Response to UK Government consultation: Integrating Greenhouse Gas Removals in the UK Emissions Trading Scheme

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About this submission

This is a response made on behalf of the Grantham Research Institute on Climate Change and the Environment to the 'Integrating Greenhouse Gas Removals in the UK Emissions Trading Scheme' joint consultation of the UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland.

The authors submitted this response on 14 August 2024, contributing answers to the questions on which they have the most expertise.

The consultation document is available at:
https://www.gov.uk/government/consultations/integrating-greenhouse-gas-removals-in-the-uk-emissions-trading-scheme.

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Key messages

- Integrating Greenhouse Gas Removals (GGR) into the UK Emissions Trading Scheme (ETS) may support the UK's nascent GGR industry to scale up across engineered and nature-based approaches. UK ETS integration, if carefully designed, could provide stable demand for GGR to 2050 if the price signal is strong enough. However, ETS prices are likely to be too low to create demand pull in the short term, and additional business model support will likely still be necessary.
- Careful attention will need to be given to the treatment of GGRs with different durations. Determining what is fungible (interchangeable) in emissions and removal accounting depends on nuanced concepts in climate science, climate economics and real-world market practices. Fungibility should therefore not be cast as technocratic and value-free: it has potentially dramatic environmental and economic implications for society.
- Non-permanent carbon removal methods require a continuous obligation to remove CO_2 after it is re-released into the atmosphere. Such methods are not equivalent to permanent GGR. However, to contribute to a diverse portfolio of GGR, it is critical to create a viable business case based on responsible governance regimes for non-permanent GGR.
- Carbon removals from land-based biological sinks, such as through afforestation or reforestation, should not be included in the UK ETS. These shorter duration removals should be incentivised using alternative policy instruments such as a short-lived greenhouse gas trading scheme to neutralise methane emissions from agriculture and landfill sites.
- Dynamic assessments of reversal risk should be the norm for calculating contribution rates to buffer pools of GGR allowances. Projects should be rewarded with lower relative contribution rates for taking active steps to mitigate reversal risk.
- Buffer pools are preferable to equivalence ratios due to the complicated normative judgements required to compare relative permanence rates.

Responses

Q2. Do you agree the Authority should maintain the gross cap for initial integration of GGRs in the UK ETS (Option 2)? Please explain your answer.

Yes.

This approach ensures that gross emissions reduce over time in line with a net zero trajectory. By maintaining the cap, a clear and consistent signal is provided to the market about the Government's commitment to reducing emissions. This should enhance investor confidence and promote long-term planning and investment.

It is conceivable that the integration of greenhouse gas removal (GGR) into the UK Emissions Trading System (ETS) could weaken the ambition to reduce gross emissions in some sectors due to an undesirable substitution within value chain emission reductions, i.e. by substituting the purchasing of emissions allowances for GGR units (Burke and Gambhir, 2022). To mitigate this, a continuous adjustment of the cap or dynamic adjustments of the cap could be achieved through the 'conditional integration' of GGR using qualitative and quantitative restrictions on the amount of GGR units that enter the market. A gross cap allows this intervention and can help ensure environmental integrity while managing the impact on the market – as the EU ETS has done in its second trading period. This is common practice within emissions trading schemes, as without adjustments to emissions caps, or tighter restrictions on eligible GGR, even relatively small amounts of GGR could create an oversupply of allowances in the market and put downward pressure on the carbon price.

However, maintaining the integrity of the original cap by adjusting it to reduce the supply of allowances and offset GGR presents several challenges that need to be considered. First, this approach may not improve liquidity and could undermine the fundamental argument set out in the 'ETS endgame' – that allowance supply will eventually reach zero (Pahle et al., 2023). Second, offsetting GGR in this manner costs the UK Exchequer through foregone revenue, as the Government has fewer allowances to auction. Third, adjusting the cap in response to the introduction of GGR, rather than in response to changes in the fundamentals of the ETS, can distort the relationship between the value of allowances and the cost of abatement as determined by those fundamentals. This may result in either the overvaluing or undervaluing of allowances.

Finally, in the event of a 'reversal' (where carbon is re-released into the atmosphere due to extreme weather events, disease, poor site/facility maintenance or poor land-use governance), a fixed cap ensures that covered emissions are not impacted, which is beneficial from the perspective of climate impacts. For example, the New Zealand ETS requires participants to surrender to the Government an equivalent number of ETS units in the event of a reversal. The unit repayment liability reduces emissions elsewhere in the system by liquidating other allowances to maintain the overall cap. This is intended to ensure landowners compensate for any reversals of credited forestry removals in a way that maintains the original intended emission reductions.

