EXCELLENCE IN SCIENCE

THE ROYAL SOCIETY

Response to the House of Commons Science and Technology Select Committee inquiry into the regulation of geoengineering

1. The Royal Society welcomes the opportunity to respond to the Select Committee inquiry into the regulation of geoengineering. We also welcome the collaboration with the US Congressional Science and Technology Committee to which Professor John Shepherd FRS gave evidence on 5 November 2009. This submission has been prepared based on the Society's report '*Geoengineering the Climate: Science, governance and uncertainty*' and ongoing streams of work. A copy of the report has been enclosed with this submission.

2. The Royal Society decided to undertake a review of the feasibility and uncertainties of the various proposed geoengineering technologies due to the increased public awareness of, and interest in geoengineering. Under the chairmanship of Professor John Shepherd FRS of Southampton University, we assembled a group of twelve experts, drawn from environmental science, oceanography, engineering, economics, law and social science. The review took one year and the report was published in September 2009. Here we emphasise three main points:

    - *First*, the report emphasises the geoengineering is not an alternative to greenhouse gas emission reductions. Geoengineering may hold longer-term potential and merits more research, but it offers no quick and easy solutions that should distract policy-makers from working toward a reduction of at least 50 percent in global carbon dioxide (CO_2) emissions by 2050.

    - *Second*, the report brings greater clarity to the debate by defining and comparing the two basic classes of geoengineering methods: Carbon Dioxide Removal (CDR) techniques that remove CO_2 from the atmosphere and Solar Radiation Management (SRM) techniques that reflect a small percentage of the sun's light and heat back into space.

    - *Third,* the report looks beyond the science to highlight a broader set of issues that need to be considered before geoengineering could proceed. The mix of factors is complex, and it is desirable that both geoengineering research, and any plans for implementation, be pursued within robust frameworks of governance, accountability and public engagement.

3. The Royal Society is now planning to develop a partnership with other science academies and governance institutions to address the governance of geoengineering. The early stages of such a process are already underway, and further details are given in paragraph 23.

Is there a need for international regulation of geoengineering and geoengineering research and if so, what international regulatory mechanisms need to be developed?

(a) Fundamental issues

4. It is important to distinguish between the need for regulation of research and the need for international regulation of deployment. We are of the opinion that some geoengineering techniques will likely require international regulation of some forms of research, and most (but possibly not all) techniques are likely to require international regulation of deployment. There is a very wide range of geoengineering methods, with diverse characteristics, methods of action and potential side effects; consideration of governance requirements is therefore best done with reference to specific techniques. We do not consider that a blanket requirement for regulation of research is necessary or desirable. Geoengineering techniques can be broadly split into two categories i.e. Carbon Dioxide Removal (CDR) and Solar Radiation Management (SRM) methods, with different features requiring a differentiated approach.

5. **Carbon Dioxide Removal (CDR)** techniques treat the cause of climate change by removing CO_2 from the atmosphere. This can potentially be achieved through a number of different technologies, e.g. air capture ("artificial trees"), ocean fertilisation, biochar / BECS, and enhanced weathering. Some of these technologies are likely to have a low risk of unintended consequences, but they will all only have a significant impact on global temperatures if applied for many decades. The ecosystem based methods, such as ocean fertilisation, have much greater potential for negative and trans-boundary side effects. Research on many of these techniques (such as air capture and biochar / BECS) could however be adequately managed by national legislation as their effects are not trans-boundary, other than via the removal of greenhouse gases (GHGs) from the atmosphere. The same also applies to deployment of these techniques, at least until the levels of GHGs in the atmosphere have been stabilised. Thereafter, international agreement on the levels to which they should be reduced will be required, but this requirement is not imminent.

6. **Solar Radiation Management (SRM)** techniques are those which reduce the net incoming short-wave solar radiation received by deflecting sunlight, or by increasing the reflectivity of the atmosphere, clouds or Earth's surface. These technologies do not treat the root cause of climate change and would not help to solve associated problems such as ocean acidification. If these techniques were deployed they would need to be sustained for a very long time (several centuries) unless and until atmospheric concentrations of greenhouse gases were reduced. SRM technologies would include space mirrors, aerosols (e.g. sulphates) in the stratosphere and cloud brightening. The effects of most SRM techniques (other than "white roofs") would occur on regional to global scales and so would require international regulation.

7. We suggest that the fundamental criteria in relation to governance are whether (and to what extent) the techniques involve;
   - trans-boundary effects (other than the removal of GHGs from the atmosphere).
   - dispersal of potentially hazardous materials in the environment.
   - direct intervention in (or major direct side-effects on) ecosystems.[1]

[1] All methods will of course involve indirect side-effects on ecosystems via their effects on climate change.

