



Imperial College
London

ATKINS
Member of the SNC-Lavalin Group

Scaling a UK Greenhouse
Gas Removal Sector:
**CHALLENGES AND
IMPLICATIONS**

September 2020



The UK's net-zero emissions target, which entered into law in 2019, represents a radical departure from the already-ambitious 80% emissions¹ reduction target that it replaced. Net-zero will require disruptive change to take place concurrently across multiple industrial sectors and technological diffusion at a rate unprecedented in the post-industrial era. Most significantly, net-zero will require the development of a UK greenhouse gas removal² (GGR) sector - involving nature based and technical options - that removes 60-90 mega-tonnes of CO2 each year by 2050.

The GGR sector is likely to be amongst the largest industrial sectors in the UK. Cutting across multiple land uses, activities, sectors and policy areas, it will need to be retrofitted and integrated within the existing urban-rural-industrial fabric - this will require substantive engagement with communities, society and industry to establish the necessary infrastructure. An unprecedented level of investment will need to take place for GGR solutions to be realised at the scales required. The public, private and third sectors face an enormous challenge to ensure these technologies can be delivered effectively, promptly, sustainably and equitably. The journey needs to start now.

Awareness of the technologies involved in GGR is, however, limited amongst the majority of actors that will be integral to adopting, enabling and endorsing the development of this sector.

This panel session sought to initiate a strategic conversation and build capacity around these little understood technologies. Speakers considered the challenge ahead and the potential implications for the UK and beyond. For a biography of the speakers see the Annex.

The panel session also announced the following initiatives:

- » Funded by the Climate Works Foundation, the latest report from Foresight Transitions, Imperial College London and ATKINS, [Putting people and communities into greenhouse gas removal: Commercial and Socio-legal Evidence](#), examines the implications of GGR deployment from the bottom up. It represented a short pilot project focused on the Leeds/Yorkshire area, informed by over 100 interviews and two participatory workshops.
- » The event also launched the [Corporate Carbon Removal Guide Project](#), which is led by Foresight Transitions with support over the coming months from Atkins. The project will build capacity for corporates to engage with ideas about GGR and look to better understand the role and needs of businesses in driving carbon removal forward.

Further initiatives that are being undertaken in the carbon removal space can be found in Box 1.

FORESIGHT TRANSITIONS-ATKINS PANEL SESSION

Foresight Transitions-ATKINS convened an expert panel to discuss the scaling of a UK Greenhouse Gas Removal Sector - the challenges and implications.



17 SEPTEMBER



67 ATTENDEES



OVER 50 ORGANISATIONS



90-MINUTE
DISCUSSION



¹ The 80% and Net Zero emissions target is for all Greenhouse Gas Emissions.

² Greenhouse gas removal is a term used synonymously with carbon dioxide removal (CDR), carbon removal, and negative emissions.

Much greater governance, co-ordination and engagement than is currently present is needed for GGR to be realised - For the UK to achieve its Paris Agreement obligations, both mitigation and GGR will be needed at large scale by 2050. Establishing and scaling nature-based and engineered GGR solutions will require dedicated national governance. High-level policies and regulations will need to be combined with mechanisms that explicitly build local awareness and accommodate community needs and values.

01.

