MD problem when GGR fails to deliver and failures are possible through lack of commercial or technical viability, and through inefficiency and leakage from assumed storage in forests, soils or underground reservoirs (see figure 1).

To estimate the extent of MD from substitution and subsequent GGR failure requires quantifying not only how much carbon might be at risk of performance failure but also what proportion of this was a substitute for planned mitigation actions.

3.2. Rebound effects

There is a range of indirect and typically unintended mechanisms through which GGR deployment could trigger additional emissions (see Box 2).

3.3. Imagined futures and mitigation foregone

Exchanging current mitigation ambitions for proposed future negative emissions from GGR is problematic as the promise alone may stimulate reductions in mitigation (this effect is known as moral hazard) and the GGR proposals may not materialise for technical reasons as mentioned above, or because of an inability to embed properly in society. If either

BOX 2

Examples of rebound effects of GGR

- If GGR produces compressed CO_2 suitable for geological storage it could be used in enhanced oil recovery (EOR) which has been done in early Bioenergy with Carbon Capture and Storage (BECCS) approaches. If this becomes an established revenue source for GGR it may support reliance on EOR and lead to continuation of emissions.
- If biomass growth is expanded for BECCS, the clearing of forested land elsewhere for growing these crops or other land use changes could negatively impact the carbon balance.
- If GGR technology relies on gas as a feedstock or energy source, the effects of methane leakage in the gas production or supply might offset, or even exceed, removals.
- Without accurate monitoring and effective regulation, GGR developers may continue to operate with these rebound effects which could lead to creation of more emissions than have been captured. As such rebound emissions effectively increase baseline emissions.