8. In designing regulatory frameworks the potential for technical and structural reversibility of the technologies should also be considered.

(b) Institutional issues

13. CDR technologies could mostly be adequately controlled by existing national and international institutions and legislation. Many of the technologies are closely related to familiar existing technologies. Air capture technologies are very similar to those of carbon capture and storage; and this is likely to be one of the most environmentally benign technologies. Ocean fertilisation techniques are currently being managed by the London Convention on ocean dumping, under the London Protocol. The Convention of Biological Diversity has also adopted a decision on ocean fertilisation which is mostly consistent with that of the London Convention. Biochar and BECS face similar regulatory issues to that of biofuels including life cycle analysis, and land use management. Ecosystem impacts of enhanced terrestrial weathering would be contained within national boundaries. Methods of enhanced weathering involving oceanic dispersion of the products would have trans-boundary effects, but may also be able to be managed under the London Convention.

14. For SRM technologies there are fewer existing institutions that could manage research and development. Land surface albedo modification could be managed under national regulatory frameworks as there are unlikely to be major trans-boundary issues. The oceanic cloud brightening technologies would not fall under national jurisdiction and no existing international institutions have a clear mandate, so modifications and extensions of existing treaties (e.g. ENMOD) and institutions would be required. Existing treaties governing the atmosphere and space (CLRTAP & OST) would similarly not be adequate to regulate stratospheric aerosols and space mirrors. There is a risk that these methods could be applied by an individual nation or corporation which highlights the need for international regulation for deployment (and in some cases research).

(c) Mechanisms

15. Governance mechanisms should be decided, and where necessary, constructed for technologies that require them, before they are needed in practice.

16. Our report proposed that the Royal Society, along with other scientific institutions, should initially develop a voluntary code of practice to govern scientific research for both SRM and CDR technologies. We are now looking to take forward this work with a number of other science academies and governance institutions (see paragraph 23).

17. Governance mechanisms will be required for some research. Theoretical (modelling) studies and small scale experiments undertaken in the laboratory would not require regulation but we would encourage maximum transparency and international collaboration on such activities. Field tests that are below a level that could have discernable negative consequences should be permitted, but further consideration and international agreement is required to determine how these *de minimis* levels should be set. International co-operation and public engagement will also be needed to maintain trust in the process. For research where effects on the environment could potentially have discernable negative consequences, it would be necessary to have governance mechanisms in place to ensure they are undertaken responsibly.

18. An important characteristic of any international mechanisms is that they should be flexible enough to deal with new proposals, and to adapt as our understanding improves of the technologies and their implications.

19. Eventual deployment of any geoengineering technologies will necessarily require involvement of and coordination within the UNFCCC.

How should international regulations be developed collaboratively?

20. Our report proposed that the Royal Society along with other scientific institutions should initially develop a voluntary code of practice to govern scientific research for both SRM and CDR technologies, as necessary. We are now looking to take forward this work with a number of other science academies and governance institutions. We are also continuing to actively engage other organisations in process to include governance specialists, NGOs and participants from a range of geographic locations.

21. We also suggested that a suitable international body (possibly the UN Commission for Sustainable Development) should commission a review of existing international and regional mechanisms to:
    - Consider the relevant roles of the following bodies (and any others that we may have overlooked): UNCLOS, LC/LP, CBD, CLRTAP, Montreal Protocol, Outer Space Treaty, Moon Treaty, UNFCCC/KP, ENMOD.
    - Identify existing mechanisms that could be used to regulate geoengineering research and deployment activities (if suitably extended as necessary).
    - Identify where regulatory gaps exist in relation to geoengineering methods proposed to date, and establish a process for the development of mechanisms to address these gaps.

22. It will be important that the development of any regulatory framework be as open, transparent and inclusive as possible.

Ongoing Royal Society work on geoengineering

23. Following on from our report we are now seeking to facilitate a process of international research and discussion to address the governance of geoengineering in partnership with other prominent scientific and policymaking organisations. The early stages of such a process are already underway, the Royal Society and the Centre for International Governance Innovation (CIGI) jointly hosted a series of three side events on '*The Science, Research and International Governance of Geoengineering*' at the COP15 in Copenhagen. These events disseminated the key messages and findings of the Royal Society report, and began engaging a broader audience of international policy-makers and stakeholders in discussions of geoengineering governance. SRM techniques present the greatest potential for near-term political, social and ethical challenges; therefore the envisioned process will focus predominantly on the governance of these techniques.

Contact

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