Notes from the UK GGR Event Day 1 breakout sessions

1. **Climate change scenarios and modelling' breakout session (in person – no online breakout)**

There were no perennial biomass people in the breakout room

What is currently being considered in models? Is there a need for joining up demonstration's methods?

There is a need to be able to quantify what future climate change could do to the different technologies, if there will only be a small effect on the technology then it doesn't matter.

There is a preference to use specific variables instead of scenarios e.g. 2 degrees or 3 degrees etc.

Climate conditions in future:

- Future emissions
- Response of long-term UK climate emissions
- Natural interval climate variability

Water V Temp impacts in different emission scenarios are quite different.

It' worth highlighting that between both high emissions and low emission scenarios the water and temperature changes due to climate change are virtually the same until 2050.

However, near the end of the century the difference between the high emission scenarios are important Water has a lot of uncertainty and not much difference between the two different emission scenarios. Need to know if it's getting wetter or dried, especially for woodlands.

Is it important that all the projects are sensitive to temperature and water in their modelling? If they are can they apply the different variables to all the different models?

Most studies look at the median but they should be looking at the extremes.

Instead of just looking at extremes they should find out which part of the climate change their model may be most sensitive to. Ask the question 'what is your tech sensitive to?'

1 storm 1 hit – how do we factor in these events? Wind speed is important to consider. We can't predict these events/ specific events but we can predict the frequency of them.

Is one extreme for one project the same for all? Do we need a common approach or individual ones.

Tail risks, worst case scenarios?

- UKCP
- If you know the climate response you can predict

- High sensitivity

2 sources of uncertainty

- Permanence, failure/ percentage loss
- Performance

Overshoot – what does that mean for each project?
Local/ regional = overshoot doesn't matter as much, but temp and CO_2 do.

Weathering has better kinetics with higher temperatures

Portfolio of options = more resilience to random changes/ unpredictable events.

Decision makers need a direction of travel

Offset schemes involve buffers to deal with these uncertainties in future scenarios e.g. with 15%. Ideally this number would be as accurate as possible so we need to put effort into looking at this buffer risk value.

(Woodland carbon code)

Afforestation is the only valuable tech right now

A request to the HUB , please ask each of the demonstrators what climate variables they are currently looking at, are they looking at means? A confidence interval? This is the first piece of work that would need to be done to see how integrated the demonstrations are already.

Do we have a consensus to having a joined-up approach?

Demonstrators should look at sensitivity under each temp.

Also choose some random extreme events such as floods and droughts

The UK extremes are other countries extremes and norms

Pathways can be determined based on what extreme event happened

You can model the frequency of extreme events and this is what is important.
This is useful for programme coordination less so for high level decisions

It will be interesting to see where different demonstrations have similar sensitivities

Cross demonstrator project would be good for the following reasons:

- Seeing the effects of deployment of multiple demonstrations
- Land is expensive so 2 techs sharing one land could be economically beneficial whilst also adding some buffering for technologies if one were to fail.

Most effective tech will change with changing climate

Finite land needs portfolio potential to find demonstrators which can work together.

Spatial resolution is small with these models,

Functional relationships which can be imported into different models

Changing specifics (temp, water etc) can be the difference of systems loosing or gaining carbon.

Final Summary

- Generally, all demonstrators see the need to understand where the technologies overlap and differ
- Many/ all processes are sensitive to future climate change
    - There are two types of unknowns
        - The temperature and rainfall quantities, this can be viewed in a range of extremes
        - The random events such as floods are harder to predict but the frequency of these events can be predicted
- There's a huge range of potential events and scenarios
- Extremes are good to understand for other countries but also what may happen in the UK
- HUB will ask the individual projects about their own sensitivities and then take it from there

2. ‘Responsible Innovation and EDI’ breakout discussion (in person)

What is responsible research and innovation?

- Anticipating impacts
- Reflecting on assumption and uncertainties
- Engaging societies
- Changing the trajectory of innovation in response to those things

How will the Hub develop this workstream?

- Field and ethnographic work
- Stakeholder participation mechanisms
- Inclusion of other forms of knowledge

What insights came from the group discussion?