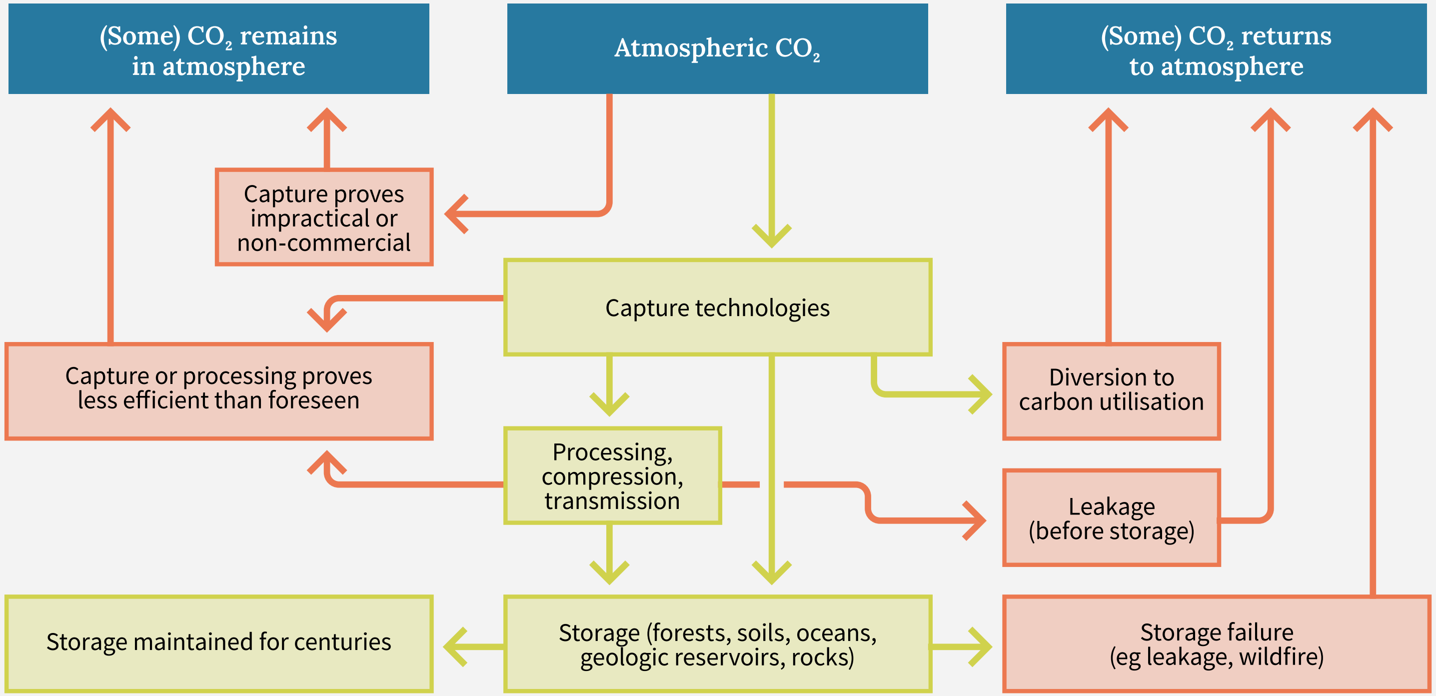

FIGURE 1: **Potential GGR Failure Routes (McLaren, 2020)**

of these occur they can become key mechanisms through which MD risks materialise (McLaren, 2020) (see box 3).

3.4. Political and economic drivers

Figure 2 illustrates the possible difference in mitigation levels up until 2100 for different scenarios when GGR is implemented and when MD occurs. It shows that when all three forms of MD occur, as in the third bar, the level of mitigation is much lower.

The current political economy, with its growth imperative, focus on market instruments, and financialised economies, is likely to increase risks of all three forms of MD. These conditions drive fungibility, and maintain the status quo of industrial practices with their exploitation of existing natural resources.

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BOX 3

Example of mitigation foregone

In attempts to demonstrate corporate responsibility many companies promise to achieve future carbon neutrality of their actions, for example through planting trees. The pledge to do this is considered a license for the company to continue emitting to the level of the promised carbon capture, even though there is no contractual security in place to ensure that removals from tree planting will be available to that business. If the offsetting does not happen in practice, then companies have made no attempt to mitigate their emissions.

