



Energy and Climate Change Committee

Oral evidence: [IPCC 5th Assessment Review](#), HC 907

Tuesday 11 March 2014

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Members present: Mr Tim Yeo (Chair); Ian Lavery; Dr Phillip Lee; Mr Peter Lilley; John Robertson; Sir Robert Smith; Graham Stringer; Dr Alan Whitehead

Questions 194-290

Witnesses: **Professor David Mackay**, Chief Scientific Adviser, DECC; **Professor Sir Mark Walport**, Government Chief Scientific Adviser; **Rt Hon. Gregory Barker MP**, Minister of State for Climate Change, DECC; **David Warrilow**, Head of Climate Science and International Evidence, DECC, gave evidence.

Examination of Witnesses

Q194 Chair: Good morning and welcome. I think you know who we are and we certainly know who you are, so we will not have any pleasantries; we will just crack on, if that is agreeable to you. There is obviously a lot of interest in this subject. We have had some interesting evidence sessions so far. Could I start with a general question about how reliable you think the IPCC climate models are in the light of discussions about the Fifth Assessment Report?

Professor Mackay: Yes. There are many models. There are complex, general-circulation models; there are simpler energy-balance models. One of the things the IPCC did was to evaluate the models that are used, and this evaluation looked at their abilities to simulate mean climate, historical events in climate change, variability on multiple timescales and regional modes of variability. There is a mixed scorecard. There are some things that are modelled well but some things such as regional variability are not yet well captured by the models. They are improving in many of these areas. As the computers become more powerful and the models are able to represent the earth's system at higher resolution, the accuracy of many of these features in the system is improving.

Specific areas where the models are getting better are in the Pacific Ocean, which is very important because it is so large and is a driver of global variability. The IPCC report said that a pervasive bias that had existed in models previously, a spurious westward cold tongue near the equator, was reducing, so it is still not perfect. The ENSO, the El Niño southern oscillation variability, is well represented in the models but the Atlantic Ocean variability is not yet well captured. The tropical Atlantic has an east-west temperature gradient that many models do not reproduce, so there is a mixed scorecard. It is definitely the case that no model is perfect, no model is right. All models are wrong but some are useful and these models are getting steadily more useful.

It is interesting to note that the models that were being used for the Fourth Assessment Report some years ago, as I said, were not perfect models and in several areas they under-predicted the rate of climate change. Most of those models under-predicted the rate of loss of Arctic sea ice, and the outcome on global sea-level rise was at the upper end of the predictions coming out of the models. It is acknowledged by the climate community that in many ways their models are not perfect and in some cases those imperfections are leading to an under-prediction of climate change.

Q195 Chair: In the technical report, on the near-term temperature predictions up to 2025, there were two projections. One was a temperature rise in the range of 0.48°C to 1.15°C. The other one was 0.3°C to 0.7°C. In the summary for policymakers, the latter and lower one was the only one referred to. Do you know why that was?

Professor Sir Mark Walport: I cannot tell you the specific reason for that but I can comment on the differences between them. In essence, if you are forecasting in the short term, you need to do that on the basis of the starting parameters and the models that David has just been talking around. I have the relevant figure here in chapter 11. It is based on 42 models. They are running, essentially, from the start of the industrial revolution when we started putting greenhouse gases out. If you want to look over the next 10 to 20 years, then you need to make an adjustment for the starting conditions and that is what they have done in their shorter-term forecast. In a sense, it would be like trying to forecast the weather for tomorrow using a climate model, and that would not make any sense at all. The basis for this is judgments based on the starting conditions, where we start at the lower end but within the range of the predictions of the models.

Professor Mackay: When the summary mentioned this forecast of the possible temperature rise over the next 30 years, this near-term forecast was given with a statement that it relied on multiple lines of evidence, including these long-term-model runs running from a century ago into the future, but using several other lines of evidence as well. That was mentioned and it documented where in the main report you can find the reasoning. The reasoning of the IPCC authors is laid out on page 1010 and they give seven points to bear in mind when coming up with their expert judgment. They label it an expert judgment and they say it is a projection that has only medium confidence, so it is an area where the science is still developing. It is very difficult to take this complex, chaotic system and try to initialise and make a forecast on a decadal scale.

Q196 Chair: Does that reflect the general difficulty of trying to make a relatively short—a decade is a pretty short period in the planet’s history—forecast for a single decade?

Professor Sir Mark Walport: Precisely.

Professor Mackay: The decade is the timescale on which there really are significant internal variabilities in the climate system and those natural variations are chaotic and therefore hard to predict.

Professor Sir Mark Walport: They qualify it in the figure by saying, “Assuming no future large volcanic eruptions”. There are events that can happen that can change what happens.

Q197 Chair: Given the natural variations, do you share the 95% confidence of the IPCC that human activity is a large cause of recently observed climate change?

Professor Sir Mark Walport: Yes.

Professor Mackay: Yes.

Q198 Chair: I am not altogether surprised. Unequivocal support for that. The factors that may be outside the general trend—the growth in Antarctic sea ice and the so-called hiatus itself—do you think those cast any significant doubt on the severity of manmade climate change?

Professor Sir Mark Walport: No. Just to comment specifically on the hiatus, there is a figure on page 264 of chapter 3. The hiatus is in the change in the atmospheric temperatures. There is absolutely no hiatus in the totality of the global energy inventory, which is going up relentlessly. Although holding up these things in committee is difficult, it is pretty obvious there is a line going up there. Well over 90% of the heat uptake is in the oceans, and that is continuing. There are multiple lines of evidence for that, including the fact that sea levels are rising by 3 millimetres per year. I do not think that that shakes the confidence at all.

Professor Mackay: I agree. Global warming has not stopped. The heat content is increasing and, moreover, these slowdowns in surface temperature warming that have been seen in the last 15 years have happened in the past. No one predicted, when they said climate change was coming, that the surface temperature would steadily, monotonically increase. It has wobbled in the past and it will wobble in the future and there are mechanical explanations for those sorts of variability, including external sources such as the sun, which had a maximum about 1998 and then had a minimum a couple of years ago. And volcanoes: the level of volcanic activity has been fairly low for the last 20 years but there has been a change in the amount of aerosols from volcanoes, which is another driver of a slight cooling effect. Finally, there is internal variability on a timescale of decades, which is largely believed to be coming from the Pacific, from the El Niño southern oscillation. When you account for those three sources of natural variation, the slowdown is essentially eliminated. It is accounted for by those sources of natural variation.

Q199 Dr Whitehead: Could I turn us to not just models but the question of the application of models for policy making and how those models might be used as far as policy making is concerned? What are your views on the link between the two?

Professor Sir Mark Walport: The policy questions follow from the predicted changes to the climate and the consequences of those. I don't think it is the models alone. There is all the observational evidence that the temperature has increased by 0.85°C since 1900. What the models tell you is the broad direction of travel. As we have already indicated, they are not accurate to within a year or two, they are showing a very strong trend. The question for policymakers is what can be done, given that we have a choice to mitigate, to adapt or to suffer. That is a choice for all of us. All the evidence in this 2000-page report shows that the direction of travel is an extremely clear one. There are of course doubts about what the change will be in 2060 compared with 2070 or 2050, but the direction of travel is absolutely clear. It is also clear that we are putting 10 gigatonnes of carbon or over 30 gigatonnes of carbon dioxide into the atmosphere each year, and once it is up there much of it is going to be there for hundreds or thousands of years. The decision for policymakers is what they do about something happening in the medium-term future. The models on their own are just one part of the evidence.

Q200 Dr Whitehead: In what other policy areas do the Government rely heavily, or perhaps this heavily, on the projections of models?

Professor Sir Mark Walport: There is a string of models. Models range from predicting the spread of pandemic flu, infectious disease in general, population growth, investment decisions, public services, economics, contracting for rail services. Models are used all the time; they are all different models. One of the very best models is David Mackay's 2050 calculator, which was commended in the review by Nick Macpherson of the use of models on the basis of its transparency. Models are used all the time. You can't really conflate them all; they are very different. They depend on the input parameters. Some are extremely reliable because you know everything about the inputs. Others are less reliable. It just depends how much you know about the system you are modelling.

Q201 Dr Whitehead: Are there parallel examples of similar kinds of controversies that have arisen concerning other models and their use in other policy areas, as there clearly are with the use of models in this particular area?

Professor Sir Mark Walport: I suppose from my own area there is infectious disease modelling, which is also a very difficult thing to do and from time to time generates controversy. What we are trying to do with all these is to understand extremely complicated, chaotic systems. My world is biology, and if one tried to model the biology of a cell, one would come up with something very, very complicated indeed, so I don't think there is a single right answer to that.

Q202 Dr Whitehead: As far as models are concerned, some people have suggested that one might wait and see if the climate models are what you might call verified over the next decade or so before taking policy actions based on their particular outputs.

Professor Sir Mark Walport: They have done pretty well over the last 100 years. Do you want another 100 years before you take action?

Professor Mackay: The point is, I think, the irreversibility. The question is when do you take out your fire insurance. If you take out your fire insurance by the time the first storey of your house is in flames, then you are a bit late. That is the challenge for policymakers.

Q203 Dr Whitehead: Would you say that as far as models are concerned—there is a question, as you say, of when you take out fire insurance—that it is difficult to produce a point at which you can say, “This is something where we can wait for verification, this is something where we can’t wait for verification or we can’t wait to see whether the model gets a little bit better.” Is that just how models work or is that a particular function of particular kinds of models.