In the event of a reversal, if a large and unanticipated reduction in the cap follows, prices could spike. Such a sudden reduction in available GGR allowances would create a supply shock, leading to a significant increase in allowance prices due to scarcity. This price spike could destabilise the market, making it more difficult for businesses to plan for and budget their emissions reductions. Therefore, a mechanism to address reversals without causing abrupt changes in the cap is crucial to maintaining market stability and ensuring that the system continues to provide consistent incentives for emissions reductions.

Q3. How can the UK ETS sustain demand for GGRs in the long-term, taking into account the consideration of setting a new cap (Option 3)?

Replacing a gross cap with a new net cap has the potential to maintain liquidity if the future supply of GGR credits is equal to what was expected when the new cap is set. But the supply of

GGR credits remains highly uncertain in the short term and relies on the Government having good information about supply dynamics – which is currently unlikely and therefore represents a substantial risk to the healthy functioning of the ETS. The Authority may need special oversight powers to effectively forecast short-term (i.e. 5-year) supply dynamics (Caldecott and Johnstone, 2024). The technologies and methods for generating GGR credits are still developing, and their scalability is not yet proven. Factors such as technological advancements and investment levels can all influence the availability of GGR credits. This uncertainty makes it challenging to accurately predict their future supply, and any miscalculation could result in either an oversupply or a shortage of allowances. An oversupply would depress allowance prices, reducing the incentive for emissions reductions, while a shortage would drive up prices, increasing compliance costs and potentially destabilising the market. Therefore, this approach introduces significant risks due to the unpredictable nature of GGR credit supply in the short term.

Supposing a steady supply of GGR is available and unconstrained integration occurs, liquidity could increase, reducing concerns of uneven market power as emissions under the ETS approach zero. This has the added benefit of also stabilising Exchequer revenues. However, it does not permit qualitative or quantitative restrictions which may be needed to address a number of risks, including abatement deterrence: regulated firms may delay decarbonisation investment until there is more information about the cost and supply of future GGR credits. As Sultani et al. (2024) outline, the longer firms wait, the more allowances they will use in the meantime, implying that the price will rise more steeply as the ETS cap approaches zero. This could in turn lead to a softening of the cap when prices surpass the politically acceptable level (Pahle et al., 2023), undermining efforts to ensure environmental integrity at least indirectly. To avoid the risk of abatement deterrence, every GGR allowance that enters the market could be reduced from the cap so that GGRs are fully additional (cap-neutral), as outlined in the previous design option (new net cap). A second risk is that, if there is an oversupply that puts downward pressure on market prices, the ETS authority has limited measures to intervene within the existing structures and may require the use of supply adjustment mechanisms.

In the long term, as the cap declines, switching from a gross cap to a new net cap may prove a more efficient option. This approach can directly address the challenges arising from the ETS endgame, particularly the issue that there will no longer be emissions allowances that can be replaced by GGR allowances. As the cap becomes progressively tighter, the number of emissions allowances diminishes, making it increasingly difficult to integrate new GGRs within the existing cap framework. However, in the context of a centrally-set carbon removal budget, as proposed by Caldecott and Johnston (2024), excess supply (which could contribute to the Nationally Determined Contribution [NDC]) could be absorbed by non-covered entities if a mechanism to remove excess GGR from the ETS is provided for.

By adopting a new net cap, the system can accommodate the expected influx of GGRs without displacing existing emissions allowances. This method enables a more seamless integration of GGRs, ensuring that the market remains liquid and functional as it transitions towards lower emissions targets. Furthermore, it provides a structured pathway for incorporating GGRs, which can become a vital component of achieving net zero emissions.

Q4. Do you agree that GGR allowances in the UK ETS should be issued ex-post (i.e. after the removal has taken place and been verified)? Please explain your answer.

Yes.

While there are benefits to ex-ante crediting, as it may enable financing to be pulled forward, it could also be a far more financially burdensome measure at the end of a project lifespan if non-delivery or a reversal occurs. The continued operation of the firm to which the credit is attached is therefore critical. If the firm goes out of business, in case of bankruptcy for example, diligence and the ability to continuously remove carbon would drop to zero. This could result in an undesirable transfer of risks from private to public bodies if there is a default and the Government is the de facto backstop. For countries like the UK with short-term carbon budgets, this could imply legal risks.

Non-delivery or a significant reversal event has the potential to breach carbon budgets unless there is a mechanism to compensate for this in the requisite timescales. To prevent this, strong regulatory guardrails will be needed (e.g. liability provisions and buffer pools). Such an approach could be complemented by the use of buffer pools and insurance to ensure finance flows to early-stage removal companies. However, the backloading of risk on companies in the event of reversals is undesirable given the aforementioned reasons. If a company remains solvent, a liquid market would still be needed in which contemporaneous ex-post purchases can be made.