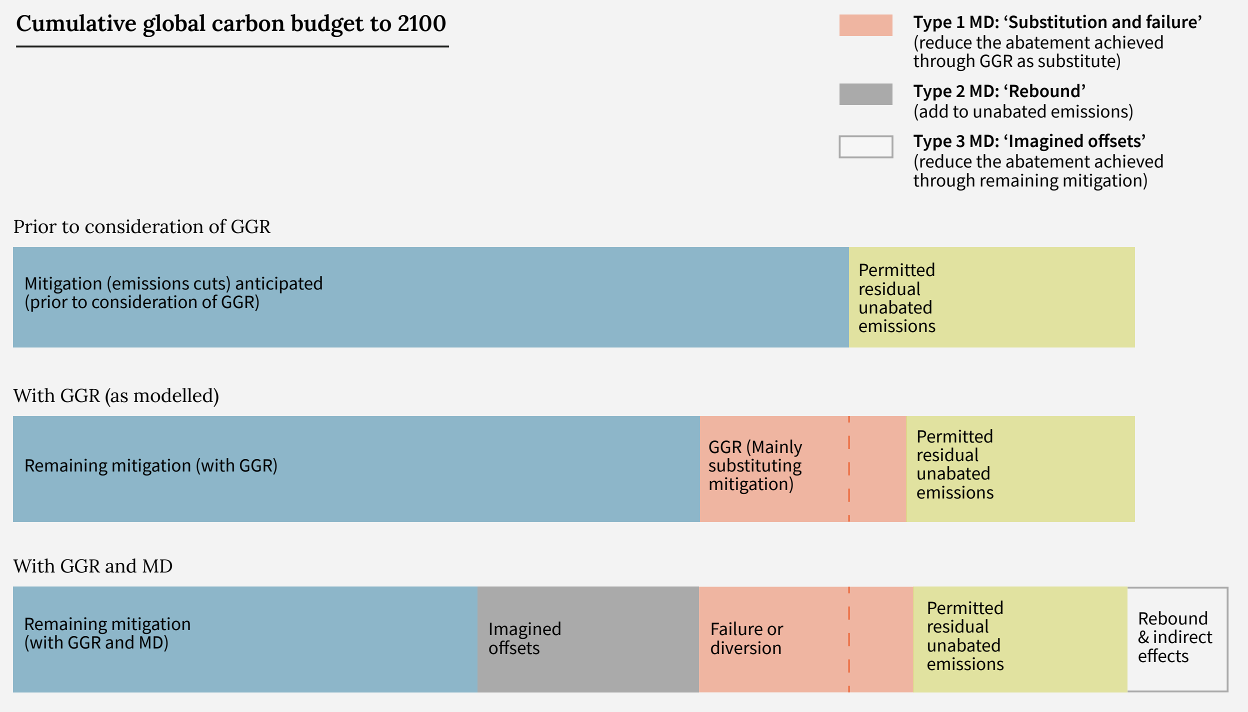

FIGURE. 2: **Schematic representation of putative global carbon budgets to 2100 under three different climate management scenarios (McLaren, 2020)**

4. How bad could mitigation deterrence effects of GGR be?

As part of the AMDEG project, researchers developed the first estimate of the size of MD effects of GGR until 2021. The method is new and draws on figures produced from carbon budget analysis and integrated assessment modelling, alongside other literature (McLaren, 2020).

The approach distinguishes between three types of MD effects as outlined in this briefing and separates formal, centrally-planned substitution (such as carbon trading schemes) from substitution undertaken without central coordination (such as corporate promises to achieve net-zero using diverse GGR techniques – see Box 3) (Rogelj et al., 2021). The worst-case estimates are that more than 500Gt of carbon are at risk from MD (see table 1). This would add up to 1.4 ℃ additional warming above a 1.5 ℃ target level. Although not a prediction, this suggests that MD risks should be taken seriously and there is a need for more research to validate or improve these estimates. Research from another group considering a more limited range of factors has estimated that continual mitigation deterrence until 2100 will lead to the temperature goals being breached by 0.2-0.3°C (Grant et al., 2021), which is similar to lowest estimates proposed by the AMDEG project.

	Low estimate	Central estimate	High estimate
Carbon at risk from GGR substitution & failure (Type 1)	50	156	229
Additional emissions form rebounds & other side-effects (Type 2)	25	71	134
Mitigation foregone in imagined offsetting (Type 3) – calculated as residual mitigation costing over $100/tonne-$CO_2$	297	216	182
Total carbon at risk	371	444	545

TABLE 1: **Worst case estimates 371-545 GtC Carbon Risk (Mclaren, 2020) [The numbers for type 3 co-vary negatively with type 1]**

5. How is mitigation deterrence perceived?

Researchers on the AMDEG project conducted interviews and workshops with UK and international stakeholders. Analysis demonstrated a tension inherent in thinking about GGR as a solution whilst also being aware of the potential MD risks that this approach brings.

For many it was important to express support for GGR as a responsible, and potentially crucial form of climate action before acknowledging the MD risks. Once that was confirmed, stakeholders also offered proposals and suggestions to help ameliorate the risks of MD, while effectively promoting GGR.

Next steps

Research into mitigation deterrence has tended to focus on climate modelling as a source of risk but there are other potential sources that need more in-depth investigation. These include the use of GGR techniques to deliver corporate responsibility.

The support and funding of demonstrator projects and real-life evaluations of GGR is an important next step to assess the technological promises that have been incorporated into research, modelling and policy to date. Accounting and monitoring in these projects need to use criteria to incorporate MD risks.

Whilst demonstrator projects will aim to ascertain the effectiveness and impact of individual GGR technologies, there is a need to consider how these GGR technologies will interact with each other and the MD that may result from these interactions. Social science has an important role to play to ensure the drive for GGR technologies to succeed does not cloud the bigger picture. It needs to be to fully embedded in future GGR research to enable the consideration of a range of perspectives, futures and issues (Markusson et al., 2020).

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There is an unequal distribution of responsibility and impact that is inherent in GGR as it stands. Currently the motivation for GGR is coming from the global North, whilst the impact– particularly for approaches like BECCS – will be felt more in the global South. To date, very little research has been done with stakeholders in these countries and there is a need to gather insight to inform fair and effective implementation of GGR.

