The Regulation of Geoengineering - Science and Technology Committee **Contents**

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3 Need for regulation of geoengineering

34. The first question in our terms of reference for this inquiry was: is there a need for international regulation of geoengineering research and deployment and if so, what international regulatory mechanisms need to be developed? The answer we received split into two: some geoengineering techniques are already subject to regulation; and as regards the remaining techniques the position is not yet clear.

Geoengineering techniques currently subject to regulation

35. The Royal Society pointed out that:

> 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 [73] 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.[74]

36. John Virgoe in a recent article identified an important shortcoming of the existing international systems of regulation. He pointed out that "No existing treaty deals explicitly with geoengineering. None of these treaties was drafted with geoengineering in mind, and none of them clearly prohibits or regulates relevant activities" but he considered that they might provide "contexts in which a possible geoengineering intervention might be regulated—or challenged.[75] He pointed out that even the UNFCCC, the basic legal instrument on climate change, did not address the possibility of intentional attempts to change the climate, except for the "enhancement of sinks and reservoirs".[76] In our view this is not a defect that could or should be rectified by excluding geoengineering from the ambit of these protocols or erecting parallel arrangements for the purposes of regulating geoengineering.

37. Instead, the existing regimes could be developed to encompass geoengineering. Mr Virgoe could "see no good reason not to encourage (carefully supervised) research in these techniques" and "to ensure carbon accounting/trading rules are crafted in a way which might include such activities (once issues of safety, verification etc are taken into account)".[77] Research Councils UK made a similar point. On the assumption that geoengineering techniques, particularly CDR, were formally recognised as contributing to climate change mitigation (that is, as part of national commitments to international climate change agreements), "such techniques will need linking to emission trading schemes or other mechanisms that may evolve".[78]

38. The existing international regulatory arrangements on climate change, such as UNFCCC, need to be developed to encompass geoengineering techniques. We see a role for the Government. **Through its involvement in the existing international regulatory arrangements such as the UN Framework Convention on Climate Change and when these instruments come up for revision we recommend that the Government raise geoengineering, particularly those for Carbon Dioxide Removal (CDR), and seek to develop, in conjunction with other governments, the arrangements provided by these international instruments so that they address research on, and deployment of, CDR geoengineering techniques.**

Geoengineering techniques currently not subject to regulation

39. In contrast, regulatory regimes for many SMR techniques have yet to be developed. Again the Royal Society summarised the position:

> 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[79] & OST)[80] 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).[81]

Dr Blackstock pointed out that for SRM "we do not have the appropriate regulatory mechanisms in place, and I do not believe we have even a forum in which that discussion has begun to occur".[82]

40. The Government appeared to share this view. It told us that geoengineering was an emerging policy area and there "were at present no international treaties or institutions with sufficient mandate to regulate the broad range of possible geoengineering activities" and that, while regulation of some of the technologies might be feasible by employing or amending existing treaties and protocols of international law, others—such as atmosphere and space-based methods—"may require new international mechanisms".[83] **We conclude that there is a gap in the regulatory framework for geoengineering techniques, especially for SRM techniques.**

41. But does this gap matter? There are three issues which we consider are relevant:

a) whether there is a need for urgency;

b) the state of the science; and

c) public attitudes.

URGENCY

42. The Government considered that there was no urgency. The Minister, Joan Ruddock MP, did not see geoengineering as a priority for Government. She said that geoengineering techniques were "far from being developed to the point of viability at the moment".[84] But the Government was keeping a "watching brief" on the subject and did "things at a *de minimis* level".[85] What it considered as urgent was "reducing greenhouse gas emissions in this country, of legislating to that effect, and of participating in the international discussions about trying to arrive at a global deal".[86] Indeed, she saw a danger in adopting Plan B[87] (that is, research into geoengineering), "if that were even feasible, which I would question, but the danger in adopting a Plan B is that you do not apply yourself to Plan A, and the point of Plan A is it is all entirely do-able."[88]