- » Large-scale GGR will be required in the UK to address the UK's net-zero target. These will come from nature-based (e.g. forestation, peatland restoration) and engineered (e.g. bioenergy carbon capture and storage and direct air capture) approaches. These removals are needed to address emissions from the hard-to-decarbonise sectors of the economy e.g. aviation, steel, cement and agriculture.
- » The sector will likely need to grow by seven orders of magnitude over the next three decades to meet the net zero target. Funds for GGR could be raised by a levy on high-emitting sectors.
- » There is a lack of dedicated national governance around the development and co-ordination of a large-scale UK GGR sector. Policymaking is presently split over three departments: **Business, Energy and Industrial Strategy, Transport and Department for Environment, Food and Rural Affairs.**
- » Building awareness of GGR amongst communities and other audiences at an early stage will be vital in order to cultivate trust early around the technologies and their associated value chains. There is presently a lack of awareness of GGR, and a range of perspectives around the different potential technologies - for example, the study found a range of cultural perspectives, and perceived benefits and values that are affecting the ability to plant trees on a large-scale. In order to have an informed dialogue, capacity needs to be built amongst civil society to understand the implications of scaling the GGR sector. This will impact technology choices, scales, and locations where they might be deployed.
- » A whole-system perspective enabled, in this context, through a renewed regional spatial planning approach could be an important facilitating role when integrating the deployment of GGR technologies into rural and urban landscapes. However, a more nuanced appreciation of the tensions that local decision making and regional planning can generate will be needed to ensure that such approaches are capable of delivering equitable outcomes. In this regard the recent MHCLG White Paper consultation on the planning regime³, though currently focused on speeding up house building, has the potential for providing a framework for better engagement on other important topics such as biodiversity net gain, beauty, and net zero etc, but more clarity will be needed as the proposed changes are finalised. The need to ensure that local planning mechanisms are appropriately resourced at a local authority level will be important in making sure they function effectively.
- » A proactive, participatory approach needs to be embedded into planning law, offering clear guidance on engagement when deploying GGR. The Climate Assembly model is a good start, but the types of engagement needed for GGR will also need to incorporate participation at the decision-making stage - the types of tools that might be considered are outlined in Annex C in the new [Foresight Transitions report](#).
- » Accommodating the inherent uncertainties in the deployment of carbon removal, some of which are untested at scale, requires adopting a novel approach to regulatory mechanisms. Ideas about Anticipatory Regulation provide a helpful model - for more details see the report, or this event held in May 2020⁴.

³ MHCLG - [Planning for the Future White Paper](#) August 2020.

⁴ ATKINS-Imperial College 2020 - [The Role of Anticipatory Regulation in achieving Net Zero in a post Covid-19 World](#).

Focusing on GGR solutions can deliver multiple economic, environmental and societal outcomes where it is done well - Nature-based greenhouse gas removal initiatives are already taking place, and engineered initiatives are being planned in the UK for the next decade. These need to ramp up now, in order to realise the scale and cost reductions needed by 2050. The UK has well-established capacity and experience across both nature-based and engineered GGR solutions upon which to draw. These initiatives could achieve a number of environmental goals if done well.

02.

- » The UK has a well-established forestry sector; direct air capture initiatives are being established in the UK;⁵ and Drax plans to deliver negative emissions through bioenergy with carbon capture and storage (BECCS) by 2027. Nonetheless, the technical feasibility of generating negative emissions through BECCS is untested, and a robust policy framework to support CCS infrastructure will be important to realise this GGR capacity. Should the UK harness the opportunity, the UK could become a world leader on the technology, as well as benefiting from the employment and economic opportunities.
- » The ability for these initiatives to be realised will be predicated on the development of a clear social licence to operate, achieved by building a trusting relationship with the local community – for example, through facility tours and educational outreach, as demonstrated by Drax.
- » The fact that the planet faces both a biodiversity and a climate emergency underscores the need for GGR initiatives to address both carbon and biodiversity objectives. This will mean ensuring suitable woodland creation in the right places, encouraging the appropriate climate-friendly agricultural practices, and restoring degraded ecosystems such as peatlands - all of which bring co-benefits for wildlife as well as human wellbeing. Such mutual benefits will be critical in improving the productivity of both land and people, something that remains a chronic issue in the UK.
- » The UK knowledge base is well-established in nature based GGR and biodiversity net gain. There are well documented examples of where projects have been done well and where projects have resulted in negative unintended consequences. In those situations where negative outcomes resulted, they have tended to be where the context specificity of an area has not been appropriately considered and/or there has been a failure to engage with the right people and communities. To ensure success in addressing both climate and biodiversity agenda the powerful data that is available needs to be better joined up and the messaging improved. At present the message around nature-based GGR is too unsophisticated i.e. the narrative is simply about planting more trees. The new [Foresight Transitions report](#) clearly demonstrates that reforestation is much more than about just planting trees e.g. flood prevention, cultural and aesthetic issues need to be considered etc.

