

- [Accessibility](#)
- [Email alerts](#)
- [RSS feeds](#)
- [Contact us](#)



- [Home](#)
- [Parliamentary business](#)
- [MPs, Lords & offices](#)
- [About Parliament](#)
- [Get involved](#)
- [Visiting](#)
- [Education](#)
  
- [House of Commons](#)
- [House of Lords](#)
- [What's on](#)
- [Bills & legislation](#)
- [Committees](#)
- [Publications & records](#)
- [Parliament TV](#)
- [News](#)
- [Topics](#)

You are here: [Parliament home page](#) > [Parliamentary business](#) > [Publications and Records](#) > [Committee Publications](#) > [All Select Committee Publications](#) > [Commons Select Committees](#) > [Science and Technology](#) > Science and Technology

## The Regulation of Geoengineering - Science and Technology Committee [Contents](#)

---

### Examination of Witnesses (Questions 34-50)

SIR DAVID KING AND DR MAARTEN VAN AALST

13 JANUARY 2010

**Chairman:** We welcome our second panel this morning, Dr Maarten van Aalst, who has flown in this morning from Holland—and we thank you very much indeed, Maarten, for doing that—and an old friend of the Science and Technology Committee, former Government Chief Scientific Adviser, Dr Sir David King. Sadly, we have lost our third panel member, Dr Kilaparti Ramakrishna, who should have been coming to us from India. Unfortunately, our video link has not worked, which is sad, but it means we have more time for our other two distinguished witnesses this morning. I wonder if I could start with you, Graham Stringer, in this round of questioning.

**Q34 Graham Stringer:** Should we be putting a lot of investment into geoengineering research at the present time?

**Sir David King:** Good morning. I am delighted to be here. Could I congratulate you on conducting much of this by video conference, which must have saved a lot of carbon dioxide, and in a sense that reply addresses this question:

because, quite clearly, the major effort has to be around defossilising our economies, and the point about defossilising our economies is that it manages a problem which is an anthropogenic problem directly rather than indirectly, which is what we have been discussing this morning. It gets right to the root of the problem. I think that, while there are real concerns about what the impact on economic growth might be, I do not really share those concerns. If we manage the transition over the next 40 years into a defossilised economy, I think we can manage it and, at the same time, even get a boost to growth through the innovation that follows from this necessity to move away from high-carbon technologies. The shorter answer to your question is, however (and it is a very important however), we need 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, let us say, of 450 parts per million of greenhouse gas CO<sub>2</sub> 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 1½ Centigrade and 4½ Centigrade with a peak in that probability distribution function above 2½ Centigrade, and so we only have a 50 per cent chance of staying below a 2½ Centigrade rise. There is still, for example, a 20 per cent chance that the temperature rise will be above 3.5½ 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.

**Q35 Graham Stringer:** Dr Aalst?

**Dr Aalst:** First of all, let me say that I am not speaking on behalf of either the British Red Cross or the International Federation of Red Cross/Red Crescent Societies but in a personal expert capacity. I would echo many of these remarks. I think 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, I would add, much more extensive capacity building and adaptation, especially among the most vulnerable groups, so I would just add to that. 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. To give you my primary perspective on that right away, it is not about what is per square metre, it is about people. I think in looking at those options, those distributional effects (and, in particular, the effects on the groups already most affected by climate change as we see it progressing and the end of the probability distribution, not just in terms of the global temperature rise but also the impacts from there) would be crucial.

**Q36 Graham Stringer:** Sir David, when you were advising on the preparation for the Climate Change Bill—and one part of good regulation is that you look at different alternatives to the proposals in the Climate Change Bill—did you seriously consider geoengineering and the costs and benefits of geoengineering as against CO<sub>2</sub> reduction?

**Sir David King:** I think the answer is, yes, seriously consider, but then, following the answer to your previous question, I do not see that what we are now discussing with geoengineering issues should be a high profile way forward. In other words, it is something, to repeat, that should be there, kept in reserve, there should be a significant effort made both into research and into regulation at this stage, but I do not think that the effort should match in any way.

**Q37 Graham Stringer:** I understand the arguments. I suppose what I am really asking is when you were doing the regulatory impact assessment on the Climate Change Bill did you quantify the costs and benefits of geoengineering against the mitigation of carbon dioxide?