43. As we explained in a previous chapter, we have disagreed strongly with the Government on the advisability of investigating geoengineering as a fallback option, Plan B. Sir David King directly addressed the concern that appears to inhibit the Government's view of geoengineering that it was a distraction from the reducing greenhouse gas emissions. He said that the major effort had to be around defossilising economies, as that would manage the anthropogenic (that is, human made) problem directly rather than indirectly through geoengineering.[89] He considered that, if "we [could] manage the transition over the next 40 years into a defossilised economy", geoengineering techniques might not be needed. It was, however, necessary:

> to factor in the probability distribution functions that the best science can deliver around what the temperature rise for the planet will be even at a level [...] of 450 parts per million of greenhouse gas CO_2 equivalent in the atmosphere. The best that science can tell us at the moment is that the eventual temperature rise is going to lie somewhere between 1° Centigrade and 4° Centigrade with a peak in that probability distribution function above 2° Centigrade, and so we only have a 50 per cent chance of staying below a 2° Centigrade rise. There is still, for example, a 20 per cent chance that the temperature rise will be above 3.5° Centigrade, and I am putting to you the idea that the 450 parts per million figure is what we ought to aim for globally—it is the lowest figure that is manageable—but even there we have to manage risks by keeping in reserve an alternative way forward.[90]

Dr Maarten van Aalst took a similar view:

> we need to be cautious of investing at too large a scale to even give the impression that this is a suitable alternative in the short-term to mitigation or [...] much more extensive capacity building and adaptation, especially among the most vulnerable groups [...] On the side of the risks, I agree that it is something that we might want to have up our sleeves, and we are nowhere near the level of certainty about what these different options are that we could consider these options that we have at this stage, so further research, in that sense, on a small scale to get slightly further in our understanding would be important.[91]

44. Sir David saw a need to manage the acidification of the oceans as the increase in carbon dioxide levels meant that more carbonic acid formed in the oceans. The oceans were "part of the ecosystem services for humanity. It is the oceans that provide the beginning of the food chain" and he saw a need to invest research in carbon dioxide removal from the oceans and for prior regulation particularly on ocean removal.[92]

45. Dr Blackstock considered that in spite of the limitations and risks "avoiding SRM research would be a mistake".[93] He pointed out that the ability to influence rapidly the climate meant SRM might be the only recourse should a climate crisis materialise. Since severe climate change could bring about such national or regional crises within decades, he considered that "prudence suggests we should improve our understanding of the likely feasibility,

effectiveness and dangers of SRM interventions" and that without prior research "uninformed and rash unilateral action by less responsible actors becomes more likely".[94] Moreover, near-term authoritative research would help "discredit ungrounded fringe claims that SRM could provide an alternative to dramatic near-term emission reductions" and he added that "establishing good governance of SRM requires good understanding of the schemes and risks to be governed, which first requires research".[95]

46. Both Professor Keith[96] and Dr Blackstock made the point that SRM technologies appeared to be relatively cheap and therefore relatively technically simplistic.[97] Dr Blackstock explained that this was:

> because most of the technologies required to actually deploy solar radiation management are things that are available to numerous countries already. These are not technologies that require huge technological progress from where existing technologies are at. The idea that we can potentially regulate and control the technology underlying solar radiation management, like we do, or attempt to do, with nuclear technologies, is not a good analogy for this. The technology is going to proliferate and be accessible to a large number of individuals or countries and, therefore, we have to look at controlling behaviours in this case, not just access to technology.[98]

47. The Sustainability Council of New Zealand put to us a scenario for unilateral action where one region was significantly affected by climate change and felt the international community was responding too slowly. The Council pointed out that developing nations would in general suffer soonest from the more serious effects of climate change and it envisaged that a small group of developing countries could deploy reflection schemes shifting the balance of power such that the pace of climate change responses in general would tend to better align with those countries' preferences.[99]

48. Nor is geoengineering confined to modelling and the distant future. Professor Keith told us that the Russians were already carrying out testing,[100] though Dr Blackstock added that the Russian tests were "extremely subscale".[101] Professor Keith also explained that it was becoming urgent to undertake tests into stratospheric geoengineering as it had become clear that the main method that had been considered did not work. He explained that if sulphur was put in the stratosphere the way scientists have been assuming, it did not do what they expected. Tests were necessary and these would have "no detectable climate effect, but they would be subscale tests, and if we want to actually understand whether this technology works or it does not, we need to do those tests relatively soon".[102]

