



Department
of Energy &
Climate Change

**Department of Energy & Climate
Change**

3 Whitehall Place,
London SW1A 2AW

www.decc.gov.uk

Our ref: 14/11435

27 June 2014

Dear

Freedom of information request: Geoengineering

Thank you for your email, dated 1st June 2014, where you requested the following information:

I wish to know what current experiments are ongoing in the UK regarding Geo-engineering and what chemicals are being used to conduct these experiments

Your request has been considered under the Environmental Information Regulations 2004 (EIRs) as the information you have sought disclosure of does, in our view, fall within the definition of 'environmental information' as stated in the EIRs.

Under the EIRs you have the right to:

- know whether we hold the information you require
- be provided with that information (subject to any exceptions under the Regulations which may apply).

In response to the first part of your question, a complete list of all climate geoengineering research being undertaken in the UK can be found in Annex A.

In response to the second part of your question, the use of chemicals is very limited and does not include any aerosol atmospheric injection programmes. Those that appear to have limited use of chemicals are items 2.1 and 2.5, listed in Annex A, that take place in a laboratory space investigating materials that could be efficiently, safely and cost-effectively used to promote ice nucleation in cirrus clouds for geoengineering. Other projects (see eg items 3.2 and 3.3 of Annex A) are adding biochar and calcium silicate to soils in small-scale field trials, and are not added directly to the atmosphere. We do not hold any further details of these experiments or the materials used.



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Appeals Procedure

If you are dissatisfied with the handling of your request, you have the right to ask for an internal review. Internal review requests should be submitted within 40 working days of the date of receipt of the response to your original letter and should be sent to the Information Rights Unit at:

Information Rights Unit
Department for Business, Innovation & Skills
1 Victoria Street
London
SW1H 0ET
E-mail: foi.requests@bis.gsi.gov.uk

Please remember to quote the reference number above in any future communications.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF

Yours sincerely,

Science Team
Department of Energy and Climate Change



Annex A - Recent and current UK research projects that are contributing to the understanding of climate geoengineering and its environmental impacts.

1. Multi-approach projects, including governance

	Title	Main funders (Funding £k; UK total)	Relevance to geoengineering	Lead research organisations	Dates
1.1	Integrated assessment of geoengineering proposals (IAGP)	EPSRC, NERC (1,729)	Development of an evaluation framework to allow in-depth comparison of all major geoengineering proposals. The project combines Earth system modelling and deliberative engagement with stakeholders and the wider public. Details: www.iagp.ac.uk	Leeds Univ, Oxford Univ, Lancaster Univ, Cardiff Univ, Bristol Univ, UK Met Office	2010 - 2014
1.2	Climate geoengineering governance	ESRC, AHRC (1,048)	Project includes i) study of ethical, legal, social and geopolitical implications of range of geoengineering approaches; ii) development of guidelines on governance and regulation; iii) stakeholder dialogue on possible role of geoengineering in relation to climate change mitigation and adaptation. Details: http://geoengineering-governance-research.org/	Oxford Univ, Sussex Univ, Univ College London	2012 - 2014
1.3	Geoengineering – a systems engineering analysis	EPSRC Training Award	This project will use a low order climate model to determine formal observability, controllability and closed-loop stability properties and to devise new concepts for geoengineering to reduce the scale of interventions required.	Strathclyde Univ	2013 - 2016
1.4	Climate engineering research: responsible innovation	EPSRC/ESRC	This project involves i) stakeholder mapping and engagement around the RCUK funded SPICE project and the wider context of Solar Radiation Management (SRM) ; and ii) a critical review of the wider risk uncertainties, ethical, legal, governance and social issues associated with the project and SRM more generally.	Exeter Univ, Univ College London	2012- 2014
1.5	The Responsible Innovation Framework: scoping study and science -policy seminar	EPSRC/ESRC	Project to develop a framework for responsible innovation to support research policy development at EPSRC, See http://www.epsrc.ac.uk/research/framework/Pages/framework.aspx	Exeter Univ	2011- 2012
1.6	Regulating geoengineering research through strategic environmental assessment	ESRC Training Award	Focus on legal aspects: how authority might be justly exercised in the absence of democratic legitimacy.	Bristol Univ	2013 - 2016
1.7	Should we geoengineer our future climate?	NERC Training Award	Model-based analysis of effectiveness of different geoengineering options	Bristol Univ	2009 - 2012
1.8	Public participation in the social appraisal of climate	Private sector Training Award	Research on the expert, stakeholder and public social appraisal of climate geoengineering proposals; using a novel and innovative participatory research method (Deliberative Mapping). Close links with IAGP project (#1.1)	Univ of East Anglia	2010 - 2013



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	geoengineering proposals				
1.9	European trans-disciplinary assessment of climate engineering (EuTRACE)	EC (266k €)	Project addresses the potentials, implications, risks and uncertainties of climate engineering (geoengineering), including stakeholder dialogue and policy development. Details: http://www.eustrace.org/	Tyndall Centre/ Univ of East Anglia; Exeter Univ, Bristol Univ, Edinburgh Univ	2011-2013
1.10	Oxford geoengineering programme (OGP)	Oxford Martin School (688)	Provides complementary 'internal' university support to extend the scope of external awards, also for pilot studies that include assessing proposals for cloud modification, and the engineering and resource constraints of CDR	Oxford Univ	2010 - 2014

