



## **2019/2020 UKRI-BBSRC STRATEGIC PRIORITIES FUND: GREENHOUSE GAS REMOVAL (GGR) DEMONSTRATORS CALL FOR PROPSALS**

### **VERSION 2 – UPDATED MAY 2020, CLOSING DATE AND TIMELINE**

Applicants should also refer to the **Full stage Guidance for Applicants** document available for download from the call [webpage](#).

#### **Call timeline**

Community Meeting	29 <sup>th</sup> April 2019
Launch date for Call for Proposals	30 <sup>th</sup> September 2019
Closing date for Expression of Interest	19 <sup>th</sup> November 2019
Assessment of Expression of Interest	w/c 27 <sup>th</sup> January 2020
Opening date for full proposals	24 <sup>th</sup> February 2020
Closing date for Full proposals (invitation only)	6 <sup>th</sup> August 2020 (4:00pm)
Assessment of Full proposals	18-19 <sup>th</sup> January 2021
Research grants awarded	March 2021
Project start	no later than 14 <sup>th</sup> May 2021
Cross-Programme kick off meeting	August 2021
Mid-term review	TBC

### **1. Summary**

This call is part of the interdisciplinary £31.5 million Strategic Priority Fund (SPF) Wave 2 Greenhouse Gas Removal Programme. The Programme is a UK Research and Innovation (UKRI) initiative involving the Arts and Humanities Research Council (AHRC), Biotechnology and Biological Sciences Research Council (BBSRC), Economic and Social Research Council (ESRC), Engineering and Physical Sciences Research Council (EPSRC), Natural Environment Research Council (NERC), and Innovate UK.

The programme will support sustainable routes for large-scale removal of greenhouse gases from the atmosphere, allowing the UK to take a major step towards achieving net-zero emissions, and placing the UK in a leading position to benefit from the estimated £400 billion future global market in greenhouse gas removal. It brings together five Research Councils and Innovate UK to tackle an immediate problem in a challenging interdisciplinary space building on investments made by the Research Councils, either

individually or in partnership, but in an area where the urgent challenge of coordination across a wide range of disciplines has not yet been possible at the scale needed.

The programme will support up to five individual GGR Demonstrators as well as a central Directorate Hub. The GGR Demonstrators will be responsible for exploring the effectiveness, cost and the limitations of large-scale methods of GGR. The Directorate Hub will provide an overarching coordination role across the suite of inter-disciplinary programme activities, with specific focus on economic, social, cultural, risk perception and communication, ethical, legal and governance issues. Information on the central Directorate Hub has been published and can be found [here](#). **Applicants are advised to read both calls in order to understand the full scope of the programme.**

**This call is for applications to the GGR Demonstrators.** Up to £22.5M has been allocated to this call for a world class research and innovation programme that will establish up to 5 interdisciplinary Demonstrators covering greenhouse gas removal technologies.

The GGR Demonstrators will be commissioned by BBSRC and the Directorate Hub will be commissioned by NERC simultaneously on behalf of UKRI partners AHRC, ESRC, EPSRC and Innovate UK.

Potential interdisciplinary Demonstrators could include, **but are not limited to:**

- **Direct air capture and carbon storage (DACCS)**
- **Enhanced terrestrial weathering**
- **Bioenergy with carbon capture and storage (BECCS)**
- **Biochar**
- **Large scale-afforestation.**

For this call, standard BBSRC eligibility rules apply, however it should be noted that **PIs and Co-Is from any discipline supported by UKRI are welcomed and encouraged to apply.** Demonstrators will have a start date of no later than 14<sup>th</sup> May 2021 and will have the duration of 4.5 years (54 months) to cover the full duration of the Programme.

## 2. Introduction

### 2.1 Programme introduction

There is overwhelming scientific evidence that the human release of greenhouse gases is changing the Earth's climate. In 2015, governments from around the world met to agree a framework that would minimise the negative consequences of climate change.