⁵ Carbon Engineering News and Updates - [Pale Blue Dot Energy and Carbon Engineering create partnership to deploy Direct Air Capture in the UK](#) dated 16th September 2020

We must not wholly rely on existing systems to deliver the needed solutions - Market forces alone will not deliver a GGR sector in a manner that is sustainable, equitable, scalable and timely.

03.

- » The ability to deliver a large-scale nature based and engineered GGR sector is as yet unproven. However, a market-based framework alone cannot deliver sustainable, equitable and genuine GGR, despite some bold initiatives in this area.⁶
- » GGR must not be seen as a silver bullet, and must not be used to offer longevity to high-carbon business models. The process of identifying residual emissions, and determining how these are balanced with negative emissions, will have to be transparent. All greenhouse gas removals will need to be verifiable, both in terms of how much carbon they remove, and whether they have delivered other objectives, such as biodiversity improvements.
- » When reporting on progress towards net-zero targets, emitters will need to make clear how these are being achieved, specifying what proportion will be addressed by mitigation versus negative emissions. Some industrial actors are already conflating the two approaches, and present practices might result in double-counting or have other distortive effects.
- » A lack of oversight and regulation will also likely lead to a dash for, and the appropriation of, cheap carbon removals. This could exclude from the market those with genuine need, and also preclude investment in the higher-cost GGR technologies, which will likely have greater permanence and therefore climate benefit.

⁶ Swiss Re dated 15th September 2020 - [Swiss Re Introduces triple-digit internal carbon levy to support transition to net-zero emissions in operations by 2030.](#)

Ongoing Greenhouse Gas Removal Projects being undertaken by Foresight Transitions, ATKINS and partners.

In addition to the engagement of business via the Corporate Carbon Removal Guide Project the following initiatives are being developed related to Carbon Removal in the UK and internationally:

BOX 1.

- » The [Carbon Removal Centre](#) and [Carbon Removal Network](#) is aiming to accelerate carbon removal from the atmosphere and build an inclusive community around the sector.
- » Foresight Transitions is seeking funding for a piece of work to follow the Putting people and communities into greenhouse gas removal: Commercial and Socio-legal Evidence project. Having established the need for community engagement in the first piece of work, the subsequent piece will be about Assessing ways and means by which publics and communities can be brought into the GGR agenda in as effective manner as possible to fulfil procedural justice and socio-legitimacy. We are working with philanthropies to fund this follow up work as well as potentially co-fund this work with industrial partners.
- » Foresight Transitions have acquired initial funding for the [Corporate Carbon Removal Guide Project](#) and are seeking funding to develop a platform to co-ordinate funding for carbon removal between national governments, industry and philanthropy, to develop greater co-operation and interaction around the activities that are being undertaken in GGR.
- » Frontiers in Climate, an open-access academic publishing journal, have recently launched an article collection that is synonymous with the theme of this webinar: [Scaling-Up Negative Emissions: The Power of Leveraging Policy, Philanthropy, Purchasing and Investment](#).

For further information on the Corporate Carbon Removal Guide Project, email Francesca Battersby at francesca@foresighttransitions.co.uk.

For the other initiatives email Mark Workman at mark@foresighttransitions.co.uk and/or Richard Heap at richard@foresighttransitions.co.uk

Biographies of Panel Members

Understanding the role of greenhouse gas removal

The UK needs a balanced portfolio of Greenhouse Gas Removal methods

Putting people into Greenhouse Gas Removal

ANNEXES.