Professor Sir Mark Walport: It simply is not just models. There are an awful lot of observations here as well. The models are part of the story and the models look into the future, but they also use the past to see whether they have modelled accurately. One of the interesting things about the fifth report is how little changed it is from the fourth report and the third report. What is happening is that the uncertainty is gradually reducing. The very short report on the physical science base is absolutely clear: warming of the climate system is unequivocal. Each of the last three decades has been successively warmer. The rate of sea-level rise has been larger. Human influence on the climate system is clear. That is the conclusion of the report. I think that is enough for policymakers to start making decisions.

Professor Mackay: The question you are asking is a very general question about how to make decisions under uncertainty, and I think the right approach is risk management. You take into account all lines of evidence that are available; you have a probability distribution of possible futures; you take into account possible actions you can take and what probability distributions might apply. That is what decision makers should do, and models will be one of the sources of evidence to guide that decision making. It is utterly inappropriate to make a decision to say, “I will not take any decision until I have perfectly hard evidence.” Obviously people should take into account risks. The advice from the Committee on Climate Change was that the risk of a warming of 4°C was a risk that should be very firmly avoided. That is one of the strong guides of Government policy.

Q204 Dr Whitehead: Do you think, in terms of the relationship between what one might think of as a reasonable imperative of reasonably short-term policy-making accuracy and the longer-term nature of a lot of modelling, that there is some misunderstanding in Government and elsewhere about how exactly models can best be related to those policy-making imperatives?

Professor Sir Mark Walport: There may be misunderstanding in some areas but I do not think there is a misunderstanding by Government as a whole.

Professor Mackay: What the climate science is saying is that there is a sensitivity to greenhouse gas emissions and I think this is now accepted by everyone, even the Global Warming Policy Foundation in their latest report. They said in their report, published on Thursday, that they think it is trivial that most of the warming that we have seen has been caused by humans, so they are now accepting that point. There is a sensitivity. The

identified uncertainty that remains is exactly how big that sensitivity is. There is a range of sensitivities in the IPCC work, but the key message is whatever that sensitivity is, climate change depends on cumulative carbon emissions. That means that if you want to limit climate change, if you want to limit global warming, then cumulative emissions will have to be capped, which means that net emission rates must reduce to zero. That is, I think, an accepted policy fact by everyone. No one is saying that the sensitivity to emissions is zero. It is positive. There is a range with considerable uncertainty, but the consequence of the fact that the climate is sensitive to emissions is that emission rates—if we want to limit climate change; if we want to avoid 4°C, for example, which is an ethical judgment involving this generation acting in the interests of future generations; if we accept that ethical judgment—must be reduced to zero. That is a very clear policy message that is completely independent of the uncertainty about the climate sensitivity.

Q205 Mr Lilley: Can we go back to the Chairman's first question? I understand that uninitialised model forecasts give the underlying trend with a lot of the short-term variations in doubt. You are saying that if they had been initialised—there was not time to do so—the models might have forecast a hiatus?

Professor Sir Mark Walport: The short answer is if you look at the recent paper from the Met Office, which has initialised it to now and done a series of model projections over the next five to 10 years, then you will find that in the range of the model outcomes there is everything from continuing hiatus to a very considerable increase.

Q206 Mr Lilley: That is not very helpful, is it?

Professor Sir Mark Walport: The answer is that if you model, and that is the point; in complex systems like this there will be periods of pause and there will be periods when it goes up, and the long-term trend is absolutely clear. The Met Office have done that and they have published it recently.

Professor Mackay: Many of the model runs do show slowdowns that last as long as the latest slowdown. They happen at random times, and it would have been an amazing coincidence if any of those simulations had happened to precisely nail—

Q207 Mr Lilley: Long answers use up a lot of time. What I am trying to get to is what the difference between the model forecast and the expert forecast is. What factors have the experts taken into account that the models did not because they were not initialised? You are effectively saying the experts initialised themselves. With what?

Professor Mackay: They identified seven points, and I can't produce all seven of them; it would take too long. One of their seven points was to look at the short-term trends that exist in the model simulations and to look at the characteristic slopes that those have—in the entire ensemble what is the maximum rate of warming that you see on a short timescale and what is the minimum—and then use that range, initialised with the state that the world is in right now to then forecast where it could get to in the next couple of

decades. That was one of the seven lines of reasoning that led to a range of, I think, 0.3°C to 0.7°C.

Mr Lilley: It was 40% lower than the trend of the models uninitialised.

Professor Mackay: That is right.

Q208 John Robertson: You have not identified what it is that has made it lower rather than higher. You can say there is a range, but why does it go for low rather than high?

Professor Sir Mark Walport: In a sense you can see it fairly clearly on this figure.

Mr Lilley: I can't from here. What page is that?

Professor Sir Mark Walport: That is on page 1011.

Mr Lilley: I don't have that.

Professor Mackay: You are right that eventually, if the prediction is that the system is going to get back on track, there will have to be a time of a speed-up. I think it is an area of uncertainty and an area of active research to try to predict what will happen when finally the speedup will occur that will get the systems back on track for the long-term trend. One of the sources of uncertainty about this is the uncertainty about aerosols. The biggest uncertainty about how big the forcing of climate change is at the moment is to do with aerosols. A possibly partial explanation of the slowdown is that aerosols are at the high level of the range, and then the prediction of when the foot gets back on the accelerator depends on when that concentration of aerosols changes. That will be the determinant of when that factor allows the surface temperature to get back on track.

Professor Sir Mark Walport: It is worth again referring to the picture on page 264 on the change in the global energy inventory. This is the cumulative and you should be able to see from here that in this so-called pause there is no change in the energy input into the planet as a whole. It is continuing to increase. The important point is that the oceans are an enormous part of the heat sink, and therefore fluctuations in overturning circulations and things like that can have quite a dramatic effect on the atmospheric component of the heating, which is a relatively small fraction.

Professor Mackay: It is the case that some climate scientists, many of them, do think that what has been happening is a temporary natural slowdown and that it will be followed—once we get a big El Niño, as long as there is not a big volcanic eruption—they predict, by significant warming and new temperature records will be set. That is mentioned among the seven reasons in chapter 11 for their expert judgment.

Mr Lilley: I have chapter 11 with me.

Professor Mackay: They mention as a consideration also that it is credible that there will at some point be a speeding up to compensate for the slowing down that has probably been caused to a large degree because of upwelling of cold water from the Pacific and subduction of warm water.

Q209 Mr Lilley: Obviously the main evidence of continuing rise in heat in the oceans—because the figures are terribly unreliable in the short term; we have only had the Argos satellites for a short while—is the fact that the sea level is rising. Over the last 18,000 years, since the end of the last ice age, it has risen 120 metres. That is an average of 6 millimetres a year. It is now forecast to average 3 millimetres a year. What was heating it at least during the last 15,000 of the last 18,000 years?

Professor Mackay: I think the correct way to describe what has happened to sea levels is that as we came out of the last ice age there was a steep rise in sea level.

Mr Lilley: For 15,000 years.

Professor Mackay: Then over the last 4,000 years or so there was a much slower trend in rise of sea level and then over the last 100 years, especially over the last 50 years, it has picked up again. You are right that the rate of change of sea level as we came out of the ice age was, perhaps unsurprisingly, a very fast change but—

Mr Lilley: But what was heating it? It was not CO₂.

Professor Mackay: The coming and going of ice ages is something that has been better understood in the last five years. There is a natural rhythm to the ice in the northern hemisphere. If you want a metaphor for what is going on, the natural coming and going of the ice, it is like a very large piece of ice on a very large spring with a damper attached to it. Initially the ice is high up so it is in a cold location. When precipitation falls it increases the amount of ice. That then weighs down the spring gradually and you get more and more ice and then the damper in the spring gives in and the ice comes down low to a place that is at a low temperature and it is in contact with the oceans, which melt away the ice. The ice is at a warm location and it all melts away, but because of the sluggishness of the damper in spring, which is the rocks of the earth, all the ice goes away and then the spring relaxes with no ice and then the cycle repeats.

That is the natural source of the coming and going of the ice ages, and this has been much better understood by climate scientists in the last five years. It is one of the significant pieces of progress in the understanding of the long-term climate change story. The emergence from the last ice age was to do with that mechanism. The precise timing of when ice ages come and go is driven by the sun because the sun is one of the drivers of climate change. That determines exactly when this sluggish ice cube tips from one of its states to the other.

Q210 Mr Lilley: It still seems odd to me that for 15,000 or 14,000 years the sea level can be rising twice as fast as we now expect it to rise in the future, without the aid of CO₂. The mechanism you suggest, that as it gets lower it gets warmer, suggests it would accelerate, whereas it decelerated.

Professor Sir Mark Walport: But we know that there are other parameters that affect global climate systems. Orbital parameters, say the Milankovitch cycles, are another one. There are, of course, cycles that affect it that are not dependent on CO₂, but here we are talking about an additional event, which is anthropogenic, which is having very serious effects.

Q211 Mr Lilley: Could I ask finally about aerosols? You said they are a great source of uncertainty and have been the past, but the IPCC report says there are now better estimates from satellites and so on of the impact of aerosols. There was not time to run these better estimates of aerosols through the models. Could you explain to the Committee what you think will be the outcome when those new and rather lower figures of aerosol forcings are run through the models?

Professor Mackay: The uncertainty about the aerosols in the latest IPCC document was that, in terms of the forcing they are producing globally, they are delivering something between minus 2 and minus 0.1 watts per square metre, whereas the greenhouse gases are delivering between 2.5 and 4 watts per square metre. That substantial uncertainty on the aerosols is a big driver of the overall uncertainty of what is happening. The effect of becoming more certain about what is going on with aerosols will eventually be to pin down more precisely the climate sensitivity. Then we will know more precisely the slope of this graph that relates overall climate change to cumulative emissions. There is a paper that just came out on Sunday in *Nature Climate Change*, which maybe sheds a little bit more light on all these issues. It is a paper by Drew Shindell from NASA, who is one of the co-authors of the Otto et al. paper that was heavily referred to by the Global Warming Policy Foundation's paper on Thursday.