**Sir David King:** A very simple answer is, no, simply because the cost of carbon dioxide capture from the top end of a coal-fired power station is already rather large and there is a much higher density of carbon dioxide at that point of the atmosphere than in the general atmosphere, where it is only 400 parts per million. The cost at our present estimate is already expensive from the top end of a coal-fired power station and, in my view, is prohibitive from the general atmosphere. It was not eliminated without examination.

**Q38 Graham Stringer:** Geoengineering is going up the agenda in a way: more people are talking about it. Where do you think the pressure is coming from for a greater investment in geoengineering? Is it from industry, NGOs, people who are profoundly sceptical about global warming?

**Sir David King:** I do not think it is any of the above. I think it is more pressure coming from people who (a) are concerned about us not managing the problem by defossilising, but (b) a group of people who do not wish to go down the defossilising route and would like to provide an alternative, and I fear that there may be quite a largish group emerging, particularly in the United States, which come from that particular line.

**Dr van Aalst:** Yes, that is my impression as well. I think on the scientific side, this debate was probably started by people with a genuine concern, wanting to map out these options for that tail end of distribution. I think we are now in a shift, and with political attention growing, there is also political attention from the other side. I would also be cautious, including the caution of establishing very large research programmes which might be interpreted as on a similar scale as the investments we are making in mitigation and adaptation.

**Q39 Graham Stringer:** I was going to say, do you think that the risks are too high to consider geoengineering, but in a sense, you have already answered that question by saying we should have it in reserve. It might be a more pertinent question to ask: what do you think the major risks of geoengineering are?

**Sir David King:** I think if I can now adopt the same approach as the previous group, we need to separate geoengineering into carbon dioxide capture and solar radiation management. In terms of solar radiation management, my own view is that there should be, if possible, a temporary ban on solar radiation management. I think the unintended consequences of that are extremely difficult to foresee. I am all in favour of research that would examine possible consequences of putting aerosols up in the stratosphere to reflect radiation away. The concerns expressed by the previous group I would match as well, the total cost of managing to put sulphates into the stratosphere is relatively small, and the technology is there, and I do think that this is something that needs to be addressed immediately, but now moving on to carbon dioxide capture, carbon dioxide capture should be dealt with as well in two forms: one is capture from the atmosphere, and one is capture from the oceans. I think as soon as we move into capture from the oceans, then again, we are dealing with an issue of long range pollution and impact problems, so cross-boundary problems. So the simple categorisation of two is not in my view sufficient. Let me just go back and make a comment about solar radiation management. Let us suppose that we could all be persuaded that Crutzen is right, and we can reduce temperatures in this way. We would still not be managing the acidification of the oceans. In other words, carbon dioxide levels going up means that we would get more carbonic acid formed in the oceans, and why is this a problem? The oceans are part of the ecosystem services for humanity. It is the oceans that provide the beginning of the food chain, and if we do not understand what is going to happen to the oceans as they become more acidified, and there are questions about that already being examined by the scientific community, then I would also be very concerned about this, even as a potential solution. So I am focusing then on these two methods, carbon dioxide removal from the atmosphere and from the oceans, and I would say we should be investing in research in those areas, and we need prior regulation particularly on ocean removal.

**Q40 Dr Iddon:** Good morning, gentlemen. Earlier, we were talking about regulating geoengineering, and, of course, it goes from modelling by computer and in the laboratory through to pilot scale, you know, on differing scales in the environment. At what stage do you think the regulation should kick in, assuming that we can get international agreements? Should it apply to the research throughout, or just to quite large scale applications in the environment?

**Dr van Aalst:** I should say, I am not an expert on research regulation per se, so with that qualifier, my impression is that there is probably some regulation in place for some of the experiments that would be considered. The risks are primarily on the trans-boundary implications, that is where we probably do not have the good structure in place, and we need to look much further; and then there is the moral side of where you invest and how you look at options, and particularly how you include all the distributional effects there, which would probably kick in much earlier. So I think it is clear that we are in that stage, once we are in the stage of testing, once we are testing, and I support the previous views that you want regulation in place before you do large scale testing. For the earlier experiments, in general, I tend to be in favour of fairly free research, so that we can explore these options, and I think we are in too large uncertainty still about many of these options to be able to even design the right regulations.