49. The Government's focus on Plan A—the reduction of the emissions of carbon dioxide and other greenhouse gases—is an approach that is becoming increasingly untenable as geoengineering testing is already beginning and SRM techniques are within the reach of a growing number of nations. Nor is its aversion to geoengineering on the grounds that it will distract from Plan A evidence-based. An equally plausible view is that, if the Government were to focus more than at present on geoengineering, it would persuade more people that the threat of global warming was serious and needed to be addressed. In this regard Sir David King made a telling point that "knowing the nature of the possible challenges in the future—[for example one country using geoengineering to divert another's monsoon]—is a very sobering way of managing the business of defossilising".[103] **We recommend that the Government review its policy on geoengineering to give it greater priority.**

GEOENGINEERING IS TOO UNPREDICTABLE

50. An argument made by some against geoengineering is that climate systems are already unpredictable and contain much "noise" and that, as the ETC Group stated, "for any research activities on geoengineering techniques to have a noticeable impact on the climate, they will have to be deployed on a massive scale, and thus any unintended consequences are also likely to be massive".[104] John Virgoe weighed up the issues:

> The state of knowledge about geoengineering, both on the technical side but also on the political, ethical and regulatory sides, is simply not at a point where I think any sensible person would be able to recommend that we should be implementing a geoengineering technique at this point. I think, however, there is increasing reason to think that we may be heading that way in the future. [It] depends to some extent on your degree of optimism about whether the world will actually get on top of global warming through the mitigation methods and through international negotiations. If we believe that we may be heading in that direction and that in some years from now [...] we may be looking seriously at a geoengineering intervention, I think it does make

> sense for us to be starting, at this point, not only to research the science and the technology, but also to think through some of these issues around the politics and the regulation so that when we do get to the point [...] we are in a position to take a mature, measured and informed decision.[105]

51. Dr Blackstock considered that because stratospheric aerosols and cloud whitening were the only category of techniques that could be used with a rapid impact on the climate system there was a need to get regulatory structures in place before large scale field tests were started.[106] He said that field experiments designed to have demonstrably negligible environmental and trans-boundary risks were valuable for feasibility testing deployment technologies, and for exploring local-scale physical, chemical and biological interactions that could damage the environment when scaled up.[107] Dr Blackstock explained that once "you start running into the potential for transboundary impacts, or at least a perception of transboundary impacts, and so international mistrust, international concern of what another country will do with that technology can come up very rapidly".[108] Professor Keith added that "governance is central at the point where we lock it, and the reason is that it is so cheap that the challenge for the international system will be to restrain unilateral action".[109]

52. Beyond the small test, Dr Blackstock said that robust understanding of SRM would eventually require tests with demonstrable climatic impacts and that confidence in SRM climate model predictions could only come from "poking" the climate system and comparing the predicted and observed responses. But due to the natural complexity and variability of the climate system, "signal-to-noise issues will plague the attribution of climatic impacts and unintended consequences to a particular test" and that for "any SRM scheme it might prove impossible to test for most impacts with 'pokes' below a scale considered (at least politically) to constitute deployment of a low-level climatic intervention".[110]

53. There is a wider issue. For understandable reasons there is a tendency to approach regulation of geoengineering as we do reducing emissions of greenhouse gases, which requires action by many parties. Reduction of emissions requires global action with a global impact. By contrast, as John Virgoe has pointed out, some geoengineering techniques only require local action to have a global impact—one possible example, would be the release of stratospheric aerosols. The regulatory regime applying to a geoengineering technique does not need to be so extensive as that for the reduction of emissions. It could focus on setting targets, managing a process and cost-sharing. This reduces the complexity of the governance task, while simultaneously reducing the need for a universal process, though wide participation would remain strongly desirable on ethical and political grounds.[111]

CONCLUSIONS ON THE NEED FOR THE REGULATION OF GEOENGINEERING

54. **The science of geoengineering is not sufficiently advanced to make the technology predictable, but this of itself is not grounds for refusing to develop regulatory frameworks, or for banning it. There are good scientific reasons for allowing investigative research and better reasons for seeking to devise and implement some regulatory frameworks, particularly for those techniques that a single country or small group of countries could test or deploy and impact the whole climate.**