In addition, if allowances are issued ex-post, project developers will want certainty that projects that commenced after ETS integration will still be valid if the project does not deliver removals for another 2–3 years. This concern could be assuaged by clearly signalling any change to minimum standards for inclusion (in consultation with the GGR industry) or providing for different allowance vintages that may correspond to a different minimum standard. Such an approach gives project developers the confidence to invest in GGR and provide allowances into the UK ETS.

Q12. Do you agree that allowances should only be awarded to UK-based GGRs? We welcome views from all stakeholders including sector-specific considerations. Please explain your answer.

Yes.

Some GGR methods, particularly those that are land based, are far more prone to reversal than others as they rely on the protection of natural carbon stocks (e.g. forests) over long periods of time. Risks of reversal will only increase over time with climate change. This can be a particular issue in jurisdictions with a chequered history of land-use governance outside of the UK. Including carbon dioxide removals in carbon markets therefore raises important considerations for regulation and temporal governance in relation to monitoring, reporting, evaluation and permanence. Forest fires that have raged in many parts of the world, exacerbated by jurisdictions with weak forest governance (e.g. Brazil – particularly under Bolsanaro), illustrate the limits to nature-based solutions.

Given the UK's history and legacy as a high-emitting country, there is an argument that it has a moral duty to decarbonise domestically as much as is feasibly possible. This argument maintains that countries that have knowingly sustained and promoted the use of fossil fuels bear responsibility for climate catastrophe and should take on more of the burden of preventing these effects.

Consideration might be given to future linkages in the medium term (up to 15 years) with international carbon removal developers. Incidentally, using international credits in the longer term (over 15 years) should bring down overall abatement costs, especially if the marginal cost of abating the final proportion of emissions in hard-to-abate sectors is particularly high. It may, for example, be cheaper to procure international GGR credits from countries where concentrated solar-driven direct air capture (DAC) may cost less than abating emissions from domestic agriculture. This decision might be attractive as it allows the UK GGR industry to scale up with domestic demand in the short term, then at a later point link to high-quality international markets to ensure sufficient supply of durable GGR for residual emissions at a lower cost. Such a decision would need to be cognizant of moral arguments that the UK should 'play its part' in mitigating climate change given its historic emissions and the clearly evidenced historic impacts on price dynamics from offshore removal integration.

Q13. Do you agree with the proposed permanence framework of both a minimum storage period, a liability measure and a fungibility measure? Please explain your answer.

Yes.

The type of permanence framework might need to differ depending on the GGR method and its level of permanence. Less permanent methods require a broader set of measures which could include, for example, mandatory insurance provisions (de-risking measures) and higher contributions to buffer pools. More permanent removal methods may require fewer provisions such as a smaller contribution to buffer pools or no contribution at all. For example, for bioenergy with carbon capture and storage (BECCS) and direct air carbon capture and storage (DACCS), low reversal risk and high additionality implies that conservative fungibility measures are less likely to be needed. This seems appropriate since policymakers need to be aware of not overburdening comparatively expensive but more durable GGR, especially as these need to significantly scale up. However, all methods should also be covered by liability measures as a bare minimum in the event of leakage or reversal.

Q14. What minimum storage period duration should the Authority set for GGRs entering the UK ETS? Please explain your answer.

Any negative emissions units integrated into the UK ETS must strive to be as mutually interchangeable as possible with the emissions allowances they replace. Given that carbon emissions from the burning of fossil fuels persist for thousands of years in the atmosphere, negative emissions must neutralise those emissions on timescales as close as possible to that of the emissions. Any storage that lasts for a shorter time than this will only partially counterbalance carbon emissions. Maintaining net zero carbon emissions – and hence halting global temperature rise – requires any residual carbon emissions from burning fossil fuels to be balanced by capturing carbon from the atmosphere and storing it on the same millennial timescale (Smith et al., 2024). Naturally, this excludes certain classes of GGRs.

GGR permanence is typically classified as the durable storage of CO_2 for either decades to centuries; centuries to millennia; or longer than 10 millennia (Smith et al., 2024). GGR methods that store CO_2 for decades to centuries are all land-based biological methods (e.g. afforestation, soil carbon sequestration, peatland or wetland restoration). GGRs with permanence of centuries to millennia include biochar, biomass burial, ocean fertilisation and biomass sinking. GGRs with expected permanence exceeding 10,000 years relies on storage in geological reservoirs (BECCS, DACCS, bio-oil), natural carbonation processes (enhanced rock weathering and mineralisation), or open-loop carbon systems (ocean alkalinity enhancement).

Allowing integration of GGRs with permanence of under a century to be considered fungible with emissions allowances representing an abated tonne of CO_2 is problematic from the perspective of effective climate mitigation. Allowing shorter-duration removals could be technically possible but would involve widespread use of liability and risk management mechanisms. These might limit the number of negative emissions units that could be sold and expose the wider system to higher reversal risks than if longer permanence thresholds or storage in particular reservoirs (i.e. geological reservoirs) are required.