Mr Lilley: I have seen it. I have also seen Nic Lewis' response to it Have you seen that?

Professor Mackay: I read the paper in *Nature* last night, getting on for midnight.

Mr Lilley: But you have not seen Nic Lewis' response to it.

Professor Mackay: I have not seen Nic Lewis' response.

Mr Lilley: I have, so I am rather ahead of it. I advise you to read it before you comment on Shindell.

Chair: Let the witness answer the question.

Professor Mackay: This paper by Drew Shindell—the title of the paper is *Inhomogeneous Forcing and Transient Climate Sensitivity*—points out that the spatial distribution of aerosols and ozone in his own work with Nic Lewis and Otto and others was implicitly assumed to be homogeneous because it was using a simple energy-balance model. He has now investigated the special distribution of aerosols and ozone, which is not uniform; not homogeneous. His work indicates that this may lead to a revision of the assessment of those previous pieces of work about the transient climate response. In particular his paper says that if he has got it right, the implication is that the transient climate response is very unlikely to be less than 1.3 °C, which was the central estimate in the Otto et al. paper.

Q212 Mr Lilley: Perhaps when you have read Nic Lewis' response to it you would like to give us further thoughts.

Professor Mackay: I look forward to reading what he has said. I have been enjoying corresponding with Nic Lewis over the last couple of days.

Q213 Graham Stringer: I have a lot of different questions now from what I had before you started speaking. Neither of you are climatologists. How much time do you spend on this? Your answers are detailed and comprehensive. How much time do you spend in your working life on this?

Professor Sir Mark Walport: I would make two comments. Firstly, you are absolutely right, I went to medical school and they did not teach me this stuff there. Secondly, I would make the point that I come with no axe to grind on this. Indeed, it is worth saying that most of the people working on this do not have axes to grind. The answer is I have spent a considerable amount of time. I have not quantified it in hours but I went through an extremely steep learning curve at the start of my time a year ago as Government Chief Scientific Adviser. I read an enormous amount. I have had the privilege of tutorials from many of the best scientists in the world. Yes, I have spent a lot of time.

Professor Mackay: DECC has a wide portfolio of activities, and climate science is a very important one of them. I would estimate about one-tenth of my time is devoted to trying to keep up with the climate science and getting briefings from people who are fulltime climate scientists.

Q214 Graham Stringer: That is very impressive. Just going back to a point behind Mr Lilley's questions, trying to find out what is happening, the best measure is the amount of energy coming into the planet and the amount of energy going out, isn't it? That is what we are trying to find.

Professor Sir Mark Walport: The balance.

Graham Stringer: Yes, the energy balance. It is very difficult to measure from satellites, isn't it? How accurate are those measurements? How close are we to getting that energy-balance figure?

Professor Mackay: Going back to the numbers I mentioned earlier, the total forcing, taking into account the aerosols and the greenhouse gases, has been estimated to be in the range of 1 watt per square metre to 3.4 watts per square metre. That is the likely range, so there is a factor of three uncertainty, taking into account all the—

Q215 Graham Stringer: Are those direct measurements? That is what I am trying to get at, what we can directly measure as opposed to getting it by models.

Professor Mackay: This is the assessment based on all lines of evidence, including the satellites, so it will have taken into account other lines of evidence too. It is a very large range of uncertainty, more than a factor of three, in what the forcing is. You are right that it would be wonderful to have better data but getting really good data is expensive.

Q216 Graham Stringer: Just going back to one of your answers about an insurance policy, the thing about insurance policies is that they should not cost more than the cost of the house that is being burnt down, should they? What conclusions do you come to about the cost of the insurance that we are making now?

Professor Sir Mark Walport: The consequences of not taking out the insurance policy are extremely serious. You are right that we have the good fortune that fires to our houses are sufficiently uncommon that the insurance is affordable. The challenge here is that this is a challenge for the whole of the planet and the consequences are very severe indeed and so the costs of this insurance policy are high. That is why I am glad I am a scientific adviser rather than a politician having to make these very difficult decisions. The reality is that we have to do all sorts of things. Part of that is developing the technologies that will enable alternative sources of energy to become cheaper, but the fact of the matter is that at more than 30 gigatonnes of carbon dioxide a year, we cannot afford to wait for the perfect technology. We have to start paying the insurance policy now. As I say, that is one for you rather than for me.

Professor Mackay: Something else to emphasise is that the costs that we are talking about, the possible costs, are costs borne by many, many, many future generations, so there is a judgment that decision makers and policymakers must make about the ethical trade-off between costs to us today and costs to the planet and future generations over very long periods of time.

Professor Sir Mark Walport: I talk about this publicly and the metaphor I use is what price a grandchild. If not what price a grandchild, then what price a grandchild's grandchild?

Q217 Graham Stringer: Do you accept Matt Ridley's point that first there are benefits and secondly the benefits outweigh the disbenefits over the next 40 or 50 years?

Professor Sir Mark Walport: I understand the point he is making but I think he is completely wrong, unfortunately. While there may be trivial benefits in some parts of the world for some of the time, the long-term direction for all of us is a negative direction. He described himself as a rational optimist. I am not sure about the "rational" bit.

Professor Mackay: If we do our decision making rationally, if we make good policies for climate change action, then there could also be many significant co-benefits from climate change action. Air pollution from coal power stations causes many thousands of deaths per year, and vehicles in London cause air pollution at the moment that is above acceptable European levels. So there are health co-benefits that should also be taken into account when we are trying to make the best policies for climate change action.

Professor Sir Mark Walport: We have been talking very much about temperature warming, but there is the question that the amount of hydrogen ions in the oceans has increased in the surface by 26%. The acidification of the oceans is already becoming a major problem. The costs of this one are very dramatic indeed.

Q218 Graham Stringer: The IPCC's projections of near and long-term climate change: what do you think the greatest risks are for the United Kingdom in the short, medium and long term? Most climatologists have been very careful to not associate the recent storms directly with climate change, but what do you think the greatest threats in the short, medium and long term are?

Professor Mackay: One of the Government's duties under the Climate Act is to make a climate change risk assessment from time to time, and we did publish the climate change risk assessment a couple of years ago. You can see the projections of the risks of climate change laid out there decade by decade and with a ranking in terms of severity of risk. Right at the top of the list of those risks was flooding, flooding, flooding. Flooding of rivers, flooding from the sea. The runner-up after flooding, which was at the very firm top of the list—the risk of flooding coming earliest in early decades in the 2020s already, the climate change risk assessment was forecasting significantly increased risk of flooding. The runner-up after that was risks associated with severe weather, storms. In terms of the risks, what has happened was predicted. The climate change risk assessment, which was led by DEFRA, predicted flooding and storms as the top risks for the UK.

Q219 Graham Stringer: As you as scientists get clearer or firmer in your views, or there is less uncertainty in your views—that is probably a better way of putting it—are you concerned that the political consensus is not following that trend? It appears to be coming apart.

Professor Sir Mark Walport: I am not sure whether the evidence supports that assertion. I had the opportunity to present the IPCC report to the Cabinet. I am confident that the Government accept the science of climate change. I clearly cannot comment on individual politicians, because everyone has their own opinions. I think the political consensus is strong. A lot of this has to be seen through the lens of energy because the changes that need to be made to mitigate climate change are largely in the space of energy, where there are three lenses that policymakers need to look through in order to determine energy policy. One is security of supply, because we can't have the lights go out. The second is what we have been talking about, which is the sustainability of the planet. The third issue the policymakers have to consider is cost and affordability. It is for you politicians, and the Government in particular, to balance those competing demands. I do not see any evidence that there is any breakdown in the Government view on the science of climate change.

Q220 Graham Stringer: Do you ever attempt, as your predecessor did, to put climate change in a pecking order of risks to the United Kingdom and the planet? Your predecessor did it against terrorism. Clearly there is a huge risk of antimicrobial resistance and there are other risks out there too. Do you ever attempt to put these risks into an order?

Professor Sir Mark Walport: I worry a great deal of my time about the national risk assessment. I spend a lot of my time worrying about that, but I think trying to construct a strict hierarchy is not a particularly useful exercise. This one is clearly an enormous risk in the medium and long term. As we have already discussed, if we are to prevent that then actions need to be taken now.

Professor Mackay: Climate change is also a risk to our supply chain. The effect of climate change on other countries, the effect of droughts and floods elsewhere in the world is important to the UK economy too.

Professor Sir Mark Walport: Destabilisation in those parts of the world that are likely to be most affected earliest is going to lead to conflict over water, potentially. Water is hugely important and in short supply in many parts of the world. It is likely to lead to migration pressures. We may be an island but we are not isolated from the effects on the rest of the planet.

Q221 Graham Stringer: My last question about when you are advising policymakers: one of my concerns about our policy as opposed to the interpretation of the science is that Europe and the United Kingdom's carbon footprint is increasing as our emissions decrease. How do you advise policymakers on that? It appears our policies are being counterproductive.

Professor Mackay: You are absolutely right that our overall carbon footprint for most of the last 15 years has trended up. There has been a slight drop in the last couple of years, but, yes, because of our imports from other countries of what we call embedded emissions, in that way of accounting things our net emissions have gone up. I do not think it is right to blame our policies for causing that outcome. It is an effect that we do need to bear in mind as we develop our policies. In particular, energy intensive industries get a lot of careful consideration in DECC and in BIS and as long as other countries are not taking equivalent action to ours, we make policies that ensure that there is compensation for energy intensive industries so as to try to eliminate the off-shoring pressure that there would otherwise be.