**Sir David King:** I certainly believe that early regulation in any issue of this kind is essential. That does not mean that we leap straight into regulation, but examining what is the optimal form of regulation is well worth doing in advance. I think, however, that in terms of solar radiation management, I would move fairly swiftly, as I have suggested, into a temporary ban, and find the feasible way forward for that. I am not happy about smaller experiments being conducted at this stage in time before the unintended consequences have been fully evaluated. We are dealing with an extraordinarily complex issue here, and we all know scientifically that complex phenomena, as complexity increases, we get emergent properties that are not always easy to predict. So I do think we need to watch the stratosphere very carefully, but at the same time, in terms of regulation of the others, get ahead of the game, precisely because firstly, you want to keep the public on side, if we lose the public, then we lose the game; and secondly, we want to see that the regulation encourages the right behaviour. Car exhaust regulation has always been progressive, saying this is the way—the new cars have to meet that standard in three years' time, and it has produced the investment in the right direction. So if the regulatory system is set out there, everyone knows what the playing field looks like.

**Dr van Aalst:** May I just add a comment, just to clarify? On regulation, I think we definitely need that sort of regulation once we go towards testing, and I would agree with the suggestion to have a ban, even on relatively small scale testing of solar radiation management. I do not think we can go quickly towards regulation of, say, model experiments of stratospheric aerosol injection, that would not even be feasible. I would think that as an alternative, or as a complement to eventual development of regulations for deployment, the sort of consultations that were discussed in the end of the previous panel would be crucial, and those should be international consultations, it should be very pro-active and engaging the public, because I think that will be a crucial factor to understand the feasibility, the acceptability of these options. That discussion needs to take place much before political decisions about eventual deployment, and I think also much ahead of actual regulation, except for a regulation to say let us try and stop it for now. I also think that we need to be realistic here; there is probably a difference between the sort of debate now taking place here in the UK and the debate around the globe, including in several different states which may already be at the stage of small scale testing of some of these options. So I think the UK is in a way also operating as an international arena, and in a way setting moral standards and setting an example for how globally we should be approaching this, which is a very important side effect for your own considerations, I think, at this stage.

**Sir David King:** Can I come back very briefly, because I think there is an important scenario or set of scenarios that we do need to examine here. If we roll forward in time, and we reach the point where the worst impacts are happening, temperature rises are quite excessive, and we take on the notion that came up in the previous discussion about one country protecting its monsoon, and another country finding it is not acceptable, this discussion is critically important to have now, well ahead of time, for two reasons. One, because we want to avoid that being done; but the second reason is knowing the nature of the possible challenges in the future is a very sobering way of managing the business of defossilising. We need to really know what the potential disastrous eventualities will be, if nations start having to take matters into their own hands, and away from the international procedures.

**Q41 Dr Iddon:** Earlier, Tim Boswell read out five principles that have been laid down by the geoengineering community to guide their research. I will not read them out again, I will just read one: "Geoengineering is to be regulated as a public good." Do you think everybody understands what public good is, and who should define it? Who should decide what is in the interests of the general public?

**Sir David King:** I feel like saying "pass".

**Q42 Dr Iddon:** You leave that to us, do you not?

**Sir David King:** It is obviously a very important issue, and within this, I presume, comes the issue of intellectual property rights as well, so I think it is a critically important issue to understand what we mean by the phrase "public good". If we are saying that there should be no intellectual property rights capable of being awarded in this area, I think I would be a bit hesitant to back it.

**Q43 Dr Iddon:** What is your view on IPR?

**Sir David King:** I think it is a very complex issue, because if we are going to go down the route of carbon dioxide capture from oceans or atmosphere, and this is going to be a good thing, we also need to know, where is the investment going to come from, to take the research into demonstration phase and into the marketplace, and there will be a marketplace with a price of carbon dioxide. That is going to be the private sector companies. If we do not allow protection of IPR, are we going to actually inhibit that process of investment? So I think I am a little hesitant to simply back the pure public good argument without IPR protection.

**Dr van Aalst:** Yes, I would support that. If these are good options, then we want the private sector to play a role in rolling them out, and then we might be excluding—but again, I think for many of these questions, we are so far from large scale deployment that it is difficult to even imagine what we need, but I would say that in principle, good regulation of the deployment, not regulation of the early stage of research, but regulation of the deployment, and having the private sector play a role, might be more effective, if we all agree that there are options in that whole range of potential techniques that we do want to use.

**Q44 Dr Iddon:** I just want to finish by looking at the developing countries, obviously some of the developing countries are already badly affected by climate change, more so than some of the developed countries. How do you think the international community should involve the developing countries in the geoengineering debate?