- There is little visibility of the question of “responsibility” in the demonstration projects, in particular on the question of deterrence. The programme could work on:
    - Responsibility to critically assess what is the considered as “residual emissions”.
    - Defining what is “responsible” demand for removals (from current emitters).

- Consider the possibilities of equity and justice to drive decisions over the ownership and deployment of technologies that develop form the program, for example, considering discussion over technical developments being given away for rapid diffusion (within the UK and globally).

- This is an opportunity to bring people on since the beginning and accelerate deployment, instead of the traditional perspective of seeing society as something that we need to “overcome”,

- Consider the responsibility over the use of communication more generally to make sure it is both effective and truthful.

- Consider the linkage between the research on and about the UK with experiences, interests, and preoccupation from developing countries given the global scale of the removals required.

3. Responsible Innovation and EDI’ breakout discussion (online)

- People don’t believe climate change is real. You have to win over those who need to be convinced.
- Practical conservation projects provide tangible evidence of work being undertaken to help address climate change.
- With GGR we need to know who is setting the agenda. We may need to think more broadly and take into account different perspectives.
- Farmers could be paid to adopt a GGR approach to ensure upscaling. Otherwise the approach may not be feasible.
- Applying rockdust or biochar may be viewed as being very similar to current agricultural practices such as applying lime.
- People are aware that crops are always changing in fields. The planting of perennial biomass crops will not be anything new to them.

- Planting trees will always be controversial. People always notice if trees are cut down or planted. People want to know where trees are being planted, how many are being planted, and if it will change the landscape. People don't like visual change.
- Some people will always oppose new technologies.
- Different ethnic groups will apply different meanings to the environment. In order to communicate about projects, different messages will be needed depending on the ethnic group. What is being said needs to be carefully considered. Climate change and GGR may not be thought of in the same way by different ethnic groups.
- Science is often viewed as inaccessible.
- People aren't aware of GGR projects. They often feel they are the last to know about projects.
- The demonstrator projects need to make the projects more visible and accessible to wider publics.
- The youth movement is important. People like Mya-Rose Craig (Birdgirl) can inspire Gen Z, and we should be using these influencers to reach out further. The next generation are suffering from climate anxiety and we need to bring forward hope.
- Nature is starting to become part of the solution for living better. But if nature is used to make lives better, then it needs to be for everyone. We can't use nature for only improving the lives of some.
- People don't support what they don't understand. Support is crucial for projects to be successful.
- Expectations need to be managed. With the demonstrator projects, people need to be told what can be done and what can't be done.

4. ‘Regulation, barriers, governance’ breakout discussion (in person)

The way in which the word “waste” (referring to mining or building water) is being used in mineral carbonation is of concern. These are products and they have been certified. He points out that the general public will not be happy about spreading so called “waste” on land and we should be careful when using that word.

All the GGR techniques are so different amongst themselves that it presents an issue for governance as we cannot create blanket policies. (In response to Manning’s first comment) Mining waste is very different (in scalability, durability, cost) than mining and grinding minerals.

There has been a lot of work done in enhanced weathering, and the way we phrase the research is critical.

Waste be a commodity, how we name things and processes is important. He also pointed out that more expensive GGR techniques, including ocean-based methods, are worth exploring as they can offer better permanence.
One of the barriers to MRV are standards. NETs should not repeat what happened with carbon credits and it is important to build and define consistent standards. Is it crucial that buyers have a clear idea of what they are buying.

We still do not know what works or does not work as GGR techniques, so when deciding which projects to fund it is important to set some of the funding aside as “flexible money”.

The regulator, the Environment Agency, needs to recognise the social benefits of GGR. (In response to Manning’s first comment) the Environment Agency has currently 1 person looking at GGR framework and switching materials from a waste to a non-waste classification is a lot of paperwork, and that may not be what we should be focussing on just now.

Who will be responsible for paying for all the GGR we need? Will this be spread across society? The cost needs to be fairly across all sectors.

It is a challenge to monitor the CO_2 stored through GGR. We can measure how much CO_2 is captured through enhanced weathering but where does the carbon end up? Is it stores as carbonates, as alkalinity in rivers? This is one of the biggest challenges in terms of developing monitoring.

