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THE GREENHOUSE GAS REMOVAL HUB

NEGEM

CO_2RE-NEGEM Workshop

Consideration of Greenhouse Gas Removals (GGR) in Emissions Trading Systems: Principles and Practice

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EXECUTIVE SUMMARY

This document synthesises the discussions of a workshop titled "Consideration of GGR into Emissions Trading Systems: Principles and Practice", held on 25 April 2022. It provides a descriptive summary of the different views expressed. The aim of the workshop was to air those different viewpoints, rather than achieve consensus over them.

The workshop provided an opportunity to hear from recognised experts in the field, participate in discussion and help formulate timely guidance on whether and how GGRs should be included within Emissions Trading Systems (ETSs), with a particular focus on the EU and UK contexts. There were forty-two registrations, with government, business, academia and the non-government sector represented evenly. It was conducted over four sessions.

The workshop was co-organised by CO_2RE and NEGEM. CO_2RE is a multi-disciplinary, multi-centre national research hub on Greenhouse Gas Removal, funded by the Natural Environment Research Council (Grant Ref: NE/V013106/1). It conducts research, co-ordinates demonstration projects around the UK, connects to other relevant national and international programmes, and commissions grants through a flexible fund. NEGEM is a Research and Innovation Action funded by the EU Horizon 2020 Programme (under Grant Agreement No. 869192), to assess the realistic potential of Negative Emission Technologies and Practices (NETPs) and their contribution to climate neutrality, as a supplementary strategy to emissions mitigation.

CONTEXT

Large-scale Greenhouse Gas Removal (GGRs), in lockstep with deep reductions in greenhouse gas emissions across the economy, is seen as fundamental to achieving global climate goals[1]. It is included in modelled decarbonisation pathways and endorsed by policymakers as part of the set of actions to achieve legislated net-zero emissions targets at both EU[2] and UK levels[3].

There is recognition of the need to provide "market pulls" for GGRs: policies and revenue streams to address commercial deployment. The UK government has committed to a call for evidence to explore the role of the UK ETS[3] as a potential long-term market for GGRs. At the same time, the European Commission's carbon removal certification mechanism (CRC-M) which will quantify carbon flows with a view to potentially allowing the integration of carbon removal credits into the EU ETS, has a consultation scheduled for early 2022.

Discussion summary

Defining the objectives. The first session set out a broad perspective, considering what overall objectives ought to be aimed for by the GGR sector and, particularly, how that relates to ETSs. The Facilitator began with two broad provocations: would inclusion of GGRs in an ETS necessarily undermine near-term emissions reductions; and do public consent, cost and prospects for scaling justify a focus on land-based GGRs? The discussion quickly moved into technical considerations, and the need to address definitions and for an appropriate taxonomy. This would need to be kept simple, from both a policy design perspective and for public communication. The prevailing sentiment was that whatever long-term mechanism would be used to deploy GGRs, the emphasis should remain on the greenhouse gas outcome. Ecosystem benefits and other externalities could be addressed either through other markets, or regulation.

The implications for GGRs. The second session focused on the GGR perspective and the criteria for success of an ETS, or other policy options, in supporting GGRs. The key questions were what policies could be used to support GGR deployment; what criteria could be used to evaluate their effectiveness; and what were the comparative issues of GGRs in an ETS, as opposed to other policy options? Five criteria were proposed: certainty for investors; scalability; administrative ease; distribution of costs; and public acceptance. The discussion added five more under the headings: general; support for first-of-kind/seed funding; avoidance of negative externalities; technology maturity and MRV; and geographic implications. Each of the criteria was considered from the perspective of inclusion in an ETS; and other policies. Despite extensive discussion, no definitive conclusions were reached, although there was consensus that while an ETS might stimulate some demand, a more comprehensive suite of policies would be required. Of those discussed, a carbon takeback obligation featured prominently.

The implications for ETSs. In the third session, the perspective changed to looking at the implications for ETSs from including GGRs. The range of considerations raised included impacts on cap level, cap integrity, market stability reserves, prices and revenues; impacts on sectoral mitigation pathways; and impacts for future ETS reforms. The discussion was framed in terms of timing and three different timeframes for ETS development were presented: in the short-term, there could be parallel development of GGRs and ETS markets; in the medium- term, the markets might be integrated and work together – the big question being how this might be achieved; and in the long-term, essentially just the GGR market. Thus, timing is a critical consideration. ETSs face many challenges already, which militate against introducing the GGR dimension in the near-term: other approaches, while less economically efficient, may be more acceptable to the public.

Getting the timing right. The final session then delved more deeply into issues of detail and milestones pertinent to connecting GGRs into ETSs. Headline questions were: should any GGR be

1 IPCC 2018 Special Report: Global Warming of 1.5°C (SR1.5)

2 European Commission, Sustainable Carbon Cycles Communication, 2021 and Land Use, Land Use Change and Forestry regulation proposal

3 HMG Net Zero Strategy: Build Back Greener. October 2021

allowed into the ETS; if so, when should they be allowed; and what concrete steps are necessary to have a uniform global price for carbon, including GGRs, in the future? Discussion proceeded under broad categories: first, inclusion of techniques with different characteristics raised issues including the fitness of any GGR techniques for ETS inclusion; the essential need for robust MRV; and how to deal with storage permanence. Second, the need for a wider global debate on the subject was emphasised. A third key issue was public engagement and the inclination of the public to equate removals and offsets, with all the attendant issues and controversies that beset the Clean Development Mechanism. In policy terms, issues included the risk of GGR availability derogating from emission reductions, distributional fairness, and uncertainty over timing.