Q222 Sir Robert Smith: I remind the Committee of entries in the Register of Members' Interests, in particular to do with the oil and gas industry and a shareholding in Shell. Is there anything from the IPCC's report that impacts on the fourth carbon budget?

Professor Mackay: The Committee on Climate Change is the Government's adviser on the carbon budgets and targets and its advice is that there should be no change in the carbon budgets in light of the IPCC's work. The IPCC's range of climate sensitivities has been fairly stable. There has been a significant uncertainty over the years through all five assessment reports and there has just been a slight nudging of one of the bounds of that range from the third report to the fourth and then back again from the fourth to the Fifth Assessment Report.

Q223 Sir Robert Smith: The hiatus does not buy time?

Professor Mackay: No. The slowdown involving the prediction from the IPCC is that in the absence of a major volcanic eruption there will be record temperatures as soon as the natural variations that have happened recently involving the Pacific Ocean swing the other way. Essentially the prediction is that next time there are some big El Niños, the subsequent year is likely to be another record breaker.

Professor Sir Mark Walport: The hiatus is only in one tiny component of the energy inventory.

Q224 Sir Robert Smith: The other advice that people are giving is that action now inefficiently might be better offset by making a longer-term plan for a more effective action in the future.

Professor Sir Mark Walport: We need to do both. These are not alternatives.

Professor Mackay: The Government's carbon plan identifies actions that we think are rational to take in this decade and the next decade. It also identifies the importance of innovation support to drive down the costs of technologies that we will want to mass-deploy by the 2030s, 2040s and 2050s. I think we are in agreement that it is extremely important to invest for innovation, for research and development, to support entrepreneurs who can help us deliver the breakthroughs so that low-carbon technologies will be cost competitive with fossil fuels.

Q225 Sir Robert Smith: In light of the other questions, the most crucial thing seems to be convincing the rest of the world to take action at the same time, because action by ourselves alone is not going to mitigate the—

Professor Sir Mark Walport: We are all in this together, but if you look at the actions that other countries are taking, countries such as China are spending an enormous amount on this. They start in a different position. If you look at our carbon emissions per head, we are still emitting much more than the major population centres of the world now, India and China.

Mr Lilley: It is slightly more than China.

Professor Mackay: Okay, but more.

Mr Lilley: It is slightly more rather than much more. The CCC pointed out it was only slightly more.

Professor Sir Mark Walport: But we are in this together.

Q226 Sir Robert Smith: Finally, does the fourth carbon budget draw upon any other sources of climate information apart from the IPCC?

Professor Mackay: I imagine that we are using the IPCC as our principal source of climate evidence, but the IPCC makes its pronouncements only every five years or so, so we certainly have other routes to obtain up-to-date information about climate science to guide Government policy making. We do talk directly to climate scientists; we fund their research; we ask them to give us the latest information in policy-relevant form. It is not the case that the IPCC is the only source of information on the climate.

Professor Sir Mark Walport: It is worth saying in this context that we have one of the world's leading institutes. The Hadley Centre is absolutely world class and the UK is very fortunate in that.

Q227 Sir Robert Smith: The science from your perspective says there should be no change in the fourth carbon budget?

Professor Mackay: That was the Committee on Climate Change's advice. The advice on setting of carbon budgets had to take into account many considerations: economics; political relationships with other countries and so forth; not just the science.

Q228 Chair: Sir Mark, you referred to the occasion when you presented the conclusions of the IPCC to the Cabinet. What sense do you have of your counterparts in other countries doing the same thing to their Governments? Were they given the same advice as you were for the most part?

Professor Sir Mark Walport: Sadly, there are not that many counterparts of a Government chief scientist in many other countries, but certainly in the United States John Holdren was doing the same in relation to the US Administration. Around the world there are many scientists who advise Government and I do not have any doubt that similar things are going on, but I cannot tell you that for sure.

Q229 Ian Lavery: What are your views on the IPCC process over all?

Professor Sir Mark Walport: I can speak from my own professional background, which is that it was really in the field of medical science that this type of meta-analysis was invented. The UK had a leading role in the Cochrane reviews, and this is an extraordinarily robust process, because it seeks out all the evidence, including some of the grey evidence, and reviews it. One knows in science that for something as complex as this you can rarely draw conclusions from any single paper.

The process in medicine is the same: if you are evaluating a drug or a surgical operation or a treatment, the most robust way of doing that is to collect all the evidence systematically, to review it in a systematic fashion and to come out with what is called a meta-analysis. That is what the IPCC process is. I think it is the most extraordinarily robust meta-analysis probably that has ever been done. This has been done on a scale far outside anything that has been either necessary or appropriate for individual medical treatments, but the principles are exactly the same. It is very robust. It is an expert review of literally thousands of papers, each of which has been peer reviewed multiply. I think it is the best process one could have.

Q230 Ian Lavery: It has been said that there is an argument saying that it is burdensome on the scientific communities.

Professor Sir Mark Walport: It is undoubtedly burdensome.

Ian Lavery: How could this burden be relieved?

Professor Sir Mark Walport: It may be burdensome but it is important, because working out what the consensus is from all the literature—I think the scientists are doing not only us a service by doing this review, they are doing their own community a service. I think that would be the way it would be viewed in medicine as well. The Cochrane reviews are a

large effort to do but they are of enormous value to both the specialists and the general community. The strength of this is that it has every variant of communication, from the 2000-page version through to the technical summary for experts through to summary for policymakers through to the two-page summary. It is an extremely good piece of communication.

Q231 Ian Lavery: Do you think shorter, more detailed reports would be more effective than these larger reports?

Professor Sir Mark Walport: Some of that happens anyway. As David outlined, there are new papers coming up all the time, there are new review articles that happen all the time.

Ian Lavery: It is about right then, you think?

Professor Sir Mark Walport: I think so, yes.

Professor MacKay: I think Governments are reviewing the IPCC's processes in consultation with the IPCC and some of the options that are on the table are to introduce a perhaps more nimble annual update on topics of greatest interest. These things are being reviewed, especially looking at using the internet, which did not exist when the IPCC started, as a way of enabling more rapid communication.

Q232 Ian Lavery: Professor MacKay, you have been quoted as saying that there is no equivalent of the IPCC in any other area of science. Why is there no equivalent in other areas?

Professor MacKay: Perhaps it is because of the extreme importance of climate change for humanity that the decision was made to create this large, significant synthesis process, but perhaps medicine is the area where there is the closest analogue because medicines and whether they are effective or not for human health is of similar importance although in medicine topics about particular treatments can be picked off one by one, by a single synthesis approach, whereas climate science is such a complex topic that all the scientific considerations need to be pulled together simultaneously.

Professor Sir Mark Walport: There is a biodiversity review process that is now drawing on the lessons learnt from the IPCC. I think what made the IPCC very unusual is its global nature, whereas the medical meta-analysis I have been talking about has been done on a national basis. In some sense it is a question of whether it is appropriate to the scale of the problem and biodiversity does lend itself to similar treatment to climate.

Q233 Ian Lavery: Finally, with regard to the conclusions of the IPCC, what sort of weight do you think the Government puts on the conclusions in order to develop its climate change policies?

Professor Sir Mark Walport: Weight is a difficult thing for me to weigh. I think the answer is they take the science very seriously. You will have the opportunity to question the Minister shortly and that is probably a more appropriate question for him to answer.

Q234 Ian Lavery: Is that a politician's answer: you are sitting on the fence?

Professor Sir Mark Walport: No. I am saying that I cannot speak for Government.

Professor MacKay: DECC does have many objectives. Climate-change action is one of them and keeping costs to consumers low is another and meeting the European renewable target is another. DECC definitely weights all of these considerations when it is making policies.

Q235 Ian Lavery: Sir Mark, your view on the Government's—

Professor Sir Mark Walport: My view is that they take the science very seriously, that there are some very challenging policy decisions and that is why they have been elected and I am there to advise them.

Chair: Were there any other points that you wanted to bring to our attention? This is our last witness session before we try to write a report. No? In that case, thank you very much for coming in.

Examination of Witnesses

Witnesses: Rt Hon Gregory Barker MP, Minister of State for Climate Change, and David Warrilow, Head of Climate Science and International Evidence, DECC, gave evidence.

Q236 Chair: Good morning and welcome. As I am sure you know there is a lot of interest in this subject, not just from the Committee. Could I ask a general question to start with? How reliable do you think the IPCC climate models are?

Gregory Barker: I think they are the most reliable evidence we have, but for a more technical understanding perhaps I would ask my colleague from the Science Department at DECC to respond.

David Warrilow: The first thing I would say is the models are not IPCC models. They are models produced by the international community and IPCC merely assesses them. The key thing is that there is a wide range of models, which you would expect, so you can probe different things with the different models. I think another thing that is very important to bear in mind is that there is an international process for inter-comparison of models and checking them against reality, which is run by the Royal Meteorological Organisation under the World Climate Research Programme. The models are as good as they can be at the level of science we have at the present time and the computing power that we have. As David Mackay said in the last session, they are not perfect but they are checked pretty thoroughly and they are always being probed.

Q237 Chair: One of the issues that you heard us raise in the last session was the difference between the two predicted temperature ranges in the full technical report. One range is 0.48°C to 1.15°C and the other one 0.3°C to 0.7°C, which was the one mentioned in the summary for policymakers. Do you have a concern about the fact that there are two quite significantly different projections and the lower one was chosen? I think there was an explanation as to the reasons given in the previous session, but do you have any concerns about that?