The Paris Agreement sets a goal to limit global average temperature increase to 'well below 2°C above preindustrial levels', and to 'pursue efforts' to limit it to 1.5°C

The role of rapid emissions reduction in meeting this target is widely understood. But it is increasingly clear that reducing emissions is not enough – we must also actively remove greenhouse gases from the atmosphere.

New technologies have emerged that show promise in removing CO<sub>2</sub> from the atmosphere, but these are not well understood and mostly unproven at large scale.

The publication of two reports in 2018: [The Royal Society report on Greenhouse Gas Removal](#) and the [IPCC report Global Warming of 1.5 °C](#) dramatically highlighted the need to evaluate, at scale, those technologies that would develop an effective greenhouse gas removal strategy for the UK.

Greenhouse gas removal (GGR) methods involve two main steps: the removal of greenhouse gases from the atmosphere and long-term storage, a process best understood for CO<sub>2</sub>. Removal can be achieved through a wide variety of techniques, involving either bio-based approaches, accelerating natural inorganic reactions with rocks or engineered chemical processes. The carbon is then stored in land mass-based biomass or products derived from biomass, sub-surface geological formations, the oceans or the built environment.

### 2.2 Strategic Priorities Fund

The Strategic Priorities Fund (SPF) has been set up to build upon the vision of a 'common research fund' set out in Sir Paul Nurse's [independent review](#) of the Research Councils. The fund will drive an increase in high-quality multi- and interdisciplinary research and innovation, ensure that UKRI's investment links up effectively with Government departments' research priorities and opportunities, and ensure that the system is able to respond to strategic priorities and opportunities. The GGR Programme is funded under Wave 2 of the Strategic Priorities Fund.

### 2.3 Programme Background

The 2015 Paris Agreement sets a goal to limit global average temperature increase to '*well below 2°C above preindustrial levels*', and to '*pursue efforts*' to limit it to 1.5°C. Dramatic reductions in emissions will not be sufficient to meet these temperature goals, nor achieve net-zero emissions in mid-century as required to control climate. The recent Intergovernmental Panel on Climate Change 1.5°C report re-confirmed that greenhouse gas

removal (GGR) is therefore required at scale this century.

Two reports were released on GGR in the autumn of 2018: one by The UK's Royal Society and Royal Academy of Engineering<sup>1</sup> (commissioned by BEIS) and another by the US National Academies of Sciences, Engineering and Medicine<sup>2</sup>. Both identified a diverse portfolio of GGR technologies at very different stages of readiness. No single GGR method can provide the scale of GGR required to meet the Paris Agreement, therefore a portfolio of approaches is needed. Research must address the potential and limitations of these technologies, including promising methods that will require significant development and testing at pilot level.

The existing [Greenhouse Gas Removal from the Atmosphere](#) strategic research programme (supported by, NERC, EPSRC, ESRC and BEIS) provides a strong knowledge base on potential options for removing carbon dioxide and other greenhouse gases, giving attention to environmental, technical, economic, governance and wider societal aspects. However, it does not incorporate large scale testing. This specific gap has now been identified in the recent Academy reports.

The implementation of sustainable GGR solutions is broader than the development of technologies. GGR methods differ widely in terms of their potential costs, environmental risks, co-benefits, political and societal acceptability and trade-offs. Further research is required to understand the range of implications of each GGR solution, how they can be designed to take into account novel business operating models and appropriate governance that takes into account ethics, potential risks and public perceptions. Support is required to help progress the technologies towards readiness, to develop appropriate incentives for their ramp up, and to strengthen links to a range of business sectors.