Tentative conclusions

Overall, the workshop provoked broad, wide-ranging, detailed discussions in each of the sessions. While not seeking to provide a specific consensus, nevertheless, some general observations might be drawn:

- Successful GGR deployment will need a broader suite of policies than just ETS inclusion. ETS inclusion could, in time, offer deployment support, but additional interventions will be needed to address other barriers, such as supply-side externalities (e.g. network effects, learning effects, scale effects) and create a supportive business environment (e.g. on monitoring, reporting and verification, accounting standards, environmental and social standards).

- Workshop participants recognised the need to compare like with like. Short-term carbon storage (as might be the outcome with biological GGRs) is not equivalent to (permanent) emissions cuts. More work is needed to understand and quantify the equivalence of different carbon management solutions, or perhaps the solution may be to focus on like-for-like links (i.e. biological GGR offsets for land-use emissions; geological GGR offsets for fossil fuel emissions).

- Getting the EU ETS to work was a hard-won achievement, which several workshop participants were reluctant to put at risk. At the same time, the inclusion of GGRs would create new trading (and cost-saving) options, and might allow a more ambitious endgame for ETSs, once caps become tighter and prices rise.

- The timing is important. For a successful link between GGRs and ETSs, the GGR market needs to be ready for ETSs and ETSs need to be ready for GGRs. The readiness of GGR requires, among other things, a sufficiently small differential between GGR costs and ETS prices, and a sufficient track record of GGRs in terms of storing carbon safely and permanently. The readiness of ETSs relates to the resilience of regulatory arrangements, cap setting processes and market stability mechanisms to absorb substantial volumes of GGRs.

Session 1: What is the "right" outcome/What do we want to achieve for GGR's impact on the climate? (facilitated by Sabine Fuss, Mercator Institute)

The first session set out a broad perspective, considering what overall objectives ought to be for the GGR sector and how that relates to emissions trading schemes. The range of issues proposed for consideration included: scaling of GGR techniques – both nature-based solutions (NBS) and technical GGRs; achieving real net emissions reductions in line with targets (including the need for net zero to be a durable rather than temporary balance); minimising costs; and public consent issues.

The Facilitator began with the following two provocations:

1. Does the inclusion of GGRs in an ETS necessarily undermine near-term emissions reductions?

   This addresses the concern put forth in discussions that GGRs may just be used as an offset for near-term emissions reductions, and by that putting ambitious climate goals out of reach. However, several arguments speak for incentivising GGRs through carbon pricing:

   a. The need to differentiate between engineered methods such as DACCS[4]/BECCS[5] (e.g. Rickels et al. 2021) and land-based GGRs (DACCS/BECCS costs are greater than the current EU ETS price and thus unlikely to substitute for current mitigation actions);

   b. Effectiveness of carbon pricing: is there a cost-optimal GGR[6] portfolio (What arguments against achieving climate targets at least cost in a currently strained society/economy? Is there risk of inefficient outcomes when picking winners);

   c. Carbon pricing can work in a number of ways, for instance, via a separately determined price, via a quantity target (reverse auctioning) or via integration in carbon markets. Real net emissions reductions could thus be in line with targets, even in the case of cheap afforestation credits, if removal targets were separated from mitigation targets to avoid unwanted interactions;

   d. Comprehensive carbon pricing would also account for emissions in the land sector and thus reduce problems with indirect Land Use Change (iLUC). (Comprehensive coverage of all sectors is needed, but other externalities such as iLUC need to be addressed at the same time, for example, by accompanying regulation for sustainable outcomes).

2. Does public consent, current cost and thus better prospects for scaling justify a focus on land-based GGRs?

   This provocation speaks to the tendency of many countries to focus their net zero strategies around land-based removals, in particular afforestation, especially where public resistance to CCS is high. The distinction made between "natural" versus "technical/engineered" solutions has not been helpful to have a differentiated discussion here. There are also a number of reasons that make integration of nature-based solutions in market mechanisms difficult and might undermine achieving the targeted outcomes:

   a. Permanence, risk of reversibility, ongoing climate change and disturbances (exclude land-based GGRs from ETS or introduce flexible mechanisms, e.g. discount factors, temporary credits?);

   b. Monitoring, reporting and verification (MRV) challenges (advances in combining mea-

4 Direct Air Capture with Carbon Storage.
5 Bioenergy with Carbon Capture and Storage
6 Greenhouse Gas Removal – GGR and Carbon Dioxide Removal (CDR) are used interchangeably in this report, although it is noted that GGR refers to a wider range of gases than just CO_2.

surements and remote sensing, but how to ensure transnationally?);

c. Land footprint, resource constraints, sustainability considerations (phased approach to deal with leakage?);

d. Need to address distributional impacts (a better understanding is needed of distributional impacts, the dynamics of asset values, especially of land. How about pilots with restricted coverage?).

The Facilitator initiated discussion by noting that GGR – or, specifically Carbon Dioxide Removal (CDR) – has its own headline statement in the 6th Assessment Report of IPCC Working Group 3 (SPM IPCC AR6 WG3 C.11). Deployment of CDR is viewed as being unavoidable, and CDR is spread out across the whole IPCC report, now being much more mainstreamed to mitigation. There are many things happening in GGR and CDR research on the supply side, however, very little on the demand side, i.e. policy, innovation or public perception. Net zero targets are now enshrined in national legislation, necessitating more knowledge for building policy and governance frameworks.

For example, the Facilitator noted traditional innovation models may not be applicable to the GGR up-scaling challenge deduced from ambitious climate change mitigation scenarios. Cost reductions will need to happen much more rapidly for GGRs (compared to experience from other mitigation options) to be able to upscale on time to meet the adoption targets needed to achieve net zero. All the same, there are other externalities that need to be covered by regulation, that do not work with carbon pricing.

Discussion

The discussion delved immediately into the more technical issue of permanence, including how it would be defined. The question was posed whether issues of permanence and related risk of reversibility could be accounted for through price differentials, e.g., by discounting on the basis of the half-life or by assigning credits for a shorter duration of time. In this context the danger of policymakers and academics making things too complicated was flagged and a "like-for-like approach" suggested, which it was proposed would go a long way to addressing permanence issues.