David Warrilow: I think it demonstrates the difficulty of comparing long-term simulations of models that are not linked to specific events and they are not trying to project, they are trying to simulate a process. When you come down to projection on the near term, like one to two decades, we are into a very different set of problems and I do not think there is an easy answer to doing that. It is something that the scientific community is now working on because they are conscious that there is an interest in trying to project what would happen in the near term, but it is almost analogous for weather forecasting. Weather forecasting is good for up to four or five days, probably, but if you try to look forward two to three weeks, the chaos of the system makes it much more difficult to predict. Even predicting a season ahead is quite difficult, but if you want to predict a decade you are trying to predict a level of chaos that is very difficult to predict. I think the IPCC has done the best that it can with the information available, but I do not think people in the IPCC would say that this is the final answer to the problem.

Q238 Chair: Given all that and given the suggestions about natural variations in the climate, does that not make it very difficult both to determine the actual contribution of human activity and, rather as a result of that, difficulty about making policy recommendations to Government?

David Warrilow: Looking at the question of the human contribution, that is more an assessment of what has happened in the past and you can use both models and observations to probe and understand the different contributions that might take place in a set period of time. I think the question of the contribution from human influence is something that is assessed retrospectively. Going forward, you have to make some judgment as to how much, say in a decade or two decades or three decades, the relative proportion of human and anthropogenic change there would be because the two things are going to be of a similar magnitude on that timescale.

Q239 Chair: Have the controversies about the so-called hiatus and the issue about the growth in Antarctic sea ice been a concern that Ministers have taken account of? I know there are persistent reports that some Ministers take different views about these issues. Have they featured in your discussions?

Gregory Barker: No Minister has raised this with me nor, as far as I am aware, with the Department. Obviously, there is a whole barrel of different evidence that informs public debate and underpins our approach. As Minister, I rely principally not on the story of the day but on the ongoing scientific advice, in the same way that I would rely on the chief medical officer to give advice on the causes of cancer or whether smoking is good for you rather than take it from the headline in the—no disrespect—*Daily Express* or another

tabloid newspaper as to what the latest current eating fad is. I think if you are making public policy one has to rely on the qualified experts for the long-term advice that they give you rather than be guided by whatever happens to feature on a tabloid headline.

Q240 Mr Lilley: Over the last 35 years, all the model ensembles evaluated by the IPCC have overestimated by 15% the trend in global warming that appeared over that period. Do you think the reason the experts are now coming out with a forecast below what the models are forecasting is that they have lost confidence in the models? Do they think the models are running too hot and they are doing the sensible thing and giving us a lower forecast?

Gregory Barker: I am not an expert on the preparation of models but taking into account the accuracy of previous models—which is not an exact science: any forecast is, by definition, a forecast—does not seem an unlikely scenario. I do not know if Mr Warrilow wants to say something about it.

David Warrilow: We need to be a little bit careful. I was looking at the IPCC's report in preparation for this and one thing that is very clear is that it is certainly true that over the last 10 or 15 years the models overestimated the change that has occurred and we have recognised that, but in the two or three decades before that, in fact, quite a lot of the models were underestimating the warming that was observed. What we need to recognise is that the models are not able necessarily to predict all the wiggles that come from natural variability and getting the models to do that in a short timescale is one of the challenges that we are facing.

Q241 Mr Lilley: The figures I am referring to, which I have in front of me, show that every model group used by CMIP5 overestimated and not just over the period of the hiatus: on average, they overestimated by 15% over the last 35 years. Did you and the two gentlemen that we have seen previously draw to the attention of Ministers this disparity between the trend over the last 35 years in the models and the trend in reality? Did anyone draw it to your attention?

Gregory Barker: I do not think anyone has specifically drawn that individual piece of analysis to my attention, but it is certainly something that I have probed and it has come up in our discussions. No one has come to me and said, "You must be aware of this thing" but it is something that would have come up in conversation and it would have come up when we talked about modelling and forecasting, which is an imprecise science.

Q242 Mr Lilley: Did officials draw to your attention the fact, although it was not mentioned in the summary for policymakers, that the projection now by the IPCC over the next 20 years is 40% below the projection given by the uninitialised models?

Gregory Barker: The overall forecast was something that has been discussed.

Mr Lilley: The disparity between that and the models?

Gregory Barker: I believe that was part of the conversation.

Mr Lilley: Do you draw any conclusion from this?

Gregory Barker: Like you, I think people are being a little more cautious about that, but we will find out in due course who is right.

Q243 Mr Lilley: How about the effect of aerosols? Could I ask Mr Warrilow? Towards the end of its studies the IPCC concluded, with better evidence now, that the cooling effect due to aerosols is less than previously thought. What implications do you think that will have for forecasts, for models, and for assessments of their reliability, when those new figures are fed through the models?

David Warrilow: There is still a large range of uncertainty on the aerosols. That is the first thing. I think there is an issue about where the aerosols are occurring. This is a very specific technical area and, without doing the review of where we are now with newer theories on how aerosols are affecting both the direct solar but also the effect on climate, we are also conscious that there are other parts of the world where aerosol loading is increasing quite considerably such as south-east Asia. I think the net effect of perhaps downgrading the scale of the response of aerosols but recognising there may be an increase in loading in some places is something that would have to be looked at in more detail. I do not have an immediate answer to that.

Q244 Mr Lilley: You would not have any difficulty in answering me if I said what would be the effect on the models of an increased amount of CO₂ in the atmosphere?

David Warrilow: No. The point I am making is that the understanding of the role of aerosols is one thing, but the burden of aerosols, in actual fact, is another important thing. Although there may be some reduction in the effect of aerosols from what the scientists tell us, at the same time we also recognise that there has been an increase in the burden of aerosols in some parts of the world, which we would need to take into account.

Q245 Mr Lilley: In general, the only way models have been able to replicate reality, given that the models forecast a bigger increase in warming than has occurred, is by assuming that that has been offset by a substantial aerosol effect.

David Warrilow: Yes.

Mr Lilley: If that is less, will the models not forecast more warming still than has occurred? Retrospectively, there will be even more warming.

David Warrilow: I guess the newer set of models, once they are run, will look at that effect and one might expect some change to take place, but it is also true that there has been a decline in the scale of warming from black carbon as well. There are pluses and minuses in this equation that I do not think, in this discussion, we can easily bottom out.

Q246 Mr Lilley: You seem very reluctant to admit that any new evidence can reduce our estimates of warming for the future.

David Warrilow: I suppose it is always possible, yes.

Q247 John Robertson: We know that DECC supports the work of climate scientists in a number of ways, including through the DECC Earth Observation Strategy. To what extent has data collected by DECC-supported schemes played an important role in the IPCC's fifth assessment review?

David Warrilow: We commission research and we also fund observational programmes to meet immediate policy requirements and to help us understand the risks of climate change. It is important that we do that for our own purposes, but we also recognise that we are part of an international process to understand the overall impact of climate change and that that is something that needs to be agreed internationally. Very much what we do, as well as meeting the UK's requirement, is feeding into processes like the IPCC and we encourage UK scientists to take part in the IPCC process.

Gregory Barker: I think the single largest element of that is the £16 million of support for climate research at the Met Office Hadley Centre. DECC provides about £12 million and DEFRA about £4 million.

John Robertson: Roughly £16 million of investment in the climate programme. Do you think that is enough?

Gregory Barker: I have no reason to think it is not.

Q248 John Robertson: We will look into that a bit more in a minute. Do you think the Earth Observation Strategy helps reduce the uncertainties you were talking about earlier?

David Warrilow: Observations are extremely important in having the bedrock to understand what is going on in the world. We in DECC have put about £2 million into observations largely of the oceans both from satellites and also from the use of what we call floating buoys in the Argo programme. These are able to take measurements of the salinity and of the temperature of the ocean down to a depth of about 2,000 metres and these are relayed back to satellite every several days. There is a lot that we still do not understand about the oceans and how they are performing in the climate system, so it is important that we have much more ground truth on that.

Q249 John Robertson: You prepare an annual compilation of UK greenhouse gas inventory to meet our legal requirements and also the Kyoto Protocol. Is it helpful? Is it producing what we need?

David Warrilow: I would say it is, yes. It has been going for many years and it is very important. It gives us a full baseline of what the UK's interests are.

John Robertson: Who uses that inventory?

David Warrilow: It is used in the international negotiations. It is used by the UK in developing its carbon plan and it is used as a way of checking how we are doing against our carbon budget.

Q250 John Robertson: You will both be aware of Professor Allen's analysis. He is a professor at Oxford and, going back to the monetary side of it, he has made some comments. Basically, his feelings are that if you want to remove a lot of the uncertainties you have to spend more money. The question then has to be, are we wasting the money we are spending because we are not doing enough or should we be spending a lot more to make sure that we are getting the information we are trying to get?

Gregory Barker: As Climate Change Minister, I would be very sympathetic to spending more money, but we have to operate within stringent budgets. As a Department we have to play our part in the overall deficit-reduction programme and we have allocated what we believe we can afford within our total departmental budget in order to be effective, but I am sure that Professor Allen could make a case for spending more money quite effectively. In total, DECC's use of evidence funded by others includes a total spend of over £100 million. £16 million comes from DECC, but total UK-funded bodies is about £100 million. That is pretty significant.

Q251 John Robertson: I understand what you are saying. My feeling is that if we are spending a lot of money, and you are telling me we are, and we are not getting the necessary information or as much information—

Gregory Barker: I am not clear, Mr Robertson, what the direct link between spending money and getting the information is.