Stuart McLaren is Technical Director of Carbon at Atkins, leading a wide range of low carbon, environmental and engineering service lines. He is also an accomplished client director, providing strategic cross-sector leadership on major infrastructure projects with a recent focus on low carbon and renewable energy schemes in the UK. Stuart leads on the development of Atkins low carbon / Net Zero services lines working closely with academia and industry actors to advance the thinking around the Net Zero Agenda.



Richard Heap, Study Author, Foresight Transitions
Richard Heap, Project Leader, is an experienced analyst managing projects across a range of technical and cross-cutting aspects. He has degrees from Imperial College, Environmental Technology (MSc) and Biology (BSc).

After selling his recycling business, which he set up and ran for 10 years, he moved into science policy, leading the Climate Change, Energy & Environment team at the Royal Society, producing influential reports on Biofuels, Ocean Acidification, Radioactive Waste Management and initiating the work on Geoengineering. At the Energy Research Partnership he focussed on energy issues including a highly regarded report on Hydrogen, CO2-Enhanced Oil Recovery, the Heat Transition and Public Engagement, which explored the need for strategic narratives.

His current focus is on the application of futures techniques combined with the use of public and stakeholder engagement to help inform decision-making and policy and regulatory development both at a system level and bottom-up from a local and regional level.



James Elliot, Senior Policy Advisor, Green Alliance.
James is a senior policy adviser at the environmental thinktank and charity Green Alliance. He joined Green Alliance in 2016, and has led the organisation's Natural Environment work programme since February 2019. His work in recent years has included a focus on the role and governance of nature based carbon sequestration and other greenhouse gas removal technologies in restoring nature and tackling the climate emergency. Green Alliance has also been experimenting with deliberative democracy, carrying out two pilot citizens' juries on climate change ahead of the House of Commons Climate Assembly in 2019.

Before joining Green Alliance, James attended the 40th meeting of the IPCC as an assistant to the Netherlands delegation, and was a Student Research Fellow with Maastricht Law Faculty. He holds an MSc in Sustainability Science and Policy from Maastricht University.



Professor Piers Forster, Director of the Priestley International Centre for Climate at the University of Leeds.

Piers has been a lead author for the past three Intergovernmental Panel on Climate Change reports. He researches various aspects of climate change, including its causes, impacts, and adaptation and mitigation strategies. Since 2018 he has sat on the UK Committee on Climate Change.



Claire Wansbury Associate Director of Ecology

Claire has a unique set of skills and experience to support clients and policy-makers in working towards delivering Environmental Net Gain. She is an ecologist with over twenty-seven years' experience and a Fellow of CIEEM.

Claire is one of the UK's top experts in Biodiversity Net Gain, and a key player driving forward best practice. In 2016, Claire co-authored the "Biodiversity Net Gain good practice principles for development". She then provided CIRIA with independent advice in procuring the author team for "Biodiversity Net Gain, Good practice guide for development: A Practical Guide" and went on to chair the Project Steering Group producing guidance on biodiversity net gain. Claire is on the working group creating principles for net gain and people, and the BSI committee creating a British Standard for Biodiversity Net Gain.



Rob Asquith, Director – Planning – Savills

Rob Asquith is Head of National Infrastructure Planning at Savills, the UK largest planning consultancy, and has over 32 years' experience practicing planning and environmental impact assessments. Rob is passionate about how planning and land use enable the transition to a Net Zero future and has led planning and consenting schemes of a wide range of major infrastructure and renewable schemes across the UK.



Angela Hepworth – Commercial Director Innovation - DRAX

Angela Hepworth is Commercial Director in the Drax Innovation team. The focus of her work is delivering the UK's first bioenergy with carbon capture and storage (BECCS) plant, which will provide a source of negative emissions as well as firm, renewable power from the late 2020s, contributing to the UK's net zero goal and Drax's ambition to be carbon negative by 2030. Prior to working for Drax, she was Policy and Regulation Director for EDF in the UK, and before that spent 10 years in a range of policy roles in the UK civil service.