Monitoring systems are a requirement to be able to quantify whether CO_2 remains durably stored for all methods. This presents a problem for open-loop marine GGR methods with high removal potential, where the theoretical underpinnings of a method are understood (i.e. air–sea gas exchange for ocean alkalinity enhancement), but the sensors/models to prove that a removal has occurred, and persists, does not exist or cannot be proven with the certainty necessary to warrant inclusion in compliance carbon markets.

Burke and Schenuit (2024) provide a conceptual framework to manage permanence across GGR methods. The authors introduce concepts of inter- and intra-fungibility whereby GGRs are fungible within the same durability bounds i.e. 10,000 years or longer (intra-fungibility) but not across durability bounds. For example, soil carbon sequestration with a carbon storage duration of decades to centuries would not be fungible with DACCS (with mineralisation or geological storage), which has a permanence of over 10,000 years.

Shorter duration GGR is still worthy of incentivising through compliance carbon markets, but these GGRs should be in a separate market and coupled with short-lived gases, as proposed by Whitmore and Preston Aragones (2022). For these reasons, we suggest 1,000 years as the minimum storage duration for inclusion in the UK ETS. This needs to be coupled with robust monitoring, reporting and verification (MRV) processes to validate the removal now and in the future.

Q15. How should the Authority manage potential reversal events from GGRs? Please consider the liability options outlined above, whether any options exist that have not been considered, and how the potential liability options could be used together or in sequence.

Where possible, potential reversal events should be managed ex-ante but with the flexibility to also address ex-post reversal.

To manage reversal risk in advance there are three policy options: (i) ex-ante perpetual removal; (ii) project type buffer pools; and (iii) economic equivalence measures. Incorporating risk at the start is preferable so that preventative measures are taken in advance, which may be beneficial depending on the future cost of removals (as outlined previously). However, this relies on the Government getting this estimate correct – particularly when designing equivalence ratios and buffer pools – and there are consequences if it is estimated incorrectly. For example, underestimating the equivalence ratio would reduce policymakers' ability to flexibly respond in the short run compared with buffer pools. Buffer pools therefore enable risk to be managed upfront in a way that equivalence ratios cannot. Managing ex-post and ex-ante risk simultaneously could be achieved using combined and removal-only buffer pools or liability measures including surrendering ETS permits, as the Government suggests.

The liability mechanism is particularly important here as the concurrent and permanent removal of CO_2 is consistently observed to be the best way to fully compensate for emissions that are too costly to directly abate (Prado and Mac Dowell, 2023). Further, with the ability to manage reversals when they happen, the Government has more flexibility to respond if the risks are miscalculated in advance. However, this relies on having robust and deliverable mechanisms to deal with reversal risk when it happens These include the solvency of a firm to deal with large and perhaps even infinite recurring debt in the case of non-permanent removals and potential leakage risks associated with carbon capture and storage-based methods, and the development of a liquid market for removals to compensate for this risk in the future.

In the event of a reversal, liable GGR operators should be required to purchase a negative emissions unit. However, (as per Q4) if there is an oversupply of units that increases the ETS gross cap, the oversupply could contribute to a buffer pool that sits outside the cap. This solution would ensure the gross cap is maintained on a downwards trajectory, GGR operators are incentivised to supply GGR units, and that a buffer pool is maintained with excess units.

Q16. Where should the liability for any re-release of stored emissions apply if there are multiple actors in the GGR value chain?

Historical discussions on carbon capture and storage policy frameworks and forestry under the REDD framework, Kyoto Protocol and Clean Development Mechanism (CDM) provide useful context. Experience has shown that buyer liability may soften credit demand, whereas seller liability has clear contracting benefits. In the absence of a legal precedent and policy frameworks to manage legal liability for MRV across nascent GGR methods (such as enhanced rock weathering), negotiation between buyers and sellers allocates risk.

Extending the previous jurisdictional concept of seller liability under the CDM would imply that liability management sits with the platforms selling GGR. It will be necessary to refine this concept to take into account the Paris Agreement where countries with NDCs face de facto liability for carbon reversals from storage sites that they host, alongside the greater role of non-jurisdictional actors (such as credit registries) who develop projects, sell credits and provide MRV services. A solution could be to make use of insurance schemes whereby selling platforms have initial liability, but this is underpinned by government-backed carbon insurance schemes that must be procured.

Regulators should therefore seek to support the development of seller liability for non-subsurface storage reservoirs for methods such as ocean fertilisation, afforestation and enhanced rock weathering. To ensure a fair allocation of risk between public and private entities, seller liability could be underpinned by government-backed carbon reinsurance schemes that sellers must procure.

Q18. Should the Authority use a buffer pool or equivalence ratio?