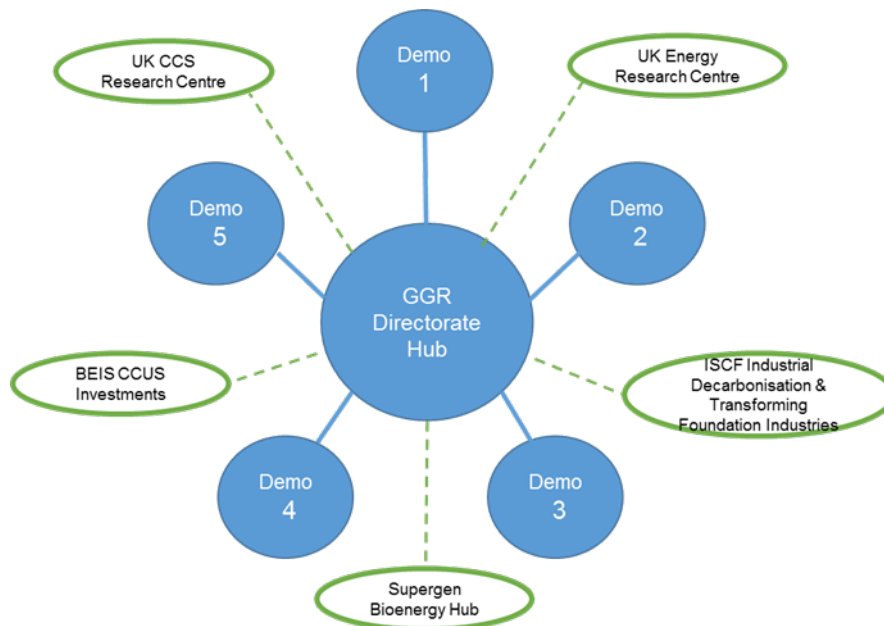
#### 2.4 Programme approach

Through this Programme up to five GGR Demonstrator facilities will be established and run over 4.5 years to test and pilot a suite of GGR methods at scale. The Demonstrators will include research on comprehensive life cycle analysis, including the full carbon budget, economics and financing, co-benefits and trade-offs, social and cultural implications, and environmental impacts as well as limitations of specific approaches to large-scale GGR for their specific method. Findings will be integrated by a Directorate Hub which will co-ordinate the activities across the Programme and link to relevant national (and international) research (Figure. 1).

---

<sup>1</sup> Royal Society & Royal Academy of Engineering (2018) *Greenhouse Gas Removal*. <https://royalsociety.org/greenhouse-gas-removal>

<sup>2</sup> National Academies of Sciences, Engineering, and Medicine. 2018. *Negative Emissions Technologies and Reliable Sequestration: A Research Agenda*. Washington, DC: The National Academies Press. DOI: <https://doi.org/10.17226/25259>



**Figure 1:** Structure of Greenhouse Gas Removal Demonstrators concept, with up to 5 Demonstrators co-ordinated by a Directorate Hub, which also links to existing relevant UK research and innovation projects

### 3. Scope

#### 3.1 Programme objectives

The objectives of the Programme are:

**(1) Development of a suite of GGR technologies at demonstrator scale - £22.5m**

**(led by BBSRC):** The Programme will establish up to 5 Demonstrators, of a size and duration that will allow the potential for large-scale emissions removal to be assessed. The Demonstrators will include research on comprehensive life cycle analysis, including the full carbon budget, economics and financing, co-benefits and trade-offs, social and cultural implications, and environmental implications.

Demonstrators could include, but are not limited to:

- Direct Air Carbon Capture and Storage (DACCS)
- Enhanced Terrestrial Weathering
- Bioenergy with Carbon Capture and Storage (BECCS)
- Biochar
- Large Scale Afforestation

**(2) Development of successful GGR solutions – understanding economics, governance, society and ethics (Directorate Hub) - £6.3m (led by NERC):**

The Hub will undertake and commission research, working with and across the Demonstrators and the broader research community on:

- how the social, cultural, behavioural, and economic contexts of GGR solutions can inform effective scale-up of the technologies;
- ethical, sustainable, economic and legal implications of proceeding with GGR solutions nationally and internationally;
- appropriate monitoring, verification, governance, and regulation;
- perceptions of risks and options for addressing them, including the role of communication and engagement;
- business models, financing options and incentives for technological interventions;
- public engagement and participation in decision-making about GGRs.