UNDERSTANDING THE ROLE OF GREENHOUSE GAS REMOVAL

Even after deep decarbonisation, there will still be residual emissions across the economy. Greenhouse gas removal (GGR) is considered an important tool for tackling these 'hard-to-abate' emissions.

What is greenhouse gas removal?

Greenhouse gas removal (GGR) refers to activities that involve the extraction from the atmosphere and long-term storage of greenhouse gases. Most often, this refers to the removal of CO₂.

A range of GGR technologies are available, including nature-based, engineered, and hybrid options. The technologies differ according to potential, cost, side effects and co-benefits, storage type, maturity, saturation, and permanence.

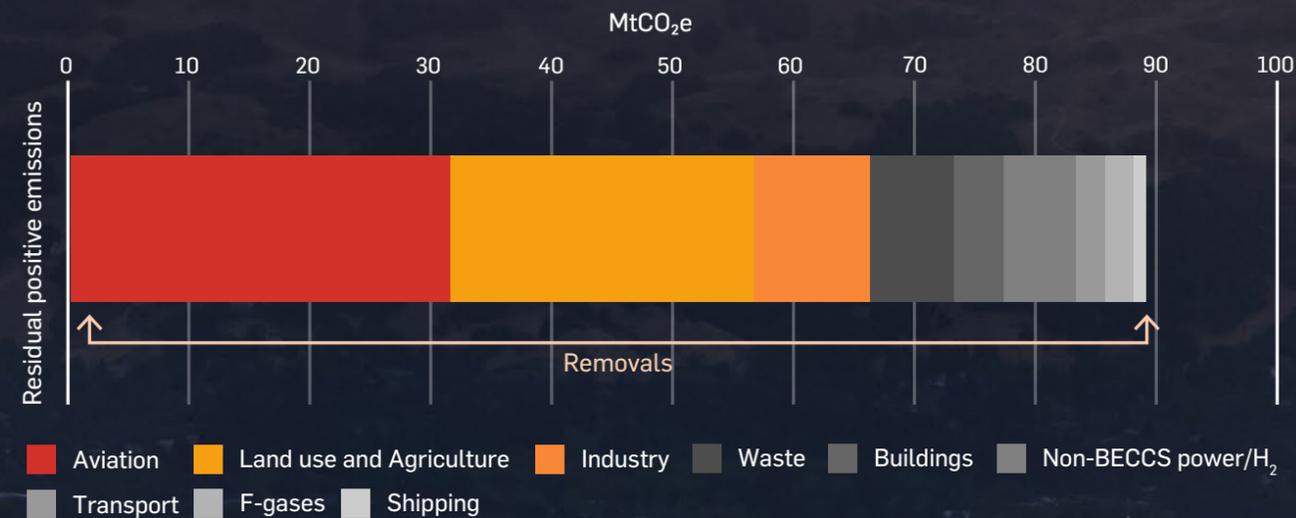
Putting people and communities into greenhouse gas removal: Commercial and Socio-legal Evidence is the latest report from Foresight Transitions. The report examines the potential implications of GGR deployment from the bottom-up, considering how local communities will be impacted and how technologies could be governed to reflect their concerns.

Investment of 1-2% of UK GDP needed to reach net-zero



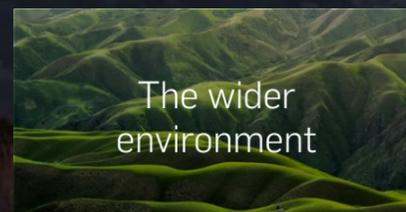
GREENHOUSE GAS REMOVALS REQUIRED TO BALANCE POSITIVE EMISSIONS

Certain sectors will find it more difficult than others to decarbonise, and will need removals to reach net-zero.



GGR NEEDS GOOD GOVERNANCE

Scaling up GGR will have implications for **people and communities**, and for **the wider environment**, as well as for **the climate**. It will be essential to ensure GGR is properly governed, so that technologies can be scaled to required levels in a manner that is sustainable and equitable.