Standards and monitoring go hand in hand.

We need to fully understand the science behind GGR before industries start buying carbon credits.

CO_2RE will be able to help with the science foundation that is needed.
Xxxxx: one of the major challenges GGR is acing is lack of MRV. GGR through land-based is easier than through ocean-based pathways as it does not require international agreements.

There is no consistent methodology for monitoring land-based GGR approaches.

Targeted regulations need to de addressed to technology. In a Net-Zero world we will only remove residual emissions, but just now what is happening is that we are using NETs to offset emissions that could be avoided such as wealthy people constantly driving and flying. Is this the responsibility of governments to regulate this.

The cheapest carbon offset is not the most reliable in terms of storage time. When calculating the CO_2 removed by GGR techniques that do not offer permanent storage, this should be multiplied by the uncertainty of getting the carbon back in 20 or 50 years.

There are political and cultural barriers to the large-scale deployment of land-based GGR. For example, if a farmer is interested in deployment GGR on their land they are risking devaluing the land. This is a real challenge.

We need to view the whole planet as one system and a broader view of carbon capture.

How can we integrate compound application of different techs to MRV? How does this equate to carbon credits?

Biochar is a GGR that can fit into other GGRs, and the regulation required will be different for each situation.

Time the main challenge. How do we make sure that we are moving in the right direction regarding MRV, society, etc, but do it quickly?
David Manning: as scientists we are frustrated that MRV is not fully developed. Modelling is happening, and this is a robust starting point.

The main lesson of their project is to make sure that targets are clearly defined. The UK is mostly coherent regarding this, but the oil and gas sectors are unreliable and make empty promises, which poses a risk in the long term. Quarries know how much material they are selling. However, the carbon capture potential of these materials is unknown as it depends on several variables (different mineralogy, different soil types where the materials will be applied, etc). This is what makes it a challenge to quantify the carbon capture well enough and use it as offset as all these variables can define the difference between a carbon positive or carbon negative technique.

We can set targets in land-based GGR scenarios and round them down.

Carbon emissions are different from carbon removal, and we should be aiming to lowering the emissions that can be cut down and parallelly we should try to remove atmospheric greenhouse gases.

We should be focusing on Net-Zero. Whether carbon is being removed or never emitted should not be our focus.

We tend to portray the fossil fuel heavy industry as reluctant actors. But in reality, if they change very quickly it can negatively impact society as it can lead to job losses. And this is when GGRs can come into play and fill in this gap.

Litigation has an important role to play.

5. ‘Regulation, barriers, governance’ breakout discussion (online)

Aims: Reflections on previous work (e.g., GGR-A projects) and how lessons may be learned for future projects (e.g., GGR-D).

Introduction:

- CG overview: UK policy landscape.
- National Infrastructure Commission report.
- NZ strategy, 5 MtCO2 removal by 2030 - CCC assessment of that report, lacking detail.
- MRV Task force report, 2021 - differences in permanence

Discussion notes:

- Complicated space for policy/regulation - lots of factors to consider.
- Mitigation deterrence & governance within industry (with rising targets for NZ)
- Farmers community - competing claims for farmers land, landscapes
- Opportunities for **lessons learnt** across the programmes?
- DACCS? - representation across the programmes?
- Lot of cross cutting issues (including findings from both programmes)
    - Sharing ideas across the demonstrators
    - Will the same stakeholders be used across the projects
- Stakeholders - usual suspects, missed communities?
    - Rural climathons - trying to get farming community engaging with the public, solutions to NZ with land. Not great uptake, not many mentions of food or carbon. More about hedges/regen farming.
- Management of residual emissions - emissions reduction in the short-term?

Summary for feedback to plenary:

- Integration across the demonstrator projects e.g. social aspects of each and how they can feed in to different parts of the programme.
- How to facilitate / formalise the process of lessons learnt from GGR-A programme for GGR-D - ways to do that?
- Need to integrate social science across the demonstrator projects e.g. social aspects of each and how they can feed in to different parts of the programme. Importance of the regulation and barriers working group in the hub as part of that
- Importance for policy and governance of minimising residual emissions
- Challenges of engaging with landowners and farmers - some innovative work bringing farmers and communities together to propose solutions climathon

6. Life Cycle Assessment breakout discussion (in person)

Existing standard produced by GHG protocol. Move to a c**hange emissions course and intervention accounting**. But it would be a long and complex report.