John Robertson: Let me quote what Professor Allen is saying. He was talking about "despite the measures that we have done" and he was linking it particularly to the floods that we have had recently. He said, "You'd actually have definitive answers"—this is if you would spend more money—"to questions about extreme weather as events happen so that we don't end up flapping our hands and saying that we are not quite sure".

Gregory Barker: I have not seen that particular comment. I am slightly surprised because we are always extremely cautious, based on the consistent scientific advice that we get, about linking any one extreme weather event to climate change. I am not sure that spending a substantially greater amount of money would give you any greater certainty on individual weather impacts. Obviously, the more you spend the more evidence you get; there would be a benefit, but I do not see a direct link between the amount we spend and a deficit in our knowledge.

Q252 John Robertson: Let me direct you to Professor Allen and have a look and see what he says and perhaps you could come back to us with some comments.

Gregory Barker: Certainly.

John Robertson: He does go into various things and it would be unfair of me to quote them if you have not had a chance to look at them in the first place, but his line is basically that if we put more effort into it then we would have a lot of the answers to what is going to happen before they happen. That is how I read it.

Gregory Barker: Is he talking just about impacts on the UK or is he talking globally? We are part of a global effort to understand climate science.

Q253 John Robertson: He is talking about the UK in particular and he did say that. He says, “The Government could do more to support climate science in the UK.” That goes back to my first question and that is, if we do not spend the extra money, what is the point of spending what we do spend unless we are getting something out of it?

David Warrilow: Just looking at the Hadley Centre, we have that regularly reviewed and the last review indicated that we were getting very good value for money from it; that the spend was not dissimilar to what was being spent in other modelling centres around the world and that it was at an appropriate level. The only real question was whether we would be able to maintain our position vis-à-vis computing power and that is something that is now being actively pursued by BIS. I think we are looking at the availability of computing power, which is one of the constraints on getting better predictions.

Gregory Barker: It is certainly true to say as someone who is involved in the international negotiation and discussions of climate around the world, I know of no other international institution that has an equally high international reputation as the Hadley Centre and the UK Met Office. There are other august bodies, but I think we definitely punch above our weight in terms of the reputation and quality of the science that is produced by those centres and it is a huge tribute to the people that work there.

Q254 John Robertson: I wholeheartedly endorse what you have said there. Having said that, if there are ways for us to be able to understand more of what is happening before it happens—the Met Office were excellent in giving us the information that the storms were coming; unfortunately, we could have done with that information a month before it happened where we could have possibly done a lot more. Having said that, I would ask you to go and have a look at it. Perhaps you can talk to him. He is obviously a very intelligent man and he knows what he is talking about. Perhaps he would give you ideas of how best to meet the financial problems you have.

Gregory Barker: I am very grateful for the advice.

Q255 Graham Stringer: Is the political consensus on climate change increasing or decreasing?

Gregory Barker: This Committee is probably better placed to judge that than I am.

Graham Stringer: You are the Minister. I would like you to answer the question. You are part of Government. You talk to your colleagues. I would just like your assessment. You have just said you are the Minister for Climate Change. Can you make an assessment about whether the political consensus on climate change—

Gregory Barker: It depends on what you mean by “political consensus”. The consensus on the science—is the climate changing, are the causes of climate change increased volumes of CO₂ being carried in the atmosphere—the basic science: I think there is increasing acceptance of the basic science of climate change. I think the number of people who are refusing to accept that the climate is changing or that man has a role in that are diminishing and I think are given disproportionate air time in the media. However, there is a lively debate about what the right response to that is and I think people are more ready to, in particular, question the cost of those particular responses and stress-test the economic models that underpin those responses. That is not least because as we go up the trajectory of emissions reduction, you get beyond the low-hanging fruit, the easy wins, and you get to some more challenging and potentially costly or potentially more cost-effective solutions. That will excite debate but, broadly speaking, the consensus of the need to act: I do not know any serious voice in Government that is questioning the Climate Change Act or the overall science of climate change.

Q256 Graham Stringer: Who was the Secretary of State referring to when he referring to people as being diabolical? Which members of Government were they, do you think?

Gregory Barker: When he was referring to what?

Graham Stringer: He referred to diabolical people denying the climate change consensus. I do not have the exact quote.

Gregory Barker: I do not recognise that quote.

Graham Stringer: You don't?

Gregory Barker: I don't read the *Guardian* all the time.

Graham Stringer: It was all over the press. I will write to you and you can send—

Gregory Barker: You are better off asking the Secretary of State. It is not for me to put words into my boss's mouth.

Q257 Graham Stringer: I am surprised you have not seen that. Which people, do you think, on the media then are getting too much exposure, who should not get exposure?

Gregory Barker: Some people, who represent a perfectly valid opinion, deny the very science of climate and there are scientific voices that have that view, but I think when it is presented as a 50/50, either/or, balanced voice—

Graham Stringer: Can you be precise? Who do you think the BBC or any other media outlet is giving exposure to, when they should not?

Gregory Barker: It would be invidious to name individuals, but I do think the climate coverage tends to over-represent the climate-sceptic opinion when it is discussing the science. I think the better place for debate, where there is a wider divergence of opinion, is on how to respond to the science and how to respond to climate change, rather than tired arguments presented as equally valid—because we know, in terms of the scientific

community, that, yes, there are dissenting voices but they are relatively small minority among the climate scientist community.

Q258 Graham Stringer: We have had very prominent scientists before this Committee—I have not met a scientist who does not accept that carbon dioxide is a greenhouse gas, so one can refer to that as a consensus—but some very serious scientists who do not accept some of the conclusions of the IPCC or the response to those conclusions. 50% of the meteorologists in the United States are unhappy with the conclusions of the IPCC. It is the nature of science to be sceptical, is it not?

Gregory Barker: Absolutely, it is the nature of science.

Q259 Graham Stringer: Who are you suggesting should not be given air time?

Gregory Barker: If you look at the number of peer review papers on the science, the vast majority of papers produced over the last decade have not questioned the fundamental science and I would just question your 50% of meteorologists in the USA. What is the basis for saying that?

Graham Stringer: Evidence to the Science and Technology Committee.

Gregory Barker: But who gave that evidence?

Graham Stringer: It was an assessment of meteorologists.

Gregory Barker: By whom?

Graham Stringer: It is usually the other way round, that we ask you the questions.

Gregory Barker: When you ask a question that is based on dodgy evidence—

Q260 Graham Stringer: If you would like me to send you the information, I will gladly send you the information, but if you care to read the evidence—

Gregory Barker: Mr Stringer, if you ask questions of me based on evidence that you cannot substantiate—

Graham Stringer: Well, I can—

Gregory Barker: It looks rather dodgy to me and that is exactly the sort of assertion masquerading as science that is so often repeated in the media. You have made a good example of taking a very tenuous assertion, dressing it up as fact and then putting it to a Minister when basically you cannot substantiate the very figure that you have put to me. I push back to you on that figure.

Q261 Graham Stringer: I can substantiate it and I will send it to you.

Gregory Barker: You cannot substantiate it.

Graham Stringer: Not at this precise second because I—

Gregory Barker: You are not substantiating it.

Graham Stringer: I am not at the present time, but I was not expecting you to say that people should not be exposed to the media who were sceptical about—

Gregory Barker: I think if you put an assertion you ought to be able to at least produce it.

Q262 Graham Stringer: I will do so and I will send you the information and then I would ask you to—

Gregory Barker: But it does illuminate the point that I was making.

Graham Stringer: —answer the very simple question, because you started asserting that certain people are given too much exposure and you will not tell the Committee who those people should be. I am going to send you that information. I would expect you to respond.

Gregory Barker: People who make unsubstantiated claims based on unattributed information: that is the sort of person that I have in mind.

Q263 Graham Stringer: I am not interested in the sort of person. I would be interested in specific names.

Gregory Barker: All right. Graham Stringer of the DECC Committee.

Graham Stringer: You think I should not go and—that is fine.

Gregory Barker: Making unsubstantiated claims that cannot be verified.

Mr Lilley: It can be verified.

Gregory Barker: But it is not being verified at this point.

Mr Lilley: I do not remember the source of every document that has appeared before this Committee, but I remember the content of many of them. May I come in? Sorry, when Graham has finished.

Q264 Graham Stringer: That is okay. The most substantial point I keep going to with Ministers and with scientific advisers is that, while Ministers will boast about the reduction in emissions, our carbon footprint is increasing. Why do you not put that into statements and what do you intend to do about it?

Gregory Barker: You raise a very important point. We have had evidence sessions on this very issue, I think the time before last that I appeared before this Committee that weighed up emissions versus consumption. The fact of the matter is national emissions are judged in this way for the world economy as a whole. While I can certainly see the point that you are making, and it has a great deal of intellectual merit, for the UK unilaterally to report its emissions in a different way would be very complex and would undermine the whole system of international reporting, but it is something that any sensible analysis of our overall progress in reducing emissions needs to take into account. In terms of being a primary measure and benchmark, I think the overall national emissions should, until there was some international consensus to do otherwise, continue to be the primary benchmark for judging success or failure.

Q265 Graham Stringer: I have no objection to emissions being reported, but it is not about reporting. It is about having an effective policy and if our policy is leading to more carbon dioxide being produced both by this country and within the European Union then should we not be concerned about that and be talking about it in DECC documents and trying to do something about it?

Gregory Barker: More carbon dioxide being produced in the European Union?

Q266 Graham Stringer: No, the European Union and this country being responsible for more carbon dioxide being produced: not in the European Union. It is what the scientists we had before us previously called “embedded carbon dioxide,” which has been involved in the production of products in China and elsewhere and the carbon dioxide produced in transporting those goods here. Overall, we are responsible for more carbon dioxide, but not in Europe or in the United Kingdom.