HOW MANY TIMES SCALING UP

GGR technologies will need to scale up significantly in order to meet Paris Agreement targets. In 2050, a GGR sector multiple times the size of the current oil and gas sector may be required.

TREE PLANTING: x1.5

13% current UK woodland cover



x1.5



19% by 2050

PEATLAND RESTORATION: OVER DOUBLE

25% UK peatland area restored today



55% needed by 2050

BECCS:

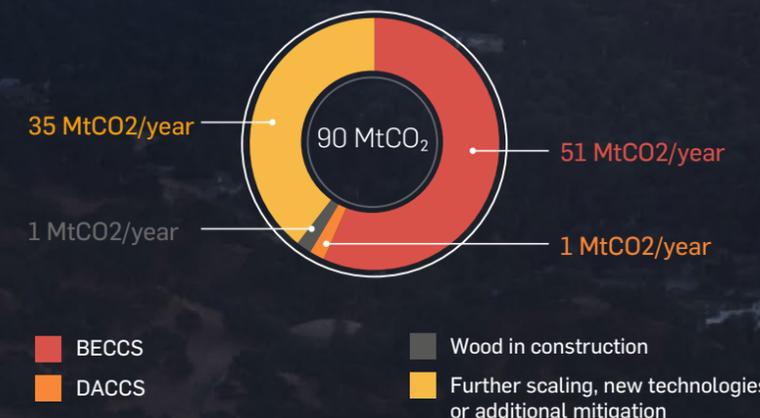
Research scales to 51-83 MtCO₂/year in 2050

DACCS:

Research scales (very small) 1-25 MtCO₂/year in 2050



SHARE OF TOTAL REMOVALS



THE UK NEEDS A BALANCED PORTFOLIO OF GREENHOUSE GAS REMOVAL METHODS

A range of methods for removing greenhouse gases are available – each with its own profile of risks and benefits. GGR will transform the landscape, interact with a number of other policy objectives, and have implications for local communities and regions. These will need to be carefully navigated.

DIRECT AIR CARBON CAPTURE AND STORAGE (DACCS)



Potential =
1-25 MtCO₂/year

Scaling DACCS will require major infrastructure that may transform local landscapes.

Delivering 25 MtCO₂/yr of DACCS will:

- » Cover 50km² of land – about the area of Loch Ness,
- » Have a substantial energy demand, requiring dedicated offshore wind capacity greater than is currently installed in the UK.

BIOENERGY WITH CARBON CAPTURE AND STORAGE (BECCS)



Potential =
51-83 MtCO₂/year

The BECCS supply chain will depend on large-scale domestic and international biomass production.

Scaling BECCS will in the UK alone will require 15-28 average-sized power stations (or 3-5 Drax-sized ones).

Nonetheless, these could generate 13-21 GW of electricity (compared with current UK gas generation of 32GW).

AFFORESTATION

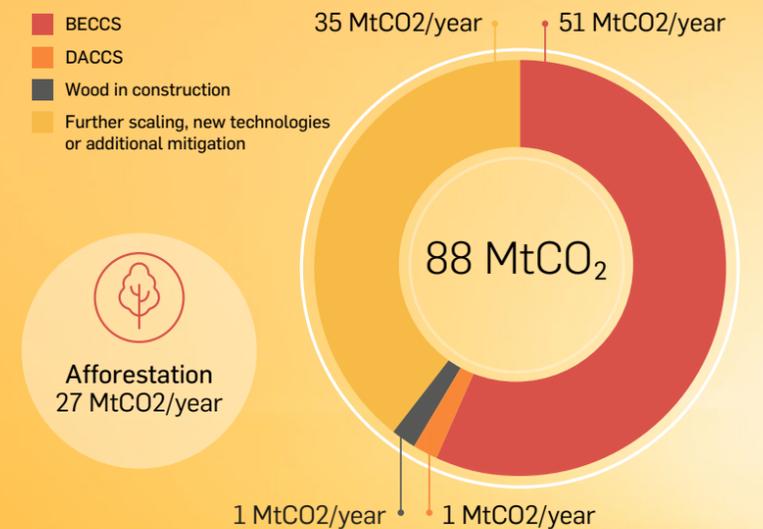


Up to
27 MtCO₂/year

Large-scale afforestation for GGR will see tree cover increase from 13% to 19% across the UK. For some areas this could mean a doubling of tree cover, with an area the size of Northern Ireland being planted.