Returning to a broader context, the Facilitator posed the question of how environmental and reversal risks might be included in pricing mechanisms, or whether they would need to be addressed through other regulation.

In response, it was observed that on the biological side, there is a nervousness that leads to treating biodiversity conservation goals as a constraint to land-based CDR upscaling, and optimising for carbon storage. The question was posed why not optimise ecosystem services, including carbon storage. The objective should include that the market covers ecosystem services.

It was noted that if degrees of permanence were considered, the technologies that are more permanent are more expensive; the cheaper, less permanent. However, if non-competitive mechanisms were to be included in the ETS, nothing would happen immediately (although this would change with price) as there would not be a business case for including GGRs in the ETS and reliance on the carbon price to drive GGR scale up would be ineffective. Another suggestion was that technology-based removals might be included in the ETS concurrently with regulation to provide other incentives.

It was noted that there are advantages to including land-based approaches, but these can also generate the wrong incentives, as for example, in the case of the types of trees that might be planted if the objective is carbon sequestration as opposed to promotion of biodiversity or water cycle management. In this respect, support was expressed for the like-for-like approach mentioned earlier, but it was asked, could a carbon market capture all the co-benefits and externalities and be addressed in the pricing (for example, biodiversity premia in the REDD+ context)?

In this respect, the possibility was raised of there being multiple markets for the different products, such as one for carbon storage, another for ecosystem services: for example, in the case of BECCS, the projects sell electricity into one market, and carbon removal into another.

On the other hand, the view was expressed also that creating a market across a wide range of ecosystem services could be very complicated. Carbon removal as a single market makes sense

as a global public good. Ecosystem services, however, are often quite local so it would be hard to include them at a large spatial scale, or all together in a single market. Also it was mentioned that carbon measurement is more advanced than biodiversity measurement, and different indicators can produce different outcomes. The Facilitator observed here that the suggestion seems to be for the multiple externalities to be addressed through regulation concurrent to the carbon removal elements being addressed in a market context.

In this respect the point was made that NGOs would probably agree that these elements (that is, the biodiversity, environment and social elements) would be better addressed through a separate mechanism rather than together with emissions removals and also that even with geological storage, there was leakage (unclear whether this refers to geological reservoir leakage, or geographical carbon leakage). All the same, it was felt that NGOs would support a separate permanent removals target.

The discussion also considered the oceans versus land aspect. It was noted that there are different approaches, timescales and risks. Some ocean-based methods store carbon geological timescales, some do not. This led into discussion of the appropriate taxonomy, for example, geological/non-geological, or geological/biological. The point was raised that carbon in products (e.g., timber products) should be considered. The Facilitator pointed out that a taxonomy based on where the CO_2 ends up, may be preferable.

The Facilitator returned the discussion to the need to scale up and the risk of not achieving sufficient scale in time to make a difference. An important point had been made earlier about giving technologies a push along with regulation to provide incentives concurrently with technology-based removals being included in markets. The point was made that irrespective of storage, there was wide recognition of the need for early financing support, as well as strong monitoring, reporting and verification (MRV). In this respect, the distinction between removals by crops and removals by forests was pointed out and supply side issues such as the scale of land required.

Summary

In summary, the session noted:

1. There remain some fundamental definitional/categorical issues:
    a. About the removal taxonomy, and the basis for that taxonomy – is it geophysical, risk-based, to aid public understanding and buy-in?
    b. About the relationship between reductions and removals in target setting.
    c. "Like for like" came out quite strongly, for both alignment with positive emissions, and to capture the specific characteristics of different methods (such as technological maturity, permanence and risk, ease of MRV, and co-benefits).
    d. As an aside, the terms CDR / GGR subsume storage, but if the focus is on outcomes, perhaps framing (and incentivising) storage separately and more prominently would be helpful, including for public understanding and buy-in.
    e. In any ultimate framing, it was highlighted that it is important to 'keep it simple' – for both policy design and public communications.
2. There seemed to be a prevailing view on the need to:
    a. Keep the integration of GGRs into whatever long-term market or mechanism focused on the greenhouse gas outcome; and
    b. treat other ecosystem aspects / externalities with other markets, or regulations.
3. The importance of incentives, likely public investment in supporting infrastructure, and strong MRV to support near-term adoption, was highlighted – but was no discussion to any great extent of public awareness or buy-in, as it was coming up in another session.

Session 2: GGR - ETS links and other policy options (facilitated by Conor Hickey, University of Oxford)

Session one broadly covered what the overall objectives for the GGR sector should be, especially in relation to ETS connection. Session two focused on the key criteria for success of an ETS or other policy options as an instrument for supporting GGRs.

The Facilitator set up three key questions for discussion:

1. What policies could be used to support GGR projects?
2. What criteria should we use to judge how effective these policies are?
3. What are the advantages and disadvantages of including GGRs in an ETS vs. other policy options?

The Facilitator presented the following points:

- The shortcomings of the ETS:
    - the ETS alone can generate large sums of money from the sale of allowances. However, competition for this funding is high, so it is unclear how much of the revenue from the ETS can be used for GGRs;
    - furthermore, the ETS has other problems for supporting GGR projects, such as uncer tain prices, an expected reduction in participation as we reach net zero (reducing available capital for GGR): thus, there is a need for governance and support to permanently remove CO_2, which the ETS does not currently provide.
- The potential options for ETS reform:
    - The ETS can only effectively support GGRs when the ETS price (with or without support) exceeds the cost of a GGR project over a sustained period of time;
    - potential options for ETS reform include no limits trading of GGRs, quantitative limits on trading GGRs, applying a multiplier value on allowances for GGRs, complimenting the ETS with a carbon contract for difference (CfD), or creating a separate removals fund.
- Other policy options:
    - There are other policy options, which could help address issues not covered by the ETS - these include: regulations and standards (including a carbon takeback obligation); state supported results-based payments (public procurement); subsidies; and tax credits.
- Evaluating the effectiveness of policies:
    - Criteria can be identified by which each of the policies can be scored for likely success;
    - Criteria proposed were:
        - certainty for investors,
        - scalability,
        - administrative ease,
        - distribution of costs, and
        - public acceptance of the scheme.