Pointing out ISO rules for LCA are not advisable, they have not clear allocation, consequential and attributional directives.

When assessing GHG removal, everything needs to be considered. When considering DACCS, even with renewable energy, you need to account for production of solar panels, production of air turbines, transportation of CO2, etc.

Lack of comparability for different and even similar projects. Understanding what the different categories are. Communicate the differences between removal and avoidance.
Differences between past and forecasted emissions. Terminal values need to be understood to model the future.

How do we categorise the future potentials? Different GGR lead to different removal at different times. It is suggested that all the removals needs to be linked with a **time** when that happens**. When and at what scale the removal happens**, together with uncertainties on the system performance → defining the futures to see how GGR technologies need to be deployed.

What happens when you store the carbon, for how long is the storage is working? What is stability, reliance on permanent sequestration. Again time. Where is carbon stored and for how long?

With energy crops you use the piece of land forever for feedstock production. With forest it needs to grow (long time). It is easy to reverse if there is a bad effect on Earth from implementing it.

All the possible scenarios or unbalance due to land use change needs to be accounted in the model.

Again, insisting on the time topic.

Emissions and removal plot vs time. How far in time can you con on the analysis? There is a limit because it won't be any intervention between the two separated scenarios. HOW FAR should it be taken? You want to make the study as far as you e.g. 200 years for biochar is not a valid timeline since it decomposes earlier.

Weakness of LCA. The temporal distribution is not clear. Carbon payback (trees once burned, need time to regrow)

Maybe LCA can learn from energy system modelling that records energy over time.

Avoid CO2 equivalence and be more transparent on each GHG that is evaluated.

Financial approach suggested. Time value carbon. Consensus on what that time value should be, and linked it with science. Life span, immediate effect or removal years after.

Do not discount CO2 based on when those removals occur. Just count and track when they physically happen.

The response of temperature with CO2 is linear. It doesn't matter when you accumulate them, when you accumulate, temperature reduces. We need to limit temperature, regardless of whenever the emissions occur.

We need to record all GHGs separately. **Transparency**.

Discounting is good in cost analysis or economic value. Then the future has less value than immediate discounts. It doesn't make sense when you contemplate cumulative emissions.
Communication problems. Convey clearly to the wide audience, together with politicians and not expert academics, what life cycle means, the importance of including all actions within the system when computing all those numbers.

Summary points

- **Temporary distribution of emissions and removals.** Tracking when emissions and removal take place.
- Transparency is a must. Record
- Financial approach for CO2 emissions was first suggested and then declined. It is important to trace when the removals happen, but the most immediate are not more valuable than the ones happening later on the time frame. Especially when cumulative emissions are accounted for global warming.

7. **Life Cycle Assessment breakout discussion (online)**

Harmonization of GGR LCA methods?

- yes, there is a need
- but it will be difficult and the group doubts if it is possible (also with the view on different stakeholders and that they want different outputs, e.g. government, DEFRA etc.)
- comment on post-harmonization > might be achievable
- maybe rather a set of guidelines; e.g. one guideline for land based practices
- considering the stakeholders and not only the researchers

Stakeholder considerations:

- regarding output (GHG, C storage)
- timeline (short term and low risk vs. long term and high risk)
- transparency will be important

Emissions trading:

- MRV and LCA should not run separate in the program
- guidelines might consider trading schemes (UK, Europe, International)

Conditions for removal:

- biological management/practices might be temporal but they are valuable till 2050
- and they are valuable in the longer term considering co-benefits

N2O emissions

- short discussion on N2O emissions from fertilizer use as direct and indirect source and where/how it is accounted for

Baseline:

- Definition of baseline will be critical (all agree)
- should also consider the political/stakeholder view

Co-Benefits:

- in all the LCAs the co-benefits (environmental, social) should be considered
- this might be also difficult to harmonize for all the GGRs