Buffer pools are preferable.

Determining what is fungible through equivalence ratios in emissions and removal accounting depends on nuanced concepts in climate science, climate economics and real-world market practices. Fungibility and equivalence ratios should therefore not be simply cast as technocratic and value-free.

Indeed, while equivalence ratios provide a framework to make difficult policy choices tractable, it is important to recognise the potential shortcomings of this approach, including the tension between technocratic responses available to policymakers and the broader social, economic and political issues that will influence outcomes. The recent vote by the EU Committee on Agriculture and Rural Development to classify biochar as a permanent carbon store alongside BECCS and DACCS illustrates the attempts of powerful actors to shape the permanence frameworks that will govern them.

The politics of carbon removal accounting are illustrated by the critical normative assumptions that underpin economic approaches (such as equivalence ratios) to valuing temporary and permanent GGR. Small differences in assessing storage times, the social cost of carbon, future discount rates and future removal costs can imply dramatic environmental and economic implications for society. Agreeing on these parameters is fraught with difficulty and contested in academic and political debates. Instead of taking the Paris Agreement goal to limit global temperature rise as a given, economic equivalence methods optimise theoretical cost-benefit calculations and can end up justifying outcomes with higher warming levels (Carbon Market Watch, 2023). Brander and Broekhoff (2023) describe these approaches as problematic as temporarily storing carbon out of the atmosphere does not mitigate long-term temperature change, which is predominantly driven by cumulative CO_2 emissions.

The ability to put an economic value on a major decision with apparent rigour is understandably appealing to policymakers as it helps them to justify their decisions. However, undoing these equivalences would better account for the potential of impermanent implementation, failure or non-additionality (Calel et al., 2021) that may arise from poor land-use governance, extreme weather events, disease or the absence of strong institutions to enforce MRV. Earlier iterations of the voluntary carbon market (VCM) and the Kyoto Protocol's Clean Development Mechanism (CDM), for which these issues persisted, has led to doubts about whether fungibility is possible or desirable.

Furthermore, equivalence ratios may obfuscate important differences in GGR credit quality, which should be avoided. Markets that sell GGR credits need more transparency, not less. A spectrum of costs needs to be visible, reflecting the diversity of carbon-removal approaches, rather than a single price for removing one tonne of CO_2 (Boyd et al., 2023). Evidence from the VCM suggests a willingness from buyers to purchase removal credits with high impact scores (Boston Consulting Group, 2023). To allow this choice to be made in compliance markets, it is imperative that price discovery is not lost under a policy framework that standardises all GGR units, which could disadvantage more costly but high-quality GGR options.

The application of equivalence ratio measures also remains largely theoretical, and as such there are no real-world examples to draw best practice from. Examples of other permanence measures in public policy exist, of which liability measures and buffer pools are the most prevalent (Arcusa and Hagood, 2023).

Finally, it could be argued that equivalence ratios obviate the need for buffer pools, since they already account for impermanence. But they in fact deal with distinct issues: buffer pools address the physical risk of reversal and tend to be more dynamic in nature, while equivalence ratios put an economic value on temporary storage and are more static. As the objectives are different, so are the assumptions that underpin each calculation and therefore the two may arrive at very different outcomes when it comes to determining how many additional permits should be surrendered or set aside for every tonne of carbon removed.

Q19. How could the Authority set the contribution rate for a buffer pool? Should this be a flat rate contribution across all applicable projects, or should this vary per project?

The Gold Standard registry requires a flat 20% contribution rate. Another incumbent VCM registry, Verra, determines contribution rates on a risk-adjusted basis by project with a minimum contribution rate of 10%. A risk-adjusted approach to contributions is preferable. The California Air Resources Board requires participants to allocate credits to the buffer pool based on different risks (Badgley et al., 2022):

- A fixed rate of 3% is required to account for disease- and insect-related mortality risks, along with another 3% for other catastrophic natural risks (wind, ice and flood events).
- Between 1 and 9% of gross credits are required for governance and financial risks (bankruptcy, land-use conversion, and excess timber harvesting).
- Between 2–4% is required to account for wildfire risks (discount given for employing mitigation measures).

The above contribution rates provide an exemplar for how the Authority might approach risk. These examples will have little relevance to engineered GGRs, but project-specific risk assessments against a centralised risk framework that incentivise project developers to actively mitigate risk could be an effective approach to managing the buffer pool. Projects should be incentivised to actively monitor equipment and CO_2 stores through lower contribution rates. This is preferable to a uniform flat contribution rate which does not account for the relative risk profiles of different methods or projects and might breed complacency among project developers that are not incentivised to actively maintain equipment and CO_2 stores.

Q20. Which factors should be considered when determining the appropriate contribution rate for a buffer pool?