Gregory Barker: I think what it underpins is the need for a stringent global agreement where we are all on the same page and that is where our efforts now very much focused. A global deal is the answer to that with all countries, developed and developing, abiding by common rules and common reporting. I think that is the only way that you will get a genuinely true picture.

Q267 Graham Stringer: We should carry on decreasing emissions and increasing our carbon footprint. Do you not think we need a change of policies?

Gregory Barker: No, I do not think we should carry on increasing our carbon footprint.

Graham Stringer: What are we going to do about it then?

Gregory Barker: There are only certain things that we can do. You start to wander into trade policy, but if we get a global deal—which is what we are pushing for at the Paris COP next year—that will shine a light on these embedded emissions and will perhaps strengthen international efforts to avoid these sorts of unintended emissions. You will get these different patterns with trade flows and the biggest thing that could happen, for example, if we can encourage China to shift to a greater proportion of gas and renewables

in its energy mix, rather than relying so heavily on coal, you will then see a big decrease in the UK's embedded emissions, as you term it. There are a number of variables here, not all of which are within our control. I understand and appreciate the point that you make. However, the answer to it is not a handbrake turn in domestic policy, but to push, with all the diplomatic skill we possess, for an ambitious global deal in 2015.

Q268 Graham Stringer: Just a final question. What would you give as the percentage chance of success, in your terms, in Paris?

Gregory Barker: I have not thought about it in that way. I would be loath to give a specific figure, but it is by no means a done deal and there is a lot of work that needs to be done in order to avoid a Copenhagen-style outcome. I think the global community has learnt from Copenhagen, where too much was left until the last moment. Too much weight was put on the ability of leaders to turn up in the final two days and conclude a deal, which is why we need a clear roadmap. I will be going to Abu Dhabi in May for the pre-leaders meeting to talk about the agenda for the Ban Ki-moon summit in September, which will be an important milestone on the road to Paris 2015; not as a negotiating session but demonstrating a clear injection of high-level political momentum into the climate change talks. I think the very fact that there have been indications that both the Chinese president and the American president are prepared to get in a room and discuss climate change at that high level for the first time since 2009 indicates positive movement. I think there are grounds for cautious optimism, but there is a lot of work we need to do before we could get anywhere close to saying that we are confident of an outcome in Paris.

Q269 Sir Robert Smith: What is the timetable and process for the review of the fourth carbon budget?

Gregory Barker: What is the timetable and process for the fourth carbon budget? Over the next few weeks we will continue to work closely with the Treasury. I do not have a specific date that I can give you but this is something that is live in Government now and will be over the spring.

Q270 Sir Robert Smith: Do you see the IPCC report having any relevance to the process?

Gregory Barker: The IPCC certainly informs our basic understanding and our imperative of continuing to act on dangerous manmade climate change. It has certainly done nothing to undermine the case and, indeed, the Climate Change Committee has advised us that the fifth assessment provides no basis for a change to the fourth carbon budget.

Q271 Sir Robert Smith: Do they not go further and do not see that there has been no change in general, or is it just on the IPCC?

Gregory Barker: In relation to the IPCC and AR5, that certainly would be no basis for a change. There are potentially other considerations because this is a unilateral Act we are

talking about: the UK's Climate Change Act. If there was simply no hope of any international movement, if there was no hope of securing a global treaty, then one would have to question the whole basis of why it would continue to be in our interest to act unilaterally, if there was no prospect of other countries coming forward or for the European Union acting more ambitiously. But that is not the case.

Q272 Sir Robert Smith: The review is more to do with the response process and the global market than a questioning of the science?

Gregory Barker: Yes. The review is very much about the level of ambition in Europe, to ensure that we are not out of step with our European partners and to make sure that what we are proposing is consistent with the wider international effort; that it is not completely out of step with that. The basis of the scientific reasons for the Act is solid and, as I said, the Committee on Climate Change has advised us that the latest science certainly gives no basis for a change in the fourth carbon budget.

Q273 Mr Lilley: In response to Mr Stringer you said that too many people who deny the basic science were allowed on the media and the BBC in particular. I have a copy of the Cook et al. study, which shows the scientific consensus that agrees with me that 97% of scientists believe that greenhouse gases contribute to global warming. Do you think I am one of the people who deny that?

Gregory Barker: Sorry, I am not quite sure what the—

Mr Lilley: The question is, do you think I am one of the people who deny the basic science and are given too much time on the media?

Gregory Barker: If you say you do not, I would not disagree with you, Mr Lilley.

Mr Lilley: Have you ever known me not to say that I do not?

Gregory Barker: That you do not?

Mr Lilley: That I do not disagree with the basic science. I do accept the basic science of global warning.

Gregory Barker: Indeed, but I was not talking about you, Mr Lilley.

Q274 Mr Lilley: You were not. Do you agree with your boss, Ed Davey, who, in an interview on EurActiv on Friday, said that people like Peter Lilley should shut up? Do you think I should not express my views on this subject?

Gregory Barker: I think, as a parliamentarian, you are perfectly entitled to express your views.

Mr Lilley: Do you agree with your boss?

Gregory Barker: Wherever possible, I endeavour to maintain a broad coalition consensus.

Mr Lilley: On this issue do you think I should shut up?

Gregory Barker: I would welcome more voices in the climate debate.

Mr Lilley: Do you think I should shut up.

Gregory Barker: Do I think you should—that would not be my choice or words, Mr Lilley. I would not use those words to any colleague.

Q275 Mr Lilley: When people do want those who are critical of them or ask questions of them to shut up, do you think it is a symptom that they find it difficult to respond to those questions or just natural intolerance?

Gregory Barker: No, I think it is invariably a frustration that we cannot move on to a more important part of the agenda, which is how we respond effectively. I think there is a frustration with some elements of the media that seek to make news by accentuating disagreement, even though that disagreement may be of minority opinion, because that makes better headlines and perhaps the BBC provides “balance”, where in actual fact consensus does not make good television or does not make good copy.

Q276 Chair: In relation to this point, do you share my concern that large sections of the public sometimes have difficulty grasping concepts of relative risk—

Gregory Barker: Absolutely.

Chair: —and that, therefore, that difficulty can sometimes be increased by appearing to give equal weight in major presentations to people with different views? Notwithstanding the fact that, as Peter has just referred to, 97% of the scientists take one view, the difficulty people have in grasping the relative risk may be enhanced sometimes by some media presentations.

Gregory Barker: I think that is right. Just to go back to Mr Lilley, while I totally accept that he accepts the science, I think if you did a straw poll of the typical listener and if you asked them, “Does Peter Lilley accept the climate science”—and this is my opinion, this is not scientific—my suspicion is that most people would think that you did not accept climate change because people do not pay attention closely to what you say or any others say. They just pick up the background noise and the way it is presented in the media is an either/or binary choice. That is the way it tends to be portrayed. I do not think many people always appreciate the sophistication of your arguments.

Q277 Mr Lilley: So far you have been unable to name anyone who denies the science and is given too much time on the media. When you accuse—

Gregory Barker: I have not been unable to.

Mr Lilley: Hang on. I have not finished the question.

Gregory Barker: I have been reluctant to. I think there is a slight difference.

Mr Lilley: Then please overcome your reluctance.

Gregory Barker: I would prefer not to, but that is not that I am unable to.

Q278 Mr Lilley: You attacked Mr Stringer seven times for not giving the source of a particular thing, though he is perfectly able to and will do in due course. Now you have made an accusation and you are not prepared to substantiate it.

Gregory Barker: I have not made an accusation.

Mr Lilley: You have made an accusation that too many people who deny the science are allowed on the media and you have not been able to name a single one.

Gregory Barker: I do not wish to get into a personality conflict. I do not want to make it about personalities. I am trying to make it about policies.

Q279 Mr Lilley: Why will you not tell us?

Gregory Barker: Because I do not wish to, Mr Lilley. I am not obliged to.

Mr Lilley: You are obliged to answer the questions this Committee puts to you.

Gregory Barker: I have answered the questions as I see fit.

Mr Lilley: It is not a satisfactory way. You have said that these people exist. You have not given us a single example. How can that be satisfactory?

Gregory Barker: I do not want to make it into a personality contest because then it becomes about individuals rather than—

Q280 Mr Lilley: It is not a personality contest. It is a simple fact. If they do deny it and you name them then that is true, is it not? There is nothing they can attack you for if you—

Gregory Barker: I am not worried about being attacked myself. What I do not want to do is turn a sensible discussion about the weight of opinion and balanced broadcasting into individual personalities.

Chair: Let us return to the IPCC.

Q281 Dr Whitehead: I am just trying to be helpful. I think the study we have been talking about was a recent survey of US meteorologists and the American Meteorological Society, which determined 64% were inclined towards an anthropological explanation of global warming, but only 13% of the American Meteorological Society has had any studies relating to climate science; a good proportion of the American Meteorological Society are not

meteorologists, but let us let that one pass. The UK contributes less than 2% to global warming of the total. In your view, would there be particular consequences, bearing that in mind, if the UK did not commit to cut its greenhouse gas emissions?

Gregory Barker: I think the importance of the UK is the leadership role it can play internationally, recognising its historic responsibilities as the first industrialised economy and recognising that no individual country is responsible for all carbon emissions. It requires a mosaic of action, but the UK, historically and currently and hopefully in the future, punches above its weight in a number of international areas. We have a seat on the Security Council. We are one of the largest economies in the world. We are enjoying a renaissance in manufacturing. We are listened to with respect for our science and our expertise in finance. Although we only have a very small share of the overall responsibility for emissions, we have a disproportionate influence and impact.