2. Solar radiation management, also known as sunlight reduction methods (SRM)

	Title	Main funders (Funding £k; UK total)	Relevance to geoengineering	Lead research organisations	Dates
2.1	Stratospheric particle injection for climate change (SPICE)	EPSRC, NERC, STFC (1,609)	Addresses issues relating to the effectiveness of stratospheric particle injection as an SRM technique: i) how much, of what, might need to be injected where into the atmosphere to effectively and safely manage the climate system; ii) what techniques might be used to deliver it there; and iii) what might be the impacts. A field component was originally planned (involving water aerosol from a tethered balloon) but was not carried out.	Bristol Univ, Oxford Univ, Cambridge Univ, Edinburgh Univ	2010 - 2014
2.2	Geoengineering model intercomparison project (GeoMIP)	Met Office/ Hadley Centre Climate Programme	GeoMIP is an international model comparison exercise, endorsed by the World Climate research Programme (WCRP). It prescribes the experiments which all participating climate models will perform. Initial focus on stratospheric SO ₂ injection and generic SRM; subsequent studies on sea spray geoengineering, including marine cloud brightening.	UK Met Office	2010 -
2.3	Marine cloud brightening using an atmosphere-only climate model	EPSRC Training Award	Model-based assessment of effect of seeding patches or all marine stratocumulus clouds	NCAS/Leeds Univ	2006 - 2010
2.4	Climate impacts of marine cloud brightening	Carnegie Inst, U.S.A.	Use of HadGEM Earth System Model to examine effect of marine cloud brightening on the Earth's climate system, targeting optimal regions for seeding	NCAS/Leeds Univ	2009 - 2013
2.5	Designer ice nuclei for geoengineering of clouds	NERC Training Award	Laboratory experiments to identify materials that could be efficiently, safely and cost-effectively used to promote ice nucleation (in cirrus clouds)	Leeds Univ	2013 - 2016
2.6	Global and regional sea level response to geoengineering by 2100	NERC Training Award	Model projections of response of sea level components (e.g. ocean heat content, ice sheet and glacier melting) to SRM geoengineering	NOC, Liverpool Univ	2013 - 2016



3. Greenhouse gas removal, also known as carbon dioxide removal or negative emission techniques (GGR, CDR and NETs)

	Title	Main funders (Funding £k; UK total)	Relevance to geoengineering	Lead research organisations	Dates
3.1	Ocean carbon-climate feedbacks and geoengineering potential	NERC Training Award	Study of how ocean uptake of CO ₂ is affected by climate in context of ocean-based CDR geoengineering (nutrient pipes, fertilization and ocean liming)	Southampton Univ	2013 - 2016
3.2	Biochar and bio-trophic carbon storage in temperate soils (AGRIFOOD)	NERC Training Award	Study of biochar treatment effects on faunal and microbial soil communities and associated impacts, including rates of C and N cycling, greenhouse gas emissions (CO ₂ , CH ₄ , N ₂ O); and climate resilience of soil organic matter. <i>Project involves small scale field trials</i>	Edinburgh Univ, CEH	2010 - 2014
3.3	Capture of atmospheric CO ₂ by mineral-plant reactions	NERC Training Award	Study of role of plants in precipitating soil carbonate (from CO ₂ / bicarbonate interacting with Ca ions) and potential enhancement of such carbon sequestration by addition of calcium silicates to soils. <i>Project involves small scale field trails</i>	Newcastle Univ	2009 - 2012

Additional notes

- There is still considerable debate about the definition of climate geoengineering. It is considered here as “A deliberate intervention in the planetary environment of a nature and scale intended to counteract anthropogenic climate change and its impacts” (CBD Technical Report 66; 2012). RCUK is aware that other definitions could be used.
- Research activities are listed in three groups: 1) multi-technique approach, including governance; 2) solar radiation management, also known as sunlight reduction methods (SRM); and 3) greenhouse gas removal, also known as carbon dioxide removal or negative emission techniques (GGR, CDR and NETs).
- Carbon capture and storage (CCS) from power plants is excluded from the definition given above. The RCUK Energy Programme has a portfolio (£68m) of CCS projects and has set up the UK CCS Research Centre¹.
- Research on bioenergy and soil carbon management can also provide understanding that is relevant to geoengineering, but projects on those topics are not included here.
- There are many other recent/current UK studies that could also be considered relevant to climate geoengineering (e.g. on the mitigation of climate change, climate dynamics, the carbon cycle, biogeochemical processes, and human impacts on biodiversity and ecosystems), since they provide important underpinning knowledge. However, unless they fully or partly contribute to improved understanding of the techniques, consequences (intended and unintended), acceptability or governance of purposeful climate remediation, they are not included here.

¹ See <http://www.ukccsrc.ac.uk/>



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- Project information given here is primarily from Envirobase (www.envirobase.info); entries are limited to those with end-dates in 2010 or later.
- Funding information in the table relates to the total project award. Such information is not given where only part of the project is considered geoengineering-relevant.

Acronyms: AHRC, Arts and Humanities Research Council; BBSRC, Biotechnology and Biological Sciences Research Council; BECCS, Bioenergy with carbon capture and storage; BGS, British Geological Survey; CEH, Centre for Ecology and Hydrology; CCS, carbon capture and storage; DECC, Department of Energy and Climate Change; EC, European Commission; EPSRC, Engineering and Physical Sciences Research Council; ESRC, Economic and Social Research Council; NCAS, National Centre for Atmospheric Science; NERC, Natural Environment Research Council; NOC, National Oceanography Centre; PML, Plymouth Marine Laboratory; STFC, Science and Technologies Facilities Council