Most experience of buffer pool contributions relates to GGR in the forestry sector. Forestry has unique risks compared to other GGRs such as enhanced rock weathering (ERW), DACCS and biochar. Thus, any policy must be adaptive to the different risk profiles of each GGR method.

When determining an appropriate contribution rate, the following permanence-related considerations should be factored in:

Biophysical

- Direct climate risks that will cascade over time (e.g. drought, extreme weather events, wildfires).
- Indirect effects (e.g. increased incursions of pest or disease).

Infrastructure

- Performance and maintenance schedule for CO_2 capture equipment and transportation network (stationary pipes, valves and meters, ships or vehicles).

Integrity of CO_2 reservoir

- Risk of rupture (through poor sealing practices, earthquakes or slow CO_2 leaks)
- CO_2 does not fully mineralise or weather, posing a challenge to MRV
- Soil erosion causes carbon to oxidise and re-release or exposes biochar to open air, causing accelerated degradation when exposed to unstable climate conditions
- Decomposition of biochar.

Governance

- Risk of land ownership change, insolvency or land-use change
- Risk of policy change or inadequate governance arrangements.

Mitigation should also be taken into account when considering contribution rates. For example, in the California Air Resources Board (California's forest carbon buffer pool), projects are required to submit 2–4% of their credits to account for wildfire risks. However, they are allowed to allocate lower levels of risks if they employ active wildfire management practices (establishing fire watch towers, remote sensing to predict and monitor wildfire risk, and funding rural firefighters). Such an approach could apply to engineered GGR, such as to storage operators that install passive acoustic sensors on the seabed above subsurface geological reservoirs, or transport and storage (T&S) pipeline operators who invest in sensors and diagnostic tools to periodically survey CO_2 transportation pipes for weak spots.

The ultimate contribution rates for engineered and novel GGRs will need to be subject to systematic actuarial or risk analysis, which takes into consideration the reported frequency and magnitude of leaks from carbon dioxide T&S infrastructure in other jurisdictions and detailed assessment of large installations in the UK. Where data is unavailable, or project/method-specific risks cannot be deduced, a flat contribution rate could be considered (of 10–20%). However, dynamic risk assessments that credit active mitigations employed by project developers are preferable.

Q21. How should the Authority decide which GGRs would be required to contribute to a buffer pool and at what level any threshold should be set for contributions?

All GGRs should contribute to a buffer pool. Irrespective of the risk profile of a given GGR, for a buffer pool to be effective it should be comprised of negative emissions units procured from projects that are spatially dispersed and a mixture of different GGR methods (Biffis et al., 2022). GGRs with higher non-permanence risk should have higher contribution rates than those with lower non-permanence risk. While some GGRs using geological storage reservoirs (i.e. BECCS and DACCS) have lower non-permanence risks, this doesn't mean that reversal risk is zero. There may be leakages during transport or injection, or arising from poorly managed or designed storage reservoirs. Thus lower-risk GGRs should contribute at a low rate of around 5–8% to mitigate their own non-permanence risk whilst also supporting wider reversal risk in the market.

For GGRs with higher non-permanence risks (e.g. woodland, soil carbon and peatland restoration) or where the foundational science or MRV are underdeveloped (e.g. marine/ocean methods, biochar and ERW), higher contribution rates of around 15–18% could be expected. However, these rates should be dynamically assessed every monitoring period. This ensures that more resilient GGRs are incentivised to enter the UK ETS as they can earn more allowances than GGRs that are less resilient. However, given that a variety of GGRs need to be supported, policy should not unfairly hamstring those which have mitigation potential but are perhaps unproven at scale.

Under this approach, all GGR projects participating in the UK ETS would contribute to the buffer pool with contribution rates specific to the GGR methods – and ideally the project. In the event of unavoidable reversal from a project, this could be proportionally covered with units based on an aggregate measure of a set contribution rate for methods – 10% for DACCS and 13% for biochar, for example. Any remaining shortfall would then be disbursed equally across all credits within the buffer pool.

Spreading risk across projects may enhance the depth and resilience of the buffer pool but it may increase the administrative complexity for policymakers as it requires other projects and project types to be of equivalent quality. For example, if credits in the buffer pool are cross-fungible, a risk-specific analysis is needed across multiple projects and buffer pools to identify whether a particular risk factor is undercapitalised or overcapitalised in the current buffer pool.

Q22. Should buffer pool contribution rates remain fixed over time or could they vary? If they vary how should this be assessed? For example, the Authority could require projects to contribute depending on an assessment of risk at each verification period, and this could change over time.