Discussion

The discussion added further criteria and different dimensions to each of the criteria (above) outlined by the Facilitator. This took the format of an open brainstorm, so no statements here can be considered the opinion of the author or a final judgement. Rather, they are different perspectives within the same conversation.

The following integrates the criteria proposed by the Facilitator, with those generated in the discussion, which were: a general category; ability to support first-of-a-kind/seed funding; the need to avoid potential (negative) side effects; maturity of the technology and MRV; and taking account of geographic implications. The table following (Table 1) aims to provide a comprehensive overview of all the potential criteria that were discussed, as well as all the comments on policies based on these criteria. The consolidated list of criteria was considered in the discussion from the perspectives of firstly, GGR inclusion in the ETS; and secondly, other GGR policies.

Table 1: Summary of session 2 discussion points (Blue signifies that the comment comes from the Facilitator's presentation).

Criteria	Discussion points on GGR inclusion in ETS	Discussion points on other GGR policies
General	There is no inherent demand for GGR, because it is an externality. Inclusion in the ETS could help create a demand pull. The ETS might be useful in eventually generating demand, but a lot of other things are needed to go with it. The EU ETS is one of the few CO_2 related options that actually works. If it is not employed to stimulate GGR, then what else should be done? The best way to gradually introduce GGR into the ETS should be worked on.	None
Administrative Ease	Administrative ease applies to policy options that already exists but require minor reform for GGRs (e.g. one for one, fraction, multiplier). CfD is quite common in the UK but not widespread across all emission trading schemes (per Facilitator)	Results-based payments (excluding CfD), tax credits and subsidies are uncommon for engineered GGR techniques, so this could require greater reform and uncertainty than more established options, making them score less highly. (per Facilitator)

Reducing risk for investors (Includes business risk, policy risk, technology risk; purpose to provide certainty for investors)	One-for-one can create volatile prices and demand which reduces certainty for investors. The fraction approach is similar but on a smaller scale. The multiplier value is also price uncertain. The fund and CfD can be underpinned by contracts with set prices and quantities which creates certainty. (per Facilitator) If the aim is to scale a viable industry to 2050 and beyond using the ETS, it might not be attractive to investors as there is not a strong case at the moment because prices are too low; in 20-30 years there may be limited participants within an ETS to pay to support the GGR industry. This points to the need to take distribution of costs and benefits over time into account. It is an open question as to when government support would be able to leave the ETS, if market liquidity reduces over time. Investors prefer contracts over policies. The ETS is somewhere in the middle: its harder to change than a policy, but easier to change than a contract.	For the obligation policy, certainty can be created around demand but less so for a price which creates less uncertainty for investors. The results-based payment or government procurement/ subsidy creates certainty because a contract exists. The tax credit only really works if there is profit. Otherwise, it could be transferred, although there is also a discussion about making tradable tax credits. (per Facilitator) Whenever there had been discussions with investors, it became clear that investors prefer contracts over policies and markets, because contracts can be enforced in a court, and policies can be changed by governments depending on support or viability. One of the big issues is the working average cost of capital. Geological GGRs are expensive and most of the costs are in the cost of capital. There are only a handful of organisations that have the balance sheet and capacity to make that kind of investment. So to get moving on GGR, we need to address the barriers that these investors face. Policies could also be in place for oil and gas companies to support their customers' use of GGRs.
First-of-a-kind support/seed funding	The ETS could provide seed funding in the EU through the innovation fund. Part of the proceeds from the sale of credits could be used to stimulate GGRs. The Swedish reverse auctions are a good example of how this could work. This is a different type of inclusion rather than letting only the market dictate how much removal will happen.	The voluntary sector is already investing money and effort into GGRs. Many are working on purchase facilities that help provide easy access to capital and equity for scaling up. This is the first step towards wider scale deployment when the time is right. Removals might not be ready to be included in the compliance sector yet, but voluntary actors are helping prepare for that moment when the time comes. Similar to the advance market commitments for GGRs in the US (e.g. Frontier). Policies could support operationalising private sector seed funding for first-of-kind projects from suitable actors (especially oil and gas companies, with large capital budgets, rents, and balance sheets).

Promoting innovation, scalability of the technology (How far does the policy drive down costs and move technology down the learning curve?)	Lack of conviction expressed that the ETS can help, as the technologies will not be competitive straight away and it is hard to see how they will become competitive without additional support. The current ETS price is too low to incentivise GGRs in Europe. If GGRs were suddenly included in the ETS, it is likely to only be a high enough price to stimulate something like the cheapest BECCS (based on woody biomass). This could have potential negative side-effects including the biodiversity, deforestation, and uncertain climate impacts; and will not help much with upscaling.	If the aim is to promote a strong payment in perpetuity, that might not incentivise [GGR providers] to bring down costs. (per Facilitator) A subsidy could probably help on the supply side, with worries like learning effects, scale effects, risk issues, cost of capital. Understanding from US is that 45Q has not worked very effectively in getting the costs of CCS down, and there are various complications with it.
Scalability of the policy	With one-for-one, a whole firm's emissions can be removed, which is scalable; with a fraction or multiplier, only part of their emissions are removed, because there is only a fixed number of EUAs, so it is less scalable as it would interfere with the cap of the ETS. The scalability of the fund and CfD is limited by how much the government thinks this is a priority and it is unlikely all ETS revenue could be used to support those. (per Facilitator)	The scalability of an obligation is almost infinite, because it can span the entire market (for example, all of oil and gas). Results-based payments are limited by a certain budget, and subsidies and tax credit budgets are limited further by money being needed for other causes. (per Facilitator)

