

Geoengineering climate

Institute of Physics response to a Royal
Society call for submissions

A full list of the Institute's submissions to
consultations and inquiries can be viewed at
www.iop.org

24 November 2008

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IOP Institute of Physics

Dear Mr Parker

Geoengineering climate

The Institute of Physics is a scientific membership organisation devoted to increasing the understanding and application of physics. It has an extensive worldwide membership and is a leading communicator of physics with all audiences from specialists through government to the general public. Its publishing company, IOP Publishing, is a world leader in scientific publishing and the electronic dissemination of physics.

The Institute welcomes the opportunity to respond to the Royal Society's call for submissions to inform its study on geoengineering the Earth's climate. This response was prepared with input from the Institute's Energy Sub-group, which includes a range of leading physicists working across the energy sector. The Sub-group reports to the Science Board of the Council.

The attached annex highlights the Institute's response to the questions listed in the call for submissions.

If you need any further information on the points raised, please do not hesitate to contact me.

Yours sincerely



Professor Peter Main
Director, Education and Science

Geoengineering climate

The Institute welcomes the Royal Society's initiative to make an objective assessment of the scientific basis for the expected efficacy of and the possible undesired consequences of a range of concepts aimed at offsetting the effects of increases in levels of atmospheric carbon dioxide. In doing so, the Institute does not imply that current national and international efforts to reduce carbon dioxide emissions should thereby be reduced or delayed. The Institute does, however, consider that the world is ill-prepared for a conceivable situation in which global warming substantially exceeds the projections of present climate models or in which we find we are approaching a catastrophic climatic tipping point. The projected study should clarify the options that might be available in such eventualities and provide the beginnings of a basis for developing international contingency plans.

1. What do you consider to be the current state of knowledge regarding the feasibility, efficacy and predicted impacts of climate geoengineering schemes?

Currently, geoengineering as a subject has not received the wide and serious examination necessary for informed and critical assessment. In 2004, the Tyndall Centre and Cambridge-MIT Institute Symposium held an invitation-only meeting in Cambridge on macro-engineering options for climate change management and mitigation which was attended by an international group of prominent scientist and engineers. The proceedings of this meeting have not been published and the projected follow-up meeting does not appear to have been held. It is timely that the November issue of the Philosophical Transactions of the Royal Society is dedicated to this theme and hopefully it will stimulate interest in resolving the issues.

2. How do you think research into climate geoengineering should be taken forward, and by whom?

Research on some of the new proposals, for example, biological or chemical carbon-to-fuel recycling could be undertaken within the UK university sector with funds earmarked for it. The research must include the secondary impacts, especially to ecological systems. As another example, the assessment of cloud albedo modification, however, would require improved knowledge of aerosol and in-cloud physical processes which are also critical to the reliable calculation of negative cloud feedback in climate modelling. This research would require extensive new measurements of in-cloud physics in conjunction with targeted terrestrial and satellite observations in cooperation with climate modellers. An international collaboration would be necessary, with the UK and the USA as leading partners.

3. What factors need to be considered before deploying any climate geoengineering schemes? Who should be responsible for any deployment?

No scheme should be deployed before careful analysis and modelling of all the impacts to establish the potential efficacy of the intervention and the scale and potential seriousness of any undesired effects. Following this, pilot-scale trials can be

considered, with clearly limited undesired risks. The spatial extent of the pilot trials should be within national boundaries, so the relevant government can take responsibility, after consultation with the international community and the scientific academies.

Larger-scale deployment must be contingent on widespread consultation and a satisfactory safety case, taking into account the results of the pilot trials, in which the duration and reversibility of the intervention are rigorously demonstrated and measures to counter and limit any undesired effects are incorporated. Where the spatial extent is international, technical consultation should include the major scientific academies worldwide. A new framework for this could possibly be established through the International Council for Science (ICSU). Other factors, particularly those impinging on sovereign rights and legal liabilities might require a new international convention and oversight body.

4. What do you consider to be the most important political, social, legal or ethical issues raised by climate geoengineering?

Climate geoengineering at scale must be considered only as a last resort. There should be no lessening of attempts to otherwise correct the harmful impacts of human economies on the Earth's ecology and climate. Therefore, the capability to deploy any geoengineering scheme should be seen as a prudent precautionary measure in case all other attempts to control dangerous climate change fail or are inadequate – for whatever reason.

5. What do you see as the main barriers to, and opportunities offered by, climate geoengineering?

The main barriers to many of the schemes will not be technical. One barrier will be objections, on principle, that any such precautionary insurance will weaken the international resolve to reduce carbon dioxide emissions. Another may be the difficulty of establishing sufficiently accurately the ecological and environmental consequences associated with any particular scheme. Another may be the cost of some schemes. For the albedo modification schemes, the opportunities include, along the way, a fuller understanding of the relevant climate processes and the development of new technologies and new industries.

6. Where do you feel that climate geoengineering fits in the greater scheme of climate research and action to mitigate and adapt to climate change?

Uniquely it offers the possibility of an ultimate insurance policy against a 'worst fears' case. We note that some of the schemes in the first category involve recycling extracted carbon dioxide into carbon-neutral fuels. These could add substantially to our portfolio of carbon recycling options and could be very important in reducing the projected reliance on large-scale carbon sequestration.

7. Are there any other issues related to climate geoengineering that you consider to be important?

Research into albedo modification by schemes in categories 2a, 2b and 2c of the call for submissions should lead to improved knowledge of processes central to the

reliable calculation of positive and negative albedo contributions in climate modelling and thus reduce the present range of uncertainty in the modelling of these effects.

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