Contributions should be dynamic and risk-adjusted based on periodic reassessment of reversal risk. If dynamic risk assessment (carried out during each monitoring period) is not possible due to MRV limitations, this should entail higher relative contribution rates. Similarly, higher direct or indirect risks (noted in Q20) should then entail a higher contribution to the buffer pool. Buffer contributions need to be closely linked and informed by the MRV framework that underpins the inclusion of GGR within the UK ETS. Dynamic risk assessment will be reliant on high-quality MRV. Therefore, the Authority must ensure that MRV requirements are rigorous, transparent and adaptive.

Buffer pools, as historically designed, place an expectation on future stakeholders to not allow releases from past credits that exceed what is held in the pool, yet no incentive is provided for them to do so (Balmford et al., 2023). This is clearly evidenced by the California Air Resources Board buffer pool where 6.6 million credits have been earmarked to replace credits lost to fire over 100 years, according to analysis by CarbonPlan (Williams and Bryan, 2024). In reality, 11 million buffer pool credits, earmarked for a variety of risks, have been used to compensate wildfire losses over the last decade. Combining buffer pools with ongoing MRV and liability measures and/or insurance after credit issuance can ensure that any credits that experience a reversal can be replaced. By implementing high-quality MRV standards, projects will be incentivised to safeguard existing carbon stores and to invest in risk mitigations, whose benefits can be monitored and result in lower buffer pool contribution rates (Balmford et al., 2024).

Where dynamic project-specific risk assessments are used, the advantage for project proponents is that their contribution rate to the buffer pool can be dialled down where risks are forecast to be low. This maximises the number of negative emission units in the market while the inverse is the case with high-risk projects. Where risks are deemed too high (as evidenced by the Californian buffer pool), forests in high-risk areas should be excluded from entry into an ETS.

Q23. How could the Authority design equivalence ratios?

Buffer pools are preferable to equivalence ratios for the reasons outlined above.

Q26. Should new ex-post woodland units generated in line with UK Woodland Carbon Code standards be considered for inclusion in the UK ETS? Please base your response on the evidence outlined around permanence, costs and wider land management impacts, and on the policy options outlined in the rest of this consultation.

No.

Such a decision implicitly assumes that a tonne of CO_2 sequestered by biotic sinks is equivalent to either a tonne of CO_2 captured by solutions with durable permanent geological storage such as BECCS or DACCS, or emissions reductions. This fails to recognise that carbon stored in woodlands is only stored for a short duration, will expire before global temperature stabilisation is achieved, and will not contribute to climate change mitigation outcomes on relevant timescales (Cullenward, 2023).

Standardisation between near-permanent and non-permanent methods could therefore mask risks. These include lack of real fungibility between emissions reductions and non-permanent removals, the potential for GGR to act as an emission reduction deterrent, and risks associated with the genuine permanence and environmental integrity of GGR (additionality and durability/permanence). In particular, there is a lack of fungibility between 'biotic' carbon (which is part of the active carbon cycle, such as from land use) and 'fossil' carbon (which is locked away in fossil fuels). Non-permanent biotic solutions are far more prone to reversal than GGR methods that store carbon in geological formations. Inclusion of non-permanent GGR in carbon markets therefore raises important considerations and costs for regulation and temporal governance in relation to MRV (Cox et al., 2018). Although non-permanent removals may appear to be more cost-effective in the short term, when ongoing MRV costs and the probability of reversal are accounted for, permanent removals will be economically preferable in the long term (Prado and Mac Dowell, 2023).

Indeed, non-permanent removals imply a liability for actors in the value chain which is subject to substantial risk since the marginal costs of abatement tend to increase over time with deployment, particularly for land management options (Fuss et al., 2018). Increasing removal costs make it more costly to finance recurring debt and thus to finance perpetual removal in the future.

GGR that stores carbon for decades to centuries is not fungible with GGR that stores carbon for centuries to millennia or 10,000 years or more. It is therefore not fungible with carbon market allowances. Hence, not all GGR can be traded in one harmonised carbon market as the poor substitutability between GGR and emissions reductions could be obscured. Policymakers seeking to include afforestation or other non-permanent GGR within compliance markets should avoid this option. Indeed, due to these challenges, the Climate Change Committee (CCC) recommended not including non-permanent solutions in the UK ETS as they cannot be relied on to have sufficient permanence (CCC, 2022).

Instead, non-permanent GGR could be incentivised through inclusion in an ETS for short-lived greenhouse gas emissions. The low permanence can in this way be used to balance out non-CO_2 emissions in the agricultural and waste sectors rather than fossil fuel carbon emissions from other sectors. Temporary storage is far more likely to be economically equivalent to non-CO_2 emissions such as methane due to their shorter atmospheric lifetimes. This would be akin to a physical equivalence approach or the like-for-like principle.

Creating a viable business case for non-permanent GGR is critical as a diverse portfolio of GGR is needed – especially those which are most scalable in the short term – to support the diversity of risk by each GGR type (Nemet et al., 2018). By examining only the time value of GGR the important co-benefits derived from non-permanent GGR may be undervalued, including their ability to protect, conserve, restore and sustainably use terrestrial, freshwater, coastal and marine ecosystems.