Distribution of costs and benefits (Distribution across demographics, sectors, consumers or producers. Key questions: Does the polluter pay, or is the cost passed on to the taxpayer? How are the revenues of CDR distributed? And how are benefits of CDR itself distributed? For example, large amounts of land-based removals increases the value of land assets, benefitting land owners. What is the distribution of costs over longer time horizons? Where does the incentive for storage fall? What is the distribution of costs and benefits for CDR across the whole value chain, and is this providing enough incentive?)	The multiplier, fund and CfD require taxpayer support. (per Facilitator) There is a strong case for the EU and the UK going net negative. Would there be the sustainable revenue stream, and balance of payments, from the sectors and organisations within an ETS? That is not to say that ETS is necessarily the wrong place for GGRs; but hard to abate emissions might come from the land sector and from aviation, for instance, and they may not be in the ETS. Policies should consider that the process of GGR is spread across different actors. For example, developing storage capacity in Europe for CO_2 is not rewarded unless ETS participants capture the CO_2 in the first place and gain the cost saving they can pass it onto the storage operator.	Subsidies and, to some extent, results-based payments and the tax credit, are dependent on the taxpayer, so the more the taxpayer is on the hook the more it may be viewed as unfair. In general, there is a large pot of money from the private sector that could be more easily operationalised for GGRs, especially in oil and gas companies (e.g. OPEC cost of production is far lower than their rents). The costs of GGRs do not just stay where they are originally levied; there is a need to look at the whole system and the system effect of certain prices. So a takeback obligation might be placed on the fossil fuel industry, for example, but this will filter down to consumers, so they will be paying for it as much as the industry itself. This means also looking at the revenues. If there is a carbon price revenue to be had, it matters hugely how those revenues are being used, for the distributional incidence. The cost of regulation (namely the obligation) might not necessarily flow down to consumers, as oil and gas companies have very high rents. The ultimate consumer price depends on the competitiveness of the market (how many alternatives are available), the elasticity of demand. This is an empirical question with different answers. One answer is that the international fossil fuel market is competitive, whereas the domestic market is not, meaning costs can be passed on. In hard to abate sectors it is difficult to imagine them being able to finance [GGR and] mitigation. There is a distributional impact if these facilities cease to exist, which may be good from a climate impact, but the social impact of that could be quite negative. The take-back obligation can play a role in rewarding both storage and removal of CO_2, which helps solve the cross chain problem. The takeback obligation could be a complementary system, rather than a separate or parallel system, to make sure that somebody gets paid for putting the CO_2 in the ground and storing it there, while somebody else gets paid for removing it.

Avoiding potential (negative) side-effects (Includes environmental effects, including biodiversity, deforestation, leakage and land use effects; mitigation deterrence effects; unintended effects on commodity and asset prices, and consequential distributional effects.)	If GGR were suddenly included in the ETS, it is likely to only be a high enough price to stimulate something like the cheapest BECCS (based on woody biomass). This could have potential negative side-effects including the biodiversity, deforestation, and uncertain climate impacts.	Removals to compensate for residual emissions are needed, not to allow the continued production of fossil fuels. There is a risk that pouring money into removals (also through the ETS!) means removal capacity will be captured to allow continued emitting of CO_2, which does not actually help the climate. On the contrary, the only way to compensate for fossil fuel use is permanent disposal of CO_2, so geological disposal does "count".
Public acceptability	A lot of citizens might think that firms have been offsetting their emissions in the past, and question how is this any different (for one for one, fraction and multiplier). CfD also uses taxpayers' money for something else. The fund might be quite popular as it has a certain level of government oversight. (per Facilitator) One might see two opposing positions. On the one hand, the notion that resonates well with people is that each tonne that is emitted has to pay for its own removal under a net zero target. This is seen as fair. But there may also be very strong opposition that [GGR inclusion in the ETS] would enable substitution between the two, which it is feared will undermine near-term emission reductions. This can be overcome only with a very clear communication on how this will be avoided, for example, through design or seperating off targets. This is something that will not go away without being addressed in the communication.	As for the fair distribution of costs, the more the taxpayer is on the hook the less publicly acceptable it may be. (per Facilitator) The optics of a subsidy would not be stellar.

Maturity of the technology and MRV (Key points: there is not a one-size fits all policy criteria scale, because it depends on how mature the technology is and how well the emissions from it can be quantified.)	There is not a one-size-fits-all policy dimension, but it is driven by questions like how mature the technology is, level of confidence in accurate measurement, and how to incentivise these technologies on the same sort of basis. Each technology might be given similar sorts of credits, but rock weathering, for example, [is still immature as a technology] as the effect on the environment is not yet known. Should the same policy apply to those sorts of solutions as, for example, DACCS, where standards are in place for geological storage and the related MRV? So it is not just a question of picking the right policy, but of mapping the policy onto the methods.	None
Geographic implications (Overlap with other criteria, but specifically international concerns, including: can the policy be scaled/integrated internationally? Clarity of carbon accounting across borders; Economic efficiency concerns; Geopolitical concerns; Public acceptability concerns.)	None	A carbon takeback obligation can be designed in different ways. If the obligation were to allow for removals outside the jurisdiction of the country where oil and gas is being used, or by many different methods, it could be difficult to regulate that. Importing oil and gas from other countries would then require a large regulatory capacity. Alternatively, the policy could require recapture within the jurisdiction. This requires different (and again distributional) trade-offs, such as between economic efficiency and job creation. There are various dimensions to the geographic element. The clarity of the accounting, the geopolitics, economic efficiency (if it is really cheaper to do it in Saudi Arabia, then why not?). But public acceptability also needs to be taken into account. If the carbon is not stored in the same location/jurisdiction/backyard, one of the first criticisms will be that waste is being exported, and having poor countries suffer, and that is not a good look.