**Sir David King:** Brian has the difficult questions today! I think it is very clear that one of the positive things to come out of Copenhagen, and the transformation of the global community between Kyoto and Copenhagen, is the much fuller engagement of the emerging powers and of the poorer countries, and the recognition that we now have at least three categories of countries: the developed nations, the emerging powers and the poorer countries. If we talk about the emerging powers in your question, I would engage them as closely as the developed world, as part of the world that can afford the investment that we are now talking about into geoengineering research as a possible way forward. The poorer countries of the world, I do not believe that this is the issue that they will be raising, and I am advising several governments in this category. I think the focus there has to be on adaptation and low carbon economic growth. I do not think this is an issue that comes to them.

**Dr van Aalst:** I would slightly disagree here. Your first point about the emerging powers is clearly right, they need to be involved, and I think if you want a good international regulatory framework, they are going to be crucial. I think they are going to be the ones very cautious once this is brought to the UN, because they want to keep all their options open. So it is also a strategic consideration, if you do want to move towards some sort of international mechanism. The more vulnerable ones, I think, are the more difficult ones, I think they will feel threatened by the possibility that the winners will protect their wins, and the losers, which clearly are mostly them, will not get anything. So politically, they are already very worried. I think there is a second dimension to it, which is the distributional effects within countries, and we have seen that in adaptation, which is, of course, much more local than some of the large scale solutions that we are talking about here, but these large scale solutions, let us not kid ourselves, we are talking globally average watts per square metre, but these options, particularly on the solar radiation management side, will have specific local impacts as well, and similarly to adaptation, we will need to manage those as well. On the adaptation side, we have seen so many examples, I just heard one last week of a little village in Senegal which was facing increasing flooding, so you think, go and do something about it; well the city further downstream was also facing increased flooding, so they made a little canal to spill some of that floodwater towards the Atlantic, and the little village got hurt. This is the sort of adaptation intervention, of which we know so

many have side effects, particularly on the most vulnerable populations, which are not paying for the solutions so they do not get to have a say. I am really afraid we will get similar parallels on the geoengineering side, and I would really like the international debate that will be fostered, and that we had a little discussion about at the end of the last panel as well, to really include attention for that human dimension, and to try and involve that side of the debate early on. They do not come to the table naturally, and certainly not based on a call for comments by the Research Council in the UK or anywhere else in the developed world.

**Q45 Dr Iddon:** With respect to the international discussion, where should that be carried on? Should it be in the United Nations, and if so, is it being carried on there, to your knowledge, or should it be going on in the scientific/engineering communities, or both?

**Sir David King:** I would have said, in terms of the scientific community, the intergovernmental panel on climate change ought to be addressing this issue. It is obviously something that has to become part of their four yearly report in my view, and that would be the proper focus for the international scientific community. In terms of the international community, again I would turn to the United Nations bodies, UNEP, it is a pity we have not got the UNEP person here, is an obvious body, but I think this is an issue that, in terms of regulation, would need to be addressed at a G20 heads of states meeting to have a real impact. I do think in terms of the solar radiation management, it is of sufficient importance that it ought to be raised at that level.

**Q46 Dr Iddon:** Dr van Aalst, do you have a view on this?

**Dr van Aalst:** Let me just be frank, and say that I hesitate, in the sense that I worry that if we elevate it to too high a political level too early, we may be sending the wrong signals, so that would be my concern, putting it that high on the agenda right away. I do think that there are more technically oriented United Nations bodies that would be more appropriate, certainly the IPCC, and I would hope that along with possibly some conscious efforts at consultation, which should primarily be looking at risks, and at whether this is an appropriate thing, and might actually be then guiding us towards more investments on the mitigation and adaptation sides. I would hope that those discussions in those UN bodies would then trigger a much wider debate, involving a larger range of stakeholders, and a more diverse set of stakeholders than have been taking part in this discussion so far.