Information on the central Directorate Hub has been published and can be found [here](#). **Applicants are advised to read both calls in order to understand the full scope of the programme.**

**(3) To develop and support sustainable GGR solutions – supporting technologies towards commercial readiness: The Hub, in conjunction with Feasibility studies - £1.5m (led by Innovate UK in year three of the programme: 2022-23).**

Moving from the Demonstrators towards implementation will require identification of commercially viable and scalable business-led innovations, which can be developed for national and international markets. This will be delivered this by:

- supporting existing and new incubators and interdisciplinary networks across relevant research and business communities;
- support for UK business-focussed conferences on GGR involving innovator and early adopters of GGR e.g. larger businesses trying to be “net zero”, carbon accountancy firms and trade associations working together;
- competitions, to be delivered by Innovate UK in year 3 of the programme to support Feasibility Studies or Collaborative R&D projects for business led BECCS projects, and/or internationally relevant GGR technologies;
- collaboration with stakeholders to co-create evidence and outputs that meet users’ needs.

To develop a “pull” from the commercial sector, strong links will also need to be made to industries and to sources of finance interested in the opportunities of a large new international market.

**Note:** the provision of Proof of Concept/ flexible funding available to each Demonstrator as part of the research budget can be used to encourage business interaction at an early stage.

This Programme will complement, but not duplicate, existing investments by the Research Councils and BEIS in carbon capture, utilisation and storage. The SPF Greenhouse Gas Removal programme fully aligns with the UK Government's [Clean Growth Strategy](#), specifically No. 7 of the Key Policies and Proposals in the strategy 'Develop our strategic approach to greenhouse gas removal technologies, building on the Government's programme of research and development and addressing the barriers to their long term deployment'. The programme aligns with the UK Government's [25 Year Environment Plan](#), specifically its goal to manage pressures on the environment by mitigating and adapting to climate change, which in the context of greenhouse gas removal encompasses policies on using and managing land sustainably, recovering nature and enhancing the beauty of landscapes. It also aligns with the focus on woodland to maximise its many benefits, which was supported in the 2018 budget with £60m for planting trees in England. It is also envisaged that research from the programme will several relevant Industrial Strategy Challenge Fund (ISCF) programmes.

The Directorate hub and Demonstrators will commit to working collaboratively, and to identify and exploit potential opportunities to work with other existing UKRI investments, where appropriate, to maximise impact. A plan for investment engagement should be included in the application. Other investments include but are not limited to

- Present UKRI [Greenhouse Gas Removal from the Atmosphere programme](#)
- Strategic Priorities Fund [Landscape Decisions: Towards a new framework for using land assets](#)
- Strategic Priorities Fund [Clean Air: Analysis & Solutions](#)
- [Valuing Nature](#)
- Centre for Climate Change and Social Transformations ([CAST](#))
- Centre for Climate Change Economics and Policy ([CCCEP](#))
- Centre for the Evaluation of Complexity Across the Nexus ([CECAN](#))
- [Supergen](#)
- [UK Energy Research Centre](#)

### *3.2 Greenhouse Gas Removal Demonstrators (detailed scope)*

Through a world-leading research and innovation programme up to 5 GGR Demonstrator facilities will be established and run over 4.5 years, to evaluate a suite of GGR approaches at a suitable scale.

The GGR Demonstrators will research the effectiveness, cost, and limitations of large-scale GGR covering GGR technologies as outlined in the [Royal Society Report on Greenhouse gas removal](#). Potential approaches include, **but are not limited to** the following:

- **Direct air capture and carbon storage (DACCS)** – Research is required to integrate significant UK expertise, to develop and to test air capture materials and components, and to engineer a commercially viable solution for DACCS.

- **Enhanced terrestrial weathering** – Research should include field assessment of the co-benefits to soil/crop mineralisation kinetics and the fate of carbon and liberated elements in the environment (i.e. soil, surface water and ocean).
- **Bioenergy with carbon capture and storage (BECCS)** – Research should include minimising land use conflicts, improved accounting practices for sustainability and carbon, and biobased carbon capture technologies.
- **Biochar** – Research should include studies on the efficiency of the pyrolysis process, the fate of its products and the biologically positive and potentially negative impacts of its addition to UK soils.
- **Large scale-afforestation** – Research should include maximising carbon drawdown and storage per area of new forest, potentially combining afforestation with biochar and enhanced terrestrial weathering.