Summary

In summary, the session concluded that:

- the Facilitator set out reasons why inclusion in the ETS alone might struggle to encourage investment into GGRs and permanently remove CO_2. Two ways of remedying this were suggested, both including different policy options:
    - extra reforms to the ETS alongside GGR inclusion (which could be through having no limits, quantitative limits, multiplier values, contracts for difference, or a separate removals fund); or
    - alternative policies to the ETS (including regulations and standards, public procurement, subsidies, or a tax credit).
- Each of these policies could be scored on their effectiveness according to certain criteria. The criteria suggested in the presentation were certainty for investors, scalability, administrative ease, distribution of costs, and public acceptability.
- The discussion debated and refined these criteria further. Extra success criteria for policies that emerged during the discussion included ability to provide seed funding/capital support, ability to bring down costs (through learning/scaling effects), avoiding negative (environmental) side effects, how well a policy leverages private capital, maturity of the technology, and the distribution of costs and benefits over time, across the value chain, over sectors, and geographically.
- No conclusions were reached, but greatest consensus seemed to be formed around:
    - the ETS being able to create some demand for removal, as well as creating a potential funding source through the sale of credits;
    - but that it is not able to do much more than that, and that a more comprehensive suite of policies will be required;
    - of the alternative policies, a carbon takeback obligation received the most discussion.

Session 3: GGR implications for ETSs (facilitated by Caroline Fischer, World Bank and Resources for the Future)

After the first two sessions took a broad perspective on what overall objectives might be and implications from the GGR perspective, this third session looked at what the implications might be for ETSs from including GGRs.

The range of considerations proposed for this session included:

- what impact there might be on cap levels, cap integrity, (free?) allocations, market stability reserves, prices, revenues;
- the implications on sectoral mitigation pathways – actor incentives within hard to decarbonise/high cost mitigation sectors;
- the legal architecture that might be required; and
- the impact on reforms to ETSs, such as the potential integration of new sectors (for example, heat, transport) as well as for linking or connecting to other ETSs.

The Facilitator began with these issues as provocations and presented three different timeframes for ETS development, summarising different aspects in the following table (Table 2):

Table 2: Timeframes for ETS development

	Short-run	Medium-run	Long-run
Emissions	Positive	Low, mostly industrial	Net Zero or negative
Emissions Price	Modest	High	Determined by GGRs
Technology	Immature	Emerging	Mature at Scale
Policies?	Complementary	ETS integrated	Broader markets
Funding	Action revenues, taxpayers	ETS demand	Negative targets

Discussion

The discussion began with consideration of the potential for inclusion of GGRs in ETSs to undermine GHG emissions reductions. The question was posed whether retirement of allowances to a market stability reserve (MSR) could be a way to include GGRs in ETSs (e.g., the EUETS) without undermining GHG emissions reductions. It was noted that the MSR is a complex construction, and the timing of overlapping policies can interact differently with the impact on emissions: for example, early introduction of GGRs could reduce emissions, allowances may then be stored in the MSR. This may be different from later introduction of GGRs, where this effect may not be triggered. Also there are other ways to develop GGR interaction with ETSs, in a technical way, to lead to genuine additional reductions in emissions whilst also supporting development and recognition of GGRs.

The discussion then moved to reflection on the short, medium and long-term timeframes, as encapsulated in the Facilitator's table (above). These could be paraphrased as:

- Short run: parallel development of the GGR and ETS markets;
- Medium run: integrated working together, where the two systems co-exist. This is the interesting part of the market, the question being how it could be done?
- Long run: basically, there would just be a GGR market.

A further question related to when it would become apparent that we had moved from the short to the medium term. In the short term, prices for GGRs will be very high, much greater than the ETS allowance prices, so price convergence could be a consideration. In the longer-run, the question becomes who should be responsible to pay for the negative emissions? This might depend on the sectors covered by the ETS. All the same, everyone is benefitting from removals, so where the sectors covered are very narrow, should this be their only responsibility? There is an efficiency and distributional dimension in that perspective. An opinion was expressed that the responsibility should be quite broad.

There was discussion about the likelihood of extending an ETS to downstream or even to individual users, in relation to, for instance, the transport sector. This could relate to who pays for GGRs. It was noted also that the public has more confidence and tolerance for regulatory standards than for carbon taxes and trading systems, despite their lower economic efficiency. This is why regulatory options like blended fuel standards, renewables obligations, and so on, have been used. This experience could lead to an approach that includes an obligation for removals on the fuel supply side.

The problem is dynamic: technologies evolve over time, and endogenously. Emissions trading systems can allow banking over time, and therefore create an inter-temporal connectivity. Similarly, the MSR has a temporal dimension. However, funding is needed for GGRs right now. Currently (and potentially in what is considered the short term in the table), this is coming from the voluntary sector, distributed across a range of different sources in different sectors. As such, it was posed that perhaps a better understanding of the voluntary market in GGRs would be helpful.

It could be imagined that in the long term, the permanent storage 'prize' for GGRs is Direct Air Carbon Capture and Storage (DACCS), so DACCS could be used as the default price. Long-term link there with ETS would be good. It was proposed that a ceiling price could be set at the price of DACCS: if this price were binding, then the revenues could be used for anything that is cheaper than that.