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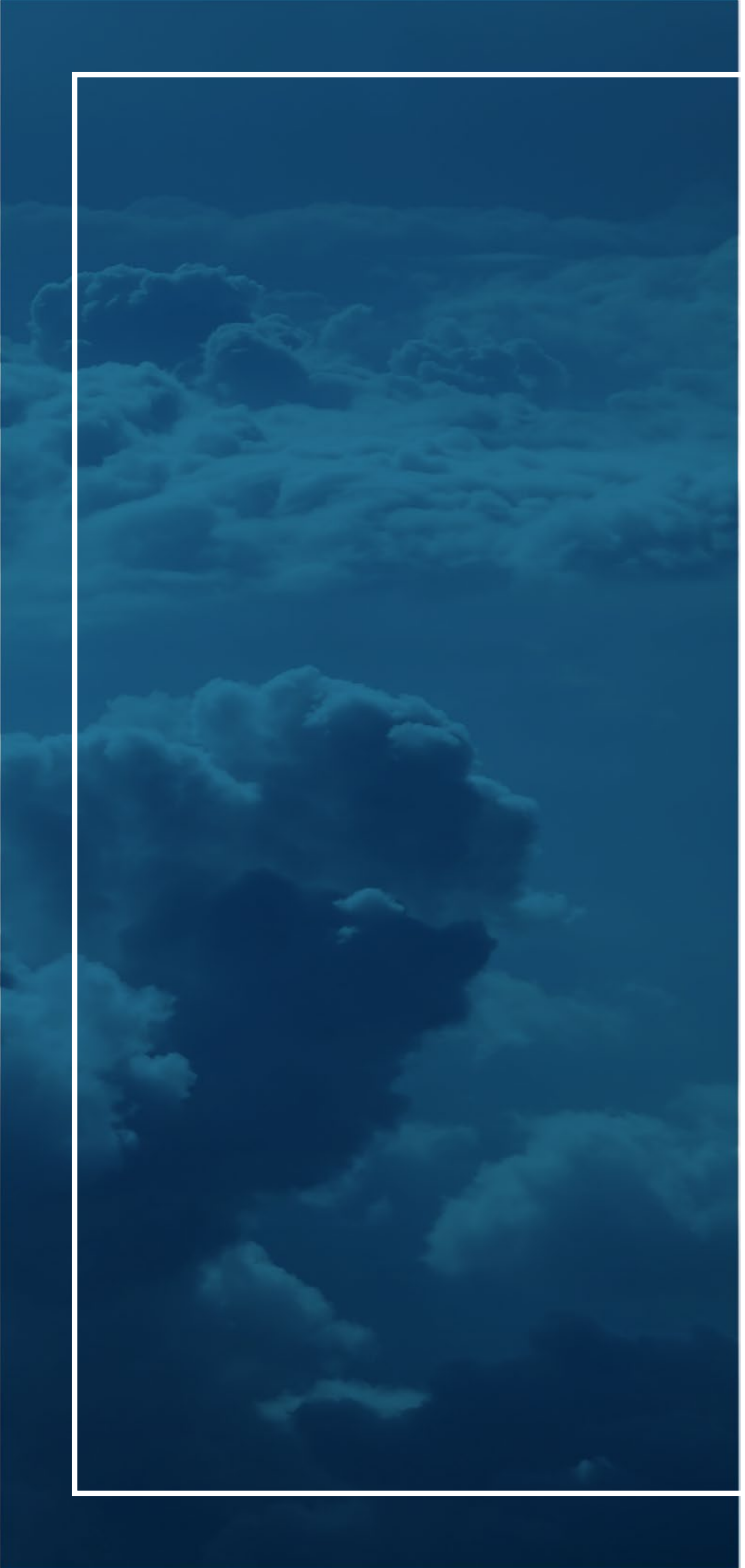
About the programme »



About the programme

The Greenhouse Gas Removal research programme aims to improve our knowledge of the options for removing carbon dioxide and other greenhouse gases from the atmosphere. Through eleven component research projects it addresses the environmental, technical, economic, governance and wider societal aspects of such approaches on a national level and in an international context to inform implementation of climate policy pathways that include large scale removal of carbon dioxide.

The 'Assessing the mitigation deterrence effects of GGR' (AMDEG) project is one of the eleven components. This policy brief was created in close collaboration with members from the project team Dr Nils Markusson and Prof. Duncan McLaren.

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