I see this when I travel around the world. People do look to the UK for being able to prove that there is an economic model that works and that is financeable, which allows an industrial economy to shift to a low carbon model of growth and to demonstrate that it is possible to reduce carbon emissions without endangering prosperity and growth. Through its own efforts and through the efforts of successive Governments, the UK has been a leader in that model. If we were to step back now—you are quite right, Mr Whitehead—in terms of absolute contribution of carbon emissions, it would not make a great deal of impact, but I think the ripples and the ricochets would be significant.

Q282 Dr Whitehead: DECC itself has said that the fifth assessment “strengthens the case for countries to agree to undertake urgent action to reduce their domestic carbon emissions and to secure an ambitious legally-binding global agreement in 2015.” First, do you think that the fifth assessment does that and, if so, what do you think those sorts of steps to achieve a legally-binding agreement might look like?

Gregory Barker: I think the fifth assessment is significantly more helpful than the fourth. I think the fact that it is seen to be more robust scientifically and has been stress-tested and peer-reviewed in a way that is quite unprecedented means that the scientific basis for policy making is stronger than it has ever been. But I live in the real world and I know that the science argument underpins the whole rationale for making these moves but ultimately, it will be other impacts as well—namely the economics and financeability of such a move—that will ultimately drive whether or not a treaty is successful.

Q283 Dr Whitehead: The likelihood of an ambitious global agreement being reached in 2015 is not perhaps overwhelming, one might think.

Gregory Barker: I do not think anyone would want to suggest it is overwhelming.

Dr Whitehead: Yes. If that is not the case, then should the UK revise its own targets at that point and does the fifth assessment have any impact on that?

Gregory Barker: If one were to consider that, the time for that would be after 2015. If the global talks end in collapse in 2015, if it is clear that there is no prospect of being able to achieve a globally-co-ordinated solution to climate change, then I think there would be

some rationale for looking again at our unilateral actions, but that is not what we expect and that is not what we are working towards.

All countries accept the science of climate change. What is very interesting are the changes that there have been. For example, I have had very constructive discussions with the Energy Minister from Saudi Arabia. I have very constructive discussions with colleagues from the Gulf countries, who not only accept the science but increasingly accept the need for a measured, but nevertheless determined, shift to a global low-carbon economy. That is not done overnight. We are not talking about eradicating fossil fuels in the coming decades, but we are talking about sensibly managing this transition and all countries accept that.

It is not the case that others are not acting: 86 countries accounting for roughly 80% of global emissions back in 2005 have pledged mitigation comments or actions in the UNFCCC and the Governments of the US and China—the world’s two largest emitters—are taking domestic action on climate change. For example, China has committed to reduce the carbon intensity of their economy by 40% to 45% by 2020 compared with 2005 levels. Whether or not this is commensurate with the scale of the challenge is another question, but the general direction of travel is increasingly encouraging. The fact that the net carbon emissions of the US economy, at a time when it is growing strongly, have been falling, thanks to shale gas, is also very encouraging.

There are technological, economic and financial developments in the global economy, particularly in the largest economies, since 2009, which I think give grounds for hope that Paris may yield a different outcome to Copenhagen. If it were just a case of sitting back in the same room with the same data, the same facts and the same economic models as we did in 2009 I think we would get the same answer, frankly.

If we look at the cost of renewables, the collapse in prices of solar, for example, which is a very important technology for many in the developing world, it is incredibly encouraging, particularly when the counterfactual is a diesel generator or imported coal. If you look at the fact that in certain countries like Brazil, wind is now competitive. If you look at the increase in availability of gas versus coal and if you look at the gas finds that there have been in developing countries, which are now being explored more ambitiously, these are all signs for hope. The innovation in the last five years in the low-carbon space has been heroic.

Q284 Dr Whitehead: The thrust of my question perhaps might be encapsulated as I think the fifth assessment, one could say, produces an imperative on policymakers. One could say, alternatively, that the extent to which policymakers across the world decide to do something, collectively or otherwise, is the primary driver of policy. Which one of those two would you—

Gregory Barker: Sorry, which two?

Dr Whitehead: The fact that there is a fifth assessment report that one could say appears to strengthen the likelihood of global warming and the reason for that being particular policies that come about in particular countries in order to put the stuff in the atmosphere in the first place, first; and, secondly the extent to which countries collectively work

together to deal with that issue and, if they do not, then the extent to which various people do their own thing. Which of the routes do you think is the one that might particularly drive policy as far as this country is concerned?

Gregory Barker: I think most of the policies that we have are based on the assumption of robust climate science and the fifth review has underpinned that and basically not given any get-out clause for any country that was looking for a sound basis on which to avoid taking action. The question now comes down not to whether there is a proper scientific base for taking prudent responsible action in response to a sensible assessment of the risk, but what is the cost of doing that and can you do that at the expense of other countries or can you rely on others to make that effort for you?

Q285 Dr Whitehead: Just relating to those other countries, what might this country do, if that is the position, to ensure valuable and growing economies can decarbonise; perhaps jump over steps in terms of their development without impeding their overall growth?

Gregory Barker: One of the most important things that we can do in the UK, apart from follow our own path—but I do not think there are big new challenges for us. I think we have set the course of decarbonisation. I think we have the main building blocks for that or the main foundations for that in place—our role now ought to be shifting to what role we can take internationally. One of the most important elements of building international action is not only a diplomatic offensive but actually creating the opportunities to fund that transition to a low-carbon model of growth.

In June I will be hosting a meeting in London that will bring together developing-economy finance and energy ministers, donor countries and major institutions from the City of London and from elsewhere around the world to drive forward the mobilisation of private sector finance into low-carbon technologies in developing countries. You will remember, Mr Whitehead, at Copenhagen there was a commitment made that developed countries would mobilise £100 billion a year into developing economies to support the low carbon growth. What is clear is that majority of that funding must come from the private sector. At the moment we are significantly below that. There are, nevertheless, very encouraging trends and there is a significant appetite in the City of London to invest in new markets for low carbon technologies and often in developing countries these technologies are at their most cost competitive.

We are exploring ways in which we can leverage our public funding from the International Climate Fund and other multilateral institutions to leverage in private sector funding and use, wherever possible, our own international climate finance as returnable capital rather than grants so that we can keep revolving that funding and get the maximum impact. In so doing, we are not only helping those countries in Africa and developing countries in Asia and South America go to a more sustainable model of economic growth, we are also creating opportunities for the UK low carbon goods and services sector, which is a high growth sector and an increasingly attractive sector of growth driving our own domestic prosperity.

Q286 Chair: What, if any, is the feedback that your Department gives to the IPCC? Is there a process or is that just left to chance?

David Warrilow: Do you mean on the fifth assessment report or more generally?

Chair: Yes.

David Warrilow: Most of the feedback to the IPCC is done while the report is being prepared. We get two opportunities to comment on the details of the report and then, finally, twice on developing the summary for policymakers. That has already been done obviously for Working Group 1 and we have done that for the other workings groups, which will be coming out in another two or three weeks. After the reports are finished, and in fact during this period, IPCC has undertaken a process to assess how it will develop beyond the fifth assessment report: what sort of products will it have; will it do a sixth review in five or six years' time? We have been feeding into that and we have already put on our website the UK's comments into that process. There is quite a lot of opportunity to feed our views into the development of the IPCC beyond where we are now.

Q287 Chair: In terms of the changes or the improvements that could be made to the IPCC process, I believe DECC has already made some suggestions on that. What are the most important things, in your view?

David Warrilow: I think one of the big challenges is to recognise that sometimes Governments need more rapid responses than currently the IPCC can give. It takes a good two years to prepare a special report and it takes some three years to produce one of these major assessments, and yet the demands from the policy community is for a more rapid turnaround. We are suggesting that they need to look again at ways of providing perhaps more frequent updates on the science and other things so that we are not waiting for six or seven years to get an update.

Q288 Chair: Is there a trade-off, however, between the speed at which that can happen and the authoritative nature of the recommendations?

David Warrilow: There is, but the issue may be that there are certain areas that are now quite well accepted, which are not changing very much scientifically, and it may allow you to focus on specific areas that are perhaps more controversial or where there is quite a flux in the science. I think that is something we would want to look at.

Chair: A more rapid response process, is it?

David Warrilow: Yes.

Q289 Chair: Have you had discussions with other Governments about this?

David Warrilow: We have had a discussion within the EU on this and we are all coming to a view that the current situation is okay. We could continue it but it poses big challenges and we do need this more frequent updating process.

Gregory Barker: There is also a recognition at a political level that the IPCC process does not respond to the news cycle at all well and part of the reason that so many sceptical voices are able to get a hearing is because they will produce some novel piece of alleged evidence or a report and that is the only climate-related material that is coming into the public domain. What we need to do is present more regularly updates that can inform public opinion, not just these huge weighty tomes that drop like tablets of stone every few years.

Q290 Chair: Yes. However, is there a risk that if you start doing this, the chance increases of leaks of work that is in preparation before the IPCC?

Gregory Barker: I think the chance of leaks is less because if you are peeling off information or updates on a regular basis then they are controlled. If you try to keep everything absolutely tight until the release then you are more likely to have leaks.

David Warrilow: Another thing that we think the IPCC needs to look at is the use of new technology; the fact that we have an interactive internet now that we can make much more use of, which was not there when IPCC initially was set up. There are challenges with that but I think there is now a time to look at things quite imaginatively and think, “Are there other ways of doing this in a way that allows you to update things without having to rewrite everything completely at the same time?”

Chair: Colleagues, any other questions? No. All right. Thank you very much indeed.