It was proposed to move to ground the discussion about GGRs in ETSs in the reality of existing ETS systems. It was posed that the EUETS is a very fragile and vulnerable system right now. There have been lots of price swings already this year, and these are not easy to explain. This undermines investor certainty and a very political revision process is going on right now, which could end in a variety of different ways. It was put that this is seen as an opportunity for different countries to direct funding to their various industries. Further, it was put that the EUETS is already not working well, not delivering real sectoral emissions reductions at the speed required. In medium term, it was put that there should be optimism that it can work, and it may be that will be when the moment is right to aspire to introduce GGRs, which cannot, if introduced now, solve the other problems already existing in the EUETS.

Alternatively, the question was put whether it should just be concluded that the EUETS is not working and that there should be honesty about that, then different approaches outside the ETS might be looked at. Or whether consideration should be given to prioritising other aspects of the ETS, such as an auction reserve price. Even so, it seems a limited mechanism.

The observation was made that no one seems to think that adding GGRs to the ETS is going to be straightforward/welcome/beneficial to the ETS itself. Did that make it a mistake? Should we be looking elsewhere? One reason for this perspective could be that the reason for including GGRs in the ETS is deliberately to leverage funding for GGRs and to promote the new technology. This begs the question whether there is a willingness to pay the 'price' of a loosened cap, in order to gain access to this funding stream for GGRs?

There are more elegant and simple solutions that can be used for GGRs, more easily, than the ETS. For example, the Common Agricultural Policy, as well as other pots of money that could be used, rather than relying on the complex system of the ETS. In Integrated Assessment Models (IAMs)

long-run carbon prices are not determined by GGRs, but by the cost of eliminating the residual demand that cannot be met by GGRs. This outcome is the result of the fact that GGR is insufficiently developed and not available at the scale required at that point in the long-term. However, it was noted that IAMs are weak on endogenous technology improvement embedded in the models. This fact, it was argued, can make some aspects of the IAM details less reliable, especially in the longer-term.

An ETS with zero emissions coverage is no longer useful at some point, as basically it becomes a CCS mechanism in relation to residual fossil fuel emissions. Thus, it is necessary to see how to move from allowance certificates to removals.

The question was asked what are the ways of reforming the ETS so that there can be a more mutually supportive relationship between the GGR aspect and the ETS emissions reductions approach? Potentially, there is a benefit to the ETS of the inclusion of GGRs, with an 'exit' period at the end of the ETS's traditional shape, as emissions tend towards zero. At the same time, there is a need to consider the differences and regulatory challenges associated with parallel purchasing of removals outside of the cap, as compared to being included within the cap.

Summary

In summary, the session noted:

Timing is a very important consideration in relation to how GGRs could and/or should be included in ETSs and the benefit to the ETS system of inclusion of GGRs could be most significant in the longer-term, that is, when only residual emissions remain.

There are many challenges in getting ETSs, with particular reference to the EUETS to operate effectively already and, considering these imperfections, it might not be a good idea to introduce the GGR dimension at the moment.

The priorities for GGRs might be best addressed through other approaches that may be less economically efficient, but might be more publicly acceptable, such as standards, noting that some more evidence may be required. Nonetheless, there are a number of specific technical approaches that can be used to fix the current ETS systems, and there could be ways of thoughtfully designing GGRs into ETS systems. All the same, it is not clear whether the outcomes are predictable.

Session 4: Timing - decision sequencing, triggers (facilitated by Baran Doda, Adelphi)

This fourth and final session considers more deeply the main issues and milestones in including GGRs in ETSs, if that is to happen. Critical questions included: when are GGRs ready for the market? When are ETSs ready for GGRs? How do the role of ETSs and GGRs evolve towards 2050 and beyond? And what might be the decision sequencing and trigger points for timing?

The Facilitator began with the following provocations:

1. Readiness:

Assessing readiness of GGRs for use in ETSs, factors might include:

- GGR method and storage medium, for instance, whether engineered or nature-based, and consequently the degree of permanence of storage
- Technological readiness level, scalability, externalities (such as impacts on other land uses, or on other sectors such as food production) and cost
- Location of GGR supply chain activities, including cross-jurisdictional regulatory considerations

Assessing readiness of ETSs for introduction of GGRs, key considerations include:

- MRV and certification mechanism for GGRs
- Impact on incentives for mitigation
- How to introduce GGR units in ETSs

2. GGRs and ETSs over different time horizons:

Interaction over three different time horizons

- Short term to 2030:
  - Get GGRs and ETSs ready
- Medium term to 2050:
  - GGRs in ETS with declining/zero caps to achieve net zero emissions
  - Evolving role of ETSs in climate policy
- Beyond 2050
  - GGRs (in ETS with negative caps?) to achieve net negative emissions

3. Sequencing and contingencies:

Essentials

- Robust MRV, certification of mechanism and governance for GGRs
- Safeguards to protect ETS integrity and minimise negative externalities
- Public acceptance of GGRs in ETSs
- Pathway towards global market for (positive and negative) emissions

Key uncertainties

- GGR unit costs too low or too high
- Domestic and international distributional consequences

Thus, the Facilitator's headline questions were:

- Which (if any) GGR units should be allowed into the ETS?
- When (if ever) should GGR units be allowed in the ETS?
- What concrete steps are necessary to have a uniform (global?) carbon price, including for GGRs, in the future?

Discussion

Inclusion of techniques with different characteristics

A GGR technique being 'ready' in terms of its fitness for purpose is not the same as its readiness for ETS. Additional criteria will need to be satisfied, before allowing the units generated by a specific technique into the ETS. It was posed that there needs to be resolution of whether a technique-neutral approach or a bespoke, technique-by-technique assessment will be necessary for entry. Inclusion into the ETS may help or hinder a technique's development including its governance by placing novel demands on the process.

The question was put whether criteria for ETS inclusion should apply to broad classes of GGRs or should inclusion be at the project level? There is a need to address the question: should full GGR 'sectors' such as afforestation be brought into the ETS, or should inclusion be at the project scale – as in, for example, a specific DACCS installation?