**Q47 Mr Boswell:** It is coming across to me, gentlemen, that it seems that witnesses are looking at this as being a contingency if defossilisation does not do the job, and I suppose it is the nature of a contingency that it needs to be ready to go fairly quickly if that situation arises, although we are not committing ourselves to that yet. I am really asking a little bit more, if I may, about research into the impacts, and the importance of doing that now, and also, and this has been touched on in evidence, in particular research into the differential impacts, either by nation states, and that may be a contingent matter, or regionally, or within quite small areas or different categories of people. I can think of hill farming, for example, if one was looking at that. I just wonder if Sir David and Dr van Aalst could say something about the importance of that research, as it were, digging down into this, in terms of physical impacts, also possibly economic impacts, which I suspect spills back into public acceptability, and the final point would be, to bring all this together, what about having some prior understanding about whether or not there needed to be some compensation mechanism, so that if we did have to use these weapons at short notice, if I may call them that, would we have got the machinery in place, and we would not be bogged down in yet another round of international argument about who should compensate who, or what could be done to mitigate it in individual cases. Is that clear? So with the backdrop of possible need to deploy at short notice, and a need to keep the political debate going, it is really looking at what research do we need to do, and in particular, how do we need to handle the findings of that research in relation to smaller impacts on individual groups?

**Dr van Aalst:** I think these are the critical questions, and also the questions where we have to be quite honest, particularly for the solar radiation management techniques, we are now in a stage of such high uncertainty that we are not really yet doing risk management, it is dealing with vast uncertainties.

**Q48 Mr Boswell:** So we need to get on with that in some sense.

**Dr van Aalst:** Yes, getting on with that in some sense to get a slightly clearer picture on what we are actually looking at is important, so I also think we are not yet at a stage where we can do proper economic impact assessments, I think the uncertainties are probably too large for most of these techniques, although you can do some back of the envelope calculations possibly. I would caution against purely economic impact assessments, in the sense that they tend to lose out on the perspective of the most vulnerable groups, which do not count much on the economic analysis side sometimes, so that is something to consider. On the compensation side, again, my previous comment hints at the fact that I think we are very early in the game to be talking about that even, but if we were, the attribution question is going to be as difficult or probably more difficult as it is for mitigation, or for carbon dioxide emissions. So I think that is a critical one, that we need to consider in how we treat this as a risk management option in the end. If we would ever deploy these options, we would be throwing it out on the world, and the attribution would make it difficult for anyone actually to take the blame, so there will be losers, but the losers will not be able to defend themselves in court possibly, to some extent, unless we go towards precautionary principles and so forth, but then from my perspective, at this stage in the game, we should be keeping them off the table mostly.

**Sir David King:** I think the issue in terms of the research into impacts, both in terms of the physical and economic

impacts, would need to take into account the impacts from rising temperature. In other words, we are talking about an issue that would come into play if we are in that piece of the distribution curve that we are hoping we are not going to move into. So this is going to be playing off a temperature rise of, let us say, 3.5 degrees centigrade against the impacts of whatever might happen if we, for example, put up sulphates into the stratosphere.

**Q49 Mr Boswell:** There are always choices, are there not, between two difficult scenarios?

**Sir David King:** Right. I think this is an enormously complicated series of questions. If we look at the impacts from temperature rise, whether it is purely temperature rise, whether it is the changes in weather patterns, rainfall patterns, and therefore food productivity, sea level rises, if you look at all those impacts against the possible impacts of an intervention of the kind we are now discussing, I think that this is an issue that we cannot really tackle in advance. We are now talking 40 years in advance of the situation arising. But we just need to remember that it is going to be a balance of impacts.

**Q50 Mr Boswell:** I am going to ask you a contingency question prompted by that, which is if we were into that position, or thinking ahead at least, to look at the scenario, what kind of mechanism would be the best one for looking at this? Because clearly, there are political feedback loops and inputs as well, and people will be trying to avoid a situation where they or their country or their region may lose out. I mean, how on earth do we keep the integrity of this process if we need it, and the management of it, because of its scale?

**Sir David King:** We are already seeing, Mr Boswell, the problems of trying to achieve equity in negotiations around dealing with CO<sub>2</sub> emissions, and the equity issues that would arise around what we are now discussing would be much more severe. That is why I think that the most important thing is to recognise the problems associated with going down this route, so that we amplify the need to go down the route of defossilising our economy.

**Chairman:** On that note, we will bring this session to an end. Could I thank you very much indeed, Dr van Aalst, for coming and joining us this morning; and thank you, Professor Sir David King, for joining us too.

---

[Previous](#)

[Contents](#)

[Next](#)

[Commons](#)

[Parliament](#)

[Lords](#)

[Search](#)

[Enquiries](#)

[Index](#)

---

© Parliamentary copyright 2010

Prepared 18 March 2010

- [A-Z index](#)
- [Glossary](#)
- [Contact us](#)
- [Freedom of Information](#)
- [Jobs](#)
- [Using this website](#)
- [Copyright](#)