Woodland can bring many additional benefits, including improved biodiversity, soil quality and flood management, as well as bringing health, well-being, and recreational value to local communities. These benefits will need to be carefully assessed and aligned with the perspectives and needs of the local communities and stakeholders.

Cost, technological readiness and overall removal potential often shape discussions about the optimal GGR technology mix. In reality, deployment will be shaped by a range of factors. Social, cultural and regulatory interactions will influence what is acceptable. Meanwhile, carbon benefits will need to integrate with other environmental objectives. Social factors will also shape which activities need GGR to decarbonise. How these interactions are navigated will be as important as the issues themselves.



Infrastructure

DACCS and BECCS will rely on infrastructure for transporting and storing CO₂. New infrastructure will impact local communities, and will require both regulatory and wider public approval. How will this be sought?



Liability

Forest carbon is vulnerable to fire, disease and drought over the lifetime of a tree and beyond.

For BECCS and DACCS, geologically-stored carbon must be monitored to ensure permanence.

Who will be liable for stored carbon?



Land Use

BECCS, Afforestation and DACCS all require land, to plant trees, grow bioenergy feedstock or build infrastructure. Where will the land come from? How will land use changes impact landscapes and local livelihoods? Challenges to local landscape, culture and heritage are likely to be contested.



New economic opportunities

The low-carbon transition will transform national and local economies. The new GGR sector will bring opportunities for local business and employment. Realising these opportunities will stem from how the local community is engaged.



Negotiating policy priorities

GGR options will interact with a range of policy areas, such as agriculture, flood management, biodiversity and wellbeing. How will these economic and non-financial values be balanced?

PUTTING PEOPLE INTO GREENHOUSE GAS REMOVAL

Engaging stakeholders early in greenhouse gas removal will help to build social acceptance, inform policy and regulatory development and stimulate innovation. Participation of the various publics will allow key questions about how we undertake greenhouse gas removal to be identified and addressed. Though this starts at the local level, it can and should influence much wider decision-making about GGR and climate action.



Prioritising mitigation

- Can a company claim to be net-zero if it has not maximised its mitigation effort?
- What if greenhouse gas removals are cheaper than mitigation?
- When is it legitimate to start using greenhouse gas removal?



Achieving net-zero

- Do we all need to be net-zero at the same time?
- If there are constraints on the availability of removals, will demand outstrip supply?



Future markets

- Does access to GGR need to be regulated?
- Should GGR credits have a standard price?
- How will the price reflect the different risks and benefits on offer?



Avoiding a pure 'least-cost' pathway

- How should GGR be valued?
- How can quality (stability and permanence) be emphasised alongside cost and volume of GHG removed?



Carbon accounting, reporting and verification

- How can trust be built into the carbon accounting and reporting process?
- Who will be liable for ensuring GHGs are stored securely?



Stimulating and capturing innovation opportunities

- Can engagement generate novel solutions and new opportunities?



Maximising co-benefits

- Who decides the balance between conflicting policy objectives?
- How will non-financial values be balanced with financial concerns?



Social legitimacy

- How do the various publics perceive climate action and the use of GGR?
- How can public trust be built into climate action and GGR?



Local impacts of deployment

- What social, cultural, environmental and ethical issues will GGR deployment raise?
- How will they affect deployment?

Securing legitimacy at the individual and community level creates a strong foundation for greenhouse gas removals that is legitimate in a wider sense

**FOR MORE
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