Q33. Do you agree with the Authority's minded to position to adopt supply controls to target other objectives, such as phasing GGR integration or addressing market impacts? Please consider how supply controls can be used in a way that is compatible with providing a strong demand signal for GGRs.

Yes.

Although the nascent nature of GGR techniques prevents any ex-post evaluation of linking these markets, the historical use of offsets in carbon markets provides useful context to highlight the risks of allowing cheap GGR permits in future carbon markets. These include reversal, governance and price risk. The latter is best demonstrated by the New Zealand carbon market where the allowance of unlimited offsets can be considered analogous to the future inclusion of unlimited cheap GGR permits in carbon markets. The NZ ETS was initially introduced with unrestricted linking to the international CDM market where Certified Emissions Reductions (CER) units could be used for compliance. When the financial crisis occurred, New Zealand experienced excess supply from both a decline in emitting activity and an oversupply of international offset credits in the trading market. This led to a collapse in the New Zealand allowance price (NZU) from $20 in May 2011 to $2 in May 2013.

Furthermore, unconstrained allowance of forestry-based offsets has led to perverse outcomes for farmers and rural communities. Between 2017 and 2023, a rising carbon price made planting monoculture conifer forests and entering these in the NZ ETS far more profitable than farming on hill country sheep and beef farms. This inverted rural land prices and lead to widespread protests regarding perceptions that rural communities were being hollowed out. Such considerations would be less salient if only BECCS and DACCS were allowed to enter the UK ETS, but it nevertheless serves to highlight the possibility of unforeseen outcomes associated with unconstrained unit supply.

The parallels with future use of GGR credits is clear. In such a scenario, facilities undertaking GGR activities could generate GGR credits or allowances to be sold to market participants that need to meet their compliance obligations. But because early abatement in offset sectors can often be achieved at relatively low costs, as is the case with cheap nature-based GGR credits, allowing unlimited use of such credits for compliance could result in a linked future GGR market that overly influences market outcomes in an ETS. When deciding whether it is appropriate to include GGRs in carbon markets, the distinction needs to be made between GGR techniques that are likely to be additional (often more expensive engineered GGRs that won't depress the market price) and GGRs that may never be additional.

In the short term, and as outlined under the cap-setting options, unrestricted linking should be avoided, regardless of the efficiency gains that may result. An optimum outcome can be achieved if restricted linking and supply controls are put in place when supply and demand imbalances occur. To ensure low-cost domestic removals do not disrupt efficient market functioning, policymakers could review the intake rate of allowances of a future UK supply adjustment mechanism (SAM) by reviewing the supply-regulating SAM as GGR permits enter the market.

Q34. What would be the optimal timing for GGRs to be integrated into the UK ETS, taking into account the considerations set out above? Please explain your answer with reference to impacts on both the UK ETS and GGR deployment.

There are several reasons to be sceptical about the ability of the carbon price delivered by an emissions trading system to drive the requisite innovation and cost reductions in GGR techniques – at least in the short term. Even though a strong future carbon price could provide a much-needed boost to the economic prospects of GGR techniques, such a price has failed to materialise in most jurisdictions to date, given the projected costs of engineered technological GGRs. This would point to integration beyond 2030.

Such considerations are likely to reveal that many complementary mechanisms are needed in addition to a pure carbon price, and that inclusion in carbon markets alone would not drive the requisite innovation, learning and cost reduction in more expensive GGR techniques. It is possible that carbon markets and other forms of carbon pricing and taxation could be used to provide subsidies to such GGR solutions – but questions remain around inter-temporality. For example, Bednar et al. (2019) demonstrate that in a 2°C scenario, subsidies required to scale up DAC far outweigh those generated by carbon pricing in the next few decades. Nemet et al. (2018) also highlight the potentially long lead times for the innovation and scaling up of negative emissions technologies. Both studies point to public, philanthropic and other finance as being essential to filling the near-term innovation funding gap.

In the short run, a more complex set of mechanisms are needed to deliver innovation cost reductions than a carbon price purely determined by an ETS. Therefore, we suggest that well before any integration of GGRs into carbon markets takes place, there should be a range of innovation and technology-specific mechanisms to drive currently expensive, yet highly scalable technological GGR down the cost curve. This involves a multi-pronged inter-temporal policy framework. In the short term, there is an immediate focus on ensuring the cost-effective, scalable and reliable development of these novel techniques through piloting and demonstration support. In the medium-term, policymakers can draw on the successful experience of promoting renewable energy sources in the electricity sector, particularly the role of Contracts for Difference (CfDs) in deploying significant quantities of offshore wind in the UK.

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