55. **We conclude that there is a need to develop a regulatory framework for geoengineering. Two areas in particular need to be addressed: (i) the existing international regulatory regimes need to develop a focus on geoengineering and (ii) regulatory systems need to be designed and implemented for those SRM techniques that currently fall outside any international regulatory framework.**

Public attitudes

56. The Royal Society said in its report that the acceptability of geoengineering would be determined as "much by social, legal and political issues as by scientific and technical factors".[112] The Minister told us that it was not for the Government to encourage a debate on the social acceptability of geoengineering, because that presumed that the Government had taken a view that geoengineering was a good thing, and that it should be deployed. The Government had not, however, taken that view. The Minister considered it was "important to involve the public in discussions as these things develop".[113] She was "alive to the fact that there would need to be public engagement" and pointed out that the Natural Environment Research Council "have a public dialogue programme that they are about to launch. So it is important to talk with the public and to avoid ignorance and prejudice, but at the same time, it is not for the Government to persuade the public of the need for this."[114]

57. Dr Adam Corner and Professor Nick Pidgeon, on behalf of the Understanding Risk Research Group at Cardiff University, said that a key consideration would be the public acceptability of both specific geoengineering proposals themselves and the governance arrangements set in place. They explained that

> Research in the UK and elsewhere on the public acceptance of the risks of new technologies (such as nuclear power or biotechnology) shows clearly that people raise a range of generic concerns about new technologies. These include concerns over:

> long-term uncertainties; who will benefit; arrangements for control and governance; and who to trust to regulate any risks. Geoengineering is unlikely to be any different in this regard.
>
> [W]ork on the technical feasibility of geoengineering should not begin prior to a thorough evaluation of governance arrangements for research. Our most fundamental concern is that a programme of public engagement should be an important component feeding into governance and research priorities. **Thus, the first challenge for geoengineering governance is to pursue an international programme of upstream public engagement.**[115]

58. While we welcome the work that NERC is doing on public engagement on geoengineering, we find the Government's approach unduly cautious. In part this appears to be a product of its view that geoengineering is a distraction from reducing carbon emissions, which, as we have already discussed, is not an evidence based approach and does not recognise some of the alternatives in pay-off of government support for geoengineering. **We recommend that the Government give greater priority to public engagement on geoengineering by, for example, showing how it relates to its policy on the reduction of carbon dioxide emissions. We welcome the work of Natural Environment Research Council (NERC) on public engagement on geoengineering and we request that, when the work is completed, the Government provide our successor committee with an explanation of how it will inform its policy on geoengineering.**

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73 Biomass with carbon sequestration. Back

74 Ev 52, para 13; see also Q 8 [Dr Blackstock] Back

75 J Virgoe, "International governance of a possible geoengineering intervention to combat climate change", *Climatic Change*, 2009, 95:103-119, para 3 Back

76 *As above Back*

77 Ev 5, para 8 Back

78 Ev 24, para 16 Back

79 The 1979 onvention on Long-range Trans-boundary Air Pollution Back

80 The 1967 Outer Space Treaty Back

81 Ev 53, para 14 Back

82 Q 9 Back

83 Ev 19 Back

84 Q 51; see also Q 58 Back

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88 Q 56 Back

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90 Q 34; see also Ev 45 [Sustainability Council of New Zealand] Back

91 Q 35 Back

92 Q 39 Back

93 Ev 2, para 11 Back

94 *As above* Back

95 *As above* Back

96 Q 17 Back

97 Q 18 [Dr Blackstock] Back

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99 Ev 45 Back

100 Q 27; see also Ev 3 [Dr Blackstock], para 15 Back

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102 *As above* Back

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107 Ev 3, para 15 Back

108 Q 8 Back

109 Q 12 Back

110 Ev 3, para 17 Back

111 J Virgoe, "International governance of a possible geoengineering intervention to combat climate change", *Climatic Change*, 2009, 95:103-119, para 2.2 Back

112 The Royal Society, *Geoengineering the climate Science, governance and uncertainty*, September 2009, p ix Back

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