

Geoengineering the climate: science, governance and uncertainty

September 1, 2009

The Royal Society has published the findings of a major study into geoengineering the climate.

The study, chaired by **Professor John Shepherd FRS**, was researched and written over a period of twelve months by twelve leading academics representing science, economics, law and social science.

Man-made climate change is happening and its impacts and costs will be large, serious and unevenly spread. The impacts may be reduced by adaptation and moderated by mitigation, especially by reducing emissions of greenhouse gases. However, global efforts to reduce emissions have not yet been sufficiently successful to provide confidence that the reductions needed to avoid dangerous climate change will be achieved. This has led to growing interest in geoengineering, defined here as the deliberate large-scale manipulation of the planetary environment to counteract anthropogenic climate change.

However, despite this interest, there has been a lack of accessible, high quality information on the proposed geoengineering techniques which remain unproven and potentially dangerous. This study provides a detailed assessment of the various methods and considers the potential efficiency and unintended consequences they may pose. It divides geoengineering methods into two basic categories:

1. Carbon Dioxide Removal (CDR) techniques, which remove CO₂ from the atmosphere. As they address the root cause of climate change, rising CO₂ concentrations, they have relatively low uncertainties and risks. However, these techniques work slowly to reduce global temperatures.
2. Solar Radiation Management (SRM) techniques, which reflect a small percentage of the sun's light and heat back into space. These methods act quickly, and so may represent the only way to lower global temperatures quickly in the event of a climate crisis. However, they only reduce some, but not all, effects of climate change, while possibly creating other problems. They also do not affect CO₂ levels and therefore fail to address the wider effects of rising CO₂, including ocean acidification.

The report recommends:

- Parties to the UNFCCC should make increased efforts towards mitigating and adapting to climate change and in particular to agreeing to global emissions reductions of at least 50% on 1990 levels by 2050 and more thereafter;
- CDR and SRM geoengineering methods should only be considered as part of a wider package of options for addressing climate change. CDR methods should be regarded as preferable to SRM methods.

- Relevant UK government departments, in association with the UK Research Councils, should together fund a 10 year geoengineering research programme at a level of the order of £10M per annum.
- The Royal Society, in collaboration with international science partners, should develop a code of practice for geoengineering research and provide recommendations to the international scientific community for a voluntary research governance framework.

The Royal Society issued a call for submissions and convened a small ethics workshop as part of the evidence gathering process. More information is available in the main report.

[Read the related press release here.](#)

UPDATED March 2010 - The Natural Environment Research Council (NERC) is carrying out a public dialogue on geoengineering to assess public opinion on how future research relating to the subject should be directed, conducted and communicated. If you would like to take part in the dialogue the following link will take you to an online survey about geoengineering.
<http://geoengineering.dialoguebydesign.net>

Related Royal Society publications:

- [Towards a low carbon future: 29 Jun 2009](#)
- [Inter-Academy Panel statement on Ocean Acidification: 1 Jun 2009](#)
- [Ground-level ozone in the 21st century: future trends, impacts and policy implications: 6 Oct 2008](#)
- [Sustainable biofuels: prospects and challenges:14 Jan 2008](#)

Media coverage of the report includes:

- [The Independent \(article\)](#)
- [The Independent \(editorial\)](#)
- [The Times](#)
- [The Sunday Times](#)
- [The Financial Times \(Clive Cookson\)](#)
- [The Financial Times \(Fiona Harvey\)](#)
- [The Guardian](#)
- [Nature](#)
- [New Scientist](#)
- [BBC news](#)
- [20:20 Science](#)
- [Bloomberg](#)

Influencing Policy

September 24, 2010 **The Royal Society**

The Royal Society's science policy work is based on the recognition that:

The Policy Centre's advisory group is chaired by Lord Krebs FRS, Master of Jesus College, Oxford.

Its other members are:

Sir Roy Anderson FRS, Rector of Imperial College

Clive Cookson, Science Editor, Financial Times

Stephen Cox CVO, Executive Director, The Royal Society

Dame Ann Dowling FRS FREng, Professor of Mechanical Engineering, University of Cambridge

Professor Julia Goodfellow, Vice-Chancellor, University of Kent

Professor Calestous Juma FRS, Professor of the Practice of International Development, John F. Kennedy School of Government, Harvard University

Dr Raghunath Mashelkar FRS, CSIR Bhatnagar Fellow, India and President of Global Research Alliance

Professor Susan Owens OBE AcSS, Professor of Environment and Policy, University of Cambridge

Professor Geoffrey Smith FRS, Head of the Department of Virology, Imperial College

Sir Martin Sweeting FRS, Director, Surrey Space Centre

- An expanding range of critical areas of public policy have scientific aspects;
- Sound policies are more likely if decision makers have access to expert, independent scientific advice;
- A modern national academy should play a prominent role in monitoring the health of the UK and international science base, and assembling evidence to support investment.

