Department for
Business, Energy
& Industrial Strategy

The UK Government's View on Greenhouse Gas Removal Technologies and Solar Radiation Management ("Geo-engineering")

What are they?

Greenhouse Gas Removal (GGR) and Solar Radiation Management (SRM) are terms describing a range of technologies that aim to counteract human-caused climate change by deliberate large-scale intervention in the Earth's natural systems. They are sometimes collectively referred to as "geo-engineering" or "climate engineering".

GGR technologies actively remove greenhouse gases from the atmosphere. Examples include afforestation, bioenergy with carbon capture and storage, direct air capture and storage and marine fertilisation. Those that specifically remove carbon dioxide (CO_2) from the atmosphere are also known as Carbon Dioxide Removal (CDR) technologies.

SRM technologies reflect some of the Sun's energy that reaches Earth back into space. Examples include the brightening of marine clouds and injection of aerosols into the stratosphere. While these would be likely to reduce the Earth's temperature, they would not reverse ocean acidification (unlike GGRs).

Despite attracting growing attention, the scientific evidence base to inform a rational debate on their potential merits or risks is currently limited.

The priority is, and must be, to tackle the root cause of climate change by reducing emissions of greenhouse gases from human activities and adapting to those impacts that are unavoidable. Mitigation of climate change by reducing emissions and protecting natural carbon sinks remains the main focus of our efforts to increase our chances of avoiding dangerous climate change.

Research, development and deployment

The Climate Change Act 2008 requires the UK to reduce greenhouse gas emissions by at least 80 per cent on 1990 levels by 2050. As the UK approaches 2050, its remaining emissions will likely be in the sectors where it is the most difficult to cut them.

Greenhouse Gas Removal

GGR technologies are likely to have an important role to play in offsetting these emissions. Further, the Paris Agreement includes an aim of achieving net zero global greenhouse gas emissions in the second half of the century. As indicated in the Clean Growth Strategy,[1] the UK Government believes it will need to legislate for a net zero emissions target at an appropriate point in the future. Our independent experts, the Committee on Climate Change (CCC), have made it clear that GGRs globally and in the UK will be central to realising this aim under the Paris Agreement.[2] In October 2018, responding quickly to the release of the Intergovernmental

[1] https://www.gov.uk/government/publications/clean-growth-strategy
[2] https://www.theccc.org.uk/publication/uk-action-following-paris/

Panel on Climate Change's Special Report on Global Warming of 1.5°C,[3] the UK, Scottish and Welsh Governments jointly asked the CCC for their advice on the implications of the Paris Agreement for long-term emissions reduction targets, including on setting net zero targets[4]. We expect the CCC to provide their evidence-based advice in spring 2019 and will consider it carefully once it is received.

The UK Government has no current policies to deploy specific GGR technologies beyond existing commitments made in the Clean Growth Strategy to plant 11 million trees in England[5], to restore peatland[6], and to increase the amount of UK timber used in construction.[7]

Any further deployment must be informed by thorough understanding of the costs, feasibility and environmental and societal impacts. Such understanding is currently limited so we are taking active steps to strengthen our understanding of these technologies and, where appropriate, move forward with deployment. For example:

- We have been working with the Research Councils, who launched an £8.6 million GGR research programme in April 2017;[8]
- In September 2018, the Royal Society and Royal Academy of Engineering published a report reviewing a broad range of GGRs, and provided related UK and international recommendations;[9]
- We have commissioned a study on how GGR activity can be incentivised in the UK and in other countries, which will be published in spring 2019.
- In November 2018, we published an action plan setting out how Government and industry can work in partnership to achieve the Government's ambition for carbon capture, usage and storage (CCUS)[10].

As indicated in the Clean Growth Strategy, we will develop our strategic approach for GGR technologies, including consideration of whether to reprioritise existing innovation spend, in light of these pieces of work.

Solar Radiation Management

The Government is not deploying SRM, and has no plans to do so.

The UK Government has commissioned research into the effects of SRM on climate, which showed that SRM deployment would produce changes in rainfall patterns and amounts. This

[3] https://www.ipcc.ch/sr15/
[4] https://www.gov.uk/government/publications/uk-climate-targets-request-for-advice-from-the-committee-on-climate-change
[5] The UK Government also has a longer term aspiration to increase woodland cover to 12% by 2060, as set out in the 25 Year Plan for the Environment (https://www.gov.uk/government/publications/25-year-environment-plan).
[6] https://www.gov.uk/government/news/new-10-million-fund-to-restore-peatland
[7] https://www.gov.uk/government/publications/clean-growth-strategy
[8] http://www.nerc.ac.uk/press/releases/2017/09-greenhousegas/
[9] https://royalsociety.org/topics-policy/projects/greenhouse-gas-removal/
[10] https://www.gov.uk/government/publications/the-uk-carbon-capture-usage-and-storage-ccus-deployment-pathway-an-action-plan

would be likely to lead to "winners" and "losers", with some regions suffering detrimental impacts.[11,12,13]

The UK Government is not commissioning further research into SRM, but the World Climate Research Programme's (WCRP's) Geoengineering Model Intercomparison Project (GeoMIP), is investigating the effects which SRM would have on the climate.[14]

Regulation

We would expect any deployment of GGRs to comply with local, national and international regulation and guidance. Some forms of geo-engineering are already regulated. For instance, in England, large-scale afforestation is covered by Environmental Impact Assessment Regulations. In addition, work has been undertaken to examine how existing instruments could apply:

- The Government has supported the Convention on Biological Diversity (CBD) in its review of existing regulatory instruments. Following consideration of this review, the 13th Conference of the Parties (COP) to the CBD adopted a decision in 2016 noting that more research is needed. The COP also recalled a previous decision in 2010 which invites Parties to take a precautionary approach on any geo-engineering activities that may affect biodiversity until there is an adequate scientific basis to justify such activities, with the exception of small-scale, controlled scientific research studies.

- The Government has also contributed to work under the London Protocol on the prevention of marine pollution by dumping of wastes and other matter, to adapt the instrument to meet this new challenge. This has resulted in adoption by Parties to the London Protocol, in October 2013, of an amendment to regulate ocean fertilisation activities and, potentially, other forms of marine geo-engineering. The UK was the first country to ratify the amendment, in 2016.

Further reading

The Royal Society, Royal Academy of Engineering (2018): Greenhouse gas removal

Update on climate geoengineering in relation to the Convention on Biological Diversity: Potential impacts and regulatory framework (2016)

Carbon Dioxide Removal and Reliable Sequestration (2015)

Climate Intervention Reflecting Sunlight to Cool Earth (2015)
https://www.nap.edu/read/18988/chapter/1

NAS Programme "Developing a Research Agenda for Carbon Dioxide Removal and Reliable Sequestration" (2018)

[11] http://onlinelibrary.wiley.com/doi/10.1029/2008JD011450/abstract
[12] https://www.atmos-chem-phys.net/10/5999/2010/
[13] http://onlinelibrary.wiley.com/doi/10.1002/jgrd.50856/abstract
[14] http://climate.envsci.rutgers.edu/GeoMIP/