Robust MRV will be essential. Inclusion in the mechanism should be grounded in technique-specific MRV evidence.

Puro.Earth shared with participants its approach to identify techniques for inclusion into a carbon removals market:[7] the organization has created a list of potential techniques, then a set of performance criteria, which has the result of eliminating many techniques. The shortlisted criteria are:

- delivered measurable rather than modelled removals;
- generated a data trail;
- would remove and store carbon for 50+ years; and
- should be scalable.

Storage permanence creates novel issues for inclusion in ETS. For example, are 'in perpetuity' removals required, or can short-term removals (e.g., <100 years) be accepted?

A global agenda

GGR is an important point on the global decarbonization agenda. So the debates about how to certify GGR units and whether or not to allow them in ETS should be conducted in the context of this wider conversation. It was put that there would be benefits if Europe does not proceed alone when designing a GGR certification mechanism. Canada has interests, the US is taking work forward, and there are also initiatives across Africa and SE Asia. It follows there is a role for international dialogue to agree standards of a high-quality GGR credits.

7 Puro Earth is developing a market place for carbon removal that seeks to overcome shortcomings of earlier carbon markets.

It was considered important that a wider global debate takes place – especially given that use will be made of larger markets outside Europe – they will be global, and a global governance dialogue is necessary and this should inform considerations concerning connections with ETSs.

Public engagement (PE)

The discussion suggested that the best way to address the PE agenda may be to start with holding small group discussions on focused issues and then gradually broadening the reach of the PE efforts. Key agenda item to address is the fact that the public typically equates removals and offsets, with all the attendant issues and controversies of the CDM era.

A key distinction to emphasise is between units generated based on emissions that are prevented from taking place in the future (i.e. activities that stop the GHG concentrations in the atmosphere from rising) versus units generated based on drawing GHGs from the atmosphere and permanently storing them elsewhere (i.e. activities that reduce the GHG concentrations in the atmosphere). Both types of units are offsets but only the latter are GGR.

It was noted also that it would be important to distinguish between the quality units generated by various GGR techniques (quality must be as high as possible) to inform public understanding. The key aspects of quality in this respect could include robust technique-specific MRV, high degree of permanence, and clear rules of liability ensuring environmental integrity in case of accidental reversals.

Policy

The point was raised that there is a potential policy challenge regarding having 'too much GGR'. This is would cause a difficult, tricky agenda and there would be a need to address it so as not to dilute mitigation efforts whilst effectively delivering GGRs. Emission Reduction (ER) must come first, but if GGR became abundant and cheap it may become difficult to force the policy community to focus on ER that is, the issue may become who would choose challenging, expensive ER over cheap, effective and easy GGR? It was put that there is a need to resolve how to work with the policy community on this potential future issue.[8]

The inclusion of GGR in ETS

The discussion noted that a number of issues drive whether to include GGRs in ETSs, including the issue of who pays; whether least-developed and developed countries have the same responsibilities; and how to balance the contesting demands for resources and trade-offs.

Some participants suggested GGRs should not be allowed in ETSs, arguing instead that there should be an explicit mandate to compensate/offset continued use of fossil energy with GGRs. That is, if a fossil energy company does not use GGRs it should not be able to sell fossil fuel. It was suggested also that if regulatory frameworks required this, the fossil fuel companies would deliver, and they have the financial capability to deliver. It was noted that it is strange not to see NGOs pushing this agenda.

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8 A good way to express this idea is that all of the following are all net zero in 2050: 0 - 0 = 0 (absolute zero); 1 – 1= 0 (high ER, low GGR); 10 – 10 = 0 (low ER, high GGR). Grossly over simplifying, the planet is largely neutral and economist would argue pick the option with the lowest social cost (i.e. after accounting for all externalities). Different stakeholders in different countries have very divergent views on the same question making the politics very challenging. (per Facilitator)

MRV at the organisation level

It was put that individual organisations may claim removals on paper, but not deliver them. This form of 'green washing' might quickly take pressure off companies or sectors that could otherwise decarbonise, giving them an opportunity to carry on with "business as usual", whilst claiming net zero. It was argued also that companies must not be allowed to use GGRs as a substitution for ER. The MRV and governance policy regime must ensure GGRs are complementary to, not a substitute for, emissions reductions.

When will ETS be ready for GGR?

The view was put that ETSs may never be ready for GGRs – it may be better to use other approaches to support the development of GGRs but this could pose problems for emissions from hard-to-abate sectors that are covered by various ETS currently in operation.

The view was put that there are genuine problems with putting GGR into ETSs and it may not be the ideal option, but the question was raised whether there any genuine alternatives?[9] The table of policy options (from Session 2 Facilitator) may help identify other possibilities.

It was posed that putting GGRs into ETSs may allow the mechanism to be more stringent in the future real world, when GGRs will be a key element of the carbon landscape. However, other policies will be required to make removals commercially viable and the least cost options that complement emission reduction for a well-functioning global carbon market ecosystem.

Finally, under current market conditions and levels of technology readiness, it was put that if GGR techniques were to be able to generate ETS credits, subsidies to the market would be needed.

Summary

In summary, the session noted:

- feasibility of inclusion of GGR techniques such as afforestation in an ETS;
- importance of MRV and governance of a market with GGR units;
- permanence;
- the need for global engagement on the issue of GGRs and ETSs;
- possibility for selective inclusion;
- approaches to public engagement;
- policy required to address integrity issues;
- uncertainty over timing and appropriateness of GGRs for the ETS.

9 The question is alternatives to what? Supporting GGR via-non ETS means, then surely there are alternatives. But achieving net zero and net negative emissions in ETS sectors - then this would be exceedingly costly without GGR. The problems are genuine but that does not mean solutions do not exist. (per Facilitator)

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