Each year, we publish several in-depth reports, produced by working groups of Royal Society Fellows and other experts, who analyse the scientific evidence related to a topical issue. But we undertake many other types of activity, including conferences and seminars, short statements, media work, consultation responses and briefings for policymakers. We organise regular PolicyLab meetings, which bring together scientists, policymakers and other thinkers to debate emerging issues in science policy. And we represent the UK in international networks such as the InterAcademy Panel and the International Council for Science.

Who we work with:

- Our 1,400 Fellows and 300 University Research Fellows provide a unique source of scientific expertise, which informs all of our policy activities. Fellows and other experts,

including economists and social scientists, participate in working groups, and the Council of the Royal Society reviews our major reports.

- Our Science Policy Advisory Group, chaired by Lord Krebs, is responsible for the overall direction of our policy work, and contributes to horizon scanning, scoping new projects, and maximising our impact.
- Our partners include science academies across Europe, the US, China, India and beyond; government departments; research and policy organisations; and charitable foundations.
- Our networks of engagement and influence include decision makers in Westminster and Whitehall, and international bodies such as the European Commission, OECD, World Bank and UN agencies.
- Our recently-established **Corporate Network** brings together business and academic leaders in an independent and influential forum.

The Royal Society – Solar Radiation Management

2009

A major new initiative to ensure strict governance of any plans for solar radiation management (SRM) geoengineering (counteracting global warming by reflecting a small percentage of the sun's light and heat back into space), will be undertaken this year by the Royal Society, in partnership with the TWAS, the academy of sciences for the developing world, and the Environmental Defense Fund (EDF).

The first output of the Initiative will be a set of recommendations for the governance of geoengineering research, to be released late in 2010.

Proposed geoengineering techniques that reflect the sun's light and heat back into space may offer valuable opportunities to reduce global warming, and could do so quite rapidly, but it is likely that their impacts would also affect rainfall, regional weather patterns and ocean currents. These impacts would not be restricted by national boundaries, so actions in one country could have highly significant effects in another, for example by changing rainfall and so affecting agriculture and water supply.

Professor John Shepherd FRS (who chaired the Royal Society's **Geoengineering the climate: Science, governance and uncertainty** report published in September 2009) said, "The disappointing outcome of Copenhagen has shown that achieving global agreement to reduce emissions of greenhouse gases is not easy. Some countries or organisations may consider geoengineering methods by which they could deliberately alter our climate. Large scale field trials of some solar radiation management techniques could cause damaging side-effects. It is essential that we consider

beforehand what legislative mechanisms and guidelines are needed, to ensure that any research that is undertaken will be done in a highly responsible and controlled manner with full international agreement where necessary.”

The Initiative being launched by the Royal Society and its partners, EDF and TWAS, will engage with a variety of organisations, concerned with natural and social science, governance and legal issues, as well as environmental and development NGOs, industry and civil society organisations, from across the globe. This will ensure that evidence and opinion is sought from a wide range of stakeholders with appropriate expertise, leading to outputs that will centre on providing:

- Recommendations for the governance of both research and possible deployment of SRM techniques
- Best practice guidelines for any emerging research into SRM technique
- A suggested framework for how SRM research could be undertaken through international cooperation

This initiative is being supported by a range of funders and partners, including Zennström Philanthropies.

- **The Royal Society – September 24, 2010**

- **Science Policy Themes**

- **Diplomacy**

- **Governance**

- **Innovation**

- **Sustainability**

- Science Policy Projects

- **People and the planet** Population is a global issue which is moving back up the agenda but debates remain polarised: many still see population as a distraction from the more urgent imperative of reducing resource consumption in the wealthiest countries. Others argue it is an issue that will solve itself, as growth rates peak and then fall from the middle of the 21st Century.

- **Brain waves** As our understanding of the brain increases, it brings new insights, new treatments, new risks and new moral dilemmas. Brain waves will explore the potential, the limitations, the risks and the policy challenges of modern neuroscience and its applications.

- **Atlas of Islamic world science and innovation** The Royal Society and its partners are undertaking a landmark study of science and innovation across the Islamic world. The new atlas will explore the

changing landscape of science and innovation across a diverse selection of countries with large Muslim populations

- **Solar radiation governance initiative** Solar radiation management is part of the new science of geoengineering and proposes to counter global warming by reflecting a small percentage of the sun's light back into space. The Royal Society and partners have launched an initiative to ensure strict governance of the research and its application.
- **Global science report** Wherever in the world you look, new entrants are reshaping the landscape for science and innovation. The Royal Society has launched a major study to map and analyse this new world, its networks of collaboration and its implications for global decision makers in science, business, NGOs and government.

See our [projects pages](#) for more information.