#### **Each Demonstrator will:**

- Undertake a full carbon budget for the Demonstrator using appropriate tools.
- Assess the environmental impacts of the chosen Demonstrator.
- Identify the key economic, financial, ethical, legal, social, cultural, behavioural and governance issues specific to the implementation of this approach to GGR, including public acceptability issues.
- Demonstrate the overall capability of the technology in relation to UK GGR targets as outlined in the Royal Society Report.
- Develop the technology to support implementation at scale, within the UK, that will eventually meet or exceed the UK's GGR 2050 targets as laid down in the Royal Society report on Greenhouse Gas Removal.
- Provide a quantitative assessment of the technology's effectiveness in CO<sub>2</sub> removal, its costs and its limitations if deployed at large scale.
- Outline potential routes for sustainable scalability. This should include scientific, technological, environmental, economic and social issues that may need to be taken into account for full scale deployment of that particular technology. This should be undertaken in cooperation with the Directorate Hub.
- Commit to working collaboratively with the other Demonstrators in the programme as well as with the Directorate Hub and identify and exploit potential opportunities to work with other existing UKRI investments, where appropriate, to maximise impact and to meet UK Government GGR targets for 2050. Other investments include but are not limited to:
  - SPF Landscape Decision making
  - SPF Clean Air
  - Valuing Nature
  - CAST
  - CCCEP
  - CECAN
  - Supergen



## ➤ UKERC

The success of GGR solutions will rely on understanding of their full implications for different groups across society, and assessment of how they can best be governed. This needs to be considered at scales from the individual to community, national and international, and across generations. It also needs to account for the full range of perspectives including cultural, societal, political, and corporate.

Each Demonstrator will co-operate and engage with the Directorate hub. The Hub will be responsible for integration of findings and research and a co-ordinate options for a balanced suite of GGR technologies that could provide a successful GGR solution for the UK. This will require understanding of the implications of each Demonstrator for different groups across society and assessment of how they can best be governed. This needs to be considered at scales from the individual to community, national and international, and across generations. It also needs to account for the full range of perspectives: cultural and societal, political, and corporate.

Applicants for Demonstrators are required to consider carefully how best to build links and contacts with potential beneficiaries and users of the research at the earliest possible stages of research design and development, and to work towards co-production of knowledge with research users where appropriate. In addition to knowledge exchange and impact strategies that focus on particular user groups or specific named beneficiary organisations.

## 4. Funding

Up to £22.5 million is available for this call and is expected to support up to 5 Demonstrators to test and pilot a suite GGR approaches at a suitable scale, moving towards TRL3-4 (or greater). Up to a maximum of £4.5 million (at 80% FEC) per Demonstrator will be available dependent on the number of Demonstrators funded). Recognising that some of the GGR approaches may have a strong capital element, capital expenditure of approximately 18% of the grant is available across all of the Demonstrators. As part of the research budget projects can apply for a Flexible Fund (up to £500K) for allocation by the Demonstrator for further research and development, and particularly to facilitate early business interaction activities prior to provision of Innovate UK funding (see Guidance to Applicants for further details

Each grant will be for a maximum of 4.5 years, with a start date of no later than 14<sup>th</sup> May 2021, and ending financial year 2025/2026. BBSRC expects all grant to be completed by November 2025 where extension will only be granted in accordance with compliance with the Equality Act.

Proposals should demonstrate clear strategic relevance to GGR and address most or all of the following requirements:

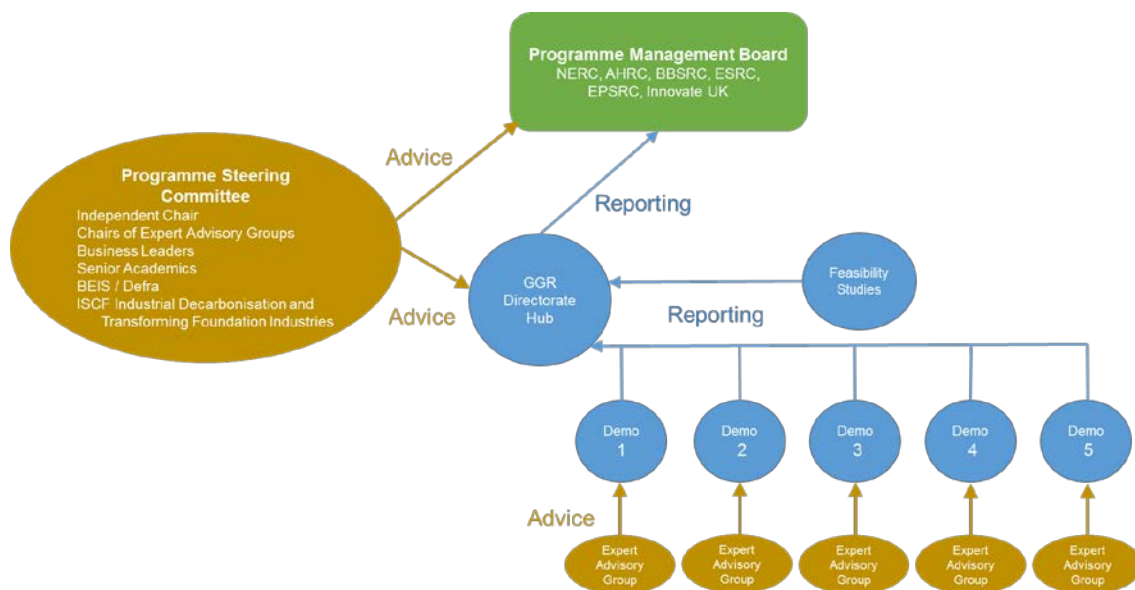
- A portfolio of existing grant support relevant to the Demonstrator research area (including UKRI and other sponsors).

- Evidence of a clear route for the implementation of the technology at a scale commensurate with the ability to meet GGR targets by 2050.
- A track record of successful translation of relevant research with business (from TRL 1 to TRL 4).
- A critical mass of researchers (academic and potentially business based) involved in the Demonstrator research area.
- Well established international links.

For this call, standard BBSRC eligibility rules apply, however it should be noted that **PIs and Co-Is from any discipline supported by UKRI are welcomed and encouraged to apply.**

## 5. Programme Management

Each Demonstrator will be required to appoint an Expert Advisory Group (Figure 2.). This group will provide specialist advice specific to that Demonstrator. Given the broad range of technologies that may be developed this specialist input is considered important. The UKRI Manager will sit on the relevant Expert Advisory Group. The Chair of each Expert Advisory Group will also be a member of the Programme Steering Committee to ensure the connection to the wider programme.



**Figure 2.** SPF GGR Governance and Project Management

Each Demonstrator will also be required to appoint a Management Board to monitor progress. Together, with the Feasibility and Collaborative R&D Studies, they will report to the Programme Board through the Directorate Hub.

The Directorate Hub will provide the co-ordination function between all of the Demonstrator investments and ensure coherence across the activities of the programme and the broader national and international research community. Working with the Demonstrators, the Hub will coordinate activity to establish options for a balanced suite of GGR technologies that

could provide a successful GGR solution for the UK (and in other nations).

The Hub will be advised by the Steering Committee, and will report to the Programme Board (on behalf of GGR Demonstrators and feasibility studies), which will be responsible for any programme decisions taken. The Steering Committee will be set up by UKRI through liaison with the Hub and Demonstrators.

## 6. Capacity building

UKRI will be looking for evidence that each Demonstrator has a strong commitment to support the development of researchers at all stages of their career. The capacity-building element of proposals should include, but not be limited to, early career stage researchers, policymakers and practitioners, local communities and businesses. Applicants are encouraged to consider how they can support the career development of *all* members of the team. The focus should be on the quality and impact of the research, and how increasing capacity of the team contributes to this. Examples of building capacity include:

- support and mentoring
- training events
- networking opportunities

Contact: [GGR@bbsrc.ukri.org](mailto:GGR@bbsrc.ukri.org)